# ict

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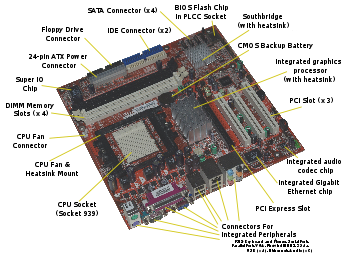
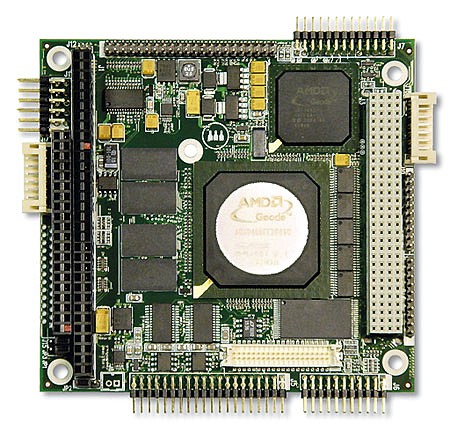
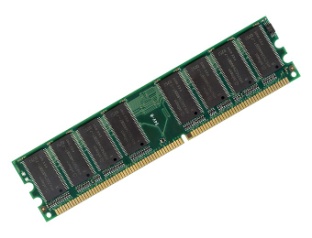
# I Hardware

Computer operation requires both hardware and software. Hardware design specifies a computer’s capability and software instructs the computer on what to do. Computer hardware is the collection of physical elements that comprise a [computer](http://en.wikipedia.org/wiki/Computer) system. It refers to the physical parts or components of computer such as monitor, keyboard, hard disk, mouse, etc.

## 

## Personal computer

A **personal computer** (**PC**) is any general-purpose [computer](http://en.wikipedia.org/wiki/Computer) whose size, capabilities, and original sales price make it useful for individuals, and which is intended to be operated directly by an [end-user](http://en.wikipedia.org/wiki/End-user) with no intervening computer operator. This contrasted with the batch processing or [time-sharing](http://en.wikipedia.org/wiki/Time-sharing_system)models which allowed larger, more expensive [minicomputer](http://en.wikipedia.org/wiki/Minicomputer) and [mainframe](http://en.wikipedia.org/wiki/Mainframe_computer) systems to be used by many people, usually at the same time. Large data processing systems require a full-time staff to operate efficiently. Software applications for personal computers include, but are not limited to, [word processing](http://en.wikipedia.org/wiki/Word_processing), [spreadsheets](http://en.wikipedia.org/wiki/Spreadsheets), [databases](http://en.wikipedia.org/wiki/Databases), [Web browsers](http://en.wikipedia.org/wiki/Web_browser) and [e-mail](http://en.wikipedia.org/wiki/E-mail)clients, [digital media](http://en.wikipedia.org/wiki/Digital_media) playback, [games](http://en.wikipedia.org/wiki/Personal_computer_game), and myriad personal productivity and special-purpose software applications. Modern personal computers often have connections to the [Internet](http://en.wikipedia.org/wiki/Internet), allowing access to the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) and a wide range of other resources. Personal computers may be connected to a [local area network](http://en.wikipedia.org/wiki/Local_area_network) (LAN), either by a cable or a wireless connection. A personal computer may be a [desktop computer](http://en.wikipedia.org/wiki/Desktop_computer) or a [laptop](http://en.wikipedia.org/wiki/Laptop), [tablet](http://en.wikipedia.org/wiki/Tablet_computer), or a[handheld PC](http://en.wikipedia.org/wiki/Handheld_PC).

* **Motherboard** - In [personal computers](http://en.wikipedia.org/wiki/Personal_computer), a **motherboard** is the central [printed circuit board](http://en.wikipedia.org/wiki/Printed_circuit_board) in many modern [computers](http://en.wikipedia.org/wiki/Computer) and holds many of the crucial components of the system, providing connectors for other peripherals. The motherboard is sometimes alternatively known as the **mainboard**, **system board**, **planar board** or, on [Apple](http://en.wikipedia.org/wiki/Apple_Inc.) computers, the [logic board](http://en.wikipedia.org/wiki/Logic_board).[[1]](http://en.wikipedia.org/wiki/Motherboard#cite_note-Engadget-0) It is also sometimes casually shortened to**mobo**. A motherboard, like a [backplane](http://en.wikipedia.org/wiki/Backplane), provides the electrical connections by which the other components of the system communicate, but unlike a backplane, it also connects the central processing unit and hosts other subsystems and devices. A typical [desktop computer](http://en.wikipedia.org/wiki/Desktop_computer) has its [microprocessor](http://en.wikipedia.org/wiki/Microprocessor), [main memory](http://en.wikipedia.org/wiki/Primary_storage), and other essential components connected to the motherboard. Other components such as [external storage](http://en.wikipedia.org/wiki/External_storage), controllers for [video](http://en.wikipedia.org/wiki/Video_card)display and [sound](http://en.wikipedia.org/wiki/Sound_card), and [peripheral](http://en.wikipedia.org/wiki/Peripheral) devices may be attached to the motherboard as plug-in cards or via cables, although in modern computers it is increasingly common to integrate some of these peripherals into the motherboard itself.
* **Central Processing Unit (CPU)** - The **central processing unit** (**CPU**, occasionally **central processor unit**[[1]](http://en.wikipedia.org/wiki/Cpu#cite_note-espin2-0)) is the hardware within a [computer](http://en.wikipedia.org/wiki/Computer) system which carries out the [instructions](http://en.wikipedia.org/wiki/Instruction_(computer_science)) of a [computer program](http://en.wikipedia.org/wiki/Computer_program) by performing the basic arithmetical, logical, and [input/output](http://en.wikipedia.org/wiki/Input/output) operations of the system. The CPU plays a role somewhat analogous to the [brain](http://en.wikipedia.org/wiki/Human_brain) in the computer. The term has been in use in the computer industry at least since the early 1960s.[[2]](http://en.wikipedia.org/wiki/Cpu#cite_note-weik1961-1) The form, design, and implementation of CPUs have changed dramatically since the earliest examples, but their fundamental operation remains much the same. On large machines, CPUs require one or more [printed circuit boards](http://en.wikipedia.org/wiki/Printed_circuit_board). On [personal computers](http://en.wikipedia.org/wiki/Personal_computers) and small workstations, the CPU is housed in a single [silicon chip](http://en.wikipedia.org/wiki/Silicon_chip) called a [microprocessor](http://en.wikipedia.org/wiki/Microprocessor). Since the 1970s the microprocessor class of CPUs has almost completely overtaken all other CPU implementations. Modern CPUs are large scale [integrated circuits](http://en.wikipedia.org/wiki/Integrated_circuit) in packages typically less than four centimeters square, with hundreds of connecting pins. Not all computational systems rely on a central processing unit. An array processor or [vector processor](http://en.wikipedia.org/wiki/Vector_processor) has multiple parallel computing elements, with no one unit considered the "center". In the [distributed computing](http://en.wikipedia.org/wiki/Distributed_computing) model, problems are solved by a distributed interconnected set of processors.
* **Random access memory (RAM)** is a form of computer data storage. One can read and over-write data in RAM.
* **Read-only memory (ROM)** is a class of storage medium used in computers and other electronic devices. Data stored in ROM cannot be modified - ROM is a type of memory that can be only read, as opposed to RAM which can be both read and written.
* **Hard Disk drive** - A **hard disk drive** (**HDD**; also **hard drive**, **hard disk**, or **disk drive**)[[2]](http://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-1) is a device for storing and retrieving digital information, primarily computer data. It consists of one or more rigid (hence "hard") rapidly rotating discs ([platters](http://en.wikipedia.org/wiki/Hard_disk_platters)) coated with magnetic material, and with [magnetic heads](http://en.wikipedia.org/wiki/Disk_read-and-write_head) arranged to write data to the surfaces and read it from them. Hard drives are classified as [non-volatile](http://en.wikipedia.org/wiki/Non-volatile_storage), [random access](http://en.wikipedia.org/wiki/Random_access), [digital](http://en.wikipedia.org/wiki/Digital), [magnetic](http://en.wikipedia.org/wiki/Magnetic_storage), [data storage devices](http://en.wikipedia.org/wiki/Data_storage_device). Introduced by [IBM](http://en.wikipedia.org/wiki/IBM) in 1956, hard disk drives have decreased in cost and physical size over the years while dramatically increasing in capacity and speed.Hard disk drives have been the dominant device for [secondary storage](http://en.wikipedia.org/wiki/Secondary_storage) of data in [general purpose computers](http://en.wikipedia.org/wiki/History_of_general_purpose_CPUs) since the early 1960s.[[3]](http://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-Mee-2) They have maintained this position because advances in their recording capacity, cost, reliability, and speed have kept pace with the requirements for secondary storage.[[3]](http://en.wikipedia.org/wiki/Hard_disk_drive#cite_note-Mee-2)

## Functions of a computer system

*The four basic functions* of a computer are input, processing, output and storage:

* **Input** is the information which is entered into the computer.
* **Processing** is performing operations on or manipulating data.
* **Output** is the result of the data processing.
* **Storage** refers to devices that can retain the data when the computer is deactivated.

The central processing unit (CPU) does process the data. Devices such as read only memory (ROM), the hard drive, compact disks (CDs) and digital versatile disks (DVDs) can store the data. When you input information into your computer with the mouse or keyboard, you're sending a signal to the CPU. The CPU has a logic unit that can do basic arithmetic. The control unit directs the computer to execute programs that have been stored in memory. The speed by which a computer executes programs is measured in millions of instructions per second (MIPS); the processor's speed is measured in gigahertz (GHz). When the information has been processed, it is output in a human-readable form through the monitor and speakers. It can also be stored again for later processing. Storage media can be used to both input and output data.  
  
The four basic functions of a computer make it possible for us to perform many tasks that were previously impossible. Using a computer, you can balance your checkbook, purchase merchandise, send and receive messages, do research, process your photographs, create music and store crucial data, among other things. If you have essential computer skills you can find better employment for higher pay. Because computers are easily networked, they can help people from remote parts of the world communicate more quickly and easily than with traditional methods.

Computers can be addictive. Computer gaming, in particular, can cause people to abandon taking care of essential responsibilities. Working long hours at a computer can contribute to eye strain, repetitive strain injury (RSI) and lower back pain. Many people may forget to eat or exercise when on a computer for long periods. Using ergonomic devices and furniture and taking frequent breaks can help to prevent many of these computer-related health issues (see Resources below).

## Units of measure

A unit of measurement is a definite magnitude of a physical quantity, defined and adopted by convention and/or by law, that is used as a standard for measurement of the same physical quantity. In [computing](http://en.wikipedia.org/wiki/Computing) and [telecommunications](http://en.wikipedia.org/wiki/Telecommunication), a **unit of information** is the capacity of some standard [data](http://en.wikipedia.org/wiki/Data) storage system or [communication channel](http://en.wikipedia.org/wiki/Communication_channel), used to measure the capacities of other systems and channels. In [information theory](http://en.wikipedia.org/wiki/Information_theory), units of information are also used to measure the [information](http://en.wikipedia.org/wiki/Information) contents or [entropy](http://en.wikipedia.org/wiki/Entropy) of random variables.

The most common units are the bit, the capacity of a system which can exist in only two states, and the byte (or octet), which is equivalent to eight bits. Multiples of these units can be formed from these with the [SI prefixes](http://en.wikipedia.org/wiki/SI_prefixes) (power-of-ten prefixes) or the newer IEC [binary prefixes](http://en.wikipedia.org/wiki/Binary_prefix) (binary power prefixes). Information capacity is a [dimensionless quantity](http://en.wikipedia.org/wiki/Dimensionless_quantity), because it refers to a count of binary symbols.

* A **bit** (a contraction of **binary digit**) is the [basic capacity](http://en.wikipedia.org/wiki/Units_of_information) of [information](http://en.wikipedia.org/wiki/Information) in [computing](http://en.wikipedia.org/wiki/Computing) and [telecommunications](http://en.wikipedia.org/wiki/Telecommunication);a bit represents either 1 or 0 (one or zero) only. The representation may be implemented, in a variety of systems, by means of a two state device. In [computing](http://en.wikipedia.org/wiki/Computing), a bit can be defined as a [variable](http://en.wikipedia.org/wiki/Variable_(computer_science)) or computed quantity that can have only two possible [values](http://en.wikipedia.org/wiki/Value_(computer_science)). These two values are often interpreted as [binary digits](http://en.wikipedia.org/wiki/Binary_notation) and are usually denoted by the [numerical digits](http://en.wikipedia.org/wiki/Numerical_digit) 0 and 1. The two values can also be interpreted as [logical values](http://en.wikipedia.org/wiki/Truth_value) (*true*/*false*, *yes*/*no*), algebraic [signs](http://en.wikipedia.org/wiki/Signed_number) (*+*/*−*), activation states (*on*/*off*), or any other two-valued attribute. The correspondence between these values and the physical states of the underlying [storage](http://en.wikipedia.org/wiki/Data_storage_device) or [device](http://en.wikipedia.org/wiki/Computing_device) is a matter of convention, and different assignments may be used even within the same device or [program](http://en.wikipedia.org/wiki/Computer_program). The length of a binary number may be referred to as its "[bit-length](http://en.wikipedia.org/wiki/Bit-length)." In [information theory](http://en.wikipedia.org/wiki/Information_theory), one bit is typically defined as the uncertainty of a binary random variable that is 0 or 1 with equal probability,[[1]](http://en.wikipedia.org/wiki/Bit#cite_note-0) or the information that is gained when the value of such a variable becomes known.[[2]](http://en.wikipedia.org/wiki/Bit#cite_note-1) In [quantum computing](http://en.wikipedia.org/wiki/Quantum_computing), a *quantum bit* or [*qubit*](http://en.wikipedia.org/wiki/Qubit) is a [quantum system](http://en.wikipedia.org/wiki/Quantum_mechanics) that can exist in [superposition](http://en.wikipedia.org/wiki/Quantum_superposition) of two bit values, "true" and "false".
* The **byte** is a [unit of digital information](http://en.wikipedia.org/wiki/Units_of_information) in [computing](http://en.wikipedia.org/wiki/Computing) and [telecommunications](http://en.wikipedia.org/wiki/Telecommunications) that most commonly consists of eight [bits](http://en.wikipedia.org/wiki/Bit). Historically, a byte was the number of bits used to encode a single[character](http://en.wikipedia.org/wiki/Character_(computing)) of text in a computer[[1]](http://en.wikipedia.org/wiki/Byte#cite_note-Bemer1962-0)[[2]](http://en.wikipedia.org/wiki/Byte#cite_note-1) and for this reason it is the basic [addressable](http://en.wikipedia.org/wiki/Address_space) element in many [computer architectures](http://en.wikipedia.org/wiki/Computer_architecture). The size of the byte has historically been hardware dependent and no definitive standards existed that mandated the size. The [*de facto* standard](http://en.wikipedia.org/wiki/De_facto_standard) of eight bits is a convenient [power of two](http://en.wikipedia.org/wiki/Power_of_two) permitting the values 0 through 255 for one byte. With ISO/IEC 80000-13, this common meaning was codified in a formal standard. Many types of applications use variables representable in eight or fewer bits, and processor designers optimize for this common usage. The popularity of major commercial computing architectures have aided in the ubiquitous acceptance of the 8-bit size.[[3]](http://en.wikipedia.org/wiki/Byte#cite_note-2)
* The **kilobyte** (symbol: **kB**) is a multiple of the unit [byte](http://en.wikipedia.org/wiki/Byte) for [digital information](http://en.wikipedia.org/wiki/Computer_data_storage). Although the prefix *kilo-* means 1000, the term *kilobyte* and symbol *kB*or *KB* have historically been used to refer to either 1024 (210) bytes or 1000 (103) bytes, dependent upon context, in the fields of [computer science](http://en.wikipedia.org/wiki/Computer_science) and[information technology](http://en.wikipedia.org/wiki/Information_technology).[[1]](http://en.wikipedia.org/wiki/Kilobyte#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Kilobyte#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Kilobyte#cite_note-2)
* The **megabyte** is a multiple of the unit [byte](http://en.wikipedia.org/wiki/Byte) for digital information [storage](http://en.wikipedia.org/wiki/Computer_storage) or transmission with three different values depending on context: 1048576bytes (220) generally for computer memory;[[1]](http://en.wikipedia.org/wiki/Megabyte#cite_note-AHSD-0)[[2]](http://en.wikipedia.org/wiki/Megabyte#cite_note-IU-1) and one million [bytes](http://en.wikipedia.org/wiki/Byte) (106, see prefix [mega-](http://en.wikipedia.org/wiki/Mega-)) generally for computer storage.[[1]](http://en.wikipedia.org/wiki/Megabyte#cite_note-AHSD-0)[[3]](http://en.wikipedia.org/wiki/Megabyte#cite_note-NIST-2) In rare cases, it is used to mean 1000×1024 (1024000) bytes.[[3]](http://en.wikipedia.org/wiki/Megabyte#cite_note-NIST-2) The [IEEE Standards](http://en.wikipedia.org/wiki/IEEE_Standards) Board has confirmed that *mega-* means 1000000, with exceptions allowed for the base-two meaning.[[3]](http://en.wikipedia.org/wiki/Megabyte#cite_note-NIST-2) It is commonly abbreviated as **Mbyte** or **MB** (compare Mb, for the [megabit](http://en.wikipedia.org/wiki/Megabit)).
* The **gigabyte** is a multiple of the unit [byte](http://en.wikipedia.org/wiki/Byte) for [digital information storage](http://en.wikipedia.org/wiki/Computer_data_storage). The [prefix](http://en.wikipedia.org/wiki/SI_prefix) [*giga*](http://en.wikipedia.org/wiki/Giga-)means 109 in the [International System of Units](http://en.wikipedia.org/wiki/International_System_of_Units) (SI), therefore 1 gigabyte is 1000000000 bytes. The unit symbol for the gigabyte is GB or Gbyte, but not Gb (lower case b) which is typically used for the [gigabit](http://en.wikipedia.org/wiki/Gigabit).. Historically, the term has also been used in some fields of computer science and information technology to denote the [gibibyte](http://en.wikipedia.org/wiki/Gibibyte), or 1073741824 (10243 or 230) bytes.
* The **terabyte** is a multiple of the unit [byte](http://en.wikipedia.org/wiki/Byte) for [digital information](http://en.wikipedia.org/wiki/Computer_data_storage). The [prefix](http://en.wikipedia.org/wiki/SI_prefix) [*tera*](http://en.wikipedia.org/wiki/Tera-) means 1012 in the [International System of Units](http://en.wikipedia.org/wiki/International_System_of_Units) (SI), and therefore 1 terabyte is 1000000000000bytes, or 1 [trillion](http://en.wikipedia.org/wiki/Orders_of_magnitude_(numbers)#1012) ([short scale](http://en.wikipedia.org/wiki/Short_scale)) bytes, or 1000 gigabytes. 1 terabyte in [binary prefixes](http://en.wikipedia.org/wiki/Binary_prefix) is 0.9095 [tebibytes](http://en.wikipedia.org/wiki/Tebibytes), or 931.32[gibibytes](http://en.wikipedia.org/wiki/Gibibytes). The unit symbol for the terabyte is **TB** or *TByte*, but not *Tb* (lower case *b*) which refers to [*terabit*](http://en.wikipedia.org/wiki/Terabit).
* A **petabyte (derived from the**[**SI prefix**](http://en.wikipedia.org/wiki/SI_prefix)[***peta-***](http://en.wikipedia.org/wiki/Peta-)**) is a unit of**[**information**](http://en.wikipedia.org/wiki/Information)**equal to one**[**quadrillion**](http://en.wikipedia.org/wiki/Quadrillion)**(**[**short scale**](http://en.wikipedia.org/wiki/Long_and_short_scales)**)**[**bytes**](http://en.wikipedia.org/wiki/Byte)**, or 1024**[**terabytes**](http://en.wikipedia.org/wiki/Terabytes)**. The unit symbol for the petabyte is PB. The prefix *peta* (P) indicates the fifth power to 1000:**

1 PB = 1000000000000000B = 10005 B = 1015 B = 1 million gigabytes = 1 thousand terabytes

The [pebibyte](http://en.wikipedia.org/wiki/Pebibyte) (PiB), using a [binary prefix](http://en.wikipedia.org/wiki/Binary_prefix), is the corresponding power of 1024, which is more than 12% greater (250 bytes = 1125899906842624bytes).

***Table of units of measure***

Unit Equivalent

1 kilobyte (KB) 1,024 bytes

1 megabyte (MB) 1,048,576 bytes (1,024 KB)

1 gigabyte (GB) 1,073,741,824 bytes (1,024 MB)

1 terabyte (TB) 1,099,511,627,776 bytes (1,024 GB)

1 petabyte (PB) 1,125,899,906,842,624 bytes (1,024 TB)

## Computer Memory

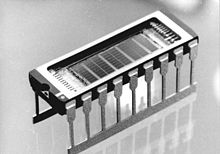
In [computing](http://en.wikipedia.org/wiki/Computing), **memory** refers to the physical devices used to store programs (sequences of instructions) or data (e.g. program [state information](http://en.wikipedia.org/wiki/State_(computer_science))) on a temporary or permanent basis for use in a [computer](http://en.wikipedia.org/wiki/Computer) or other [digital](http://en.wikipedia.org/wiki/Digital) [electronic](http://en.wikipedia.org/wiki/Electronics) device. The term [primary memory](http://en.wikipedia.org/wiki/Primary_memory) is used for the information in physical systems which are fast (i.e. [RAM](http://en.wikipedia.org/wiki/RAM)), as a distinction from [secondary memory](http://en.wikipedia.org/wiki/Secondary_memory), which are physical devices for [program and data storage](http://en.wikipedia.org/wiki/Computer_data_storage) which are slow to access but offer higher memory capacity. Primary memory stored on secondary memory is called "[virtual memory](http://en.wikipedia.org/wiki/Virtual_memory)".

The term "storage" is often (but not always) used in separate computers of traditional [secondary memory](http://en.wikipedia.org/wiki/Secondary_memory) such as tape, magnetic disks and optical discs ([CD-ROM](http://en.wikipedia.org/wiki/CD-ROM) and [DVD-ROM](http://en.wikipedia.org/wiki/DVD-ROM)). The term "memory" is often (but not always) associated with addressable [semiconductor memory](http://en.wikipedia.org/wiki/Semiconductor_memory), i.e. [integrated circuits](http://en.wikipedia.org/wiki/Integrated_circuits) consisting of[silicon](http://en.wikipedia.org/wiki/Silicon)-based [transistors](http://en.wikipedia.org/wiki/Transistors), used for example as [primary memory](http://en.wikipedia.org/wiki/Primary_memory) but also other purposes in computers and other [digital](http://en.wikipedia.org/wiki/Digital) [electronic](http://en.wikipedia.org/wiki/Electronics) devices.

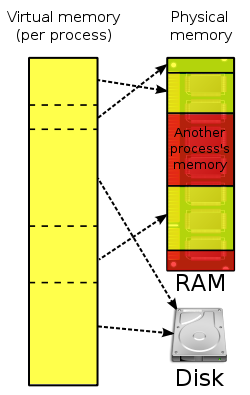
There are two main types of semiconductor memory: [volatile](http://en.wikipedia.org/wiki/Volatile_memory) and [non-volatile](http://en.wikipedia.org/wiki/Non-volatile_memory). Examples of [non-volatile memory](http://en.wikipedia.org/wiki/Non-volatile_memory) are [flash memory](http://en.wikipedia.org/wiki/Flash_memory) (sometimes used as secondary, sometimes primary computer memory) and [ROM](http://en.wikipedia.org/wiki/Read-only_memory)/[PROM](http://en.wikipedia.org/wiki/Programmable_read-only_memory)/[EPROM](http://en.wikipedia.org/wiki/EPROM)/[EEPROM](http://en.wikipedia.org/wiki/EEPROM) memory (used for [firmware](http://en.wikipedia.org/wiki/Firmware) such as boot programs). Examples of [volatile memory](http://en.wikipedia.org/wiki/Volatile_memory) are[primary memory](http://en.wikipedia.org/wiki/Primary_memory) (typically dynamic [RAM](http://en.wikipedia.org/wiki/RAM), [DRAM](http://en.wikipedia.org/wiki/DRAM)), and fast [CPU cache](http://en.wikipedia.org/wiki/CPU_cache) memory (typically static RAM, [SRAM](http://en.wikipedia.org/wiki/Static_random-access_memory), which is fast but energy-consuming and offer lower memory capacity per area unit than DRAM) .

The semiconductor memory is organized into [memory cells](http://en.wikipedia.org/wiki/Computer_data_storage) or [bistable flip-flops](http://en.wikipedia.org/wiki/Bistable_flip-flop), each storing one binary [bit](http://en.wikipedia.org/wiki/Bit) (0 or 1). The memory cells are grouped into words of fix [word length](http://en.wikipedia.org/wiki/Word_length), for example 1, 2, 4, 8, 16, 32, 64 or 128 bit. Each word can be accessed by a binary address of *N* bit, making it possible to store 2 raised by *N*words in the memory. This implies that [processor](http://en.wikipedia.org/wiki/CPU) [registers](http://en.wikipedia.org/wiki/Processor_register) normally are not considered as memory, since they only store one word and do not include an addressing mechanism.

## Random access memory (RAM)

**Random access memory** (**RAM**) is a form of [computer data storage](http://en.wikipedia.org/wiki/Computer_data_storage). Today, it takes the form of [integrated circuits](http://en.wikipedia.org/wiki/Integrated_circuit) that allow stored [data](http://en.wikipedia.org/wiki/Data) to be accessed in any order with a worst case performance of [constant time](http://en.wikipedia.org/wiki/Constant_time).

One can read and over-write data in RAM. Many computer systems have a memory hierarchy consisting of [CPU registers](http://en.wikipedia.org/wiki/CPU_register), on-die [SRAM](http://en.wikipedia.org/wiki/Static_random_access_memory) caches, external [caches](http://en.wikipedia.org/wiki/CPU_cache), [DRAM](http://en.wikipedia.org/wiki/DRAM), [paging](http://en.wikipedia.org/wiki/Paging) systems, and [virtual memory](http://en.wikipedia.org/wiki/Virtual_memory) or [swap space](http://en.wikipedia.org/wiki/Swap_space) on a hard drive. This entire pool of memory may be referred to as "RAM" by many developers, even though the various subsystems can have very different [access times](http://en.wikipedia.org/wiki/Access_time), violating the original concept behind the *random access* term in RAM. Even within a hierarchy level such as DRAM, the specific row, column, bank, [rank](http://en.wikipedia.org/wiki/Memory_rank), channel, or [interleave](http://en.wikipedia.org/wiki/Interleave) organization of the components make the access time variable, although not to the extent that rotating [storage media](http://en.wikipedia.org/wiki/Storage_media) or a tape is variable. The overall goal of using a memory hierarchy is to obtain the higher possible average access performance while minimizing the total cost of the entire memory system (generally, the memory hierarchy follows the access time with the fast CPU registers at the top and the slow hard drive at the bottom). In many modern personal computers, the RAM comes in an easily upgraded form of modules called [memory modules](http://en.wikipedia.org/wiki/DIMM) or DRAM modules about the size of a few sticks of chewing gum. These can quickly be replaced should they become damaged or when changing needs demand more storage capacity. As suggested above, smaller amounts of RAM (mostly SRAM) are also integrated in the[CPU](http://en.wikipedia.org/wiki/CPU) and other [ICs](http://en.wikipedia.org/wiki/Integrated_circuit) on the [motherboard](http://en.wikipedia.org/wiki/Motherboard), as well as in hard-drives, [CD-ROMs](http://en.wikipedia.org/wiki/CD-ROM), and several other parts of the computer system.

In addition to serving as temporary storage and working space for the operating system and applications, RAM is used in numerous other ways.

## Virtual memory

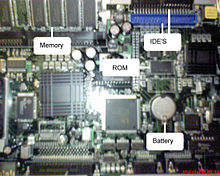
***Virtual memory*** - In [computing](http://en.wikipedia.org/wiki/Computing), **virtual memory** is a [memory management](http://en.wikipedia.org/wiki/Memory_management) technique developed for [multitasking](http://en.wikipedia.org/wiki/Computer_multitasking) [kernels](http://en.wikipedia.org/wiki/Kernel_(computing)). This technique [virtualizes](http://en.wikipedia.org/wiki/Hardware_virtualization) a [computer architecture](http://en.wikipedia.org/wiki/Computer_architecture)'s various forms of [computer data storage](http://en.wikipedia.org/wiki/Computer_data_storage) (such as [random-access memory](http://en.wikipedia.org/wiki/Random-access_memory) and [disk storage](http://en.wikipedia.org/wiki/Disk_storage)), allowing a [program](http://en.wikipedia.org/wiki/Application_software) to be designed as though there is only one kind of memory, "virtual" memory, which behaves like directly addressable read/write memory (RAM). Virtual memory makes application programming easier by hiding [fragmentation](http://en.wikipedia.org/wiki/Fragmentation_(computer)) of physical memory; by delegating to the kernel the burden of managing the [memory hierarchy](http://en.wikipedia.org/wiki/Computer_data_storage#Hierarchy_of_storage) (eliminating the need for the program to handle [overlays](http://en.wikipedia.org/wiki/Overlay_(programming)) explicitly); and, when each process is run in its own dedicated address space, by obviating the need [to relocate](http://en.wikipedia.org/wiki/Relocation_(computer_science)) program code or to access memory with [relative addressing](http://en.wikipedia.org/wiki/Addressing_mode#PC-relative). [Memory virtualization](http://en.wikipedia.org/wiki/Memory_virtualization) is a generalization of the concept of virtual memory. Virtual memory is an integral part of a [computer architecture](http://en.wikipedia.org/wiki/Computer_architecture); implementations require hardware support, typically in the form of a [memory management unit](http://en.wikipedia.org/wiki/Memory_management_unit) built into the [CPU](http://en.wikipedia.org/wiki/Central_processing_unit). While not necessary, [emulators](http://en.wikipedia.org/wiki/Emulators) and [virtual machines](http://en.wikipedia.org/wiki/Virtual_machine) can employ hardware support to increase performance of their virtual memory implementations.[[1]](http://en.wikipedia.org/wiki/Virtual_memory#cite_note-1)

## RAM disk

***RAM disk*** - A **RAM disk** or **RAM drive** is a block of [RAM](http://en.wikipedia.org/wiki/Random-access_memory) ([primary storage](http://en.wikipedia.org/wiki/Primary_storage) or [volatile memory](http://en.wikipedia.org/wiki/Volatile_memory)) that a computer's software is treating as if the memory were a [disk drive](http://en.wikipedia.org/wiki/Disk_drive) ([secondary storage](http://en.wikipedia.org/wiki/Secondary_storage)). It is sometimes referred to as a "virtual RAM drive" or "software RAM drive" to distinguish it from a "hardware RAM drive" that uses separate hardware containing RAM, which is a type of [solid-state drive](http://en.wikipedia.org/wiki/Solid-state_drive).

***Shadow RAM*** - Sometimes, the contents of a relatively slow ROM chip are copied to read/write memory to allow for shorter access times. The ROM chip is then disabled while the initialized memory locations are switched in on the same block of addresses (often write-protected). This process, sometimes called *shadowing*, is fairly common in both computers and [embedded systems](http://en.wikipedia.org/wiki/Embedded_systems).

## Read-only memory (ROM)

**Read-only memory** (**ROM**) is a class of [storage](http://en.wikipedia.org/wiki/Computer_storage) medium used in [computers](http://en.wikipedia.org/wiki/Computer) and other electronic devices. Data stored in ROM cannot be modified, as opposed to RAM which can be both read and written. Since it cannot be modified, ROM memory is suitable for storing data. To that end, ROM has been used in many computers to store [look-up tables](http://en.wikipedia.org/wiki/Look-up_table) for the evaluation of mathematical and logical functions (for example, a [floating-point unit](http://en.wikipedia.org/wiki/Floating-point_unit) might [tabulate the sine function](http://en.wikipedia.org/wiki/Look-up_table#Sine_Table_Example) in order to facilitate faster computation). This was especially effective when [CPUs](http://en.wikipedia.org/wiki/CPU) were slow and ROM was cheap compared to RAM.

## Flash memory

**Flash memory** is a [non-volatile](http://en.wikipedia.org/wiki/Non-volatile_memory) [computer storage](http://en.wikipedia.org/wiki/Computer_storage) chip that can be electrically erased and reprogrammed. It was developed from [EEPROM](http://en.wikipedia.org/wiki/EEPROM) (electrically erasable programmable read-only memory) and must be erased in fairly large blocks before these can be rewritten with new data. The high density NAND type must also be programmed and read in (smaller) blocks, or pages, while the NOR type allows a single [machine word](http://en.wikipedia.org/wiki/Machine_word) (byte) to be written or read independently. The NAND type is primarily used in [memory cards](http://en.wikipedia.org/wiki/Memory_card), [USB flash drives](http://en.wikipedia.org/wiki/USB_flash_drive), [solid-state drives](http://en.wikipedia.org/wiki/Solid-state_drive), and similar products, for general storage and transfer of data. Example applications of both types of flash memory include personal computers, [PDAs](http://en.wikipedia.org/wiki/Personal_digital_assistant), digital audio players, [digital cameras](http://en.wikipedia.org/wiki/Digital_camera), mobile phones, synthesizers, video games, [scientific instrumentation](http://en.wikipedia.org/wiki/Scientific_instrument), [industrial robotics](http://en.wikipedia.org/wiki/Industrial_robotics), [medical electronics](http://en.wikipedia.org/wiki/Medical_electronics), and so on. In addition to being non-volatile, flash memory offers fast read[access times](http://en.wikipedia.org/wiki/Access_time), as fast as [dynamic RAM](http://en.wikipedia.org/wiki/Dynamic_RAM), although not as fast as [static RAM](http://en.wikipedia.org/wiki/Static_RAM) or ROM. Its mechanical shock resistance helps explain its popularity over [hard disks](http://en.wikipedia.org/wiki/Hard_disk)in portable devices; as does its high durability, being able to withstand high pressure, temperature, immersion in water etc.[[1]](http://en.wikipedia.org/wiki/Flash_memory#cite_note-0)

## CPU cache

A **CPU cache** is a [cache](http://en.wikipedia.org/wiki/Cache_(computing)) used by the [central processing unit](http://en.wikipedia.org/wiki/Central_processing_unit) of a [computer](http://en.wikipedia.org/wiki/Computer) to reduce the average time to access [memory](http://en.wikipedia.org/wiki/Computer_storage). The cache is a smaller, faster memory which stores copies of the data from the most frequently used [main memory](http://en.wikipedia.org/wiki/Main_memory) locations. As long as most memory accesses are cached memory locations, the average [latency](http://en.wikipedia.org/wiki/RAM_latency) of memory accesses will be closer to the cache latency than to the latency of main memory.

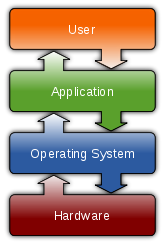
## Input and output devices

In [computing](http://en.wikipedia.org/wiki/Computing), **input/output**, or **I/O**, refers to the communication between an [information processing system](http://en.wikipedia.org/wiki/Information_processing_system) (such as a [computer](http://en.wikipedia.org/wiki/Computer)), and the outside world, possibly a human, or another information processing system. [Inputs](http://en.wikipedia.org/wiki/Information) are the signals or data received by the system, and [outputs](http://en.wikipedia.org/wiki/Output) are the signals or data sent from it. The term can also be used as part of an action; to "perform I/O" is to perform an [input or output operation](http://en.wikipedia.org/wiki/I/O_scheduling). I/O devices are used by a person (or other system) to communicate with a computer. For instance, a [keyboard](http://en.wikipedia.org/wiki/Computer_keyboard) or a [mouse](http://en.wikipedia.org/wiki/Computer_mouse) may be an input device for a computer, while[monitors](http://en.wikipedia.org/wiki/Computer_monitor) and [printers](http://en.wikipedia.org/wiki/Computer_printer) are considered output devices for a computer. Devices for communication between computers, such as [modems](http://en.wikipedia.org/wiki/Modem) and [network cards](http://en.wikipedia.org/wiki/Network_card), typically serve for both input and output.

Note that the designation of a device as either input or output depends on the perspective. Mouse and keyboards take as input physical movement that the human user outputs and convert it into signals that a computer can understand. The output from these devices is input for the computer. Similarly, printers and monitors take as input signals that a computer outputs. They then convert these signals into representations that human users can see or read. For a human user the process of reading or seeing these representations is receiving input. These interactions between computers and humans is studied in a field called [human–computer interaction](http://en.wikipedia.org/wiki/Human%E2%80%93computer_interaction).

* In [computing](http://en.wikipedia.org/wiki/Computing), an **input device** is any [peripheral](http://en.wikipedia.org/wiki/Peripheral) (piece of [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware) equipment) used to provide data and control signals to an [information processing system](http://en.wikipedia.org/wiki/Information_processing_system) such as a [computer](http://en.wikipedia.org/wiki/Computer) or other [information appliance](http://en.wikipedia.org/wiki/Information_appliance). Input and [output devices](http://en.wikipedia.org/wiki/Output_device) make up the hardware interface between a computer and a [scanner](http://en.wikipedia.org/wiki/Image_scanner) or [6DOF](http://en.wikipedia.org/wiki/Six_degrees_of_freedom) controller.Types of Input devices are:
  + **Keyboard** - A 'keyboard' is a human interface device which is represented as a layout of buttons. Each button, or key, can be used to either input a linguistic character to a computer, or to call upon a particular function of the computer. Traditional keyboards use spring-based buttons, though newer variations employ virtual keys, or even projected keyboards.
  + **Pointing devices** - A **pointing device** is an input interface (specifically a [human interface device](http://en.wikipedia.org/wiki/Human_interface_device)) that allows a user to input spatial (i.e., continuous and multi-dimensional) data to a [computer](http://en.wikipedia.org/wiki/Computer). [CAD](http://en.wikipedia.org/wiki/Computer-aided_design) systems and [graphical user interfaces](http://en.wikipedia.org/wiki/Graphical_user_interface) (GUI) allow the user to control and provide data to the computer using physical [gestures](http://en.wikipedia.org/wiki/Mouse_gesture) — point, click, and drag — for example, by moving a hand-held [mouse](http://en.wikipedia.org/wiki/Mouse_(computing)) across the surface of the physical desktop and activating switches on the mouse. Movements of the pointing device are echoed on the screen by movements of the [pointer](http://en.wikipedia.org/wiki/Pointer_(computing_WIMP)) (or [cursor](http://en.wikipedia.org/wiki/Cursor_(computers))) and other visual changes. While the most common pointing device by far is the mouse, many more devices have been developed. A "rodent" is a technical term referring to a device which generates mouse-like input. However, the term "mouse" is commonly used as a metaphor for devices that move the cursor.
  + **Composite devices** - Input devices, such as buttons and joysticks, can be combined on a single physical device that could be thought of as a composite device. Many gaming devices have controllers like this. Technically mice are composite devices, as they both track movement and provide buttons for clicking, but composite devices are generally considered to have more than two different forms of input.
  + **Imaging and Video input devices** such as digital camera, web camera, scanners, bar code readers, etc.
  + **Audio** input devices such as microphone
* An **output device** is any piece of [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware) equipment used to communicate the results of [data processing](http://en.wikipedia.org/wiki/Data_processing) carried out by an [information processing system](http://en.wikipedia.org/wiki/Information_processing_system) (such as a [computer](http://en.wikipedia.org/wiki/Computer)) which converts the electronically generated information into human-readable form.[[1]](http://en.wikipedia.org/wiki/Output_device#cite_note-NIOS-0)[[2]](http://en.wikipedia.org/wiki/Output_device#cite_note-PC_Mag-1) There are many input and output devices such as [multifunction printers](http://en.wikipedia.org/wiki/Multifunction_printer) and [computer-based navigation systems](http://en.wikipedia.org/wiki/Navigation_system) that are used for specialised or unique applications.[[1]](http://en.wikipedia.org/wiki/Output_device#cite_note-NIOS-0) In computing, [input/output](http://en.wikipedia.org/wiki/Input/output), or I/O, refers to the communication between an [information processing system](http://en.wikipedia.org/wiki/Information_processing_system) (such as a [computer](http://en.wikipedia.org/wiki/Computer)), and the outside world. Inputs are the signals or data received by the system, and outputs are the signals or data sent from it. Some types of **output devices** are speakers, headphones, printers, projectors, television, monitor, etc.

# II SOFTWARE



**Computer software**, or just **software**, is a collection of [computer programs](http://en.wikipedia.org/wiki/Computer_program) and related [data](http://en.wikipedia.org/wiki/Data) that provides the instructions for telling a [computer](http://en.wikipedia.org/wiki/Computer) what to do and how to do it. Software refers to one or more computer programs and data held in the storage of the computer for some purposes. In other words, software is a set of *programs, procedures, algorithms* and its *documentation* concerned with the operation of a data processing system. Program software performs the [function](http://en.wikipedia.org/wiki/Function_(engineering)) of the [program](http://en.wikipedia.org/wiki/Computer_program) it implements, either by directly providing [instructions](http://en.wikipedia.org/wiki/Instruction_(computer_science)) to the computer hardware or by serving as input to another piece of software. The [term](http://en.wikipedia.org/wiki/Terminology) was coined to contrast to the old term [hardware](http://en.wikipedia.org/wiki/Computer_hardware) (meaning physical devices). In contrast to hardware, software "cannot be touched".[[1]](http://en.wikipedia.org/wiki/Software#cite_note-0) Software is also sometimes used in a more narrow sense, meaning [application software](http://en.wikipedia.org/wiki/Application_software) only. Sometimes the term includes data that has not traditionally been associated with computers, such as film, tapes, and records.[[2]](http://en.wikipedia.org/wiki/Software#cite_note-1)

[Computer](http://en.wikipedia.org/wiki/Computer) software is so called to distinguish it from [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware), which encompasses the physical interconnections and devices required to store and execute (or run) the software. At the lowest level, executable code consists of machine language instructions specific to an individual processor. A machine language consists of groups of binary values signifying processor instructions that change the state of the computer from its preceding state. Programs are an ordered sequence of instructions for changing the state of the computer in a particular sequence. It is usually written in [high-level programming languages](http://en.wikipedia.org/wiki/High-level_programming_language) that are easier and more efficient for humans to use (closer to [natural language](http://en.wikipedia.org/wiki/Natural_language)) than machine language. High-level languages are compiled or interpreted into machine language object code. Software may also be written in an [assembly language](http://en.wikipedia.org/wiki/Assembly_language), essentially, a mnemonic representation of a machine language using a natural language alphabet. Assembly language must be assembled into object code via an [assembler](http://en.wikipedia.org/wiki/Assemblers).

Software includes all the various forms and roles that digitally stored *data* may have and play in a computer (or similar system), regardless of whether the data is used as *code* for a CPU, or other [interpreter](http://en.wikipedia.org/wiki/Interpreter), or whether it represents other kinds of [information](http://en.wikipedia.org/wiki/Information). Software thus encompasses a wide array of products that may be developed using different techniques such as ordinary [programming languages](http://en.wikipedia.org/wiki/Programming_languages), [scripting languages](http://en.wikipedia.org/wiki/Scripting_languages), [microcode](http://en.wikipedia.org/wiki/Microcode), or an [FPGA](http://en.wikipedia.org/wiki/Field-programmable_gate_array) configuration.

The types of software include [web pages](http://en.wikipedia.org/wiki/Web_pages) developed in languages and frameworks like [HTML](http://en.wikipedia.org/wiki/HTML), [PHP](http://en.wikipedia.org/wiki/PHP), [Perl](http://en.wikipedia.org/wiki/Perl), [JSP](http://en.wikipedia.org/wiki/JavaServer_Pages), [ASP.NET](http://en.wikipedia.org/wiki/ASP.NET), [XML](http://en.wikipedia.org/wiki/XML), and [desktop applications](http://en.wikipedia.org/wiki/Desktop_application) like[OpenOffice.org](http://en.wikipedia.org/wiki/OpenOffice.org), [Microsoft Word](http://en.wikipedia.org/wiki/Microsoft_Word) developed in languages like [C](http://en.wikipedia.org/wiki/C_(programming_language)), [C++](http://en.wikipedia.org/wiki/C%2B%2B), [Objective-C](http://en.wikipedia.org/wiki/Objective-C), [Java](http://en.wikipedia.org/wiki/Java_(programming_language)), [C#](http://en.wikipedia.org/wiki/C_Sharp_(programming_language)), or [Smalltalk](http://en.wikipedia.org/wiki/Smalltalk). [Application software](http://en.wikipedia.org/wiki/Application_software) usually runs on an underlying software [operating systems](http://en.wikipedia.org/wiki/Operating_system) such as [Linux](http://en.wikipedia.org/wiki/Linux) or [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows). Software (or [firmware](http://en.wikipedia.org/wiki/Firmware)) is also used in [video games](http://en.wikipedia.org/wiki/Video_game) and for the configurable parts of the [logic](http://en.wikipedia.org/wiki/Logic)systems of [automobiles](http://en.wikipedia.org/wiki/Automobile), [televisions](http://en.wikipedia.org/wiki/Television), and other [consumer electronics](http://en.wikipedia.org/wiki/Consumer_electronics).

Practical [computer systems](http://en.wikipedia.org/wiki/Computer_system) divide [software systems](http://en.wikipedia.org/wiki/Software_system) into three major classes: [system software](http://en.wikipedia.org/wiki/System_software), [programming software](http://en.wikipedia.org/wiki/Programming_software) and [application software](http://en.wikipedia.org/wiki/Application_software), although the distinction is arbitrary, and often blurred.

## Operating system

An **operating system** (**OS**) is a set of software that manages [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware) resources and provides common services for [computer programs](http://en.wikipedia.org/wiki/Computer_program). The operating system is a vital component of the [system software](http://en.wikipedia.org/wiki/System_software) in a computer system. Application programs require an operating system to function.

Time-sharing operating systems schedule tasks for efficient use of the system and may also include accounting for cost allocation of processor time, mass storage, printing, and other resources.

For hardware functions such as input and output and [memory allocation](http://en.wikipedia.org/wiki/Dynamic_memory_allocation), the operating system acts as an intermediary between programs and the computer hardware,[[1]](http://en.wikipedia.org/wiki/Operating_system#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Operating_system#cite_note-1) although the application code is usually executed directly by the hardware and will frequently make a [system call](http://en.wikipedia.org/wiki/System_call) to an OS function or be interrupted by it. Operating systems can be found on almost any device that contains a computer—from [cellular phones](http://en.wikipedia.org/wiki/Cellular_phone) and [video game consoles](http://en.wikipedia.org/wiki/Video_game_console) to [supercomputers](http://en.wikipedia.org/wiki/Supercomputer) and [web servers](http://en.wikipedia.org/wiki/Web_server).

Examples of popular modern operating systems include [Android](http://en.wikipedia.org/wiki/Android_(operating_system)), [BSD](http://en.wikipedia.org/wiki/BSD), [iOS](http://en.wikipedia.org/wiki/IOS), [GNU/Linux](http://en.wikipedia.org/wiki/GNU/Linux), [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X), [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows),[[3]](http://en.wikipedia.org/wiki/Operating_system#cite_note-netapplications-2) [Windows Phone](http://en.wikipedia.org/wiki/Windows_Phone), and [IBM z/OS](http://en.wikipedia.org/wiki/IBM_z/OS). All these, except Windows and z/OS, share roots in [UNIX](http://en.wikipedia.org/wiki/UNIX).

## System software

**System software** is [computer software](http://en.wikipedia.org/wiki/Computer_software) designed to operate and control the [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware) and to provide a platform for running [application software](http://en.wikipedia.org/wiki/Application_software).[[1]](http://en.wikipedia.org/wiki/System_software#cite_note-0)[[2]](http://en.wikipedia.org/wiki/System_software#cite_note-1)

[Device drivers](http://en.wikipedia.org/wiki/Device_driver) such as computer [BIOS](http://en.wikipedia.org/wiki/BIOS) and device [firmware](http://en.wikipedia.org/wiki/Firmware) provide basic functionality to operate and control the hardware connected to or built into the computer. The [operating system](http://en.wikipedia.org/wiki/Operating_system) (prominent examples being [z/OS](http://en.wikipedia.org/wiki/Z/OS), [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows), [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X) and [Linux](http://en.wikipedia.org/wiki/Linux)), allows the parts of a computer to work together by performing tasks like transferring [data](http://en.wikipedia.org/wiki/Data_(computing)) between [memory](http://en.wikipedia.org/wiki/Random_access_memory) and [disks](http://en.wikipedia.org/wiki/Disk_storage) or rendering output onto a [display device](http://en.wikipedia.org/wiki/Display_device). It also provides a platform to run high-level system software and [application software](http://en.wikipedia.org/wiki/Application_software). [Window systems](http://en.wikipedia.org/wiki/Window_system) are components of a [graphical user interface](http://en.wikipedia.org/wiki/Graphical_user_interface) (GUI), and more specifically of a [desktop environment](http://en.wikipedia.org/wiki/Desktop_environment), which supports the implementation of [window managers](http://en.wikipedia.org/wiki/Window_manager), and provides basic support for graphics hardware, pointing devices such as mice, and keyboards. The mouse cursor is also generally drawn by the [windowing system](http://en.wikipedia.org/wiki/Windowing_system). [Utility software](http://en.wikipedia.org/wiki/Utility_software) helps to analyze, configure, optimize and maintain the computer.

[Servers](http://en.wikipedia.org/wiki/Server_(computing)) are computer programs running to serve the requests of other programs, the "[clients](http://en.wikipedia.org/wiki/Client_(computing))". The server performs some computational task on behalf of clients which may run on either the same computer or on other computers connected through a network.

In some publications, the term *system software* is also used to designate [software development](http://en.wikipedia.org/wiki/Software_development) tools (like a [compiler](http://en.wikipedia.org/wiki/Compiler), [linker](http://en.wikipedia.org/wiki/Linker_(computing)) or [debugger](http://en.wikipedia.org/wiki/Debugger)).[[3]](http://en.wikipedia.org/wiki/System_software#cite_note-2)

In contrast to system software, software that allows users to do things like create text documents, play games, listen to music, or surf the web is called [application software](http://en.wikipedia.org/wiki/Application_software).[[4]](http://en.wikipedia.org/wiki/System_software#cite_note-3)

## Programming software

A **programming tool** or **software development tool** is a [program](http://en.wikipedia.org/wiki/Computer_program) or [application](http://en.wikipedia.org/wiki/Application_software) that [software developers](http://en.wikipedia.org/wiki/Software_developer) use to create, debug, maintain, or otherwise support other programs and applications. The term usually refers to relatively simple programs that can be combined together to accomplish a task, much as one might use multiple hand [tools](http://en.wikipedia.org/wiki/Tool) to fix a physical object. Programming tool or programming software is a sub-category of [system software](http://en.wikipedia.org/wiki/System_software) but sometimes it is stated as a separate category of software along with application and system software.[[1]](http://en.wikipedia.org/wiki/Programming_software#cite_note-0)

## Application software

**Application software**, also known as an **application** or an **app**, is [computer software](http://en.wikipedia.org/wiki/Computer_software) designed to help the user to perform specific tasks. Examples include [enterprise software](http://en.wikipedia.org/wiki/Enterprise_software), [accounting software](http://en.wikipedia.org/wiki/Accounting_software), [office suites](http://en.wikipedia.org/wiki/Office_suite), [graphics software](http://en.wikipedia.org/wiki/Graphics_software) and [media players](http://en.wikipedia.org/wiki/Media_player_(application_software)). Many application programs deal principally with [documents](http://en.wikipedia.org/wiki/Document_file_format). Apps may be [bundled](http://en.wikipedia.org/wiki/Product_bundling) with the computer and its system software, or may be published separately. Some users are satisfied with the bundled apps and need never install one.

Application software is contrasted with [system software](http://en.wikipedia.org/wiki/System_software) and [middleware](http://en.wikipedia.org/wiki/Middleware), which manage and integrate a computer's capabilities, but typically do not directly apply in the performance of tasks that benefit the user. The system software serves the application, which in turn serves the user.

Similar relationships apply in other fields. For example, a shopping mall does not provide the merchandise a shopper is seeking, but provides space and services for retailers that serve the shopper. A bridge may similarly support rail tracks which support trains, allowing the trains to transport passengers.

This category includes:

* + - Business software
    - Computer-aided design
    - Databases
    - Decision-making software
    - Educational software
    - Image editing
    - Industrial automation
    - Mathematical software
    - Medical software
    - Molecular modeling software
    - Quantum chemistry and solid state physics software
    - Simulation software
    - Spreadsheets
    - Telecommunications (i.e., the Internet and everything that flows on it)
    - Video editing software
    - Video games
    - Word processing

## Commercial Software

**Commercial software**, or less commonly, **payware**, is [computer software](http://en.wikipedia.org/wiki/Computer_software) that is produced for [sale](http://en.wikipedia.org/wiki/Selling)[[1]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-0) or that serves [commercial](http://en.wikipedia.org/wiki/Commerce) purposes. Commercial software is most often [proprietary software](http://en.wikipedia.org/wiki/Proprietary_software), but [free software](http://en.wikipedia.org/wiki/Free_software) packages [may also be commercial software.](http://en.wikipedia.org/wiki/Open_source_commercial_software)[[2]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-2)[[4]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-3)

All or parts of software packages and services that support commerce are increasingly made available as [free software](http://en.wikipedia.org/wiki/Free_software). This includes products from [Red Hat](http://en.wikipedia.org/wiki/Red_Hat), [Apple Computer](http://en.wikipedia.org/wiki/Apple_Computer), [Sun Microsystems](http://en.wikipedia.org/wiki/Sun_Microsystems), [Google](http://en.wikipedia.org/wiki/Google), and [Microsoft Corporation](http://en.wikipedia.org/wiki/Microsoft_Corporation). Microsoft Corporation uses "commercial software", to describe their [business model](http://en.wikipedia.org/wiki/Business_model).[[5]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-4)

## Free and open-source software

While less common than commercial proprietary software, [free](http://en.wikipedia.org/wiki/Free_software) and [open-source software](http://en.wikipedia.org/wiki/Open-source_software) may also be commercial software. This is a fact that the [Free Software Foundation](http://en.wikipedia.org/wiki/Free_Software_Foundation) emphasizes,[[6]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-5) and is the basis of the [Open Source Initiative](http://en.wikipedia.org/wiki/Open_Source_Initiative).

Under the free software business model, free software vendors may charge a fee for distribution and offer pay support and software customization services. Proprietary software uses a different business model, where a customer of the proprietary software pays a fee for a license to use the software. This license may grant the customer the ability to configure some or no parts of the software themselves. Often some level of support is included in the purchase of proprietary software, but additional support services (especially for enterprise applications) are usually available for an additional fee. Some proprietary software vendors will also customize software for a fee.[[7]](http://en.wikipedia.org/wiki/Commercial_software#cite_note-6)

Free software is generally available at no cost and can result in permanently lower costs compared to [proprietary software](http://en.wikipedia.org/wiki/Proprietary_software). With free software, businesses can fit software to their specific needs by changing the software themselves or by hiring programmers to modify it for them. Free software often has no warranty, and more importantly, generally does not assign legal liability to anyone. However, warranties are permitted between any two parties upon the condition of the software and its usage. Such an agreement is made separately from the free software license.

## Freeware

**Freeware** ([portmanteau](http://en.wikipedia.org/wiki/Portmanteau) of "free" and "software") is [software](http://en.wikipedia.org/wiki/Software) that is available for use at no cost or for an optional fee,[[1]](http://en.wikipedia.org/wiki/Freeware#cite_note-0) but usually with one or more restricted usage rights.[[2]](http://en.wikipedia.org/wiki/Freeware#cite_note-linfo-1)[[3]](http://en.wikipedia.org/wiki/Freeware#cite_note-lawrence-2)[[4]](http://en.wikipedia.org/wiki/Freeware#cite_note-gnu-3) Freeware is in contrast to [commercial software](http://en.wikipedia.org/wiki/Commercial_software), which is typically sold for profit, but might be distributed for a business or commercial purpose in the aim to expand the [marketshare](http://en.wikipedia.org/wiki/Marketshare) of a "premium" product.

According to the[Free Software Foundation](http://en.wikipedia.org/wiki/Free_Software_Foundation), "freeware" is a loosely defined category and it has no clear accepted definition, although FSF says it must be distinguished from [free software](http://en.wikipedia.org/wiki/Free_software) (libre).[[4]](http://en.wikipedia.org/wiki/Freeware#cite_note-gnu-3) Popular examples of[closed-source](http://en.wikipedia.org/wiki/Closed-source) freeware include [Adobe reader](http://en.wikipedia.org/wiki/Adobe_reader) and [Skype](http://en.wikipedia.org/wiki/Skype).

## Shareware

The term **shareware** (also termed **trialware** or **demoware**) is [proprietary software](http://en.wikipedia.org/wiki/Proprietary_software) that is provided to users without payment on a trial basis and is often limited by any combination of [functionality](http://en.wiktionary.org/wiki/function),[availability](http://en.wikipedia.org/wiki/Availability) (it may be functional for a limited time period only), or [convenience](http://en.wikipedia.org/wiki/Convenience) (the software may present a dialog at startup or during usage, reminding the user to purchase it; "nagging dialogs"). Shareware is often offered as a [download](http://en.wikipedia.org/wiki/Download) from an [Internet](http://en.wikipedia.org/wiki/Internet) [website](http://en.wikipedia.org/wiki/Website) or as a [compact disc](http://en.wikipedia.org/wiki/Compact_disc) included with a [periodical](http://en.wikipedia.org/wiki/Periodical) such as a [newspaper](http://en.wikipedia.org/wiki/Newspaper) or [magazine](http://en.wikipedia.org/wiki/Magazine). The rationale behind shareware is to give buyers the opportunity to use the program and judge its usefulness before purchasing a [license](http://en.wikipedia.org/wiki/Software_license) for the full version of the software. Firms with superior software thus have an incentive to offer samples, except if their product is already well known, or if they do not want to be listed in direct competition with other products on shareware repositories.[[1]](http://en.wikipedia.org/wiki/Shareware#cite_note-0)

Shareware is usually offered either with certain [features](http://en.wikipedia.org/wiki/Feature_(software_design)) only available after the license is purchased, or as a full version but for a limited trial period of time. Once the trial period has passed, the program may stop running until a license is purchased. Shareware is often offered without supports or updates which only become available with the purchase of a license. The words "free trial" or "trial version" are indicative of shareware.

The term shareware is used in contrast to [*retail software*](http://en.wikipedia.org/wiki/Retail_software), which refers to [commercial software](http://en.wikipedia.org/wiki/Commercial_software) available only with the purchase of a license which may not be copied for others; [*public domain software*](http://en.wikipedia.org/wiki/Public_domain_software), which refers to software not [copyright](http://en.wikipedia.org/wiki/Copyright) protected; [*open-source software*](http://en.wikipedia.org/wiki/Open-source_software), in which the [source code](http://en.wikipedia.org/wiki/Source_code) is available for anyone to inspect and alter; and [*freeware*](http://en.wikipedia.org/wiki/Freeware), which refers to copyrighted software for which the developers solicit no payment (though they may request donations).

## Retail software

**Retail software** is [computer software](http://en.wikipedia.org/wiki/Computer_software) sold to [end consumers](http://en.wikipedia.org/wiki/End_consumer), usually under restricted licenses. Until the emergence of the [Internet](http://en.wikipedia.org/wiki/Internet), retail software represented, until the 2000s, the vast majority of all end consumer software used and was referred to as **shrinkware** because software almost always ships in a [shrinkwrapped](http://en.wikipedia.org/wiki/Shrinkwrap) box. An important historical event that led to the expansion of the market for retail software was the [Open Letter to Hobbyists](http://en.wikipedia.org/wiki/Open_Letter_to_Hobbyists) by [Bill Gates](http://en.wikipedia.org/wiki/Bill_Gates) in 1976.

The rise of the [Internet](http://en.wikipedia.org/wiki/Internet) and [software licensing](http://en.wikipedia.org/wiki/Software_licensing) schemes has dramatically changed the retail software market. Users are capable of finding [shareware](http://en.wikipedia.org/wiki/Shareware), [freeware](http://en.wikipedia.org/wiki/Freeware) and [free software](http://en.wikipedia.org/wiki/Free_software) products or use Web services as easily as retail.[[1]](http://en.wikipedia.org/wiki/Retail_software#cite_note-0) Producers of proprietary software have shifted to providing much of their software and services via the Internet, including [Google](http://en.wikipedia.org/wiki/Google), [Microsoft](http://en.wikipedia.org/wiki/Microsoft), [Yahoo!](http://en.wikipedia.org/wiki/Yahoo!), and [Apple Inc.](http://en.wikipedia.org/wiki/Apple_Inc.). Software is also becoming available as part of an integrated device, as well.

**OEM Pack** - This is a licensed copy of software given by the software manufacturer to a computer manufacturer to pre-install on a computer being sold to a customer. A backup copy may or may not be provided on a CD to the end user along with the computer.

**Box Pack** - This is a licensed copy of software that an end user buys off the shelf from any authorized retail outlet. They may sometimes be more highly priced than OEM versions as you generally get additional software along with the main software within the pack.

**Paper License** - This is a scheme provided by the software manufacturer to companies or businesses that require large number of copies of particular software to be installed on multiple computers within the organization. Say for example, a company requires installing software on 50 computers in its office. Instead of buying 50 CDs and managing those 50 individually, the company can buy one copy of the software and request the software vendor to issue a paper license authorizing them to use it on 50 computers. The software vendor then charges them accordingly. This method is also much cheaper than buying 50 individual packs.

## 

## Inventory management

Inventory management is primarily about specifying the shape and percentage of stocked goods. It is required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials.

The scope of inventory management concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods, and demand forecasting. Balancing these competing requirements leads to optimal inventory levels, which is an on-going process as the business needs shift and react to the wider environment.

Inventory management involves a retailer seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check. It also involves systems and processes that identify inventory requirements, set targets, provide replenishment techniques, report actual and projected inventory status and handle all functions related to the tracking and management of material. This would include the monitoring of material moved into and out of stockroom locations and the reconciling of the inventory balances. It also may include ABC analysis, lot tracking, cycle counting support, etc. Management of the inventories, with the primary objective of determining/controlling stock levels within the physical distribution system, functions to balance the need for product availability against the need for minimizing stock holding and handling costs.

