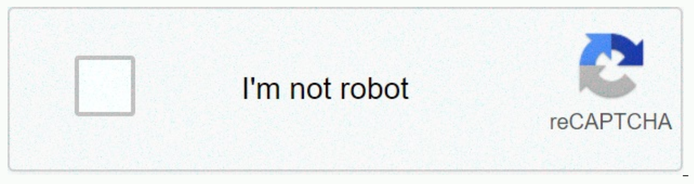

Continue

Hard drive capacity laptop

As someone who recently decided to upgrade my hard drive capacity when buying a laptop, I struggled to justify how much space I used compared to how much I wanted. With the utility -- and incredible capacity -- external hard drives, it seems to me that you should always pay for what you need and just bump up a number ever so-incremental for future use. The rest can go on an external hard drive to keep it safe. Article Related To How Hard Drive WorkWhit is a virtual hard drive? How Apple Inc. Work Solid-State Drive Is Good to know: Storage. 2012. (13 Sept, 2012) PC Blog. From 50 GB to 2TB How Big A Hard Drive Do I Need? Jan 16, 2012. (13 Sept 2012) Mike. One Gigalite Hard Drive for $25,000. The author blocks Live. Nov. 7, 2005. (13 Sept, 2012) . Apple Macintosh Performa 550 Specs. 2012. (13 Sept, 2012) Rex. Timeline: 50 Years Hard Drive. PC World. Sept 13, 2006. (13 Sept, 2012) Table Tables. Choosing a Hard Disk. March 7, 2012. (13 Sept, 2012) Michael J. Hard Drive Technology: Lots of Storage in Small Space. PCMag. July 12th, 2011. (13 Sept 2012) Dong. Seagate reaches 1TB per square inch, hard drive to reach a capacity of 60 TB. CNET. March 19, 2012. (13 Sept, 2012) Dong. WD breaks the capacity limit with a 3TB hard drive. CNET. Oct 19, 2010. (13 Sept 2012) Kirk. Hardware Tip: Get the Right Hard Drive for You and Your PC. PC World. April 27, 2004. (13 Sept, 2012) Hard drive redirected here. For other uses, see Hard disks (disambiguation). Hard disk drive Data storage deviceInternals hard disk SATA 2.5 inches driven CreationDecember 24, 1954; 65 years ago (1954-12-24)[a]Created by a team ofIBM led by Rey Johnson A dismantled and labelled 1997 HDD lying over the play music mirror The portrayal of how HDDs worked the computer kind of memory type common memory cell memory hierarchy MOS memory storage door volatile RAM DRUM SDRAM DDR HDDR HBM SRAM History Williams-Kilburn tube (1946-47) Delayed memory line (1947) Mellon optical memory (1951) Selected tubes (1952) (1952) T-RAM (2009) Z-RAM (2002-2010) ROM VOLATILE MROM PROM EPROM EEPROM Flash memory NVRAM PCM (3D XPoint) MRAM Early Stage NVRAM FeRAM ReRAM FeFET memory Magnetic Magnetic storage data tape Magnetic (Linear Tape-Open) Hard drive Optical CD DVD Blu-ray In CBRAM Racetrack memory development NRAM Millipede Memory ECRAM Data Storage Paper History (1725) Drum memory (1932) Magnetic core memory (1949) Coated wire memory (1932) Magnetic core memory (1949) Coated wire memory () 1957)) Core core memory (1960s) Thin film memory (1962) Disk Pack (1962) Twistor Memory (~1968) Bubble memory (~ 1970) Floppy disk (1971) vte Hard disk drive (HDD), hard disk, Hard disk, or fixed disk[b] is an electro-mechanical data storage device that stores and obtains digital data using magnetic storage and one or more rigidly rapidly rotating platters paired with magnetic heads, usually stacked on moving activatory arms, which read and write data onto the surface of the plate. [2] Randomly accessed data, meaning that individual data blocks can be stored and taken in any order. HDD is a type of volatile storage, retaining data stored even when turned off. [3] [4] [5] Introduced by IBM in 1956,[6] HDD is a dominant secondary storage device for general purpose computers starting in the early 1960s. HDD retains this position into the modern era of servers and personal computers, despite personal computing devices produced in large numbers, such as mobile phones and tablets, depending on flash products. More than 224 companies have historically produced HDD, even after the vast industry consolidation of most units was produced by Seagate, Toshiba, and Western Digital. HDD controls the amount of storage generated (exabytes per year) for servers. Although production grew slowly (by exabytes delivered[7]), sales and delivery revenue decreased due to solid state drives (SSDs) had higher data transfer rates, higher waste storage density, improved reliability,[8] and lower latency and access time. [9] [10] [11] Revenue for SSDs, many of which used NAND, slightly exceeded flash storage products. [13] Had more than doubled the hard drive income in 2017[update]. [14] Although SSDs have costs four to nine times higher per bit,[15][16] they replace HDD in applications where speed, power consumption, small size, high capacity and durability are important. [12] Square costs for SSDs fell, and price premiums on HDD were cramped. [16] The main features of the HDD are its capacity and performance. Capacity is determined in the prefix of the unit corresponding to the power of 1000: a 1-terabyte (TB) drive has 1,000 gigabrics (GB; where 1 gigalite = 1 billion (109) bytes). Usually, some HDD capacity is not available to users because it is used by file systems and computer computers system, and possibly build redundancy for correction of errors and recovery. There is also confusion about storage capacity, since the capacity is expressed in decimal Gigabyit (10 power) by the HDD manufacturer, while some operating systems report capacity in binary Gibibytes, which produces a smaller amount than advertised. The performance is determined by the time it takes to move the head to the track or cylinder (average access time) adding the time required for the sector required to move under the head (average latency, which is a function of physical rotation speed in the revolution per minute), and finally the speed at which the data is transmitted (data rate). The two most common form factors for modern HDDs are 3.5-inches, for desktop computers, and 2.5-inches, especially for laptops. HDD is connected to a system according to standard interface cables such as PATA (Parallel ATA), SATA (Serial ATA), USB or SAS CABLE (Serialed Attached SCSI). Main Article History: History of hard disk drive Play Video Video of modern HDD operations (released) Increased HDD features over time Parameters Started with (1957) Upgrade Capacity (2019) (formatted) 3.75 megabyit[17] 18 terabytes (until 2020[update])[18] 4.8 million-to-one[19] Physical volume of 68 cubic feet (1.9 m3)[c[c][6] 2.1 cubic inches (34 cm3)[20][d] 56,000-to-one[21] Weighing 2,000 pounds (910 kg)[910 kg)[210 kg)[210 kg)[21] 6] 2.2 ounces(62 g)[20] 15,000-to-one[22] Average access time of approximately 600 migrants[6] 2.5 ms to 10 ms; RW RAM bergantung kepada kira-kira200-kepada-satu[23] Harga US$9,200 setiap megabait (1961)[24] US$0.024 per gigabait menjelang 2020[25][26][27] 383 juta-to-one[25][27] 383 juta-to-one[25][27] 383 juta-to-one[202028] Ketumpatan data 2,000 bit per inci persegi[29] 1.3 terabit setiap inci persegi pada tahun 2015[30] 650 juta-kepada-satu[31] Purata jangka hayat c. 2000 jam MTBF[petikan petikan diperlukan] c. 2,500,000 jam (~285 tahun) MTBF[32] 1250-to-one[33] Pemacu cakera keras IBM pengeluaran pertama, storan cakera 350, dihantar pada tahun 1957 sebagai komponen sistem RAMAC IBM 305. It is approximately the size of two medium-sized refrigerators and stores five million six-bit (3.75 megabytes) characters[17] on a stack of 52 disks (100 surfaces used). [34] 350 had a single sleeve with two read/write heads, one up and one down, which moved horrorly across a pair of plate and vertical from a set of plate to the second set. [35] [36] [37] The IBM 350 variants were IBM 355, IBM 7300 and IBM 1405. In 1961 IBM announced, and in 1962 it was delivered, the IBM 1301,[38] disc storage unit that replaced IBM 350 and similar drives. 1301 consists of one (for Model 1) or two (for 2 models) modules, each containing 25 plates, each plate about 1⁄8-inch (3.2 mm) thick and 24 inches respectively mm) diameter. [39] Although the previous IBM disc drove using only two read/write heads per arm, 1301 uses a variety of heads of 48[e] (comb), each horrified moving deceased as units, one head per surface used. The read/write cylinder mode operation is supported, and the head flew about 250 micro-inches (about 6 μm) above the dish surface. The motion of the head depends on the system of addition of hydraulic actuation which guarantees repeated positions. The 1301 cabinet is all about the size of three house refrigerators placed side by side, storing the equivalent of about 21 million bytes eight bits per module. Access time is about a quarter of a second. Also in 1962, IBM introduced a 1311 disk drive model, which is about the size of a washing machine and stores two million characters on removable disk packs. Consumers can buy extra packs and exchange them as needed, just like magnetic tape reels. Then removable pack drive models, from IBM and others, became prevalent in most computer installations and reached a capacity of 300 megabytes by the early 1980s. In 1963 IBM introduced 1302,[40] with double track capacity and twice as many tracks per cylinder as 1301. 