# III Operating Data

In [computer science](http://en.wikipedia.org/wiki/Computer_science), data is information in a form suitable for use with a [computer](http://en.wikipedia.org/wiki/Computer).[[1]](http://en.wikipedia.org/wiki/Data_(computing)#cite_note-0) Data is often distinguished from [programs](http://en.wikipedia.org/wiki/Computer_program). A program is a sequence of [instructions](http://en.wikipedia.org/wiki/Instruction_(computer_science)) that detail a task for the computer to perform. In this sense, data is thus everything in a [software](http://en.wikipedia.org/wiki/Software) that is not program code.[[2]](http://en.wikipedia.org/wiki/Data_(computing)#cite_note-1)

## Computer files

A **computer file** is a block of arbitrary information, or resource for storing information, which is available to a [computer program](http://en.wikipedia.org/wiki/Computer_program) and is usually based on some kind of durable [storage](http://en.wikipedia.org/wiki/Computer_storage). A file is durable in the sense that it remains available for programs to use after the current program has finished. Computer files can be considered as the modern counterpart of paper [documents](http://en.wikipedia.org/wiki/Document) which traditionally are kept in offices' and libraries' [files](http://en.wikipedia.org/wiki/Filing_cabinet), and this is the source of the term.

**File size**

At any instant in time, a file might have a size, normally expressed as number of [bytes](http://en.wikipedia.org/wiki/Byte), that indicates how much storage is associated with the file. In most modern operating systems the size can be any non-negative whole number of bytes up to a system limit.

**File operations**

At the most basic level there are only two types of file operations; read and write. For example: adding text to a document involves; opening the file (read), inputting the text and saving the file (write)

Files on a computer can be created, moved, modified, grown, shrunk and deleted. In most cases, computer programs that are executed on the computer handle these operations, but the user of a computer can also manipulate files if necessary. For instance, [Microsoft Word](http://en.wikipedia.org/wiki/Microsoft_Word) files are normally created and modified by the Microsoft Word program in response to user commands, but the user can also move, rename, or delete these files directly by using a [file manager program](http://en.wikipedia.org/wiki/File_manager) such as [Windows Explorer](http://en.wikipedia.org/wiki/Windows_Explorer) (on Windows computers).

In [Unix-like](http://en.wikipedia.org/wiki/Unix-like) systems, user-space processes do not normally deal with files at all; the [operating system](http://en.wikipedia.org/wiki/Operating_system) provides a level of [abstraction](http://en.wikipedia.org/wiki/Abstraction_(computer_science)) which means that almost all interaction with files from user-space is through [hard links](http://en.wikipedia.org/wiki/Hard_links). Hard links allow a name to be associated with a file (or they can be anonymous - and therefore temporary); files do not have names in the OS. For example, a user-space program cannot delete a file; it can delete a link to a file (for example, using the [shell](http://en.wikipedia.org/wiki/Shell_(computing)) commands rm or mv or, in the anonymous case, simply by exiting), and if the kernel determines that there are no more existing hard links to the file ([symbolic links](http://en.wikipedia.org/wiki/Symbolic_links) will simply fail to resolve), it may then allow the memory location for the deleted file to be allocated for another file. Because [Unix-like](http://en.wikipedia.org/wiki/Unix-like) systems only delete the pointer to the file the data remains intact on disk, this creates what is known as [free space](http://en.wikipedia.org/wiki/Data_remanence), which is commonly considered a security risk due to the existence of [file recovery software](http://en.wikipedia.org/wiki/File_recovery). Such a risk has given rise to the secure deletion programs such as [srm](http://en.wikipedia.org/wiki/Srm_(Unix)). In fact, it really is only the kernel that deals with files, but it serves to handle all user-space interaction with (virtual) files in a manner that is transparent to the user-space programs.

Although the way programs manipulate files varies according to the operating system and file system involved, the following operations are typical:

* *Creating* a file with a given name
* Setting *attributes* that control operations on the file
* *Opening* a file to use its contents
* *Reading* or *updating* the contents
* *Committing* updated contents to durable storage
* *Closing* the file, thereby losing access until it is opened again

**Identifying files**

Many (but not all) computer systems use [extensions](http://en.wikipedia.org/wiki/Filename_extension) in file names to help identify what they contain, also known as the file type. On Windows computers, extensions consist of a dot (period) at the end of a file name, followed by a few letters to identify the type of file. An extension of .txt identifies a text file; a .doc extension identifies any type of document or documentation, commonly in the [Microsoft Word](http://en.wikipedia.org/wiki/Microsoft_Word) [file format](http://en.wikipedia.org/wiki/File_format); [and so on](http://en.wikipedia.org/wiki/List_of_file_formats). Even when extensions are used in a computer system, the degree to which the computer system recognizes and heeds them can vary; in some systems, they are required, while in other systems, they are completely ignored if they are presented.

Examples of filename extensions are

* .png - Portable Network Graphic
* .exe - Executable File (Microsoft Corporation)
* .dmg - Mountable disk image created in Mac OS X
* .txt - Text file

**Protecting files**

Many modern computer systems provide methods for protecting files against accidental and deliberate damage. Computers that allow for multiple users implement [file permissions](http://en.wikipedia.org/wiki/File_permissions) to control who may or may not modify, delete, or create files and folders. For example, a given user may be granted only permission to read a file or folder, but not to modify or delete it; or a user may be given permission to read and modify files or folders, but not to execute them.

**Backing up files**

When computer files contain information that is extremely important, a [*back-up*](http://en.wikipedia.org/wiki/Back-up) process is used to protect against disasters that might destroy the files. Backing up files simply means making copies of the files in a separate location so that they can be restored if something happens to the computer, or if they are deleted accidentally.

**File Format**

A **file format** is a particular way that information is encoded for storage in a [computer file](http://en.wikipedia.org/wiki/Computer_file), as files need a way to be represented as [bits](http://en.wikipedia.org/wiki/Bits) when stored on a [disc drive](http://en.wikipedia.org/wiki/Disc_drive) or other digital storage medium.

There are different types of file format. Most important ones are:

* [MP3](http://en.wikipedia.org/wiki/MP3)  - an open standard, but subject to patents in some countries [[4]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-3)
* [CDR](http://en.wikipedia.org/wiki/CorelDraw#CDR_file_format) - (non-documented) CorelDraw's native format primarily used for vector graphic drawings
* [DWG](http://en.wikipedia.org/wiki/.dwg) - (non-documented) [AutoCAD](http://en.wikipedia.org/wiki/AutoCAD) drawing
* [PSD](http://en.wikipedia.org/wiki/Adobe_Photoshop#Features) - (non-documented) [Adobe Photoshop](http://en.wikipedia.org/wiki/Adobe_Photoshop)'s native image format
* [RAR](http://en.wikipedia.org/wiki/RAR) - (partially documented) archive and compression file format owned by Alexander L. Roshal[[5]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-4)
* [WMA](http://en.wikipedia.org/wiki/Windows_Media_Audio) - a closed format, owned by [Microsoft](http://en.wikipedia.org/wiki/Microsoft)[[6]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-WMA-5)
* [DOC](http://en.wikipedia.org/wiki/DOC_(computing)) - Microsoft Word Document (formerly closed/undocumented, now [Microsoft Open Specification Promise](http://en.wikipedia.org/wiki/Microsoft_Open_Specification_Promise))
* [XLS](http://en.wikipedia.org/wiki/Microsoft_Excel_file_format) - Microsoft Excel spreadsheet file format (formerly closed/undocumented, now [Microsoft Open Specification Promise](http://en.wikipedia.org/wiki/Microsoft_Open_Specification_Promise))
* [PPT](http://en.wikipedia.org/wiki/Microsoft_PowerPoint#File_formats) - Microsoft PowerPoint Presentation file format (formerly closed/undocumented, now [Microsoft Open Specification Promise](http://en.wikipedia.org/wiki/Microsoft_Open_Specification_Promise))
* PIC – An image file format
* [RTF](http://en.wikipedia.org/wiki/Rich_Text_Format) - a formatted text format (proprietary[[7]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-6)[[8]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-e-gov-uk-7)[[9]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-8)[[10]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-9), published specification, defined and maintained only by Microsoft)
* [SWF](http://en.wikipedia.org/wiki/SWF) - Adobe Flash format (formerly closed/undocumented, now partially or completely open)
* [XFA](http://en.wikipedia.org/wiki/XFA) - Adobe XML Forms Architecture, used in PDF files (published specification, but not included in the PDF ISO 32000-1 standard; controlled and maintained only by Adobe[[11]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-gnupdf-fdf-10)[[12]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-acroforms-appligent-11))
* [ZIP](http://en.wikipedia.org/wiki/ZIP_(file_format)) - a base version of this data compression and archive file format is in the [public domain](http://en.wikipedia.org/wiki/Public_domain), but newer versions have some patented features[[13]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-12)[[14]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-13)[[15]](http://en.wikipedia.org/wiki/Proprietary_format#cite_note-14)
* [GIF](http://en.wikipedia.org/wiki/Graphics_Interchange_Format) - CompuServe's Graphics Interchange Format (open since 2004)
* [PDF](http://en.wikipedia.org/wiki/Portable_Document_Format) - Adobe's Portable Document Format (open since 2008), but the specification allows some proprietary extensions
* [JPEG 2000](http://en.wikipedia.org/wiki/JPEG_2000) — an image format standardized by ISO/IEC

## Computer folders

In [computing](http://en.wikipedia.org/wiki/Computing), a **folder**, **directory**,[[1]](http://en.wikipedia.org/wiki/Computer_folder#cite_note-0) **catalog**, or **drawer**,[[2]](http://en.wikipedia.org/wiki/Computer_folder#cite_note-1) is a virtual container within a digital [file system](http://en.wikipedia.org/wiki/File_system), in which groups of [computer files](http://en.wikipedia.org/wiki/Computer_file) and possibly other folders can be kept and organized.

Files are kept organized by storing related files in the same folder. A folder contained inside another folder is called a **subfolder**, **subdirectory**, or **child** of that folder, while the containing folder is called the **parent** folder. The top-most parent folder, which does not have a parent folder of its own, is called the **root** folder within the file system. Together, the folders form a [hierarchy](http://en.wikipedia.org/wiki/Hierarchy), or tree structure of one or more levels.

## Word Processing

A word processor is a [computer](http://en.wikipedia.org/wiki/Computer) [application](http://en.wikipedia.org/wiki/Application_software) used for the production (including composition, editing, formatting, and possibly printing) of any sort of printable material.

*Word processing* typically implies the presence of text manipulation functions that extend beyond a basic ability to enter and change text, such as automatic generation of:

* batch mailings using a form letter [template](http://en.wikipedia.org/wiki/Template_(word_processing)) and an address database (also called mail merging);
* indices of keywords and their page numbers;
* tables of contents with section titles and their page numbers;
* tables of figures with caption titles and their page numbers;
* cross-referencing with section or page numbers;
* footnote numbering;
* new [versions](http://en.wikipedia.org/wiki/Revision_control) of a document using variables (e.g. model numbers, product names, etc.)

Other word processing functions include [spell checking](http://en.wikipedia.org/wiki/Spell_checking) (actually checks against wordlists), "grammar checking" (checks for what seem to be simple grammar errors), and a "thesaurus" function (finds words with similar or opposite meanings). Other common features include collaborative editing, comments and annotations, support for images and diagrams and internal cross-referencing.

Almost all word processors enable users to employ *styles*, which are used to automate consistent formatting of text body, titles, subtitles, highlighted text, and so on. Styles greatly simplify managing the formatting of large documents, since changing a style automatically changes all text that the style has been applied to. Even in shorter documents styles can save a lot of time while formatting.

**Document statistics**

Most current word processors can calculate various [statistics](http://en.wikipedia.org/wiki/Statistics) pertaining to a document. These usually include:

* [Character](http://en.wikipedia.org/wiki/Character_(computing)) count, [word count](http://en.wikipedia.org/wiki/Word_count), [sentence](http://en.wikipedia.org/wiki/Sentence_(linguistics)) count, line count, [paragraph](http://en.wikipedia.org/wiki/Paragraph) count, [page](http://en.wikipedia.org/wiki/Page_(paper)) count.
* Word, sentence and paragraph length.
* Editing time.

Errors are common; for instance, a dash surrounded by spaces — like either of these — may be counted as a word.

**Typical usage**

Word processors have a variety of uses and applications within the business world, home, and education.

**Business**

Within the business world, word processors are extremely useful tools. Typical uses include:

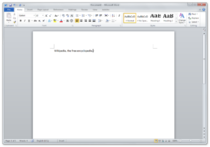
* [legal copies](http://en.wikipedia.org/wiki/US_copyright_law)
* [letters](http://en.wikipedia.org/wiki/Letter_(message)) and [letterhead](http://en.wikipedia.org/wiki/Letterhead)
* [memos](http://en.wikipedia.org/wiki/Memo)
* reference documents

Businesses tend to have their own format and style for any of these. Thus, versatile word processors with layout editing and similar capabilities find widespread use in most businesses.

**Home**

While many homes have word processors on their computers, word processing in the home tends to be educational, planning or business related, dealing with assignments or work being completed at home, or occasionally recreational, e.g. writing short stories. Some use word processors for letter writing, résumé creation, and card creation. However, many of these home publishing processes have been taken over by desktop publishing programs specifically oriented toward home use which are better suited to these types of documents.

## Microsoft Word

Microsoft Office Word is a [proprietary](http://en.wikipedia.org/wiki/Proprietary_software) [word processor](http://en.wikipedia.org/wiki/Word_processor) designed by [Microsoft](http://en.wikipedia.org/wiki/Microsoft). It was first released in 1983 under the name *Multi-Tool Word* for [Xenix](http://en.wikipedia.org/wiki/Xenix) systems.[[1]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-PCHistory-0)[[2]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-2) Subsequent versions were later written for several other platforms including [IBM PCs](http://en.wikipedia.org/wiki/IBM_PC) running [DOS](http://en.wikipedia.org/wiki/DOS) (1983), the [Apple Macintosh](http://en.wikipedia.org/wiki/Apple_Macintosh) (1984), the AT&T [Unix PC](http://en.wikipedia.org/wiki/3B1) (1985), [Atari ST](http://en.wikipedia.org/wiki/Atari_ST) (1986), [SCO UNIX](http://en.wikipedia.org/wiki/SCO_OpenServer), [OS/2](http://en.wikipedia.org/wiki/OS/2), and [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) (1989). It is a component of the [Microsoft Office](http://en.wikipedia.org/wiki/Microsoft_Office) software system; it is also sold as a standalone product and included in [Microsoft Works Suite](http://en.wikipedia.org/wiki/Microsoft_Works). The current versions are Microsoft Office Word 2010 for Windows and Microsoft Office Word 2011 for Mac.

**Features and flaws**

Among its features, Word includes a built-in spell checker, a thesaurus, a dictionary, and utilities for manipulating and editing text. The following are some aspects of its feature set.

**WordArt**

WordArt enables drawing text in a Microsoft Word document such as a title, watermark, or other text, with graphical effects such as skewing, shadowing, rotating, stretching in a variety of shapes and colors and even including three-dimensional effects, starting at version 2007, and prevalent in Office 2010. Users can apply formatting effects such as shadow, bevel, glow, and reflection to their document text as easily as applying bold or underline. Users can also spell-check text that uses visual effects, and add text effects to paragraph styles.

**Macros**

A Macro is a rule of pattern that specifies how a certain input sequence(often a sequence of characters) should be mapped to an output sequence according to defined process. Frequently used or repetitive sequences of keystrokes and mouse movements can be automated. Like other [Microsoft Office](http://en.wikipedia.org/wiki/Microsoft_Office) documents, Word files can include advanced [macros](http://en.wikipedia.org/wiki/Macro_(computer_science)) and even embedded programs. The language was originally [WordBasic](http://en.wikipedia.org/w/index.php?title=WordBasic&action=edit&redlink=1), but changed to [Visual Basic for Applications](http://en.wikipedia.org/wiki/Visual_Basic_for_Applications) as of Word 97.

This extensive functionality can also be used to run and propagate [viruses](http://en.wikipedia.org/wiki/Computer_virus) in documents. The tendency for people to exchange Word documents via email, [USB flash drives](http://en.wikipedia.org/wiki/USB_flash_drive), and [floppy disks](http://en.wikipedia.org/wiki/Floppy_disk) made this an especially attractive vector in 1999. A prominent example was the [Melissa virus](http://en.wikipedia.org/wiki/Melissa_virus), but countless others have existed in the wild.

These macro viruses were the only known cross-platform threats between Windows and Macintosh computers and they were the only infection vectors to affect any [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X) system up until the advent of [video codec trojans](http://en.wikipedia.org/wiki/Zlob_trojan) in 2007. Microsoft released patches for Word X and Word 2004 that effectively eliminated the macro problem on the Mac by 2006.

Word's macro security setting, which regulates when macros may execute, can be adjusted by the user, but in the most recent versions of Word, is set to HIGH by default, generally reducing the risk from macro-based viruses, which have become uncommon.

**Layout issues**

Before Word 2010 (Word 14) for Windows, the program was unable to handle [ligatures](http://en.wikipedia.org/wiki/Ligature_(typography)) defined in [TrueType](http://en.wikipedia.org/wiki/TrueType) fonts[[62]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-61) those ligature glyphs with [Unicode](http://en.wikipedia.org/wiki/Unicode) code points may be inserted manually, but are not recognized by Word for what they are, breaking spell checking, while custom ligatures present in the font are not accessible at all. Since Word 2010, the program now has advanced [typesetting](http://en.wikipedia.org/wiki/Typesetting) features which can be enabled:[[63]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-62) [OpenType](http://en.wikipedia.org/wiki/OpenType) ligatures,[[64]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-63) [kerning](http://en.wikipedia.org/wiki/Kerning), and [hyphenation](http://en.wikipedia.org/wiki/Hyphenation_algorithm). Other layout deficiencies of Word include the inability to set crop marks or thin spaces. Various third-party workaround utilities have been developed.[[65]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-64) Similarly, [combining diacritics](http://en.wikipedia.org/wiki/Combining_diacritic) are handled poorly: Word 2003 has "improved support", but many diacritics are still misplaced, even if a precomposed glyph is present in the font.

Additionally, as of Word 2002, Word does automatic [font substitution](http://en.wikipedia.org/wiki/Font_substitution) when it finds a character in a document that does not exist in the font specified. It is impossible to deactivate this, making it very difficult to spot when a glyph used is missing from the font in use. If "Mirror margins" or "Different odd and even" are enabled, Word will not allow the user to freshly begin page numbering an even page after a section break (and vice versa). Instead it inserts a mandatory blank page which cannot be removed.[[66]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-65)

In Word 2004 for Macintosh, support of [complex scripts](http://en.wikipedia.org/wiki/Complex_scripts) was inferior even to Word 97and Word 2004 does not support [Apple Advanced Typography](http://en.wikipedia.org/wiki/Apple_Advanced_Typography) features like ligatures or glyph variants.[[67]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-66)

**Bullets and numbering**

Word has extensive list of bullets and numbering features used for tables, lists, pages, chapters, headers, footnotes, and tables of content. Bullets and numbering can be applied directly or using a button or by applying a style or through use of a template. Some problems with numbering have been found in Word 97-2003. An example is Word's system for restarting numbering.[[68]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-67) The Bullets and Numbering system has been significantly overhauled for Office 2007, which is intended to reduce the severity of these problems.

ະະະCreatingະະະ Users can also create tables in MS Word. Depending on the version, Word can perform simple calculations. Formulae are supported as well. Creating is an act of making a document as an input and it can be printed out as a hardcopy.

**AutoSummarize**

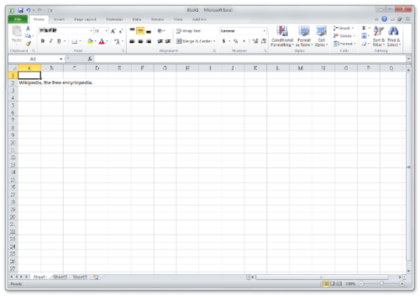
AutoSummarize highlights passages or phrases that it considers valuable. The amount of text to be retained can be specified by the user as a percentage of the current amount of text.

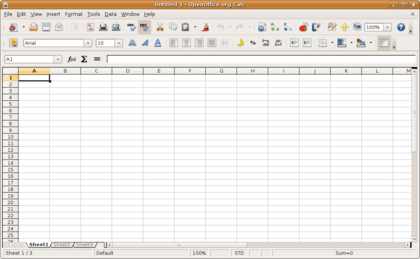
According to Ron Fein of the Word 97 team, AutoSummarize cuts wordy copy to the bone by counting words and ranking sentences. First, AutoSummarize identifies the most common words in the document (barring "a" and "the" and the like) and assigns a "score" to each word—the more frequently a word is used, the higher the score. Then, it "averages" each sentence by adding the scores of its words and dividing the sum by the number of words in the sentence—the higher the average, the higher the rank of the sentence. "It's like the ratio of wheat to chaff," explains Fein.[[69]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-68)

AutoSummarize was removed from Microsoft Word for Mac 2011, although it was present in Word for Mac 2008. AutoSummarize was removed from the Office 2010 release version (14) as well.[[70]](http://en.wikipedia.org/wiki/Microsoft_word#cite_note-69)

## 

## Spreadsheet

[](http://en.wikipedia.org/wiki/File:Excel_2010.png)A **spreadsheet** is a [computer application](http://en.wikipedia.org/wiki/Computer_application) with tools that increase the user's [productivity](http://en.wikipedia.org/wiki/Productivity) in capturing, analyzing, and sharing tabular [data sets](http://en.wikipedia.org/wiki/Data_set). It displays multiple cells usually in a two-dimensional matrix or grid consisting of rows and columns (in other words, a [table](http://en.wikipedia.org/wiki/Table_(information)), hence "tabular"). Each cell contains [alphanumeric](http://en.wikipedia.org/wiki/Alphanumeric) text, numeric values, or formulas. A [formula](http://en.wikipedia.org/wiki/Formula) defines how the content of that cell is to be calculated from the contents of any other cell (or combination of cells) each time any cell is updated. A pseudo third dimension to the matrix is sometimes applied as another layer, or layers/sheets, of two-dimensional data.

[](http://en.wikipedia.org/wiki/File:OpenOffice.org_Calc.png)Spreadsheets developed as computerized simulations of paper accounting [worksheets](http://en.wikipedia.org/wiki/Worksheet). They boost [productivity](http://en.wikipedia.org/wiki/Productivity) because of their ability to re-calculate the entire sheet automatically after a change to a single cell is made (which was a manual process in the days of paper ledgers). Spreadsheets have now replaced paper-based systems throughout the business world, with any exceptions being rare, because of the much greater [productivity](http://en.wikipedia.org/wiki/Productivity) that they make possible, and thus the [competitive](http://en.wikipedia.org/wiki/Competition_(economics)) disadvantage of spreadsheet [illiteracy](http://en.wikipedia.org/wiki/Digital_literacy). Although they were first developed for accounting or bookkeeping tasks, they now are used extensively in any context where tabular lists are built, sorted, and shared.

A modern spreadsheet file consists of multiple **worksheets** (usually called by the shorter name **sheets**) that make up one **workbook**, with each file being one workbook. A cell on one sheet is capable of referencing cells on other, different sheets, whether within the same workbook or even, in some cases, in different workbooks.

Spreadsheets share many principles and traits of [databases](http://en.wikipedia.org/wiki/Database), but spreadsheets and databases are not the same thing. A spreadsheet is essentially just one table, whereas a database is a collection of many tables with [machine-readable](http://en.wikipedia.org/wiki/Machine-readable_medium) semantic relationships between them. Spreadsheets are often [imported](http://en.wikipedia.org/wiki/Import_and_export_of_data) into databases to become tables within them. While it is true that a workbook that contains three sheets is indeed a file containing multiple tables that can interact with each other, it lacks the relational structure of a database.

A spreadsheet app is one of four or five main component apps of an [office productivity suite](http://en.wikipedia.org/wiki/Office_suite) (such as [OpenOffice](http://en.wikipedia.org/wiki/OpenOffice.org) or [Microsoft Office](http://en.wikipedia.org/wiki/Microsoft_Office) [MSO]). Such suites group a spreadsheet app (such as [OpenOffice Calc](http://en.wikipedia.org/wiki/OpenOffice.org_Calc) or [Microsoft Office Excel](http://en.wikipedia.org/wiki/Microsoft_Excel)) with a [word processor](http://en.wikipedia.org/wiki/Word_processor), a [presentation program](http://en.wikipedia.org/wiki/Presentation_program), and a [database management system](http://en.wikipedia.org/wiki/Database_management_system) (and, optionally, various other apps) into a [solution stack](http://en.wikipedia.org/wiki/Solution_stack) that aids the [productivity](http://en.wikipedia.org/wiki/Productivity) of most office work, from administrative to managerial.

[Visicalc](http://en.wikipedia.org/wiki/Visicalc) was the first electronic spreadsheet on a microcomputer, and it helped turn the [Apple II computer](http://en.wikipedia.org/wiki/Apple_II_family) into a success and greatly assisted in their widespread application. [Lotus 1-2-3](http://en.wikipedia.org/wiki/Lotus_1-2-3) was the leading spreadsheet when [DOS](http://en.wikipedia.org/wiki/DOS) was the dominant operating system. [Excel](http://en.wikipedia.org/wiki/Microsoft_Excel) now has the largest market share on the Windows and Macintosh platforms.[[1]](http://en.wikipedia.org/wiki/Spreadsheet#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Spreadsheet#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Spreadsheet#cite_note-2) Since the advent of [web apps](http://en.wikipedia.org/wiki/Web_app), office suites now also exist in web-app form, with [Google Docs](http://en.wikipedia.org/wiki/Google_Docs) and Microsoft [Office Web Apps](http://en.wikipedia.org/wiki/Office_Web_Apps) being the biggest competitors in the segment, and thus Google spreadsheets now share the market with Excel. As [cloud computing](http://en.wikipedia.org/wiki/Cloud_computing) gradually replaces desktop computing, spreadsheet apps continue to be important components for typical end users.

Concepts

The main concepts are those of a grid of [cells](http://en.wikipedia.org/wiki/Table_cell), called sheet, with either raw data, called values, or formulas in the cells. Formulas say how to mechanically compute new values from existing values. Values are generally numbers, but can be also pure text, dates, months, etc. Extensions of these concepts include logical spreadsheets. Various tools for programming sheets, visualizing data, remotely connecting sheets, displaying cells dependencies, etc. are commonly provided.

**Cells**

A **"cell"** can be thought of as a box for holding a [datum](http://en.wikipedia.org/wiki/Datum). A single cell is usually referenced by its column and row (A2 would represent the cell below containing the value 10). Usually rows, representing the [dependant variables](http://en.wikipedia.org/wiki/Dependent_and_independent_variables), are referenced in [decimal notation](http://en.wikipedia.org/wiki/Decimal_notation) starting from 1, while columns representing the [independent variables](http://en.wikipedia.org/wiki/Dependent_and_independent_variables) use 26-adic [bijective numeration](http://en.wikipedia.org/wiki/Bijective_numeration) using the letters A-Z as numerals. Its physical size can usually be tailored for its content by dragging its height or width at box intersections (or for entire columns or rows by dragging the column or rows headers).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **My Spreadsheet** | | | | |
|  | **A** | **B** | **C** | **D** |
| **01** | **value1** | **value2** | **added** | **multiplied** |
| **02** | **10** | **20** | **30** | **200** |

An array of cells is called a "sheet" or "worksheet". It is analogous to an array of [variables](http://en.wikipedia.org/wiki/Variable_(programming)) in a conventional [computer program](http://en.wikipedia.org/wiki/Computer_program) (although certain unchanging values, once entered, could be considered, by the same analogy, [constants](http://en.wikipedia.org/wiki/Constant_(computer_science))). In most implementations, many worksheets may be located within a single spreadsheet. A worksheet is simply a subset of the spreadsheet divided for the sake of clarity. Functionally, the spreadsheet operates as a whole and all cells operate as [global variables](http://en.wikipedia.org/wiki/Global_variable) within the spreadsheet ('read' access only except its own containing cell).

A cell may contain a [value](http://en.wikipedia.org/wiki/Value_(computer_science)) or a [formula](http://en.wikipedia.org/wiki/Formula), or it may simply be left empty. By convention, formulas usually begin with **=** sign.

**Values**

A value can be entered from the computer keyboard by directly typing into the cell itself. Alternatively, a value can be based on a formula (see below), which might perform a calculation, display the current date or time, or retrieve external data such as a stock quote or a database value.

**The Spreadsheet *Value Rule*** Computer scientist [Alan Kay](http://en.wikipedia.org/wiki/Alan_Kay) used the term *value rule* to summarize a spreadsheet's operation: a cell's value relies solely on the formula the user has typed into the cell.[[16]](http://en.wikipedia.org/wiki/Spreadsheet#cite_note-15) The formula may rely on the value of other cells, but those cells are likewise restricted to user-entered data or formulas. There are no 'side effects' to calculating a formula: the only output is to display the calculated result inside its occupying cell. There is no natural mechanism for permanently modifying the contents of a cell unless the user manually modifies the cell's contents. In the context of programming languages, this yields a limited form of first-order [functional programming](http://en.wikipedia.org/wiki/Functional_programming).[[17]](http://en.wikipedia.org/wiki/Spreadsheet#cite_note-16)

**Automatic recalculation**

A standard of spreadsheets since the mid 80s, this optional feature eliminates the need to manually request the spreadsheet program to recalculate values (nowadays typically the default option unless specifically 'switched off' for large spreadsheets, usually to improve performance). Some earlier spreadsheets required a manual request to recalculate, since recalculation of large or complex spreadsheets often reduced data entry speed. Many modern spreadsheets still retain this option.

**Real-time update**

This feature refers to updating a cell's contents periodically when its value is derived from an external source - such as a cell in another "remote" spreadsheet. For shared, web-based spreadsheets, it applies to "immediately" updating cells that have been altered by another user. All dependent cells have to be updated also.

**Locked cell**

Once entered, selected cells (or the entire spreadsheet) can optionally be "locked" to prevent accidental overwriting. Typically this would apply to cells containing formulas but might be applicable to cells containing "constants" such as a kilogram/pounds conversion factor (2.20462262 to eight decimal places). Even though individual cells are marked as locked, the spreadsheet data are not protected until the feature is activated in the file preferences.

**Data format**

A cell or range can optionally be defined to specify how the value is displayed. The default display format is usually set by its initial content if not specifically previously set, so that for example "31/12/2007" or "31 Dec 2007" would default to the cell format of "date". Similarly adding a % sign after a numeric value would tag the cell as a [percentage](http://en.wikipedia.org/wiki/Percentage) cell format. The cell contents are not changed by this format, only the displayed value.

Some cell formats such as "numeric" or "[currency](http://en.wikipedia.org/wiki/Currency)" can also specify the number of [decimal places](http://en.wikipedia.org/wiki/Decimal_place).

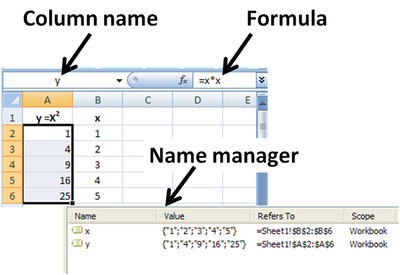
This can allow invalid operations (such as doing multiplication on a cell containing a date), resulting in illogical results without an appropriate warning.

**Cell formatting**

Depending on the capability of the spreadsheet application, each cell (like its counterpart the "style" in a [word processor](http://en.wikipedia.org/wiki/Word_processor)) can be separately formatted using the [attributes](http://en.wikipedia.org/wiki/Attribute_(computing)) of either the content (point size, color, bold or italic) or the cell (border thickness, background shading, color). To aid the readability of a spreadsheet, cell formatting may be conditionally applied to data - for example, a negative number may be displayed in red.

A cell's formatting does not typically affect its content and depending on how cells are referenced or copied to other worksheets or applications, the formatting may not be carried with the content.

**Named cells**

In most implementations, a cell, or group of cells in a column or row, can be "named" enabling the user to refer to those cells by a name rather than by a grid reference. Names must be unique within the spreadsheet, but when using multiple sheets in a spreadsheet file, an identically named cell range on each sheet can be used if it is distinguished by adding the sheet name. One reason for this usage is for creating or running macros that repeat a command across many sheets. Another reason is that formulas with named variables are readily checked against the algebra they are intended to implement (they resemble Fortran expressions). Use of named variables and named functions also makes the spreadsheet structure more transparent.

**Cell reference**

In place of a named cell, an alternative approach is to use a cell (or grid) reference. Most cell references indicate another cell in the same spreadsheet, but a cell reference can also refer to a cell in a different sheet within the same spreadsheet, or (depending on the implementation) to a cell in another spreadsheet entirely, or to a value from a remote application.

A typical **cell reference** in "A1" style consists of one or two case-insensitive letters to identify the column (if there are up to 256 columns: A-Z and AA-IV) followed by a row number (e.g. in the range 1-65536). Either part can be relative (it changes when the formula it is in is moved or copied), or absolute (indicated with $ in front of the part concerned of the cell reference). The alternative "R1C1" reference style consists of the letter R, the row number, the letter C, and the column number; relative row or column numbers are indicated by enclosing the number in square brackets. Most current spreadsheets use the A1 style, some providing the R1C1 style as a compatibility option.

When the computer calculates a formula in one cell to update the displayed value of that cell, cell reference(s) in that cell, naming some other cell(s), cause the computer to fetch the value of the named cell(s).

A cell on the same "sheet" is usually addressed as:-

=A1

A cell on a different sheet of the same spreadsheet is usually addressed as:-

=SHEET2!A1 (that is; the first cell in sheet 2 of same spreadsheet).

Some spreadsheet implementations allow a cell references to another spreadsheet (not the current open and active file) on the same computer or a local network. It may also refer to a cell in another open and active spreadsheet on the same computer or network that is defined as shareable. These references contain the complete filename, such as:-

='C:\Documents and Settings\Username\My spreadsheets\[main sheet]Sheet1!A1

In a spreadsheet, references to cells are automatically updated when new rows or columns are inserted or deleted. Care must be taken however when adding a row immediately before a set of column totals to ensure that the totals reflect the additional rows values - which often they do not!

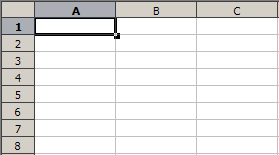
A [circular reference](http://en.wikipedia.org/wiki/Circular_reference) occurs when the formula in one cell has a reference that directly—or indirectly, through a chain of references, each one pointing to another cell that has another reference to the next cell on the chain—points to the one cell. Many common kinds of errors cause such circular references. However, there are some valid techniques that use such circular references. Such techniques, after many recalculations of the spreadsheet, (usually) converge on the correct values for those cells.

**Cell ranges**

Likewise, instead of using a named range of cells, a range reference can be used. Reference to a range of cells is typically of the form (A1:A6) which specifies all the cells in the range A1 through to A6. A formula such as "=SUM(A1:A6)" would add all the cells specified and put the result in the cell containing the formula itself.

**Sheets**

In the earliest spreadsheets, cells were a simple two-dimensional grid. Over time, the model has been expanded to include a third dimension, and in some cases a series of named grids, called sheets. The most advanced examples allow inversion and rotation operations which can slice and project the data set in various ways.

[](http://en.wikipedia.org/wiki/File:Spreadsheet_animation.gif)**Formulas**

Animation of a simple spreadsheet that multiplies values in the left column by 2, then sums the calculated values from the right column to the bottom-most cell. In this example, only the values in the A column are entered (10, 20, 30), and the remainder of cells are formulas. Formulas in the B column multiply values from the A column using relative references, and the formula in B4uses the SUM() function to find the [sum](http://en.wikipedia.org/wiki/Summation) of values in theB1:B3 range.

A formula identifies the [calculation](http://en.wikipedia.org/wiki/Calculation) needed to place the result in the cell it is contained within. A cell containing a formula therefore has two display components; the formula itself and the resulting value. The formula is normally only shown when the cell is selected by "clicking" the mouse over a particular cell; otherwise it contains the result of the calculation.

A formula assigns values to a cell or range of cells, and typically has the format:

|  |
| --- |
| =*expression* |

where the [expression](http://en.wikipedia.org/wiki/Expression_(programming)) consists of:

* [values](http://en.wikipedia.org/wiki/Value_(computer_science)), such as 2, 9.14 or 6.67E-11;
* [references](http://en.wikipedia.org/wiki/Reference_(computer_science)) to other cells, such as, e.g., A1 for a single cell or B1:B3 for a range;
* [arithmetic operators](http://en.wikipedia.org/wiki/Operator_(programming)), such as +, -, \*, /, and others;
* [relational operators](http://en.wikipedia.org/wiki/Relational_operator), such as >=, <, and others; and,
* [functions](http://en.wikipedia.org/wiki/Function_(programming)), such as SUM(), TAN(), and many others.

When a cell contains a formula, it often contains references to other cells. Such a cell reference is a type of variable. Its value is the value of the referenced cell or some derivation of it. If that cell in turn references other cells, the value depends on the values of those. References can be relative (e.g., A1, or B1:B3), absolute (e.g., $A$1, or $B$1:$B$3) or mixed row-wise or column-wise absolute/relative (e.g., $A1 is column-wise absolute and A$1 is row-wise absolute).

The available options for valid formulas depends on the particular spreadsheet implementation but, in general, most arithmetic operations and quite complex nested conditional operations can be performed by most of today's commercial spreadsheets. Modern implementations also offer functions to access custom-build functions, remote data, and applications.

A formula may contain a condition (or nested conditions) - with or without an actual calculation - and is sometimes used purely to identify and **highlight errors**. In the example below, it is assumed the sum of a column of percentages (A1 through A6) is tested for validity and an explicit message put into the adjacent right-hand cell.

=IF(SUM(A1:A6) > 100, "More than 100%", SUM(A1:A6))

A spreadsheet does not, in fact, have to contain any formulas at all, in which case it could be considered merely a collection of data arranged in rows and columns (a [database](http://en.wikipedia.org/wiki/Database)) like a calendar, timetable or simple list. Because of its ease of use, formatting and [hyperlinking](http://en.wikipedia.org/wiki/Hyperlinking) capabilities, many spreadsheets are used solely for this purpose.

**Functions**

Spreadsheets usually contain a number of supplied [functions](http://en.wikipedia.org/wiki/Function_(mathematics)), such as arithmetic operations (for example, summations, averages and so forth), trigonometric functions, statistical functions, and so forth. In addition there is often a provision for *user-defined functions*. In Microsoft Excel these functions are defined using [Visual Basic for Applications](http://en.wikipedia.org/wiki/Visual_Basic_for_Applications) in the supplied Visual Basic editor, and such functions are automatically accessible on the worksheet. In addition, programs can be written that pull information from the worksheet, perform some calculations, and report the results back to the worksheet. In the figure, the name *sq* is user-assigned, and function *sq* is introduced using the [*Visual Basic*](http://en.wikipedia.org/wiki/Visual_basic_for_applications) editor supplied with Excel. *Name Manager* displays the spreadsheet definitions of named variables *x* & *y*.

**Subroutines**

Functions themselves cannot write into the worksheet, but simply return their evaluation. However, in Microsoft Excel, [subroutines](http://en.wikipedia.org/wiki/Subroutine) can write values or text found within the subroutine directly to the spreadsheet. The figure shows the Visual Basic code for a subroutine that reads each member of the named column variable *x*, calculates its square, and writes this value into the corresponding element of named column variable *y*. The *y*-column contains no formula because its values are calculated in the subroutine, not on the spreadsheet, and simply are written in.

**Remote spreadsheet**

Whenever a reference is made to a cell or group of cells that are not located within the current physical spreadsheet file, it is considered as accessing a "remote" spreadsheet. The contents of the referenced cell may be accessed either on first reference with a manual update or more recently in the case of web based spreadsheets, as a near real time value with a specified automatic refresh interval.

**Charts**

Many spreadsheet applications permit [charts](http://en.wikipedia.org/wiki/Chart), [graphs](http://en.wikipedia.org/wiki/Graph_(data_structure)) or [histograms](http://en.wikipedia.org/wiki/Histogram) to be generated from specified groups of cells which are dynamically re-built as cell contents change. The generated graphic component can either be embedded within the current sheet or added as a separate object.

**Multi-dimensional spreadsheets**

These multi-dimensional spreadsheets enabled viewing data and [algorithms](http://en.wikipedia.org/wiki/Algorithm) in various self-documenting ways, including simultaneous multiple synchronized views.

In these programs, a [time series](http://en.wikipedia.org/wiki/Time_series), or any variable, was an object in itself, not a collection of cells which happen to appear in a row or column. Variables could have many attributes, including complete awareness of their connections to all other variables, data references, and text and image notes. Calculations were performed on these objects, as opposed to a range of cells, so adding two time series automatically aligns them in calendar time, or in a user-defined time frame. Data were independent of worksheets—variables, and therefore data, could not be destroyed by deleting a row, column or entire worksheet.

**Logical spreadsheets**

Spreadsheets that have a formula language based upon [logical expressions](http://en.wikipedia.org/wiki/Logic), rather than [arithmetic expressions](http://en.wikipedia.org/wiki/Arithmetic) are known as [logical spreadsheets](http://en.wikipedia.org/wiki/Logical_spreadsheet). Such spreadsheets can be used to reason [deductively](http://en.wikipedia.org/wiki/Deductive_reasoning) about their cell values.

## Presentation program

A **presentation program** (also called a **presentation graphics** program) is a [computer software](http://en.wikipedia.org/wiki/Computer_software) package used to display information, normally in the form of a [slide show](http://en.wikipedia.org/wiki/Slide_show). It typically includes three major functions: an editor that allows text to be inserted and formatted, a method for inserting and manipulating graphic images and a slide-show system to display the content.

## Notable examples

## [Microsoft PowerPoint](http://en.wikipedia.org/wiki/Microsoft_PowerPoint)

## [Corel Presentations](http://en.wikipedia.org/wiki/Corel_Presentations)

## [Google Docs](http://en.wikipedia.org/wiki/Google_Docs)

## [Harvard Graphics](http://en.wikipedia.org/wiki/Harvard_Graphics) (obsolete)

## [IBM Lotus Freelance Graphics](http://en.wikipedia.org/wiki/IBM_Lotus_Freelance_Graphics) (obsolete)

## [Kingsoft Presentation](http://en.wikipedia.org/wiki/Kingsoft_Presentation)

## [Libre Office Impress](http://en.wikipedia.org/wiki/Libre_Office) (open source)

## [OpenOffice.org Impress](http://en.wikipedia.org/wiki/OpenOffice.org_Impress) (open source)

## [SlideRocket](http://en.wikipedia.org/wiki/SlideRocket)

## [Prezi](http://en.wikipedia.org/wiki/Prezi)

## [Apple Keynote](http://en.wikipedia.org/wiki/Apple_Keynote)

## Microsoft PowerPoint

**Microsoft PowerPoint** is the name of a [proprietary](http://en.wikipedia.org/wiki/Proprietary_software) [commercial](http://en.wikipedia.org/wiki/Commercial_software) software [presentation program](http://en.wikipedia.org/wiki/Presentation_program) developed by [Microsoft](http://en.wikipedia.org/wiki/Microsoft). It was developed by[Microsoft](http://en.wikipedia.org/wiki/Microsoft) and officially launched on May 22, 1990. It is part of the [Microsoft Office](http://en.wikipedia.org/wiki/Microsoft_Office) suite, and runs on [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) and [Apple](http://en.wikipedia.org/wiki/Apple_Inc.)'s [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X) operating system. The current versions are Microsoft Office PowerPoint 2010 for Windows and Microsoft Office PowerPoint 2011 for Mac.

**Operation**

PowerPoint presentations consist of a number of individual pages or "slides". The "slide" analogy is a reference to the [slide projector](http://en.wikipedia.org/wiki/Slide_projector). A better analogy would be the "foils" (or transparencies/plastic sheets) that are shown with an overhead projector, although they are in decline now. Slides may contain text, graphics, sound, movies, and other objects, which may be arranged freely.

The presentation can be printed, displayed live on a computer, or navigated through at the command of the presenter. For larger audiences the computer display is often projected using a [video projector](http://en.wikipedia.org/wiki/Video_projector). Slides can also form the basis of [webcasts](http://en.wikipedia.org/wiki/Webcasts).

PowerPoint provides three types of movements:

1. Entrance, emphasis, and exit of elements on a slide itself are controlled by what PowerPoint calls [Custom Animations](http://en.wikipedia.org/wiki/PowerPoint_animation).
2. Transitions, on the other hand, are movements between slides. These can be animated in a variety of ways.
3. Custom animation can be used to create small story boards by animating pictures to enter, exit or move.

## PowerPoint Viewer

Microsoft Office PowerPoint Viewer is a program used to run presentations on computers that do not have PowerPoint installed. Office PowerPoint Viewer is added by default to the same disk or network location that contains one or more presentations packaged by using the Package for CD feature.

PowerPoint Viewer is installed by default with a Microsoft Office 2003 installation for use with the Package for CD feature. The PowerPoint Viewer file is also available for download from the Microsoft Office Online Web site.

Presentations password-protected for opening or modifying can be opened by PowerPoint Viewer. The Package for CD feature allows packaging any password-protected file or setting a new password for all packaged presentations. PowerPoint Viewer prompts for a password if the file is open password-protected.

PowerPoint Viewer supports opening presentations created using PowerPoint 97 and later. In addition, it supports all file content except OLE objects and scripting. PowerPoint Viewer is currently only available for computers running on Microsoft Windows.

## Databases

A **database** is an organized collection of [data](http://en.wikipedia.org/wiki/Data), today typically in digital form. The data are typically organized to model relevant aspects of reality (for example, the availability of rooms in hotels), in a way that supports processes requiring this information (for example, finding a hotel with vacancies).

The term *database* is correctly applied to the data and their supporting [data structures](http://en.wikipedia.org/wiki/Data_structures), and not to the [database management system](http://en.wikipedia.org/wiki/Database_management_system) (DBMS). The database data collection with DBMS is called a [database system](http://en.wikipedia.org/wiki/Database_system).

The following are examples of various database types. Some of them are not main-stream types, but most of them have received special attention (e.g., in research) due to end-user requirements. Some exist as specialized DBMS products, and some have their functionality types incorporated in existing general-purpose DBMSs.:

* **Cloud database**

*Main article:*[*Cloud database*](http://en.wikipedia.org/wiki/Cloud_database)

A *Cloud database* is a database that relies on [cloud technology](http://en.wikipedia.org/wiki/Cloud_computing). Both the database and most of its DBMS reside remotely, "in the cloud," while its applications are both developed by programmers and later maintained and utilized by (application's) end-users through a [Web browser](http://en.wikipedia.org/wiki/Web_browser) and [Open APIs](http://en.wikipedia.org/wiki/Open_API). More and more such database products are emerging, both of new vendors and by virtually all established database vendors.

* **End-user database**

These databases consist of data developed by individual end-users. Examples of these are collections of documents, spreadsheets, presentations, multimedia, and other files. Several products exist to support such databases.

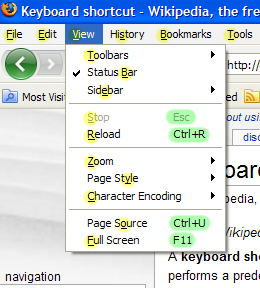
* **Hypermedia databases**

The [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) can be thought of as a database, albeit one spread across millions of independent computing systems. Web browsers "process" this data one page at a time, while [Web crawlers](http://en.wikipedia.org/wiki/Web_crawlers) and other software provide the equivalent of database indexes to support search and other activities.

* **Document-oriented database**

A document-oriented database is a computer program designed for storing, retrieving, and managing document-oriented, or semi structured data, information. Document-oriented databases are one of the main categories of so-called NoSQL databases and the popularity of the term "document-oriented database" (or "document store") has grown with the use of the term NoSQL itself.

Utilized to conveniently store, manage, edit and retrieve documents.



## Keyboard shortcut

In [computing](http://en.wikipedia.org/wiki/Computing), a **keyboard shortcut** is a finite set of one or more [keys](http://en.wikipedia.org/wiki/Computer_keyboard) that invoke a [software](http://en.wikipedia.org/wiki/Software) or [operating system](http://en.wikipedia.org/wiki/Operating_system) operation when triggered by the [user](http://en.wikipedia.org/wiki/User_(computing)). A meaning of term "keyboard shortcut" can vary depending on software manufacturer. For instance, Microsoft differentiates keyboard shortcuts from**hotkeys** (mnemonics) whereby the former consists of a specific key combination used to trigger an action, and the latter represents a designated letter in a menu command or toolbar button that when pressed together with the Alt key, activates such command.

**Description**

Keyboard shortcuts are typically an alternate means for invoking one or more commands that would otherwise be accessible only through a [menu](http://en.wikipedia.org/wiki/Menu_(computing)), a [pointing device](http://en.wikipedia.org/wiki/Pointing_device), different levels of a [user interface](http://en.wikipedia.org/wiki/User_interface), or via a [command console](http://en.wikipedia.org/wiki/Command_line). Keyboard shortcuts generally expedite common operations by reducing input sequences to a few keystrokes, hence the term "shortcut".[[1]](http://en.wikipedia.org/wiki/Keyboard_shortcut#cite_note-shortcut_lingo-0)

Some keyboard shortcuts require the user to press a single key or a sequence of keys one after the other. Other keyboard shortcuts require pressing and holding several keys simultaneously. For simultaneous keyboard shortcuts, one usually first holds down the [modifier key](http://en.wikipedia.org/wiki/Modifier_key)(s), then quickly presses and releases the regular (non-modifier) key, and finally releases the modifier key(s). This distinction is important, as trying to press all the keys simultaneously will frequently either miss some of the modifier keys, or cause unwanted auto-repeat. One exception is shortcuts involving the Esckey, which almost always requires pressing and releasing the Esc key before pressing the next key.

[Mnemonics](http://en.wikipedia.org/wiki/Mnemonics_(keyboard)) are distinguishable from keyboard shortcuts. One difference between them is that the keyboard shortcuts are not localized on multi-language software but the mnemonics are generally localized to reflect the symbols and letters used in the specific locale. In most [GUIs](http://en.wikipedia.org/wiki/GUI), a program's keyboard shortcuts are discoverable by browsing the program's menus - the shortcut is indicated in the menu choice. There are keyboards, commonly called [Specialty Keyboards](http://en.wikipedia.org/wiki/Specialty_Keyboards) that have the shortcuts for a particular application already marked on them. These keyboards can help the users learn the shortcuts and improve their speed of using the particular applications. In certain cases, those keyboards can be created by applying shortcut stickers on a regular keyboard, which usually gives quicker access to software program features not visible otherwise. Such keyboards are often used for editing video, audio, or graphics,[[2]](http://en.wikipedia.org/wiki/Keyboard_shortcut#cite_note-1) as well as in software training courses.

**Customization**

When shortcuts are referred to as **key bindings** it carries the connotation that the shortcuts are customizable to a user's preference and that program functions may be 'bound' to a different set of keystrokes instead of or in addition to the default.This highlights a difference in philosophy regarding shortcuts. Some systems, typically [end-user](http://en.wikipedia.org/wiki/End-user)-oriented systems such as [Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) or [Macintosh](http://en.wikipedia.org/wiki/Macintosh) consider standardized shortcuts essential to the environment's ease of use. These systems usually limit a user's ability to change shortcuts, typically requiring a separate, possibly third-party, utility to perform the task. Other systems, typically [Unix](http://en.wikipedia.org/wiki/Unix) and related, consider shortcuts to be a user's prerogative, and that they should be changeable to suit individual preference. [Hardcore gamers](http://en.wikipedia.org/wiki/Hardcore_gamers) often customize their key bindings in order to increase performance via faster reaction times. In most real-world environments, both philosophies co-exist; a core set of *sacred* shortcuts remain fixed while others, typically involving an otherwise unused modifier key or keys, are under the user's control.

**"Sacred" key bindings**

The original Macintosh interface defined a set of keyboard shortcuts that would remain consistent across application programs. This provides a better [user experience](http://en.wikipedia.org/wiki/User_experience) than the situation then prevalent of applications using wholly unrelated keys for different functions. This could result in [data loss](http://en.wikipedia.org/wiki/Data_loss) under multitasking systems if, for example, one program used ⌘-D to mean "Delete" while another used it to access a "Disk" menu. The standard bindings were:

* ⌘Q : **Q**uit
* ⌘W : Close **W**indow
* ⌘I : **I**talicize text
* ⌘U : **U**nderline text
* ⌘O : **O**pen
* ⌘P : **P**rint
* ⌘A : Select **A**ll
* ⌘S : **S**ave
* ⌘F : **F**ind
* ⌘Z : Undo (resembles the action of striking out a mistake)
* ⌘X : Cut (resembles scissors)
* ⌘C : **C**opy
* ⌘V : Paste (resembles an arrow pointing downward "into" the document, or a brush used for applying paste)
* ⌘B : **B**old text
* ⌘N : **N**ew Document
* ⌘. : User interrupt
* ⌘? : Help (? signifies a question or confusion)

## Access key

In a [web browser](http://en.wikipedia.org/wiki/Web_browser), an **access key** or **accesskey** allows a [computer](http://en.wikipedia.org/wiki/Computer) [user](http://en.wikipedia.org/wiki/User_(computing)) immediately to jump to a specific part of a [web page](http://en.wikipedia.org/wiki/Web_page) via the [keyboard](http://en.wikipedia.org/wiki/Computer_keyboard). They were introduced in 1999 and quickly achieved near-universal browser support.

In the summer of 2002, a Canadian Web Accessibility[[1]](http://en.wikipedia.org/wiki/Access_key#cite_note-0) consultancy did an informal survey to see if implementing accesskeys caused issues for users of [adaptive technology](http://en.wikipedia.org/wiki/Adaptive_technology), especially [screen reading technology](http://en.wikipedia.org/wiki/Screen_reader) used by blind and low vision users. These users require numerous keyboard shortcuts to access web pages, as “pointing and clicking” a mouse is not an option for them. Their research showed that most key stroke combinations did in fact present a conflict for one or more of these technologies, and their final recommendation was to avoid using accesskeys altogether.

**Access in different browsers**

A more complete list, which browser support the HTML Access keys are compared in the [comparison of web browsers](http://en.wikipedia.org/wiki/Comparison_of_web_browsers#Accessibility_features_.28continued.29).

In most web browsers, the user invokes the access key by pressing [Alt](http://en.wikipedia.org/wiki/Alt_key) (on PC) or [Ctrl](http://en.wikipedia.org/wiki/Control_key) (on Mac) simultaneously with the appropriate character on the keyboard.

|  |  |  |  |
| --- | --- | --- | --- |
| [**Web Browser**](http://en.wikipedia.org/wiki/Web_Browser) | [**Modifier**](http://en.wikipedia.org/wiki/Modifier_key) | **Effect** | **Notes** |
| [Amaya](http://en.wikipedia.org/wiki/Amaya_(web_browser)) | Ctrl *or* Alt |  | Adjustable in preferences |
| [Blazer](http://en.wikipedia.org/wiki/Blazer_(web_browser)) |  | Element is activated immediately upon key press. | No modifier is needed for this web browser used on mobile devices. |
| [Camino](http://en.wikipedia.org/wiki/Camino) | Ctrl |  |  |
| [Google Chrome](http://en.wikipedia.org/wiki/Google_Chrome) 3 and higher | Alt on Windows and Linux (Note: ⇧ Shift is required in some circumstances)  Ctrl + ⌥ Opt on Mac |  | Supported in versions of Chrome >2.x |
| [Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox) 2 and higher | Alt+⇧ Shift on Windows and Linux[[3]](http://en.wikipedia.org/wiki/Access_key#cite_note-ui-key-contentAccess-2)[[4]](http://en.wikipedia.org/wiki/Access_key#cite_note-3)  Ctrl on Mac[[3]](http://en.wikipedia.org/wiki/Access_key#cite_note-ui-key-contentAccess-2) |  | Prior to version 2.0 Firefox used just Alt; configurable via [about:config](http://en.wikipedia.org/wiki/About:_URI_scheme)[[3]](http://en.wikipedia.org/wiki/Access_key#cite_note-ui-key-contentAccess-2) |
| [Internet Explorer](http://en.wikipedia.org/wiki/Internet_Explorer) | [Alt](http://en.wikipedia.org/wiki/Alt_key) | Prior to IE8, Alt + Access Key focused on the element, but required ↵ Enter to be pressed in order to activate the element. This is still the case for [hyperlinks](http://en.wikipedia.org/wiki/Hyperlink) in version 9. |  |
| [Konqueror](http://en.wikipedia.org/wiki/Konqueror) | Ctrl | The modifier key must be released before the regular key is pressed. |  |
| [Opera](http://en.wikipedia.org/wiki/Opera_(web_browser)) | ⇧ Shift+Esc | The modifier key must be released before the regular key is pressed. Once the modifier key is released, browser lists the set of access keys on that page with action and user can hit the desired key. | Configurable via [Graphical user interface](http://en.wikipedia.org/wiki/Graphical_user_interface) |
| [Safari](http://en.wikipedia.org/wiki/Safari_(web_browser)) 3 | [Ctrl](http://en.wikipedia.org/wiki/Control_key) for Mac  [Alt](http://en.wikipedia.org/wiki/Alt_key) for Windows |  |  |
| Safari 4 and higher | [Ctrl](http://en.wikipedia.org/wiki/Control_key)+⌥ [Opt](http://en.wikipedia.org/wiki/Option_key) on Mac  [Alt](http://en.wikipedia.org/wiki/Alt_key) on Windows |  |  |

### Multiple access keys

If multiple identical accesskeys are assigned within the same document, IE will tab through them on each keypress (IE will tab backwards if ⇧ Shift is pressed as well). This way, elements can be logically grouped in various accesskey rings for easier navigation. IE 4.0 only supported letters of the English alphabet as accesskeys. Firefox 2.0 will activate the last of a group of elements assigned the same accesskey.

## Table of keyboard shortcuts

In [computing](http://en.wikipedia.org/wiki/Computing), a [keyboard shortcut](http://en.wikipedia.org/wiki/Keyboard_shortcut) is a sequence or combination of keystrokes on a [computer keyboard](http://en.wikipedia.org/wiki/Computer_keyboard) which invokes commands in [software](http://en.wikipedia.org/wiki/Software).

Some keyboard shortcuts require the user to press a single key or a sequence of keys one after the other. Other keyboard shortcuts require pressing and holding several keys simultaneously. Keyboard shortcuts may depend on the keyboard layout (localisation).

**Comparison of keyboard shortcuts**

Keyboard shortcuts are a common aspect of most modern operating systems and associated software applications. Their use is pervasive enough that some users consider them an essential element of their routine interactions with a computer. Whether used as a matter of personal preference or for [adaptive technology](http://en.wikipedia.org/wiki/Adaptive_technology), the pervasiveness of common conventions enables the comparison of keyboard shortcuts across different systems. The following sections detail some of these comparisons in widely used operating systems.

**General shortcuts**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Activate current application's**[**Menu bar**](http://en.wikipedia.org/wiki/Menu_bar) | Alt | With *full keyboard access* active (System Preferences > Keyboard > Full Keyboard Access > All Controls):[[1]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-HT2840-0)[[2]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-HT1343-1)  Ctrl+F2 (or Fn+Ctrl+F2 on some keyboards) |
| [**File menu**](http://en.wikipedia.org/wiki/File_menu) | Alt+F | Ctrl+F2, then F |
| [**Edit menu**](http://en.wikipedia.org/wiki/Edit_menu) | Alt+E | Ctrl+F2, then E |
| **View menu** | Alt+V | Ctrl+F2, then V |
| [**Undo**](http://en.wikipedia.org/wiki/Undo)**the last operation** | Ctrl+Z | ⌘ Cmd+Z |
| [**Redo**](http://en.wikipedia.org/wiki/Redo)**the last operation** | Ctrl+Y | ⇧ Shift+⌘ Cmd+Z |
| **Cut the selected area and store it in the**[**clipboard**](http://en.wikipedia.org/wiki/Clipboard_(software)) | Ctrl+X or ⇧ Shift+Del | ⌘ Cmd+X |
| **Copy the selected area into the**[**clipboard**](http://en.wikipedia.org/wiki/Clipboard_(software)) | Ctrl+C, or Ctrl+[Ins](http://en.wikipedia.org/wiki/Insert_key) | ⌘ Cmd+C |
| **Paste contents of**[**clipboard**](http://en.wikipedia.org/wiki/Clipboard_(software))**at**[**cursor**](http://en.wikipedia.org/wiki/Cursor_(computers)) | Ctrl+V, or ⇧ Shift+Ins | ⌘ Cmd+V |
| **Paste special** | Ctrl+Alt+V |  |
| **Select everything in focused control or window** | Ctrl+A | ⌘ Cmd+A |
| **Toggle among installed keyboard languages** | ⇧ Shift+Alt | ⌘ Cmd+Space  Configure desired keypress in*Keyboard and Mouse Preferences*,*Keyboard Shortcuts*, *Select the next source in Input menu*.[[3]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-HT2490-2) |

**Navigation**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Run new application** | ⊞ Win, enter executable name or ⊞ Win+R, enter executable name | ⌘ Cmd+Space , enter executable name |
| **Open new browser window with same page as current** | Alt+(D then ↵ Enter ) |  |
| **Make new folder** | Ctrl+⇧ Shift+N | ⇧ Shift+⌘ Cmd+N |
| **Applications menu** | ⊞ Win or Ctrl+Esc |  |
| **Lock desktop** | ⊞ Win+L[[4]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-lockd-3) |  |
| **Show desktop** | ⊞ Win+D or ⊞ Win+M (then use ⊞ Win+⇧ Shift+M to bring back all windows) | F11 |
| **Log out user** |  | ⇧ Shift+⌘ Cmd+Q |
| **Switch active user** | ⊞ Win+L[[5]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-userswitchxp-4) |  |
| [**Task manager**](http://en.wikipedia.org/wiki/Task_manager) | Ctrl+⇧ Shift+Esc, [Ctrl](http://en.wikipedia.org/wiki/Control-Alt-Delete)+[Alt](http://en.wikipedia.org/wiki/Control-Alt-Delete)+[Delete](http://en.wikipedia.org/wiki/Control-Alt-Delete)[[6]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-taskmanager-5) | Alt+⌘ Cmd+Esc |
| **Rename object** | F2 | ↵ Enter |
| **Open file or program** | ↵ Enter | ⌘ Cmd+O |
| **Switch to next/previous**[**focused**](http://en.wikipedia.org/wiki/Focus_(computing))**window** | Alt+Tab ⇆ /  ⇧ Shift+Alt+Tab ⇆ | ⌘ Cmd+Tab ⇆ /  ⇧ Shift+⌘ Cmd+Tab ⇆ |
| **Switch focus to the next/previous window (without dialog)** | Alt+Esc /  ⇧ Shift+Alt+Esc |  |
| **Open the Run dialog box** | ⊞ Win+R | ⌘ Cmd+Space |
| **Open the Search dialog box** | ⊞ Win, enter executable name or ⊞ Win+F | ⌘ Cmd+Space /  Alt+F |
| **Change input orientation of "Search programs and files" field in Start Menu** | Ctrl+L (left) Ctrl+R (right) Ctrl+E (center) |  |

**Power management**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Place computer into sleep/standby mode** | Sleep (available on some keyboards, configurable in Power Options dialog) | ⌥ [Opt](http://en.wikipedia.org/wiki/Option_key)+⌘ Cmd+Eject[[2]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-HT1343-1) |
| **Shutdown computer** | press window+R (shutdown -s -t time in seconds) | Ctrl+⌥ [Opt](http://en.wikipedia.org/wiki/Option_key)+⌘ Cmd+Eject  (no confirmation, shutdown is immediate) |
| **Restart computer** | press window+r (shutdown -r -t time in seconds) | Ctrl+⌘ Cmd+Eject[[2]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-HT1343-1)  (no confirmation, restart is immediate) |
| **Place display in sleep mode** |  | Ctrl+⇧ Shift+Eject |
| **Bring up power/sleep dialog box** | Alt+F4 (while on Desktop only) | Ctrl+Eject |

**Screenshots**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Save**[**screenshot**](http://en.wikipedia.org/wiki/Screenshot)**of entire screen as file** |  | ⇧ Shift+⌘ Cmd+3 |
| **Copy screenshot of entire screen to clipboard** | Print Screen or Ctrl+Print Screen | Ctrl+⇧ Shift+⌘ Cmd+3 |
| **Save screenshot of window as file** |  | ⇧ Shift+⌘ Cmd+4 then Space |
| **Copy screenshot of window to clipboard** | Alt+Print Screen | Ctrl+⇧ Shift+⌘ Cmd+4 then Space |
| **Copy screenshot of arbitrary area to clipboard** |  | Ctrl+⇧ Shift+⌘ Cmd+4 |
| **Save screenshot of arbitrary area as file** |  | ⇧ Shift+⌘ Cmd+4 |
| **Screencasting** |  |  |

**Text editing**

Many of these commands may be combined with ⇧ Shift to select a region of text.[[10]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-9)

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Delete char to the right of cursor** | Del | Del or Fn+← Backspace |
| **Delete word to the right of cursor** | Ctrl+Del | ⌥ Opt+Del or ⌥ Opt+ Fn+← Backspace |
| **Delete word to the left of cursor** | Ctrl+← Backspace | ⌥ Opt+← Backspace |
| **Go to start of line** | Home | ⌘ Cmd+← or Ctrl+A |
| **Go to end of line** | End | ⌘ Cmd+→ or Ctrl+E |
| **Go to start of document** | Ctrl + Home | ⌘ Cmd+↑ |
| **Go to end of document** | Ctrl + End | ⌘ Cmd+↓ |
| **Go to previous word** | Ctrl+← | ⌥ [Opt](http://en.wikipedia.org/wiki/Option_key)+← |
| **Go to next word** | Ctrl+→ | ⌥ Opt+→ |
| **Go to previous line** | ↑ | ↑ |
| **Go to next line** | ↓ | ↓ |
| **Go to previous line break (paragraph)** | Ctrl+↑ | ⌥ Opt+↑ |
| **Go to next line break** | Ctrl+↓ | ⌥ Opt+↓ |
| **Go to find** | Ctrl+F | ⌘ Cmd+F  ⌘ Cmd+E (Search with current selection) |
| **Go to next search result** | F3 | ⌘ Cmd+G |
| **Go to previous search result** | ⇧ Shift+F3 | ⇧ Shift+⌘ Cmd+G |
| **Search and replace** | Ctrl+H | ⌘ Cmd+F |
| **Search a**[**regular expression**](http://en.wikipedia.org/wiki/Regular_expression) |  |  |
| **Search and replace a regular expression** |  |  |

**Text formatting**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Make selected text bold/regular** | Ctrl+B | ⌘ Cmd+B |
| **Toggle underlining of selected text** | Ctrl+U | ⌘ Cmd+U |
| **Make selected text italic/regular** | Ctrl+I | ⌘ Cmd+I |
| **Change to upper/lower case** | ⇧ Shift+F3 (Works for Microsoft Word and Powerpoint but not Microsoft Excel)[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] | ⌥ Opt+⌘ Cmd+C |
| **Make selected text superscript** | Ctrl+⇧ Shift++ | Ctrl+⌘ Cmd++ (Pages and Adobe Applications only?) |
| **Make selected text subscript** | Ctrl+= | Ctrl+⌘ Cmd+- (Pages and Adobe Applications only?) |
| **Make selected text larger/smaller** | Ctrl+⇧ Shift+>/Ctrl+⇧ Shift+< |  |

**Browsers / Go menu**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Go to Browser's Address Bar** | Alt+D or Alt+C  according language | ⌘ Cmd+L |
| **Go to the previous location in history** | Alt+← or ← Backspace | ⌘ Cmd+[ or ⌘ Cmd+← |
| **Go to the next location in history** | Alt+→ or ⇧ Shift+← Backspace (web browser only) | ⌘ Cmd+] or ⌘ Cmd+→ |
| **Go up one level in the navigation hierarchy** | Alt+↑(Vista and 7 only) or← Backspace(Windows Explorer) | ⌘ Cmd+↑ |
| **Go to the starting page defined by the user or application** | Alt+Home | ⌘ Cmd+Home |

**Web browsers**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Bookmarks menu** | Ctrl+B | ⌘ Cmd+B ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) |
| **URL Shortcuts (Adds www. + .com)** | Ctrl+↵ Enter | ⌘ Cmd+↵ Enter ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) or  Control+↵ Enter ([Chrome](http://en.wikipedia.org/wiki/Google_Chrome)) |
| **URL Shortcuts (Adds www. + .org)** | Ctrl+⇧ Shift+↵ Enter | ⇧ Shift+⌘ Cmd+↵ Enter ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) |
| **URL Shortcuts (Adds www. + .net)** | ⇧ Shift +↵ Enter | ⇧ Shift +↵ Enter ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) |
| **Add bookmark for current page** | Ctrl+D | ⌘ Cmd+D |
| **Add bookmark for current link** |  |  |
| **Manage bookmarks** | Ctrl+B | ⌘ Cmd+⌥ Opt+B ([Chrome](http://en.wikipedia.org/wiki/Google_Chrome)/[Safari](http://en.wikipedia.org/wiki/Safari_(web_browser))) or  ⌘ Cmd+⇧ Shift+B ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) |
| **Focus and select Web search bar** | Ctrl+E | ⌘ Cmd+E ([Opera](http://en.wikipedia.org/wiki/Opera_(web_browser))) or  ⌘ Cmd+K ([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)) or ⌥ Opt+⌘ Cmd+F ([Safari](http://en.wikipedia.org/wiki/Safari_(web_browser))) |
| **Focus and select address bar** | Ctrl+L or F6 or Alt+D | ⌘ Cmd+L |
| **Refresh a webpage** | F5 or Ctrl+R | ⌘ Cmd+R |
| **Open a new window** | Ctrl+N | ⌘ Cmd+N ([Chrome](http://en.wikipedia.org/wiki/Google_Chrome)) |
| **Zoom Options (zoom in +, zoom out -, zoom 100%)** | Ctrl++ and Ctrl+- and Ctrl+0 | ⌘ Cmd++ and ⌘ Cmd+- and⌘ Cmd+0 |

**Tab management**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Create a new tab** | Ctrl+T | ⌘ Cmd+T |
| **Close current tab** | Ctrl+W | ⌘ Cmd+W |
| **Close all tabs but the current one** |  |  |
| **Go to next tab** | Ctrl+Tab ⇆ | Control+Tab ⇆ or ⌘ Cmd+⇧ Shift+→([Safari](http://en.wikipedia.org/wiki/Safari_(web_browser))) |
| **Go to previous tab** | Ctrl+⇧ Shift+Tab ⇆ | ⇧ Shift+Control+Tab ⇆ or⌘ Cmd+⇧ Shift+← ([Safari](http://en.wikipedia.org/wiki/Safari_(web_browser))) |
| **Go to tab-*n*** | Ctrl+*n* ([Chrome](http://en.wikipedia.org/wiki/Chrome_(web_browser))[Firefox](http://en.wikipedia.org/wiki/Firefox_(web_browser))) | ⌘ Cmd+*n* ([Chrome](http://en.wikipedia.org/wiki/Chrome_(web_browser))) |
| **Open a previously closed tab** | Ctrl+⇧ Shift+T | ⌘ Cmd+⇧ Shift+T([Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox)/[Opera](http://en.wikipedia.org/wiki/Opera_(web_browser))/[Chrome](http://en.wikipedia.org/wiki/Google_Chrome)) |

**Window management**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Pop up window menu** | Alt+Space |  |
| **Close the focused window** | Alt+F4 or Ctrl+F4 or Ctrl +W or Alt+Space then C[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27) | ⌘ Cmd+W |
| **Restore the focused window to its previous size** | Alt+Space then R[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27) |  |
| **Move the focused window** | Alt+Space then M[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27) thenArrow Keys |  |
| **Resize the focused window** | Alt+Space then S[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27) thenArrow Keys |  |
| **Hide the focused window** |  | ⌘ Cmd+H |
| **Hide all except the focused window** |  | ⌘ Cmd+⌥ Option+H |
| **Minimize the focused window** | Alt+Space then N[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27), or⊞ Win+↓ (Windows 7 and Vista Home Premium) | ⌘ Cmd+M |
| **Maximize the focused window** | Alt+Space then X[[28]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-AltSpaceLanguage-27), or⊞ Win+↑ (Windows 7 only) |  |
| **Maximize horizontally** |  |  |
| **Maximize vertically** | ⊞ Win+⇧ Shift+↑ (Windows 7 only) |  |
| **Minimize all** | ⊞ Win+M or ⊞ Win+D | ⌘ Cmd+Alt+M |
| **Minimize all non focused windows** | ⊞ Win+Home (Windows 7 only) |  |
| **Undo minimize all** | ⇧ Shift+⊞ Win+M |  |
| **Switch fullscreen/normal size** | F11 |  |
| **Show the window in full screen mode, with no border, menubar, toolbar or statusbar** |  | *Depends on application* |
| **Rollup/down window** |  |  |
| **Show all open windows** | ⊞ Win+Tab ⇆ | F9 or  Move mouse pointer to configured *hot corner* or *active screen corner*[[29]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-docs.info.apple.com-28)[[30]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-ReferenceA-29) |
| **Show all windows of current application** |  | F10 or  Move mouse pointer to configured *hot corner* or *active screen corner*[[29]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-docs.info.apple.com-28)[[30]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-ReferenceA-29) |
| **Show all workspaces** |  | F8 or  Move mouse pointer to configured *hot corner* or *active screen corner*[[29]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-docs.info.apple.com-28)[[30]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-ReferenceA-29) |
| **Move window to left/right/up/down workspace** | ⊞ Win+←/→ (Windows 7 only) |  |
| **Move window between multiple monitors** | ⊞ Win+⇧ Shift+←/→(Windows 7 only) |  |
| **Move window to workspace *n*** |  |  |
| **Switch to next/previous workspace list** |  |  |
| **Go to workspace *n*** |  | Ctrl+*n* |
| **Go to left/right/up/down workspace** | [[31]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-moveToWorkspace_Windows-30) | Ctrl+← /  Ctrl+→ / Ctrl+↑ / Ctrl+↓(OS X 10.5 to 10.6), Ctrl+← /Ctrl+→ (OS X 10.7) |
| **Show / hide desktop** | ⊞ Win+D | F11 or  Move mouse pointer to configured *hot corner* or *active screen corner*[[29]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-docs.info.apple.com-28)[[30]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-ReferenceA-29) |
| **Activate window demanding attention** |  |  |
| **Quit application of current window** | Alt+F4 or Ctrl+F4 *varies*[[32]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-xpclose-31) | ⌘ Cmd+Q[[33]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-macoskill-32) |
| **Close dialog** | Esc | Esc |
| **Open/Focus (preview) pinned program on the taskbar** | ⊞ Win+(#) where "#" is the position of the program on the Windows 7 Taskbar (Windows 7 only) |  |
| **Open new program window of pinned program in Quick Launch** | ⊞ Win+(#) where "#" is the position of the program on the Quick Launch toolbar (Windows Vista and 7) |  |
| **Open new program window of the pinned program on the taskbar (if program is already opened)** | ⊞ Win+⇧ Shift+(#) where "#" is the position of the program on the Windows 7 Taskbar (Windows 7 only) |  |
| **Focus the first taskbar entry. Pressing again will cycle through them** | ⊞ Win+T , you can ←→back and forth. Hold ⇧ Shift to cycle backwards (Windows 7 only) |  |
| **Peek at the desktop** | ⊞ Win+Space (Windows 7 only) | F11 or  Move mouse pointer to configured *hot corner* or *active screen corner*[[29]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-docs.info.apple.com-28)[[30]](http://en.wikipedia.org/wiki/Table_of_keyboard_shortcuts#cite_note-ReferenceA-29) |
| **Bring gadgets to the front of the Z-order and cycle between gadgets** | ⊞ Win+G (Windows Vista,7) or⊞ Win+Space (Vista only, no cycling) |  |
| **External display options (mirror, extend desktop, etc.)** | ⊞ Win+P (Windows 7 only) |  |

**User interface navigation (widgets and controls)**

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Moves keyboard focus to next/previous control** | Tab ⇆ / ⇧ Shift+Tab ⇆ | With full keyboard access active (System Preferences > Keyboard > Full Keyboard Access > All Controls)  Tab ⇆ / ⇧ Shift+Tab ⇆ |
| **Pop up tooltip for currently focused control** | ⇧ Shift+F1 |  |
| **Show context-sensitive help for currently focused window or control** | ⇧ Shift+F1 | ⌘ Cmd+? |
| **Give focus to next/previous pane** | Ctrl+F6 / Alt+F6 | ⌘ Cmd+` |
| **Give focus to splitter bar in paned window** |  |  |
| **Give focus to window's menu bar** | F10 or Alt | Ctrl+F2  (or Fn+Ctrl+F2 on some keyboards) |
| **Pop up**[**contextual menu**](http://en.wikipedia.org/wiki/Contextual_menu)**for currently selected objects (aka*context menu*)** | ⇧ Shift+F10 or ≣ Menu | Varies with laptop / extended keyboard type; enable [Mouse keys](http://en.wikipedia.org/wiki/Mouse_keys) in [Universal Access](http://en.wikipedia.org/wiki/Universal_Access), then Function+Ctrl+5 orCtrl+5 (numeric keypad) orFunction+Ctrl+i (laptop) |
| **Toggle selected state of focused checkbox, radio button, or toggle button** | Space | Space |
| **Activate focused button, menu item etc.** | ↵ Enter | Space (also ↵ Enter for menu items) |
| **Select/move to first/last item in selected widget** |  |  |
| **Scroll selected view by one page up/left/down/right** |  | ⇞ / ⇟  (or Fn+↑}+Fn+↓ on some keyboards) |
| **Scroll selected view to top/bottom** |  | ↖ or on MacBook Pro Fn + ⌥ [Opt](http://en.wikipedia.org/wiki/Option_key) +↖  ↘ or on MacBook Pro Fn + ⌥ [Opt](http://en.wikipedia.org/wiki/Option_key) +↘ |
| **Switch focus to the next/previous tab within a window** | Ctrl+Tab ⇆ | Ctrl+Tab ⇆ /  ⌘ Cmd+` |
| **Switch focus to the next/previous panel on the desktop** |  |  |
| **Switch focus to the next/previous panel (without dialog)** |  |  |

**Command line shortcuts**

Below is a list of common keyboard shortcuts that are used in a [command line environment](http://en.wikipedia.org/wiki/Command_line_interface).

|  |  |  |
| --- | --- | --- |
| **Action** | **Microsoft Windows (**[**cmd.exe**](http://en.wikipedia.org/wiki/Cmd.exe)**)** | **Microsoft Windows (**[**Windows PowerShell**](http://en.wikipedia.org/wiki/Windows_PowerShell)**)** |
| **Scroll through History of typed commands** | ↑/↓ | ↑/↓ |
| **Signal**[**end-of-file**](http://en.wikipedia.org/wiki/End-of-file) | Ctrl+Z |  |
| **Abort current command/typing** | Ctrl+C | Ctrl+C |
| **Erase word to the left** |  |  |
| **Erase word to the right** |  |  |
| **Erase line to the left** | Ctrl+Home |  |
| **Erase line to the right** | Ctrl+End | Ctrl+End |
| **Yank/paste previously erased string** |  |  |
| **Move one word to the left (backward)** | Ctrl+← | Ctrl+← |
| **Move one word to the right (forward)** | Ctrl+→ | Ctrl+→ |
| **Move to beginning of line** | Home | Home |
| **Move to end of line** | End | End |
| **Reverse search of history** | F8 | F8 |
| **Stop execution of the current job** |  |  |
| **Insert the next character typed verbatim** |  |  |
| **Autocomplete command/file name** | Tab ⇆ (enabled by default in Windows XP and later) | Tab ⇆ |
| **Paste contents of**[**clipboard**](http://en.wikipedia.org/wiki/Clipboard_(software))**at**[**cursor**](http://en.wikipedia.org/wiki/Cursor_(computers)) |  |  |
| **Scroll window up** | ⇧ Shift+PageUp (may not work in some versions of Windows XP) |  |
| **Scroll window down** | ⇧ Shift+PageDown (may not work in some versions of Windows XP) |  |

**Accessibility**

* In Windows, it is possible to disable these shortcuts using the Accessibility or Ease of Access control panel.
* \*\*\*In GNOME, these shortcuts are possible if Universal Access is enabled.

| **Action** | [**Windows**](http://en.wikipedia.org/wiki/Microsoft_Windows) | [**Mac OS**](http://en.wikipedia.org/wiki/Mac_OS) |
| --- | --- | --- |
| **Utility Manager** | ⊞ Win+U |  |
| **Use keyboard to control cursor** | (Left Alt+Left Shift+Numlock |  |
| **Allow user to press shortcuts one key at a time** | (⇧ Shift 5 times) |  |
| **Hear beep when -lock key pressed** | (Numlock for 5 seconds) |  |
| **Stop/slow repeating characters when key is pressed** | (Right Shift for 8 seconds) |  |
| **Inverse (Reverse Colors) Mode** | Left Alt+Left Shift+PrtScn | ⌘ Cmd+⌥ Opt+Ctrl+8 |

# IV Telecommunications

**Telecommunication** is the [transmission](http://en.wikipedia.org/wiki/Transmission_(telecommunications)) of [information](http://en.wikipedia.org/wiki/Information) over significant distances to communicate.

In earlier times, telecommunications involved the use of visual signals, such as [beacons](http://en.wikipedia.org/wiki/Beacon), [smoke signals](http://en.wikipedia.org/wiki/Smoke_signal), [semaphore telegraphs](http://en.wikipedia.org/wiki/Semaphore_line), [signal flags](http://en.wikipedia.org/wiki/Signal_flag), and optical [heliographs](http://en.wikipedia.org/wiki/Heliograph), or audio messages such as coded [drumbeats](http://en.wikipedia.org/wiki/Drum_(communication)), lung-blown horns, and loud whistles.

In modern times, telecommunications involves the use of electrical devices such as the [telegraph](http://en.wikipedia.org/wiki/Electrical_telegraph), [telephone](http://en.wikipedia.org/wiki/Telephone), and [teleprinter](http://en.wikipedia.org/wiki/Teleprinter), as well as the use of radio and [microwave communications](http://en.wikipedia.org/wiki/Microwave_transmission), as well as [fiber optics](http://en.wikipedia.org/wiki/Optical_fiber) and their associated electronics, plus the use of the [orbiting satellites](http://en.wikipedia.org/wiki/Communications_satellite) and the [Internet](http://en.wikipedia.org/wiki/Internet).

A revolution in [wireless telecommunications](http://en.wikipedia.org/wiki/Wireless_communication) began in the 1900s (decade) with pioneering developments in [wireless radio](http://en.wikipedia.org/wiki/Wireless) [communications](http://en.wikipedia.org/wiki/Radio_communications) by [Nikola Tesla](http://en.wikipedia.org/wiki/Nikola_Tesla) and [Guglielmo Marconi](http://en.wikipedia.org/wiki/Guglielmo_Marconi).

## Telecommunication systems

A number of key concepts reoccur throughout the literature on modern telecommunication systems. Some of these concepts are discussed below.

**Basic elements**

A basic [telecommunication system](http://en.wikipedia.org/wiki/Communication_system) consists of three primary units that are always present in some form:

* A [transmitter](http://en.wikipedia.org/wiki/Transmitter) that takes information and converts it to a [signal](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)).
* A [transmission medium](http://en.wikipedia.org/wiki/Transmission_medium), also called the "physical channel" that carries the signal. An example of this is the ["free space channel"](http://en.wikipedia.org/wiki/Free-space_optical_communication).
* A [receiver](http://en.wikipedia.org/wiki/Receiver_(radio)) that takes the signal from the channel and converts it back into usable information.

For example, in a [radio broadcasting station](http://en.wikipedia.org/wiki/Radio_station) the station's large [power amplifier](http://en.wikipedia.org/wiki/Electronic_amplifier) is the transmitter; and the broadcasting [antenna](http://en.wikipedia.org/wiki/Antenna_(radio)) is the interface between the power amplifier and the "free space channel". The free space channel is the transmission medium; and the receiver's antenna is the interface between the free space channel and the receiver. Next, the [radio receiver](http://en.wikipedia.org/wiki/Radio_receiver) is the destination of the radio signal, and this is where it is converted from electricity to sound for people to listen to.

Sometimes, telecommunication systems are ["duplex"](http://en.wikipedia.org/wiki/Duplex_(telecommunications)) (two-way systems) with a single box of [electronics](http://en.wikipedia.org/wiki/Electronics) working as both a transmitter and a receiver, or a *transceiver*. For example, a [cellular telephone](http://en.wikipedia.org/wiki/Cellular_telephone) is a transceiver.[[26]](http://en.wikipedia.org/wiki/Telecommunication#cite_note-stallings-intro-25) The transmission electronics and the receiver electronics in a transceiver are actually quite independent of each other. This can be readily explained by the fact that radio transmitters contain power amplifiers that operate with electrical powers measured in the [watts](http://en.wikipedia.org/wiki/Watt) or [kilowatts](http://en.wikipedia.org/wiki/Kilowatt), but radio receivers deal with radio powers that are measured in the [microwatts](http://en.wikipedia.org/wiki/Microwatt) or [nanowatts](http://en.wikipedia.org/wiki/Nanowatt). Hence, transceivers have to be carefully designed and built to isolate their high-power circuitry and their low-power circuitry from each other.

Telecommunication over telephone lines is called [point-to-point communication](http://en.wikipedia.org/wiki/Point-to-point_communication_(telecommunications)) because it is between one transmitter and one receiver. Telecommunication through radio broadcasts is called [broadcast communication](http://en.wikipedia.org/wiki/Broadcasting) because it is between one powerful transmitter and numerous low-power but sensitive radio receivers.[[26]](http://en.wikipedia.org/wiki/Telecommunication#cite_note-stallings-intro-25)

Telecommunications in which multiple transmitters and multiple receivers have been designed to cooperate and to share the same physical channel are called [multiplex systems](http://en.wikipedia.org/wiki/Multiplexing).

Mayor components of telecommunication systems are:

* Hardware and communications media
* Switches and routers
* Communication protocols and application software

## Signal

A ***signal*** as referred to in [communication systems](http://en.wikipedia.org/wiki/Communication_systems), [signal processing](http://en.wikipedia.org/wiki/Signal_processing), and [electrical engineering](http://en.wikipedia.org/wiki/Electrical_engineering) "is a function that conveys [information](http://en.wikipedia.org/wiki/Information) about the behavior or attributes of some phenomenon".[[1]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-Priemer-0) In the physical world, any quantity exhibiting variation in time or variation in space (such as an image) is potentially a signal that might provide information on the status of a physical system, or convey a[message](http://en.wikipedia.org/wiki/Message) between observers, among other possibilities.[[2]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-Note-1) The *IEEE Transactions on Signal Processing* elaborates upon the term "signal" as follows:[[3]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-IEEE-2)

"The term 'signal' includes, among others, [audio](http://en.wikipedia.org/wiki/Audio_signal), [video](http://en.wikipedia.org/wiki/Video), speech, [image](http://en.wikipedia.org/wiki/Image), communication, geophysical, sonar, radar, medical and musical signals."

Other examples of signals are the output of a [thermocouple](http://en.wikipedia.org/wiki/Thermocouple), which conveys temperature information, and the output of a [pH meter](http://en.wikipedia.org/wiki/PH_meter) which conveys acidity information.[[1]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-Priemer-0) Typically, signals often are provided by a [sensor](http://en.wikipedia.org/wiki/Sensor), and often the original form of a signal is converted to another form of energy using a [transducer](http://en.wikipedia.org/wiki/Transducer). For example, a [microphone](http://en.wikipedia.org/wiki/Microphone) converts an acoustic signal to a [voltage](http://en.wikipedia.org/wiki/Voltage) waveform, and a [speaker](http://en.wikipedia.org/wiki/Loudspeaker) does the reverse.[[1]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-Priemer-0)

The formal study of the information content of signals is the field of [information theory](http://en.wikipedia.org/wiki/Information_theory). The information in a signal usually is accompanied by [noise](http://en.wikipedia.org/wiki/Noise_(electronics)). The term *noise* usually means an undesirable random disturbance, but often is extended to include unwanted signals conflicting with the desired signal (such as [crosstalk](http://en.wikipedia.org/wiki/Crosstalk)). The prevention of noise is covered in part under the heading of [signal integrity](http://en.wikipedia.org/wiki/Signal_integrity). The separation of desired signals from a background is the field of [signal recovery](http://en.wikipedia.org/wiki/Detection_theory),[[4]](http://en.wikipedia.org/wiki/Signal_(electrical_engineering)#cite_note-Wilmshurst-3) one branch of which is [estimation theory](http://en.wikipedia.org/wiki/Estimation_theory), a probabilistic approach to suppressing random disturbances.

Engineering disciplines such as [electrical engineering](http://en.wikipedia.org/wiki/Electrical_engineering) have led the way in the design, study, and implementation of systems involving [transmission](http://en.wikipedia.org/wiki/Information_transmission), [storage](http://en.wikipedia.org/wiki/Information_storage), and [manipulation of information](http://en.wikipedia.org/wiki/Information_processor). In the latter half of the 20th century, [electrical engineering](http://en.wikipedia.org/wiki/Electrical_engineering) itself separated into several disciplines, specializing in the design and analysis of systems that manipulate physical signals; [electronic engineering](http://en.wikipedia.org/wiki/Electronic_engineering) and [computer engineering](http://en.wikipedia.org/wiki/Computer_engineering) as examples; while [design engineering](http://en.wikipedia.org/wiki/Industrial_design) developed to deal with functional design of [man–machine interfaces](http://en.wikipedia.org/wiki/User_interface).

## Infrared

**Infrared** (**IR**) light is [electromagnetic radiation](http://en.wikipedia.org/wiki/Electromagnetic_radiation) with longer [wavelengths](http://en.wikipedia.org/wiki/Wavelength) than those of [visible light](http://en.wikipedia.org/wiki/Light), extending from the nominal [red](http://en.wikipedia.org/wiki/Red) edge of the visible [spectrum](http://en.wikipedia.org/wiki/Spectrum)at 0.74 [micrometres](http://en.wikipedia.org/wiki/Micrometre) (µm) to 300 µm. This range of wavelengths corresponds to a [frequency](http://en.wikipedia.org/wiki/Frequency_spectrum) range of approximately 1 to 400 [THz](http://en.wikipedia.org/wiki/THz),[[1]](http://en.wikipedia.org/wiki/Infrared#cite_note-0) and includes most of the [thermal radiation](http://en.wikipedia.org/wiki/Thermal_radiation) emitted by objects near room temperature. Infrared light is emitted or absorbed by molecules when they change their [rotational-vibrational](http://en.wikipedia.org/wiki/Infrared_spectroscopy) movements.

Infrared light is used in industrial, scientific, and medical applications. Its uses include [thermal efficiency](http://en.wikipedia.org/wiki/Thermal_efficiency) analysis, environmental monitoring, industrial facility inspections, remote temperature sensing, short-ranged [wireless communication](http://en.wikipedia.org/wiki/Wireless_communication), [spectroscopy](http://en.wikipedia.org/wiki/Spectroscopy), and [weather forecasting](http://en.wikipedia.org/wiki/Weather_forecasting).

## Radio-frequency identification

**Radio-frequency identification** (**RFID**) is the use of a wireless non-contact system that uses radio-frequency [electromagnetic fields](http://en.wikipedia.org/wiki/Electromagnetic_field) to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered by the electromagnetic fields used to read them. Others use a local power source and emit [radio](http://en.wikipedia.org/wiki/Radio) waves ([electromagnetic radiation](http://en.wikipedia.org/wiki/Electromagnetic_radiation) at radio frequencies). The tag contains electronically stored information which can be read from up to several meters (yards) away. Unlike a [bar code](http://en.wikipedia.org/wiki/Bar_code), the tag does not need to be within line of sight of the reader and may be embedded in the tracked object.

RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. [Livestock and pets may have tags injected](http://en.wikipedia.org/wiki/Microchip_implant_(animal)), allowing positive identification of the animal. RFID identity cards can give employees access to locked areas of a building, and RF transponders mounted in automobiles can be used to bill motorists for access to toll roads or parking.

Since RFID tags can be attached to clothing, possessions, or even [implanted within people](http://en.wikipedia.org/wiki/Microchip_implant_(human)), the possibility of reading personally-linked information without consent has raised privacy concerns.

## Near field communication

**Near field communication** (**NFC**) is a set of standards for [smartphones](http://en.wikipedia.org/wiki/Smartphone) and similar devices to establish [radio](http://en.wikipedia.org/wiki/Radio) communication with each other by touching them together or bringing them into close proximity, usually no more than a few centimeters. Present and anticipated applications include contactless transactions, data exchange, and simplified setup of more complex communications such as [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi).[[1]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-WhatIsNFC-0) Communication is also possible between an NFC device and an unpowered NFC [chip](http://en.wikipedia.org/wiki/Integrated_circuit), called a "tag".[[2]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-Gadgetronica-1)

NFC standards cover communications protocols and data exchange formats, and are based on existing [radio-frequency identification](http://en.wikipedia.org/wiki/Radio-frequency_identification) (RFID) standards including [ISO/IEC 14443](http://en.wikipedia.org/wiki/ISO/IEC_14443) and [FeliCa](http://en.wikipedia.org/wiki/FeliCa).[[3]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-NFCForumSpecList-2) The standards include ISO/IEC 18092[[4]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-ISO18092-3) and those defined by the NFC Forum, which was founded in 2004 by [Nokia](http://en.wikipedia.org/wiki/Nokia), [Philips](http://en.wikipedia.org/wiki/Philips) and [Sony](http://en.wikipedia.org/wiki/Sony), and now has more than 160 members. The Forum also promotes NFC and certifies device compliance.[[5]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-AboutNFCForum-4)

**Uses**

NFC builds upon [RFID](http://en.wikipedia.org/wiki/Radio-frequency_identification) systems by allowing two-way communication between endpoints, where earlier systems such as [contactless smart cards](http://en.wikipedia.org/wiki/Contactless_smart_card) were one-way only.[[6]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-PopSciNFC-5)Since unpowered NFC "tags" can also be read by NFC devices,[[2]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-Gadgetronica-1) it is also capable of replacing earlier one-way applications.

**Commerce**

NFC devices can be used in [contactless payment](http://en.wikipedia.org/wiki/Contactless_payment) systems, similar to those currently used in [credit cards](http://en.wikipedia.org/wiki/Credit_card) and [electronic ticket](http://en.wikipedia.org/wiki/Electronic_ticket) smartcards, and allow [mobile payment](http://en.wikipedia.org/wiki/Mobile_payment)to replace or supplement these systems. For example, [Google Wallet](http://en.wikipedia.org/wiki/Google_Wallet) allows consumers to store credit card and store loyalty card information in a virtual wallet and then use an NFC-enabled device at terminals that also accept [MasterCard PayPass](http://en.wikipedia.org/wiki/MasterCard#PayPass) transactions[[7]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-GoogleWalletNFC-6). [Germany](http://en.wikipedia.org/wiki/Germany)[[8]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-GermanyNFCTrial-7), [Austria](http://en.wikipedia.org/wiki/Austria)[[9]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-AustriaNFCTrial-8), [Latvia](http://en.wikipedia.org/wiki/Latvia)[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] and [Italy](http://en.wikipedia.org/wiki/Italy)[[10]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-ItalyNFCTrial-9) have trialled NFC ticketing systems for public transport. China is using it all over the country in public bus transport[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] and India is implementing NFC based transactions in box offices for ticketing purposes[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)].

Uses of NFC:

* Matching encrypted security code and transporting access key;
* Due to short transmission range, NFC-based transactions are possibly secure;
* Instant payments and coupon delivery using your handset, as we do with your credit card or debit card;
* Exchange of information such as schedules, maps, business card and coupon delivery in a few hundred milliseconds;
* Pay for items just by waving your phone over the NFC capable devices
* Transferring images, posters for displaying and printing
* Social media e.g Like on Facebook, Follow on Twitter via NFC [smart stickers](http://www.tapitnfc.com/) in retail stores

**Bluetooth and WiFi connections**

NFC offers a low-speed connection with extremely simple setup, and could be used to [bootstrap](http://en.wikipedia.org/wiki/Bootstrap) more capable wireless connections.[[11]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-TechEnabler-10) It could, for example, replace the pairing step of establishing [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth) connections or the configuration of [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) networks.

**Social networking**

NFC can be used in [social networking](http://en.wikipedia.org/wiki/Social_networking_service) situations, such as sharing contacts, photos, videos or files,[[12]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-GoogleIO2011-11) and entering multiplayer [mobile games](http://en.wikipedia.org/wiki/Mobile_game).[[13]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-12)

**Identity documents**

The NFC Forum promotes the potential for NFC-enabled devices to act as electronic [identity documents](http://en.wikipedia.org/wiki/Identity_document) and [keycards](http://en.wikipedia.org/wiki/Keycard_lock).[[11]](http://en.wikipedia.org/wiki/Near_Field_Communication#cite_note-TechEnabler-10) As NFC has a short range and supports encryption, it may be more suitable than earlier, less private RFID systems.

## Bluetooth

**Bluetooth** is a [proprietary](http://en.wikipedia.org/wiki/Proprietary_protocol) [open](http://en.wikipedia.org/wiki/Open_standard) [wireless](http://en.wikipedia.org/wiki/Wireless) technology standard for exchanging data over short distances (using short-wavelength radio transmissions in the [ISM](http://en.wikipedia.org/wiki/ISM_band) band from 2400–2480 MHz) from fixed and mobile devices, creating [personal area networks](http://en.wikipedia.org/wiki/Personal_area_network) (PANs) with high levels of security. Created by telecoms vendor [Ericsson](http://en.wikipedia.org/wiki/Ericsson) in 1994,[[1]](http://en.wikipedia.org/wiki/Bluetooth#cite_note-0) it was originally conceived as a wireless alternative to [RS-232](http://en.wikipedia.org/wiki/RS-232) data cables. It can connect several devices, overcoming problems of synchronization.

Bluetooth is managed by the [Bluetooth Special Interest Group](http://en.wikipedia.org/wiki/Bluetooth_Special_Interest_Group), which has more than 16,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics.[[2]](http://en.wikipedia.org/wiki/Bluetooth#cite_note-autogenerated1-1) The SIG oversees the development of the specification, manages the qualification program, and protects the trademarks.[[3]](http://en.wikipedia.org/wiki/Bluetooth#cite_note-2) To be marketed as a Bluetooth device, it must be [qualified](http://en.wikipedia.org/wiki/Bluetooth_Special_Interest_Group#Qualification) to standards defined by the SIG. A network of [patents](http://en.wikipedia.org/wiki/Patent) is required to implement the technology and are licensed only for those qualifying devices; thus the protocol, whilst open, may be regarded as proprietary.

## Global Positioning System

The **Global Positioning System** (**GPS**) is a space-based [satellite navigation](http://en.wikipedia.org/wiki/Satellite_navigation) system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the [United States](http://en.wikipedia.org/wiki/United_States) government and is freely accessible to anyone with a [GPS receiver](http://en.wikipedia.org/wiki/GPS_receiver).

The GPS program provides critical capabilities to military, civil and commercial users around the world. In addition, GPS is the backbone for modernizing the global air traffic system.

The GPS project was developed in 1973 to overcome the limitations of previous navigation systems,[[1]](http://en.wikipedia.org/wiki/GPS#cite_note-0) integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. GPS was created and realized by the [U.S. Department of Defense](http://en.wikipedia.org/wiki/U.S._Department_of_Defense) (DoD) and was originally run with 24 satellites. It became fully operational in 1994.

Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS system and implement the next generation of GPS III satellites and Next Generation Operational Control System (OCX).[[2]](http://en.wikipedia.org/wiki/GPS#cite_note-losangelesmil-1) Announcements from the Vice President and the White House in 1998 initiated these changes. In 2000, U.S. Congress authorized the modernization effort, referred to as GPS III.

**Basic concept of GPS**

A GPS receiver calculates its position by precisely timing the signals sent by GPS [satellites](http://en.wikipedia.org/wiki/Satellites) high above the Earth. Each satellite continually transmits messages that include

* the time the message was transmitted
* satellite position at time of message transmission

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite. These distances along with the satellites' locations are used with the possible aid of [trilateration](http://en.wikipedia.org/wiki/Trilateration), depending on which algorithm is used, to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes.

Three satellites might seem enough to solve for position since space has three dimensions and a position near the Earth's surface can be assumed. However, even a very small clock error multiplied by the very large [speed of light](http://en.wikipedia.org/wiki/Speed_of_light)[[37]](http://en.wikipedia.org/wiki/GPS#cite_note-36) — the speed at which satellite signals propagate — results in a large positional error. Therefore receivers use four or more satellites to solve for both the receiver's location and time. The very accurately computed time is effectively hidden by most GPS applications, which use only the location. A few specialized GPS applications do however use the time; these include [time transfer](http://en.wikipedia.org/wiki/Time_transfer), traffic signal timing, and [synchronization of cell phone base stations](http://en.wikipedia.org/wiki/IS-95#Physical_layer).

Although four satellites are required for normal operation, fewer apply in special cases. If one variable is already known, a receiver can determine its position using only three satellites. For example, a ship or aircraft may have known elevation. Some GPS receivers may use additional clues or assumptions such as reusing the last known [altitude](http://en.wikipedia.org/wiki/Altitude), [dead reckoning](http://en.wikipedia.org/wiki/Dead_reckoning), [inertial navigation](http://en.wikipedia.org/wiki/Inertial_navigation_system), or including information from the vehicle computer, to give a less degraded position when fewer than four satellites are visible.[[38]](http://en.wikipedia.org/wiki/GPS#cite_note-37)[[39]](http://en.wikipedia.org/wiki/GPS#cite_note-NAVGPS-38)[[40]](http://en.wikipedia.org/wiki/GPS#cite_note-39)

## Computer network

A **computer network**, often simply referred to as a network, is a collection of computers and other [hardware](http://en.wikipedia.org/wiki/Networking_hardware) components interconnected by communication channels that allow sharing of resources and information.[[1]](http://en.wikipedia.org/wiki/Computer_network#cite_note-0) Where at least one process in one device is able to send/receive data to/from at least one process residing in a remote device, then the two devices are said to be in a network. Simply, more than one computer interconnected through a communication medium for information interchange is called a computer network.

Networks may be classified according to a wide variety of characteristics, such as the medium used to transport the data, [communications protocol](http://en.wikipedia.org/wiki/Communications_protocol) used, scale,[topology](http://en.wikipedia.org/wiki/Network_topology), and organizational scope.

Communications protocols define the rules and data formats for exchanging information in a computer network, and provide the basis for [network programming](http://en.wikipedia.org/wiki/Computer_network_programming). Well-known communications protocols include [Ethernet](http://en.wikipedia.org/wiki/Ethernet), a hardware and [link layer](http://en.wikipedia.org/wiki/Link_layer) standard that is ubiquitous in [local area networks](http://en.wikipedia.org/wiki/Local_area_network), and the [Internet protocol suite](http://en.wikipedia.org/wiki/Internet_protocol_suite), which defines a set of protocols for internetworking, i.e. for data communication between multiple networks, as well as host-to-host data transfer, and application-specific data transmission formats.

Computer networking is sometimes considered a sub-discipline of [electrical engineering](http://en.wikipedia.org/wiki/Electrical_engineering), [telecommunications](http://en.wikipedia.org/wiki/Telecommunications), [computer science](http://en.wikipedia.org/wiki/Computer_science), [information technology](http://en.wikipedia.org/wiki/Information_technology) or [computer engineering](http://en.wikipedia.org/wiki/Computer_engineering), since it relies upon the theoretical and practical application of these disciplines.

Properties

Computer networks:

**Facilitate communications**

Using a network, people can communicate efficiently and easily via email, instant messaging, chat rooms, telephone, video telephone calls, and video conferencing.

**Permit sharing of files, data, and other types of information**

In a network environment, authorized users may access data and information stored on other computers on the network. The capability of providing access to data and information on shared storage devices is an important feature of many networks.

**Share network and computing resources**

In a networked environment, each computer on a network may access and use resources provided by devices on the network, such as printing a document on a shared network printer. [Distributed computing](http://en.wikipedia.org/wiki/Distributed_computing) uses computing resources across a network to accomplish tasks.

**May be insecure**

A computer network may be used by [computer hackers](http://en.wikipedia.org/wiki/Hacker_(computer_security)) to deploy [computer viruses](http://en.wikipedia.org/wiki/Computer_virus) or [computer worms](http://en.wikipedia.org/wiki/Computer_worm) on devices connected to the network, or to prevent these devices from normally accessing the network ([denial of service](http://en.wikipedia.org/wiki/Denial-of-service_attack)).

**May interfere with other technologies**

[Power line communication](http://en.wikipedia.org/wiki/Power_line_communication) strongly disturbs certain forms of radio communication, e.g., amateur radio.[[5]](http://en.wikipedia.org/wiki/Computer_network#cite_note-4) It may also interfere with [last mile](http://en.wikipedia.org/wiki/Last_mile) access technologies such as [ADSL](http://en.wikipedia.org/wiki/ADSL) and [VDSL](http://en.wikipedia.org/wiki/VDSL).[[6]](http://en.wikipedia.org/wiki/Computer_network#cite_note-5)

**May be difficult to set up**

A complex computer network may be difficult to set up. It may also be very costly to set up an effective computer network in a large organization or company.

## Communication media

Computer networks can be classified according to the hardware and associated software technology that is used to interconnect the individual devices in the network, such as [electrical cable](http://en.wikipedia.org/wiki/Cable)([HomePNA](http://en.wikipedia.org/wiki/HomePNA), [power line communication](http://en.wikipedia.org/wiki/Power_line_communication), [G.hn](http://en.wikipedia.org/wiki/G.hn)), [optical fiber](http://en.wikipedia.org/wiki/Optical_fiber), and [radio waves](http://en.wikipedia.org/wiki/Radio_waves) ([wireless LAN](http://en.wikipedia.org/wiki/Wireless_LAN)). In the [OSI model](http://en.wikipedia.org/wiki/OSI_model), these are located at levels 1 and 2.

A well-known *family* of communication media is collectively known as [Ethernet](http://en.wikipedia.org/wiki/Ethernet). It is defined by [IEEE 802](http://en.wikipedia.org/wiki/IEEE_802) and utilizes various standards and media that enable communication between devices. Wireless LAN technology is designed to connect devices without wiring. These devices use [radio waves](http://en.wikipedia.org/wiki/Radio_waves) or [infrared](http://en.wikipedia.org/wiki/IrDA) signals as a transmission medium.

**Wired technologies**

The order of the following wired technologies is, roughly, from slowest to fastest transmission speed.

* [*Twisted pair*](http://en.wikipedia.org/wiki/Twisted_pair)*wire* is the most widely used medium for telecommunication. Twisted-pair cabling consist of copper wires that are twisted into pairs. Ordinary telephone wires consist of two insulated copper wires twisted into pairs. Computer networking cabling (wired [Ethernet](http://en.wikipedia.org/wiki/Ethernet) as defined by [IEEE 802.3](http://en.wikipedia.org/wiki/IEEE_802.3)) consists of 4 pairs of copper cabling that can be utilized for both voice and data transmission. The use of two wires twisted together helps to reduce [crosstalk](http://en.wikipedia.org/wiki/Crosstalk_(electronics)) and [electromagnetic induction](http://en.wikipedia.org/wiki/Electromagnetic_induction). The transmission speed ranges from 2 million bits per second to 10 billion bits per second. Twisted pair cabling comes in two forms: unshielded twisted pair (UTP) and shielded twisted-pair (STP). Each form comes in several category ratings, designed for use in various scenarios.
* [*Coaxial cable*](http://en.wikipedia.org/wiki/Coaxial_cable) is widely used for cable television systems, office buildings, and other work-sites for local area networks. The cables consist of copper or aluminum wire surrounded by an insulating layer (typically a flexible material with a high dielectric constant), which itself is surrounded by a conductive layer. The insulation helps minimize interference and distortion. Transmission speed ranges from 200 million bits per second to more than 500 million bits per second.
* [ITU-T](http://en.wikipedia.org/wiki/ITU-T) [G.hn](http://en.wikipedia.org/wiki/G.hn) technology uses existing [home wiring](http://en.wikipedia.org/wiki/Home_wiring) ([coaxial cable](http://en.wikipedia.org/wiki/Ethernet_over_coax), phone lines and [power lines](http://en.wikipedia.org/wiki/Power_line_communication)) to create a high-speed (up to 1 Gigabit/s) local area network.
* An [optical fiber](http://en.wikipedia.org/wiki/Optical_fiber) is a glass fiber. It uses pulses of light to transmit data. Some advantages of optical fibers over metal wires are less transmission loss, immunity from electromagnetic radiation, and very fast transmission speed, up to trillions of bits per second. One can use different colors of lights to increase the number of messages being sent over a fiber optic cable.

**Wireless technologies**

* *Terrestrial*[*microwave*](http://en.wikipedia.org/wiki/Microwave) – Terrestrial microwave communication uses Earth-based transmitters and receivers resembling satellite dishes. Terrestrial microwaves are in the low-gigahertz range, which limits all communications to line-of-sight. Relay stations are spaced approximately 48 km (30 mi) apart.
* *Communications*[*satellites*](http://en.wikipedia.org/wiki/Satellite) – The satellites communicate via microwave radio waves, which are not deflected by the Earth's atmosphere. The satellites are stationed in space, typically in geosynchronous orbit 35,400 km (22,000 mi) above the equator. These Earth-orbiting systems are capable of receiving and relaying voice, data, and TV signals.
* *Cellular and PCS systems* use several radio communications technologies. The systems divide the region covered into multiple geographic areas. Each area has a low-power transmitter or radio relay antenna device to relay calls from one area to the next area.
* *Radio and spread spectrum technologies* – Wireless local area network use a high-frequency radio technology similar to digital cellular and a low-frequency radio technology. Wireless LANs use spread spectrum technology to enable communication between multiple devices in a limited area. [IEEE 802.11](http://en.wikipedia.org/wiki/IEEE_802.11) defines a common flavor of open-standards wireless radio-wave technology.
* [Infrared communication](http://en.wikipedia.org/wiki/Infrared_communication) can transmit signals for small distances, typically no more than 10 meters. In most cases, [line-of-sight propagation](http://en.wikipedia.org/wiki/Line-of-sight_propagation) is used, which limits the physical positioning of communicating devices.
* A [global area network](http://en.wikipedia.org/wiki/Global_area_network) (GAN) is a network used for supporting mobile across an arbitrary number of wireless LANs, satellite coverage areas, etc. The key challenge in mobile communications is handing off user communications from one local coverage area to the next. In IEEE Project 802, this involves a succession of terrestrial [wireless LANs](http://en.wikipedia.org/wiki/Wireless_LAN).[[7]](http://en.wikipedia.org/wiki/Computer_network#cite_note-6)

**Exotic technologies**

There have been various attempts at transporting data over more or less exotic media:

* [IP over Avian Carriers](http://en.wikipedia.org/wiki/IP_over_Avian_Carriers) was a humorous April fool's [Request for Comments](http://en.wikipedia.org/wiki/Request_for_Comments), issued as [**RFC 1149**](http://tools.ietf.org/html/rfc1149). It was implemented in real life in 2001.[[8]](http://en.wikipedia.org/wiki/Computer_network#cite_note-7)
* Extending the Internet to interplanetary dimensions via radio waves.[[9]](http://en.wikipedia.org/wiki/Computer_network#cite_note-8)

Both cases have a large [round-trip delay time](http://en.wikipedia.org/wiki/Round-trip_delay_time), which prevents useful communication.

## Communications protocols and network programming

A communications protocol is a set of rules for exchanging information over a network. It is typically a [protocol stack](http://en.wikipedia.org/wiki/Protocol_stack) (also see the [OSI model](http://en.wikipedia.org/wiki/OSI_model)), which is a "stack" of protocols, in which each protocol uses the protocol below it. An important example of a protocol stack is [HTTP](http://en.wikipedia.org/wiki/HTTP) running over [TCP](http://en.wikipedia.org/wiki/Transmission_control_protocol) over [IP](http://en.wikipedia.org/wiki/Internet_protocol) over [IEEE 802.11](http://en.wikipedia.org/wiki/IEEE_802.11) (TCP and IP are members of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite), and IEEE 802.11 is a member of the [Ethernet](http://en.wikipedia.org/wiki/Ethernet) protocol suite). This stack is used between the[wireless router](http://en.wikipedia.org/wiki/Wireless_router) and the home user's personal computer when the user is surfing the web.

Communication protocols have various properties, such as whether they are [connection-oriented](http://en.wikipedia.org/wiki/Connection-oriented_communication) or [connectionless](http://en.wikipedia.org/wiki/Connectionless_communication), whether they use [circuit mode](http://en.wikipedia.org/wiki/Circuit_mode) or [packet switching](http://en.wikipedia.org/wiki/Packet_switching), or whether they use hierarchical or flat addressing.

There are many communication protocols, a few of which are described below.

**Ethernet**

Ethernet is a family of connectionless protocols used in LANs, described by a set of standards together called [IEEE 802](http://en.wikipedia.org/wiki/IEEE_802) published by the [Institute of Electrical and Electronics Engineers](http://en.wikipedia.org/wiki/Institute_of_Electrical_and_Electronics_Engineers). It has a flat addressing scheme and is mostly situated at levels 1 and 2 of the [OSI model](http://en.wikipedia.org/wiki/OSI_model). For home users today, the most well-known member of this protocol family is [IEEE 802.11](http://en.wikipedia.org/wiki/IEEE_802.11), otherwise known as [Wireless LAN](http://en.wikipedia.org/wiki/Wireless_LAN) (WLAN). However, the complete protocol suite deals with a multitude of networking aspects not only for home use, but especially when the technology is deployed to support a diverse range of business needs. [MAC](http://en.wikipedia.org/wiki/Media_access_control)[bridging](http://en.wikipedia.org/wiki/Bridging_(networking)) ([IEEE 802.1D](http://en.wikipedia.org/wiki/IEEE_802.1D)) deals with the routing of Ethernet packets using a [Spanning Tree Protocol](http://en.wikipedia.org/wiki/Spanning_Tree_Protocol), [IEEE 802.1Q](http://en.wikipedia.org/wiki/IEEE_802.1Q) describes [VLANs](http://en.wikipedia.org/wiki/Virtual_LAN), and [IEEE 802.1X](http://en.wikipedia.org/wiki/IEEE_802.1X) defines a port-based [Network Access Control](http://en.wikipedia.org/wiki/Network_Access_Control) protocol, which forms the basis for the authentication mechanisms used in VLANs, but it is also found in WLANs – it is what the home user sees when the user has to enter a "wireless access key".

**Internet Protocol Suite**

The [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite), often also called TCP/IP, is the foundation of all modern internetworking. It offers connection-less as well as connection-oriented services over an inherently unreliable network traversed by datagram transmission at the [Internet protocol](http://en.wikipedia.org/wiki/Internet_protocol) (IP) level. At its core, the protocol suite defines the addressing, identification, and routing specification in form of the traditional[Internet Protocol Version 4](http://en.wikipedia.org/wiki/IPv4) (IPv4) and IPv6, the next generation of the protocol with a much enlarged addressing capability.

**SONET/SDH**

Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH) are standardized [multiplexing](http://en.wikipedia.org/wiki/Multiplexing) protocols that transfer multiple digital bit streams over optical fiber using lasers. They were originally designed to transport circuit mode communications from a variety of different sources, primarily to support real-time, uncompressed, [circuit-switched](http://en.wikipedia.org/wiki/Circuit_switching) voice encoded in [PCM](http://en.wikipedia.org/wiki/Pulse_code_modulation) format. However, due to its protocol neutrality and transport-oriented features, SONET/SDH also was the obvious choice for transporting [Asynchronous Transfer Mode](http://en.wikipedia.org/wiki/Asynchronous_Transfer_Mode) (ATM) frames.

**Asynchronous Transfer Mode**

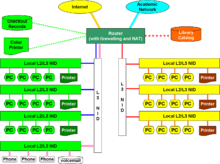
Asynchronous Transfer Mode (ATM) is a switching technique for telecommunication networks. It uses asynchronous [time-division multiplexing](http://en.wikipedia.org/wiki/Time-division_multiplexing) and encodes data into small, fixed-sized [cells](http://en.wikipedia.org/wiki/Cell_relay). This differs from other protocols such as the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite) or [Ethernet](http://en.wikipedia.org/wiki/Ethernet) that use variable sized packets or [frames](http://en.wikipedia.org/wiki/Frame_Relay). ATM has similarity with both [circuit](http://en.wikipedia.org/wiki/Circuit_switching) and [packet](http://en.wikipedia.org/wiki/Packet_switching) switched networking. This makes it a good choice for a network that must handle both traditional high-throughput data traffic, and real-time, [low-latency](http://en.wikipedia.org/wiki/Latency_(engineering)) content such as voice and video. ATM uses a [connection-oriented](http://en.wikipedia.org/wiki/Connection-oriented) model in which a [virtual circuit](http://en.wikipedia.org/wiki/Virtual_circuit) must be established between two endpoints before the actual data exchange begins.

While the role of ATM is diminishing in favor of [next-generation networks](http://en.wikipedia.org/wiki/Next_generation_network), it still plays a role in the [last mile](http://en.wikipedia.org/wiki/Last_mile), which is the connection between an [Internet service provider](http://en.wikipedia.org/wiki/Internet_service_provider) and the home user. For an interesting write-up of the technologies involved, including the deep stacking of communications protocols used, see.[[10]](http://en.wikipedia.org/wiki/Computer_network#cite_note-9)

**Network programming**

[Computer network programming](http://en.wikipedia.org/wiki/Computer_network_programming) involves writing computer programs that communicate with each other across a computer network. Different programs must be written for the [client](http://en.wikipedia.org/wiki/Client_(computing)) process, which initiates the communication, and for the [server](http://en.wikipedia.org/wiki/Server_(computing)) process, which waits for the communication to be initiated. Both endpoints of the communication flow are implemented as [network sockets](http://en.wikipedia.org/wiki/Network_sockets); hence network programming is basically socket programming.

**Scale**

[](http://en.wikipedia.org/wiki/File:NETWORK-Library-LAN.png)Networks are often classified by their physical or organizational extent or their purpose. Usage, trust level, and access rights differ between these types of networks.

**Personal area network**

A [personal area network](http://en.wikipedia.org/wiki/Personal_area_network) (PAN) is a computer network used for communication among computer and different information technological devices close to one person. Some examples of devices that are used in a PAN are personal computers, printers, fax machines, telephones, PDAs, scanners, and even video game consoles. A PAN may include wired and wireless devices. The reach of a PAN typically extends to 10 meters.[[11]](http://en.wikipedia.org/wiki/Computer_network#cite_note-10) A wired PAN is usually constructed with USB and Firewire connections while technologies such as Bluetooth and infrared communication typically form a wireless PAN.

**Local area network**

A [local area network](http://en.wikipedia.org/wiki/Local_area_network) (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node. Current wired LANs are most likely to be based on [Ethernet](http://en.wikipedia.org/wiki/Ethernet) technology, although new standards like [ITU-T](http://en.wikipedia.org/wiki/ITU-T) [G.hn](http://en.wikipedia.org/wiki/G.hn) also provide a way to create a wired LAN using existing home wires (coaxial cables, phone lines and power lines).[[12]](http://en.wikipedia.org/wiki/Computer_network#cite_note-11)

A sample LAN is depicted in the accompanying diagram. All interconnected devices must understand the network layer (layer 3), because they are handling multiple subnets (the different colors). Those inside the library, which have only 10/100 Mbit/s Ethernet connections to the user device and a Gigabit Ethernet connection to the central router, could be called "layer 3 switches" because they only have Ethernet interfaces and must understand [IP](http://en.wikipedia.org/wiki/Internet_Protocol). It would be more correct to call them access routers, where the router at the top is a distribution router that connects to the Internet and academic networks' customer access routers.

The defining characteristics of LANs, in contrast to WANs (Wide Area Networks), include their higher data transfer rates, smaller geographic range, and no need for leased telecommunication lines. Current Ethernet or other [IEEE 802.3](http://en.wikipedia.org/wiki/IEEE_802.3) LAN technologies operate at data transfer rates up to 10 Gbit/s. [IEEE](http://en.wikipedia.org/wiki/IEEE) has projects investigating the standardization of 40 and 100 Gbit/s.[[13]](http://en.wikipedia.org/wiki/Computer_network#cite_note-12) LANs can be connected to Wide area network by using routers.

**Home area network**

A [home area network](http://en.wikipedia.org/wiki/Home_area_network) (HAN) is a residential LAN which is used for communication between digital devices typically deployed in the home, usually a small number of personal computers and accessories, such as printers and mobile computing devices. An important function is the sharing of Internet access, often a broadband service through a cable TV or [Digital Subscriber Line](http://en.wikipedia.org/wiki/Digital_Subscriber_Line) (DSL) provider.

**Storage area network**

A [storage area network](http://en.wikipedia.org/wiki/Storage_area_network) (SAN) is a dedicated network that provides access to consolidated, block level data storage. SANs are primarily used to make storage devices, such as disk arrays, tape libraries, and optical jukeboxes, accessible to servers so that the devices appear like locally attached devices to the operating system. A SAN typically has its own network of storage devices that are generally not accessible through the local area network by other devices. The cost and complexity of SANs dropped in the early 2000s to levels allowing wider adoption across both enterprise and small to medium sized business environments.

**Campus area network**

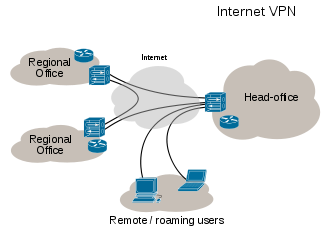
A [campus area network](http://en.wikipedia.org/wiki/Campus_area_network) (CAN) is a computer network made up of an interconnection of LANs within a limited geographical area. The networking equipment (switches, routers) and transmission media (optical fiber, copper plant, [Cat5](http://en.wikipedia.org/wiki/Category_5_cable) cabling etc.) are almost entirely owned (by the campus tenant / owner: an enterprise, university, government etc.).

In the case of a university campus-based campus network, the network is likely to link a variety of campus buildings including, for example, academic colleges or departments, the university library, and student residence halls.

**Backbone network**

A [backbone network](http://en.wikipedia.org/wiki/Backbone_network) is part of a computer network infrastructure that interconnects various pieces of network, providing a path for the exchange of information between different LANs or subnetworks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than that of the networks connected to it.

A large corporation which has many locations may have a backbone network that ties all of these locations together, for example, if a server cluster needs to be accessed by different departments of a company which are located at different geographical locations. The equipment which ties these departments together constitute the network backbone. [Network performance management](http://en.wikipedia.org/wiki/Network_performance_management) including[network congestion](http://en.wikipedia.org/wiki/Network_congestion) are critical parameters taken into account when designing a network backbone.

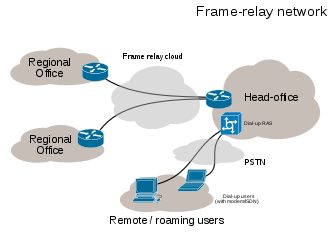
[](http://en.wikipedia.org/wiki/File:Virtual_Private_Network_overview.svg)A specific case of a backbone network is the [Internet backbone](http://en.wikipedia.org/wiki/Internet_backbone), which is the set of wide-area network connections and [core routers](http://en.wikipedia.org/wiki/Core_router) that interconnect all networks connected to the [Internet](http://en.wikipedia.org/wiki/Internet).

**Metropolitan area network**

A [Metropolitan area network](http://en.wikipedia.org/wiki/Metropolitan_area_network) (MAN) is a large computer network that usually spans a city or a large campus.

Sample EPN made of [Frame relay](http://en.wikipedia.org/wiki/Frame_relay) WAN connections and dialup remote access.

**Wide area network**

[](http://en.wikipedia.org/wiki/File:EPN_Frame-Relay_and_Dial-up_Network.svg)A [wide area network](http://en.wikipedia.org/wiki/Wide_area_network) (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves. A WAN often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the [OSI reference model](http://en.wikipedia.org/wiki/OSI_model): the [physical layer](http://en.wikipedia.org/wiki/Physical_layer), the [data link layer](http://en.wikipedia.org/wiki/Data_link_layer), and the [network layer](http://en.wikipedia.org/wiki/Network_layer).

**Enterprise private network**

An [enterprise private network](http://en.wikipedia.org/wiki/Enterprise_private_network) is a network built by an enterprise to interconnect various company sites, e.g., production sites, head offices, remote offices, shops, in order to share computer resources.

**Virtual private network**

A [virtual private network](http://en.wikipedia.org/wiki/Virtual_private_network) (VPN) is a computer network in which some of the links between nodes are carried by open connections or virtual circuits in some larger network (e.g., the Internet) instead of by physical wires. The data link layer protocols of the virtual network are said to be tunneled through the larger network when this is the case. One common application is secure communications through the public Internet, but a VPN need not have explicit security features, such as authentication or content encryption. VPNs, for example, can be used to separate the traffic of different user communities over an underlying network with strong security features.

VPN may have best-effort performance, or may have a defined service level agreement (SLA) between the VPN customer and the VPN service provider. Generally, a VPN has a topology more complex than point-to-point.

**Internetwork**

An [internetwork](http://en.wikipedia.org/wiki/Internetwork) is the connection of multiple computer networks via a common routing technology using routers. The [Internet](http://en.wikipedia.org/wiki/Internet) is an aggregation of many connected internetworks spanning the [Earth](http://en.wikipedia.org/wiki/Earth).