1302 has one (for Model 1) or two (for Model 2) modules, each containing a separate combination for the first 250 tracks and the last 250 tracks. Some high-critical HDDs were produced with one head per track, for example, burroughs B-475 in 1964, IBM 2305 in 1970, so that no physically lost time transferred head to the runway and the only latch was the time for the data block to rotate to the bottom of the head. [41] Known as regular disk drives head or head per track, they are very expensive and no longer in production. [42] In 1973, IBM introduced a new type of HDD code named Winchester. Its main feature is that the disc head is not completely withdrawn from the disk plate stack when the drive is powered. On the other hand, heads are allowed to land in a special area of the disk surface when the rotation down, take off again when the disk is then powered. This greatly reduces the cost of the headmobilizer mechanism, but prevents removing only disks from the drive as did with the disc pack that day. Instead, Winchester's first model of technology drive features a removable disk module, which includes both disk packs and head installations, leaving the mover's motor in the drive when removal. Then Winchester drove abandoning the concept of removable media and returned to a plate that could not be removed. Like the first removable pack drive, the first Winchester drive uses a 14-inch (360 mm) diameter. A few years later, designers explore the possibility that smaller physical plates offers advantages. Drives with an irrectable eight-inch plate appear, and then a drive that uses a form factor of 5 1⁄4 in (130 mm) (mounting width is equivalent to those used by contemporary contemporary floppy disks The latter is primarily intended for the later personal computer (PC) market. In the 1980s began, HDD was a rare and very expensive additional feature in PCs, but in the late 1980s their costs were reduced to the point where they were standard on all but the cheapest computers. Most HDDs in the early 1980s were sold to end-users of PCs as external, additional subsets. The subsystem is not sold under the driver manufacturer's name but under the names of subsystem manufacturers such as Corvus Systems and Tallgrass Technologies, or under the names of PC system manufacturers such as Apple ProFile. IBM PC/XT in 1983 included 10 MB of internal HDD, and shortly afterwards internal HDDs were inseminated on personal computers. External HDD remains popular longer on Apple Macintosh. Many Macintosh computers made between 1986 and 1998 featured SCSI ports on the back, making external expansion easy. The compact Macintosh computer doesn't have a user-accessible hard drive bay (indeed, Macintosh 128K, Macintosh 512K, and Macintosh Plus doesn't have a hard drive bay at all), so on external SCSI disk models are the only reasonable option to grow on any internal storage. HDD improvements have been driven by increased density of canals, listed in the table above. The app grew through the 2000s, from major computers late 1950s to most mass storage applications including computers and user applications such as entertainment content storage. In the 2000s and 2010s, NAND began terrorizing HDD in apps that required mobile or high performance. NAND performance improved faster than HDD, and applications for HDD eroding. In 2018, the largest hard drive had a capacity of 15 TB, while the largest capacity of SSD had a capacity of 100 TB. [43] As of 2018[update], HDD is forecast to reach 100 TB capacity around 2025,[44] but until 2019[updated] the expected improvement rate has been compared back to 50 TB by 2026. [45] Smaller form factors, 1.8-inch and below, were halted around 2010. The cost of keeping a solid state (NAND), represented by Moore's laws, improved faster than HDD. NAND has a higher employability of demand from HDD, and this drives market growth. [46] In the late 2000s and 2010s, the life cycle of HDD products entered a mature phase, and slow sales may indicate the onset of a declining phase. [47] Thailand's 2011 floods damaged manufacturing plants and impacted the cost of hard drive drives between 2011 and 2013. [48] Technology Magnetic Cross Section &; Frequency modulation encodes Magnetic Binary Data View also: magnet Data on modern HDD records by enlarging thin films of ferromagnetic materials[f] on both sides of the disc. Seceding changes toward magnetization represent bits of binary data. Data is from the disc by detecting a transition in a magnet. User data is encoded using encoding schemes, such as long-term limited encoding,[g] which determines how data is represented by magnetic transitions. The typical HDD design consists of a spindle that holds a flat circle disk, called a plate, which holds recorded data. Plates are made of non-magnetic materials, usually aluminum alloys, glass, or ceramics. They are coated with a shallow layer of magnetic material usually 10-20 nm deeper, with an outer layer of carbon for protection. [52] For reference, a standard copy paper is 0.07–0.18 mm (70,000–180–180,000 nm)[53] thick. Destroy the hard drive, the glass platter appears Figure Picture that labels the main component of the HDD computer Recording a single bit magnetite recording at 200 MB HDD-plate (recordings made appear to be using CMOS-MagView). [54] Longing recordings (standard) &; diagrams of dissident recordings in contemporary HDD are spun at varying speeds from 4,200 RPM in energy-efficient mobile devices, to 15,000 rpm for high connected servers. [55] The first HDD devoted to 1,200 rpm[6] and, over the years, 3,600 rpm was the norm. [56] As of November 2019[update], the plate in most user-grade HDDs rotations is at 5,400 or 7,200 RPM. The information is written and read from the plate as it twists past devices called read and write heads placed to operate very close to the magnetic surface, with their flying height often within the range of dozens of nanoeters. Read and write heads are used to detect and modify the enlargement of the material passing immediately underneath. In modern drives, there is one head for each surface of the magnoltic platter on the spindle, mounted on a regular arm. The actuation arm (or access arm) moves the head on the arc (about a radial) across the plate as they rotate, allowing each head to access almost the entire surface of the plate as it rotates. The arms are moved using a voice ring mover or in some older design motor stepper. The initial hard drive wrote data on several continuous bits per second, causing all tracks to have the same amount of data per track but modern drives (since the 1990s) used bit recording zones - increasing the write-from-internal speed to the outer zone and thereby saving more data per track in the outer zone. In modern drives, the small size of the magnetic area creates the danger that their magnetic conditions may disappear due to thermal effect - heat-instability-induced magnets commonly known as superparamagnetic limits. To overcome this, the plate is coated with two layers of parallel magnetic, separated the three atomic layers of ruthenium are non-magnetic elements, and both layers are magnified in opposite orientations, thereor thereor are confirming each other. [57] Another technology used to The thermal effect of enabling greater density of recordings is secular recordings, first delivered in 2005,[58] and as of 2007[update] used in certain HDDs. [59] [60] [61] In 2004, high-twin recording media was introduced, consisting of a soft and harsh coupling of so-called magnetic storage technology spring media exchanges, also known as coupling composite media exchanges, enabling good reliability due to the nature of soft aid writings. However, heat stability is determined only by the hardest layer and is not influenced by a soft layer. [63] HDD components with discs and motor hubs removed, revealing acres of copper-colored stators surrounding the bearing in the middle of a rotating motor. The orange strip along the side of the arm is a thin printed circuit cable, the rotating bearing is in the middle and the activation is at the top left. Typical HDD has two electric motors: a rotating motor that rotates disks and activators (motors) that place the read/write head installation across a rotating disc. The disk motor has an external rotor attached to the disc; winding up stators is set in place. Contrary to the activation at the end