## Asymmetric digital subscriber line

**Asymmetric digital subscriber line** (**ADSL**) is a type of [digital subscriber line](http://en.wikipedia.org/wiki/Digital_subscriber_line) technology, a data communications technology that enables faster data transmission over [copper](http://en.wikipedia.org/wiki/Copper) [telephone lines](http://en.wikipedia.org/wiki/Telephone_line) than a conventional [voiceband](http://en.wikipedia.org/wiki/Voiceband) [modem](http://en.wikipedia.org/wiki/Modem) can provide. It does this by utilizing frequencies that are not used by a voice [telephone call](http://en.wikipedia.org/wiki/Telephone_call).[[1]](http://en.wikipedia.org/wiki/Adsl#cite_note-0) A splitter, or [DSL filter](http://en.wikipedia.org/wiki/DSL_filter), allows a single telephone connection to be used for both ADSL service and voice calls at the same time. ADSL can generally only be distributed over short distances from the [telephone exchange](http://en.wikipedia.org/wiki/Telephone_exchange) (the [last mile](http://en.wikipedia.org/wiki/Last_mile)), typically less than 4 kilometres (2 mi),[[2]](http://en.wikipedia.org/wiki/Adsl#cite_note-1) but has been known to exceed 8 kilometres (5 mi) if the originally laid [wire gauge](http://en.wikipedia.org/wiki/Wire_gauge) allows for further distribution.

At the telephone exchange the line generally terminates at a [digital subscriber line access multiplexer](http://en.wikipedia.org/wiki/Digital_subscriber_line_access_multiplexer) (DSLAM) where another frequency splitter separates the voice band [signal](http://en.wikipedia.org/wiki/Signal_(electronics)) for the conventional [phone network](http://en.wikipedia.org/wiki/Telecommunications_network). Data carried by the ADSL are typically routed over the [telephone company](http://en.wikipedia.org/wiki/Telephone_company)'s data network and eventually reach a conventional [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) network.

**Overview**

ADSL differs from the less common [symmetric digital subscriber line](http://en.wikipedia.org/wiki/Symmetric_digital_subscriber_line) (SDSL) in that [bandwidth](http://en.wikipedia.org/wiki/Bandwidth_(computing)) (and [bit rate](http://en.wikipedia.org/wiki/Bit_rate)) is greater toward the customer premises (known as[downstream](http://en.wikipedia.org/wiki/Downstream_(networking))) than the reverse (known as [upstream](http://en.wikipedia.org/wiki/Upstream_(networking))). This is why it is called asymmetric. Providers usually market ADSL as a service for consumers to provide [Internet access](http://en.wikipedia.org/wiki/Internet_access) in a relatively passive mode: able to use the higher speed direction for the [download](http://en.wikipedia.org/wiki/Download) from the Internet but not needing to run servers that would require high speed in the other direction.

There are both technical and marketing reasons why ADSL is in many places the most common type offered to home users. On the technical side, there is likely to be more [crosstalk](http://en.wikipedia.org/wiki/Crosstalk) from other circuits at the DSLAM end (where the wires from many local loops are close to each other) than at the customer premises. Thus the upload signal is weakest at the noisiest part of the local loop, while the download signal is strongest at the noisiest part of the local loop. It therefore makes technical sense to have the DSLAM transmit at a higher bit rate than does the modem on the customer end. Since the typical home user in fact does prefer a higher download speed, the telephone companies chose to make a virtue out of necessity, hence ADSL. On the marketing side, limiting upload speeds limits the attractiveness of this service to business customers, often causing them to purchase higher cost [leased line](http://en.wikipedia.org/wiki/Leased_line) services instead. In this fashion, it segments the digital communications market between business and home users.

## Integrated Services Digital Network

**Integrated Services Digital Network** (**ISDN**) is a set of communications standards for simultaneous [digital](http://en.wikipedia.org/wiki/Digital) [transmission](http://en.wikipedia.org/wiki/Transmission_(telecommunications)) of voice, video, data, and other network services over the traditional circuits of the [public switched telephone network](http://en.wikipedia.org/wiki/Public_switched_telephone_network). It was first defined in 1988 in the [CCITT](http://en.wikipedia.org/wiki/CCITT) red book.[[1]](http://en.wikipedia.org/wiki/Isdn#cite_note-0) Prior to ISDN, the telephone system was viewed as a way to transport voice, with some special services available for data. The key feature of ISDN is that it integrates speech and data on the same lines, adding features that were not available in the [classic telephone system](http://en.wikipedia.org/wiki/Plain_old_telephone_service). There are several kinds of access interfaces to ISDN defined as [Basic Rate Interface](http://en.wikipedia.org/wiki/Basic_Rate_Interface) (BRI), [Primary Rate Interface](http://en.wikipedia.org/wiki/Primary_Rate_Interface) (PRI) and [Broadband ISDN](http://en.wikipedia.org/wiki/Broadband_ISDN) (B-ISDN).

ISDN is a [circuit-switched](http://en.wikipedia.org/wiki/Circuit_switching) [telephone network](http://en.wikipedia.org/wiki/Telephone_network) system, which also provides access to [packet switched networks](http://en.wikipedia.org/wiki/Packet_switched_network), designed to allow digital transmission of voice and [data](http://en.wikipedia.org/wiki/Data) over ordinary [telephone copper wires](http://en.wikipedia.org/wiki/Twisted_pair), resulting in potentially better voice quality than an analog phone can provide. It offers circuit-switched connections (for either voice or data), and packet-switched connections (for data), in increments of 64 [kilobit](http://en.wikipedia.org/wiki/Kilobit)/s. A major market application for ISDN in some countries is [Internet access](http://en.wikipedia.org/wiki/Internet_access), where ISDN typically provides a maximum of 128 kbit/s in both upstream and downstream directions. [Channel bonding](http://en.wikipedia.org/wiki/Channel_bonding) can achieve a greater data rate; typically the ISDN B-channels of 3 or 4 BRIs (6 to 8 64 kbit/s channels) are bonded.

However, common use reduced ISDN to be limited to Q.931 and related protocols, which are a set of [protocols](http://en.wikipedia.org/wiki/Protocol_(computing)) for [establishing and breaking circuit switched connections](http://en.wikipedia.org/wiki/Signalling_(telecommunications)), and for advanced [calling features](http://en.wikipedia.org/wiki/Calling_feature) for the user. They were introduced in 1986.[[2]](http://en.wikipedia.org/wiki/Isdn#cite_note-1)

In a [videoconference](http://en.wikipedia.org/wiki/Videoconference), ISDN provides simultaneous voice, video, and text transmission between individual desktop videoconferencing systems and group (room) videoconferencing systems.

## Local area network

A **local area network (LAN)** is a [computer network](http://en.wikipedia.org/wiki/Computer_network) that interconnects computers in a limited area such as a home, school, computer laboratory, or office building using network media.[[1]](http://en.wikipedia.org/wiki/Local_area_network#cite_note-0) The defining characteristics of LANs, in contrast to [wide area networks](http://en.wikipedia.org/wiki/Wide_area_network) (WANs), include their usually higher [data-transfer rates](http://en.wikipedia.org/wiki/Bit_rate), smaller geographic area, and lack of a need for [leased telecommunication lines](http://en.wikipedia.org/wiki/Leased_line).

[ARCNET](http://en.wikipedia.org/wiki/ARCNET), [Token Ring](http://en.wikipedia.org/wiki/Token_Ring) and other technology standards have been used in the past, but [Ethernet](http://en.wikipedia.org/wiki/Ethernet) over [twisted pair](http://en.wikipedia.org/wiki/Twisted_pair) cabling, and [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) are the two most common technologies currently used to build LANs.

## Ethernet

**Ethernet** play [/](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English)[ˈiːθərnɛt](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English#Key)[/](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English) is a family of [computer networking](http://en.wikipedia.org/wiki/Computer_network) technologies for [local area networks](http://en.wikipedia.org/wiki/Local_area_network) (LANs). Ethernet was commercially introduced in 1980 and standardized in 1985 as [IEEE 802.3](http://en.wikipedia.org/wiki/IEEE_802.3). Ethernet has largely replaced competing wired LAN technologies.

The [Ethernet standards](http://en.wikipedia.org/wiki/Category:Ethernet_standards) comprise several wiring and signaling variants of the [OSI physical layer](http://en.wikipedia.org/wiki/Physical_layer) in use with Ethernet. The original [10BASE5](http://en.wikipedia.org/wiki/10BASE5) Ethernet used[coaxial cable](http://en.wikipedia.org/wiki/Coaxial_cable) as a [shared medium](http://en.wikipedia.org/wiki/Shared_medium). Later the coaxial cables were replaced by [twisted pair](http://en.wikipedia.org/wiki/Twisted_pair) and [fiber optic](http://en.wikipedia.org/wiki/Optical_fiber) links in conjunction with [hubs](http://en.wikipedia.org/wiki/Ethernet_hub) or [switches](http://en.wikipedia.org/wiki/Ethernet_switch). Data rates were periodically increased from the original 10 megabits per second, to 100 gigabits per second.

Systems communicating over Ethernet divide a stream of data into shorter pieces called [frames](http://en.wikipedia.org/wiki/Frame_(networking)). Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. As per the [OSI model](http://en.wikipedia.org/wiki/OSI_model) Ethernet provides services up to and including the [data link layer](http://en.wikipedia.org/wiki/Data_link_layer).

Since its commercial release, Ethernet has retained a good degree of compatibility. Features such as the 48-bit [MAC address](http://en.wikipedia.org/wiki/MAC_address) and [Ethernet frame](http://en.wikipedia.org/wiki/Ethernet_frame) format have influenced other networking protocols.

## Extranet

An **extranet** is a [computer network](http://en.wikipedia.org/wiki/Computer_network) that allows controlled access from the outside, for specific business or educational purposes. In a [business-to-business](http://en.wikipedia.org/wiki/Business-to-business) context, an extranet can be viewed as an extension of an organization's [intranet](http://en.wikipedia.org/wiki/Intranet) that is extended to users outside the organization, usually partners, vendors, and suppliers, in isolation from all other Internet users. In contrast, [business-to-consumer](http://en.wikipedia.org/wiki/Business-to-consumer) (B2C) models involve known servers of one or more companies, communicating with previously unknown consumer users. An extranet is similar to a [DMZ](http://en.wikipedia.org/wiki/DMZ_(computing)) in that it provides access to needed services for channel partners, without granting access to an organization's entire network.

## Intranet

An **intranet** is a [computer network](http://en.wikipedia.org/wiki/Computer_network) that uses [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) technology to share information, operational systems, or computing services within an organization. The term is used in contrast to*internet*, a network between organizations, and instead refers to a network within an organization. Sometimes, the term refers only to the organization's internal [website](http://en.wikipedia.org/wiki/Website), but may be a more extensive part of the organization's information technology infrastructure, and may be composed of multiple [local area networks](http://en.wikipedia.org/wiki/Local_area_network). The objective is to organise each individual's desktop with minimal cost, time and effort to be more productive, cost efficient, timely and competitive.

An intranet may host multiple private websites and constitute an important component and focal point of internal communication and collaboration. Any of the well known Internet protocols may be found in an intranet, such as [HTTP](http://en.wikipedia.org/wiki/HTTP) (web services), [SMTP](http://en.wikipedia.org/wiki/SMTP) (e-mail), and [FTP](http://en.wikipedia.org/wiki/File_Transfer_Protocol) (file transfer protocol). Internet technologies are often deployed to provide modern interfaces to legacy information systems hosting corporate data.

An intranet can be understood as a private analog of the [Internet](http://en.wikipedia.org/wiki/Internet), or as a private extension of the Internet confined to an organization. The first intranet websites and home pages began to appear in organizations in 1996-1997. Although not officially noted, the term intranet first became common-place among early adopters, such as universities and technology corporations, in 1992.[[*dubious*](http://en.wikipedia.org/wiki/Wikipedia:Disputed_statement)*–*[*discuss*](http://en.wikipedia.org/wiki/Talk:Intranet#Dubious)]

Intranets are sometimes contrasted to [extranets](http://en.wikipedia.org/wiki/Extranet). While intranets are generally restricted to employees of the organization, extranets may also be accessed by customers, suppliers, or other approved parties.[[1]](http://en.wikipedia.org/wiki/Intranet#cite_note-0) Extranets extend a private network onto the Internet with special provisions for authentication, authorization and accounting ([AAA protocol](http://en.wikipedia.org/wiki/AAA_protocol)).

In many organizations, intranets are protected from unauthorized external access by means of a network [gateway](http://en.wikipedia.org/wiki/Gateway_(telecommunications)) and [firewall](http://en.wikipedia.org/wiki/Firewall_(networking)). For smaller companies, intranets may be created simply by using private IP address ranges, such as 192.168.0.0/16. In these cases, the intranet can only be directly accessed from a computer in the local network; however, companies may provide access to off-site employees by using a [virtual private network](http://en.wikipedia.org/wiki/Virtual_private_network), or by other access methods, requiring user [authentication](http://en.wikipedia.org/wiki/Authentication) and [encryption](http://en.wikipedia.org/wiki/Encryption).

## Networking cables

**Networking cables** are used to connect one network device to other or to connect two or more computers to share [printer](http://en.wikipedia.org/wiki/Printer_(computing)), [scanner](http://en.wikipedia.org/wiki/Image_scanner) etc. Different types of network cables like [Coaxial cable](http://en.wikipedia.org/wiki/Coaxial_cable), [Optical fiber cable](http://en.wikipedia.org/wiki/Optical_fiber_cable), [Twisted Pair](http://en.wikipedia.org/wiki/Twisted_Pair) cables are used depending on the network's [topology](http://en.wikipedia.org/wiki/Network_topology), [protocol](http://en.wikipedia.org/wiki/Network_Protocols) and size. The devices can be separated by a few meters (e.g. via [Ethernet](http://en.wikipedia.org/wiki/Ethernet)) or nearly unlimited distances (e.g. via the interconnections of the [Internet](http://en.wikipedia.org/wiki/Internet)).

While [wireless](http://en.wikipedia.org/wiki/Wireless_network) may be the wave of the future, most [computer networks](http://en.wikipedia.org/wiki/Computer_networks) today still utilize cables to transfer signals from one point to another.[[1]](http://en.wikipedia.org/wiki/Network_cable#cite_note-0)

## Twisted pair

*Twisted pair* cabling is a form of wiring in which two conductors (the forward and return conductors of a single [circuit](http://en.wikipedia.org/wiki/Electronic_circuit)) are twisted together for the purposes of canceling out [electromagnetic interference](http://en.wikipedia.org/wiki/Electromagnetic_interference)(EMI) from external sources. This type of cable is used for home and corporate [Ethernet](http://en.wikipedia.org/wiki/Ethernet) networks. Twisted pair cables consist of two insulated copper wires. There are three types of twisted pair cables: Shielded, Unshielded and Foiled.

## Optical fiber cable

An 'optical fiber cable' is a [cable](http://en.wikipedia.org/wiki/Cable) containing one or more [optical fibers](http://en.wikipedia.org/wiki/Optical_fiber). The optical fiber elements are typically individually coated with plastic layers and contained in a protective tube suitable for the environment where the cable will be deployed. It carries light impulses. It is expensive but have higher bandwidth and transmit data over longer distance

## Coaxial cable

Coaxial lines confine the electromagnetic wave to the area inside the cable, between the center conductor and the shield. The transmission of energy in the line occurs totally through the dielectric inside the cable between the conductors. Coaxial lines can therefore be bent and twisted (subject to limits) without negative effects, and they can be strapped to conductive supports without inducing unwanted currents in them.

The most common use for coaxial cables is for television and other signals with bandwidth of multiple megahertz. Although in most homes coaxial cables have been installed for transmission of [TV](http://en.wikipedia.org/wiki/TV)signals, new technologies (such as the [ITU-T](http://en.wikipedia.org/wiki/ITU-T) [G.hn](http://en.wikipedia.org/wiki/G.hn) standard) open the possibility of using home coaxial cable for high-speed [home networking](http://en.wikipedia.org/wiki/Home_network) applications ([Ethernet over coax](http://en.wikipedia.org/wiki/Ethernet_over_coax)).

In the 20th century they carried [long distance network &telephone connections](http://en.wikipedia.org/w/index.php?title=Long_distance_network_%26telephone_connection&action=edit&redlink=1).

## Patch cable

A *patch cable* is an [electrical](http://en.wikipedia.org/wiki/Electric) or [optical](http://en.wikipedia.org/wiki/Optical) cable used to connect one electronic or optical device to another for [signal](http://en.wiktionary.org/wiki/signal) routing. Devices of different types (i.e. a switch connected to a computer, or a switch connected to a router) are connected with patch cords. It is a very fast connection speed. Patch cords are usually produced in many different colors so as to be easily distinguishable,[[2]](http://en.wikipedia.org/wiki/Network_cable#cite_note-1) and are relatively short, perhaps no longer than two metres.

## Ethernet crossover cable

An **Ethernet crossover cable** is a type of [Ethernet cable](http://en.wikipedia.org/wiki/Ethernet_cable) used to connect computing devices together directly where they would normally be connected via a [network switch](http://en.wikipedia.org/wiki/Network_switch), [hub](http://en.wikipedia.org/wiki/Network_hub) or [router](http://en.wikipedia.org/wiki/Router_(computing)), such as directly connecting two [personal computers](http://en.wikipedia.org/wiki/Personal_computer) via their [network](http://en.wikipedia.org/wiki/Computer_networking) adapters. Cross Cable is used to connect the same devices such as pc to pc, hub to hub, switch to switch etc.but i have noticed that a cross over cable can be used to connect two devices of different types, NO COMMENTS for straight cable in this context.

## Router

A **router** is a device that forwards [data packets](http://en.wikipedia.org/wiki/Data_packet) between [computer networks](http://en.wikipedia.org/wiki/Computer_network), creating an overlay [internetwork](http://en.wikipedia.org/wiki/Internetwork). A router is connected to two or more data lines from different networks. When a data packet comes in on one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its [routing table](http://en.wikipedia.org/wiki/Routing_table) or [routing policy](http://en.wikipedia.org/wiki/Routing_policy), it directs the packet to the next network on its journey. Routers perform the "traffic directing" functions on the [Internet](http://en.wikipedia.org/wiki/Internet). A data packet is typically forwarded from one router to another through the networks that constitute the internetwork until it gets to its destination node.[[1]](http://en.wikipedia.org/wiki/Router_(computing)#cite_note-0)

The most familiar type of routers are [home and small office routers](http://en.wikipedia.org/wiki/Home_router) that simply pass data, such as web pages and email, between the home computers and the owner's [cable](http://en.wikipedia.org/wiki/Cable_modem) or [DSL modem](http://en.wikipedia.org/wiki/DSL_modem), which connects to the Internet through an [ISP](http://en.wikipedia.org/wiki/Internet_service_provider). More sophisticated routers, such as enterprise routers, connect large business or ISP networks up to the powerful [core routers](http://en.wikipedia.org/wiki/Core_router) that forward data at high speed along the [optical fiber](http://en.wikipedia.org/wiki/Optical_fiber) lines of the [Internet backbone](http://en.wikipedia.org/wiki/Internet_backbone).

## Wireless

**Wireless** [telecommunications](http://en.wikipedia.org/wiki/Telecommunication) is the transfer of information between two or more points that are not physically connected. Distances can be short, such as a few metres for [television](http://en.wikipedia.org/wiki/Television) remote control, or as far as thousands or even millions of kilometres for deep-space radio communications. It encompasses various types of fixed, mobile, and portable [two-way radios](http://en.wikipedia.org/wiki/Two-way_radio), [cellular telephones](http://en.wikipedia.org/wiki/Mobile_phone), [personal digital assistants](http://en.wikipedia.org/wiki/Personal_digital_assistant) (PDAs), and [wireless networking](http://en.wikipedia.org/wiki/Wireless_network). Other examples of*wireless technology* include [GPS](http://en.wikipedia.org/wiki/Global_Positioning_System) units, [Garage door openers](http://en.wikipedia.org/wiki/Garage_door_opener) or garage doors, wireless [computer mice](http://en.wikipedia.org/wiki/Mouse_(computing)), [keyboards](http://en.wikipedia.org/wiki/Keyboard_(computing)) and [Headset (audio)](http://en.wikipedia.org/wiki/Headset_(audio)), [headphones](http://en.wikipedia.org/wiki/Headphone), [radio receivers](http://en.wikipedia.org/wiki/Radio_receiver), [satellite television](http://en.wikipedia.org/wiki/Satellite_television), [broadcast television](http://en.wikipedia.org/wiki/Broadcast_television) and cordless [telephones](http://en.wikipedia.org/wiki/Telephone).

Introduction

Wireless operations permit services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g. radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g. [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) (RF),acoustic energy, etc.) to transfer information without the use of wires.[[1]](http://en.wikipedia.org/wiki/Wireless#cite_note-FS1037C-0) Information is transferred in this manner over both short and long distances.

Wireless services

Common examples of wireless equipment include:

* Telemetry control and traffic control systems
* Infrared and ultrasonic remote control devices
* Modulated laser light systems for point to point communications
* Professional LMR ([Land Mobile Radio](http://en.wikipedia.org/wiki/Land_Mobile_Radio)) and SMR (Specialized [Mobile Radio](http://en.wikipedia.org/wiki/Mobile_Radio)) typically used by business, industrial and Public Safety entities.
* Consumer [Two way radio](http://en.wikipedia.org/wiki/Two_way_radio) including FRS [Family Radio Service](http://en.wikipedia.org/wiki/Family_Radio_Service), GMRS (General Mobile Radio Service) and Citizens band ("CB") radios.
* The [Amateur Radio](http://en.wikipedia.org/wiki/Amateur_Radio) Service (Ham radio).
* Consumer and professional [Marine VHF radios](http://en.wikipedia.org/wiki/Marine_radio).
* [Airband](http://en.wikipedia.org/wiki/Airband) and [radio navigation](http://en.wikipedia.org/wiki/Radio_navigation) equipment used by [aviators](http://en.wikipedia.org/wiki/Aviator) and [air traffic control](http://en.wikipedia.org/wiki/Air_traffic_control)
* [Cellular telephones](http://en.wikipedia.org/wiki/Cellular_telephone) and pagers: provide connectivity for portable and mobile applications, both personal and business.
* [Global Positioning System](http://en.wikipedia.org/wiki/Global_Positioning_System) (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth.[[2]](http://en.wikipedia.org/wiki/Wireless#cite_note-1)
* Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless using technology such as [Wireless USB](http://en.wikipedia.org/wiki/Wireless_USB) or[Bluetooth](http://en.wikipedia.org/wiki/Bluetooth)
* [Cordless telephone](http://en.wikipedia.org/wiki/Cordless_telephone) sets: these are limited-range devices, not to be confused with cell phones.
* [Satellite television](http://en.wikipedia.org/wiki/Satellite_television): Is broadcast from satellites in [geostationary orbit](http://en.wikipedia.org/wiki/Geostationary_orbit). Typical services use [direct broadcast satellite](http://en.wikipedia.org/wiki/Direct_broadcast_satellite) to provide multiple [television](http://en.wikipedia.org/wiki/Television) channels to viewers.

Wireless networks

[Wireless networking](http://en.wikipedia.org/wiki/Wireless_networking) (i.e. the various types of unlicensed 2.4 GHz WiFi devices) is used to meet many needs. Perhaps the most common use is to connect laptop users who travel from location to location. Another common use is for mobile networks that connect via satellite. A wireless transmission method is a logical choice to network a LAN segment that must frequently change locations. The following situations justify the use of wireless technology:

* To span a distance beyond the capabilities of typical cabling,
* To provide a backup communications link in case of normal network failure,
* To link portable or temporary workstations,
* To overcome situations where normal cabling is difficult or financially impractical, or
* To remotely connect mobile users or networks.

Modes

*Wireless communications* can be via:

* [radio](http://en.wikipedia.org/wiki/Radio) frequency communication,
* [microwave](http://en.wikipedia.org/wiki/Microwave) communication, for example long-range line-of-sight via highly directional antennas, or short-range communication,
* [infrared](http://en.wikipedia.org/wiki/Infrared) (IR) short-range communication, for example from [consumer IR](http://en.wikipedia.org/wiki/Consumer_IR) devices such as [remote controls](http://en.wikipedia.org/wiki/Remote_control) or via [Infrared Data Association](http://en.wikipedia.org/wiki/Infrared_Data_Association) (IrDA).

Applications may involve [point-to-point communication](http://en.wikipedia.org/wiki/Point-to-point_(telecommunications)), [point-to-multipoint communication](http://en.wikipedia.org/wiki/Point-to-multipoint_communication), [broadcasting](http://en.wikipedia.org/wiki/Broadcasting), [cellular networks](http://en.wikipedia.org/wiki/Cellular_network) and other [wireless networks](http://en.wikipedia.org/wiki/Wireless_network).

## Applications of wireless technology

### Mobile telephones

One of the best-known examples of wireless technology is the [mobile phone](http://en.wikipedia.org/wiki/Mobile_phone), also known as a cellular phone, with more than 4.6 billion mobile cellular subscriptions worldwide as of the end of 2010.[[6]](http://en.wikipedia.org/wiki/Wireless#cite_note-5)These wireless phones use radio waves to enable their users to make phone calls from many locations worldwide. They can be used within range of the [mobile telephone site](http://en.wikipedia.org/wiki/Cell_site) used to house the equipment required to transmit and receive the [radio signals](http://en.wikipedia.org/wiki/Radio) from these instruments.

### Wireless data communications

Wireless data communications are an essential component of mobile computing.[[7]](http://en.wikipedia.org/wiki/Wireless#cite_note-TCO_Insights-6) The various available technologies differ in local availability, coverage range and performance,[[8]](http://en.wikipedia.org/wiki/Wireless#cite_note-Geeks-7)[[9]](http://en.wikipedia.org/wiki/Wireless#cite_note-8) and in some circumstances, users must be able to employ multiple connection types and switch between them. To simplify the experience for the user, connection manager software can be used,[[10]](http://en.wikipedia.org/wiki/Wireless#cite_note-9)[[11]](http://en.wikipedia.org/wiki/Wireless#cite_note-10) or a [mobile VPN](http://en.wikipedia.org/wiki/Mobile_virtual_private_network) deployed to handle the multiple connections as a secure, single [virtual network](http://en.wikipedia.org/wiki/Virtual_network).[[12]](http://en.wikipedia.org/wiki/Wireless#cite_note-11) Supporting technologies include:

**Wi-Fi** is a wireless [local area network](http://en.wikipedia.org/wiki/Local_area_network) that enables portable computing devices to connect easily to the [Internet](http://en.wikipedia.org/wiki/Internet).[[13]](http://en.wikipedia.org/wiki/Wireless#cite_note-12) Standardized as [IEEE 802.11](http://en.wikipedia.org/wiki/IEEE_802.11) a,b,g,n, [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) approaches speeds of some types of wired [Ethernet](http://en.wikipedia.org/wiki/Ethernet). Wi-Fi has become the de facto standard for access in private homes, within offices, and at public hotspots.[[14]](http://en.wikipedia.org/wiki/Wireless#cite_note-13) Some businesses charge customers a monthly fee for service, while others have begun offering it for free in an effort to increase the sales of their goods.[[15]](http://en.wikipedia.org/wiki/Wireless#cite_note-14)

**Cellular data service** offers coverage within a range of 10-15 miles from the nearest [cell site](http://en.wikipedia.org/wiki/Cell_site).[[8]](http://en.wikipedia.org/wiki/Wireless#cite_note-Geeks-7) Speeds have increased as technologies have evolved, from earlier technologies such as [GSM](http://en.wikipedia.org/wiki/GSM),[CDMA](http://en.wikipedia.org/wiki/Code_division_multiple_access) and [GPRS](http://en.wikipedia.org/wiki/General_Packet_Radio_Service), to [3G](http://en.wikipedia.org/wiki/3G) networks such as [W-CDMA](http://en.wikipedia.org/wiki/W-CDMA_(UMTS)), [EDGE](http://en.wikipedia.org/wiki/Enhanced_Data_Rates_for_GSM_Evolution) or [CDMA2000](http://en.wikipedia.org/wiki/CDMA2000).[[16]](http://en.wikipedia.org/wiki/Wireless#cite_note-15)[[17]](http://en.wikipedia.org/wiki/Wireless#cite_note-16)

**Mobile Satellite Communications** may be used where other wireless connections are unavailable, such as in largely rural areas[[18]](http://en.wikipedia.org/wiki/Wireless#cite_note-17) or remote locations.[[8]](http://en.wikipedia.org/wiki/Wireless#cite_note-Geeks-7) [Satellite communications](http://en.wikipedia.org/wiki/Communications_satellite) are especially important for [transportation](http://en.wikipedia.org/wiki/Transport), [aviation](http://en.wikipedia.org/wiki/Aviation), [maritime](http://en.wikipedia.org/wiki/Sea) and [military](http://en.wikipedia.org/wiki/Military) use.[[19]](http://en.wikipedia.org/wiki/Wireless#cite_note-18)

### Wireless energy transfer

*Main article:*[*Wireless energy transfer*](http://en.wikipedia.org/wiki/Wireless_energy_transfer)

Wireless energy transfer is a process whereby electrical energy is transmitted from a power source to an electrical load that does not have a built-in power source, without the use of interconnecting wires.

### Computer interface devices

Answering the call of customers frustrated with cord clutter, many manufactures of computer peripherals turned to wireless technology to satisfy their consumer base. Originally these units used bulky, highly limited transceivers to mediate between a computer and a keyboard and mouse, however more recent generations have used small, high quality devices, some even incorporating [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth). These systems have become so ubiquitous that some users have begun complaining about a lack of wired peripherals.[[*who?*](http://en.wikipedia.org/wiki/Wikipedia:Avoid_weasel_words)] Wireless devices tend to have a slightly slower response time than their wired counterparts, however the gap is decreasing. Concerns about the security of wireless keyboards arose at the end of 2007, when it was revealed that Microsoft's implementation of encryption in some of its 27 MHz models was highly insecure.[[20]](http://en.wikipedia.org/wiki/Wireless#cite_note-19)

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## Categories of wireless implementations, devices and standards

* [Radio communication system](http://en.wikipedia.org/wiki/Radio_communication_system)
* [Broadcasting](http://en.wikipedia.org/wiki/Broadcasting)
* [Amateur radio](http://en.wikipedia.org/wiki/Amateur_radio)
* [Land Mobile Radio](http://en.wikipedia.org/wiki/Land_Mobile_Radio_System) or [Professional Mobile Radio](http://en.wikipedia.org/wiki/Professional_Mobile_Radio): [TETRA](http://en.wikipedia.org/wiki/Terrestrial_Trunked_Radio), [P25](http://en.wikipedia.org/wiki/Project_25), [OpenSky](http://en.wikipedia.org/wiki/OpenSky), [EDACS](http://en.wikipedia.org/wiki/EDACS), [DMR](http://en.wikipedia.org/wiki/Digital_Mobile_Radio), [dPMR](http://en.wikipedia.org/wiki/DPMR)
* [Cordless telephony](http://en.wikipedia.org/wiki/Cordless_telephone):DECT ([Digital Enhanced Cordless Telecommunications](http://en.wikipedia.org/wiki/Digital_Enhanced_Cordless_Telecommunications))
* [Cellular networks](http://en.wikipedia.org/wiki/Cellular_network): [0G](http://en.wikipedia.org/wiki/0G), [1G](http://en.wikipedia.org/wiki/1G), [2G](http://en.wikipedia.org/wiki/2G), [3G](http://en.wikipedia.org/wiki/3G), [Beyond 3G (4G)](http://en.wikipedia.org/wiki/4G), Future wireless
* [List of emerging technologies](http://en.wikipedia.org/wiki/List_of_emerging_technologies)
* Short-range point-to-point communication : [Wireless microphones](http://en.wikipedia.org/wiki/Wireless_microphone), [Remote controls](http://en.wikipedia.org/wiki/Remote_control), [IrDA](http://en.wikipedia.org/wiki/Infrared_Data_Association), [RFID (Radio Frequency Identification)](http://en.wikipedia.org/wiki/Radio-frequency_identification), [TransferJet](http://en.wikipedia.org/wiki/TransferJet), [Wireless USB](http://en.wikipedia.org/wiki/Wireless_USB), [DSRC (Dedicated Short Range Communications)](http://en.wikipedia.org/wiki/Dedicated_short-range_communications), [EnOcean](http://en.wikipedia.org/wiki/EnOcean), [Near Field Communication](http://en.wikipedia.org/wiki/Near_Field_Communication)
* [Wireless sensor networks](http://en.wikipedia.org/wiki/Wireless_sensor_network): [ZigBee](http://en.wikipedia.org/wiki/ZigBee), [EnOcean](http://en.wikipedia.org/wiki/EnOcean); [Personal area networks](http://en.wikipedia.org/wiki/Personal_area_network), [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth), [TransferJet](http://en.wikipedia.org/wiki/TransferJet), [Ultra-wideband](http://en.wikipedia.org/wiki/Ultra-wideband) (UWB from [WiMedia Alliance](http://en.wikipedia.org/wiki/WiMedia_Alliance)).
* [Wireless networks](http://en.wikipedia.org/wiki/Wireless_network): [Wireless LAN](http://en.wikipedia.org/wiki/Wireless_LAN) (WLAN), ([IEEE 802.11](http://en.wikipedia.org/wiki/IEEE_802.11) branded as [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) and [HiperLAN](http://en.wikipedia.org/wiki/HiperLAN)), [Wireless Metropolitan Area Networks](http://en.wikipedia.org/w/index.php?title=Wireless_Metropolitan_Area_Network&action=edit&redlink=1) (WMAN) and ([LMDS](http://en.wikipedia.org/wiki/Local_Multipoint_Distribution_Service), [WiMAX](http://en.wikipedia.org/wiki/WiMAX), and [HiperMAN](http://en.wikipedia.org/wiki/HiperMAN))

## WiMAX

**WiMAX** (**Worldwide Interoperability for Microwave Access**) is a [wireless](http://en.wikipedia.org/wiki/Wireless) communications standard designed to provide 30 to 40 megabit-per-second data rates,[[1]](http://en.wikipedia.org/wiki/Wimax#cite_note-0) with the 2011 update providing up to 1 Gbit/s for fixed stations. It is a part of a “fourth generation,” or [4G](http://en.wikipedia.org/wiki/4G), of wireless-communication technology. WiMax far surpasses the 30-metre wireless range of a conventional [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) [local area network](http://en.wikipedia.org/wiki/Local_area_network) (LAN), offering a metropolitan area network with a signal radius of about 50 km. The name "WiMAX" was created by the **WiMAX Forum**, which was formed in June 2001 to promote conformity and interoperability of the standard. The forum describes WiMAX as "a standards-based technology enabling the delivery of [last mile](http://en.wikipedia.org/wiki/Last_mile) wireless broadband access as an alternative to cable and DSL".[[2]](http://en.wikipedia.org/wiki/Wimax#cite_note-1) WiMax offers data-transfer rates that can be superior to conventional [cable-modem](http://en.wikipedia.org/wiki/Cable_broadband) and [DSL](http://en.wikipedia.org/wiki/DSL) connections, however, the bandwidth must be shared among multiple users and thus yields lower speeds in practice.[[3]](http://en.wikipedia.org/wiki/Wimax#cite_note-2)

# V Mobile phone

[](http://en.wikipedia.org/wiki/File:Two_Cell_Phones.png)[Page semi-protected](http://en.wikipedia.org/wiki/Wikipedia:Protection_policy#semi)

A **mobile phone** (also known as a **cellular phone**, **cell phone** and a **hand phone**) is a device that can make and receive [telephone calls](http://en.wikipedia.org/wiki/Telephone_call) over a [radio link](http://en.wikipedia.org/wiki/Radio_Link_Protocol) whilst moving around a wide geographic area. It does so by connecting to a [cellular network](http://en.wikipedia.org/wiki/Cellular_network) provided by a [mobile phone operator](http://en.wikipedia.org/wiki/Mobile_phone_operator), allowing access to the [public telephone network](http://en.wikipedia.org/wiki/PSTN). By contrast, a [cordless telephone](http://en.wikipedia.org/wiki/Cordless_telephone) is used only within the short range of a single, private base station.

In addition to telephony, modern mobile phones also support a wide variety of other [services](http://en.wikipedia.org/wiki/GSM_services) such as [text messaging](http://en.wikipedia.org/wiki/Text_messaging), [MMS](http://en.wikipedia.org/wiki/Multimedia_Messaging_Service), [email](http://en.wikipedia.org/wiki/Email), Internet access, short-range wireless communications ([infrared](http://en.wikipedia.org/wiki/Infrared_port), [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth)), business applications, gaming and photography. Mobile phones that offer these and more general computing capabilities are referred to as [smartphones](http://en.wikipedia.org/wiki/Smartphone).

***Generations of mobile communication standards***

* **3G** or **3rd generation mobile telecommunications** is a generation of standards for [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone) and [mobile telecommunication](http://en.wikipedia.org/wiki/Mobile_telecommunication) services fulfilling the **International Mobile Telecommunications-2000 (IMT-2000)** specifications by the [International Telecommunication Union](http://en.wikipedia.org/wiki/International_Telecommunication_Union).[[1]](http://en.wikipedia.org/wiki/3G_phones#cite_note-0) Application services include wide-area wireless voice [telephone](http://en.wikipedia.org/wiki/Telephone), [mobile Internet](http://en.wikipedia.org/wiki/Mobile_Internet) access, [video calls](http://en.wikipedia.org/wiki/Videotelephony) and [mobile TV](http://en.wikipedia.org/wiki/Multimedia_Broadcast_Multicast_Service), all in a mobile environment.

The following standards are typically branded 3G:

* the [UMTS](http://en.wikipedia.org/wiki/UMTS) system, first offered in 2001, standardized by [3GPP](http://en.wikipedia.org/wiki/3GPP), used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by [GSM](http://en.wikipedia.org/wiki/GSM) [2G](http://en.wikipedia.org/wiki/2G) system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure:
  + The original and most widespread radio interface is called [W-CDMA](http://en.wikipedia.org/wiki/W-CDMA).
  + The [TD-SCDMA](http://en.wikipedia.org/wiki/TD-SCDMA) radio interface was commercialised in 2009 and is only offered in China.
  + The latest UMTS release, [HSPA+](http://en.wikipedia.org/wiki/HSPA%2B), can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink.
* the [CDMA2000](http://en.wikipedia.org/wiki/CDMA2000) system, first offered in 2002, standardized by [3GPP2](http://en.wikipedia.org/wiki/3GPP2), used especially in North America and South Korea, sharing infrastructure with the [IS-95](http://en.wikipedia.org/wiki/IS-95) 2G standard. The cell phones are typically CDMA2000 and IS-95 hybrids. The latest release [EVDO](http://en.wikipedia.org/wiki/EVDO) Rev B offers peak rates of 14.7 Mbit/s downstream.

The above systems and radio interfaces are based on [spread spectrum](http://en.wikipedia.org/wiki/Spread_spectrum) radio transmission technology. While the [GSM EDGE](http://en.wikipedia.org/wiki/Enhanced_Data_Rates_for_GSM_Evolution) standard ("2.9G"), [DECT](http://en.wikipedia.org/wiki/DECT) cordless phones and [Mobile WiMAX](http://en.wikipedia.org/wiki/Mobile_WiMAX) standards formally also fulfill the IMT-2000 requirements and are approved as 3G standards by ITU, these are typically not branded 3G, and are based on completely different technologies.

A new generation of cellular standards has appeared approximately every tenth year since [1G](http://en.wikipedia.org/wiki/1G) systems were introduced in 1981/1982. Each generation is characterized by new frequency bands, higher data rates and non backwards compatible transmission technology. The first release of the [3GPP Long Term Evolution](http://en.wikipedia.org/wiki/3GPP_Long_Term_Evolution) (LTE) standard does not completely fulfill the ITU 4G requirements called IMT-Advanced. First release LTE is not backwards compatible with 3G, but is a pre-4G or [3.9G](http://en.wikipedia.org/wiki/LTE_(telecommunication)) technology, however sometimes branded "4G" by the service providers. Its evolution [LTE Advanced](http://en.wikipedia.org/wiki/LTE_Advanced) is a [4G](http://en.wikipedia.org/wiki/4G)technology. [WiMAX](http://en.wikipedia.org/wiki/WiMAX) is another technology verging on or marketed as [4G](http://en.wikipedia.org/wiki/4G).

**Applications of 3G**

The bandwidth and location information available to 3G devices gives rise to applications not previously available to mobile phone users. Some of the applications are:

* [Mobile TV](http://en.wikipedia.org/wiki/Mobile_TV)
* [Video on demand](http://en.wikipedia.org/wiki/Video_on_demand)
* [Videoconferencing](http://en.wikipedia.org/wiki/Videoconferencing)
* [Telemedicine](http://en.wikipedia.org/wiki/Telemedicine)
* [Location-based services](http://en.wikipedia.org/wiki/Location-based_service)



* In [telecommunications](http://en.wikipedia.org/wiki/Telecommunication), **4G** is the fourth generation of [cell phone](http://en.wikipedia.org/wiki/Cellular_network) [mobile communications](http://en.wikipedia.org/wiki/Mobile_communication) standards. It is a successor of the [third generation](http://en.wikipedia.org/wiki/3G) (3G) standards. A 4G system provides [mobile ultra-broadband](http://en.wikipedia.org/wiki/Mobile_broadband) Internet access, for example to laptops with [USB](http://en.wikipedia.org/wiki/USB) [wireless modems](http://en.wikipedia.org/wiki/Wireless_modem), to [smartphones](http://en.wikipedia.org/wiki/Smartphone), and to other mobile devices. Conceivable applications include amended [mobile web](http://en.wikipedia.org/wiki/Mobile_web) access, [IP telephony](http://en.wikipedia.org/wiki/IP_telephony), gaming services, [high-definition](http://en.wikipedia.org/wiki/HDTV) [mobile TV](http://en.wikipedia.org/wiki/Mobile_TV), video conferencing and [3D television](http://en.wikipedia.org/wiki/3D_television).

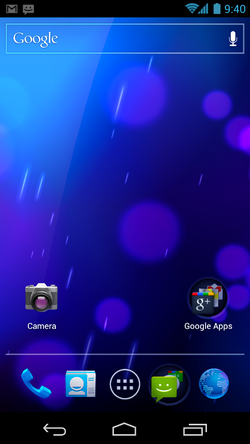
Two 4G candidate systems are commercially deployed: The [Mobile WiMAX](http://en.wikipedia.org/wiki/Mobile_WiMAX) standard (at first in South Korea in 2006), and the first-release [Long term evolution](http://en.wikipedia.org/wiki/Long_term_evolution) (LTE) standard (in Scandinavia since 2009). It has however been debated if these first-release versions should be considered as 4G or not. USB wireless modems have been available since the start, while WiMAX smartphones have been available since 2010, and LTE smartphones since 2011. Equipment made for different continents are not always compatible, because of different frequency bands. Mobile WiMAX and LTE smartphones are currently (April 2012) not available for the European market.

## 

## Smartphones

A **smartphone** is a [mobile phone](http://en.wikipedia.org/wiki/Mobile_phone) built on a [mobile computing](http://en.wikipedia.org/wiki/Mobile_operating_system) platform, with more advanced computing ability and connectivity than a [feature phone](http://en.wikipedia.org/wiki/Feature_phone).[[1]](http://en.wikipedia.org/wiki/Smartphones#cite_note-phonescoop-smartphone-0)[[2]](http://en.wikipedia.org/wiki/Smartphones#cite_note-phonescoop-featurephone-1)[[3]](http://en.wikipedia.org/wiki/Smartphones#cite_note-2) The first smartphones mainly combined the functions of a [personal digital assistant](http://en.wikipedia.org/wiki/Personal_digital_assistant) (PDA) and a mobile phone or [camera phone](http://en.wikipedia.org/wiki/Camera_phone). Today's models also serve to combine the functions of [portable media players](http://en.wikipedia.org/wiki/Portable_media_player), low-end [compact](http://en.wikipedia.org/wiki/Compact_camera) [digital cameras](http://en.wikipedia.org/wiki/Digital_cameras), [pocket video cameras](http://en.wikipedia.org/wiki/Pocket_video_camera), and [GPS](http://en.wikipedia.org/wiki/GPS) navigation units. Modern smartphones typically also include high-resolution [touchscreens](http://en.wikipedia.org/wiki/Touchscreen), [web browsers](http://en.wikipedia.org/wiki/Web_browser) that can access and properly display standard web pages rather than just mobile-optimized sites, and high-speed data access via [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi) and [mobile broadband](http://en.wikipedia.org/wiki/Mobile_broadband). The most common [mobile operating systems](http://en.wikipedia.org/wiki/Mobile_operating_system) (OS) used by modern smartphones include [Google](http://en.wikipedia.org/wiki/Google)'s [Android](http://en.wikipedia.org/wiki/Android_(operating_system)), [Apple's](http://en.wikipedia.org/wiki/Apple_Inc.) [iOS](http://en.wikipedia.org/wiki/IOS), [Nokia](http://en.wikipedia.org/wiki/Nokia)'s [Symbian](http://en.wikipedia.org/wiki/Symbian), [RIM's](http://en.wikipedia.org/wiki/Research_In_Motion) [BlackBerry OS](http://en.wikipedia.org/wiki/BlackBerry_OS), [Samsung](http://en.wikipedia.org/wiki/Samsung)'s [Bada](http://en.wikipedia.org/wiki/Bada), [Microsoft](http://en.wikipedia.org/wiki/Microsoft)'s [Windows Phone](http://en.wikipedia.org/wiki/Windows_Phone), [HP](http://en.wikipedia.org/wiki/HP)'s [webOS](http://en.wikipedia.org/wiki/WebOS), and [embedded Linux](http://en.wikipedia.org/wiki/Embedded_Linux) distributions such as [Maemo](http://en.wikipedia.org/wiki/Maemo) and [MeeGo](http://en.wikipedia.org/wiki/MeeGo). Such operating systems can be installed on many different phone models, and typically each device can receive multiple OS software updates over its lifetime. The distinction between smartphones and feature phones can be vague and there is no official definition for what constitutes the difference between them. One of the most significant differences is that the advanced [application programming interfaces](http://en.wikipedia.org/wiki/Application_programming_interface) (APIs) on smartphones for running third-party applications[[4]](http://en.wikipedia.org/wiki/Smartphones#cite_note-PCmag-3) can allow those applications to have better integration with the phone's OS and hardware than is typical with feature phones. In comparison, feature phones more commonly run on proprietary[firmware](http://en.wikipedia.org/wiki/Firmware), with third-party software support through platforms such as [Java ME](http://en.wikipedia.org/wiki/Java_ME) or [BREW](http://en.wikipedia.org/wiki/Binary_Runtime_Environment_for_Wireless).[[1]](http://en.wikipedia.org/wiki/Smartphones#cite_note-phonescoop-smartphone-0) An additional complication in distinguishing between smartphones and feature phones is that over time the capabilities of new models of feature phones can increase to exceed those of phones that had been promoted as smartphones in the past.

Some manufacturers use the term "superphone" for their high end phones with unusually large screens and other expensive features.[[5]](http://en.wikipedia.org/wiki/Smartphones#cite_note-4)[[6]](http://en.wikipedia.org/wiki/Smartphones#cite_note-5) Other commentators prefer "phablet" in recognition of their convergence with low-end [tablet computers](http://en.wikipedia.org/wiki/Tablet_computer).[[7]](http://en.wikipedia.org/wiki/Smartphones#cite_note-6)[[8]](http://en.wikipedia.org/wiki/Smartphones#cite_note-7)

* ******Android is a [Linux](http://en.wikipedia.org/wiki/Linux)-based [operating system for mobile devices](http://en.wikipedia.org/wiki/Mobile_operating_system) such as [smartphones](http://en.wikipedia.org/wiki/Smartphone) and [tablet computers](http://en.wikipedia.org/wiki/Tablet_computer). It is developed by the [Open Handset Alliance](http://en.wikipedia.org/wiki/Open_Handset_Alliance), led by [Google](http://en.wikipedia.org/wiki/Google), and other companies.[[2]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-philosophy-1)

Google purchased the initial developer of the software, Android Inc., in 2005.[[7]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-AndroidInc-6) The unveiling of the Android distribution in 2007 was announced with the founding of the Open Handset Alliance, a consortium of 86 [hardware](http://en.wikipedia.org/wiki/Computer_hardware), software, and [telecommunication](http://en.wikipedia.org/wiki/Telecommunication) companies devoted to advancing [open standards](http://en.wikipedia.org/wiki/Open_standard) for mobile devices.[[8]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-AndroidAnnouncement-7) Google releases the Android code as [open-source](http://en.wikipedia.org/wiki/Open-source), under the [Apache License](http://en.wikipedia.org/wiki/Apache_License).[[9]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-AndroidOverview-8) The [Android Open Source Project](http://en.wikipedia.org/wiki/Android_Open_Source_Project) (AOSP) is tasked with the maintenance and further development of Android.[[10]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-source.android.com-9)

Android has a large community of developers writing applications ("[apps](http://en.wikipedia.org/wiki/Mobile_apps)") that extend the functionality of the devices. Developers write primarily in a customized version of [Java](http://en.wikipedia.org/wiki/Java_(programming_language)).[[11]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-10) Apps can be downloaded from third-party sites or through online stores such as [Google Play](http://en.wikipedia.org/wiki/Google_Play) (formerly *Android Market*), the app store run by Google. In October 2011, there were more than 500,000 apps available for Android,[[12]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-appstats-500k-11) and the estimated number of applications downloaded from the Android Market as of December 2011 exceeded 10 billion.[[13]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-wired10billion-12)

Android became the world’s leading smartphone platform at the end of 2010.[[14]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-canalysQ42010-13) For the first quarter of 2012, Android had a 59% smartphone market share worldwide, with a 331 million devices installed base and 85 millions activations or 934,000 per day.[[15]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-2012-05-16-snstelecom-14) Analysts points to the advantage for Android to be a multi-channel, multi-carrier OS.[[16]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-15)

Current features and specifications:[[47]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-WhatIsAndroid-46)[[48]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-EnSDK-47)[[49]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-mediaformats-48)

**Handset layouts**

The platform is adaptable to larger, [VGA](http://en.wikipedia.org/wiki/Video_Graphics_Array), [2D graphics](http://en.wikipedia.org/wiki/2D_computer_graphics) library, [3D graphics](http://en.wikipedia.org/wiki/3D_computer_graphics) library based on [OpenGL ES](http://en.wikipedia.org/wiki/OpenGL_ES) 2.0 specifications, and traditional smartphone layouts.

**Storage**

[SQLite](http://en.wikipedia.org/wiki/SQLite), a lightweight [relational database](http://en.wikipedia.org/wiki/Relational_database), is used for [data](http://en.wikipedia.org/wiki/Data) storage purposes.

**Connectivity**

Android supports connectivity technologies including [GSM](http://en.wikipedia.org/wiki/GSM)/[EDGE](http://en.wikipedia.org/wiki/Enhanced_Data_Rates_for_GSM_Evolution), [IDEN](http://en.wikipedia.org/wiki/Integrated_Digital_Enhanced_Network), [CDMA](http://en.wikipedia.org/wiki/Code_division_multiple_access), [EV-DO](http://en.wikipedia.org/wiki/Evolution-Data_Optimized), [UMTS](http://en.wikipedia.org/wiki/Universal_Mobile_Telecommunications_System), [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth), [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi), [LTE](http://en.wikipedia.org/wiki/LTE_Advanced), [NFC](http://en.wikipedia.org/wiki/Near_field_communication) and [WiMAX](http://en.wikipedia.org/wiki/WiMAX).

**Messaging**

[SMS](http://en.wikipedia.org/wiki/SMS) and [MMS](http://en.wikipedia.org/wiki/Multimedia_Messaging_Service) are available forms of messaging, including threaded [text messaging](http://en.wikipedia.org/wiki/Text_messaging) and now [Android Cloud To Device Messaging](http://en.wikipedia.org/wiki/Android_Cloud_To_Device_Messaging) (C2DM) is also a part of Android Push Messaging service.

**Multiple language support**

Android supports multiple languages.[[50]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-gingerbread-highlights-49)

**Web browser**

The web browser available in Android is based on the open-source [WebKit](http://en.wikipedia.org/wiki/WebKit) layout engine, coupled with [Chrome](http://en.wikipedia.org/wiki/Google_Chrome)'s [V8 JavaScript engine](http://en.wikipedia.org/wiki/V8_JavaScript_engine). The browser scores 100/100 on the [Acid3](http://en.wikipedia.org/wiki/Acid3#Mobile_browsers) test on Android 4.0.

**Java support**

While most Android applications are written in [Java](http://en.wikipedia.org/wiki/Java_(programming_language)), there is no [Java Virtual Machine](http://en.wikipedia.org/wiki/Java_Virtual_Machine) in the platform and Java byte code is not executed. Java classes are compiled into Dalvik executables and run on [Dalvik](http://en.wikipedia.org/wiki/Dalvik_virtual_machine), a specialized virtual machine designed specifically for Android and optimized for battery-powered mobile devices with limited memory and CPU. [J2ME](http://en.wikipedia.org/wiki/J2ME) support can be provided via third-party applications.

**Media support**

Android supports the following audio/video/still media formats: [WebM](http://en.wikipedia.org/wiki/WebM), [H.263](http://en.wikipedia.org/wiki/H.263), [H.264](http://en.wikipedia.org/wiki/H.264) (in [3GP](http://en.wikipedia.org/wiki/3GP) or [MP4](http://en.wikipedia.org/wiki/MP4) [container](http://en.wikipedia.org/wiki/Container_format_(digital))), [MPEG-4 SP](http://en.wikipedia.org/wiki/MPEG-4_Part_2), [AMR](http://en.wikipedia.org/wiki/Adaptive_multi-rate_compression), [AMR-WB](http://en.wikipedia.org/wiki/AMR-WB) (in 3GP container), [AAC](http://en.wikipedia.org/wiki/Advanced_Audio_Coding), [HE-AAC](http://en.wikipedia.org/wiki/HE-AAC) (in MP4 or 3GP container), [MP3](http://en.wikipedia.org/wiki/MP3), [MIDI](http://en.wikipedia.org/wiki/Musical_Instrument_Digital_Interface), [Ogg Vorbis](http://en.wikipedia.org/wiki/Vorbis), [FLAC](http://en.wikipedia.org/wiki/Free_Lossless_Audio_Codec), [WAV](http://en.wikipedia.org/wiki/WAV), [JPEG](http://en.wikipedia.org/wiki/JPEG), [PNG](http://en.wikipedia.org/wiki/Portable_Network_Graphics), [GIF](http://en.wikipedia.org/wiki/Graphics_Interchange_Format), [BMP](http://en.wikipedia.org/wiki/BMP_file_format), [WebP](http://en.wikipedia.org/wiki/WebP).[[49]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-mediaformats-48)

**Streaming media support**

RTP/RTSP streaming ([3GPP PSS](http://en.wikipedia.org/w/index.php?title=3GPP_PSS&action=edit&redlink=1), [ISMA](http://en.wikipedia.org/wiki/Internet_Streaming_Media_Alliance)), HTML progressive download ([HTML5 <video> tag](http://en.wikipedia.org/wiki/HTML5_video)). Adobe Flash Streaming (RTMP) and HTTP Dynamic Streaming are supported by the [Flash plugin](http://en.wikipedia.org/wiki/Adobe_Flash_Player#Mobile_platforms).[[51]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-50)Apple HTTP Live Streaming is supported by [RealPlayer for Android](http://en.wikipedia.org/wiki/RealPlayer_for_Android),[[52]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-51) and by the operating system in Android 3.0 (Honeycomb).[[53]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-honeycomb-highlights-52)

**Additional hardware support**

Android can use video/still cameras, [touchscreens](http://en.wikipedia.org/wiki/Touchscreen), [GPS](http://en.wikipedia.org/wiki/Global_Positioning_System), [accelerometers](http://en.wikipedia.org/wiki/Accelerometer), [gyroscopes](http://en.wikipedia.org/wiki/Gyroscope), [barometers](http://en.wikipedia.org/wiki/Barometer), [magnetometers](http://en.wikipedia.org/wiki/Magnetometer), dedicated gaming controls, [proximity](http://en.wikipedia.org/wiki/Proximity_sensor) and [pressure sensors](http://en.wikipedia.org/wiki/Pressure_sensor), [thermometers](http://en.wikipedia.org/wiki/Thermometer), accelerated 2D [bit blits](http://en.wikipedia.org/wiki/Bit_blit) (with hardware orientation, scaling, pixel format conversion) and accelerated 3D graphics.

**Multi-touch**

Android has native support for [multi-touch](http://en.wikipedia.org/wiki/Multi-touch) which was initially made available in handsets such as the [HTC Hero](http://en.wikipedia.org/wiki/HTC_Hero). The feature was originally disabled at the kernel level (possibly to avoid infringing Apple's patents on touch-screen technology at the time).[[54]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-53) Google has since released an update for the [Nexus One](http://en.wikipedia.org/wiki/Nexus_One) and the [Motorola Droid](http://en.wikipedia.org/wiki/Motorola_Droid) which enables multi-touch natively.[[55]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-54)

**Bluetooth**

Supports [A2DP](http://en.wikipedia.org/wiki/A2DP), [AVRCP](http://en.wikipedia.org/wiki/AVRCP), sending files ([OPP](http://en.wikipedia.org/wiki/Object_Push_Profile)), accessing the phone book ([PBAP](http://en.wikipedia.org/wiki/Bluetooth_profile#Phone_Book_Access_Profile_.28PBAP.2C_PBA.29)), voice dialing and sending contacts between phones. Keyboard, mouse and joystick ([HID](http://en.wikipedia.org/wiki/Bluetooth_profile#Human_Interface_Device_Profile_.28HID.29)) support is available in Android 3.1+, and in earlier versions through manufacturer customizations and third-party applications.[[56]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-55)

**Video calling**

Android does not support native video calling, but some handsets have a customized version of the operating system that supports it, either via the [UMTS](http://en.wikipedia.org/wiki/UMTS) network (like the [Samsung Galaxy S](http://en.wikipedia.org/wiki/Samsung_Galaxy_S)) or over IP. Video calling through Google Talk is available in Android 2.3.4 and later. Gingerbread allows [Nexus S](http://en.wikipedia.org/wiki/Nexus_S) to place Internet calls with a SIP account. This allows for enhanced VoIP dialing to other SIP accounts and even phone numbers. Skype 2.1 offers video calling in Android 2.3, including front camera support.

**Multitasking**

Multitasking of applications, with unique handling of memory allocation, is available.[[57]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-56)

**Voice based features**

Google search through voice has been available since initial release.[[58]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-57) Voice actions for calling, texting, navigation, etc. are supported on Android 2.2 onwards.[[59]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-58)

**Tethering**

Android supports [tethering](http://en.wikipedia.org/wiki/Tethering), which allows a phone to be used as a wireless/wired [Wi-Fi hotspot](http://en.wikipedia.org/wiki/Wi-Fi_hotspot). Before Android 2.2 this was supported by third-party applications or manufacturer customizations.[[60]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-59)

**Screen capture**

Android supports capturing a [screenshot](http://en.wikipedia.org/wiki/Screenshot) by pressing the power and volume-down buttons at the same time.[[61]](http://en.wikipedia.org/wiki/Android_(operating_system)#cite_note-60) Prior to Android 4.0, the only methods of capturing a screenshot were through manufacturer and third-party customizations or otherwise by using a PC connection (DDMS developer's tool). These alternative methods are still available with the latest Android.

**External storage**

Most Android devices include microSD slot and can read microSD cards formatted with [FAT32](http://en.wikipedia.org/wiki/FAT32), [Ext3](http://en.wikipedia.org/wiki/Ext3) or [Ext4](http://en.wikipedia.org/wiki/Ext4) file system. To allow use of high-capacity storage media such as [USB flash drives](http://en.wikipedia.org/wiki/USB_flash_drive) and[USB HDDs](http://en.wikipedia.org/wiki/USB_HDD), many Android tablets also include [USB](http://en.wikipedia.org/wiki/USB) 'A' receptacle. Storage formatted with [FAT32](http://en.wikipedia.org/wiki/FAT32) is handled by [Linux Kernel](http://en.wikipedia.org/wiki/Linux_Kernel) VFAT driver, while 3rd party solutions are required to handle other popular file systems such as [NTFS](http://en.wikipedia.org/wiki/NTFS), [HFS Plus](http://en.wikipedia.org/wiki/HFS%2B) and [exFAT](http://en.wikipedia.org/wiki/ExFAT).

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* iOS (originally **iPhone OS**) is a [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system) developed and distributed by [Apple Inc.](http://en.wikipedia.org/wiki/Apple_Inc.)

Originally released in 2007 for the [iPhone](http://en.wikipedia.org/wiki/IPhone) and [iPod Touch](http://en.wikipedia.org/wiki/IPod_Touch), it has been extended to support other Apple devices such as the [iPad](http://en.wikipedia.org/wiki/IPad) and [Apple TV](http://en.wikipedia.org/wiki/Apple_TV). Unlike [Windows CE](http://en.wikipedia.org/wiki/Windows_CE) ([Mobile](http://en.wikipedia.org/wiki/Windows_Mobile) and [Phone](http://en.wikipedia.org/wiki/Windows_Phone)) and [Android](http://en.wikipedia.org/wiki/Android_(operating_system)), Apple does not license iOS for installation on non-Apple hardware. As of June 12, 2012, Apple's [App Store](http://en.wikipedia.org/wiki/App_Store_(iOS)) contained more than 650,000 iOS applications, which have collectively been downloaded more than 30 billion times.[[3]](http://en.wikipedia.org/wiki/IOS#cite_note-WWDC_2012_Keynote-2) It had a 16% share of the [smartphone](http://en.wikipedia.org/wiki/Smartphone) operating system units sold in the last quarter of 2010, behind both [Google](http://en.wikipedia.org/wiki/Google)'s [Android](http://en.wikipedia.org/wiki/Android_(operating_system)) and [Nokia](http://en.wikipedia.org/wiki/Nokia)'s [Symbian](http://en.wikipedia.org/wiki/Symbian).[[4]](http://en.wikipedia.org/wiki/IOS#cite_note-3)[[*dated info*](http://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style/Dates_and_numbers#Precise_language)] In May 2010, in the United States, it accounted for 59% of mobile web data consumption (including use on both the [iPod Touch](http://en.wikipedia.org/wiki/IPod_Touch) and the [iPad](http://en.wikipedia.org/wiki/IPad)).[[5]](http://en.wikipedia.org/wiki/IOS#cite_note-4)[[*dated info*](http://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style/Dates_and_numbers#Precise_language)]

The [user interface](http://en.wikipedia.org/wiki/User_interface) of iOS is based on the concept of [direct manipulation](http://en.wikipedia.org/wiki/Direct_manipulation), using [multi-touch gestures](http://en.wikipedia.org/wiki/Multi-touch_gestures). Interface control elements consist of sliders, switches, and buttons. The response to user input is immediate and provides a fluid interface. Interaction with the OS includes gestures such as *swipe*, *tap*, *pinch*, and*reverse pinch*, all of which have specific definitions within the context of the iOS operating system and its multi-touch interface. Internal [accelerometers](http://en.wikipedia.org/wiki/Accelerometer) are used by some applications to respond to shaking the device (one common result is the undo command) or rotating it in three dimensions (one common result is switching from portrait to landscape mode).

iOS is derived from [OS X](http://en.wikipedia.org/wiki/OS_X), with which it shares the [Darwin](http://en.wikipedia.org/wiki/Darwin_(operating_system)) foundation, and is therefore a [Unix](http://en.wikipedia.org/wiki/Unix) operating system.