of the head support arm is a read-write head; thin printed circuit cables connect the write reading head to the electronic amplifier installed on the activator's pivot. The head support arm is very light, but also stirring; in modern drives, the acceleration on the head reaches 550 g. A head stack with an activative geung on the left and read/write head on the right side of the read-write head, indicating the side facing the Activation plate is a permanent magnet and moving the geut motor that swings the head to the desired position. Metal plates support neodymium-iron-iron squat (NIB) magnets. Under this plate is a moving geil, often referred to as a voice coil by analogy to the geut in the speaker, which is attached to the actuator hub, and underneath which is the second NIB magnet, mounted on the bottom plate of the motor (some drivers only have one magnetic). The voice tremor itself is shaped quite like an arrow head and is made of skeptical copper magnetic wire. The inner layer is insulation, and the outside is thermoplastic, which binds rust together after it wounds on the shape, making it self-supporting. The slide sections along both sides of the arrow's head (which points to the actutifer bearing center) then interact with a fixed magnetic field. While flowing radially out along one side of the arrow's head and radially into the other produces a tangential force. If the magnetic field is uniform, each side will generate an opponent's force that will cancel one equally Therefore, the magnetic surface is half the north pole and half the south pole, with the radial dividing line in the middle, causing both sides of the egg to see magnetic fields and produce added force instead of cancelling. The current along the top and bottom of the inaugural money produces a radius force that does not twist the head. Electronic HDD controls the activative movements and disk rotation and performs readings and writes upon request from the disc controller. Electronic feedback is achieved through a special segment of the disk dedicated to getting feedback. This is either a complete conversion circle (in the case of specialized servo technology) or an alternate segment with real data (in case of embedded servo technology). Servo feedback optimizes the ratio of signals to the sound of the GMR sensor by adjusting the voice tremor of the activated arm. Spinning disk also uses a servo motor. Modern disk firmware is capable of reading and writing efficiently on the surface of the plate and the failed media rehatficiation sector. Modern driver error and handling rates use error correction code (ECC), especially Reed-Solomon error correction. These techniques store additional bits, determined by the mathematical formula, for each data block; additional bits allow many errors to be corrected invisible. The additional bits themselves take up space on the HDD, but allow higher recording density to be employed without causing incorrect errors, causing greater storage capacity. [64] For example, a regular 1 TB hard drive with a 512-byte sector provides an additional capacity of about 93 GB for ECC data. [65] In the latest driver, in 2009[update],[66] a low-fighting parity inspection code (LDPC) replaced Reed-Solomon; The LDPC code allows for performance close to the Shannon Limit and therefore provides the highest storage density available. [66] [67] Typical hard drives are trying to agitate data in the failed physical sector to the replacement physical sector provided by a spare sector pool (also called a reserve pool),[68] while relying on the ECC to recover stored data while the number of errors in the bad sector is still low enough. S.M.a.r.t (self-monitoring, Analysis and Reporting Technology) feature calculates the number of errors in the entire HDD set by the ECC (although not on all hard drives such as those related to the S.M.A.R.T described the ECC Hardware Recover and Soft ECC Corrections not supported consistently), and the amount done No-ID Format, Developed by IBM in the mid-1990s, it contains information on which sectors were bad and where the repaired sectors were placed. [69] Only a fraction of the error detected ends as cannot be corrected. Examples of incorrect bit reading error rates include: Specification 2013 for drivers SAS company declares correct rate to be an incorrect bit reading in every 1016 bit read,[70][71] The 2018 specification for the user's SATA hard disk states that the error rate became an incorrect bit reading error in every bit of 1014. [73] In certain manufacturer models the incorrect bit error rate is usually the same regardless of the drive capacity. [70] [71] [72] [73] The worst type of error was silent data corruption which was an undetectable error by a disc rigid software or host operating system; some of these errors may be caused by hard drive damage while others come from elsewhere in the connection between the drive and the host. [74] The development of leading hard drive drives was an areal density from 1956 to 2009 compared with Moore's laws. By 2016, progress has slowed significantly under the trend of extrapolitive density. [75] The rate of canal density progress was similar to Moore's laws (doubling every two years) through 2010: 60% p.a. in 1988-1996, 100% in 1996-2003 and 30% in 2003-2010. [76] Speaking in 1997, Gordon Moore called the rise of flabbergasting,[77] while observing later that growth could not continue indefinitely. [78] Price increases declined to −12% per annum during 2010-2017,[79] as canal density growth slowed. The progress rate for areal density slowed to 10% per annum in 2010-2016,[80] and there was difficulty migrating from perpendicular recordings to newer technologies. [81] When the cell size is slightly reduced, more data can be inserted into a single drive plate. In 2013, the desktop production of 3 TB HDD (with four plate) would have a canal density of about 500 Gbit/in2 which would amount to a small amount of cells comprising about 18 magnetic grains (11 by 1.6 grains). [82] Since the mid-2000s the progress of areal density has been challenged by superparamagnetic trilemmas involving cereal size, magnetic strength of cereals and headward ability to write. [83] To maintain acceptable signals for smaller grain noise is required; Smaller cereals can rewind themselves (electromet stability) unless their magnetic strength increases, but the known write-head material cannot generate a magnetic field strong enough to write a medium in the smaller space taken by cereals. Magnetic storage technology is being developed to address these trilemma, and compete with flash memory-based solid state drivers (SSDs). In 2013, Seagate introduced a shingled magnetic recording (SMR),[84] which was meant as a stopgap technology between PMR and a seagate substitute intended for magnetic recording successors of thermal aid (HAMR), SMR the track overlaps for increased data density, with lower cost of design complexity and access speed (mainly writing speed and random access speed of 4k). [85] On the other hand, Western Digital focuses on developing ways to seal helium-filled drivers rather than regularly censored air. This reduces and friction, and fitting more plate into the same barn space, although helium gas is very difficult to avoid escaping. Other recording technology is being developed in 2019[update], including magntic recordings of Seagate heat aid (HAMR). HAMR requires different architecture with redesigned media and read/write heads, new lasers, and optical transdusers near the new field. [87] HAMR is expected to deliver commercially by the end of 2020 or 2021. [88] Technical issues postponed the introduction of HAMR by a decade, from the initial projections of 2009,[90] 2015,[91] 2016,[92] and the first half of 2019. Some drives have adopted a two-free activation weapon to increase read/write speed and compete with SSDs.