******In iOS, there are four [abstraction layers](http://en.wikipedia.org/wiki/Abstraction_layer): the Core OS layer, the [Core Services](http://en.wikipedia.org/wiki/Core_Services) layer, the Media layer, and the [Cocoa Touch](http://en.wikipedia.org/wiki/Cocoa_Touch) layer.

* Symbian is a [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system) (OS) and [computing platform](http://en.wikipedia.org/wiki/Computing_platform) designed for [smartphones](http://en.wikipedia.org/wiki/Smartphone) and currently maintained by [Accenture](http://en.wikipedia.org/wiki/Accenture).[[7]](http://en.wikipedia.org/wiki/Symbian#cite_note-mca-6) The Symbian platform is the successor to [Symbian OS](http://en.wikipedia.org/wiki/History_of_Symbian) and Nokia [Series 60](http://en.wikipedia.org/wiki/S60_(software_platform)); unlike Symbian OS, which needed an additional [user interface](http://en.wikipedia.org/wiki/User_interface) system, Symbian includes a user interface component based on S60 5th Edition.

*Symbian OS* was originally developed by [Symbian Ltd.](http://en.wikipedia.org/wiki/Symbian_Ltd.)[[10]](http://en.wikipedia.org/wiki/Symbian#cite_note-9) It is a descendant of [Psion](http://en.wikipedia.org/wiki/Psion)'s EPOC and runs exclusively on [ARM](http://en.wikipedia.org/wiki/ARM_architecture) [processors](http://en.wikipedia.org/wiki/Central_processing_unit), although an unreleased [x86](http://en.wikipedia.org/wiki/X86) port existed.

On February 11, 2011, Nokia announced that it would migrate from Symbian to [Windows Phone 7](http://en.wikipedia.org/wiki/Windows_Phone_7). Nokia CEO Stephen Elop announced Nokia's first Windows phones at Nokia World 2011: the Lumia 800 and Lumia 710.

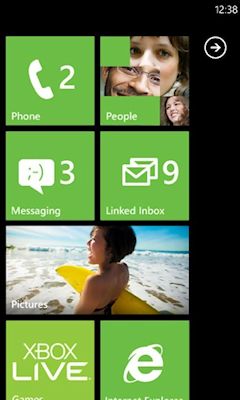
* BlackBerry OS is a proprietary [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system), developed by [Research In Motion](http://en.wikipedia.org/wiki/Research_In_Motion) (RIM) for its [BlackBerry](http://en.wikipedia.org/wiki/BlackBerry) line of [smartphone](http://en.wikipedia.org/wiki/Smartphone) handheld devices. The operating system provides [multitasking](http://en.wikipedia.org/wiki/Computer_multitasking) and supports specialized input devices that have been adopted by RIM for use in its handhelds, particularly the [trackwheel](http://en.wikipedia.org/wiki/Trackwheel), [trackball](http://en.wikipedia.org/wiki/Trackball), and most recently, the [trackpad](http://en.wikipedia.org/wiki/Trackpad) and [touchscreen](http://en.wikipedia.org/wiki/Touchscreen).

The BlackBerry platform is perhaps best known for its native support for corporate email, through [MIDP](http://en.wikipedia.org/wiki/MIDP) 1.0 and, more recently, a subset of MIDP 2.0, which allows complete wireless activation and synchronization with [Microsoft Exchange](http://en.wikipedia.org/wiki/Microsoft_Exchange), [Lotus Domino](http://en.wikipedia.org/wiki/Lotus_Domino), or [Novell GroupWise](http://en.wikipedia.org/wiki/Novell_GroupWise) email, calendar, tasks, notes, and contacts, when used with [BlackBerry Enterprise Server](http://en.wikipedia.org/wiki/BlackBerry_Enterprise_Server). The operating system also supports [WAP](http://en.wikipedia.org/wiki/Wireless_Application_Protocol) 1.2.

Updates to the operating system may be automatically available from wireless carriers that support the BlackBerry over the air software loading (OTASL) service.

* Bada is an [operating system for mobile devices](http://en.wikipedia.org/wiki/Mobile_operating_system) such as [smartphones](http://en.wikipedia.org/wiki/Smartphone) and [tablet computers](http://en.wikipedia.org/wiki/Tablet_computer). It is developed by [Samsung Electronics](http://en.wikipedia.org/wiki/Samsung_Electronics) and it ranges from mid-range to high-end smartphones.[[3]](http://en.wikipedia.org/wiki/Bada#cite_note-badaInfo-2)

To foster adoption of Bada OS, Samsung is reportedly considering releasing the source code under an [open-source](http://en.wikipedia.org/wiki/Open-source) license, and expanding device support to include [Smart TVs](http://en.wikipedia.org/wiki/Smart_TV).[[4]](http://en.wikipedia.org/wiki/Bada#cite_note-3) Samsung has announced it will merge Bada into the [Tizen](http://en.wikipedia.org/wiki/Tizen) project, but it is not confirmed.[[5]](http://en.wikipedia.org/wiki/Bada#cite_note-4)[[6]](http://en.wikipedia.org/wiki/Bada#cite_note-5)

With the release of the Samsung Wave, Samsung opened an international application store, [Samsung Apps](http://en.wikipedia.org/wiki/Samsung_Apps), for the Bada platform.[[15]](http://en.wikipedia.org/wiki/Bada#cite_note-SamsungApps-14) Samsung Apps has over 2400 applications.[[16]](http://en.wikipedia.org/wiki/Bada#cite_note-15)

* Windows Phone is a [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system) developed by [Microsoft](http://en.wikipedia.org/wiki/Microsoft), and is the successor to its [Windows Mobile](http://en.wikipedia.org/wiki/Windows_Mobile) platform,[[1]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-Q.26A-0) although incompatible with it.[[2]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-1) Unlike its predecessor, it is primarily aimed at the consumer market rather than the [enterprise](http://en.wikipedia.org/wiki/Enterprise_software) market.[[3]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-2) It was launched in the second half of 2010, with a release in Asia following in early 2011.[[4]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-3) With Windows Phone, Microsoft created a new user interface, featuring its [design language](http://en.wikipedia.org/wiki/Design_language) called [Metro](http://en.wikipedia.org/wiki/Metro_(design_language)). Additionally, the software is integrated with third party services and Microsoft services, and sets minimum requirements for the hardware on which it runs.[[5]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-4)

***Features***

**User interface**

Windows Phone features a new [user interface](http://en.wikipedia.org/wiki/User_interface), based upon Microsoft's Windows Phone design system, codenamed [Metro](http://en.wikipedia.org/wiki/Metro_Design_Language).[[37]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-36) The home screen, called the "Start screen", is made up of "Live Tiles". Tiles are links to applications, features, functions and individual items (such as contacts, web pages, applications or media items). Users can add, rearrange, or remove Tiles.[[38]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-37) Tiles are dynamic and update in real time – for example, the tile for an email account would display the number of unread messages or a Tile could display a live update of the weather.[[39]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-ReferenceA-38)

Several features of Windows Phone are organized into "**hubs**", which combine local and online content via Windows Phone's integration with popular [social networks](http://en.wikipedia.org/wiki/Social_network_service) such as Facebook, [Windows Live](http://en.wikipedia.org/wiki/Windows_Live), and Twitter.[[39]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-ReferenceA-38)

Windows Phone uses [multi-touch](http://en.wikipedia.org/wiki/Multi-touch) technology.[[39]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-ReferenceA-38) The default Windows Phone user interface has a dark theme that prolongs battery life on [OLED screens](http://en.wikipedia.org/wiki/OLED) as fully black pixels don't emit light.[[40]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-39) The user may choose a light theme instead, and can also choose from several accent colors.[[41]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-40) User interface elements such as tiles are shown in the user's chosen accent color. [Third-party applications](http://en.wikipedia.org/wiki/Third-party_software_component)can be automatically themed with these colors.[[42]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-41)[[43]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-42)

**Text input**

Users input text by using an on-screen [virtual keyboard](http://en.wikipedia.org/wiki/Virtual_keyboard), which has a dedicated key for inserting [emoticons](http://en.wikipedia.org/wiki/Emoticons),[[44]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-windows_phone_preview-43) and features spell checking[[44]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-windows_phone_preview-43) and word prediction.[[45]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-44) App developers (both inhouse and ISV) may specify different versions of the virtual keyboard in order to limit users to certain character sets, such as numeric characters alone. Users may change a word after it has been typed by tapping the word,[[46]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-45) which will invoke a list of similar words. Pressing and holding certain keys will reveal similar characters. The keys are somewhat larger and spaced farther apart when in landscape mode. Phones may also be made with a hardware keyboard for text input.[[47]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-46)

**Messaging**

Windows Phone combined messaging through "threads". Threads allow the Windows Phone user to engage with their contacts through Windows Live Messenger and Facebook Chat as well as traditional text messages. Text message can also be composed through voice recognition. Voice recognition allows speech to be converted to text message and also allows text message to be converted to speech which can be read aloud.

[](http://en.wikipedia.org/wiki/File:Internet_Explorer_Mobile_9.png)**Web browser**

Windows Phone 7.5 features a version of [Internet Explorer Mobile](http://en.wikipedia.org/wiki/Internet_Explorer_Mobile) with a rendering engine that is based on [Internet Explorer 9](http://en.wikipedia.org/wiki/Internet_Explorer_9).[[48]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-redial-47)

Internet Explorer on Windows Phone allows the user to maintain a list of favorite web pages and tiles linking to web pages on the Start screen. The browser supports up to 6 tabs, which can all load in parallel.[[49]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-48) Other features include multi-touch gestures, a streamlined UI, smooth zoom in/out animations, the ability to save pictures that are on web pages, share web pages via email, and support for inline search which allows the user to search for a word or phrase in a web page by typing it.[[50]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-49) Microsoft has announced plans to regularly update the Windows Phone web browser and its layout engine independently from the Windows Phone Update system.[[51]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-50)

In a demo, Microsoft said that users will be able to stream YouTube videos from the browser. Clicking on a video from the mobile YouTube website will launch the video in a standalone app and will also add the YouTube video to the Music + Video Hub.[[52]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-51)

**Contacts**

Contacts are organized via the "**People hub**". Contacts can be manually entered into contacts or imported from Facebook, Windows Live Contacts, Twitter, and LinkedIn. A "What's New" section show news feed and a "Pictures" section show pictures from those social networks made by the contacts. A "Me" section show the phone user's own social networks status and wall, allow the user to update his status, and check-in to Bing and Facebook Places. Contacts can be added to the home screen by pinning them to the start. The contact's "**Live Tile**" displays his social network status and profile picture on the homescreen and the contact's hub displays his Facebook wall as well as all of the rest of his contact information and information from his other social networks.

If a contact has information stored on multiple networks, users can link the two separate contact accounts, allowing the information to be viewed and accessed from a single card.[[53]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-52) As of Windows Phone 7.5, contacts can also be sorted into "Groups". Here, information from each of the contacts is combined into a single page which can be accessed directly from the Hub or pinned to the Start screen.

**Email**

Windows Phone supports [Hotmail](http://en.wikipedia.org/wiki/Hotmail), [Exchange](http://en.wikipedia.org/wiki/Microsoft_Exchange), [Yahoo! Mail](http://en.wikipedia.org/wiki/Yahoo!_Mail), and [Gmail](http://en.wikipedia.org/wiki/Gmail) natively and supports many other services via the [POP](http://en.wikipedia.org/wiki/Post_Office_Protocol) and [IMAP](http://en.wikipedia.org/wiki/Internet_Message_Access_Protocol) protocols. For the native account types, contacts and calendars may be synced as well. Users can also search through their email by searching in the subject, body, senders, and receivers. Emails are shown in threading view and multiple email inboxes can be combined or kept separate.

**Multimedia**

Zune for Windows Phone is a built-in application providing entertainment and synchronization capabilities between PC and Windows Phone.[[54]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-53) The Windows Phone multimedia experience is divided into two distinct hubs, the "Music + Videos" hub and the "Pictures" hub, both of which are similar in appearance and functionality to that of the [Zune HD](http://en.wikipedia.org/wiki/Zune_HD).

The "**Music + Videos hub**" allows the user to access music, videos, and podcasts stored on the device, and links directly to the Windows Phone Marketplace to buy music, or rent it with the [Zune Pass](http://en.wikipedia.org/wiki/Zune_Pass#Zune_Music_Pass) subscription service. When browsing the music by a particular artist, users are able to view artist biographies and photos, provided by the Zune Software.[[44]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-windows_phone_preview-43) This hub integrates with many apps that provide video and music service, including, but not limited to, [iHeartRadio](http://en.wikipedia.org/wiki/IHeartRadio), Youtube, and [Vevo](http://en.wikipedia.org/wiki/Vevo). This hub also includes Smart DJ which compiles a playlist of songs stored on the phone similar to the song or artist selected.

The "**Pictures hub**" displays the user's Facebook and [Windows Live](http://en.wikipedia.org/wiki/Windows_Live) photo albums, as well as photos taken with the phone's built-in camera. Users can also upload photos to social networks, comment on others photos, and tag photos on social networks directly from the Pictures hub.[[44]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-windows_phone_preview-43) Multi-touch gestures permit zooming in and out of photos.

**Media support**

According to Brandon Miniman's test review for pocketnow.com, he stated "*if Zune can play it, your Windows Phone 7 device can play it*" – this refers to the supported playback of files.[[55]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-54) The audio file formats, supported, include WAV, MP3, WMA, AMR, [AAC/MP4/M4A/M4B](http://en.wikipedia.org/wiki/Advanced_Audio_Coding) and [3GP/3G2](http://en.wikipedia.org/wiki/3GP_and_3G2) as standards. The video file formats, supported, include WMV, AVI, MP4/M4V, [3GP/3G2](http://en.wikipedia.org/wiki/3GP_and_3G2) and [MOV (QuickTime)](http://en.wikipedia.org/wiki/.mov) standards. These supported audio and video formats would be dependent on the codecs contained inside them. It has also been previously reported that the [DivX](http://en.wikipedia.org/wiki/DivX) and [Xvid](http://en.wikipedia.org/wiki/Xvid) codecs within AVI are also playable on the system.[[56]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-55)[[57]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-56) Unlike the previous Windows Mobile operating system, there are currently no third-party applications for handling other video formats. The image file formats that are supported include [JPG/JPEG](http://en.wikipedia.org/wiki/JPEG), PNG, GIF, TIF and Bitmap (BMP).[[58]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-57)[[59]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-58)

Custom ringtones were added with Mango. Ringtones must be under 1MB, less than 40 seconds long and the genre marked as Ringtone to appear on the phone, and are either created on the computer or downloaded through apps. Custom ringtones cannot be used for text messages, IMs or emails.

**Games**

Xbox Live on Windows Phone provides some Xbox 360 features on Windows Phone devices by displaying the user's [avatar](http://en.wikipedia.org/wiki/Avatar_(Xbox_360)) in a 3D fashion. Via "**Games hub**", the users are able to interact with the avatar, view gamerscore and leaderboards, message Xbox Live friends, and Spotlight.[[60]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-59) Multiplayer (turn-based) gaming with live multiplayer are also released.[[61]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-60) Microsoft has unveiled more than 50 premium Windows Phone Games titles at [Gamescom](http://en.wikipedia.org/wiki/Gamescom) that makes use of Xbox Live on mobile.[[62]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-61) Xbox Live on Windows Phone currently doesn't offer real-time multiplayer games, but will be added in the future.[[63]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-62) Some key features of Xbox Live on Windows Phone include ability to be signed in simultaneously on the console and phone, send and receive messages between Console and Phone, unlock unique gamer points only available by purchasing the gaming title on the phone, etc.

[](http://en.wikipedia.org/wiki/File:WP7Bing.jpg)**Search**

Microsoft's hardware requirements stipulate that every Windows Phone must have a dedicated Search button on the front of the device that performs different actions.[[39]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-ReferenceA-38)Pressing the search button while an application is open will allow users to search within applications that take advantage of this feature; for example, pressing Search in the People hub will let the users search their contact list for specific people.[[64]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-Slashgear_series-63) This has been changed in Windows Phone 7.5 however – as the search button is reserved for Bing – so applications that previously used this feature (such as the Marketplace) now include soft search buttons.

In other cases, pressing the Search button will allow the user to perform a search of web sites, news, and map locations using the [Bing](http://en.wikipedia.org/wiki/Bing_(search_engine)) application.[[65]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-MaryJo_Will-64)

Windows Phone also has a [voice recognition](http://en.wikipedia.org/wiki/Voice_recognition) function, powered by [TellMe](http://en.wikipedia.org/wiki/Tellme_Networks), which allows the user to perform a Bing search, call contacts or launch applications by speaking. This can be activated by pressing and holding the phone's Start button.

Bing is the default [search engine](http://en.wikipedia.org/wiki/Web_search_engine) on Windows Phone handsets due to its deep integration of functions into the OS (which also include the utilization of its [map service](http://en.wikipedia.org/wiki/Bing_Maps) for location-based searches and queries). However, Microsoft has stated that other search engine applications can be used.[[65]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-MaryJo_Will-64)[[66][66]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-Lint_default-65)

Aside from location-based searches, Bing Maps also provide [turn-by-turn navigation](http://en.wikipedia.org/wiki/Turn-by-turn_navigation) service to Windows Phone user and Local Scout shows interest points such as attractions and restaurants in the nearby area.

Bing Audio allows the user to match a song with its name and Bing Vision allows the user to match barcodes and tags with the product online.

**Office suite**

The "**Office hub**" organizes all Microsoft Office apps and documents. Microsoft Office Mobile provides interoperability between Windows Phone and the desktop version of [Microsoft Office](http://en.wikipedia.org/wiki/Microsoft_Office). Word Mobile, Excel Mobile, PowerPoint Mobile, [OneNote](http://en.wikipedia.org/wiki/OneNote) Mobile, and SharePoint Workspace Mobile allow most Microsoft Office file formats to be viewed and edited directly on a Windows Phone device.

Microsoft Office files from SkyDrive and Office 365, as well as files stored locally on the phone, can be accessed through the Office Hub. Office files are sorted by tiles: Word documents (blue tile), Excel spreadsheets (green tile), PowerPoint presentations (red tile), and OneNote documents (purple tile).

**Multitasking**

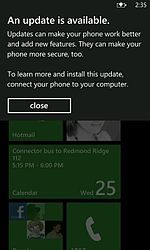
In Windows Phone 7, multitasking is limited to bundled apps. Starting with Windows Phone 7.5, a card-based task switcher can be accessed by pressing and holding the back button. The screenshot of last five open app are shown as cards. Apps can be kept running even when out of view through "Live Agents".[[67]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-66) In other cases, apps are suspended and can be quickly resumed.

**Sync**

Zune Software manages the contents on Windows Phone devices and Windows Phone can wirelessly sync with Zune Software. In addition to accessing on the Windows Phone devices, Zune software can also access the Zune Marketplace to purchase music, videos, and all apps for Windows Phone. While music and videos are both stored locally on the PC and on the phone, apps are only stored on the phone even if purchased from the Zune Software. Zune Software can also be used to update all Windows Phone devices. Although Zune Software is unavailable on [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X) operating system, Microsoft has released Windows Phone Connector which allow Windows Phone devices to sync with iTunes for Mac and iPhoto.[[68]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-67)[[69]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-68)[[70]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-69)

Windows Phone OS doesn't support usual [USB](http://en.wikipedia.org/wiki/USB) sync with [Microsoft Outlook](http://en.wikipedia.org/wiki/Microsoft_Outlook)'s Contacts, Tasks and Notes as opposed to older versions of [Windows Mobile](http://en.wikipedia.org/wiki/Windows_Mobile) with Desktop [ActiveSync](http://en.wikipedia.org/wiki/ActiveSync).[[71]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-70)[[72]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-71) Syncing Contacts and Appointments is done via a [cloud](http://en.wikipedia.org/wiki/Cloud_computing)-based service ([Windows Live](http://en.wikipedia.org/wiki/Windows_Live), [Google](http://en.wikipedia.org/wiki/Google), or [Exchange Server](http://en.wikipedia.org/wiki/Exchange_Server)) only. There's no way to sync this personal information directly from a computer to a Windows Phone and back.[[73]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-72) A petition to Microsoft was filed to reinstate USB sync for Outlook.[[74]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-73)

**Updates**

[](http://en.wikipedia.org/wiki/File:WinPhoneUpdate.jpg)A test notification of an "update available" pop-up in the Windows Phone emulator.

According to Microsoft documentation, software updates will be delivered to Windows Phone users via Microsoft Update, as is the case with other Windows operating systems.[[75]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-74) Microsoft had the intention to directly update any phone running Windows Phone instead of relying on [OEMs](http://en.wikipedia.org/wiki/OEM) or [wireless carriers](http://en.wikipedia.org/wiki/Wireless_carrier),[[76]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-75) but on January 6, 2012, Microsoft changed their policy to let carriers decide if an update will be delivered.[[77]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-76) The software component, called Windows Phone Update, exists both on the phone (for smaller updates, over-the-air) and in the Zune Software for Windows PCs (for larger updates, via [USB](http://en.wikipedia.org/wiki/USB) connection). Users will be notified to attach their phones to a PC if such an update is required.[[78]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-77) Microsoft has said that in the future, all updates, both large and small will eventually support over-the-air downloads.[[79]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-78)

All third-party applications can be updated automatically from the [Windows Phone Marketplace](http://en.wikipedia.org/wiki/Windows_Phone_Marketplace).[[82]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-81)

**Advertising platform**

Microsoft has also launched an advertising platform for the Windows Phone platform. Microsoft's General Manager for Strategy and Business Development, Kostas Mallios, said that Windows Phone will be an "ad-serving machine", pushing advertising and brand-related content to the user. The platform will feature advertising tiles near applications and [toast notifications](http://en.wikipedia.org/wiki/Toast_(computing)), which will bring updating advertising notifications. Mallios said that Windows Phone will be able to "preserve the brand experience by going directly from the web site right to the application", and that Windows Phone "enables advertisers to connect with consumers over time".[[83]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-Newsfactor_Ads-82) Mallios continued: "you're now able to push information as an advertiser, and stay in touch with your customer. It's a dynamic relationship that is created and provides for an ongoing dialog with the consumer."[[84]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-Informationweek_Ads-83)

**Bluetooth**

Windows Phone supports the following [Bluetooth profiles](http://en.wikipedia.org/wiki/Bluetooth_profile):[[85]](http://en.wikipedia.org/wiki/Windows_Phone#cite_note-84)

1. Advanced Audio Distribution Profile (A2DP 1.2)
2. Audio/Video Remote Control Profile (AVRCP 1.3)
3. Hands Free Profile (HFP 1.5)
4. Headset Profile (HSP 1.1)
5. Phone Book Access Profile (PBAP 1.1)

* HP webOS is a [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system) based on a [Linux kernel](http://en.wikipedia.org/wiki/Linux_kernel), initially developed by [Palm](http://en.wikipedia.org/wiki/Palm,_Inc.), which

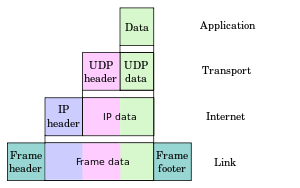
was later acquired by [Hewlett-Packard](http://en.wikipedia.org/wiki/Hewlett-Packard).[[2]](http://en.wikipedia.org/wiki/WebOS#cite_note-1) The official name is *webOS*, uncapitalised,[[3]](http://en.wikipedia.org/wiki/WebOS#cite_note-2) but *WebOS* is also used.

WebOS was introduced by Palm in January 2009. Various versions of webOS have been featured on several devices, including [Pre](http://en.wikipedia.org/wiki/Palm_Pre), [Pixi](http://en.wikipedia.org/wiki/Palm_Pixi), and [Veer](http://en.wikipedia.org/wiki/HP_Veer) phones and the [HP TouchPad](http://en.wikipedia.org/wiki/HP_TouchPad) tablet.

* Embedded Linux is the use of [Linux](http://en.wikipedia.org/wiki/Linux) in [embedded computer](http://en.wikipedia.org/wiki/Embedded_computer) systems such as [mobile phones](http://en.wikipedia.org/wiki/Mobile_phone),

[personal digital assistants](http://en.wikipedia.org/wiki/Personal_digital_assistant), [media players](http://en.wikipedia.org/wiki/Home_theater_PC), [set-top boxes](http://en.wikipedia.org/wiki/Set-top_boxes), and other [consumer electronics](http://en.wikipedia.org/wiki/Consumer_electronic) devices, [networking](http://en.wikipedia.org/wiki/Computer_network) equipment, machine control, [industrial automation](http://en.wikipedia.org/wiki/Industrial_automation), navigation equipment and medical instruments.

# VI Internet

[](http://en.wikipedia.org/wiki/File:UDP_encapsulation.svg)The **Internet** is a global system of interconnected [computer networks](http://en.wikipedia.org/wiki/Computer_network) that use the standard [Internet protocol suite](http://en.wikipedia.org/wiki/Internet_protocol_suite) (often called TCP/IP, although not all applications use TCP) to serve billions of users worldwide. It is a *network of networks* that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies.

The Internet carries an extensive range of information resources and services, such as the inter-linked [hypertext](http://en.wikipedia.org/wiki/Hypertext) documents of the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) (WWW) and the [infrastructure](http://en.wikipedia.org/wiki/Information_infrastructure) to support email.

Most traditional communications media including telephone, music, film, and television are reshaped or redefined by the Internet, giving birth to new services such as [Voice over Internet Protocol](http://en.wikipedia.org/wiki/Voice_over_Internet_Protocol) (VoIP) and [Internet Protocol Television](http://en.wikipedia.org/wiki/Internet_Protocol_Television) (IPTV). Newspaper, book and other print publishing are adapting to [Web site](http://en.wikipedia.org/wiki/Web_site) technology, or are reshaped into [blogging](http://en.wikipedia.org/wiki/Blogging) and [web feeds](http://en.wikipedia.org/wiki/Web_feed). The Internet has enabled and accelerated new forms of human interactions through [instant messaging](http://en.wikipedia.org/wiki/Instant_messaging), Internet forums, and [social networking](http://en.wikipedia.org/wiki/Social_network_service). [Online shopping](http://en.wikipedia.org/wiki/Online_shopping) has boomed both for major retail outlets and small [artisans](http://en.wikipedia.org/wiki/Artisan) and traders. [Business-to-business](http://en.wikipedia.org/wiki/Business-to-business) and [financial services](http://en.wikipedia.org/wiki/Financial_services) on the Internet affect [supply chains](http://en.wikipedia.org/wiki/Supply_chain) across entire industries.

The Internet has no centralized governance in either technological implementation or policies for access and usage; each constituent network sets its own standards. Only the overreaching definitions of the two principal [name spaces](http://en.wikipedia.org/wiki/Name_space) in the Internet, the [Internet Protocol address](http://en.wikipedia.org/wiki/IP_address) space and the [Domain Name System](http://en.wikipedia.org/wiki/Domain_Name_System), are directed by a maintainer organization, the [Internet Corporation for Assigned Names and Numbers](http://en.wikipedia.org/wiki/Internet_Corporation_for_Assigned_Names_and_Numbers) (ICANN). The technical underpinning and standardization of the core protocols ([IPv4](http://en.wikipedia.org/wiki/IPv4) and [IPv6](http://en.wikipedia.org/wiki/IPv6)) is an activity of the [Internet Engineering Task Force](http://en.wikipedia.org/wiki/Internet_Engineering_Task_Force) (IETF), a non-profit organization of loosely affiliated international participants that anyone may associate with by contributing technical expertise.

***Technology***

**Protocols**

As the user data is processed down through the protocol stack, each layer adds an encapsulation at the sending host. Data is transmitted "over the wire" at the link level, left to right. The encapsulation stack procedure is reversed by the receiving host. Intermediate relays remove and add a new link encapsulation for retransmission, and inspect the IP layer for routing purposes.

The communications infrastructure of the Internet consists of its hardware components and a system of software layers that control various aspects of the architecture. While the hardware can often be used to support other software systems, it is the design and the rigorous standardization process of the software architecture that characterizes the Internet and provides the foundation for its scalability and success. The responsibility for the architectural design of the Internet software systems has been delegated to the [Internet Engineering Task Force](http://en.wikipedia.org/wiki/Internet_Engineering_Task_Force)(IETF).[[27]](http://en.wikipedia.org/wiki/Internet#cite_note-26) The IETF conducts standard-setting work groups, open to any individual, about the various aspects of Internet architecture. Resulting discussions and final standards are published in a series of publications, each called a [Request for Comments](http://en.wikipedia.org/wiki/Request_for_Comments) (RFC), freely available on the IETF web site. The principal methods of networking that enable the Internet are contained in specially designated RFCs that constitute the [Internet Standards](http://en.wikipedia.org/wiki/Internet_Standard). Other less rigorous documents are simply informative, experimental, or historical, or document the best current practices (BCP) when implementing Internet technologies.

The Internet standards describe a framework known as the [Internet protocol suite](http://en.wikipedia.org/wiki/Internet_protocol_suite). This is a model architecture that divides methods into a layered system of protocols ([RFC 1122](http://tools.ietf.org/html/rfc1122), [RFC 1123](http://tools.ietf.org/html/rfc1123)). The layers correspond to the environment or scope in which their services operate. At the top is the [application layer](http://en.wikipedia.org/wiki/Application_layer), the space for the application-specific networking methods used in software applications, e.g., a web browser program. Below this top layer, the [transport layer](http://en.wikipedia.org/wiki/Transport_layer) connects applications on *different hosts* via the network (e.g., [client–server model](http://en.wikipedia.org/wiki/Client%E2%80%93server_model)) with appropriate data exchange methods. Underlying these layers are the core networking technologies, consisting of two layers. The [internet layer](http://en.wikipedia.org/wiki/Internet_layer)enables computers to identify and locate each other via [Internet Protocol (IP) addresses](http://en.wikipedia.org/wiki/IP_address), and allows them to connect to one-another via intermediate (transit) networks. Last, at the bottom of the architecture, is a software layer, the [link layer](http://en.wikipedia.org/wiki/Link_layer), that provides connectivity between hosts on the same local network link, such as a local area network ([LAN](http://en.wikipedia.org/wiki/LAN)) or a [dial-up connection](http://en.wikipedia.org/wiki/Dial-up_Internet_access). The model, also known as [TCP/IP](http://en.wikipedia.org/wiki/TCP/IP), is designed to be independent of the underlying hardware, which the model therefore does not concern itself with in any detail. Other models have been developed, such as the [Open Systems Interconnection](http://en.wikipedia.org/wiki/Open_Systems_Interconnection) (OSI) model, but they are not compatible in the details of description or implementation; many similarities exist and the TCP/IP protocols are usually included in the discussion of OSI networking.

The most prominent component of the Internet model is the Internet Protocol (IP), which provides addressing systems ([IP addresses](http://en.wikipedia.org/wiki/IP_address)) for computers on the Internet. IP enables internetworking and in essence establishes the Internet itself. IP Version 4 ([IPv4](http://en.wikipedia.org/wiki/IPv4)) is the initial version used on the first generation of today's Internet and is still in dominant use. It was designed to address up to ~4.3 billion (109) Internet hosts. However, the explosive growth of the Internet has led to [IPv4 address exhaustion](http://en.wikipedia.org/wiki/IPv4_address_exhaustion), which entered its final stage in 2011,[[28]](http://en.wikipedia.org/wiki/Internet#cite_note-27) when the global address allocation pool was exhausted. A new protocol version, IPv6, was developed in the mid-1990s, which provides vastly larger addressing capabilities and more efficient routing of Internet traffic. [IPv6](http://en.wikipedia.org/wiki/IPv6) is currently in growing [deployment](http://en.wikipedia.org/wiki/IPv6_deployment) around the world, since Internet address registries ([RIRs](http://en.wikipedia.org/wiki/Regional_Internet_registry)) began to urge all resource managers to plan rapid adoption and conversion.[[29]](http://en.wikipedia.org/wiki/Internet#cite_note-28)

**Routing**

Internet packet routing is accomplished among various tiers of Internet Service Providers.

[Internet Service Providers](http://en.wikipedia.org/wiki/Internet_Service_Provider) (ISP) connect customers (thought of at the "bottom" of the routing hierarchy) to customers of other ISPs. At the "top" of the routing hierarchy are ten or so [Tier 1 networks](http://en.wikipedia.org/wiki/Tier_1_network), large telecommunication companies which exchange traffic directly "across" to all other Tier 1 networks via unpaid [peering](http://en.wikipedia.org/wiki/Peering) agreements. [Tier 2 networks](http://en.wikipedia.org/wiki/Tier_2_network) buy [Internet transit](http://en.wikipedia.org/wiki/Internet_transit) from other ISP to reach at least some parties on the global Internet, though they may also engage in unpaid peering (especially for local partners of a similar size). ISPs can use a single "upstream" provider for connectivity, or use [multihoming](http://en.wikipedia.org/wiki/Multihoming) to provide protection from problems with individual links. [Internet exchange points](http://en.wikipedia.org/wiki/Internet_exchange_point) create physical connections between multiple ISPs, often hosted in buildings owned by independent third parties.

Computers and routers use [routing tables](http://en.wikipedia.org/wiki/Routing_table) to direct IP packets among locally connected machines. Tables can be constructed manually or automatically via [DHCP](http://en.wikipedia.org/wiki/DHCP) for an individual computer or a [routing protocol](http://en.wikipedia.org/wiki/Routing_protocol) for routers themselves. In single-homed situations, a [default route](http://en.wikipedia.org/wiki/Default_route) usually points "up" toward an ISP providing transit. Higher-level ISPs use the [Border Gateway Protocol](http://en.wikipedia.org/wiki/Border_Gateway_Protocol) to sort out paths to any given [range of IP addresses](http://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing) across the complex connections of the global Internet.

Academic institutions, large companies, governments, and other organizations can perform the same role as ISPs, engaging in peering and purchasing transit on behalf of their internal networks of individual computers. Research networks tend to interconnect into large subnetworks such as [GEANT](http://en.wikipedia.org/wiki/GEANT), [GLORIAD](http://en.wikipedia.org/wiki/GLORIAD), [Internet2](http://en.wikipedia.org/wiki/Internet2), and the UK's [national research and education network](http://en.wikipedia.org/wiki/National_research_and_education_network), [JANET](http://en.wikipedia.org/wiki/JANET). These in turn are built around smaller networks (see the list of [academic computer network organizations](http://en.wikipedia.org/wiki/Category:Academic_computer_network_organizations)).

Not all [computer networks](http://en.wikipedia.org/wiki/Computer_networks) are connected to the Internet. For example, some [classified United States websites](http://en.wikipedia.org/wiki/Classified_United_States_website) are only accessible from separate secure networks.

**General structure**

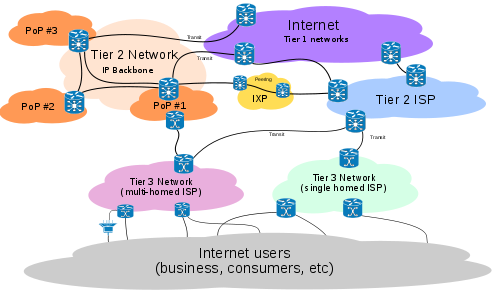
The Internet structure and its usage characteristics have been studied extensively. It has been determined that both the Internet IP routing structure and hypertext links of the World Wide Web are examples of [scale-free networks](http://en.wikipedia.org/wiki/Scale-free_network).[[30]](http://en.wikipedia.org/wiki/Internet#cite_note-29)

Many computer scientists describe the Internet as a "prime example of a large-scale, highly engineered, yet highly complex system".[[31]](http://en.wikipedia.org/wiki/Internet#cite_note-30) The Internet is heterogeneous; for instance, [data transfer rates](http://en.wikipedia.org/wiki/Data_transfer_rate)and physical characteristics of connections vary widely. The Internet exhibits "[emergent phenomena](http://en.wikipedia.org/wiki/Emergence)" that depend on its large-scale organization. For example, data transfer rates exhibit temporal [self-similarity](http://en.wikipedia.org/wiki/Self-similarity). The principles of the routing and addressing methods for traffic in the Internet reach back to their origins in the 1960s when the eventual scale and popularity of the network could not be anticipated. Thus, the possibility of developing alternative structures is investigated.[[32]](http://en.wikipedia.org/wiki/Internet#cite_note-31) The Internet structure was found to be highly robust[[33]](http://en.wikipedia.org/wiki/Internet#cite_note-32) to random failures and very vulnerable to high degree attacks.[[34]](http://en.wikipedia.org/wiki/Internet#cite_note-33)

**Modern uses**

The Internet allows greater flexibility in working hours and location, especially with the spread of unmetered high-speed connections. The Internet can be accessed almost anywhere by numerous means, including through [mobile Internet devices](http://en.wikipedia.org/wiki/Mobile_Internet_device). Mobile phones, [datacards](http://en.wikipedia.org/wiki/Datacard), [handheld game consoles](http://en.wikipedia.org/wiki/Handheld_game_console) and [cellular routers](http://en.wikipedia.org/wiki/Cellular_router) allow users to connect to the Internet [wirelessly](http://en.wikipedia.org/wiki/Wireless). Within the limitations imposed by small screens and other limited facilities of such pocket-sized devices, the services of the Internet, including email and the web, may be available. Service providers may restrict the services offered and mobile data charges may be significantly higher than other access methods.

Educational material at all levels from pre-school to post-doctoral is available from websites. Examples range from [CBeebies](http://en.wikipedia.org/wiki/CBeebies), through school and high-school revision guides, [virtual universities](http://en.wikipedia.org/wiki/Virtual_university), to access to top-end scholarly literature through the likes of [Google Scholar](http://en.wikipedia.org/wiki/Google_Scholar). For [distance education](http://en.wikipedia.org/wiki/Distance_education), help with [homework](http://en.wikipedia.org/wiki/Homework) and other assignments, self-guided learning, whiling away spare time, or just looking up more detail on an interesting fact, it has never been easier for people to access educational information at any level from anywhere. The Internet in general and the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) in particular are important enablers of both [formal](http://en.wikipedia.org/wiki/Education) and [informal education](http://en.wikipedia.org/wiki/Informal_education).

[](http://en.wikipedia.org/wiki/File:Internet_Connectivity_Distribution_&_Core.svg)The low cost and nearly instantaneous sharing of ideas, knowledge, and skills has made [collaborative](http://en.wikipedia.org/wiki/Collaboration) work dramatically easier, with the help of [collaborative software](http://en.wikipedia.org/wiki/Collaborative_software). Not only can a group cheaply communicate and share ideas but the wide reach of the Internet allows such groups more easily to form. An example of this is the [free software movement](http://en.wikipedia.org/wiki/Free_software_movement), which has produced, among other things, [Linux](http://en.wikipedia.org/wiki/Linux), [Mozilla Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox), and [OpenOffice.org](http://en.wikipedia.org/wiki/OpenOffice.org). Internet chat, whether in the form of an [IRC](http://en.wikipedia.org/wiki/IRC) chat room or channel, via an [instant messaging](http://en.wikipedia.org/wiki/Instant_messaging) system, or a [social networking](http://en.wikipedia.org/wiki/Social_networking) website, allows colleagues to stay in touch in a very convenient way when working at their computers during the day. Messages can be exchanged even more quickly and conveniently than via email. These systems may allow files to be exchanged, drawings and images to be shared, or voice and video contact between team members.

[Content management](http://en.wikipedia.org/wiki/Content_management) systems allow collaborating teams to work on shared sets of documents simultaneously without accidentally destroying each other's work. Business and project teams can share calendars as well as documents and other information. Such collaboration occurs in a wide variety of areas including scientific research, software development, conference planning, political activism and creative writing. Social and political collaboration is also becoming more widespread as both Internet access and [computer literacy](http://en.wikipedia.org/wiki/Computer_literacy) spread.

The Internet allows computer users to [remotely access](http://en.wikipedia.org/wiki/Remote_access) other computers and information stores easily, wherever they may be. They may do this with or without [computer security](http://en.wikipedia.org/wiki/Computer_security), i.e. authentication and encryption technologies, depending on the requirements. This is encouraging new ways of working from home, collaboration and information sharing in many industries. An accountant sitting at home can [audit](http://en.wikipedia.org/wiki/Audit) the books of a company based in another country, on a [server](http://en.wikipedia.org/wiki/Server_(computing)) situated in a third country that is remotely maintained by IT specialists in a fourth. These accounts could have been created by home-working bookkeepers, in other remote locations, based on information emailed to them from offices all over the world. Some of these things were possible before the widespread use of the Internet, but the cost of private [leased lines](http://en.wikipedia.org/wiki/Leased_line) would have made many of them infeasible in practice. An office worker away from their desk, perhaps on the other side of the world on a business trip or a holiday, can access their emails, access their data using [cloud computing](http://en.wikipedia.org/wiki/Cloud_computing), or open a [remote desktop](http://en.wikipedia.org/wiki/Remote_Desktop_Protocol) session into their office PC using a secure [Virtual Private Network](http://en.wikipedia.org/wiki/Virtual_Private_Network) (VPN) connection on the Internet. This can give the worker complete access to all of their normal files and data, including email and other applications, while away from the office. This concept has been referred to among [system administrators](http://en.wikipedia.org/wiki/System_administrator) as the Virtual Private Nightmare,[[36]](http://en.wikipedia.org/wiki/Internet#cite_note-35) because it extends the secure perimeter of a corporate network into remote locations and its employees' homes.

**Services**

**Information**

Many people use the terms *Internet* and *World Wide Web*, or just the *Web*, interchangeably, but the two terms are not [synonymous](http://en.wikipedia.org/wiki/Synonymous). The [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) is a global set of [documents](http://en.wikipedia.org/wiki/Documents), [images](http://en.wikipedia.org/wiki/Computer_graphics) and other resources, logically interrelated by [hyperlinks](http://en.wikipedia.org/wiki/Hyperlink) and referenced with [Uniform Resource Identifiers](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier) (URIs). URIs symbolically identify services, [servers](http://en.wikipedia.org/wiki/Web_servers), and other databases, and the documents and resources that they can provide. [Hypertext Transfer Protocol](http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol) (HTTP) is the main access protocol of the World Wide Web, but it is only one of the hundreds of communication protocols used on the Internet. [Web services](http://en.wikipedia.org/wiki/Web_service) also use HTTP to allow software systems to communicate in order to share and exchange business logic and data.

World Wide Web browser software, such as Microsoft's [Internet Explorer](http://en.wikipedia.org/wiki/Internet_Explorer), [Mozilla Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox), [Opera](http://en.wikipedia.org/wiki/Opera_(web_browser)), [Apple](http://en.wikipedia.org/wiki/Apple_Inc.)'s [Safari](http://en.wikipedia.org/wiki/Safari_(web_browser)), and [Google Chrome](http://en.wikipedia.org/wiki/Google_Chrome), lets users navigate from one web page to another via hyperlinks embedded in the documents. These documents may also contain any combination of [computer data](http://en.wikipedia.org/wiki/Computer_data), including graphics, sounds, [text](http://en.wikipedia.org/wiki/Plain_text), [video](http://en.wikipedia.org/wiki/Web_video), [multimedia](http://en.wikipedia.org/wiki/Multimedia) and interactive content that runs while the user is interacting with the page. [Client-side software](http://en.wikipedia.org/wiki/Client-side_scripting) can include animations, [games](http://en.wikipedia.org/wiki/Web_game), [office applications](http://en.wikipedia.org/wiki/Office_applications) and scientific demonstrations. Through [keyword](http://en.wikipedia.org/wiki/Keyword_(Internet_search))-driven [Internet research](http://en.wikipedia.org/wiki/Internet_research) using [search engines](http://en.wikipedia.org/wiki/Web_search_engine) like[Yahoo!](http://en.wikipedia.org/wiki/Yahoo!_Search) and [Google](http://en.wikipedia.org/wiki/Google_(search_engine)), users worldwide have easy, instant access to a vast and diverse amount of online information. Compared to printed media, books, encyclopedias and traditional libraries, the World Wide Web has enabled the decentralization of information on a large scale.

The Web has also enabled individuals and organizations to [publish](http://en.wikipedia.org/wiki/Publish) ideas and information to a potentially large [audience](http://en.wikipedia.org/wiki/Audience) online at greatly reduced expense and time delay. Publishing a web page, a blog, or building a website involves little initial [cost](http://en.wikipedia.org/wiki/Cost) and many cost-free services are available. Publishing and maintaining large, professional web sites with attractive, diverse and up-to-date information is still a difficult and expensive proposition, however. Many individuals and some companies and groups use *web logs* or blogs, which are largely used as easily updatable online diaries. Some commercial organizations encourage [staff](http://en.wikipedia.org/wiki/Employees) to communicate advice in their areas of specialization in the hope that visitors will be impressed by the expert knowledge and free information, and be attracted to the corporation as a result. One example of this practice is [Microsoft](http://en.wikipedia.org/wiki/Microsoft), whose [product developers](http://en.wikipedia.org/wiki/Software_developer) publish their personal blogs in order to pique the public's interest in their work. Collections of personal web pages published by large service providers remain popular, and have become increasingly sophisticated. Whereas operations such as [Angelfire](http://en.wikipedia.org/wiki/Angelfire) and [GeoCities](http://en.wikipedia.org/wiki/GeoCities) have existed since the early days of the Web, newer offerings from, for example, Facebook and Twitter currently have large followings. These operations often brand themselves as [social network services](http://en.wikipedia.org/wiki/Social_network_service) rather than simply as web page hosts.

[Advertising](http://en.wikipedia.org/wiki/Online_advertising) on popular web pages can be lucrative, and [e-commerce](http://en.wikipedia.org/wiki/E-commerce) or the sale of products and services directly via the Web continues to grow.

When the Web began in the 1990s, a typical web page was stored in completed form on a web server, formatted in [HTML](http://en.wikipedia.org/wiki/HTML), ready to be sent to a user's browser in response to a request. Over time, the process of creating and serving web pages has become more automated and more dynamic. Websites are often created using [content management](http://en.wikipedia.org/wiki/Content_management) or [wiki](http://en.wikipedia.org/wiki/Wiki) software with, initially, very little content. Contributors to these systems, who may be paid staff, members of a club or other organization or members of the public, fill underlying databases with content using editing pages designed for that purpose, while casual visitors view and read this content in its final HTML form. There may or may not be editorial, approval and security systems built into the process of taking newly entered content and making it available to the target visitors.

**Communication**

Email is an important communications service available on the Internet. The concept of sending electronic text messages between parties in a way analogous to mailing letters or memos predates the creation of the Internet. Pictures, documents and other files are sent as [email attachments](http://en.wikipedia.org/wiki/Email_attachment). Emails can be [cc-ed](http://en.wikipedia.org/wiki/Carbon_copy) to multiple [email addresses](http://en.wikipedia.org/wiki/Email_address).

[Internet telephony](http://en.wikipedia.org/wiki/Internet_telephony) is another common communications service made possible by the creation of the Internet. [VoIP](http://en.wikipedia.org/wiki/VoIP) stands for Voice-over-[Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol), referring to the protocol that underlies all Internet communication. The idea began in the early 1990s with [walkie-talkie](http://en.wikipedia.org/wiki/Walkie-talkie)-like voice applications for personal computers. In recent years many VoIP systems have become as easy to use and as convenient as a normal telephone. The benefit is that, as the Internet carries the voice traffic, VoIP can be free or cost much less than a traditional telephone call, especially over long distances and especially for those with always-on Internet connections such as [cable](http://en.wikipedia.org/wiki/Cable_modem) or [ADSL](http://en.wikipedia.org/wiki/ADSL). VoIP is maturing into a competitive alternative to traditional telephone service. Interoperability between different providers has improved and the ability to call or receive a call from a traditional telephone is available. Simple, inexpensive VoIP network adapters are available that eliminate the need for a personal computer.

Voice quality can still vary from call to call, but is often equal to and can even exceed that of traditional calls. Remaining problems for VoIP include [emergency telephone number](http://en.wikipedia.org/wiki/Emergency_telephone_number) dialing and reliability. Currently, a few VoIP providers provide an emergency service, but it is not universally available. Traditional phones are line-powered and operate during a power failure; VoIP does not do so without a[backup power source](http://en.wikipedia.org/wiki/Uninterruptible_power_supply) for the phone equipment and the Internet access devices. VoIP has also become increasingly popular for gaming applications, as a form of communication between players. Popular VoIP clients for gaming include [Ventrilo](http://en.wikipedia.org/wiki/Ventrilo) and [Teamspeak](http://en.wikipedia.org/wiki/Teamspeak). [Wii](http://en.wikipedia.org/wiki/Wii), [PlayStation 3](http://en.wikipedia.org/wiki/PlayStation_3), and [Xbox 360](http://en.wikipedia.org/wiki/Xbox_360) also offer VoIP chat features.

**Data transfer**

[File sharing](http://en.wikipedia.org/wiki/File_sharing) is an example of transferring large amounts of data across the Internet. A [computer file](http://en.wikipedia.org/wiki/Computer_file) can be emailed to customers, colleagues and friends as an attachment. It can be uploaded to a website or [FTP](http://en.wikipedia.org/wiki/File_Transfer_Protocol) server for easy download by others. It can be put into a "shared location" or onto a [file server](http://en.wikipedia.org/wiki/File_server) for instant use by colleagues. The load of bulk downloads to many users can be eased by the use of "[mirror](http://en.wikipedia.org/wiki/Mirror_(computing))" servers or [peer-to-peer](http://en.wikipedia.org/wiki/Peer-to-peer) networks. In any of these cases, access to the file may be controlled by user [authentication](http://en.wikipedia.org/wiki/Authentication), the transit of the file over the Internet may be obscured by[encryption](http://en.wikipedia.org/wiki/Encryption), and money may change hands for access to the file. The price can be paid by the remote charging of funds from, for example, a credit card whose details are also passed – usually fully encrypted – across the Internet. The origin and authenticity of the file received may be checked by [digital signatures](http://en.wikipedia.org/wiki/Digital_signature) or by [MD5](http://en.wikipedia.org/wiki/MD5) or other message digests. These simple features of the Internet, over a worldwide basis, are changing the production, sale, and distribution of anything that can be reduced to a computer file for transmission. This includes all manner of print publications, software products, news, music, film, video, photography, graphics and the other arts. This in turn has caused seismic shifts in each of the existing industries that previously controlled the production and distribution of these products.

[Streaming media](http://en.wikipedia.org/wiki/Streaming_media) is the real-time delivery of digital media for the immediate consumption or enjoyment by end users. Many radio and television broadcasters provide Internet feeds of their live audio and video productions. They may also allow time-shift viewing or listening such as Preview, Classic Clips and Listen Again features. These providers have been joined by a range of pure Internet "broadcasters" who never had on-air licenses. This means that an Internet-connected device, such as a computer or something more specific, can be used to access on-line media in much the same way as was previously possible only with a television or radio receiver. The range of available types of content is much wider, from specialized technical [webcasts](http://en.wikipedia.org/wiki/Webcast) to on-demand popular multimedia services. [Podcasting](http://en.wikipedia.org/wiki/Podcast) is a variation on this theme, where – usually audio – material is downloaded and played back on a computer or shifted to a [portable media player](http://en.wikipedia.org/wiki/Portable_media_player) to be listened to on the move. These techniques using simple equipment allow anybody, with little censorship or licensing control, to broadcast audio-visual material worldwide.

[Webcams](http://en.wikipedia.org/wiki/Webcam) are a low-cost extension of this phenomenon. While some webcams can give full-frame-rate video, the picture either is usually small or updates slowly. Internet users can watch animals around an African waterhole, ships in the [Panama Canal](http://en.wikipedia.org/wiki/Panama_Canal), traffic at a local roundabout or monitor their own premises, live and in real time. Video [chat rooms](http://en.wikipedia.org/wiki/Chat_rooms) and [video conferencing](http://en.wikipedia.org/wiki/Video_conferencing) are also popular with many uses being found for personal webcams, with and without two-way sound. YouTube was founded on 15 February 2005 and is now the leading website for free streaming video with a vast number of users. It uses a [flash](http://en.wikipedia.org/wiki/Adobe_Flash)-based web player to stream and show video files. Registered users may upload an unlimited amount of video and build their own personal profile. YouTube claims that its users watch hundreds of millions, and upload hundreds of thousands of videos daily.[[38]](http://en.wikipedia.org/wiki/Internet#cite_note-37)

## Access

Common methods of [Internet access](http://en.wikipedia.org/wiki/Internet_access) in homes include dial-up, landline [broadband](http://en.wikipedia.org/wiki/Broadband_Internet_access) (over [coaxial cable](http://en.wikipedia.org/wiki/Coaxial_cable), [fiber optic](http://en.wikipedia.org/wiki/Fiber_optic) or copper wires), [Wi-Fi](http://en.wikipedia.org/wiki/Wi-Fi), [satellite](http://en.wikipedia.org/wiki/Satellite_Internet) and [3G](http://en.wikipedia.org/wiki/3G)/[4G](http://en.wikipedia.org/wiki/4G) technology [cell phones](http://en.wikipedia.org/wiki/Mobile_phone). Public places to use the Internet include libraries and [Internet cafes](http://en.wikipedia.org/wiki/Internet_cafe), where computers with Internet connections are available. There are also [Internet access points](http://en.wikipedia.org/wiki/Internet_kiosk) in many public places such as airport halls and coffee shops, in some cases just for brief use while standing. Various terms are used, such as "public Internet kiosk", "public access terminal", and "Web [payphone](http://en.wikipedia.org/wiki/Payphone)". Many hotels now also have public terminals, though these are usually fee-based. These terminals are widely accessed for various usage like ticket booking, bank deposit, online payment etc. Wi-Fi provides wireless access to computer networks, and therefore can do so to the Internet itself. [Hotspots](http://en.wikipedia.org/wiki/Hotspot_(Wi-Fi)) providing such access include [Wi-Fi cafes](http://en.wikipedia.org/wiki/Wi-Fi#Internet_access), where would-be users need to bring their own wireless-enabled devices such as a laptop or [PDA](http://en.wikipedia.org/wiki/Personal_Digital_Assistant). These services may be free to all, free to customers only, or fee-based. A hotspot need not be limited to a confined location. A whole campus or park, or even an entire city can be enabled.

[Grassroots](http://en.wikipedia.org/wiki/Grassroots) efforts have led to [wireless community networks](http://en.wikipedia.org/wiki/Wireless_community_network). Commercial Wi-Fi services covering large city areas are in place in London, [Vienna](http://en.wikipedia.org/wiki/Vienna), [Toronto](http://en.wikipedia.org/wiki/Toronto), San Francisco, [Philadelphia](http://en.wikipedia.org/wiki/Philadelphia), Chicago and[Pittsburgh](http://en.wikipedia.org/wiki/Pittsburgh). The Internet can then be accessed from such places as a park bench.[[39]](http://en.wikipedia.org/wiki/Internet#cite_note-38) Apart from Wi-Fi, there have been experiments with proprietary mobile wireless networks like [Ricochet](http://en.wikipedia.org/wiki/Ricochet_(Internet_service)), various high-speed data services over cellular phone networks, and fixed wireless services. High-end mobile phones such as [smartphones](http://en.wikipedia.org/wiki/Smartphone) in general come with Internet access through the phone network. Web browsers such as [Opera](http://en.wikipedia.org/wiki/Opera_(web_browser)) are available on these advanced handsets, which can also run a wide variety of other Internet software. More mobile phones have Internet access than PCs, though this is not as widely used.[[40]](http://en.wikipedia.org/wiki/Internet#cite_note-39) An Internet access provider and protocol matrix differentiates the methods used to get online.

## Social impact

The Internet has enabled entirely new forms of social interaction, activities, and organizing, thanks to its basic features such as widespread usability and access. In the first decade of the 21st century, the first generation is raised with widespread availability of Internet connectivity, bringing consequences and concerns in areas such as personal privacy and identity, and distribution of copyrighted materials. These "[digital natives](http://en.wikipedia.org/wiki/Digital_natives)" face a variety of challenges that were not present for prior generations.

**Social networking and entertainment**

Many people use the World Wide Web to access news, weather and sports reports, to plan and book vacations and to find out more about their interests. People use [chat](http://en.wikipedia.org/wiki/Online_chat), messaging and email to make and stay in touch with friends worldwide, sometimes in the same way as some previously had [pen pals](http://en.wikipedia.org/wiki/Pen_pal). The Internet has seen a growing number of [Web desktops](http://en.wikipedia.org/wiki/Web_desktop), where users can access their files and settings via the Internet.

[Social networking](http://en.wikipedia.org/wiki/Social_network_service) websites such as Facebook, Twitter, and MySpace have created new ways to socialize and interact. Users of these sites are able to add a wide variety of information to pages, to pursue common interests, and to connect with others. It is also possible to find existing acquaintances, to allow communication among existing groups of people. Sites like [LinkedIn](http://en.wikipedia.org/wiki/LinkedIn)foster commercial and business connections. YouTube and [Flickr](http://en.wikipedia.org/wiki/Flickr) specialize in users' videos and photographs.

The Internet has been a major outlet for leisure activity since its inception, with entertaining social experiments such as [MUDs](http://en.wikipedia.org/wiki/MUD)and [MOOs](http://en.wikipedia.org/wiki/MOO) being conducted on university servers, and humor-related [Usenet](http://en.wikipedia.org/wiki/Usenet) groups receiving much traffic. Today, many[Internet forums](http://en.wikipedia.org/wiki/Internet_forums) have sections devoted to games and funny videos; short cartoons in the form of [Flash movies](http://en.wikipedia.org/wiki/Flash_animation) are also popular. Over 6 million people use blogs or message boards as a means of communication and for the sharing of ideas. The pornography and gambling industries have taken advantage of the World Wide Web, and often provide a significant source of advertising revenue for other websites.[[55]](http://en.wikipedia.org/wiki/Internet#cite_note-54) Although many governments have attempted to restrict both industries' use of the Internet, in general this has failed to stop their widespread popularity.[[56]](http://en.wikipedia.org/wiki/Internet#cite_note-55)

Another area of leisure activity on the Internet is [multiplayer gaming](http://en.wikipedia.org/wiki/Multiplayer_gaming).[[57]](http://en.wikipedia.org/wiki/Internet#cite_note-56) This form of recreation creates communities, where people of all ages and origins enjoy the fast-paced world of multiplayer games. These range from [MMORPG](http://en.wikipedia.org/wiki/MMORPG) to [first-person shooters](http://en.wikipedia.org/wiki/First-person_shooter), from [role-playing video games](http://en.wikipedia.org/wiki/Role-playing_video_game) to [online gambling](http://en.wikipedia.org/wiki/Online_gambling). While online gaming has been around since the 1970s, modern modes of online gaming began with subscription services such as [GameSpy](http://en.wikipedia.org/wiki/GameSpy_Arcade) and [MPlayer](http://en.wikipedia.org/wiki/MPlayer.com).[[58]](http://en.wikipedia.org/wiki/Internet#cite_note-57) Non-subscribers were limited to certain types of game play or certain games. Many people use the Internet to access and download music, movies and other works for their enjoyment and relaxation. Free and fee-based services exist for all of these activities, using centralized servers and distributed peer-to-peer technologies. Some of these sources exercise more care with respect to the original artists' copyrights than others.

Internet usage has been correlated to users' loneliness.[[59]](http://en.wikipedia.org/wiki/Internet#cite_note-58) Lonely people tend to use the Internet as an outlet for their feelings and to share their stories with others, such as in the "[I am lonely will anyone speak to me](http://en.wikipedia.org/wiki/I_am_lonely_will_anyone_speak_to_me)" thread.

[Cybersectarianism](http://en.wikipedia.org/wiki/Cybersectarianism) is a new organizational form which involves: "highly dispersed small groups of practitioners that may remain largely anonymous within the larger social context and operate in relative secrecy, while still linked remotely to a larger network of believers who share a set of practices and texts, and often a common devotion to a particular leader. Overseas supporters provide funding and support; domestic practitioners distribute tracts, participate in acts of resistance, and share information on the internal situation with outsiders. Collectively, members and practitioners of such sects construct viable virtual communities of faith, exchanging personal testimonies and engaging in collective study via email, on-line chat rooms and web-based message boards."[[60]](http://en.wikipedia.org/wiki/Internet#cite_note-59)

[Cyberslacking](http://en.wikipedia.org/wiki/Cyberslacking) can become a drain on corporate resources; the average UK employee spent 57 minutes a day surfing the Web while at work, according to a 2003 study by Peninsula Business Services.[[61]](http://en.wikipedia.org/wiki/Internet#cite_note-60) [Internet addiction disorder](http://en.wikipedia.org/wiki/Internet_addiction_disorder) is excessive computer use that interferes with daily life. Psychologist Nicolas Carr believe that Internet use has other [effects on individuals](http://en.wikipedia.org/wiki/How_internet_use_affects_humans), for instance improving skills of scan-reading and interfering with the deep thinking that leads to true creativity.[[62]](http://en.wikipedia.org/wiki/Internet#cite_note-61)

**Censorship**

Some governments, such as those of [Iran](http://en.wikipedia.org/wiki/Iran), North Korea, [Burma](http://en.wikipedia.org/wiki/Burma), the People's Republic of China, and [Saudi Arabia](http://en.wikipedia.org/wiki/Saudi_Arabia), restrict what people in their countries can access on the Internet, especially political and religious content. This is accomplished through software that filters domains and content so that they may not be easily accessed or obtained without elaborate circumvention.[[70]](http://en.wikipedia.org/wiki/Internet#cite_note-69)

In Norway, Denmark, Finland, and Sweden, major Internet service providers have voluntarily, possibly to avoid such an arrangement being turned into law, agreed to restrict access to sites listed by authorities. While this list of forbidden URLs is supposed to contain addresses of only known child pornography sites, the content of the list is secret.[[71]](http://en.wikipedia.org/wiki/Internet#cite_note-The_Register-70) Many countries, including the United States, have enacted laws against the possession or distribution of certain material, such as [child pornography](http://en.wikipedia.org/wiki/Child_pornography), via the Internet, but do not mandate filtering software. There are many free and commercially available software programs, called [content-control software](http://en.wikipedia.org/wiki/Content-control_software), with which a user can choose to block offensive websites on individual computers or networks, in order to limit a child's access to pornographic materials or depiction of violence.

## Internet protocol suite (TCP/IP)

The **Internet protocol suite** is the set of [communications protocols](http://en.wikipedia.org/wiki/Communications_protocol) used for the [Internet](http://en.wikipedia.org/wiki/Internet) and similar networks, and generally the most popular [protocol stack](http://en.wikipedia.org/wiki/Protocol_stack) for [wide area networks](http://en.wikipedia.org/wiki/Wide_area_network). It is commonly known as **TCP/IP**, because of its most important protocols: [Transmission Control Protocol](http://en.wikipedia.org/wiki/Transmission_Control_Protocol) (TCP) and [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) (IP), which were the first networking protocols defined in this standard. It is occasionally known as the **DoD model** due to the foundational influence of the [ARPANET](http://en.wikipedia.org/wiki/ARPANET) in the 1970s (operated by [DARPA](http://en.wikipedia.org/wiki/DARPA), an agency of the [United States Department of Defense](http://en.wikipedia.org/wiki/United_States_Department_of_Defense)).

TCP/IP provides end-to-end connectivity specifying how data should be formatted, addressed, transmitted, [routed](http://en.wikipedia.org/wiki/Routing) and received at the destination. It has four abstraction layers, each with its own protocols.[[1]](http://en.wikipedia.org/wiki/TCP/IP#cite_note-0)[[2]](http://en.wikipedia.org/wiki/TCP/IP#cite_note-1) From lowest to highest, the layers are:

1. The [link layer](http://en.wikipedia.org/wiki/Link_layer) (commonly [Ethernet](http://en.wikipedia.org/wiki/Ethernet)) contains communication technologies for a [local network](http://en.wikipedia.org/wiki/Local_area_network).
2. The [internet layer](http://en.wikipedia.org/wiki/Internet_layer) (IP) connects local networks, thus establishing [internetworking](http://en.wikipedia.org/wiki/Internetworking).
3. The [transport layer](http://en.wikipedia.org/wiki/Transport_layer) (TCP) handles host-to-host communication.
4. The [application layer](http://en.wikipedia.org/wiki/Application_layer) (for example [HTTP](http://en.wikipedia.org/wiki/HTTP)) contains all protocols for specific data communications services on a process-to-process level (for example how a web browser communicates with a web server).

The TCP/IP model and related protocols are maintained by the [Internet Engineering Task Force](http://en.wikipedia.org/wiki/Internet_Engineering_Task_Force) (IETF).

## Transmission Control Protocol (TCP)

The Transmission Control Protocol (TCP) is one of the core [protocols](http://en.wikipedia.org/wiki/Communications_protocol) of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite). TCP is one of the two original components of the suite, complementing the [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) (IP), and therefore the entire suite is commonly referred to as TCP/IP. TCP provides reliable, ordered delivery of a stream of bytes from a program on one computer to another program on another computer. TCP is the protocol used by major Internet applications such as the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web), [email](http://en.wikipedia.org/wiki/Email), [remote administration](http://en.wikipedia.org/wiki/Remote_administration) and [file transfer](http://en.wikipedia.org/wiki/File_transfer). Other applications, which do not require reliable data stream service, may use the [User Datagram Protocol](http://en.wikipedia.org/wiki/User_Datagram_Protocol) (UDP), which provides a [datagram](http://en.wikipedia.org/wiki/Datagram) service that emphasizes reduced [latency](http://en.wikipedia.org/wiki/Latency_(engineering)) over reliability.

## Internet Protocol (IP)

The **Internet Protocol** (**IP**) is the principal [communications protocol](http://en.wikipedia.org/wiki/Communications_protocol) used for relaying [datagrams](http://en.wikipedia.org/wiki/Datagram) (also known as [network packets](http://en.wikipedia.org/wiki/Network_packet)) across an [internetwork](http://en.wikipedia.org/wiki/Internetwork) using the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite). Responsible for [routing](http://en.wikipedia.org/wiki/Routing) packets across network boundaries, it is the primary protocol that establishes the [Internet](http://en.wikipedia.org/wiki/Internet).

IP is the primary protocol in the [Internet Layer](http://en.wikipedia.org/wiki/Internet_Layer) of the Internet Protocol Suite and has the task of delivering datagrams from the source [host](http://en.wikipedia.org/wiki/Host_(network)) to the destination host solely based on the [addresses](http://en.wikipedia.org/wiki/IP_address). For this purpose, IP defines datagram structures that [encapsulate](http://en.wikipedia.org/wiki/Encapsulation_(networking)) the data to be delivered. It also defines [addressing methods](http://en.wikipedia.org/wiki/IP_address) that are used to label the datagram source and destination.

Historically, IP was the connectionless datagram service in the original Transmission Control Program introduced by [Vint Cerf](http://en.wikipedia.org/wiki/Vint_Cerf) and [Bob Kahn](http://en.wikipedia.org/wiki/Bob_Kahn) in 1974, the other being the connection-oriented [Transmission Control Protocol](http://en.wikipedia.org/wiki/Transmission_Control_Protocol) (TCP). The Internet Protocol Suite is therefore often referred to as TCP/IP.

The first major version of IP, [Internet Protocol Version 4](http://en.wikipedia.org/wiki/IPv4) (IPv4), is the dominant protocol of the internet. Its successor is [Internet Protocol Version 6](http://en.wikipedia.org/wiki/IPv6) (IPv6), which is increasing in use.

The Internet Protocol is responsible for addressing hosts and routing datagrams (packets) from a source host to the destination host across one or more IP networks. For this purpose the Internet Protocol defines an addressing system that has two functions: identifying hosts and providing a logical location service. This is accomplished by defining standard datagrams and a standard addressing system.

## Hypertext Transfer Protocol (HTTP)

The **Hypertext Transfer Protocol** (**HTTP**) is an [application protocol](http://en.wikipedia.org/wiki/Application_protocol) for distributed, collaborative, [hypermedia](http://en.wikipedia.org/wiki/Hypermedia) information systems.[[1]](http://en.wikipedia.org/wiki/Http#cite_note-ietf2616-0) HTTP is the foundation of data communication for the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web).

[Hypertext](http://en.wikipedia.org/wiki/Hypertext) is a multi-linear set of objects, building a network by using logical links (the so-called [hyperlinks](http://en.wikipedia.org/wiki/Hyperlinks)) between the [nodes](http://en.wikipedia.org/wiki/Nodes) (e.g. text or words). HTTP is the protocol to exchange or transfer hypertext.

HTTP functions as a [request-response](http://en.wikipedia.org/wiki/Request-response) protocol in the [client-server](http://en.wikipedia.org/wiki/Client-server) computing model. A [web browser](http://en.wikipedia.org/wiki/Web_browser), for example, may be the *client* and an application running on a computer [hosting](http://en.wikipedia.org/wiki/Host_(network)) a [web site](http://en.wikipedia.org/wiki/Web_site) may be the *server*. The client submits an HTTP *request* message to the server. The server, which provides *resources* such as [HTML](http://en.wikipedia.org/wiki/HTML) files and other content, or performs other functions on behalf of the client, returns a *response* message to the client. The response contains completion status information about the request and may also contain requested content in its message body.

A web browser is an example of a [*user agent*](http://en.wikipedia.org/wiki/User_agent) (UA). Other types of user agent include the indexing software used by search providers ([web crawlers](http://en.wikipedia.org/wiki/Web_crawler)), [voice browsers](http://en.wikipedia.org/wiki/Voice_browser), [mobile apps](http://en.wikipedia.org/wiki/Mobile_apps) and other software that accesses, consumes or displays web content.

HTTP is designed to permit intermediate network elements to improve or enable communications between clients and servers. High-traffic websites often benefit from [web cache](http://en.wikipedia.org/wiki/Web_cache) servers that deliver content on behalf of [upstream servers](http://en.wikipedia.org/wiki/Upstream_server) to improve response time. Web browsers cache previously accessed web resources and reuse them when possible to reduce network traffic. HTTP [proxy servers](http://en.wikipedia.org/wiki/Proxy_server) at [private network](http://en.wikipedia.org/wiki/Private_network) boundaries can facilitate communication for clients without a globally routable address, by relaying messages with external servers.

HTTP is an [application layer](http://en.wikipedia.org/wiki/Application_layer) protocol designed within the framework of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite). Its definition presumes an underlying and reliable [transport layer](http://en.wikipedia.org/wiki/Transport_layer) protocol,[[2]](http://en.wikipedia.org/wiki/Http#cite_note-1) and [Transmission Control Protocol](http://en.wikipedia.org/wiki/Transmission_Control_Protocol) (TCP) predominates for this purpose. However HTTP can use unreliable protocols such as the [User Datagram Protocol](http://en.wikipedia.org/wiki/User_Datagram_Protocol) (UDP), for example in [Simple Service Discovery Protocol](http://en.wikipedia.org/wiki/Simple_Service_Discovery_Protocol) (SSDP).

## User Datagram Protocol (UDP)

The **User Datagram Protocol** (**UDP**) is one of the core members of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite), the set of network protocols used for the [Internet](http://en.wikipedia.org/wiki/Internet). With UDP, computer applications can send messages, in this case referred to as [*datagrams*](http://en.wikipedia.org/wiki/Datagram), to other hosts on an [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) (IP) network without requiring prior communications to set up special transmission channels or data paths.

UDP uses a simple transmission model without implicit [handshaking](http://en.wikipedia.org/wiki/Handshaking) dialogues for providing reliability, ordering, or data integrity. Thus, UDP provides an unreliable service and datagrams may arrive out of order, appear duplicated, or go missing without notice. UDP assumes that error checking and correction is either not necessary or performed in the application, avoiding the overhead of such processing at the network interface level. Time-sensitive applications often use UDP because dropping packets is preferable to waiting for delayed packets, which may not be an option in a real-time system.[[1]](http://en.wikipedia.org/wiki/User_Datagram_Protocol#cite_note-kuroseross-0) If error correction facilities are needed at the network interface level, an application may use the [Transmission Control Protocol](http://en.wikipedia.org/wiki/Transmission_Control_Protocol) (TCP) or [Stream Control Transmission Protocol](http://en.wikipedia.org/wiki/Stream_Control_Transmission_Protocol)(SCTP) which are designed for this purpose.

UDP's [stateless](http://en.wikipedia.org/wiki/Stateless_server) nature is also useful for servers answering small queries from huge numbers of clients, such as [Domain Name System](http://en.wikipedia.org/wiki/Domain_Name_System) (DNS), [streaming media](http://en.wikipedia.org/wiki/Streaming_media) applications such as [IPTV](http://en.wikipedia.org/wiki/IPTV), [Voice over IP](http://en.wikipedia.org/wiki/Voice_over_IP) (VoIP), [Trivial File Transfer Protocol](http://en.wikipedia.org/wiki/Trivial_File_Transfer_Protocol) (TFTP), [IP tunneling](http://en.wikipedia.org/wiki/IP_tunneling) protocols and many [online games](http://en.wikipedia.org/wiki/Online_game).

## File Transfer Protocol (FTP)

**File Transfer Protocol** (**FTP**) is a standard [network protocol](http://en.wikipedia.org/wiki/Network_protocol) used to transfer files from one [host](http://en.wikipedia.org/wiki/Host_(network)) to another host over a [TCP](http://en.wikipedia.org/wiki/Transmission_Control_Protocol)-based network, such as the[Internet](http://en.wikipedia.org/wiki/Internet). It is often used to upload web pages and other documents from a private development machine to a public web-hosting server. FTP is built on a [client-server](http://en.wikipedia.org/wiki/Client-server_model) architecture and uses separate control and data connections between the client and the server.[[1]](http://en.wikipedia.org/wiki/Ftp#cite_note-for-0) FTP users may authenticate themselves using a [clear-text](http://en.wikipedia.org/wiki/Clear_text) sign-in protocol, normally in the form of a username and password, but can connect anonymously if the server is configured to allow it. For secure transmission that hides (encrypts) the username and password, and encrypts the content, [SSH File Transfer Protocol](http://en.wikipedia.org/wiki/SSH_File_Transfer_Protocol) may be used.

The first FTP client applications were interactive command-line tools, implementing standard commands and syntax. [Graphical user interfaces](http://en.wikipedia.org/wiki/GUI) have since been developed for many of the popular desktop operating systems in use today,[[2]](http://en.wikipedia.org/wiki/Ftp#cite_note-tcpip-1)[[3]](http://en.wikipedia.org/wiki/Ftp#cite_note-net.2B-2) including general web design programs like [Microsoft Expression Web](http://en.wikipedia.org/wiki/Microsoft_Expression_Web), and specialist FTP clients such as [CuteFTP](http://en.wikipedia.org/wiki/CuteFTP).

## Simple Mail Transfer Protocol (SMTP)

**Simple Mail Transfer Protocol** (**SMTP**) is an [Internet standard](http://en.wikipedia.org/wiki/Internet_standard) for [electronic mail](http://en.wikipedia.org/wiki/E-mail) (e-mail) transmission across [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) (IP) networks. SMTP was first defined by [RFC 821](http://tools.ietf.org/html/rfc821) (1982, eventually declared [STD](http://en.wikipedia.org/wiki/Internet_standard) 10),[[1]](http://en.wikipedia.org/wiki/Simple_Mail_Transfer_Protocol#cite_note-rfc821-0) and last updated by [RFC 5321](http://tools.ietf.org/html/rfc5321) (2008)[[2]](http://en.wikipedia.org/wiki/Simple_Mail_Transfer_Protocol#cite_note-rfc5321-1) which includes the [extended SMTP](http://en.wikipedia.org/wiki/Extended_SMTP) (ESMTP) additions, and is the protocol in widespread use today. SMTP connections secured by [SSL](http://en.wikipedia.org/wiki/Secure_Sockets_Layer) are known by the shorthand [SMTPS](http://en.wikipedia.org/wiki/SMTPS), though SMTPS is not a protocol in its own right.

While electronic [mail servers](http://en.wikipedia.org/wiki/Mail_server) and other [mail transfer agents](http://en.wikipedia.org/wiki/Mail_transfer_agent) use SMTP to send and receive mail messages, user-level client mail applications typically only use SMTP for sending messages to a mail server for [relaying](http://en.wikipedia.org/wiki/Mail_relay). For receiving messages, client applications usually use either the [Post Office Protocol](http://en.wikipedia.org/wiki/Post_Office_Protocol) (POP) or the [Internet Message Access Protocol](http://en.wikipedia.org/wiki/Internet_Message_Access_Protocol) (IMAP) or a proprietary system (such as Microsoft Exchange or [Lotus Notes](http://en.wikipedia.org/wiki/Lotus_Notes)/[Domino](http://en.wikipedia.org/wiki/IBM_Lotus_Domino)) to access their mail box accounts on a mail server.

## Post Office Protocol (POP)

In computing, the **Post Office Protocol** (**POP**) is an [application-layer](http://en.wikipedia.org/wiki/Application_layer) [Internet standard](http://en.wikipedia.org/wiki/Internet_standard) [protocol](http://en.wikipedia.org/wiki/Protocol_(computing)) used by local [e-mail clients](http://en.wikipedia.org/wiki/E-mail_client) to retrieve [e-mail](http://en.wikipedia.org/wiki/E-mail) from a remote [server](http://en.wikipedia.org/wiki/Mail_server) over a [TCP/IP](http://en.wikipedia.org/wiki/Internet_protocol_suite) connection.[[1]](http://en.wikipedia.org/wiki/Post_Office_Protocol#cite_note-Network.2B_Guide_to_Networks-0) POP and [IMAP](http://en.wikipedia.org/wiki/IMAP) (Internet Message Access Protocol) are the two most prevalent [Internet](http://en.wikipedia.org/wiki/Internet) standard protocols for e-mail retrieval.[[2]](http://en.wikipedia.org/wiki/Post_Office_Protocol#cite_note-Red_Hat-1) Virtually all modern e-mail clients and [servers](http://en.wikipedia.org/wiki/Server_(computing)) support both. The POP protocol has been developed through several versions, with version 3 (POP3) being the current standard. Most [webmail](http://en.wikipedia.org/wiki/Webmail) service providers such as [Hotmail](http://en.wikipedia.org/wiki/Hotmail), [Gmail](http://en.wikipedia.org/wiki/Gmail) and [Yahoo! Mail](http://en.wikipedia.org/wiki/Yahoo!_Mail) also provide IMAP and POP3 service.

## Internet Message Access Protocol (IMAP)

**Internet message access protocol** (**IMAP**) is one of the two most prevalent [Internet standard](http://en.wikipedia.org/wiki/Internet_standard) protocols for [e-mail](http://en.wikipedia.org/wiki/E-mail) retrieval, the other being the [Post Office Protocol](http://en.wikipedia.org/wiki/Post_Office_Protocol) (POP).[[1]](http://en.wikipedia.org/wiki/IMAP#cite_note-0) Virtually all modern [e-mail clients](http://en.wikipedia.org/wiki/E-mail_client) and [mail servers](http://en.wikipedia.org/wiki/Mail_server) support both protocols as a means of transferring e-mail messages from a server.

IMAP supports both [on-line and off-line](http://en.wikipedia.org/wiki/On-line_and_off-line) modes of operation. E-mail clients using IMAP generally leave messages on the server until the user explicitly deletes them. This and other characteristics of IMAP operation allow multiple clients to manage the same mailbox. Most e-mail *clients* support IMAP in addition to POP to retrieve messages; however, fewer email *services* support IMAP.[[2]](http://en.wikipedia.org/wiki/IMAP#cite_note-1) IMAP offers access to the mail storage. Clients may store local copies of the messages, but these are considered to be a temporary cache. Incoming e-mail messages are sent to an e-mail server that stores messages in the recipient's email box. The user retrieves the messages with an e-mail client that uses one of a number of e-mail retrieval protocols. Some clients and servers preferentially use vendor-specific, [proprietary protocols](http://en.wikipedia.org/wiki/Proprietary_protocol), but most support the Internet standard protocols, [SMTP](http://en.wikipedia.org/wiki/SMTP) for sending e-mail and POP and IMAP for retrieving e-mail, allowing interoperability with other servers and clients. For example, [Microsoft](http://en.wikipedia.org/wiki/Microsoft)'s [Outlook](http://en.wikipedia.org/wiki/Microsoft_Outlook) client uses a proprietary protocol to communicate with a [Microsoft Exchange Server](http://en.wikipedia.org/wiki/Microsoft_Exchange_Server) server as does [IBM](http://en.wikipedia.org/wiki/IBM)'s [Notes](http://en.wikipedia.org/wiki/Lotus_Notes) client when communicating with a [Domino](http://en.wikipedia.org/wiki/IBM_Lotus_Domino) server, but all of these products also support POP, IMAP, and outgoing SMTP. Support for the Internet standard protocols allows many e-mail clients such as [Pegasus Mail](http://en.wikipedia.org/wiki/Pegasus_Mail) or [Mozilla Thunderbird](http://en.wikipedia.org/wiki/Mozilla_Thunderbird) (see [comparison of e-mail clients](http://en.wikipedia.org/wiki/Comparison_of_e-mail_clients)) to access these servers, and allows the clients to be used with other servers (see [list of mail servers](http://en.wikipedia.org/wiki/List_of_mail_servers)).

## World Wide Web (WWW)

The **World Wide Web** (abbreviated as **WWW** or **W3**,[[2]](http://en.wikipedia.org/wiki/Www#cite_note-1) commonly known as **the Web**, or the "Information Superhighway"), is a [system](http://en.wikipedia.org/wiki/Information_system) of interlinked [hypertext](http://en.wikipedia.org/wiki/Hypertext) documents accessed via the [Internet](http://en.wikipedia.org/wiki/Internet). With a [web browser](http://en.wikipedia.org/wiki/Web_browser), one can view [web pages](http://en.wikipedia.org/wiki/Web_page) that may contain text, images, videos, and other [multimedia](http://en.wikipedia.org/wiki/Multimedia), and [navigate](http://en.wikipedia.org/wiki/Web_navigation) between them via [hyperlinks](http://en.wikipedia.org/wiki/Hyperlink).

The terms Internet and World Wide Web are often used in everyday speech without much distinction. However, the Internet and the World Wide Web are not one and the same. The Internet is a global system of interconnected [computer networks](http://en.wikipedia.org/wiki/Computer_networks). In contrast, the Web is one of the services that runs on the Internet. It is a collection of text documents and other resources, linked by hyperlinks and URLs, usually accessed by [web browsers](http://en.wikipedia.org/wiki/Web_browsers) from [web servers](http://en.wikipedia.org/wiki/Web_servers). In short, the Web can be thought of as an [application](http://en.wikipedia.org/wiki/Application_software) "running" on the Internet.[[24]](http://en.wikipedia.org/wiki/Www#cite_note-23)

Viewing a [web page](http://en.wikipedia.org/wiki/Web_page) on the World Wide Web normally begins either by typing the [URL](http://en.wikipedia.org/wiki/Uniform_Resource_Locator) of the page into a [web browser](http://en.wikipedia.org/wiki/Web_browser) or by following a [hyperlink](http://en.wikipedia.org/wiki/Hyperlink) to that page or resource. The web browser then initiates a series of communication messages, behind the scenes, in order to fetch and display it. As an example, consider accessing a page with the URL <http://example.org/wiki/World_Wide_Web>.

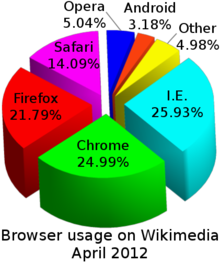
First, the browser resolves the server-name portion of the URL (*example.org*) into an [Internet Protocol address](http://en.wikipedia.org/wiki/IP_address) using the globally distributed database known as the [Domain Name System](http://en.wikipedia.org/wiki/Domain_Name_System) (DNS); this lookup returns an IP address such as *208.80.152.2*. The browser then requests the resource by sending an [HTTP](http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol) request across the Internet to the computer at that particular address. It makes the request to a particular application port in the underlying [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite) so that the computer receiving the request can distinguish an HTTP request from other network protocols it may be servicing such as e-mail delivery; the HTTP protocol normally uses [port 80](http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers). The content of the HTTP request can be as simple as the two lines of text

## Web browser

A **web browser** is a [software application](http://en.wikipedia.org/wiki/Software_application) for retrieving, presenting, and traversing information resources on the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web). An *information resource* is identified by a [Uniform Resource Identifier](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier) (URI) and may be a [web page](http://en.wikipedia.org/wiki/Web_page), image, video, or other piece of content.[[1]](http://en.wikipedia.org/wiki/Web_browser#cite_note-0)

[Hyperlinks](http://en.wikipedia.org/wiki/Hyperlinks) present in resources enable users easily to navigate their [browsers](http://en.wikipedia.org/wiki/Browse) to related resources. A web browser can also be defined as an [application software](http://en.wikipedia.org/wiki/Application_software) or program designed to enable users to access, retrieve and view documents and other resources on the [Internet](http://en.wikipedia.org/wiki/Internet).

Although browsers are primarily intended to access the World Wide Web, they can also be used to access information provided by [web servers](http://en.wikipedia.org/wiki/Web_servers) in [private networks](http://en.wikipedia.org/wiki/Private_networks) or files in [file systems](http://en.wikipedia.org/wiki/File_systems). The major web browsers are [Firefox](http://en.wikipedia.org/wiki/Firefox), [Google Chrome](http://en.wikipedia.org/wiki/Google_Chrome), [Internet Explorer](http://en.wikipedia.org/wiki/Internet_Explorer), [Opera](http://en.wikipedia.org/wiki/Opera_(web_browser)), and [Safari](http://en.wikipedia.org/wiki/Safari_(web_browser)).[[2]](http://en.wikipedia.org/wiki/Web_browser#cite_note-1)

[](http://en.wikipedia.org/wiki/File:Wikimedia_browser_share_pie_chart_3.png)The primary purpose of a web browser is to bring information resources to the user. This process begins when the user inputs a [Uniform Resource Locator](http://en.wikipedia.org/wiki/Uniform_Resource_Locator) (URL), for example *http://en.wikipedia.org/*, into the browser. The prefix of the URL, the Uniform Resource Identifier or [URI](http://en.wikipedia.org/wiki/URI), determines how the URL will be interpreted. The most commonly used kind of URI starts with *http:* and identifies a resource to be retrieved over the [Hypertext Transfer Protocol](http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol) (HTTP)[[10]](http://en.wikipedia.org/wiki/Web_browser#cite_note-9). Many browsers also support a variety of other prefixes, such as *https:* for [HTTPS](http://en.wikipedia.org/wiki/HTTPS), *ftp:* for the [File Transfer Protocol](http://en.wikipedia.org/wiki/File_Transfer_Protocol), and *file:* for [local files](http://en.wikipedia.org/wiki/Computer_file). Prefixes that the web browser cannot directly handle are often handed off to another application entirely. For example, *mailto:* URIs are usually passed to the user's default e-mail application, and *news:* URIs are passed to the user's default newsgroup reader.

In the case of *http*, *https*, *file*, and others, once the resource has been retrieved the web browser will display it. [HTML](http://en.wikipedia.org/wiki/HTML) is passed to the browser's [layout engine](http://en.wikipedia.org/wiki/Layout_engine) to be transformed from [markup](http://en.wikipedia.org/wiki/Markup_language) to an interactive document. Aside from HTML, web browsers can generally display any kind of content that can be part of a web page. Most browsers can display images, audio, video, and [XML](http://en.wikipedia.org/wiki/XML) files, and often have [plug-ins](http://en.wikipedia.org/wiki/Plug-in_(computing)) to support [Flash](http://en.wikipedia.org/wiki/Adobe_Flash) applications and [Java applets](http://en.wikipedia.org/wiki/Java_applets). Upon encountering a file of an unsupported type or a file that is set up to be downloaded rather than displayed, the browser prompts the user to save the file to disk.

Information resources may contain [hyperlinks](http://en.wikipedia.org/wiki/Hyperlinks) to other information resources. Each link contains the URI of a resource to go to. When a link is clicked, the browser navigates to the resource indicated by the link's target URI, and the process of bringing content to the user begins again.

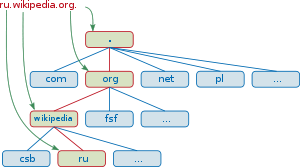
## Uniform resource identifier (URI)

In [computing](http://en.wikipedia.org/wiki/Information_technology), a **uniform resource identifier** (**URI**) is a [string](http://en.wikipedia.org/wiki/Character_string_(computer_science)) of [characters](http://en.wikipedia.org/wiki/Character_(computing)) used to [identify](http://en.wikipedia.org/wiki/Identifier) a name or a [resource](http://en.wikipedia.org/wiki/Resource_(Web)). Such identification enables interaction with representations of the resource over a network (typically the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web)) using specific [protocols](http://en.wikipedia.org/wiki/Protocol_(computing)). Schemes specifying a concrete [syntax](http://en.wikipedia.org/wiki/Syntax) and associated protocols define each URI.

URIs can be classified as locators (URLs), as names (URNs), or as both. A [uniform resource name](http://en.wikipedia.org/wiki/Uniform_resource_name) (URN) functions like a person's name, while a [uniform resource locator](http://en.wikipedia.org/wiki/Uniform_resource_locator) (URL) resembles that person's street address. In other words: the URN defines an item's identity, while the URL provides a method for finding it.

## Uniform resource locator (URL)

In [computing](http://en.wikipedia.org/wiki/Information_technology), a **uniform resource locator** (**URL**) is a specific [character string](http://en.wikipedia.org/wiki/Character_string) that constitutes a reference to an [Internet](http://en.wikipedia.org/wiki/Internet) resource.

[](http://en.wikipedia.org/wiki/File:DNS-names-ru.svg)A URL is technically a type of [uniform resource identifier](http://en.wikipedia.org/wiki/Uniform_resource_identifier) (URI) but in many technical documents and verbal discussions URL is often used as a synonym for URI.[[1]](http://en.wikipedia.org/wiki/Url#cite_note-0)

Every URL consists of some of the following: the [scheme name](http://en.wikipedia.org/wiki/URI_scheme) (commonly called protocol), followed by a colon, two slashes,[[note 1]](http://en.wikipedia.org/wiki/Url#cite_note-6) then, depending on scheme, a server name (exp. ftp., www., smtp., etc.) followed by a dot (.) then a [domain name](http://en.wikipedia.org/wiki/Domain_name)[[note 2]](http://en.wikipedia.org/wiki/Url#cite_note-7) (alternatively, [IP address](http://en.wikipedia.org/wiki/IP_address)), a [port number](http://en.wikipedia.org/wiki/Port_number), the path of the resource to be fetched or the program to be run, then, for programs such as [Common Gateway Interface](http://en.wikipedia.org/wiki/Common_Gateway_Interface) (CGI) [scripts](http://en.wikipedia.org/wiki/Script_(computing)), a [query string](http://en.wikipedia.org/wiki/Query_string),[[7]](http://en.wikipedia.org/wiki/Url#cite_note-8)[[8]](http://en.wikipedia.org/wiki/Url#cite_note-parse_url-9) and an optional [fragment identifier](http://en.wikipedia.org/wiki/Fragment_identifier).[9]

## Domain name

A **domain name** is an identification [string](http://en.wikipedia.org/wiki/String_(computer_science)) that defines a realm of administrative autonomy, authority, or control on the [Internet](http://en.wikipedia.org/wiki/Internet). Domain names are formed by the rules and procedures of the [Domain Name System](http://en.wikipedia.org/wiki/Domain_Name_System) (DNS).

Domain names are used in various networking contexts and application-specific naming and addressing purposes. In general, a domain name represents an [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) (IP) resource, such as a personal computer used to access the Internet, a server computer hosting a [web site](http://en.wikipedia.org/wiki/Web_site), or the web site itself or any other service communicated via the Internet.

Domain names are organized in subordinate levels (subdomains) of the [DNS root](http://en.wikipedia.org/wiki/DNS_root) domain, which is nameless. The first-level set of domain names are the [top-level domains](http://en.wikipedia.org/wiki/Top-level_domain) (TLDs), including the [generic top-level domains](http://en.wikipedia.org/wiki/Generic_top-level_domain) (gTLDs), such as the prominent domains [com](http://en.wikipedia.org/wiki/.com), [net](http://en.wikipedia.org/wiki/.net) and [org](http://en.wikipedia.org/wiki/.org), and the [country code top-level domains](http://en.wikipedia.org/wiki/Country_code_top-level_domain) (ccTLDs). Below these top-level domains in the DNS hierarchy are the second-level and third-level domain names that are typically open for reservation by end-users who wish to connect local area networks to the Internet, create other publicly accessible Internet resources or run web sites. The registration of these domain names is usually administered by [domain name registrars](http://en.wikipedia.org/wiki/Domain_name_registrar) who sell their services to the public.

Domain names serve as humanly-memorable names for Internet participants, like computers, networks, and services. A domain name represents an Internet Protocol (IP) resource. Individual Internet host computers use domain names as host identifiers, or hostnames. Hostnames are the leaf labels in the domain name system usually without further subordinate domain name space. Hostnames appear as a component in [Uniform Resource Locators](http://en.wikipedia.org/wiki/Uniform_Resource_Locator) (URLs) for Internet resources such as [web sites](http://en.wikipedia.org/wiki/Web_site) (e.g., en.wikipedia.org).

Domain names are also used as simple identification labels to indicate ownership or control of a resource. Such examples are the realm identifiers used in the [Session Initiation Protocol](http://en.wikipedia.org/wiki/Session_Initiation_Protocol) (SIP), the[DomainKeys](http://en.wikipedia.org/wiki/DomainKeys) used to verify DNS domains in [e-mail](http://en.wikipedia.org/wiki/E-mail) systems, and in many other [Uniform Resource Identifiers](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier) (URIs).

An important function of domain names is to provide easily recognizable and memorizable names to numerically [addressed](http://en.wikipedia.org/wiki/IP_address) Internet resources. This abstraction allows any resource to be moved to a different physical location in the address topology of the network, globally or locally in an [intranet](http://en.wikipedia.org/wiki/Intranet). Such a move usually requires changing the IP address of a resource and the corresponding translation of this IP address to and from its domain name.

Domain names are often referred to simply as *domains* and domain name registrants are frequently referred to as *domain owners*, although domain name registration with a registrar does not confer any legal ownership of the domain name, only an exclusive right of use.

## Domain Name System (DNS)

The **Domain Name System** (**DNS**) is a hierarchical distributed naming system for computers, services, or any resource connected to the [Internet](http://en.wikipedia.org/wiki/Internet) or a [private network](http://en.wikipedia.org/wiki/Private_network). It associates various information with [domain names](http://en.wikipedia.org/wiki/Domain_name) assigned to each of the participating entities. A **Domain Name Service** resolves queries for these names into [IP addresses](http://en.wikipedia.org/wiki/IP_address) for the purpose of locating computer services and devices worldwide. By providing a worldwide, distributed [keyword](http://en.wikipedia.org/wiki/Index_term)-based redirection service, the Domain Name System is an essential component of the functionality of the [Internet](http://en.wikipedia.org/wiki/Internet).

An often-used analogy to explain the Domain Name System is that it serves as the [phone book](http://en.wikipedia.org/wiki/Telephone_directory) for the Internet by translating human-friendly computer [hostnames](http://en.wikipedia.org/wiki/Hostname) into [IP addresses](http://en.wikipedia.org/wiki/IP_address). For example, the domain name [www.example.com](http://en.wikipedia.org/wiki/Example.com) translates to the addresses 192.0.43.10 ([IPv4](http://en.wikipedia.org/wiki/IPv4)) and 2620:0:2d0:200::10 ([IPv6](http://en.wikipedia.org/wiki/IPv6)). Unlike a phone book, however, DNS can be quickly updated and these updates distributed, allowing a service's location on the network to change without affecting the end users, who continue to use the same hostname. Users take advantage of this when they recite meaningful [Uniform Resource Locators](http://en.wikipedia.org/wiki/Uniform_Resource_Locator) (URLs) and [e-mail addresses](http://en.wikipedia.org/wiki/E-mail_address) without having to know how the computer actually locates the services.

The Domain Name System distributes the responsibility of assigning domain names and mapping those names to IP addresses by designating [authoritative name servers](http://en.wikipedia.org/wiki/Authoritative_name_server) for each domain. Authoritative name servers are assigned to be responsible for their particular domains, and in turn can assign other authoritative name servers for their sub-domains. This mechanism has made the DNS distributed and fault tolerant and has helped avoid the need for a single central register to be continually consulted and updated. Additionally, the responsibility for maintaining and updating the master record for the domains is spread among many [domain name registrars](http://en.wikipedia.org/wiki/Domain_name_registrar), who compete for the end-user's, domain-owner's, business. Domains can be moved from registrar to registrar at any time.

The Domain Name System also specifies the technical functionality of this database service. It defines the DNS protocol, a detailed specification of the data structures and communication exchanges used in DNS, as part of the [Internet Protocol Suite](http://en.wikipedia.org/wiki/Internet_Protocol_Suite).

## IP address

[Page semi-protected](http://en.wikipedia.org/wiki/Wikipedia:Protection_policy#semi)

An **Internet Protocol address** (**IP address**) is a numerical label assigned to each device (e.g., computer, printer) participating in a [computer network](http://en.wikipedia.org/wiki/Computer_network) that uses the [Internet Protocol](http://en.wikipedia.org/wiki/Internet_Protocol) for communication.[[1]](http://en.wikipedia.org/wiki/IP_adress#cite_note-rfc760-0) An IP address serves two principal functions: host or network interface [identification](http://en.wikipedia.org/wiki/Identification_(information)) and location [addressing](http://en.wikipedia.org/wiki/Logical_address). Its role has been characterized as follows: "*A*[*name*](http://en.wikipedia.org/wiki/Hostname)*indicates what we seek. An address indicates where it is. A route indicates how to get there.*"[[2]](http://en.wikipedia.org/wiki/IP_adress#cite_note-rfc791-1)

IP addresses are [binary numbers](http://en.wikipedia.org/wiki/Binary_number), but they are usually stored in text files and displayed in [human-readable](http://en.wikipedia.org/wiki/Human-readable) notations, such as 172.16.254.1 (for IPv4), and 2001:db8:0:1234:0:567:8:1 (for IPv6).

## HyperText Markup Language (HTML)

**HyperText Markup Language** (**HTML**) is the main [markup language](http://en.wikipedia.org/wiki/Markup_language) for displaying web pages and other information that can be displayed in a web browser.

HTML is written in the form of [HTML elements](http://en.wikipedia.org/wiki/HTML_element) consisting of *tags* enclosed in [angle brackets](http://en.wikipedia.org/wiki/Angle_brackets) (like <html>), within the web page content. HTML tags most commonly come in pairs like <h1> and </h1>, although some tags, known as *empty elements*, are unpaired, for example <img>. The first tag in a pair is the *start tag*, the second tag is the *end tag* (they are also called *opening tags* and *closing tags*). In between these tags web designers can add text, tags, comments and other types of text-based content.

The purpose of a [web browser](http://en.wikipedia.org/wiki/Web_browser) is to read HTML documents and compose them into visible or audible web pages. The browser does not display the HTML tags, but uses the tags to interpret the content of the page.

HTML elements form the building blocks of all websites. HTML allows [images and objects](http://en.wikipedia.org/wiki/Img_(HTML_element)) to be embedded and can be used to create [interactive forms](http://en.wikipedia.org/wiki/Fieldset). It provides a means to create [structured documents](http://en.wikipedia.org/wiki/Structured_document) by denoting structural [semantics](http://en.wikipedia.org/wiki/Semantic) for text such as headings, paragraphs, lists, links, quotes and other items. It can embed [scripts](http://en.wikipedia.org/wiki/Scripting_language) in languages such as [JavaScript](http://en.wikipedia.org/wiki/JavaScript) which affect the behavior of HTML webpages.

Web browsers can also refer to [Cascading Style Sheets](http://en.wikipedia.org/wiki/Cascading_Style_Sheets) (CSS) to define the appearance and layout of text and other material. The [W3C](http://en.wikipedia.org/wiki/W3C), maintainer of both the HTML and the CSS standards, encourages the use of CSS over explicitly presentational HTML markup.[[1]](http://en.wikipedia.org/wiki/Html#cite_note-deprecated-0)

## Internet Communication

## E-mail

**Electronic mail**, commonly known as **email** or **e-mail** is an important communications service available on the Internet.

Email, is a method of exchanging digital messages from an author to one or more recipients. Modern email operates across the [Internet](http://en.wikipedia.org/wiki/Internet) or other [computer networks](http://en.wikipedia.org/wiki/Computer_network). Some early email systems required that the author and the recipient both be [online](http://en.wikipedia.org/wiki/Online_and_offline) at the same time, in common with [instant messaging](http://en.wikipedia.org/wiki/Instant_messaging). Today's email systems are based on a [store-and-forward](http://en.wikipedia.org/wiki/Store-and-forward) model. Email [servers](http://en.wikipedia.org/wiki/Computer_server) accept, forward, deliver and store messages. Neither the users nor their computers are required to be online simultaneously; they need connect only briefly, typically to an [email server](http://en.wikipedia.org/wiki/E-mail_server), for as long as it takes to send or receive messages.

An email message consists of three components, the message *envelope*, the message *header*, and the message *body*. The message header contains control information, including, minimally, an originator's [email address](http://en.wikipedia.org/wiki/Email_address) and one or more recipient addresses. Usually descriptive information is also added, such as a subject header field and a message submission date/time stamp. It is structured into [fields](http://en.wikipedia.org/wiki/Field_(computer_science)) such as From, To, CC, Subject, Date, and other information about the email. *Body* represent the basic content, as unstructured text; sometimes containing a [signature block](http://en.wikipedia.org/wiki/Signature_block) at the end. This is exactly the same as the body of a regular letter.

The header is separated from the body by a blank line.

In the process of transporting email messages between systems, SMTP communicates delivery parameters using a message *envelope* separate from the message (header and body) itself.

## E-mail address

An **email address** identifies an [email box](http://en.wikipedia.org/wiki/Email_box) to which [email messages](http://en.wikipedia.org/wiki/Email) are delivered. The general format of an email address is jsmith@example.org. It consists of two parts: the part before the [@](http://en.wikipedia.org/wiki/@) sign is the *local-part* of the address, often the [username](http://en.wikipedia.org/wiki/Username) of the recipient (jsmith), and the part after the @ sign is a *domain name* to which the email message will be sent (example.org).

It is not clear from the email address [domain name](http://en.wikipedia.org/wiki/Domain_name) what is the actual destination (the mailbox host) of an email. A [mail server](http://en.wikipedia.org/wiki/Mail_server) will use the [Domain Name System](http://en.wikipedia.org/wiki/Domain_Name_System), which is a distributed database, to find the [IP address](http://en.wikipedia.org/wiki/IP_address) of the host of the domain. The server queries the DNS for any mail exchanger records ([MX records](http://en.wikipedia.org/wiki/MX_record)) to find the [IP address](http://en.wikipedia.org/wiki/IP_address) of a designated [mail transfer agent](http://en.wikipedia.org/wiki/Mail_transfer_agent) (MTA) for that address. That way, the organization holding the delegation for a given domain —the *mailbox provider*— can define which are the target hosts for all email destined to its domain. The mail exchanger does not need to be located in the domain of the destination mail box, it must simply accept mail for the domain. The target hosts are configured with a mechanism to deliver mail to all destination mail boxes. If no MX servers are configured, a mail server queries the [A record](http://en.wikipedia.org/wiki/A_record) for the domain. There is a chance that this server will accept email for this domain.

The local-part of an email address has no significance to intermediate mail relay systems other than the final mailbox host. For example, it must not be assumed to be case-insensitive. The same mailbox can be set up to receive emails from multiple email addresses. Conversely, a single email address may be an alias and have a distribution function to many mailboxes. [Email aliases](http://en.wikipedia.org/wiki/Email_alias), [electronic mailing lists](http://en.wikipedia.org/wiki/Electronic_mailing_list), [sub-addressing](http://en.wikipedia.org/wiki/Email_address#Address_tags), and [catch-all](http://en.wikipedia.org/wiki/Catch-all_(Mail)) addresses, the latter being mailboxes that receive messages irrespectively of the local part, are common patterns for achieving such results.

The addresses found in the header fields of an email message are not the ones used by SMTP servers to deliver the message. Servers use the so-called *message envelope* to route mail. While envelope and header addresses may be equal, forged email addresses are often seen in [spam](http://en.wikipedia.org/wiki/Email_spam), [phishing](http://en.wikipedia.org/wiki/Phishing), and many other internet-based scams. This has led to several initiatives which aim to make such forgeries easier to spot.

## Spamming and computer viruses

The usefulness of email is being threatened by four phenomena: [email bombardment](http://en.wikipedia.org/wiki/Email_bomb), [spamming](http://en.wikipedia.org/wiki/E-mail_spam), [phishing](http://en.wikipedia.org/wiki/Phishing), and [email worms](http://en.wikipedia.org/wiki/Computer_worm).

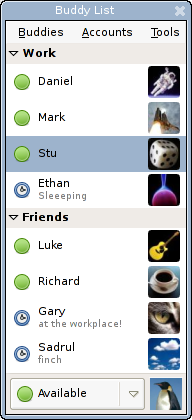
**Email spam**, also known as **junk email** or **unsolicited bulk email** (**UBE**), is a subset of [electronic spam](http://en.wikipedia.org/wiki/Spam_(electronic)) involving nearly identical messages sent to numerous recipients by [email](http://en.wikipedia.org/wiki/Email). Definitions of spam usually include the aspects that email is unsolicited and sent in bulk.[[1]](http://en.wikipedia.org/wiki/Email_spam#cite_note-spamfaq-0)[[2]](http://en.wikipedia.org/wiki/Email_spam#cite_note-rhyolite-1)[[3]](http://en.wikipedia.org/wiki/Email_spam#cite_note-spamcop-2)[[4]](http://en.wikipedia.org/wiki/Email_spam#cite_note-abuse-3)[[5]](http://en.wikipedia.org/wiki/Email_spam#cite_note-monkeys-4) One subset of UBE is *UCE* (unsolicited commercial email). The opposite of "spam", email which one wants, is called "ham", usually when referring to a message's automated analysis (such as Bayesian filtering).[[6]](http://en.wikipedia.org/wiki/Email_spam#cite_note-5)

Email spam has steadily grown since the early 1990s. [Botnets](http://en.wikipedia.org/wiki/Botnet), networks of [virus](http://en.wikipedia.org/wiki/Computer_virus)-infected computers, are used to send about 80% of spam. Since the expense of the spam is borne mostly by the recipient,[[7]](http://en.wikipedia.org/wiki/Email_spam#cite_note-spam-costs-6) it is effectively [postage due](http://en.wikipedia.org/wiki/Postage_due) advertising.

Spammers collect email addresses from chatrooms, websites, customer lists, newsgroups, and viruses which harvest users' address books, and are sold to other spammers. They also use a practice known as "email appending" or "epending" in which they use known information about their target (such as a postal address) to search for the target's email address. Much of spam is sent to invalid email addresses.

**Email worms** use email as a way of replicating themselves into vulnerable computers. Although the [first email worm](http://en.wikipedia.org/wiki/Morris_(computer_worm)) affected [UNIX](http://en.wikipedia.org/wiki/UNIX) computers, the problem is most common today on the more popular [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) operating system.

The combination of spam and worm programs results in users receiving a constant drizzle of junk email, which reduces the usefulness of email as a practical tool.



## Instant messaging

**Instant messaging** (IM) is a form of [communication](http://en.wikipedia.org/wiki/Communication) over the [Internet](http://en.wikipedia.org/wiki/Internet) that offers an instantaneous transmission of [text-based](http://en.wikipedia.org/wiki/Text-based) messages from sender to receiver. In [push mode](http://en.wikipedia.org/wiki/Push_technology) between two or more people using personal computers or other devices, along with shared [clients](http://en.wikipedia.org/wiki/Client_(computing)), instant messaging basically offers [real-time](http://en.wikipedia.org/wiki/Real-time_text) [direct](http://en.wikipedia.org/wiki/Peer-to-peer)[written language](http://en.wikipedia.org/wiki/Written_language)-based [online chat](http://en.wikipedia.org/wiki/Online_chat). The user's text is conveyed over a [network](http://en.wikipedia.org/wiki/Computer_network), such as the Internet. It may address [point-to-point](http://en.wikipedia.org/wiki/Point-to-point_(telecommunications)) communications as well as [multicast](http://en.wikipedia.org/wiki/Multicast) communications from one sender to many receivers. More advanced instant messaging allows enhanced modes of communication, such as live voice or [video calling](http://en.wikipedia.org/wiki/Videophone), [video chat](http://en.wikipedia.org/wiki/Video_chat) and inclusion of [hyperlinks](http://en.wikipedia.org/wiki/Hyperlink) to media.

## Mobile instant messaging

[Mobile instant messaging](http://en.wikipedia.org/wiki/Mobile_instant_messaging) (MIM) is the technology that allows instant messaging services to be accessed from -a portable device, ranging from standard mobile phones, to [smartphones](http://en.wikipedia.org/wiki/Smartphone) (e.g. devices using operating systems such as [Android](http://en.wikipedia.org/wiki/Android_(operating_system)), [Blackberry OS](http://en.wikipedia.org/wiki/Blackberry_OS), [iOS](http://en.wikipedia.org/wiki/IOS_(Apple)), [Symbian OS](http://en.wikipedia.org/wiki/Symbian_OS), [Windows Phone](http://en.wikipedia.org/wiki/Windows_Phone), *et al.*). It is done two ways:

* *Embedded clients* – tailored IM client for every specific device.
* *Clientless platform* – a browser-based application that does not need to download any software to the handset, and which enables all users and all devices from any network to connect to their Internet IM service, ideally. In practice, browser limits can pose problems.

## Online chat

**Online chat** may refer to any kind of [communication](http://en.wikipedia.org/wiki/Communication) over the [Internet](http://en.wikipedia.org/wiki/Internet), that offers a [real time](http://en.wikipedia.org/wiki/Real-time_text) [direct](http://en.wikipedia.org/wiki/Peer-to-peer) transmission of [text-based](http://en.wikipedia.org/wiki/Text-based) messages from sender to receiver, hence the delay for visual access to the sent message shall not hamper the flow of communications in any of the directions. Online chat may address [point-to-point](http://en.wikipedia.org/wiki/Point-to-point_(telecommunications)) communications as well as [multicast](http://en.wikipedia.org/wiki/Multicast) communications from one sender to many receivers and voice and [video chat](http://en.wikipedia.org/wiki/Video_chat) or may be a feature of a [Web conferencing](http://en.wikipedia.org/wiki/Web_conferencing) service.

***Software and protocols***

The following are common chat programs and protocols:

|  |  |
| --- | --- |
| * [AOL Instant Messenger](http://en.wikipedia.org/wiki/AOL_Instant_Messenger) (AIM) * [Camfrog](http://en.wikipedia.org/wiki/Camfrog) * [Campfire](http://en.wikipedia.org/wiki/Campfire_(software)) * [Gadu-Gadu](http://en.wikipedia.org/wiki/Gadu-Gadu) * [Google Talk](http://en.wikipedia.org/wiki/Google_Talk) * [iChat](http://en.wikipedia.org/wiki/IChat) * [ICQ](http://en.wikipedia.org/wiki/ICQ) (OSCAR) * [Internet Relay Chat](http://en.wikipedia.org/wiki/Internet_Relay_Chat) (IRC) * [MUD](http://en.wikipedia.org/wiki/MUD) * [Paltalk](http://en.wikipedia.org/wiki/Paltalk) * [Yahoo! Messenger](http://en.wikipedia.org/wiki/Yahoo!_Messenger) | * [QQ](http://en.wikipedia.org/wiki/Tencent_QQ) * [ActivEngage](http://en.wikipedia.org/w/index.php?title=ActivEngage&action=edit&redlink=1) * [SILC](http://en.wikipedia.org/wiki/SILC_(protocol)) * [Skype](http://en.wikipedia.org/wiki/Skype) * [Talk](http://en.wikipedia.org/wiki/Talk_(software)) * [Talker](http://en.wikipedia.org/wiki/Talker) * [TeamSpeak](http://en.wikipedia.org/wiki/TeamSpeak) (TS) * [WhatsApp](http://en.wikipedia.org/wiki/WhatsApp) * [Windows Live Messenger](http://en.wikipedia.org/wiki/Windows_Live_Messenger) * [XMPP](http://en.wikipedia.org/wiki/Extensible_Messaging_and_Presence_Protocol) |

Chat programs supporting multiple protocols:

* [Adium](http://en.wikipedia.org/wiki/Adium)
* [Google Talk](http://en.wikipedia.org/wiki/Google_Talk)
* [IMVU](http://en.wikipedia.org/wiki/IMVU)
* [Kopete](http://en.wikipedia.org/wiki/Kopete)
* [IBM Sametime](http://en.wikipedia.org/wiki/IBM_Lotus_Sametime)
* [Miranda IM](http://en.wikipedia.org/wiki/Miranda_IM)
* [Pidgin](http://en.wikipedia.org/wiki/Pidgin_(software))
* [Quiet Internet Pager](http://en.wikipedia.org/wiki/Quiet_Internet_Pager)
* [Trillian](http://en.wikipedia.org/wiki/Trillian_(software))

Web sites with browser-based chat services (also see [web chat](http://en.wikipedia.org/wiki/Web_chat)):

* [eBuddy](http://en.wikipedia.org/wiki/EBuddy)
* [Facebook](http://en.wikipedia.org/wiki/Facebook)
* [FilmOn](http://en.wikipedia.org/wiki/FilmOn)
* [Gmail](http://en.wikipedia.org/wiki/Gmail)
* [MeBeam](http://en.wikipedia.org/wiki/MeBeam)
* [Meebo](http://en.wikipedia.org/wiki/Meebo)
* [Mibbit](http://en.wikipedia.org/wiki/Mibbit)
* [Omegle](http://en.wikipedia.org/wiki/Omegle)
* [Tinychat](http://en.wikipedia.org/wiki/Tinychat)
* [Trillian](http://en.wikipedia.org/wiki/Trillian_(software))
* [Userplane](http://en.wikipedia.org/wiki/Userplane)
* [Convore](http://en.wikipedia.org/wiki/Convore)
* [Woo Media](http://en.wikipedia.org/wiki/Woo_Media)
* [Google+](http://en.wikipedia.org/wiki/Google%2B)

## Internet vulnerabilities

## Web threat

A **web threat** is any threat that uses the internet to facilitate [cybercrime](http://en.wikipedia.org/wiki/Cybercrime). Web threats use multiple types of malware and fraud, all of which utilize HTTP or HTTPS protocols, but may also employ other protocols and components, such as links in email or IM, or malware attachments or on servers that access the Web. They benefit cybercriminals by stealing information for subsequent sale and help absorb infected PCs into [botnets](http://en.wikipedia.org/wiki/Botnets).

Web threats pose a broad range of risks, including financial damages, identity theft, loss of confidential information/data, theft of network resources, damaged brand/personal reputation, and erosion of consumer confidence in e-commerce and online banking.

It is a type of [threat](http://en.wikipedia.org/wiki/Threat_(computer)) related to information technology (IT). The [IT risk](http://en.wikipedia.org/wiki/IT_risk), i.e. risk affecting has gained and increasing impact on society due to the spread of IT processes. [[1]](http://en.wikipedia.org/wiki/Web_threats#cite_note-0) [[2]](http://en.wikipedia.org/wiki/Web_threats#cite_note-1) [[3]](http://en.wikipedia.org/wiki/Web_threats#cite_note-2)

**Delivery methods**

Web threats can be divided into two primary categories, based on delivery method – push and pull.[[4]](http://en.wikipedia.org/wiki/Web_threats#cite_note-3)

Push-based threats use [spam](http://en.wikipedia.org/wiki/E-mail_spam), [phishing](http://en.wikipedia.org/wiki/Phishing), or other fraudulent means to lure a user to a malicious (often spoofed) website which then collects information and/or injects [malware](http://en.wikipedia.org/wiki/Malware). Push attacks use phishing, [DNS poisoning](http://en.wikipedia.org/wiki/DNS_poisoning) (or [pharming](http://en.wikipedia.org/wiki/Pharming)), and other means to appear to originate from a trusted source. Precisely-targeted push-based web threats are often referred to as spear phishing to reflect the focus of their data gathering attack. Spear phishing typically targets specific individuals and groups for financial gain. In other push-based web threats, malware authors use social engineering such as enticing subject lines that reference holidays, popular personalities, sports, pornography, world events and other hot topics to persuade recipients to open the email and follow links to malicious websites or open attachments with malware that accesses the Web.

Pull-based web threats are often referred to as “[drive-by](http://en.wikipedia.org/wiki/Drive-by_download)” threats by experts (and more commonly as “drive-by downloads” by journalists and the general public), since they can affect any website visitor. Cybercriminals infect legitimate websites, which unknowingly transmit malware to visitors or alter search results to take users to malicious websites. Upon loading the page, the user’s browser passively runs a malware downloader in a hidden HTML frame (IFRAME) without any user interaction.

**Growth of web threats**

“And if today’s malware runs mostly runs on Windows because it’s the commonest executable platform, tomorrow’s will likely run on the Web, for the very same reason. Because, like it or not, the Web is already a huge executable platform, and we should start thinking of it this way, from a security perspective.” – Giorgio Maone [[5]](http://en.wikipedia.org/wiki/Web_threats#cite_note-4)

The growth of web threats is a result of the popularity of the Web – a relatively unprotected, widely and consistently used medium that is crucial to business productivity, online banking, and e-commerce as well as the everyday lives of people worldwide. The appeal of Web 2.0 applications and websites increases the vulnerability of the Web. Most Web 2.0 applications make use of AJAX, a group of [web development](http://en.wikipedia.org/wiki/Web_development) programming tools used for creating interactive [web applications](http://en.wikipedia.org/wiki/Web_applications) or [rich Internet applications](http://en.wikipedia.org/wiki/Rich_Internet_applications). While users benefit from greater interactivity and more dynamic websites, they are also exposed to the greater security risks inherent in browser client processing.[[6]](http://en.wikipedia.org/wiki/Web_threats#cite_note-5)

**Prevention and detection**

Conventional approaches have failed to fully protect consumers and businesses from web threats. The most viable approach is to implement multi-layered protection—protection in the cloud, at the Internet gateway, across network servers and on the client.

## Computer crime

**Computer crime** refers to any crime that involves a [computer](http://en.wikipedia.org/wiki/Computer) and a [network](http://en.wikipedia.org/wiki/Computer_network).[[1]](http://en.wikipedia.org/wiki/Cybercrime#cite_note-moore-0) The computer may have been used in the commission of a crime, or it may be the target.[[2]](http://en.wikipedia.org/wiki/Cybercrime#cite_note-kruse-1)

**Netcrime** refers to criminal exploitation of the [Internet](http://en.wikipedia.org/wiki/Internet).[[3]](http://en.wikipedia.org/wiki/Cybercrime#cite_note-2) Cybercrimes are defined as: "Offences that are committed against individuals or groups of individuals with a criminal motive to intentionally harm the reputation of the victim or cause physical or mental harm to the victim directly or indirectly, using modern telecommunication networks such as Internet (Chat rooms, emails, notice boards and groups) and mobile phones (SMS/MMS)".[[4]](http://en.wikipedia.org/wiki/Cybercrime#cite_note-3)  Issues surrounding this type of crime have become high-profile, particularly those surrounding [cracking](http://en.wikipedia.org/wiki/Hacker_(computer_security)), [copyright infringement](http://en.wikipedia.org/wiki/Copyright_infringement), [child pornography](http://en.wikipedia.org/wiki/Child_pornography), and [child grooming](http://en.wikipedia.org/wiki/Child_grooming).

## Hacking

[Page move-protected](http://en.wikipedia.org/wiki/Wikipedia:Protection_policy#move)

**Hacking** means finding out weaknesses in a computer or computer network and exploiting them, though the term can also refer to someone with an advanced understanding of computers and computer networks.[[1]](http://en.wikipedia.org/wiki/Hacker_(computer_security)#cite_note-0) Hackers may be motivated by a multitude of reasons, such as profit, protest, or challenge.[[2]](http://en.wikipedia.org/wiki/Hacker_(computer_security)#cite_note-crackdown-1) The subculture that has evolved around hackers is often referred to as the computer underground but it is now an open [community](http://en.wikipedia.org/wiki/Community).[[3]](http://en.wikipedia.org/wiki/Hacker_(computer_security)#cite_note-2)

## Cyber spying

**Cyber spying** or **Cyber**[**espionage**](http://en.wikipedia.org/wiki/Espionage) is the act or practice of obtaining secrets without the permission of the holder of the information (personal, sensitive, proprietary or of classified nature), from individuals, competitors, rivals, groups, governments and enemies for personal, economic, political or military advantage using methods on the Internet, networks or individual computers through the use of [cracking](http://en.wikipedia.org/wiki/Hacker_(computer_security)) techniques and [malicious software](http://en.wikipedia.org/wiki/Malicious_software) including [Trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)) and [spyware](http://en.wikipedia.org/wiki/Spyware). It may wholly be perpetrated online from computer desks of professionals on bases in far away countries or may involve infiltration at home by computer trained conventional [spies](http://en.wikipedia.org/wiki/Espionage) and [moles](http://en.wikipedia.org/wiki/Mole_(espionage)) or in other cases may be the [criminal](http://en.wikipedia.org/wiki/Criminal) handiwork of [amateur](http://en.wikipedia.org/wiki/Amateur) malicious hackers and [software programmers](http://en.wikipedia.org/wiki/Software_programmer).

Cyber spying typically involves the use of such access to secrets and classified information or control of individual computers or whole networks for a [strategic](http://en.wikipedia.org/wiki/Strategy) advantage and for [psychological](http://en.wikipedia.org/wiki/Psychological_subversion), [political](http://en.wikipedia.org/wiki/Subversion_(politics)) and physical subversion activities and [sabotage](http://en.wikipedia.org/wiki/Sabotage). More recently, cyber spying involves analysis of public activity on social networking sites like [Facebook](http://en.wikipedia.org/wiki/Facebook) and [Twitter](http://en.wikipedia.org/wiki/Twitter).[[1]](http://en.wikipedia.org/wiki/Cyber_spying#cite_note-0)

Such operations, like non-cyber espionage, are typically illegal in the victim country while fully supported by the highest level of government in the aggressor country. The ethical situation likewise depends on one's viewpoint, particularly one's opinion of the governments involved.

# VII Electronic Business (eBusiness)

**Electronic business**, commonly referred to as "**eBusiness**" or "**e-business**", or an internet business, may be defined as the application of information and communication technologies ([ICT](http://en.wikipedia.org/wiki/Information_and_communication_technologies)) in support of all the activities of business. Commerce constitutes the exchange of products and services between businesses, groups and individuals and can be seen as one of the essential activities of any business. Electronic commerce focuses on the use of ICT to enable the external activities and relationships of the business with individuals, groups and other businesses.[[1]](http://en.wikipedia.org/wiki/E-business#cite_note-0)

## The principle of e-Business, internet as new and exciting channel for business

The term "e-business" was coined by [IBM](http://en.wikipedia.org/wiki/IBM)'s marketing and Internet teams in 1996.[[2]](http://en.wikipedia.org/wiki/E-business#cite_note-1)[[3]](http://en.wikipedia.org/wiki/E-business#cite_note-2)

Electronic business methods enable companies to link their internal and external data processing systems more efficiently and flexibly, to work more closely with suppliers and partners, and to better satisfy the needs and expectations of their customers.

In practice, e-business is more than just [e-commerce](http://en.wikipedia.org/wiki/E-commerce). While e-business refers to more strategic focus with an emphasis on the functions that occur using electronic capabilities, [e-commerce](http://en.wikipedia.org/wiki/E-commerce) is a subset of an overall e-business strategy. E-commerce seeks to add revenue streams using the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) or the [Internet](http://en.wikipedia.org/wiki/Internet) to build and enhance relationships with clients and partners and to improve efficiency using the [Empty Vessel](http://en.wikipedia.org/wiki/Empty_Vessel) strategy. Often, e-commerce involves the application of [knowledge management](http://en.wikipedia.org/wiki/Knowledge_management) systems.