[93] planned substitute HAMR, bit patterned recordings (BPR),[94] were removed from Western Digital and Seagate's roadmap. [95] Magic recordings assisted by the Western Digital microwave (MAMR),[96][97] are expected to be delivered commercially in 2021, with samples in 2020. [98] Two-dimensional magnetic recordings (TDMR)[82][99] and current perpendiculars for giant magnetoresistance (CPP/GMR) head airplanes have appeared in research papers. [100] [101] [102] The concept of activated 3D vacuum drivers (3DHD) was proposed. [103] The rate of canal density growth has fallen below Moore's historical legal rate of 40% per annum. [75] Depending on the assumptions regarding the feasibility and time of this technology, Seagate predicted that areal density would grow 20% per annum in 2020-2034. [45] Capacity Two seagate barracuda drives, from 2003 and 2009 - 160GB and 1TB respectively. As of 2020[update] Seagate offers capacity up to 16TB. The highest-rated desktop HDD had 16 TB at the end of 2019. [104] The capacity of the hard disk drive, as reported by the operating system to the end user, is smaller than the amount specified by the manufacturer for a number of reasons: the operating system uses little space, the use of space for data release, and the use of space for file system structure. Also the difference in capacity reported in the preliminary UNIT of decimal SI vs. binary preliminary can lead to false effects of lost capacity. The calculation of modern hard drives appears on their host controller as a set of logical block contiguouss, and the capacity of rough drives is calculated by multiplying the number of blocks by the size of the block. This information is available from the manufacturer's product specifications, and from the driver itself through the use of operating system functions using low-level drive instructions. [105] Some older drivers, for example, IBM 1301, CKD, have variable long records and capacity calculations must take into account record features. Some new DASDs conclude and the same capacity formula applies. Gross capacity of older sector-oriented HDD calculated as a product of the number of cylinders per recording zone, recording, number of bytes per sector (the most common 512), and drive zone count. [citation required] Some modern SATA drives also report cylinder-head-sector (CHS) capacity, but this is not a physical parameter because the value reported is constrained by the historic operating system interface. The C/H/S scheme has been replaced by a logical block address (LBA), a simple linear address scheme that detects blocks by the integer index, which starts on the LBA 0 for the first block and subsequent increments. [107] When using the C/H/S method to describe modern large drives, the number of heads is often set to 64, although the usual hard drive drive, in 2013[update], has between one and four plates. In modern HDDs, spare capacity for disability management is not included in the published capacity; However, in many early HDDs some sectors were reserved instead, therein to reduce the capacity available to the operating system. For the RAID substem, data integrity and error tolerance requirements also reduce the realized capacity. For example, array RAID 1 has approximately half of the total capacity due to data mirroring, while array RAID 5 with drive n lose capacity 1/n (which is equivalent to a single drive capacity) due to storing parity information. The RAID substem is a range of drives that appear to be one drive or more drive to the user, but provides error tolerance. Most RAID vendors use checksums to improve data integrity at the block level. Some vendors designed the system using HDD with a sector of 520 bytes to contain 512 bytes of user data and eight bytes of checksum, or by using a separate 512-byte sector for checksum data. [108] Some systems can use hidden partitions for system recovery, reducing the capacity available to end users. Primary Article formatting: Disk formatting data is stored on a hard disk in a series of logical blocks. Each block is discussed by a marker that identifies the beginning and end, errors detect and corrects information, and spaces between blocks to enable small time variations. This block often contains 512 bytes of data that can be used, but other sizes have been used. As drive density increases, an initiative known as Advanced Format extends the size of the block to 4096 bytes of usable data, with a significant reduction in the amount of disk space used for block headers, error check data, and distance. The process of starting this logical block on a physical disk plate is called low-level formatting, which is usually done in the factory and is usually unchanged in the field. [109] High-level formatting wrote the data structure used by the operating system to data files on the disc. This includes writing partitions and file system structure to selected logic blocks. For example, some disk space will be used to hold a directory of disk file names and lists of logical blocks associated with specific files. Examples of partition mapping schemes include Master boot records (MBR) and GUID Partition Table (GPT). Examples of data structures stored on disks to recover files include File Allocation Schedule (FAT) in DOS and inode file systems in many UNIX file systems, as well as other operating system data structures (also known as metadata). As a result, not all spaces on HDD are available for user files, but the overheads of the system are usually small compared to user data. Unit View also: Binary Prefix § Decimal disk drive and prefix binary unit[110][111] Capacity advertised by manufacturer[h] Expected capacity by some users[i] Reported capacity of Windows[i] macOS ver 10.6+[h] With Bytes Bytes Diff Prefix. 100 GB 100,000,000,000 107,374,182,400 7.37% 93.1 GB 100 GB 1 TB 1,000,000,000,000 1,099,511,627,776 9.95% 931 GB 1,000 GB, 1,000,000 MB Total HDD capacity given by manufacturers using SI decimal preocedents such as gigabite (1 GB = 1,000,000,000 bytes) and bytes terabytes (1 TB = 1,000,000,000 bytes). [110] The practice dates back to the early days of computing; [112] by the 1970s, millions, mega and M were used consistently in the sense of decimals for drive capacity. [113] [114] However, memory capacity was quoted using preliminary binary interpretations, using 1024 power instead of 1000. The software reports the hard disk or memory capacity in different forms using either decimal or binary preterminants. The Family of Microsoft Windows operating system uses binary conventions when reporting storage capacity, so HDD offered by its manufacturer as a 1 TB driver was reported by this operating system as HDD 931 GB. Mac OS X 10.6 (Snow Leopard) uses decimal convention when reporting HDD capacity. [116] The default behavior of command-line df utilities on Linux is to report HDD capacity as several 1024-byte units. [117] The difference between the preliminary interpretation of decimals and binary confusion caused some consumer confusion and led to a class-action suit against the HDD manufacturer. The plaintiffs argue that the prefix use of decimal effectively misleads consumers while the defendant denies any wrongdoing or liability, asserting that their marketing and advertising comply with all aspects with the law and that no class member suffered any damage or injury. [118] [120] HDD Evolution prices per annum increased by −40% per annum in 1988-1996, −51% p.a. in 1996–2003 and −34% p.a. in 2003–2010. [27] Price increases declined to −13% per annum during 2011-2014, as density continued to rise and Thailand's 2011 floods damaged manufacturing facilities[81] and had on -11% per annum throughout 2010-2017. [121] The Federal Reserve Authority has published The price index for large-scale enterprise storage systems includes three or more enterprise HDDs and controllers, shelves and related cables. The price of this large-scale storage system improved at the rate1230% per annum in 2004-2009 and \u201222% per annum throughout 2009–2014. [76] Main article form factors: List of 8-, 5.25-, 3.5-, 2.5-, 1.8- and 1-inch HDD drive factors, along with payers to show the size of the plate and head read A newer 2.5-inch (63.5 mm) 6,495 MB HDD compared to older 5.25 inches full of height 110 MB HDD first hard drive, IBM 350, using a fifty-24-inch stack of dishes, stored 3.75 MB of data (approximately the size of one modern digital picture), and a size comparable to two large refrigerators. In 1962, IBM introduced its model 1311 disks, which used six 14-inch (nominal size) plates in removable packs and roughly the size of the washing machine. This becomes the standard plate size for many years, used also by other manufacturers. [122] IBM 2314 used the same size plate in an eleven-high pack and introduced the drive layout in a drawer. sometimes called a pizza oven, although the drawer is not a complete drive. In the 1970s HDD was offered in a multi-dimensional standalone cabinet containing from one to four HDDs. Starting in the late 1960s drives were offered a fully suitable drive into the lush that would mount in a 19-inch shelf. RK05 and RL01 digital are early examples of using a 14-inch single plate in a removable pack, the entire installation of drives in shelf space as high as 10.5 inches (six shelf units). In the mid-to-late 1980s