E-business involves business processes spanning the entire [value chain](http://en.wikipedia.org/wiki/Value_chain): electronic purchasing and [supply chain management](http://en.wikipedia.org/wiki/Supply_chain_management), processing orders electronically, handling customer service, and cooperating with business partners. Special technical standards for e-business facilitate the exchange of data between companies. E-business software solutions allow the integration of intra and inter firm business processes. E-business can be conducted using the [Web](http://en.wikipedia.org/wiki/World_Wide_Web), the Internet, [intranets](http://en.wikipedia.org/wiki/Intranet), [extranets](http://en.wikipedia.org/wiki/Extranet), or some combination of these.

Basically, electronic commerce (EC) is the process of buying, transferring, or exchanging products, services, and/or information via computer networks, including the internet. EC can also be beneficial from many perspectives including business process, service, learning, collaborative, community. EC is often confused with e-business.

**Subsets**

Applications can be divided into three categories:

1. Internal business systems:
   * [customer relationship management](http://en.wikipedia.org/wiki/Customer_relationship_management)
   * [enterprise resource planning](http://en.wikipedia.org/wiki/Enterprise_resource_planning)
   * [document management systems](http://en.wikipedia.org/wiki/Document_management_system)
   * [human resources management](http://en.wikipedia.org/wiki/Human_resources_management)
2. Enterprise communication and collaboration:
   * [VoIP](http://en.wikipedia.org/wiki/VoIP)
   * [content management system](http://en.wikipedia.org/wiki/Content_management_system)
   * [e-mail](http://en.wikipedia.org/wiki/E-mail)
   * [voice mail](http://en.wikipedia.org/wiki/Voice_mail)
   * [Web conferencing](http://en.wikipedia.org/wiki/Web_conferencing)
   * [Digital work flows](http://en.wikipedia.org/w/index.php?title=Digital_work_flows&action=edit&redlink=1) (or [business process management](http://en.wikipedia.org/wiki/Business_process_management))
3. [electronic commerce](http://en.wikipedia.org/wiki/Electronic_commerce) - [business-to-business electronic commerce](http://en.wikipedia.org/wiki/Business-to-business_electronic_commerce) (B2B) or [business-to-consumer electronic commerce](http://en.wikipedia.org/w/index.php?title=Business-to-consumer_electronic_commerce&action=edit&redlink=1) (B2C):
   * [internet shop](http://en.wikipedia.org/wiki/Internet_shop)
   * [supply chain management](http://en.wikipedia.org/wiki/Supply_chain_management)
   * [online marketing](http://en.wikipedia.org/wiki/Online_marketing)
   * [offline marketing](http://en.wikipedia.org/w/index.php?title=Offline_marketing&action=edit&redlink=1)

**Models**

When organizations go online, they have to decide which e-business models best suit their goals.[[4]](http://en.wikipedia.org/wiki/E-business#cite_note-3) A [business model](http://en.wikipedia.org/wiki/Business_model) is defined as the organization of product, [service](http://en.wikipedia.org/wiki/Service_(economics)) and information flows, and the source of revenues and benefits for [suppliers](http://en.wikipedia.org/wiki/Suppliers) and [customers](http://en.wikipedia.org/wiki/Customers). The concept of e-business model is the same but used in the online presence. The following is a list of the currently most adopted e-business models such as:

* [E-shops](http://en.wikipedia.org/wiki/Online_shop)
* [E-commerce](http://en.wikipedia.org/wiki/Electronic_commerce)
* [E-procurement](http://en.wikipedia.org/wiki/E-procurement)
* [E-malls](http://en.wikipedia.org/w/index.php?title=E-malls&action=edit&redlink=1)
* [E-auctions](http://en.wikipedia.org/wiki/Reverse_auction)
* [Virtual Communities](http://en.wikipedia.org/wiki/Virtual_Communities)
* [Collaboration Platforms](http://en.wikipedia.org/wiki/Collaboration_platform)
* [Third-party Marketplaces](http://en.wikipedia.org/wiki/Amazon_Marketplace)
* [Value-chain Integrators](http://en.wikipedia.org/w/index.php?title=Value-chain_Integrators&action=edit&redlink=1)
* [Value-chain Service Providers](http://en.wikipedia.org/wiki/Virtual_Value_Chain)
* [Information Brokerage](http://en.wikipedia.org/wiki/Information_Brokerage)
* [Telecommunication](http://en.wikipedia.org/wiki/Telecommunication)
* [Customer relationship](http://en.wikipedia.org/w/index.php?title=Customer_relationship&action=edit&redlink=1)

## Classification by provider and consumer

Roughly dividing the world into providers/producers and consumers/clients one can classify e-businesses into the following categories:

* [business-to-business](http://en.wikipedia.org/wiki/Business-to-business) (B2B)
* [business-to-consumer](http://en.wikipedia.org/wiki/Business-to-consumer) (B2C)
* [business-to-employee](http://en.wikipedia.org/wiki/Business-to-employee) (B2E)
* [business-to-government](http://en.wikipedia.org/wiki/Business-to-government) (B2G)
* [government-to-business](http://en.wikipedia.org/wiki/Government-to-business) (G2B)
* [government-to-government](http://en.wikipedia.org/wiki/Government-to-government) (G2G)
* [government-to-citizen](http://en.wikipedia.org/wiki/Government-to-citizen) (G2C)
* [consumer-to-consumer](http://en.wikipedia.org/wiki/Consumer-to-consumer) (C2C)
* [consumer-to-business](http://en.wikipedia.org/wiki/Consumer-to-business) (C2B)

## Electronic Business Security

E-Business systems naturally have greater security risks than traditional business systems, therefore it is important for e-business systems to be fully protected against these risks. A far greater number of people have access to e-businesses through the internet than would have access to a traditional business. Customers, suppliers, employees, and numerous other people use any particular e-business system daily and expect their confidential information to stay secure. Hackers are one of the great threats to the security of e-businesses. Some common security concerns for e-Businesses include keeping business and customer information private and confidential, authenticity of data, and data integrity. Some of the methods of protecting e-business security and keeping information secure include physical security measures as well as data storage, data transmission, anti-virus software, firewalls, and encryption to list a few.[[5]](http://en.wikipedia.org/wiki/E-business#cite_note-Pitts-4)[[6]](http://en.wikipedia.org/wiki/E-business#cite_note-canada-5)

## Digital economy

A **Digital Economy** refers to an economy that is based on digital technologies (computers, communication networks, software and other related technologies. The digital economy is also sometimes called the *Internet Economy*, the *New Economy*, or *Web Economy*.

The concept of a digital economy emerged in the last decade of the 20th century. [Nicholas Negroponte](http://en.wikipedia.org/wiki/Nicholas_Negroponte) (1995) used a metaphor of shifting from processing atoms to processing bits. He discussed the disadvantages of the former (e.g., mass, materials, transport) and advantages of the latter (e.g., weightlessness, virtual, instant global movement). In this new economy, digital networking and communication infrastructures provide a global platform over which people and organizations devise strategies, interact, communicate, collaborate and search for information. For example:

* A vast array of digitizable products - databases, news and information, books, magazines, etc which are delivered over the digital infrastructure anytime, anywhere in the world.

## Digital economy in eGovernment

With growing population and resource mobilisation, digital economy is not limited to business trading and services only but, it encompasses every aspect of life from health to education and from business to banking. Further while everything is happening on digital medium then why not communication with government. eGovernment is already playing its part in this digital economy by providing eservices through various ministry/department to its eCitizen.

## The principle of e-Commerce

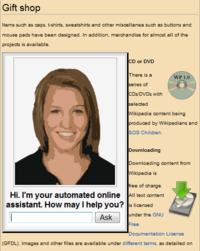
**Electronic commerce**, commonly known as **e-commerce** or **e-comm**, refers to the buying and selling of [products](http://en.wikipedia.org/wiki/Product_(business)) or [services](http://en.wikipedia.org/wiki/Service_(economics)) over electronic systems such as the [Internet](http://en.wikipedia.org/wiki/Internet) and other [computer networks](http://en.wikipedia.org/wiki/Computer_network). Electronic commerce draws on such technologies as [electronic funds transfer](http://en.wikipedia.org/wiki/Electronic_funds_transfer), [supply chain management](http://en.wikipedia.org/wiki/Supply_chain_management), [Internet marketing](http://en.wikipedia.org/wiki/Internet_marketing), [online transaction processing](http://en.wikipedia.org/wiki/Online_transaction_processing), [electronic data interchange](http://en.wikipedia.org/wiki/Electronic_data_interchange) (EDI),[inventory management](http://en.wikipedia.org/wiki/Inventory_management) systems, and automated data collection systems. Modern electronic commerce typically uses the [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) at least at one point in the transaction's life-cycle, although it may encompass a wider range of technologies such as [e-mail](http://en.wikipedia.org/wiki/E-mail), mobile devices and telephones as well.

Electronic commerce is generally considered to be the sales aspect of [e-business](http://en.wikipedia.org/wiki/E-business). It also consists of the exchange of data to facilitate the financing and payment aspects of business transactions.

E-commerce can be divided into:

* E-tailing or "virtual storefronts" on Web sites with online catalogs, sometimes gathered into a "virtual mall"
* The gathering and use of demographic data through Web contacts
* Electronic Data Interchange (EDI), the business-to-business exchange of data
* E-mail and fax and their use as media for reaching prospects and established customers (for example, with newsletters)
* Business-to-business buying and selling
* The security of business transactions

**Business applications**

[](http://en.wikipedia.org/wiki/File:Automated_online_assistant.png)An example of an [automated online assistant](http://en.wikipedia.org/wiki/Automated_online_assistant) on a merchandising website. Some common applications related to electronic commerce are the following:

* [Document automation](http://en.wikipedia.org/wiki/Document_automation) in [supply chain](http://en.wikipedia.org/wiki/Supply_chain) and [logistics](http://en.wikipedia.org/wiki/Logistics)
* Domestic and international [payment systems](http://en.wikipedia.org/wiki/Payment_system)
* [Enterprise content management](http://en.wikipedia.org/wiki/Enterprise_content_management)
* [Group buying](http://en.wikipedia.org/wiki/Group_buying)
* [Automated online assistants](http://en.wikipedia.org/wiki/Automated_online_assistant)
* [Instant messaging](http://en.wikipedia.org/wiki/Instant_messaging)
* [Newsgroups](http://en.wikipedia.org/wiki/Newsgroups)
* [Online shopping](http://en.wikipedia.org/wiki/Online_shopping) and order tracking
* [Online banking](http://en.wikipedia.org/wiki/Online_banking)
* [Online office suites](http://en.wikipedia.org/wiki/Online_office_suite)
* [Shopping cart software](http://en.wikipedia.org/wiki/Shopping_cart_software)
* [Teleconferencing](http://en.wikipedia.org/wiki/Teleconferencing)
* [Electronic tickets](http://en.wikipedia.org/wiki/Electronic_ticket)

**Global trends**

Business models across the world continue to change drastically with the advent of e-commerce and this change is not just restricted to USA. Other countries are also contributing to the growth of e-commerce. For example, the United Kingdom has the biggest e-commerce market in the world when measured by the amount spent per capita, even higher than the USA. The [internet economy](http://en.wikipedia.org/wiki/Internet_economy) in UK is likely to grow by 10% between 2010 to 2015. This has led to changing dynamics for the advertising industry [[23]](http://en.wikipedia.org/wiki/Electronic_commerce#cite_note-22)

Amongst emerging economies, China's e-commerce presence continues to expand. With 384 million internet users, China's online shopping sales rose to $36.6 billion in 2009 and one of the reasons behind the huge growth has been the improved trust level for shoppers. The Chinese retailers have been able to help consumers feel more comfortable shopping online.[[24]](http://en.wikipedia.org/wiki/Electronic_commerce#cite_note-23) eCommerce is also expanding across the Middle East. Having recorded the world’s fastest growth in internet usage between 2000 and 2009, the region is now home to more than 60 million internet users. Retail, travel and gaming are the region’s top eCommerce segments, in spite of difficulties such as the lack of region-wide legal frameworks and logistical problems in cross-border transportation.[[25]](http://en.wikipedia.org/wiki/Electronic_commerce#cite_note-24) E-Commerce has become an important tool for businesses worldwide not only to sell to customers but also to engage them.[[26]](http://en.wikipedia.org/wiki/Electronic_commerce#cite_note-25)

**Distribution channels**

E-commerce has grown in importance as companies have adopted Pure-Click and [Brick and Click](http://en.wikipedia.org/wiki/Bricks_and_clicks) channel systems. We can distinguish between pure-click and brick and click channel system adopted by companies.

* Pure-Click companies are those that have launched a website without any previous existence as a firm. It is imperative that such companies must set up and operate their e-commerce websites very carefully. Customer service is of paramount importance.
* Brick and Click companies are those existing companies that have added an online site for e-commerce. Initially, Brick and Click companies were skeptical whether or not to add an online e-commerce channel for fear that selling their products might produce channel conflict with their off-line retailers, agents, or their own stores. However, they eventually added internet to their distribution channel portfolio after seeing how much business their online competitors were generating.

**Examples of e-Commerce transactions**:

* + Trading at eBay.com
  + Trading at Amazon.com
  + Trading shares at the stock market online
  + Online booking
  + Different purchases on the Internet
  + A retailer orders merchandise using an EDI network
  + Etc.

## The principle of m-Commerce

Mobile Commerce, also known as M-Commerce or mCommerce, is the ability to conduct commerce using a mobile device, such as a mobile phone, a Personal Digital Assistant (PDA), a smartphone, or other emerging mobile equipment such as [dashtop mobile](http://en.wikipedia.org/wiki/Dashtop_mobile) devices. Mobile Commerce has been defined as follows:

"Mobile Commerce is any transaction, involving the transfer of ownership or rights to use goods and services, which is initiated and/or completed by using mobile access to computer-mediated networks with the help of an electronic device."[[1]](http://en.wikipedia.org/wiki/Mobile_commerce#cite_note-0)

According to [comScore](http://en.wikipedia.org/wiki/ComScore), up to November 2011 there were 38 percent of smartphone owners have used their phone to make a purchase at least once.[[2]](http://en.wikipedia.org/wiki/Mobile_commerce#cite_note-1)

***Products and services available:***

* **Mobile ticketing**

Tickets can be sent to mobile phones using a variety of technologies. Users are then able to use their tickets immediately, by presenting their phones at the venue.

Tickets can be booked and cancelled on the mobile device with the help of simple application downloads, or by accessing the WAP portals of various travel agents or direct service providers.

* **Mobile vouchers, coupons and loyalty cards**

Mobile ticketing technology can also be used for the distribution of vouchers, coupons, and loyalty cards. These items are represented by a virtual token that is sent to the mobile phone. A customer presenting a mobile phone with one of these tokens at the [point of sale](http://en.wikipedia.org/wiki/Point_of_sale) receives the same benefits as if they had the traditional token. Stores may send coupons to customers using [location-based services](http://en.wikipedia.org/wiki/Location-based_service) to determine when the customer is nearby.

* **Content purchase and delivery**

Currently, mobile content purchase and delivery mainly consists of the sale of ring-tones, wallpapers, and games for mobile phones. The convergence of mobile phones, portable audio players, and video players into a single device is increasing the purchase and delivery of full-length music tracks and video. The download speeds available with [4G](http://en.wikipedia.org/wiki/4G) networks make it possible to buy a movie on a mobile device in a couple of seconds.

* **Location-based services**

The location of the mobile phone user is an important piece of information used during mobile commerce or m-commerce transactions. Knowing the location of the user allows for [location-based services](http://en.wikipedia.org/wiki/Location-based_service) such as:

* Local discount offers
* Local weather
* Tracking and monitoring of people
* **Information services**

A wide variety of information services can be delivered to mobile phone users in much the same way as it is delivered to PCs. These services include:

* [News](http://en.wikipedia.org/wiki/News)
* [Stock quotes](http://en.wikipedia.org/wiki/Ticker_tape)
* Sports scores
* Financial records
* [Traffic reporting](http://en.wikipedia.org/wiki/Traffic_reporting)

Customized traffic information, based on a user's actual travel patterns, can be sent to a mobile device. This customized data is more useful than a generic traffic-report broadcast, but was impractical before the invention of modern mobile devices due to the [bandwidth](http://en.wikipedia.org/wiki/Bandwidth_(computing)) requirements.

* **Mobile banking**

*Main article:*[*Mobile Banking*](http://en.wikipedia.org/wiki/Mobile_Banking)

Banks and other financial institutions use mobile commerce to allow their customers to access account information and make transactions, such as purchasing stocks, remitting money. This service is often referred to as [*Mobile Banking*](http://en.wikipedia.org/wiki/Mobile_Banking), or M-Banking.

* **Mobile StoreFront**

The reinvention of the mobile phone as a touch sensitive handheld computer has for the first time made mobile commerce practically feasible. 'According to ABI Research, mobile is going to get a lot bigger in the ecommerce market. The research firm is predicting that in 2015, $119bn worth of goods and services will be purchased via a mobile phone.'

* **Mobile brokerage**

Stock market services offered via mobile devices have also become more popular and are known as Mobile Brokerage. They allow the subscriber to react to market developments in a timely fashion and irrespective of their physical location.

* **Auctions**

Over the past three years[[*when?*](http://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style_(dates_and_numbers)#Chronological_items)] [mobile reverse auction](http://en.wikipedia.org/wiki/Mobile_reverse_auction) solutions have grown in popularity.[[*by whom?*](http://en.wikipedia.org/wiki/Wikipedia:Avoid_weasel_words)] Unlike traditional auctions, the reverse auction (or low-bid auction) bills the consumer's phone each time they place a bid. Many mobile [SMS](http://en.wikipedia.org/wiki/SMS) commerce solutions rely on a one-time purchase or one-time subscription; however, reverse auctions offer a high return for the mobile vendor as they require the consumer to make multiple transactions over a long period of time.

* **Mobile Browsing**

Using a mobile browser—a [World Wide Web](http://en.wikipedia.org/wiki/World_Wide_Web) browser on a mobile device—customers can shop online without having to be at their personal computer.

* **Mobile Purchase**

[Catalog merchants](http://en.wikipedia.org/wiki/Catalog_merchants) can accept orders from customers electronically, via the customer's mobile device. In some cases, the merchant may even deliver the catalog electronically, rather than mailing a paper catalog to the customer. Some merchants provide [mobile websites](http://en.wikipedia.org/wiki/Mobile_web) that are customized for the smaller screen and limited user interface of a mobile device.

* **Mobile marketing and advertising**

In the context of mobile commerce, **mobile marketing** refers to marketing sent to mobile devices. Companies have reported that they see better response from mobile marketing campaigns than from traditional campaigns. Research demonstrates that consumers of mobile and wire line markets represent two distinct groups who are driven by different values and behaviors, and who exhibit dissimilar psychographic and demographic profiles.[[5]](http://en.wikipedia.org/wiki/Mobile_commerce#cite_note-4) As a result, successful mobile commerce requires the development of marketing campaigns targeted to this particular market segment.

**Influence on youth markets**

Mobile media is a rapidly changing field. New technologies, such as [WiMax](http://en.wikipedia.org/wiki/WiMax), act to accelerate innovation in mobile commerce. Early pioneers in mobile advertising include [Vodafone](http://en.wikipedia.org/wiki/Vodafone), [Orange](http://en.wikipedia.org/wiki/Orange_(telecommunications)), and [SK Telecom](http://en.wikipedia.org/wiki/SK_Telecom).

Mobile devices are heavily used in South Korea to conduct mobile commerce. Mobile companies in South Korea believed that mobile technology would become synonymous with youth life style, based on their experience with previous generations of South Koreans.

**Payment methods**

Consumers can use many forms of payment in mobile commerce, including:

* [Premium-rate telephone numbers](http://en.wikipedia.org/wiki/Premium-rate_telephone_number)', which apply charges to the consumer's long-distance bill
* Charges added to the consumer's mobile telephone bill, including deductions to pre-paid calling plans
* [Credit cards](http://en.wikipedia.org/wiki/Credit_card)
  + Some providers allow credit cards to be linked to a phone's [SIM card](http://en.wikipedia.org/wiki/SIM_card)
* [Micropayment](http://en.wikipedia.org/wiki/Micropayment) services
* [Stored-value cards](http://en.wikipedia.org/wiki/Stored-value_card), often used with mobile-device application stores or music stores

## Different classification of e-Commerce system

Roughly dividing the world into providers/producers and consumers/clients one can classify e-businesses into the following categories:

**Business-to-Business (B2B)**

**Business-to-business** (**B2B**) describes commerce transactions between businesses, such as between a [manufacturer](http://en.wikipedia.org/wiki/Manufacturer) and a [wholesaler](http://en.wikipedia.org/wiki/Wholesaler), or between a wholesaler and a retailer. Contrasting terms are business-to-consumer ([B2C](http://en.wikipedia.org/wiki/Business-to-consumer)) and business-to-government ([B2G](http://en.wikipedia.org/wiki/Business-to-government)).

The volume of B2B (Business-to-Business) transactions is much higher than the volume of B2C transactions. [[1]](http://en.wikipedia.org/wiki/Business-to-business#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Business-to-business#cite_note-1)[[3]](http://en.wikipedia.org/wiki/Business-to-business#cite_note-2) The primary reason for this is that in a typical [supply chain](http://en.wikipedia.org/wiki/Supply_chain) there will be many B2B transactions involving sub components or [raw materials](http://en.wikipedia.org/wiki/Raw_materials), and only one B2C transaction, specifically sale of the finished product to the end customer. For example, an automobile manufacturer makes several B2B transactions such as buying tires, glass for windscreens, and rubber hoses for its vehicles. The final transaction, a finished vehicle sold to the consumer, is a single ([B2C](http://en.wikipedia.org/wiki/Business-to-consumer)) transaction.

B2B is also used in the context of communication and collaboration. Many businesses are now using social media to connect with their consumers (B2C); however, they are now using similar tools within the business so employees can connect with one another. When communication is taking place amongst employees, this can be referred to as "B2B" communication.

**Business-to-Consumer (B2C)**

**Retail** is the [sale](http://en.wikipedia.org/wiki/Sales) of goods and services from individuals or businesses to the [end-user](http://en.wikipedia.org/wiki/End-user). Retailers are part of an integrated system called the [supply-chain](http://en.wikipedia.org/wiki/Supply-chain). A retailer purchases goods or [products](http://en.wikipedia.org/wiki/Product_(business)) in large quantities from [manufacturers](http://en.wikipedia.org/wiki/Manufacturing) or directly through a [wholesaler](http://en.wikipedia.org/wiki/Wholesale), and then sells smaller quantities to the [consumer](http://en.wikipedia.org/wiki/Consumer) for a profit.

B2C (Business to Consumer) represents online retailing/transaction that occurs between a company and a consumer.

**Business-to-employee** (**B2E)**

**Business-to-employee** (**B2E**) [electronic commerce](http://en.wikipedia.org/wiki/Electronic_commerce) uses an intrabusiness [network](http://en.wikipedia.org/wiki/Computer_network) which allows companies to provide products and/or services to their employees. Typically, companies use B2E networks to automate employee-related corporate processes.

Examples of B2E applications include:

* Online insurance policy management
* Corporate announcement dissemination
* Online supply requests
* Special employee offers
* [Employee benefits](http://en.wikipedia.org/wiki/Employee_benefits) reporting
* [401(k)](http://en.wikipedia.org/wiki/401(k)) Management

**Business-to-government** (**B2G**)

**Business-to-government** (**B2G**) is a derivative of [B2B marketing](http://en.wikipedia.org/wiki/Business-to-business) and often referred to as a market definition of "public sector marketing" which encompasses marketing products and services to various government levels - including federal, state and local - through integrated marketing communications techniques such as strategic public relations, branding, marcom, advertising, and web-based communications.

B2G networks provide a platform for businesses to bid on government opportunities which are presented as solicitations in the form of [RFPs](http://en.wikipedia.org/wiki/RFP) in a [reverse auction](http://en.wikipedia.org/wiki/Reverse_auction) fashion. Public sector organizations (PSOs) post [tenders](http://en.wikipedia.org/wiki/Call_for_bids) in the form of RFPs, [RFIs](http://en.wikipedia.org/wiki/Request_for_information), [RFQs](http://en.wikipedia.org/wiki/Request_for_quotation), Sources Sought, etc. and suppliers respond to them.

**Government-to-Business (G2B)**

**Government-to-Business** (abbreviated [G2B](http://en.wikipedia.org/wiki/G2B_(disambiguation))) is the [online](http://en.wikipedia.org/wiki/Online) non-commercial interaction between local and central government and the commercial business sector, rather than private individuals ([G2C](http://en.wikipedia.org/wiki/G2C)), with the purpose of providing businesses information and advice on [e-business](http://en.wikipedia.org/wiki/E-business) '[best practices](http://en.wikipedia.org/wiki/Best_practices)'.

**Government-to-Government (G2G)**

**Government-to-Government** (abbreviated G2G) is the online non-commercial interaction between Government organisations, departments, and authorities and other Government organisations, departments, and authorities. Its use is common in the [UK](http://en.wikipedia.org/wiki/UK), along with [G2C](http://en.wikipedia.org/wiki/G2C), the online non-commercial interaction of local and central Government and private individuals, and [G2B](http://en.wikipedia.org/wiki/Government-to-business) the online non-commercial interaction of local and central Government and the commercial business sector.

**Government-to-Citizen (G2C)**

**Government-to-Citizen** (abbreviated G2C) is the communication link between a government and private individuals or residents. Such G2C communication most often refers to that which takes place through [Information and Communication Technologies](http://en.wikipedia.org/wiki/Information_and_Communication_Technologies) (ICTs), but can also include [direct mail](http://en.wikipedia.org/wiki/Direct_mail) and media campaigns. G2C can take place at the federal, state, and local levels. G2C stands in contrast to G2B, or [Government-to-Business](http://en.wikipedia.org/wiki/Government-to-business) networks.

**Consumer-to-consumer  (C2C)**

**Consumer-to-consumer** (C2C) (or *citizen-to-citizen*) [**electronic commerce**](http://en.wikipedia.org/wiki/Electronic_commerce) involves the electronically facilitated transactions between consumers through some third party. A common example is the[online auction](http://en.wikipedia.org/wiki/Online_auction), in which a consumer posts an item for sale and other consumers bid to purchase it; the third party generally charges a [flat fee](http://en.wikipedia.org/wiki/Flat_fee) or [commission](http://en.wikipedia.org/wiki/Commission_(remuneration)). The sites are only intermediaries, just there to match consumers. They do not have to check quality of the products being offered.

**Consumer-to-consumer**[[1]](http://en.wikipedia.org/wiki/Consumer_to_consumer#cite_note-multiple-0) (C2C) [**marketing**](http://en.wikipedia.org/wiki/Marketing) is the creation of a product or service with the specific promotional strategy being for consumers to share that product or service with others as brand [advocates](http://en.wikipedia.org/wiki/Advocates) based on the value of the product. The investment into concepting and developing a top of the line product or service that consumers are actively looking for is equatable to a [Business-to-consumer](http://en.wikipedia.org/wiki/Business-to-consumer) [[1]](http://en.wikipedia.org/wiki/Consumer_to_consumer#cite_note-multiple-0) (B2C) pre launch product awareness marketing spend.

**Consumer-to-business** (**C2B**)

**Consumer-to-business** (**C2B**) is a [business model](http://en.wikipedia.org/wiki/Business_model) in which consumers (individuals) create value, and firms consume this value. For example, when a consumer writes reviews, or when a consumers gives a useful idea for new product development, then this individual is creating value to the firm, if the firm adopts the input.

Another form of C2B is the [electronic commerce](http://en.wikipedia.org/wiki/Electronic_commerce) business model, in which consumers can offer products and services to companies and the companies pay them. This business model is a complete reversal of traditional business model where companies offer goods and services to consumers ([business-to-consumer](http://en.wikipedia.org/wiki/Business-to-consumer) = B2C). We can see this example in [blogs](http://en.wikipedia.org/wiki/Blogs) or [internet forums](http://en.wikipedia.org/wiki/Internet_forums) where the author offers a link back to an online business facilitating the purchase of some product (like a book on [Amazon.com](http://en.wikipedia.org/wiki/Amazon.com)), and the author might receive affiliate revenue from a successful sale.

This kind of economic relationship is qualified as an inverted business type. The advent of the C2B scheme is due to major changes:

* Connecting a large group of people to a bidirectional network has made this sort of commercial relationship possible. The large traditional media outlets are one direction relationship whereas the internet is bidirectional one.
* Decreased cost of technology : Individuals now have access to technologies that were once only available to large companies ( digital printing and acquisition technology, high performance computer, powerful software)

# VIII Information system and management

An **information system** (IS)[[1]](http://en.wikipedia.org/wiki/Information_system#cite_note-0) - is any combination of [information technology](http://en.wikipedia.org/wiki/Information_technology) and people's activities that support operations, management and decision making.[[2]](http://en.wikipedia.org/wiki/Information_system#cite_note-1) In a very broad sense, the term *information system* is frequently used to refer to the interaction between people, processes, data and technology. In this sense, the term is used to refer not only to the [information and communication technology](http://en.wikipedia.org/wiki/Information_and_communication_technology) (ICT) that an organization uses, but also to the way in which people interact with this technology in support of business processes.[[3]](http://en.wikipedia.org/wiki/Information_system#cite_note-2)

Some make a clear distinction between information systems, computer systems, and business processes. Information systems typically include an ICT component but are not purely concerned with ICT, focusing in instead, on the end use of information technology. Information systems are also different from business processes. Information systems help to control the performance of business processes.[[4]](http://en.wikipedia.org/wiki/Information_system#cite_note-3)

Alter argues for an information system as a special type of work system. A work system is a system in which humans and/or machines perform work using resources to produce specific products and/or services for customers. An information system is a work system whose activities are devoted to processing (capturing, transmitting, storing, retrieving, manipulating and displaying) information.[[5]](http://en.wikipedia.org/wiki/Information_system#cite_note-4)

As such, information systems inter-relate with [data systems](http://en.wikipedia.org/wiki/Data_systems) on the one hand and activity systems on the other. An information system is a form of [communication](http://en.wikipedia.org/wiki/Communication) system in which data represent and are processed as a form of social memory. An information system can also be considered a semi-formal language which supports human [decision making](http://en.wikipedia.org/wiki/Decision_making) and action.

Information systems are the primary focus of study for the [information systems discipline](http://en.wikipedia.org/wiki/Information_systems_(discipline)) and for [organizational informatics](http://en.wikipedia.org/wiki/Organizational_informatics).[[6]](http://en.wikipedia.org/wiki/Information_system#cite_note-5)

**Components**

It consists of computers, instructions, stored facts, people and procedures.

ISs can be categorized in five parts:

1. [Management Information System](http://en.wikipedia.org/wiki/Management_Information_System) (MIS)
2. [Decision Support System](http://en.wikipedia.org/wiki/Decision_Support_System) (DSS)
3. [Executive Information System](http://en.wikipedia.org/wiki/Executive_Information_System) (EIS)
4. [Transaction Processing System](http://en.wikipedia.org/wiki/Transaction_Processing_System) (TPS)

## Management information system

A **management information system** (**MIS**) provides information that is needed to manage organizations efficiently and effectively.[[1]](http://en.wikipedia.org/wiki/Management_Information_System#cite_note-0) Management [information systems](http://en.wikipedia.org/wiki/Information_system) involve three primary resources: people, technology, and information or decision making. Management information systems are distinct from other [information systems](http://en.wikipedia.org/wiki/Information_system) in that they are used to analyze operational activities in the organization.[[2]](http://en.wikipedia.org/wiki/Management_Information_System#cite_note-obrien-1) Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision-making, e.g. [decision support systems](http://en.wikipedia.org/wiki/Decision_support_system), [expert systems](http://en.wikipedia.org/wiki/Expert_system), and [executive information systems](http://en.wikipedia.org/wiki/Executive_information_system).[[2]](http://en.wikipedia.org/wiki/Management_Information_System#cite_note-obrien-1)

## Overview

Early business computers were used for simple operations such as tracking sales or payroll data, with little detail or structure. Over time, these [computer applications](http://en.wikipedia.org/wiki/Computer_application) became more complex, [hardware](http://en.wikipedia.org/wiki/Computer_hardware) [storage capacities](http://en.wikipedia.org/wiki/Computer_data_storage) grew, and technologies improved for connecting previously [isolated](http://en.wikipedia.org/wiki/Islands_of_automation) applications. As more and more data was stored and linked, managers sought greater detail as well as greater abstraction with the aim of creating entire management reports from the raw, stored data. The term "MIS" arose to describe such applications providing managers with information about sales, inventories, and other data that would help in managing the enterprise. Today, the term is used broadly in a number of contexts and includes (but is not limited to): [decision support systems](http://en.wikipedia.org/wiki/Decision_support_systems), [resource](http://en.wikipedia.org/wiki/Resource_management) and [people management](http://en.wikipedia.org/wiki/Human_resource_management) applications, [enterprise resource planning](http://en.wikipedia.org/wiki/Enterprise_resource_planning) (ERP), [enterprise performance management](http://en.wikipedia.org/wiki/Enterprise_performance_management) (EPM), [supply chain management](http://en.wikipedia.org/wiki/Supply_chain_management) (SCM), [customer relationship management](http://en.wikipedia.org/wiki/Customer_relationship_management) (CRM),[project management](http://en.wikipedia.org/wiki/Project_management) and database retrieval applications.

A successful MIS supports a business' long range plans, providing reports based upon performance analysis in areas critical to those plans, with feedback loops that allow for titivation of every aspect of the enterprise, including recruitment and training regimens. MIS not only indicates how things are going, but also why and where performance is failing to meet the plan. These reports include near-real-time performance of cost centers and projects with detail sufficient for individual accountability.

## Types

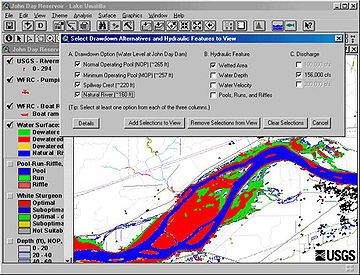
Most management information systems specialize in particular commercial and industrial sectors, aspects of the enterprise, or management substructure.

* *Management information systems (MIS)*, *per se*, produce fixed, regularly scheduled reports based on data extracted and summarized from the firm’s underlying [transaction processing systems](http://en.wikipedia.org/wiki/Transaction_processing_systems)[[4]](http://en.wikipedia.org/wiki/Management_Information_System#cite_note-3) to middle and operational level managers to identify and inform structured and semi-structured decision problems.
* [*Decision support systems*](http://en.wikipedia.org/wiki/Decision_support_system)*(DSS)* are computer program applications used by middle management to compile information from a wide range of sources to support problem solving and decision making.
* [*Executive information systems*](http://en.wikipedia.org/wiki/Executive_information_system)*(EIS)* is a reporting tool that provides quick access to summarized reports coming from all company levels and departments such as accounting, human resources and operations.
* [*Marketing information systems*](http://en.wikipedia.org/wiki/Marketing_information_system) are MIS designed specifically for managing the [marketing](http://en.wikipedia.org/wiki/Marketing) aspects of the business.
* [*Office automation systems*](http://en.wikipedia.org/wiki/Office_automation)*(OAS)* support communication and productivity in the enterprise by automating work flow and eliminating bottlenecks. OAS may be implemented at any and all levels of management.

**Enterprise applications**

* *Enterprise systems*, also known as [*enterprise resource planning*](http://en.wikipedia.org/wiki/Enterprise_resource_planning)*(ERP)* systems provide an organization with integrated software modules and a unified database which enable efficient planning, managing, and controlling of all core business processes across multiple locations. Modules of ERP systems may include finance, accounting, marketing, human resources, production, inventory management and distribution.
* [*Supply chain management*](http://en.wikipedia.org/wiki/Supply_chain_management)*(SCM)* systems enable more efficient management of the supply chain by integrating the links in a supply chain. This may include suppliers, manufacturer, wholesalers, retailers and final customers.
* [*Customer relationship management*](http://en.wikipedia.org/wiki/Customer_relationship_management)*(CRM)* systems help businesses manage relationships with potential and current customers and business partners across marketing, sales, and service.
* [*Knowledge management*](http://en.wikipedia.org/wiki/Knowledge_management)*system (KMS)* helps organizations facilitate the collection, recording, organization, retrieval, and dissemination of knowledge. This may include documents, accounting records, and unrecorded procedures, practices and skills.

## Decision support system

A **decision support system** (**DSS**) is a computer-based [information system](http://en.wikipedia.org/wiki/Information_system) that supports business or organizational [decision-making](http://en.wikipedia.org/wiki/Decision-making) activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

DSSs include [knowledge-based systems](http://en.wikipedia.org/wiki/Expert_system). A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, and personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present includes:

* inventories of information assets (including legacy and relational data sources, cubes, [data warehouses](http://en.wikipedia.org/wiki/Data_warehouse), and [data marts](http://en.wikipedia.org/wiki/Data_mart)),
* comparative sales figures between one period and the next,
* projected revenue figures based on product sales assumptions.

## Components

Three fundamental components of a DSS [architecture](http://en.wikipedia.org/wiki/Systems_architecture) are:[[5]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Haettenschwiler_1999-4)[[6]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Power_2002-5)[[10]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Sprague_and_Carlson_1982-9)[[11]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-10)[[12]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Marakas.2C_G._M._1999-11)

1. the [database](http://en.wikipedia.org/wiki/Database) (or [knowledge base](http://en.wikipedia.org/wiki/Knowledge_base)),
2. the [model](http://en.wikipedia.org/wiki/Model_(abstract)) (i.e., the decision context and user criteria), and
3. the [user interface](http://en.wikipedia.org/wiki/User_interface).

The [users](http://en.wikipedia.org/wiki/End-user_(computer_science)) themselves are also important components of the architecture.[[5]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Haettenschwiler_1999-4)[[12]](http://en.wikipedia.org/wiki/Decision_Support_System#cite_note-Marakas.2C_G._M._1999-11)

## Executive information system

An **executive information system** (EIS) is a type of [management information system](http://en.wikipedia.org/wiki/Management_information_system) intended to facilitate and support the information and [decision-making](http://en.wikipedia.org/wiki/Decision-making) needs of senior executives by providing easy access to both internal and external information relevant to meeting the strategic goals of the [organization](http://en.wikipedia.org/wiki/Organization). It is commonly considered as a specialized form of [decision support system](http://en.wikipedia.org/wiki/Decision_support_system) (DSS).[[1]](http://en.wikipedia.org/wiki/Executive_Information_System#cite_note-0)

The emphasis of EIS is on graphical displays and easy-to-use [user interfaces](http://en.wikipedia.org/wiki/User_interface). They offer strong reporting and [drill-down](http://en.wikipedia.org/wiki/Drill-down) capabilities. In general, EIS are enterprise-wide DSS that help top-level executives analyze, compare, and highlight trends in important [variables](http://en.wikipedia.org/wiki/Variable_(math)) so that they can monitor performance and identify opportunities and problems. EIS and [data warehousing](http://en.wikipedia.org/wiki/Data_warehousing) technologies are converging in the marketplace.

In recent years, the term EIS has lost popularity in favor of [business intelligence](http://en.wikipedia.org/wiki/Business_intelligence) (with the sub areas of reporting, [analytics](http://en.wikipedia.org/wiki/Analytics), and [digital dashboards](http://en.wikipedia.org/wiki/Dashboard_(business))).

## Components

The components of an EIS can typically be classified as:

### Hardware

When talking about [computer hardware](http://en.wikipedia.org/wiki/Computer_hardware) for an EIS environment, we should focus on the hardware that meet the executive’s needs. The executive must be put first and the executive’s needs must be defined before the hardware can be selected. The basic hardware needed for a typical EIS includes four components:

1. Input data-entry devices. These devices allow the executive to enter, verify, and update data immediately
2. The central processing unit ([CPU](http://en.wikipedia.org/wiki/CPU)), which is the kernel because it controls the other computer system components
3. Data storage files. The executive can use this part to save useful business information, and this part also help the executive to search historical business information easily
4. Output devices, which provide a visual or permanent record for the executive to save or read. This device refers to the visual output device such as monitor or printer

In addition, with the advent of local area networks ([LAN](http://en.wikipedia.org/wiki/LAN)), several EIS products for networked workstations became available. These systems require less support and less expensive computer hardware. They also increase access of the EIS information to many more users within a company.

### Software

Choosing the appropriate software is vital to design an effective EIS.Therefore, the software components and how they integrate the data into one system are very important. The basic software needed for a typical EIS includes four components:

1. Text base software. The most common form of text are probably documents
2. Database. Heterogeneous databases residing on a range of vendor-specific and open computer platforms help executives access both internal and external data
3. Graphic base. Graphics can turn volumes of text and statistics into visual information for executives. Typical graphic types are: time series charts, [scatter diagrams](http://en.wikipedia.org/wiki/Scatter_plot), [maps](http://en.wikipedia.org/wiki/Maps), motion graphics, sequence charts, and comparison-oriented graphs (i.e., [bar charts](http://en.wikipedia.org/wiki/Bar_chart))
4. Model base. The EIS models contain routine and special statistical, financial, and other quantitative analysis

### User interface

An EIS needs to be efficient to retrieve relevant data for decision makers, so the [user interface](http://en.wikipedia.org/wiki/User_Interface) is very important. Several types of interfaces can be available to the EIS structure, such as scheduled reports, questions/answers, menu driven, command language, natural language, and input/output.

### Telecommunication

As decentralizing is becoming the current trend in companies, telecommunications will play a pivotal role in networked information systems. Transmitting data from one place to another has become crucial for establishing a reliable network. In addition, telecommunications within an EIS can accelerate the need for access to distributed data.

## Applications

EIS enables executives to find those data according to user-defined criteria and promote information-based insight and understanding. Unlike a traditional management information system presentation, EIS can distinguish between vital and seldom-used data, and track different key critical activities for executives, both which are helpful in evaluating if the company is meeting its corporate objectives. After realizing its advantages, people have applied EIS in many areas, especially, in manufacturing, marketing, and finance areas.

### Manufacturing

Basically, manufacturing is the transformation of raw materials into finished goods for sale, or intermediate processes involving the production or finishing of semi-manufactures. It is a large branch of industry and of secondary production. Manufacturing operational control focuses on day-to-day operations, and the central idea of this process is effectiveness and efficiency.

### Marketing

In an organization, marketing executives’ role is to create the future. Their main duty is managing available marketing resources to create a more effective future. For this, they need make judgments about risk and uncertainty of a project and its impact on the company in short term and long term. To assist marketing executives in making effective marketing decisions, an EIS can be applied. EIS provides an approach to sales forecasting, which can allow the market executive to compare sales forecast with past sales. EIS also offers an approach to product price, which is found in venture analysis. The market executive can evaluate pricing as related to competition along with the relationship of product quality with price charged. In summary, EIS software package enables marketing executives to manipulate the data by looking for trends, performing audits of the sales data, and calculating totals, averages, changes, variances, or ratios.

### Financial

A financial analysis is one of the most important steps to companies today. The executive needs to use financial ratios and cash flow analysis to estimate the trends and make capital investment decisions. An EIS is a responsibility-oriented approach that integrates planning or budgeting with control of performance reporting, and it can be extremely helpful to finance executives. Basically, EIS focuses on accountability of financial performance and it recognizes the importance of cost standards and flexible budgeting in developing the quality of information provided for all executive levels.

## Transaction processing system

A **transaction processing system** is a type of [information system](http://en.wikipedia.org/wiki/Management_information_system). TPSs collect, store, modify, and retrieve the [transactions](http://en.wikipedia.org/wiki/Transaction_processing) of an organization. A transaction is an event that generates or modifies [data](http://en.wikipedia.org/wiki/Data) that is eventually stored in an information system. It is recommended that a transaction processing system should pass the [ACID test](http://en.wikipedia.org/wiki/ACID). The essence of a transaction program is that it manages data that must be left in a consistent state, e.g. if an electronic payment is made, the amount must be both withdrawn from one account and added to the other; it cannot complete only one of those steps. Either both must occur, or neither. In case of a failure preventing transaction completion, the partially executed transaction must be '[rolled back](http://en.wikipedia.org/wiki/Rollback_(data_management))' by the TPS. While this type of integrity must be provided also for [batch transaction processing](http://en.wikipedia.org/wiki/Batch_processing), it is particularly important for online processing: if e.g. an airline seat reservation system is accessed by multiple operators, after an empty seat inquiry, the seat reservation data must be locked until the reservation is made, otherwise another user may get the impression a seat is still free while it is actually being booked at the time. Without proper transaction monitoring, double bookings may occur. Other transaction monitor functions include [deadlock](http://en.wikipedia.org/wiki/Deadlock) detection and resolution (deadlocks may be inevitable in certain cases of cross-dependence on data), and transaction logging (in 'journals') for 'forward recovery' in case of massive failures.

Transaction Processing is not limited to application programs. For example, [Journaling file systems](http://en.wikipedia.org/wiki/Journaling_file_system) also employ the notion of transactions.

## Types

### Contrasted with batch processing

[Batch processing](http://en.wikipedia.org/wiki/Batch_processing) is a form of transaction processing. Batch processing involves processing several transactions at the same time, and the results of each transaction are not immediately available when the transaction is being entered;[[1]](http://en.wikipedia.org/wiki/Transaction_processing_system#endnote_HSC) there is a time delay. Transactions are accumulated for a certain period (say for day) where updates are made especially after work. Online transaction processing is the form of transaction processing that processes data as it becomes available.

### Real-time and batch processing

There are a number of differences between **real-time** and **batch processing**. These are outlined below:

Each transaction in real-time processing is unique. It is not part of a group of transactions, even though those transactions are processed in the same manner. Transactions in real-time processing are stand-alone both in the entry to the system and also in the handling of output.

Real-time processing requires the master file to be available more often for updating and reference than batch processing. The database is not accessible all of the time for batch processing.

Real-time processing has fewer errors than batch processing, as [transaction data](http://en.wikipedia.org/wiki/Transaction_data) is validated and entered immediately. With batch processing, the data is organised and stored before the master file is updated. Errors can occur during these steps.

Infrequent errors may occur in real-time processing; however, they are often tolerated. It is not practical to shut down the system for infrequent errors.

More computer operators are required in real-time processing, as the operations are not centralised. It is more difficult to maintain a real-time processing system than a batch processing system.

## Intelligent decision support systems

**Intelligent Decision Support Systems** (IDSS) is a term that describes [decision support systems](http://en.wikipedia.org/wiki/Decision_support_systems) that make extensive use of [artificial intelligence](http://en.wikipedia.org/wiki/Artificial_intelligence) (AI) techniques. Use of AI techniques in [management information systems](http://en.wikipedia.org/wiki/Management_information_systems) has a long history, indeed terms such as [Knowledge-based systems](http://en.wikipedia.org/wiki/Knowledge-based_systems) (KBS) and [intelligent systems](http://en.wikipedia.org/wiki/Intelligent_Systems) have been used since the early 1980s to describe components of management systems, but the term "Intelligent decision support system" is thought to originate with Clyde Holsapple and [Andrew Whinston](http://en.wikipedia.org/wiki/Andrew_B._Whinston)[[1]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-0)[[2]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-1) in the late 1970s. [Flexible manufacturing systems](http://en.wikipedia.org/wiki/Flexible_manufacturing_system) (FMS) [[3]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-2), intelligent marketing decision support systems [[4]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-3) and medical diagnosis systems [[5]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-4) can also be considered examples of intelligent decision support systems.

Ideally, an intelligent decision support system should behave like a human consultant; [supporting decision makers](http://en.wikipedia.org/wiki/Decision_support) by gathering and analysing evidence, identifying and diagnosing problems, proposing possible courses of action and evaluating the proposed actions. The aim of the AI techniques embedded in an intelligent decision support system is to enable these tasks to be performed by a computer, whilst emulating human capabilities as closely as possible.

Many IDSS implementations are based on [expert systems](http://en.wikipedia.org/wiki/Expert_systems)[[6]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-5), a well established type of KBS that encode the cognitive behaviours of human experts using predicate logic rules and have been shown to perform better than the original human experts in some circumstances.[[7]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-6)[[8]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-7) [Expert systems](http://en.wikipedia.org/wiki/Expert_systems) emerged as practical applications in the 1980s [[9]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-8) based on research in artificial intelligence performed during the late 1960s and early 1970s.[[10]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-9) They typically combine knowledge of a particular application domain with an [inference](http://en.wikipedia.org/wiki/Inference) capability to enable the system to propose decisions or diagnoses. Accuracy and consistency can be comparable to (or even exceed) that of human experts when the decision parameters are well known (e.g. if a common disease is being diagnosed), but performance can be poor when novel or uncertain circumstances arise.

Some research in AI, focused on enabling systems to respond to novelty and uncertainty in more flexible ways is starting to be used in intelligent decision support systems. For example [intelligent agents](http://en.wikipedia.org/wiki/Intelligent_agent)[[11]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-10) [[12]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-11) that perform complex [cognitive tasks](http://en.wikipedia.org/wiki/Cognition) without any need for human intervention have been used in a range of decision support applications.[[13]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-12) Capabilities of these intelligent agents include[knowledge sharing](http://en.wikipedia.org/wiki/KQML), [machine learning](http://en.wikipedia.org/wiki/Machine_learning), [data mining](http://en.wikipedia.org/wiki/Data_mining), and automated [inference](http://en.wikipedia.org/wiki/Inference). A range of AI techniques such as [case based reasoning](http://en.wikipedia.org/wiki/Case_based_reasoning), [rough sets](http://en.wikipedia.org/wiki/Rough_set)[[14]](http://en.wikipedia.org/wiki/Intelligent_decision_support_systems#cite_note-13) and [fuzzy logic](http://en.wikipedia.org/wiki/Fuzzy_logic) have also been used to enable decision support systems to perform better in uncertain conditions.

## Strategic information system

The concept of **Strategic Information Systems** or "SIS" was first introduced into the field of [information systems](http://en.wikipedia.org/wiki/Information_systems_(discipline)) in 1982-83 by Dr. Charles Wiseman, President of a newly formed [consultancy](http://en.wikipedia.org/wiki/Consultancy) called "Competitive Applications," (cf. NY State records for consultancies formed in 1982) who gave a series of public [lectures](http://en.wikipedia.org/wiki/Lecture) on SIS in [NYC](http://en.wikipedia.org/wiki/New_York_City) sponsored by the Datamation Institute, a subsidiary of[Datamation](http://en.wikipedia.org/wiki/Datamation) Magazine.

In 1985 Wiseman published an [article](http://en.wikipedia.org/wiki/Article_(publishing)) on this subject (co-authored by Prof. Ian MacMillan) in the Journal of Business Strategy (Journal of Business Strategy, fall, 1984)

In 1985 he published the first book on SIS called "Strategy and Computers: Information Systems as Competitive Weapons" (Dow-Jones Irwin, 1985; translated into French by Bertrand Kaulek and into Italian by Professor Fabio Corno of [Bocconi University](http://en.wikipedia.org/wiki/Bocconi_University)). In 1988 an expanded version of this book called "Strategic Information Systems" was published by Richard D. Irwin. This book was translated into Japanese by Professor Shinroki Tsuji and published by Diamond Publishing. Over 50,000 copies have been sold.

The following [quotations](http://en.wikipedia.org/wiki/Quotation) from the [Preface](http://en.wikipedia.org/wiki/Preface) of the first book ("Strategy and Computers: Information Systems as Competitive Weapons") establishes the basic idea behind the notion of SIS:

"I began collecting instances of [information systems](http://en.wikipedia.org/wiki/Information_system) used for strategic purposes five years ago, dubbing them "strategic information systems" (Internal Memo, [American Can Company](http://en.wikipedia.org/wiki/American_Can_Company) (Headquarters),[Greenwich, CT](http://en.wikipedia.org/wiki/Greenwich,_Connecticut), 1980). But from the start I was puzzled by their occurrence. At least theoretically I was unprepared to admit the existence of a new variety of [computer application](http://en.wikipedia.org/wiki/Computer_application). The conventional view at the time recognized only [management information systems](http://en.wikipedia.org/wiki/Management_information_system), and management support systems, the former used to satisfy the information needs and the latter to automate basic [business processes](http://en.wikipedia.org/wiki/Business_process) of decision makers. (Cf. articles by Richard Nolan, Jack Rockart, Michael Scott Morton, et al. at that time)...But as my file of cases grew, I realized that the conventional perspective on information systems was incomplete, unable to account for SIS. The examples belied the theory,and the theory in general blinded believers from seeing SIS. Indeed, some conventional information systems planning methodologies, which act like theories in guiding the systematic search for computer application opportunities, exclude certain SIS possibilities from what might be found. (ibid.)"

"This growing awareness of the inadequacy of the dominant [dogma](http://en.wikipedia.org/wiki/Dogma) of the day led me to investigate the conceptual foundations, so to speak, of information systems. At first, I believed that the conventional gospel could be enlarged to accommodate SIS. But as my research progressed, I abandoned this position and concluded that to explain SIS and facilitate their discovery, one needed to view uses of computer (information) technology from a radically different perspective."

"I call this the strategic perspective on information systems (technology). The chapters to follow present my conception of it. Written for top executives and line managers, they show how computers (information technology) can be used to support or shape competitive strategy."

Most of the second book, Strategic Information Systems, was exposed from 1985 to 1988 to MBA students at the [Columbia University Graduate School of Business](http://en.wikipedia.org/wiki/Columbia_University_Graduate_School_of_Business) and to a large number of practitioners seeking to apply SIS concepts to disparate industry settings. Since that time the concept has stimulated journals on the subject, [dissertations](http://en.wikipedia.org/wiki/Dissertation), and extensive critical research. (References: search Google Scholar, Clusty, et al. using the terms: Strategic Information Systems, SIS, Charles Wiseman, et al.)

## Document management system

A **document management system** (DMS) is a [computer system](http://en.wikipedia.org/wiki/Computer_system) (or set of computer programs) used to track and store [electronic documents](http://en.wikipedia.org/wiki/Electronic_document) and/or [images](http://en.wikipedia.org/wiki/Digital_image) of paper documents. It is usually also capable of keeping track of the different versions modified by different users (history tracking). The term has some overlap with the concepts of [content management systems](http://en.wikipedia.org/wiki/Content_management_system). It is often viewed as a component of [enterprise content management](http://en.wikipedia.org/wiki/Enterprise_content_management) (ECM) systems and related to [digital asset management](http://en.wikipedia.org/wiki/Digital_asset_management), [document imaging](http://en.wikipedia.org/wiki/Document_imaging), [workflow](http://en.wikipedia.org/wiki/Workflow) systems and [records management](http://en.wikipedia.org/wiki/Records_management) systems.

## Data management

**Data management** comprises all the [disciplines](http://en.wikipedia.org/wiki/List_of_academic_disciplines) related to managing [data](http://en.wikipedia.org/wiki/Data) as a valuable resource.

**Usage**

In modern [management usage](http://en.wikipedia.org/wiki/Management_fad), one can easily discern a trend away from the term 'data' in composite expressions to the term [information](http://en.wikipedia.org/wiki/Information) or even [knowledge](http://en.wikipedia.org/wiki/Knowledge) when talking in non-technical context. Thus there exists not only data management, but also [information management](http://en.wikipedia.org/wiki/Information_management) and [knowledge management](http://en.wikipedia.org/wiki/Knowledge_management). This is a misleading trend as it obscures that traditional data is managed or somehow[processed](http://en.wikipedia.org/wiki/Data_processing) on second looks. The distinction between data and derived values can be seen in the [information ladder](http://en.wikipedia.org/wiki/Information_ladder). While data can exist as such, 'information' and 'knowledge' are always in the "eye" (or rather the brain) of the beholder and can only be measured in relative units.

## Data hub

A **data hub** (**data management system**, or **DMS**) is software for collaborating on gathering, sharing and using analytical data.[[1]](http://en.wikipedia.org/wiki/Data_management_system#cite_note-okfn_notebook-0)

The term is usually used to refer to the new web-based generation of such products. They can be either platforms for handling lots of different kinds of data, or in verticals specialising in one particular field.

## Features

At core, a DMS is a list of datasets that are of diverse schema.

Once you have that, people expect the following features, and/or tight integration with tools that provide them:[[2]](http://en.wikipedia.org/wiki/Data_management_system#cite_note-cms_to_dms-1)

* Load and update data from any source (ETL)
* Store datasets and index them for querying
* View, analyse and update data in a tabular interface (spreadsheet)
* Visualise data, for example with charts or maps
* Analyse data, for example with statistics and machine learning
* Organise many people to enter or correct data (crowd-sourcing)
* Measure and ensure the quality of data, and its provenance
* Permissions; data can be open, private or shared
* Find datasets, and organise them to help others find them
* Sell data, sharing processing costs between users

## Knowledge management

**Knowledge management** (**KM**) comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of [insights](http://en.wikipedia.org/wiki/Insight) and [experiences](http://en.wikipedia.org/wiki/Experience). Such insights and experiences comprise [knowledge](http://en.wikipedia.org/wiki/Knowledge), either embodied in individuals or embedded in organizations as [processes](http://en.wikipedia.org/wiki/Business_process) or practices.

An established [discipline](http://en.wikipedia.org/wiki/List_of_academic_disciplines) since 1991 (see [Nonaka 1991](http://en.wikipedia.org/wiki/Knowledge_management#CITEREFNonaka1991)), KM includes courses taught in the fields of [business administration](http://en.wikipedia.org/wiki/Business_administration), [information systems](http://en.wikipedia.org/wiki/Information_systems), management, and library and [information sciences](http://en.wikipedia.org/wiki/Information_sciences)([Alavi & Leidner 1999](http://en.wikipedia.org/wiki/Knowledge_management#CITEREFAlaviLeidner1999)). More recently, other fields have started contributing to KM research; these include information and media, [computer science](http://en.wikipedia.org/wiki/Computer_science), [public health](http://en.wikipedia.org/wiki/Public_health), and [public policy](http://en.wikipedia.org/wiki/Policy).

Many large companies and non-profit organizations have resources dedicated to internal KM efforts, often as a part of their [business strategy](http://en.wikipedia.org/wiki/Strategic_management), information technology, or [human resource management](http://en.wikipedia.org/wiki/Human_resource_management)departments ([Addicott, McGivern & Ferlie 2006](http://en.wikipedia.org/wiki/Knowledge_management#CITEREFAddicottMcGivernFerlie2006)). Several consulting companies also exist that provide strategy and advice regarding KM to these organizations.

Knowledge management efforts typically focus on organizational [objectives](http://en.wikipedia.org/wiki/Goal) such as improved performance, [competitive advantage](http://en.wikipedia.org/wiki/Competitive_advantage), innovation, the sharing of lessons learned, integration and [continuous improvement](http://en.wikipedia.org/wiki/Continuous_improvement) of the organization. KM efforts overlap with [organizational learning](http://en.wikipedia.org/wiki/Organizational_learning), and may be distinguished from that by a greater focus on the management of knowledge as a strategic asset and a focus on encouraging the sharing of knowledge. It is seen as an enabler of organisational learning[[1]](http://en.wikipedia.org/wiki/Knowledge_management#cite_note-0) and a more concrete mechanism than the previous abstract research.

**Strategies**

Knowledge may be accessed at three stages: before, during, or after KM-related activities. Different organizations have tried various knowledge capture [incentives](http://en.wikipedia.org/wiki/Incentives), including making content submission mandatory and incorporating rewards into [performance measurement](http://en.wikipedia.org/wiki/Performance_measurement) plans. Considerable controversy exists over whether incentives work or not in this field and no consensus has emerged.

One strategy to KM involves actively managing knowledge (push strategy). In such an instance, individuals strive to explicitly encode their knowledge into a shared knowledge repository, such as a[database](http://en.wikipedia.org/wiki/Database), as well as retrieving knowledge they need that other individuals have provided to the repository.[[13]](http://en.wikipedia.org/wiki/Knowledge_management#cite_note-12) This is also commonly known as the Codification approach to KM.

Another strategy to KM involves individuals making knowledge requests of experts associated with a particular subject on an ad hoc basis (pull strategy). In such an instance, expert individual(s) can provide their [insights](http://en.wikipedia.org/wiki/Insights) to the particular person or people needing this ([Snowden 2002](http://en.wikipedia.org/wiki/Knowledge_management#CITEREFSnowden2002)). This is also commonly known as the Personalization approach to KM.

Other knowledge management strategies and instruments for companies include:

* rewards (as a means of motivating for knowledge sharing)
* [storytelling](http://en.wikipedia.org/wiki/Storytelling) (as a means of transferring tacit knowledge)
* cross-project learning
* [after action reviews](http://en.wikipedia.org/wiki/After_action_review)
* knowledge mapping (a map of knowledge repositories within a company accessible by all)
* [communities of practice](http://en.wikipedia.org/wiki/Communities_of_practice)
* expert directories (to enable knowledge seeker to reach to the experts)
* best practice transfer
* [knowledge fairs](http://en.wikipedia.org/w/index.php?title=Knowledge_fairs&action=edit&redlink=1)
* competence management (systematic evaluation and planning of competences of individual organization members)
* proximity & architecture (the physical situation of employees can be either conducive or obstructive to knowledge sharing)
* master-apprentice relationship
* collaborative technologies ([groupware](http://en.wikipedia.org/wiki/Groupware), etc.)
* knowledge repositories (databases, [bookmarking engines](http://en.wikipedia.org/wiki/Enterprise_bookmarking), etc.)
* measuring and reporting intellectual capital (a way of making explicit knowledge for companies)
* [knowledge brokers](http://en.wikipedia.org/wiki/Knowledge_broker) (some organizational members take on responsibility for a specific "field" and act as first reference on whom to talk about a specific subject)
* [social software](http://en.wikipedia.org/wiki/Social_software) (wikis, social bookmarking, blogs, etc.)
* Inter-project knowledge transfer

# VIII Security

**Security** is the degree of protection against danger, damage, loss, and [crime](http://en.wikipedia.org/wiki/Crime). Securities as a form of protection are *structures and processes that provide or improve security as a condition.*

## Categorising security

There is an immense literature on the analysis and categorisation of security. Part of the reason for this is that, in most security systems, the "weakest link in the chain" is the most important. The situation is asymmetric since the 'defender' must cover all points of attack while the attacker need only identify a single weak point upon which to concentrate.

**Types of security:**

|  |
| --- |
| * [Application security](http://en.wikipedia.org/wiki/Application_security) * [Computing security](http://en.wikipedia.org/wiki/Computer_security) * [Data security](http://en.wikipedia.org/wiki/Data_security) * [Information security](http://en.wikipedia.org/wiki/Information_security) * [Network security](http://en.wikipedia.org/wiki/Network_security) |

## Application security

**Application security** encompasses measures taken throughout the application's life-cycle to prevent exceptions in the [security policy](http://en.wikipedia.org/wiki/Security_policy) of an [application](http://en.wikipedia.org/wiki/Application_software) or the underlying [system](http://en.wikipedia.org/wiki/Operating_system) ([vulnerabilities](http://en.wikipedia.org/wiki/Vulnerability_(computer_science))) through flaws in the [design](http://en.wikipedia.org/wiki/Software_design), [development](http://en.wikipedia.org/wiki/Software_engineering), [deployment](http://en.wikipedia.org/wiki/Software_deployment), [upgrade](http://en.wikipedia.org/wiki/Software_upgrading), or [maintenance](http://en.wikipedia.org/wiki/Software_maintenance) of the application.