the same Fujitsu Eagle, which was used (incidentally) 10.5-inch dishes, was a popular product. With the increase in sales of microcomputers already built in floppy disk drives (FDD), HDDs that correspond to FDD mounting become desirable. Starting with the Shugart Associates SA1000 HDD Form factor, initially followed by an 8-inch, 51/2-inch floppy disk drive, and a 31/2-inch floppy disk drive. Although referred to by this nominal size, the actual size of all three drives is 9.5, 5.75 and 4 wide respectively. Because there are no smaller floppy disk drives, smaller HDD form factors are developed from product offerings or industry standards. The 21/2-inch drive is actually 2.75 wide. As of 2019[update], 21/2-inch and 31/2-inch hard drives are the most popular sizes. By 2009, all manufacturers had halted the development of new products for 1.3-inch, 1-inch and 0.85-inch form factors due to the fall in flash memory prices,[123][124] which had no moving parts. Although the nominal size is in an inch, the actual dimensions are expressed in millimetres. Features Main Article: Hard drive performance features Factors that limit the time to access data on HDDs are mostly related to mechanical mechanical Rotating discs and moving heads, including: Find time is a measure of how long it takes a heads rally to travel to a disc track that contains data. The spin is borne because the desired disk sector may not be under the head when data transfer is requested. The average rotation soak is shown in the table, based on the statistical relationship that the average sediment is half the rotation period. The rate of bits or data transfer rates (once the head is in the correct position) creates a delay that is the function of the number of blocks transferred; usually relatively small, but can be quite old with a large file transfer that is amidst. Delays may also occur if the driver disk is stopped to save energy. Defragmentation is a procedure used to minimize delays in recovering data by transferring items related to the physical proxy area on the disk. [125] Some computer operating systems perform defragmentation automatically. Although automatic debris is intended to reduce access delays, performance will be temporarily reduced while the procedure is in progress. [126] The time to access data can be improved by increasing the rotational speed (theretorefore reducing latency) or by reducing the time spent searching. Increased density continues to increase by increasing data rates and by increasing the amount of data below one headset, thereence potentially reducing activity looking for a certain amount of data. The time to access the data is not stored with increased operation, which itself is not stored with growth in bit density and storage capacity. Latency Rotation Speed[rpm] Average rotational turn[ms] 15,000 2 10,000 3 7,200 4.16 5,400 5.55 4,800 6.25 Data transfer rate In 2010[update], Plain 7,200-rpm desktop HDD has a continuous disk-to-buffer data transfer rate of up to 1,030 Mbit/s.[127] This rate depends on track location; rates are higher for data on the outer track (where there are more data sectors per rotation) and lower towards internal tracks (where there is less data sector per rotation); and is generally quite high for 10,000-rpm drives. The current standard widely used for the buffer-to-computer interface is 3.0 Gbit/s SATA, which can send about 300 megabytes/s (10-bit coding) from buffer to computer, and therefore still comfortably topped the disk-to-buffer transfer rate today. Data transfer rates (read/write) can be measured by writing large files to the disc using a special file generator tool, then reading back files. Transfer rates can be affected by file system fragments and file layouts. [125] Transfer rate HDD depends on the rotational speed of the plate and the density of data recordings. Because of the heat and vibration limits of spin speed, density advances into the main method of increasing seceding transfer rates. Higher speeds require powerful spindle motors, which create more heat. Despite the progress of areal density by increasing both the number of tracks across disks and the number of sectors per track,[128] only the latter increased the data transfer rate for the given rpm. As data transfer rate performance tracks only one of the two components of areal density, its performance improved at a lower rate. [129] Other considerations of performance considerations include quality-adjusted pricing, power consumption, audible noise, and both operational and non-operational shock resistance. Access and interface Main Article: Inner hard disk interface displayS HDD Seagate 1998 which uses a 2.5-inch Parallel ATA interface sata drive on a 3.5-inch SATA drive, shows data close (7-pin) and (15-pin) power connectors While hard drives connect to computers more than several types of buses, including parallel ATA, Serial ATA, SCSI, SCSI Serial Series Attached SCSI (SAS), and Fibre Channel. Some drives, especially external mobile drives, use IEEE 1394, or USB. All of these interfaces are digital; electronics on the analog signal drive process from the read/write head. The current drive presents a consistent interface to the entire computer, free from internally used data encoding schemes, and is free of the physical number of disks and heads in the drive. Usually the DSP in the electronics in the drive takes raw analogue voltage from the read head and uses the PRML and Reed-Solomon error corrections[130] to decode the data, then send the data out of the standard interface. That the DSP also watched error rates detected by detection and error correction, and did poor sector rehighing, data collection for Self-Monitoring, Analysis, and Reporting Technology, and other internal tasks. The modern interface connects the driver to the host interface with a single data/control cable. Each drive also has an additional power cable, usually directly to the power supply unit. The older interface has separate cables for data alerts and for driver control signals. The Small Computer System Interface (SCSI), originally named SASI for Shugart Affiliated System Interface, is standard on servers, workstations, Commodore Amiga, Atari ST and Apple Macintosh computers through the mid-1990s, where most models were leased to the IDE (and then, SATA) family disks. The data cable length limit allows external SCSI devices. Integrated Drive Electronics (IDE), then standardized under the name AT Attachment (ATA, with the PATA alias (Parallel ATA) added retroactively when the SATA identification) moves the HDD controller from the interface card to the disk drive. This helps standardize host/controller face, reduce the complexity of programming in the host device driver, and reduce the cost of systems and complexity. 40-pin IDE/ATA extension transfers 16 bits at a time on the data cable. The data cable was originally 40 conductors, but later higher speed requirements led to an ultra-DMA (UDMA) mode using 80 conductor cables with additional wires to reduce cross talk at high speeds. EIDE is an unofficial update (by Western Digital) to the original IDE standard, with the main upgrade being the use of direct memory access (DMA) to transfer data between disks and computers without CPU engagement, an increase that was later adopted by official ATA standards. By transferring data directly between memory and disks, DMA eliminates the need for CPU to copy bytes per byte, thus allowing it to process other tasks while data transfer occurs. Fibre Channel (FC) is a substitute for the parallel SCSI interface in the enterprise market. It's a serial protocol. In disk drives are usually the topology of the Fibre Channel Arbitrated Loop (FC-AL) connection used. FC has a wider use of the disk interface alone, and it is the basis of the storage area network (SANs). Recently other protocols for the field, such as iSCSI and ATA over Ethernet have also been developed. Confusingly, drives typically use copper intercepted cables for Fibre Channel, not optical fibers. The latter is traditionally reserved for larger devices, such as servers or multi-disc controllers. Serials attached SCSI (SAS). SAS is a new generation serial communication protocol for devices designed to enable higher speed data transfer and is compatible with SATA. SAS uses data and mechanical power connectors similar to STANDARD 3.5-inch SATA1/SATA2 HDDs, and many SAS RAID server-oriented controllers are also capable of handling SATA HDDs. SAS using serial communications rather than parallel methods found in traditional SCSI devices but still use SCSI commands. Serial ATA (SATA). SATA data cable has one pair of data for the transmission of different data to the device, and one pair for differential receipts from the device, similar to EIA-422. That requires data to be sent serially. The same differential signal system is used in RS485, LocalTalk, USB, FireWire, and SCSI differential. SATA I to III is designed to be compatible with, and uses, subset SAS commands, and compatible interfaces. Therefore, the SATA hard drive can be connected and controlled by the SAS hard drive controller (with some minor exceptions such as drive/controller with limited compatibility). However they can't connect otherwise round—the SATA controller can't be connected to a SAS drive. Integrity and failure Shut down HDD heads rest on a disc plate; its mirror reflection can be seen on the surface of the plate. Main: Hard disk drive failure and Data Recovery See also: Solid state drives § SSD reliability and failure mode Due to very close distance between head and disk surface, HDD HDD exposure to damage by head accidents - a disc failure in which the head scrapes across the surface of the plate, often grinding out thin magnetic films and causing data loss. Head accidents can be caused by electronic failure, sudden power failure, physical shock, internal enclosure pollution drives, wear and tear, corrosion, or less produced plate and head. The HDD spindle system depends on the air density inside the disc enclosure to support the head at the correct flying height while the disc rotates. HDD requires a variety of air density to operate properly. Connections to the external environment and density occur through a small hole in the barn (about 0.5 mm in breeding), usually with a filter in the inside (the filter breathes). [131] If the air density is too low, then there is not enough lift for the head to fly, so the head is too close to the disc, and there is a risk of head accidents and data loss. A specially sealed and pressed disk is required for reliable high altitude operations, exceeding approximately 3,000 m (9,800 feet). [132] Modern disks include temperature sensors and adjust their operations to the operating environment. Breathable holes are visible on all disk drives – they usually have stickers next to them, warning users not to close the hole. The air inside the operating drive is always moving as well, drifted off motion by friction with a rotating plate. This air passes through an internal redistribution filter (or recirc) to remove any residual contaminants from manufacturing, any particles or chemicals that may have somehow entered the enclosure, and any particles or outgasings produced internally in normal operation. Very high humidity is present for a long period of time can errate the head and plate. For giant magnetoresistive heads (GMR) in particular, small head failures from pollution (which do not remove the magnetic surface of the disk) still result in overheating heads temporarily, due to friction with the surface of the disk, and can cause data unreadable for a short period until the head temperature is stable (called heat asperity, a problem that can partially be dealt with with , the drive can often be restored to functional order and data recovers by replacing the circuit board with one of the same hard drives. In case of writing reading head faults, they can be replaced using specialized tools in a dust-free environment. If the disk plate is not damaged, it can be moved into the same enclosure and the data can be copied or cloned to a new drive. In the event of a disc-plate failure, dismantling and a disk plate may be required. [133] For logical damage to file systems, various tools, tools, fsck on systems such as UNIX and CHKDSK on Windows, can be used for data recovery. Recovery from logical damage can require file carving. The general expectation is that hard disk drives designed and marketed for server use will fail less often than the user grade drives commonly used on desktop computers. However, two independent studies by Carnegie Mellon University[134] and Google[135] found that drive grades were not related to the driver failure rate. A summary of the 2011 research, into the pattern of SSD and magnetic disk failures by the findings of summarized Tom hardware research as follows:[136] Meanwhile between failures (MTBF) shows no reliability; annual failure rates are higher and usually more relevant. As of 2019,[update], storage providers reported an annual failure rate of two per cent per annum for storage farms with 110,000 off-the-shelf HDDs. Reliability varies between model and manufacturer. [137] Magic discs do not tend to fail during initial use, and the temperature only has minor effects; On the other hand, the rate of failure is increasing with age. The S.M.A.R.T. warns of mechanical issues but not other issues affecting reliability, and therefore not an indicator of reliable conditions. [138] The rate of driver failures sold as enterprises and consumers is very similar, although these types of drives are tailored to their different operating environments. [139] In various drives, a single driver failure significantly increases the short-term risk of failed second drivers. To minimize costs and overcome individual HDD failures, the storage system provider depends on the excess range of HDDs. The HDD failed to be replaced continuously. [137] [90] HDD Desktop market segments They usually store between 60 GB and 8 TB and rotate at 5,400 to 10,000 rpm, and have a media transfer rate of 0.5 Gbit/s or higher (1 GB = 109 bytes; 1 Gbit/s = 1) Previous drives (1980s-1990s) tended to be slower in spin speed. As of May 2019,[update], the highest-rated HDD desktop kept 16 TB,[141][142] with plans to release 18 TB drives later in 2019. [143] 18 HDD TB was released in 2020. As of 2016[update], the typical speed of the hard drive on the average desktop computer is 7200 RPM, while low-cost desktop computers can use RPM 5900 or 5400 RPM drives. For some time in the 2000s and early 2010s some desktop users and data centers also used 10k RPM drivers such as western Digital Raptor but such drives have become more rare in 2016[update] and are not commonly used now, having been replaced by NAND SSDs. Mobile (riba computer) HDD Two sata grade 2.5-inch enterprise 10,000 rpm HDD, refinery installed in a customized frame 3.5 inches Smaller than desktop and their company, they tend to be slower and have lower capacity. The mobile HDD rotates at 4,200 rpm, 5,200 rpm, 5,400 rpm, or 7,200 rpm, at 5,400 rpm the most common. 7,200 rpm drives tend to be more expensive and have smaller capacity, while 4,200 rpm models usually have very high storage capacity. Because of smaller plates, mobile HDDs usually have lower capacities than their desktop counterparts. There is also a 2.5-inch rotating drive at 10,000 rpm, which belongs to an enterprise segment without the intention of being used in laptops. Enterprise HDDs Are typically used with multi-user computers running enterprise software. Examples are: transaction processing database, internet infrastructure (email, webserver, ecommerce), scientific computing software, and storage management software nearby. Enterprise drivers usually operate continuously (24/7) in demanding environment while providing the highest possible performance without sacrificing reliability. Maximum capacity is not the ultimate goal, and as a result drivers are often offered in relatively low capacity in relation to their costs. [144] The fastest HDD enterprise rotates at 10,000 or 15,000 rpm, and can reach a sequential media transfer speed of more than 1.6 Gbit/s[145] and a continuous transfer rate of up to 1 Gbit/s.[145] Drives run at 10,000 or 15,000 rpm using smaller platters to reduce increased power needs (because they have less air drag) and therefore generally have lower capacity than the highest capacity desktop drive. HDD Enterprise is usually connected via SERIAL SCSI Attached (SAS) or Fibre Channel (FC). Some support multiple ports, so they can be connected to the host bus adapracer excessively. HDD Enterprises can have sector sizes larger than 512 bytes (often 520, 524, 528 or 536 bytes). Additional sectoral space can be used by controller or hardware RAID applications to store Integrity Field (DIF) data or Data Integrity Connection (DIX), resulting in higher reliability and silent data corruption prevention. [146] Electronic HDD users They include drivers embedded into digital video recorders and automotive vehicles. The container is configured to provide a guaranteed streaming capacity, even in the face of read and write errors, while the latter is built to counter a larger number of shocks. They usually rotate at a speed of 5400 RPM. Manufacturers and Sale Diagrams of HDD manufacturers View also: The history of hard disk drives and a list of hard drive manufacturers that do not work More than 200 companies have removed HDD over time, but consolidation has devoted production to only three manufacturers today: Western Digital, Seagate, and Toshiba. Production in the Pacific rim. Worldwide revenue for disk storage slumped eight per cent a year, from a peak of $38 billion in 2012 to $22 billion (estimated) in 2019. [45] HDD storage production increased 15% per annum in 2011-2017, from 335 to 780 exabytes per year. [147] HDD shipments declined seven per cent each during this period, from 620 to 406 million units. [147] [80] HDD deliveries were projected to drop by 18% in 2018-2019, from 375 million to 309 million units. [148] In 2018, Seagate had a 40% shipment of units, Western Digital had a 37% shipment of units, whilst Toshiba had a 23% shipment of units. [149] The average selling price for the two biggest producers was $60 per unit in 2015. [150] Competition from SSD HDDs is replaced by solid state drives (SSD) in the market where their speed is higher (up to 4950