Applications only control the use of resources [granted](http://en.wikipedia.org/wiki/Access_control) to them, and not *which* resources are granted to them. They, in turn, determine the use of these resources by users of the application through application security.

Open Web Application Security Project ([OWASP](http://en.wikipedia.org/wiki/OWASP)) and Web Application Security Consortium ([WASC](http://en.wikipedia.org/wiki/WASC)) updates on the latest threats which impair web based applications. This aids developers, security testers and architects to focus on better design and mitigation strategy. OWASP Top 10 has become an industrial norm in assessing Web Applications.

## Computer security

**Computer security** is a branch of computer technology known as [information security](http://en.wikipedia.org/wiki/Information_security) as applied to [computers](http://en.wikipedia.org/wiki/Computer) and networks. The objective of computer security includes protection of information and property from theft, corruption, or natural disaster, while allowing the information and property to remain accessible and productive to its intended users. The term computer system security means the collective processes and mechanisms by which sensitive and valuable information and services are protected from publication, tampering or collapse by unauthorized activities or untrustworthy individuals and unplanned events respectively. The strategies and methodologies of computer security often differ from most other computer technologies because of its somewhat elusive objective of preventing unwanted computer behavior instead of enabling wanted computer behavior.

## Data security

Data Security means protecting a database from destructive forces and the unwanted actions of unauthorised users.[[1]](http://en.wikipedia.org/wiki/Data_security#cite_note-0)

## Information security

**Information security** means protecting information and [information systems](http://en.wikipedia.org/wiki/Information_system) from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction.[[1]](http://en.wikipedia.org/wiki/Information_security#cite_note-0)

The terms information security, [computer security](http://en.wikipedia.org/wiki/Computer_security) and [information assurance](http://en.wikipedia.org/wiki/Information_assurance) are frequently used interchangeably. These fields are interrelated often and share the common goals of protecting the [confidentiality](http://en.wikipedia.org/wiki/Confidentiality), [integrity](http://en.wikipedia.org/wiki/Data_integrity) and [availability](http://en.wikipedia.org/wiki/Availability) of information; however, there are some subtle differences between them. These differences lie primarily in the approach to the subject, the methodologies used, and the areas of concentration. Information security is concerned with the confidentiality, integrity and availability of [data](http://en.wikipedia.org/wiki/Data) regardless of the form the data may take: electronic, print, or other forms. Computer security can focus on ensuring the availability and correct operation of a [computer system](http://en.wikipedia.org/wiki/Computer_system) without concern for the information stored or processed by the computer. Information assurance focuses on the reasons for assurance that information is protected, and is thus reasoning about information security.

[Governments](http://en.wikipedia.org/wiki/Governments), [military](http://en.wikipedia.org/wiki/Military), [corporations](http://en.wikipedia.org/wiki/Corporations), [financial institutions](http://en.wikipedia.org/wiki/Financial_institutions), [hospitals](http://en.wikipedia.org/wiki/Hospitals), and private [businesses](http://en.wikipedia.org/wiki/Businesses) amass a great deal of confidential information about their employees, customers, products, research, and financial status. Most of this information is now collected, processed and stored on electronic [computers](http://en.wikipedia.org/wiki/Computers) and transmitted across [networks](http://en.wikipedia.org/wiki/Computer_network) to other computers. Should confidential information about a business' customers or finances or new product line fall into the hands of a competitor, such a breach of security could lead to negative consequences. Protecting confidential information is a business requirement, and in many cases also an ethical and legal requirement.

For the individual, information security has a significant effect on [privacy](http://en.wikipedia.org/wiki/Privacy), which is viewed very differently in different [cultures](http://en.wikipedia.org/wiki/Cultures).

The field of information security has grown and evolved significantly in recent years. There are many ways of gaining entry into the field as a career. It offers many areas for specialization including: securing network(s) and allied [infrastructure](http://en.wikipedia.org/wiki/Infrastructure), securing [applications](http://en.wikipedia.org/wiki/Application_software) and [databases](http://en.wikipedia.org/wiki/Database), [security testing](http://en.wikipedia.org/wiki/Security_testing), information systems [auditing](http://en.wikipedia.org/wiki/Audit), [business continuity planning](http://en.wikipedia.org/wiki/Business_continuity_planning) and [digital forensics](http://en.wikipedia.org/wiki/Digital_forensics) science, etc.

## Network security

**Network security**[[1]](http://en.wikipedia.org/wiki/Network_security#cite_note-0) consists of the provisions and [policies](http://en.wikipedia.org/wiki/Policies) adopted by a [network administrator](http://en.wikipedia.org/wiki/Network_administrator) to prevent and monitor [unauthorized](http://en.wikipedia.org/wiki/Unauthorized) access, misuse, modification, or denial of a [computer network](http://en.wikipedia.org/wiki/Computer_network) and network-accessible resources. Network security involves the authorization of access to data in a network, which is controlled by the network administrator. Users choose or are assigned an ID and password or other authenticating information that allows them access to information and programs within their authority. Network security covers a variety of computer networks, both public and private, that are used in everyday jobs conducting transactions and communications among businesses, government agencies and individuals. Networks can be private, such as within a company, and others which might be open to public access. Network security is involved in organizations, enterprises, and other types of institutions. It does as its title explains: It secures the network, as well as protecting and overseeing operations being done. The most common and simple way of protecting a network resource is by assigning it a unique name and a corresponding password.

## IT security essentials

**Internet secutiry**

**Internet security** is a branch of [computer security](http://en.wikipedia.org/wiki/Computer_security) specifically related to the [Internet](http://en.wikipedia.org/wiki/Internet), often involving [browser security](http://en.wikipedia.org/wiki/Browser_security) but also [network security](http://en.wikipedia.org/wiki/Network_security) on a more general level as it applies to other applications or [operating systems](http://en.wikipedia.org/wiki/Operating_systems) on a whole. Its objective is to establish rules and measures to use against attacks over the Internet.[[1]](http://en.wikipedia.org/wiki/Internet_security#cite_note-0) The Internet represents an insecure channel for exchanging information leading to a high risk of [intrusion](http://en.wikipedia.org/wiki/Hacker_(computer_security)) or fraud, such as [phishing](http://en.wikipedia.org/wiki/Phishing).[[2]](http://en.wikipedia.org/wiki/Internet_security#cite_note-1) Different methods have been used to protect the transfer of data, including [encryption](http://en.wikipedia.org/wiki/Encryption).

**Internet safety**

**Internet safety**, or **online safety**, is the security of people and their information when using the [internet](http://en.wikipedia.org/wiki/Internet). Numerous groups, Internet sites and governments have expressed concerns over the safety of children using the Internet. In the [UK](http://en.wikipedia.org/wiki/United_Kingdom) the [Get Safe Online](http://en.wikipedia.org/wiki/Get_Safe_Online) campaign has received sponsorship from government agency [Serious Organized Crime Agency (SOCA)](http://en.wikipedia.org/wiki/Serious_Organized_Crime_Agency) and major Internet companies such as [Microsoft](http://en.wikipedia.org/wiki/Microsoft) and [eBay](http://en.wikipedia.org/wiki/EBay). Several [crimes](http://en.wikipedia.org/wiki/Crime) can be committed on the Internet such as stalking, identity theft and more. Most social networking and chat sites have a page about safety.

**Issues**

The main issues with Internet safety include:

* Avoiding 'net nasties' including: [phishing](http://en.wikipedia.org/wiki/Phishing), [malware](http://en.wikipedia.org/wiki/Malware) and [viruses](http://en.wikipedia.org/wiki/Computer_virus).
* Avoiding online [scams and confidence tricks](http://en.wikipedia.org/wiki/Confidence_tricks), [Internet fraud](http://en.wikipedia.org/wiki/Internet_fraud) and [computer crime](http://en.wikipedia.org/wiki/Computer_crime).
* Avoiding unwelcome sites, particularly pornography and other sites that may be unsuitable for children.
* Avoiding unsuitable and undesirable message exchanging on networking sites, perhaps with people who could be dangerous to unsuspecting children. There are over 3000 cases a year of people who have been cyberbullied, stalked and worse by strangers online, or have had their internet networking site pages hacked into.[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]

**Tips**

* Don't give out *any* personal information online.
* Try not to speak to people you don't know.
* Don't tell your password to other people.

## Browser security

**Browser security** is the application of [internet security](http://en.wikipedia.org/wiki/Internet_security) to [web browsers](http://en.wikipedia.org/wiki/Web_browser) to protect [computer systems](http://en.wikipedia.org/wiki/Computer_system), [networks](http://en.wikipedia.org/wiki/Computer_network), and data, from malware or breaches of privacy. Browser security exploits often use [JavaScript](http://en.wikipedia.org/wiki/JavaScript) - sometimes with [cross-site scripting](http://en.wikipedia.org/wiki/Cross-site_scripting) (XSS)[[1]](http://en.wikipedia.org/wiki/Browser_security#cite_note-mozilla-noscript-0) - sometimes with a secondary payload using [Adobe Flash](http://en.wikipedia.org/wiki/Adobe_Flash),[[2]](http://en.wikipedia.org/wiki/Browser_security#cite_note-mozilla-betterprivacy-1) but can also take advantage of many other [vulnerabilities](http://en.wikipedia.org/wiki/Vulnerability_(computing)) (security holes) that are commonly exploited in all browsers; including [Mozilla Firefox](http://en.wikipedia.org/wiki/Mozilla_Firefox),[[3]](http://en.wikipedia.org/wiki/Browser_security#cite_note-Firefox_vulnerability_confirmed-2) [Google Chrome](http://en.wikipedia.org/wiki/Google_Chrome),[[4]](http://en.wikipedia.org/wiki/Browser_security#cite_note-Chrome_dirty_dozen-3) [Opera](http://en.wikipedia.org/wiki/Opera_(web_browser))[[5]](http://en.wikipedia.org/wiki/Browser_security#cite_note-Opera_severe_hole-4) and  [Microsoft Internet Explorer](http://en.wikipedia.org/wiki/Microsoft_Internet_Explorer).[[6]](http://en.wikipedia.org/wiki/Browser_security#cite_note-time_to_drop_IE6-5)

Breaches of browser security are usually for the purpose of bypassing protections to display [pop-up advertising](http://en.wikipedia.org/wiki/Pop-up_advertising)[[7]](http://en.wikipedia.org/wiki/Browser_security#cite_note-mozilla-adblock-plus-6) collecting [personally identifiable information](http://en.wikipedia.org/wiki/Personally_identifiable_information) (PII) for either [internet marketing](http://en.wikipedia.org/wiki/Internet_marketing) or [identity theft](http://en.wikipedia.org/wiki/Identity_theft), [website tracking](http://en.wikipedia.org/wiki/Website_tracking) or [web analytics](http://en.wikipedia.org/wiki/Web_analytics) about a user against their will using tools such as [webvbugs](http://en.wikipedia.org/wiki/Web_bug), [Clickjacking](http://en.wikipedia.org/wiki/Clickjacking), [Likejacking](http://en.wikipedia.org/wiki/Likejacking) (where [Facebook](http://en.wikipedia.org/wiki/Facebook)'s [like button](http://en.wikipedia.org/wiki/Like_button) is targeted)[[8]](http://en.wikipedia.org/wiki/Browser_security#cite_note-7)[[9]](http://en.wikipedia.org/wiki/Browser_security#cite_note-8)[[10]](http://en.wikipedia.org/wiki/Browser_security#cite_note-cnet-privacy-scrutiny-9)[[11]](http://en.wikipedia.org/wiki/Browser_security#cite_note-10), [HTTP cookies](http://en.wikipedia.org/wiki/HTTP_cookie), [zombie cookies](http://en.wikipedia.org/wiki/Zombie_cookie) or [Flash cookies](http://en.wikipedia.org/wiki/Local_shared_object) (Local Shared Objects or LSOs);[[2]](http://en.wikipedia.org/wiki/Browser_security#cite_note-mozilla-betterprivacy-1) installing [adware](http://en.wikipedia.org/wiki/Adware), [viruses](http://en.wikipedia.org/wiki/Viruses), [spyware](http://en.wikipedia.org/wiki/Spyware) such as [Trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)) (to gain access to users' [personal computers](http://en.wikipedia.org/wiki/Personal_computer) via [cracking](http://en.wikipedia.org/wiki/Cracker_(computer_security))) or other [malware](http://en.wikipedia.org/wiki/Malware) including [online banking](http://en.wikipedia.org/wiki/Online_banking) theft using [man-in-the-browser](http://en.wikipedia.org/wiki/Man-in-the-browser) attacks.

Vulnerabilities in the browser software itself can be minimised by keeping browser software updated, [[12]](http://en.wikipedia.org/wiki/Browser_security#cite_note-11) but will not be sufficient if the underlying operating system is compromised, for example, by a rootkit.[[13]](http://en.wikipedia.org/wiki/Browser_security#cite_note-12) Some subcomponents of browsers such as scripting, add-ons, and cookiesare particularly vulnerable ("the [confused deputy problem](http://en.wikipedia.org/wiki/Confused_deputy_problem)") and also need to be addressed.

Following the principle of [defence in depth](http://en.wikipedia.org/wiki/Defence_in_depth), a fully patched and correctly configured browser may not be sufficient to ensure that browser-related security issues cannot occur. For example, a [rootkit](http://en.wikipedia.org/wiki/Rootkit) can [capture keystrokes](http://en.wikipedia.org/wiki/Keystroke_logger) while someone logs into a banking website, or carry out a [man-in-the-middle](http://en.wikipedia.org/wiki/Man-in-the-middle) attack by modifying network traffic to and from a web browser. [DNS hijacking](http://en.wikipedia.org/wiki/DNS_hijacking) or [DNS spoofing](http://en.wikipedia.org/wiki/DNS_spoofing) may be used to return false positives for mistyped website names, or to subvert search results for popular search engines. Malware such as [RSPlug](http://en.wikipedia.org/wiki/RSPlug) simply modifies a system's configuration to point at rogue DNS servers.

Browsers can use more secure methods of [network communication](http://en.wikipedia.org/wiki/Network_protocols) to help prevent some of these attacks:

* [DNS](http://en.wikipedia.org/wiki/Domain_Name_System): [DNSSec](http://en.wikipedia.org/wiki/DNSSec) and [DNSCrypt](http://en.wikipedia.org/wiki/DNSCrypt), for example with non-default [DNS servers](http://en.wikipedia.org/wiki/DNS_server) such as [Google Public DNS](http://en.wikipedia.org/wiki/Google_Public_DNS) or [OpenDNS](http://en.wikipedia.org/wiki/OpenDNS).
* [HTTP](http://en.wikipedia.org/wiki/HTTP): [HTTP Secure](http://en.wikipedia.org/wiki/HTTP_Secure) and [SPDY](http://en.wikipedia.org/wiki/SPDY) with digitally signed [public key certificates](http://en.wikipedia.org/wiki/Public_key_certificate) or [Extended Validation Certificates](http://en.wikipedia.org/wiki/Extended_Validation_Certificate).

Perimeter defenses, typically through firewalls and the use of [filtering](http://en.wikipedia.org/wiki/Content-control_software) [proxy servers](http://en.wikipedia.org/wiki/Proxy_server) that block malicious websites and perform antivirus scans of any file downloads, are commonly implemented as a best practice in large organisations to block malicious network traffic before it reaches a browser.

## Firewall

A **firewall** can either be software-based or hardware-based and is used to help keep a network secure. Its primary objective is to control the incoming and outgoing network traffic by analyzing the data packets and determining whether it should be allowed through or not, based on a predetermined rule set. A network's firewall builds a bridge between an internal network that is assumed to be secure and trusted, and another network, usually an external (inter)network, such as the Internet, that is not assumed to be secure and trusted.[[1]](http://en.wikipedia.org/wiki/Firewall_(computing)#cite_note-0)

Many personal computer [operating systems](http://en.wikipedia.org/wiki/Operating_system) include software-based firewalls to protect against threats from the public Internet. Many [routers](http://en.wikipedia.org/wiki/Router_(computing)) that pass data between networks contain firewall components and, conversely, many firewalls can perform basic routing functions.[[2]](http://en.wikipedia.org/wiki/Firewall_(computing)#cite_note-1)

***Types***

There are different types of firewalls depending on where the communication is taking place, where the communication is intercepted and the state that is being traced.[[13]](http://en.wikipedia.org/wiki/Firewall_(computing)#cite_note-12)

**Network layer or packet filters**

Network layer firewalls, also called packet filters, operate at a relatively low level of the [TCP/IP](http://en.wikipedia.org/wiki/Internet_protocol_suite) [protocol stack](http://en.wikipedia.org/wiki/Protocol_stack), not allowing packets to pass through the firewall unless they match the established rule set. The firewall administrator may define the rules; or default rules may apply. The term "packet filter" originated in the context of [BSD](http://en.wikipedia.org/wiki/BSD) [operating systems](http://en.wikipedia.org/wiki/Operating_systems).

Modern firewalls can filter traffic based on many packet attributes like source [IP address](http://en.wikipedia.org/wiki/IP_address), source [port](http://en.wikipedia.org/wiki/TCP_and_UDP_port), destination IP address or port, destination service like [WWW](http://en.wikipedia.org/wiki/World_Wide_Web) or [FTP](http://en.wikipedia.org/wiki/File_transfer_protocol). They can filter based on protocols, [TTL](http://en.wikipedia.org/wiki/Time_to_live) values, [netblock](http://en.wikipedia.org/w/index.php?title=Netblock&action=edit&redlink=1) of originator, of the source, and many other attributes.

Commonly used packet filters on various versions of Unix are [*ipf*](http://en.wikipedia.org/wiki/IPFilter) (various), [*ipfw*](http://en.wikipedia.org/wiki/Ipfirewall) ([FreeBSD](http://en.wikipedia.org/wiki/FreeBSD)/[Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X)), [*pf*](http://en.wikipedia.org/wiki/PF_(firewall)) ([OpenBSD](http://en.wikipedia.org/wiki/OpenBSD), and all other [BSDs](http://en.wikipedia.org/wiki/BSD)), [*iptables*](http://en.wikipedia.org/wiki/Netfilter)/[*ipchains*](http://en.wikipedia.org/wiki/Ipchains) ([Linux](http://en.wikipedia.org/wiki/Linux)).

**Application-layer**

Application-layer firewalls work on the application level of the TCP/IP stack (i.e., all browser traffic, or all [telnet](http://en.wikipedia.org/wiki/Telnet) or [ftp](http://en.wikipedia.org/wiki/Ftp) traffic), and may intercept all packets traveling to or from an application. They block other packets (usually dropping them without acknowledgment to the sender).

On inspecting all packets for improper content, firewalls can restrict or prevent outright the spread of networked [computer worms](http://en.wikipedia.org/wiki/Computer_worm) and [trojans](http://en.wikipedia.org/wiki/Trojan_horse_(computing)). The additional inspection criteria can add extra latency to the forwarding of packets to their destination.

Application firewalls function by determining whether a process should accept any given connection.

**Proxies**

A proxy server (running either on dedicated hardware or as software on a general-purpose machine) may act as a firewall by responding to input packets (connection requests, for example) in the manner of an application, while blocking other packets. A proxy server is a gateway from one network to another for a specific network application, in the sense that it functions as a proxy on behalf of the network user.[[15]](http://en.wikipedia.org/wiki/Firewall_(computing)#cite_note-14)

Proxies make tampering with an internal system from the external network more difficult and misuse of one internal system would not necessarily cause a security breach exploitable from outside the firewall (as long as the application proxy remains intact and properly configured). Conversely, intruders may [hijack](http://en.wiktionary.org/wiki/Hijack) a publicly-reachable system and use it as a proxy for their own purposes; the proxy then [masquerades](http://en.wikipedia.org/wiki/Spoofing_attack) as that system to other internal machines. While use of internal address spaces enhances security, [crackers](http://en.wikipedia.org/wiki/Security_cracking) may still employ methods such as [IP spoofing](http://en.wikipedia.org/wiki/IP_spoofing) to attempt to pass packets to a target network.

**Network address translation**

Firewalls often have [network address translation](http://en.wikipedia.org/wiki/Network_address_translation) (NAT) functionality, and the hosts protected behind a firewall commonly have addresses in the "private address range", as defined in [RFC 1918](http://tools.ietf.org/html/rfc1918). Firewalls often have such functionality to hide the true address of protected hosts. Originally, the NAT function was developed to address the limited number of IPv4 routable addresses that could be used or assigned to companies or individuals as well as reduce both the amount and therefore cost of obtaining enough public addresses for every computer in an organization. Hiding the addresses of protected devices has become an increasingly important defense against [network reconnaissance](http://en.wikipedia.org/wiki/Vulnerability_scanner).

## Antivirus

**Antivirus** or **anti-virus software** is [software](http://en.wikipedia.org/wiki/Software) used to prevent, detect and remove [malware](http://en.wikipedia.org/wiki/Malware), such as: [computer viruses](http://en.wikipedia.org/wiki/Computer_virus), [adware](http://en.wikipedia.org/wiki/Adware), [backdoors](http://en.wikipedia.org/wiki/Backdoor_(computing)), malicious [BHOs](http://en.wikipedia.org/wiki/Browser_Helper_Object), [dialers](http://en.wikipedia.org/wiki/Dialer), [fraudtools](http://en.wikipedia.org/wiki/Fraudtool), [hijackers](http://en.wikipedia.org/wiki/Browser_hijacking), [keyloggers](http://en.wikipedia.org/wiki/Keylogger), malicious [LSPs](http://en.wikipedia.org/wiki/Layered_Service_Provider), [rootkits](http://en.wikipedia.org/wiki/Rootkit), [spyware](http://en.wikipedia.org/wiki/Spyware), [trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)) and [worms](http://en.wikipedia.org/wiki/Computer_worm). [Computer security](http://en.wikipedia.org/wiki/Computer_security), including protection from [social engineering](http://en.wikipedia.org/wiki/Social_engineering_(security)) techniques, is commonly offered in products and services of antivirus software companies. This page discusses the software used for the prevention and removal of malware [threats](http://en.wikipedia.org/wiki/Threat_(computer)), rather than computer security implemented by software methods.

A variety of strategies are typically employed. Signature-based detection involves searching for known patterns of data within [executable code](http://en.wikipedia.org/wiki/Executable_code). However, it is possible for a computer to be infected with new malware for which no signature is yet known. To [counter](http://en.wikipedia.org/wiki/Countermeasure_(computer)) such so-called [zero-day threats](http://en.wikipedia.org/wiki/Zero-day_virus), [heuristics](http://en.wikipedia.org/wiki/Heuristics#Computer_science) can be used. One type of heuristic approach, generic signatures, can identify new viruses or variants of existing viruses by looking for known malicious code, or slight variations of such code, in files. Some antivirus software can also predict what a file will do by running it in a [sandbox](http://en.wikipedia.org/wiki/Sandbox_(computer_security)) and analyzing what it does to see if it performs any malicious actions.

No matter how useful antivirus software can be, it can sometimes have drawbacks. Antivirus software can impair a [computer's performance](http://en.wikipedia.org/wiki/Computer_performance). Inexperienced users may also have trouble understanding the prompts and decisions that antivirus software presents them with. An incorrect decision may lead to a security breach. If the antivirus software employs heuristic detection, success depends on achieving the right balance between [false positives](http://en.wikipedia.org/wiki/False_positive) and [false negatives](http://en.wikipedia.org/wiki/False_negative). False positives can be as destructive as false negatives.[[1]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-0) Finally, antivirus software generally runs at the highly trusted [kernel](http://en.wikipedia.org/wiki/Kernel_(computing)) level of the [operating system](http://en.wikipedia.org/wiki/Operating_system), creating a potential avenue of [attack](http://en.wikipedia.org/wiki/Attack_(computing)).[[2]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-1)

Installed antivirus software running on an individual computer is only one method of guarding against viruses. Other methods are also used, including cloud-based antivirus, firewalls and on-line scanners.

**Cloud antivirus**

Cloud antivirus is a technology that uses lightweight agent software on the protected computer, while offloading the majority of data analysis to the provider's infrastructure.[[59]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-58)

One approach to implementing cloud antivirus involves scanning suspicious files using multiple antivirus engines. This approach was proposed by an early implementation of the cloud antivirus concept called CloudAV. CloudAV was designed to send programs or documents to a [network cloud](http://en.wikipedia.org/wiki/Cloud_computing) where multiple antivirus and behavioral detection programs are used simultaneously in order to improve detection rates. Parallel scanning of files using potentially incompatible antivirus scanners is achieved by spawning a virtual machine per detection engine and therefore eliminating any possible issues. CloudAV can also perform "retrospective detection," whereby the cloud detection engine rescans all files in its file access history when a new threat is identified thus improving new threat detection speed. Finally, CloudAV is a solution for effective virus scanning on devices that lack the computing power to perform the scans themselves.[60]

**Network firewall**

[Network firewalls](http://en.wikipedia.org/wiki/Firewall_(computing)) prevent unknown programs and processes from accessing the system. However, they are not antivirus systems and make no attempt to identify or remove anything. They may protect against infection from outside the protected computer or [network](http://en.wikipedia.org/wiki/LAN), and limit the activity of any malicious software which is present by blocking incoming or outgoing requests on certain TCP/IP ports. A firewall is designed to deal with broader system threats that come from network connections into the system and is not an alternative to a virus protection system.

**Online scanning**

Some antivirus vendors maintain websites with free online scanning capability of the entire computer, critical areas only, local disks, folders or files. Periodic online scanning is a good idea for those that run antivirus applications on their computers because those applications are frequently slow to catch threats. One of the first things that malicious software does in an attack is disable any existing antivirus software and sometimes the only way to know of an attack is by turning to an online resource that is not installed on the infected computer.[[61]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-60)

**Specialist tools**

Virus removal tools are available to help remove stubborn infections or certain types of infection. Examples include [Trend Micro](http://en.wikipedia.org/wiki/Trend_Micro)'s *Rootkit Buster*,[[62]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-61) and [rkhunter](http://en.wikipedia.org/wiki/Rkhunter) for the detection of [rootkits](http://en.wikipedia.org/wiki/Rootkit), [Avira](http://en.wikipedia.org/wiki/Avira)'s *AntiVir Removal Tool*,[[63]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-antivir-62) [*PCTools*](http://en.wikipedia.org/wiki/PC_Tools_(company))*Threat Removal Tool*,[[64]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-63) and [AVG](http://en.wikipedia.org/wiki/AVG_(software))'s Anti-Virus Free 2011.[[65]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-64)

A rescue disk that is bootable, such as a CD or USB storage device, can be used to run antivirus software outside of the installed operating system, in order to remove infections while they are dormant. A bootable antivirus disk can be useful when, for example, the installed operating system is no longer bootable or has malware that is resisting all attempts to be removed by the installed antivirus software. Examples of some of these bootable disks include the [*Avira*](http://en.wikipedia.org/wiki/Avira) *AntiVir Rescue System*,[[63]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-antivir-62) [*PCTools*](http://en.wikipedia.org/wiki/PC_Tools_(company))*Alternate Operating System Scanner*,[[66]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-65) and [*AVG*](http://en.wikipedia.org/wiki/AVG_(software))*Rescue CD*.[[67]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-avgcd-66) The AVG Rescue CD software can also be installed onto a USB storage device that is bootable on newer computers.[[67]](http://en.wikipedia.org/wiki/Antivirus_software#cite_note-avgcd-66)

## 

## Anti-spyware programs

Many programmers and some commercial firms have released products dedicated to remove or block spyware. Programs such as PC Tools' [Spyware Doctor](http://en.wikipedia.org/wiki/Spyware_Doctor), Lavasoft's [*Ad-Aware SE*](http://en.wikipedia.org/wiki/Ad-Aware_SE) (free scans for non-commercial users, must pay for other features) and Patrick Kolla's [*Spybot - Search & Destroy*](http://en.wikipedia.org/wiki/Spybot_-_Search_%26_Destroy) (all features free for non-commercial use) rapidly gained popularity as effective tools to remove, and in some cases intercept, spyware programs. On December 16, 2004, [Microsoft](http://en.wikipedia.org/wiki/Microsoft) acquired the [*GIANT AntiSpyware*](http://en.wikipedia.org/wiki/GIANT_AntiSpyware) software,[[57]](http://en.wikipedia.org/wiki/Spyware#cite_note-56) rebranding it as *Windows AntiSpyware beta* and releasing it as a free download for Genuine Windows XP and Windows 2003 users. In 2006, [Microsoft](http://en.wikipedia.org/wiki/Microsoft) renamed the beta software to [Windows Defender](http://en.wikipedia.org/wiki/Windows_Defender) (free), and it was released as a free download in October 2006 and is included as standard with Windows Vista as well as Windows 7.

Major anti-virus firms such as [Symantec](http://en.wikipedia.org/wiki/Symantec), [PC Tools](http://en.wikipedia.org/wiki/PC_Tools_(company)), [McAfee](http://en.wikipedia.org/wiki/McAfee) and [Sophos](http://en.wikipedia.org/wiki/Sophos) have come later to the table, adding anti-spyware features to their existing anti-virus products. Early on, anti-virus firms expressed reluctance to add anti-spyware functions, citing lawsuits brought by spyware authors against the authors of web sites and programs which described their products as "spyware". However, recent versions of these major firms' home and business anti-virus products do include anti-spyware functions, albeit treated differently from viruses. Symantec Anti-Virus, for instance, categorizes spyware programs as "extended threats" and now offers [real-time protection](http://en.wikipedia.org/wiki/Real-time_protection) from them (as it does for viruses).

In June 2006, the anti-virus company [Grisoft](http://en.wikipedia.org/wiki/Grisoft), creator of [AVG Anti-Virus](http://en.wikipedia.org/wiki/AVG_Anti-Virus), acquired anti-spyware firm Ewido Networks, re-labeling their Ewido anti-spyware program as AVG Anti-Spyware Professional Edition. AVG also used this product to add an integrated anti-spyware solution to some versions of the [AVG Anti-Virus](http://en.wikipedia.org/wiki/AVG_Anti-Virus) family of products, and a [freeware](http://en.wikipedia.org/wiki/Freeware) AVG Anti-Spyware Free Edition available for private and non-commercial use. This shows a trend by anti virus companies to launch a dedicated solution to spyware and malware. Zone Labs, creator of [Zone Alarm](http://en.wikipedia.org/wiki/Zone_Alarm) [firewall](http://en.wikipedia.org/wiki/Firewall_(computing)) have also released an anti-spyware program.

Anti-spyware programs can combat spyware in two ways:

1. They can provide real time protection against the installation of spyware software on the computer. This type of spyware protection works the same way as that of anti-virus protection in that the anti-spyware software scans all incoming network data for spyware software and blocks any threats it comes across.
2. Anti-spyware software programs can be used solely for detection and removal of spyware software that has already been installed onto the computer. This type of spyware protection is normally much easier to use and more popular. With this spyware protection software the user can schedule weekly, daily, or monthly scans of the computer to detect and remove any spyware software that have been installed on the computer. This type of anti-spyware software scans the contents of the windows registry, operating system files, and installed programs on the computer and will provide a list of any threats found, allowing the user to choose what to delete and what to keep.

Such programs inspect the contents of the Windows registry, the operating system files, and installed programs, and remove files and entries which match a list of known spyware components. Real-time protection from spyware works identically to real-time anti-virus protection: the software scans disk files at download time, and blocks the activity of components known to represent spyware. In some cases, it may also intercept attempts to install start-up items or to modify browser settings. Because many spyware and adware are installed as a result of browser exploits or user error, using security software (some of which are antispyware, though many are not) to [sandbox](http://en.wikipedia.org/wiki/Sandbox_(computer_security)) browsers can also be effective to help restrict any damage done.

Like most anti-virus software, many anti-spyware/adware tools require a frequently-updated database of threats. As new spyware programs are released, anti-spyware developers discover and evaluate them, making "signatures" or "definitions" which allow the software to detect and remove the spyware. As a result, anti-spyware software is of limited usefulness without a regular source of updates. Some vendors provide a subscription-based update service, while others provide updates free. Updates may be installed automatically on a schedule or before doing a scan, or may be done manually.

Not all programs rely on updated definitions. Some programs rely partly (for instance many antispyware programs such as Windows Defender, [Spybot](http://en.wikipedia.org/wiki/Spybot_-_Search_%26_Destroy)'s TeaTimer and Spysweeper) or fully (programs falling under the class of [HIPS](http://en.wikipedia.org/wiki/Intrusion-prevention_system) such as BillP's WinPatrol) on historical observation. They watch certain configuration parameters (such as certain portions of the Windows registry or browser configuration) and report any change to the user, without judgment or recommendation. While they do not rely on updated definitions, which may allow them to spot newer spyware, they can offer no guidance. The user is left to determine "what did I just do, and is this configuration change appropriate?"

[Windows Defender](http://en.wikipedia.org/wiki/Windows_Defender)'s SpyNet attempts to alleviate this through offering a community to share information, which helps guide both users, who can look at decisions made by others, and analysts, who can spot fast-spreading spyware. A popular generic spyware removal tool used by those with a certain degree of expertise is [HijackThis](http://en.wikipedia.org/wiki/HijackThis), which scans certain areas of the Windows OS where spyware often resides and presents a list with items to delete manually. As most of the items are legitimate windows files/registry entries it is advised for those who are less knowledgeable on this subject to post a HijackThis log on the numerous antispyware sites and let the experts decide what to delete.

If a spyware program is not blocked and manages to get itself installed, it may resist attempts to terminate or uninstall it. Some programs work in pairs: when an anti-spyware scanner (or the user) terminates one running process, the other one respawns the killed program. Likewise, some spyware will detect attempts to remove registry keys and immediately add them again. Usually, booting the infected computer in [safe mode](http://en.wikipedia.org/wiki/Safe_mode) allows an anti-spyware program a better chance of removing persistent spyware. Killing the process tree may also work.

A new breed of spyware (Look2Me spyware by NicTechNetworks is a good example) hides inside system-critical processes and start up even in safe mode, see [rootkit](http://en.wikipedia.org/wiki/Rootkit). With no process to terminate they are harder to detect and remove. Sometimes they do not even leave any on-disk signatures. [Rootkit](http://en.wikipedia.org/wiki/Rootkit) technology is also seeing increasing use,[[58]](http://en.wikipedia.org/wiki/Spyware#cite_note-rootkit-57) as is the use of [NTFS](http://en.wikipedia.org/wiki/NTFS) [alternate data streams](http://en.wikipedia.org/wiki/Fork_(filesystem)). Newer spyware programs also have specific countermeasures against well known anti-malware products and may prevent them from running or being installed, or even uninstall them. An example of one that uses all three methods is Gromozon, a new breed of malware. It uses alternate data streams to hide. A [rootkit](http://en.wikipedia.org/wiki/Rootkit) hides it even from alternate data streams scanners and actively stops popular [rootkit](http://en.wikipedia.org/wiki/Rootkit) scanners from running.

## 

## Encryption software

**Encryption software** is [software](http://en.wikipedia.org/wiki/Software) whose main task is [encryption](http://en.wikipedia.org/wiki/Encryption) and [decryption](http://en.wikipedia.org/wiki/Decryption) of data, usually in the form of files on (or sectors of) [hard drives](http://en.wikipedia.org/wiki/Hard_drive) and [removable media](http://en.wikipedia.org/wiki/Removable_media), [email](http://en.wikipedia.org/wiki/Email) messages, or in the form of packets sent over [computer networks](http://en.wikipedia.org/wiki/Computer_network).

Encryption software executes an [algorithm](http://en.wikipedia.org/wiki/Algorithm) that is designed to [encrypt](http://en.wikipedia.org/wiki/Encrypt) computer data in such a way that it cannot be recovered without access to the key. Software encryption is a fundamental part of all aspects of modern computer communication and file protection and may include features like file shredding.

The purpose of encryption is to prevent third parties from recovering the original information. This is particularly important for sensitive data like credit card numbers.

## Vulnerability scanner

A **vulnerability scanner** is a [computer program](http://en.wikipedia.org/wiki/Computer_program) designed to assess computers, computer systems, [networks](http://en.wikipedia.org/wiki/Computer_network) or [applications](http://en.wikipedia.org/wiki/Application_software) for weaknesses. There are a number of types of vulnerability scanners available today, distinguished from one another by a focus on particular targets. While functionality varies between different types of vulnerability scanners, they share a common, core purpose of enumerating the vulnerabilities present in one or more targets. Vulnerability scanners are a core technology component of [vulnerability management](http://en.wikipedia.org/wiki/Vulnerability_management).

## System vulnerability and abuse

In [computer security](http://en.wikipedia.org/wiki/Computer_security), a **vulnerability** is a weakness which allows an [attacker](http://en.wikipedia.org/wiki/Hacker_(computer_security)) to reduce a system's [information assurance](http://en.wikipedia.org/wiki/Information_assurance).

There are different types of vulnerability. The most known are:

* A **computer virus** is a [computer program](http://en.wikipedia.org/wiki/Computer_program) that can replicate itself [[1]](http://en.wikipedia.org/wiki/Threat_of_internet_viruses#cite_note-vx.netlux.org-0) and spread from one computer to another. The term "virus" is also commonly, but erroneously, used to refer to other types of [malware](http://en.wikipedia.org/wiki/Malware), including but not limited to [adware](http://en.wikipedia.org/wiki/Adware) and [spyware](http://en.wikipedia.org/wiki/Spyware) programs that do not have a reproductive ability.

[Malware](http://en.wikipedia.org/wiki/Malware) includes computer viruses, [computer worms](http://en.wikipedia.org/wiki/Computer_worm), [Trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)), most [rootkits](http://en.wikipedia.org/wiki/Rootkit), [spyware](http://en.wikipedia.org/wiki/Spyware), dishonest [adware](http://en.wikipedia.org/wiki/Adware) and other malicious or unwanted software, including true viruses. Viruses are sometimes confused with worms and Trojan horses, which are technically different. A worm can exploit security [vulnerabilities](http://en.wikipedia.org/wiki/Vulnerability_(computing)) to spread itself automatically to other computers through networks, while a Trojan horse is a program that appears harmless but hides malicious functions. Worms and Trojan horses, like viruses, may harm a computer system's data or performance. Some viruses and other malware have symptoms noticeable to the computer user, but many are surreptitious or simply do nothing to call attention to themselves. Some viruses do nothing beyond reproducing themselves.

***Classification***

In order to replicate itself, a virus must be permitted to execute code and write to memory. For this reason, many viruses attach themselves to executable files that may be part of legitimate programs (see [code injection](http://en.wikipedia.org/wiki/Code_injection)). If a user attempts to launch an infected program, the virus' code may be executed simultaneously. Viruses can be divided into two types based on their behavior when they are executed. Nonresident viruses immediately search for other hosts that can be infected, infect those targets, and finally transfer control to the [application program](http://en.wikipedia.org/wiki/Application_software) they infected. Resident viruses do not search for hosts when they are started. Instead, a resident virus loads itself into memory on execution and transfers control to the host program. The virus stays active in the background and infects new hosts when those files are accessed by other programs or the operating system itself.

**Nonresident viruses**

Nonresident viruses can be thought of as consisting of a *finder module* and a *replication module*. The finder module is responsible for finding new files to infect. For each new executable file the finder module encounters, it calls the replication module to infect that file.

**Resident viruses**

Resident viruses contain a replication module that is similar to the one that is employed by nonresident viruses. This module, however, is not called by a finder module. The virus loads the replication module into memory when it is executed instead and ensures that this module is executed each time the operating system is called to perform a certain operation.

* A **computer worm** is a standalone [malware](http://en.wikipedia.org/wiki/Malware) [computer program](http://en.wikipedia.org/wiki/Computer_program) that replicates itself in order to spread to other computers. Often, it uses a [computer network](http://en.wikipedia.org/wiki/Computer_network) to spread itself. This is due to security shortcomings on the target computer. Unlike a [computer virus](http://en.wikipedia.org/wiki/Computer_virus), it does not need to attach itself to an existing program. Worms almost always cause at least some harm to the network, even if only by consuming [bandwidth](http://en.wikipedia.org/wiki/Bandwidth_(computing)), whereas viruses almost always corrupt or modify files on a targeted computer.
* A **Trojan horse**, or **Trojan**, is a standalone malicious file or program that does not attempt to inject itself into other files unlike a [computer virus](http://en.wikipedia.org/wiki/Computer_virus) and often masquerades as a legitimate file or program. Trojan horses can make copies of themselves, steal information, or harm their host computer systems.[[1]](http://en.wikipedia.org/wiki/Trojan_horse_(computing)#cite_note-0) The first and many current Trojan horses attempt to appear as helpful programs. Others rely on [drive-by downloads](http://en.wikipedia.org/wiki/Drive-by_download) in order to reach target computers.

**Purpose and uses**

A Trojan may give a [hacker](http://en.wikipedia.org/wiki/Hacker_(computer_security)) remote access to a targeted computer system. Once a Trojan has been installed on a targeted computer system, hackers may be given remote access to the computer allowing them to perform all kinds of operations. Operations that could be performed by a hacker on a targeted computer system may include but are not limited to:

* Use of the machine as part of a [botnet](http://en.wikipedia.org/wiki/Botnet) (e.g. to perform automated [spamming](http://en.wikipedia.org/wiki/Spam_(electronic)) or to [distribute Denial-of-service attacks](http://en.wikipedia.org/wiki/Denial-of-service_attack#Distributed_attack))
* [Electronic money](http://en.wikipedia.org/wiki/Electronic_money) theft[[7]](http://en.wikipedia.org/wiki/Trojan_horse_(computing)#cite_note-6)
* [Data theft](http://en.wikipedia.org/wiki/Data_theft) (e.g. retrieving passwords or credit card information)
* Installation of software, including third-party malware
* [Downloading or uploading](http://en.wikipedia.org/wiki/Uploading_and_downloading) of files on the user's computer
* Modification or [deletion of files](http://en.wikipedia.org/wiki/File_deletion)
* [Keystroke logging](http://en.wikipedia.org/wiki/Keystroke_logging)
* [Watching the user's screen](http://en.wikipedia.org/wiki/Data_scraping#Screen_scraping)
* [Crashing the computer](http://en.wikipedia.org/wiki/Crash_(computing))
* [Anonymizing internet viewing](http://en.wikipedia.org/wiki/Anonymous_web_browsing)

Trojan horses in this way may require interaction with a [hacker](http://en.wikipedia.org/wiki/Hacker_(computer_security)) to fulfill their purpose, though the hacker does not have to be the individual responsible for distributing the Trojan horse. It is possible for individual hackers to scan computers on a network using a [port scanner](http://en.wikipedia.org/wiki/Port_scanner) in the hope of finding one with a malicious Trojan horse installed, which the hacker can then use to control the target computer.[[8]](http://en.wikipedia.org/wiki/Trojan_horse_(computing)#cite_note-Crapanzano-7)

A recent innovation in Trojan horse code takes advantage of a security flaw in older versions of Internet Explorer and Google Chrome to use the host computer as an [anonymizer proxy](http://en.wikipedia.org/wiki/Anonymizer) to effectively hide internet usage. A [hacker](http://en.wikipedia.org/wiki/Hacker_(computer_security)) is able to view internet sites while the tracking cookies, internet history, and any IP logging are maintained on the host computer. The host's computer may or may not show the internet history of the sites viewed using the computer as a proxy. The first generation of anonymizer Trojan horses tended to leave their tracks in the page view histories of the host computer. Newer generations of the Trojan horse tend to "cover" their tracks more efficiently. Several versions of [Slavebot](http://en.wikipedia.org/w/index.php?title=Slavebot&action=edit&redlink=1) have been widely circulated in the US and Europe and are the most widely distributed examples of this type of Trojan horse.[[8]](http://en.wikipedia.org/wiki/Trojan_horse_(computing)#cite_note-Crapanzano-7)

**Popular Trojan horses**

* Netbus (by Carl-Fredrik Neikter)
* Subseven or [Sub7](http://en.wikipedia.org/wiki/Sub7)(by Mobman)
* Y3K Remote Administration Tool (by Konstantinos & Evangelos Tselentis)
* Back Orifice (Sir Dystic)
* [Beast](http://en.wikipedia.org/wiki/Beast_Trojan_(trojan_horse))
* [Zeus](http://en.wikipedia.org/wiki/Zeus_(Trojan_horse))
* The [Blackhole exploit kit](http://en.wikipedia.org/wiki/Blackhole_exploit_kit)[[11]](http://en.wikipedia.org/wiki/Trojan_horse_(computing)#cite_note-10)
* Flashback Trojan (Trojan.BackDoor.Flashback)
* A **rootkit** is software that implements stealth capabilities that are designed to hide the existence of certain processes or programs. While some uses of the technology may be beneficial, the most notable usage is by [malware](http://en.wikipedia.org/wiki/Malware) seeking to avoid detection by [antivirus software](http://en.wikipedia.org/wiki/Antivirus_software).[[1]](http://en.wikipedia.org/wiki/Rootkits#cite_note-McAfee1-0)

Rootkit installation can be automated, or an [attacker](http://en.wikipedia.org/wiki/Hacker_(computer_security)) can install it once they've obtained root or Administrator access. Obtaining this access is either a result of direct attack on a system (i.e. exploiting a known vulnerability, password (either by [cracking](http://en.wikipedia.org/wiki/Password_cracking), [privilege escalation](http://en.wikipedia.org/wiki/Privilege_escalation), or [social engineering](http://en.wikipedia.org/wiki/Social_engineering_(security))). Once installed it becomes possible to hide the intrusion as well as to maintain privileged access. Like any software they can have a good purpose or a malicious purpose. The key is the root or Administrator access. Full control over a system means that existing software can be modified, including software that might otherwise be used to detect or circumvent it.

Rootkit detection is difficult because a rootkit may be able to subvert the software that is intended to find it. Detection methods include using an alternative, trusted [operating system](http://en.wikipedia.org/wiki/Operating_system); [behavioral](http://en.wikipedia.org/wiki/Behavioral#Computer_science)-based methods; signature scanning; difference scanning; and [memory dump](http://en.wikipedia.org/w/index.php?title=Sore_dump&action=edit&redlink=1) analysis. Removal can be complicated or practically impossible, especially in cases where the rootkit resides in the [kernel](http://en.wikipedia.org/wiki/Kernel_(computing)); reinstallation of the operating system may be the only available solution to the problem. When dealing with [firmware](http://en.wikipedia.org/wiki/Firmware) rootkits, removal may require hardware replacement, or specialised equipment.

* **Malware**, [short for](http://en.wikipedia.org/wiki/Portmanteau) **malicious software**, is software to help hackers disrupt users computer operation, gather sensitive information, or gain unauthorized access to a computer system. While it is often software, it can also appear in the form of [script](http://en.wikipedia.org/wiki/Script_(computing)) or [code](http://en.wikipedia.org/wiki/Source_code). [[1]](http://en.wikipedia.org/wiki/Malware#cite_note-0) 'Malware' is a general term used by computer professionals to mean a variety of forms of hostile, intrusive, or annoying software or code.[[2]](http://en.wikipedia.org/wiki/Malware#cite_note-1)

Malware includes [computer viruses](http://en.wikipedia.org/wiki/Computer_virus), [worms](http://en.wikipedia.org/wiki/Computer_worm), [trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)), [spyware](http://en.wikipedia.org/wiki/Spyware), [adware](http://en.wikipedia.org/wiki/Adware), most [rootkits](http://en.wikipedia.org/wiki/Rootkit), and other malicious programs.

Malware is not the same as defective software, which is software that has a legitimate purpose but contains harmful [bugs](http://en.wikipedia.org/wiki/Software_bug) that were not noticed before release. Sometimes, malware is disguised as genuine software, and may come from an official company website. An example would be software used for useful purposes that also includes tracking software to gather marketing statistics for advertising.

Therefore, some security programs may find "potentially unwanted programs" or "PUP". Though a [computer virus](http://en.wikipedia.org/wiki/Computer_virus) is malware that can reproduce itself, the term is sometimes used erroneously to refer to the entire category.

* **Phishing** is attempting to acquire information (and sometimes, indirectly, money) such as usernames, [passwords](http://en.wikipedia.org/wiki/Password), and credit card details by masquerading as a trustworthy entity in an [electronic communication](http://en.wikipedia.org/wiki/Electronic_communication). Communications purporting to be from popular social web sites, auction sites, online payment processors or IT administrators are commonly used to lure the unsuspecting public. Phishing is typically carried out by [e-mail](http://en.wikipedia.org/wiki/E-mail) [spoofing](http://en.wikipedia.org/wiki/E-mail_spoofing) or [instant messaging](http://en.wikipedia.org/wiki/Instant_messaging),[[1]](http://en.wikipedia.org/wiki/Phising#cite_note-0) and it often directs users to enter details at a fake website whose [look and feel](http://en.wikipedia.org/wiki/Look_and_feel) are almost identical to the legitimate one. Phishing is an example of [social engineering](http://en.wikipedia.org/wiki/Social_engineering_(computer_security)) techniques used to deceive users,[[2]](http://en.wikipedia.org/wiki/Phising#cite_note-1) and exploits the poor usability of current web security technologies.[[3]](http://en.wikipedia.org/wiki/Phising#cite_note-Jos2007-2) Attempts to deal with the growing number of reported phishing incidents include [legislation](http://en.wikipedia.org/wiki/Legislation), user training, public awareness, and technical security measures.

**List of phishing techniques**

**Phishing**

[Phishing](http://en.wiktionary.org/wiki/phishing) is a way of attempting to acquire information such as usernames, [passwords](http://en.wikipedia.org/wiki/Password), and credit card details by masquerading as a trustworthy entity in an [electronic communication](http://en.wikipedia.org/wiki/Electronic_communication).

**Spear Phishing**

Phishing attempts directed at specific individuals or companies have been termed [**spearphishing**](http://en.wiktionary.org/wiki/spearphishing).[[30]](http://en.wikipedia.org/wiki/Phising#cite_note-29) Attackers may gather personal information about their target to increase their probability of success.

**Clone Phishing**

A type of phishing attack whereby a legitimate, and previously delivered, email containing an attachment or link has had its content and recipient address(es) taken and used to create an almost identical or [cloned](http://en.wiktionary.org/wiki/clone) email. The attachment or Link within the email is replaced with a malicious version and then sent from an email address spoofed to appear to come from the original sender. It may claim to be a re-send of the original or an updated version to the original.

This technique could be used to pivot (indirectly) from a previously infected machine and gain a foothold on another machine, by exploiting the social trust associated with the inferred connection due to both parties receiving the original email.

**Whaling**

Several recent phishing attacks have been directed specifically at senior executives and other high profile targets within businesses, and the term **whaling** has been coined for these kinds of attacks.[[31]](http://en.wikipedia.org/wiki/Phising#cite_note-30)

**Phone phishing**

Not all phishing attacks require a fake website. Messages that claimed to be from a bank told users to dial a phone number regarding problems with their bank accounts.[[45]](http://en.wikipedia.org/wiki/Phising#cite_note-44) Once the phone number (owned by the phisher, and provided by a [Voice over IP](http://en.wikipedia.org/wiki/Voice_over_IP) service) was dialed, prompts told users to enter their account numbers and PIN. [Vishing](http://en.wikipedia.org/wiki/Vishing) (voice phishing) sometimes uses fake caller-ID data to give the appearance that calls come from a trusted organization.[[46]](http://en.wikipedia.org/wiki/Phising#cite_note-45)

**Website forgery**

Once a victim visits the phishing website, the deception is not over. Some phishing scams use [JavaScript](http://en.wikipedia.org/wiki/JavaScript) commands in order to alter the [address bar](http://en.wikipedia.org/wiki/URL_bar).[[39]](http://en.wikipedia.org/wiki/Phising#cite_note-38) This is done either by placing a picture of a legitimate URL over the address bar, or by closing the original address bar and opening a new one with the legitimate URL.[[40]](http://en.wikipedia.org/wiki/Phising#cite_note-39)

An attacker can even use flaws in a trusted website's own scripts against the victim.[[41]](http://en.wikipedia.org/wiki/Phising#cite_note-40) These types of attacks (known as [cross-site scripting](http://en.wikipedia.org/wiki/Cross-site_scripting)) are particularly problematic, because they direct the user to sign in at their bank or service's own web page, where everything from the [web address](http://en.wikipedia.org/wiki/URL) to the [security certificates](http://en.wikipedia.org/wiki/Transport_Layer_Security) appears correct. In reality, the link to the website is crafted to carry out the attack, making it very difficult to spot without specialist knowledge. Just such a flaw was used in 2006 against [PayPal](http://en.wikipedia.org/wiki/PayPal).[[42]](http://en.wikipedia.org/wiki/Phising#cite_note-41)

* **Spyware** is a type of [malware](http://en.wikipedia.org/wiki/Malware) (malicious software) installed on [computers](http://en.wikipedia.org/wiki/Computer) that collects information about users without their knowledge. The presence of spyware is typically hidden from the user and can be difficult to detect. Spyware is often secretly installed on a user's [personal computer](http://en.wikipedia.org/wiki/Personal_computer) without their knowledge. However, some spyware such as [keyloggers](http://en.wikipedia.org/wiki/Keylogger) may be installed by the owner of a shared, corporate, or [public computer](http://en.wikipedia.org/wiki/Public_computer) on purpose in order to intentionally monitor users.

While the term *spyware* suggests software that monitors a user's computing, the functions of spyware can extend beyond simple monitoring. Spyware can collect almost any type of data, including [personal information](http://en.wikipedia.org/wiki/Personally_identifiable_information) like [Internet surfing](http://en.wikipedia.org/wiki/Internet_surfing) habits, user logins, and bank or credit account information. Spyware can also interfere with user control of a computer by installing additional software or redirecting [Web browsers](http://en.wikipedia.org/wiki/Web_browser). Some spyware can change computer settings, resulting in slow Internet connection speeds, un-authorized changes in browser settings or functionality of other software.

Sometimes, spyware is included along with genuine software, and may come from an official software vendor. In an attempt to increase the understanding of spyware, a more formal classification of its included software types is provided by the term [privacy-invasive software](http://en.wikipedia.org/wiki/Privacy-invasive_software). In response to the emergence of spyware, a small industry has sprung up dealing in [anti-spyware](http://en.wikipedia.org/wiki/Anti-spyware) software. Running anti-spyware software has become a widely recognized element of [computer security](http://en.wikipedia.org/wiki/Computer_security) practices for computers, especially those running [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows). A number of jurisdictions have passed anti-spyware laws, which usually target any software that is surreptitiously installed to control a user's computer.

* **Browser hijacking** is the modification of a [web browser](http://en.wikipedia.org/wiki/Web_browser)'s settings by [malware](http://en.wikipedia.org/wiki/Malware). The term "hijacking" is used as the changes are performed without the user's permission. Some browser hijacking can be easily reversed, while other instances may be difficult to reverse. Various software packages exist to prevent such modification.

## Defense strategies and safekeeping, ways to defend against potential threats

**Antivirus**

**Antivirus** or **anti-virus software** is [software](http://en.wikipedia.org/wiki/Software) used to prevent, detect and remove [malware](http://en.wikipedia.org/wiki/Malware), such as: [computer viruses](http://en.wikipedia.org/wiki/Computer_virus), [adware](http://en.wikipedia.org/wiki/Adware), [backdoors](http://en.wikipedia.org/wiki/Backdoor_(computing)), malicious [BHOs](http://en.wikipedia.org/wiki/Browser_Helper_Object), [dialers](http://en.wikipedia.org/wiki/Dialer), [fraudtools](http://en.wikipedia.org/wiki/Fraudtool), [hijackers](http://en.wikipedia.org/wiki/Browser_hijacking), [keyloggers](http://en.wikipedia.org/wiki/Keylogger), malicious [LSPs](http://en.wikipedia.org/wiki/Layered_Service_Provider), [rootkits](http://en.wikipedia.org/wiki/Rootkit), [spyware](http://en.wikipedia.org/wiki/Spyware), [trojan horses](http://en.wikipedia.org/wiki/Trojan_horse_(computing)) and [worms](http://en.wikipedia.org/wiki/Computer_worm). [Computer security](http://en.wikipedia.org/wiki/Computer_security), including protection from [social engineering](http://en.wikipedia.org/wiki/Social_engineering_(security)) techniques, is commonly offered in products and services of antivirus software companies. This page discusses the software used for the prevention and removal of malware [threats](http://en.wikipedia.org/wiki/Threat_(computer)), rather than computer security implemented by software methods.

**Firewall**

A **firewall** can either be software-based or hardware-based and is used to help keep a network secure. Its primary objective is to control the incoming and outgoing network traffic by analyzing the data packets and determining whether it should be allowed through or not, based on a predetermined rule set.

**Data loss prevention software**

Data leakage prevention solution is a system that is designed to detect potential data breach incidents in timely manner and prevent them by monitoring data while **in-use** (endpoint actions), **in-motion**(network traffic), and **at-rest** (data storage) [[1]](http://en.wikipedia.org/wiki/Data_loss_prevention#cite_note-dlpbook-0). In data leakage incidents, sensitive data is disclosed to unauthorized personnel either by malicious intent or inadvertent mistake. Such sensitive data can come in the form of private or company information, intellectual property (IP), financial or patient information, credit-card data, and other information depending on the business and the industry.

**Data recovery**

**Data recovery** is the process of salvaging data from damaged, failed, corrupted, or inaccessible [secondary storage](http://en.wikipedia.org/wiki/Computer_data_storage#Secondary_storage) media when it cannot be accessed normally. Often the data are being salvaged from storage media such as internal or external [hard disk drives](http://en.wikipedia.org/wiki/Hard_disk_drive), [solid-state drives](http://en.wikipedia.org/wiki/Solid-state_drives) (SSD), [USB flash drive](http://en.wikipedia.org/wiki/USB_flash_drive), storage tapes, CDs, DVDs, [RAID](http://en.wikipedia.org/wiki/RAID), and other electronics. Recovery may be required due to physical damage to the storage device or logical damage to the [file system](http://en.wikipedia.org/wiki/File_system) that prevents it from being mounted by the host [operating system](http://en.wikipedia.org/wiki/Operating_system).

The most common "data recovery" scenario involves an [operating system](http://en.wikipedia.org/wiki/Operating_system) (OS) failure (typically on a single-disk, single-[partition](http://en.wikipedia.org/wiki/Disk_partition), single-OS system), in which case the goal is simply to copy all wanted files to another disk. This can be easily accomplished with a [Live CD](http://en.wikipedia.org/wiki/Live_CD), most of which provide a means to [mount](http://en.wikipedia.org/wiki/Mount_(computing)) the system drive and backup disks or removable media, and to move the files from the system disk to the backup media with a [file manager](http://en.wikipedia.org/wiki/File_manager) or [optical disc authoring software](http://en.wikipedia.org/wiki/Optical_disc_authoring_software).

Another scenario involves a disk-level failure, such as a compromised [file system](http://en.wikipedia.org/wiki/File_system) or disk [partition](http://en.wikipedia.org/wiki/Partition_table), or a [hard disk failure](http://en.wikipedia.org/wiki/Hard_disk_failure). In any of these cases, the data cannot be easily read. Depending on the situation, solutions involve repairing the file system, partition table or [master boot record](http://en.wikipedia.org/wiki/Master_boot_record), or hard disk recovery techniques ranging from software-based recovery of corrupted data to hardware replacement on a physically damaged disk. If hard disk recovery is necessary, the disk itself has typically failed permanently, and the focus is rather on a one-time recovery, salvaging whatever data can be read.

In a third scenario, files have been "[deleted](http://en.wikipedia.org/wiki/File_deletion)" from a storage medium. Typically, the contents of deleted files are not removed immediately from the drive; instead, references to them in the directory structure are removed, and the space they occupy is made available for later overwriting. In the meantime, the original file contents remain, often in a number of disconnected [fragments](http://en.wikipedia.org/wiki/File_system_fragmentation), and may be recoverable.

**Encrypting File System**

The **Encrypting File System** (**EFS**) on [Microsoft](http://en.wikipedia.org/wiki/Microsoft) [Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) is a feature introduced in version 3.0 of [NTFS](http://en.wikipedia.org/wiki/NTFS)[[1]](http://en.wikipedia.org/wiki/Encrypting_File_System#cite_note-0) that provides [file system-level encryption](http://en.wikipedia.org/wiki/Filesystem-level_encryption). The technology enables files to be transparently [encrypted](http://en.wikipedia.org/wiki/Encryption) to protect confidential data from attackers with physical access to the computer.

**Defragmentation**

In the maintenance of [file systems](http://en.wikipedia.org/wiki/File_system), **defragmentation** is a process that reduces the amount of [fragmentation](http://en.wikipedia.org/wiki/File_system_fragmentation). It does this by physically organizing the contents of the [mass storage](http://en.wikipedia.org/wiki/Mass_storage) device used to store [files](http://en.wikipedia.org/wiki/Computer_file) into the smallest number of [contiguous](http://en.wikipedia.org/wiki/Contiguity#Computer_science) regions (fragments). It also attempts to create larger regions of free space using *compaction* to impede the return of fragmentation. Some defragmentation utilities try to keep smaller files within a single directory together, as they are often accessed in sequence.

Defragmentation is advantageous and relevant to file systems on electromechanical [disk drives](http://en.wikipedia.org/wiki/Disk_storage). The movement of the [hard drive's read/write heads](http://en.wikipedia.org/wiki/Disk_read-and-write_head) over different areas of the disk when accessing fragmented files is slower, compared to accessing the entire contents of a non-fragmented file sequentially without moving the read/write heads to [seek](http://en.wikipedia.org/wiki/Disk_drive_performance_characteristics#Seek_time) other fragments.

**Disk Cleanup**

**Disk Cleanup** (cleanmgr.exe) is a computer maintenance utility included in [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) designed to free up disk space on a computer's hard drive. The utility first searches and analyzes the hard drive for files that are no longer of any use, and then removes the unnecessary files. There are a number of different file categories that Disk Cleanup targets when performing the initial disk analysis:

* Compression of old files
* Temporary Internet files
* Temporary Windows file
* Downloaded program files
* Recycle Bin
* Removal of unused applications or optional Windows components
* Setup log files
* Off-line files

Aside from removing unnecessary files, users also have the option of compressing files that have not been accessed over a set period of time. This option provides a systematic compression scheme. Infrequently accessed files are compressed to free up disk space while leaving the frequently used files uncompressed for faster read/write access times.

**Other tips for computer and internet safety:**

* Update operating system
* Don’t safe logon information
* Don’t enter sensitive information to public computer
* Don’t leave your computer unattended
* Avoid opening email attachments that comes unexpectedly
* Beware downloading
* Backup files