megabytes per second for M.2 (NGFF) NVME SSDs[151] or 2500 megabytes per second for PCIe expansion card drivers[152]), rotation, and lower power are more important than prices, considering the cost of SSD bits is four to nine times higher than HDD. [16] [15] In 2016[update], HDD reportedly had a failure rate of 2-9% per annum, while SSD had fewer failures: 1-3% per annum. [153] However, SSDs have more data errors that cannot be corrected from HDD. [153] SSD offers greater capacity (up to 100 TB[43]) of the largest HDD and/or higher storage density (100 TB and 30 TB of SSD placed in H case 2.5-inch HDD but with equal height as HDD 3.5-inch[154][155][156][157][158]), although the cost remained prohibitive. The NAND 1.33-Tb 3D chip laboratory demonstration with 96 layers (NAND is usually used in solid state drives (SSD)) has 5.5 Tbit/in2 in 2019[update],[159] while the maximum waste density for HDD is 1.5 Tbit/in2. The areal density of flash memory is doubling every two years, similar to Moore's law (40% per annum) and faster than 10-20% per annum for HDD. As of 2018,[update], maximum capacity is 16 terabytes for HDD,[160] and 100 terabytes for SSD. [30] HDD is used in 70% of desktop computers and notebooks produced in 2016, and SSD is used in 30%. The share of HDD usage decreased and could fall below 50% in 2018-2019 according to one forecast, as the SSD replaced smaller HDDs (less than one terabyte) in desktop computers and notebooks and MP3 players. [161] The market for silicon-based flash memory chips (NAND), used in SSDs and other applications, grew faster than HDDs. NAND revenue worldwide rose 16% per annum from $22 billion to $57 billion during 2011-2017, while production rose 45% per annum from 19 exabytes to 17 [147] External hard disk drives See also: USB mass storage device classes and Disk Enclosures This article lost information about the newer and faster USB 3.0. Please expand the article to enter this information. More information may exist on the discussion page. (August Two 2.5 external USB hard drives Are unusually connected via USB; variants using the USB 2.0 interface generally have a slower data transfer rate when compared to installed internal hard drives connected via SATA. Turn on and play driver drivers offers system compatibility and has a large storage option and mobile design. As of March 2015,[update], the capacity available for external hard drives ranges from 500 GB to 10 TB. [162] External hard drives are usually available as integrated products installed but can also be installed by combining external enclosures (with USB or other interfaces) with separately purchased drivers. It is available in sizes of 2.5 inches and 3.5 inches; The 2.5-inch variant is commonly called a portable external drive, while a 3.5-inch variant is referred to as desktop external drives. Mobile drives are packed in smaller and lighter enclosures than desktop drives; In addition, portable drives use the power provided by a USB connection, while desktop drivers require an external power brick. Features such as encryption, Wi-Fi connection,[163] biometric security or various interfaces (for example, FireWire) are available at a higher cost. [164] There is a pre-installed external hard disk drive that, when taken out of its enclosure, cannot be used internally on a laptop or desktop computer because the USB interface is embedded on their printed circuit board, and the lack of SATA interface (or Parallel ATA). [165] In GUIS, hard disk drives are usually symbolized with the drive icon See also electronic portal Automatic Acoustic Management Cleanroom Click of death Data erasure Drive mapping Control error performance control hard disk feature hybrid drive Microdrive drive Network (file server, file server, shared source) Storage objects Write comparison encryption software Note encryption software ^ This is the original filing date of the application leading to U.S. Patent 3,503,060 , generally accepted as the ultimate hard drive patent. [1] ^ Unconscionable terms used to describe various hard disk drives including disk drives, disk files, direct access storage devices (DASD), CKD disks, and Winchester disk drives (after IBM 3340 disk drives). The term DASD includes another device next to the disc. ^ Comparable to size to refrigerator next to large side. ^ 1.8-inch form factor is obsolete; sizes smaller than 2.5 inches have been replaced with flash memory. ^ 40 for user data, one for format track, 6 for alternative surfaces and one for maintenance. ^ Initially the gamma iron particles in erectile binding, the deep-recording layer of modern HDD is usually a cobalt-Chrome-Platinum-platinum-based alloy domain physically isolated by oxide to enable perpendicular recordings. [49] ^ Historically various limited running codes have been used in magnetic recordings including for example, codes named FM, MFM and GCR that are no longer used in modern HDDs. ^ Expressed using multiples of decimals. ^ b Stated using binary multiples. References ^ Kean, David W., IBM San Jose, quarter-century innovation, 1977. ^ Arpaci-Dusseau, Arpaci-Dusseau, H.; Arpaci-Dusseau, Andrea C. (2014). Operating System: Three Simple Pieces, Chapter: Hard Drive (PDF). Arpaci-Dusseau's book. Archived (PDF) from the original on 16 February 2015. Receded 7 March 2014. ^ Patterson, David; Hennessy, John (1971). Computer organization and Design: Hardware/Software Interface. Elsevier. p. 23. ISBN 9780080502571. ^ Domingo, Joel. SSD vs HDD: What's the difference?. UK PC magazine. Archived from the original on 28 March 2018. Receded 21 March 2018. ^ Mustafa, Naveed Ul; Armejach, Adria; Ozturk, Ozcan; Cristal, Adrian; Unfounded, Osman S. (2016). Volatile memory implications as key storage for database management systems. 2016 International Conference on Embedded Computer Systems: Architecture, Modelling and Simulation (SAMOS). Ieee. pp. 164-171. doi:10.1109/SAMOS.2016.7818344. hdl:11693/37609. ISBN 978-1-5090-3076-7. S2CID 17794134. ^ a b IBM Archives: IBM 350 disk storage unit. January 23, 2003. Archived from the original on 31 May 2008. Receptioned 19 October 2012. ^ Shilov, Anton. Request for HDD Storage Booming: 240 EB Sent in Q3 2019. www.anandtech.com. ^ Confirms the Reliability of State Intel Solid Drives (PDF). Intel. July 2011. Archived (PDF) from the original on 19 October 2016. Recedaled 10 February 2012. ^ Fullerton, Eric (March 2018). 5th Unpredictable Memories Workshop (NVMW 2018) (PDF). Ieee. Archived from the original (PDF) on 28 September 2018. Receded 23 April 2018. ^ Useful, James (31 July 2012). For Fab Deficiency... Objective Analysis. Archived from the original on January 1, 2013. Receptioned 25 November 2012. ^ b Hutchinson, Lee. (25 June 2012) How the SSD conquered mobile devices and modern OSes Archived July 7, 2017, on the Wayback Machine. Ars Technica. Receded 7 January 2013. ^ b Santo Domingo, Joel (May 10, 2012). SSD vs HDD: What's the difference?. PC Magazine. Archived from the original on 19 March 2017. Receptioned 24 November 2012. ^ Hough, Jack (May 14, 2018). Why Western Digital can get 45% even if the HDD business declines. Barron's. Archived from the original on 15 May 2018. Receptioned 15 May 2018. ^ Mellor, Chris (July 31, 2017). NAND it... The flash chip industry is worth twice the biz disk drive. Receptioned 21 November 2019. ^ b John C. McCallum (November 2019). Disk Drive Storage Price Decreases with Time (1955-2019). jcmit.com. Receded on 25 November 2019. ^ b Mellor, Chris (28 August 2019). How long before the SSD replaces a disk drive nearby?. Receptioned November 15, 2019. ^ b Time Capsule, 1956 Hard Drive. Oracle Magazine. Oracle. July 2014. Archived from the original on 11 August 2014. Receded 19 September 2014. IBM 350 disk drives held 3.75 MB ^ WD GOLD hard drives with 18 Terabyte Storage Volume start listing for 649 dollars. teacher3D. Archived from the original on July 18 July 18, 2020. ^ 16,000,000,000,000 divided by 3,750,000. ^ b Toshiba Storage Solutions - MK3233GSG. Archived from the original on 9 May 2012. Receded 7 November 2009. ^ 68 x 12 x 12 x 12 divided by 2.1. ^ 910,000 divided by 62. ^ 600 divided by 2.5 . ^ 305 RAMAC 2 March 2015 Ballistic Research Laboratory domestic ELECTRONIC COMPUTING SYSTEM, March 1961, a section on IBM 305 RAMAC Archive March 2, 2015, at Wayback Machines (p. 314-331) stated the purchase price of $34,500 which counts to $9,200 / MB. ^ Desire Athow (May 2020). The largest hard drive available is still a 16TB drive. www.techradar.com. ^ $387.55÷16,000 GB. ^ a b John C. McCallum (May 16, 2015). Disk Drive Price (1955-2015). jcmit.com. Archived from the original on 14 July 2015. Recedaled 25 July 2015. ^ 9,200,000 divided by 0.024. ^ Magnetic head development. IBM Archives. Archived from the original on 21 March 2015. Reception was achieved on 11 August 2014. ^ b Shilov, Anton (March 19, 2018). Unlimited 5-Year Durability: SSD 100TB of Nimbus Data. AnandTech. Archived from the original on 24 December 2018. Receded December 24, 2018. ^ 1,300,000,000,000 divided by 2,000. ^ Ultrastar DC HC500 HDD Series. Hgst.com. Archived from the original on 29 August 2018. Recedaled 20 February 2019. ^ 2,500,000 divided by 2,000. ^ IBM Archives: IBM 350 disk storage unit. Ibm. January 23, 2003. Archived from the original on June 17, 2015. Recedaled 26 July 2015. ^ DISK STORAGE 355, IBM Operations Manual 650 RAMAC (4th ed.), June 1, 1957, p. 17, 22-6270-3, Three branches of mechanical free access are provided for each file unit, and each arm can be directed independently to any track in the file. ^ Disk Storage (PDF), IBM Reference Manual 7070 Data Processing System (ed.), January 1960, A22-7003-1, Each disk storage unit has three branches of mechanical free access, all of which can find at the same time. ^ IBM RAMAC System 1401 (PDF), IBM Reference Manual 1401 Data Processing System (ed.), April 1962, p. 63, A24-1403-5, The disk storage unit can have two branches of access. One is standard and the other is available as a special feature. ^ IBM Archives: IBM 1301 disk storage unit. ibm.com January 23, 2003. Archived from the original on 19 December 2014. Receptioned 25 June 2015. ^ DiskPlatter-1301. computermuseum.li. Archived from the original on 28 March 2015. ^ IBM 1301, Models 1 and 2, Disk Storage and IBM 1302, Models 1 and 2, Disk Storage with IBM 7090, 7094 and 7094 II Data Processing System (PDF). Ibm. A22-6785. ^ Microsoft Windows NT Workstation 4.0 Resource Guide 1995, Chapter 17 – Basic Disk System and File ^ P. PAL Chaudhuri, P. Pal (15 April 2008). Computer organization and Design (ed 3rd.). Learning PHI Pvt. Ltd. p. 568. ISBN 978-81-203-3511-0. ^ b Alcorn, Paul (March 19, 2018). 100TB SSD? Nimbus Data Has Been Protected With ExaDrive DC100. Tomshardware.com. Receded on 20 February 2019. ^ Mott, Nathaniel (November 7, 2018). Seagate Wants Ships 100TB HDD by 2025. Tomshardware.com. Receded on 20 February 2019. ^ b Mellor, Chris (September 23, 2019). How long before the SSD replaces a disk drive nearby?. Receptioned November 15, 2019. The volume of the market that can be addressed for disk drives will grow from $21.8bn in 2019 ^ Kanellos, Michael (January 17, 2006). Lightning goes notebook. CNET. Archived from the original on 19 May 2018. Receptioned 15 May 2018. ^ Industrial Lifecycle - Encyclopedia - Business Terms | Inc.com. Magazine Inc. Archived from the original on 8 July 2018. Receptioned 15 May 2018. ^ Agriculture hard drive: how Backblaze weathered Thailand's driving crisis. blaze.com. 2013. Archived from the original on 25 June 2014. Receptioned 23 May 2014. ^ Plumer, M. L.; van Ek, J.; Cain, W.C. (2012). New paradigma in Magnetic Recording. arXiv:1201.5543 [physics.pop-ph]. ^ Hard Drive. escotal.com. Archived from the original on 3 September 2011. Recedaled 16 July 2011. ^ What is my head accident & how can it result in permanent loss of my hard drive data?. data-master.com. Archived from the original on 8 July 2011. Recedaled 16 July 2011. ^ Hard disk assistance. hardrivehelp.com. Archived from the original on 3 September 2011. Recedaled 16 July 2011. ^ Elert, Glenn. Thickness of a Piece of Paper. hypertextbook.com. Archived from the original on 8 June 2017. Recedaled 9 July 2011. ^ CMOS-MagView Archive January 13, 2012, at Wayback Machine is an instrument that depicts the structure and strength of the magnetic field. ^ Blount, Walker C. (November 2007). Why 7,200 RPM Portable Hard Drives? (PDF). Archived from the original (PDF) on 19 April 2012. Recedaled 17 July 2011. ^ Kozierok, Charles (October 20, 2018). Hard Drive Spindle Speed. PC Guide. Archived from the original on 26 May 2019. Receptioned 26 May 2019. ^ Hayes, Brian. Terabyte Province. American scientists. p. 212. Archived from the original on 8 July 2014. Receded 20 September 2014. ^ Press Release December 14, 2004. Toshiba. Archived from the original on 14 April 2009. Recedaled 13 March 2009. ^ Seagate Momentus 21/2 HDD per Website January 2008. Seagate.com. 24 October 2008. Archived from the original on 11 March 2009. Recedaled 13 March 2009. ^ Seagate Barracuda 31/2 HDD per January 2008 website. Seagate.com. Archived from the original on 14 March 2009. Recedaled 13 March 2009. ^ Western Digital Scorpio 21/2 and Greenpower 31/2 HDD per quarterly conference, July 2007. Wdc.com. Archived from the original on 16 March 2009. Recedaled 13 March 2009. ^ D. Suess; et al. (2004). Exchange spring media recordings for areal density up to 10Tbit/in2. A. Magn. Mag. Mat. ^ R. et al. (2005). Composite media for perpendicular magnik IEEE Trans. Mag. Mat. 41 (2): 537-542. Bibcode:2005ITM.... 41..537V. doi:10.1109/TMAG.2004.838075. S2CID 29531529. ^ Kozierok, Charles (November 25, 2018). Hard Disk Error Correction Code (ECC). PC Guide. Archived from the original on 26 May 2019. Receptioned 26 May 2019. ^ Curtis E. Stevens (2011). Advanced Format in Legacy Infrastructure: More Transparent than Disturbing (PDF). idema.org. Archived from the original (PDF) on 5 November 2013. Receptioned November 5, 2013. ^ b Iterative Detection Read Channel Technology in Hard Drive, Hitachi ^ 2.5-inch Hard Drive with High Recording Density and High Shock Resistance Archive 26 May 2019, at Wayback Machine, Toshiba, 2011 ^ MjM Data Recovery Ltd. Data Recovery MJM Ltd: Bad Sector Mapping Techniques Datarecovery.mjm.co.uk. Archived from the original on 1 February 2014. Recedaled 21 January 2014. ^ Kozierok, Charles (December 23, 2018). Format and Structure of Hard Drive Sector. PC Guide. Archived from the original on 26 May 2019. Receptioned 26 May 2019. ^ b Enterprise Performance 15K HDD: Data Sheet (PDF). Seagate. 2013. Archived (PDF) from the original on 29 October 2013. Receptioned 24 October 2013. ^ b WD Xe: Datacenter hard disk (PDF). Western Digital. 2013. Archived (PDF) from the original on 29 October 2013. Receptioned 24 October 2013. ^ b 3.5 BarraCuda data sheet (PDF). Seagate. June 2018. Archived (PDF) from the original on 28 July 2018. Recedived 28 July 2018. ^ b WD Red Desktop/Mobile Series Spec Sheet (PDF). Western Digital. April 2018. Archived (PDF) from the original on 28 July 2018. Recedived 28 July 2018. ^ David S. H. Rosenthal (October 1, 2010). Keeping Bits Safe: How Hard Can It Be?. ACM Queues. Archived from the original on 17 December 2013. Receded 2 January 2014. ^ b Hayes, Brian (March 27, 2016). Where is My Petabyte Disk Drive?. p. chart courtesy of historical data of Edward Grochowski. Receded December 1, 2019. ^ b Byrne, David (July 1, 2015). Prices for IT Data Storage Equipment and Conditions of Innovation. The Federal Reserve Board notes the FEDS. p. Table 2. Archived from the original on 8 July 2015. Recedaled 5 July 2015. ^ Gallium Arsenide. PC Magazine. March 25, 1997. Archived from the original on 21 August 2014. Recedaled 16 August 2014. Gordon Moore: ... The ability of magnetic discs to continue to increase density is flabbergasting-which has moved at least as fast as the semiconductor complexity. ^ Dubash, Manek (April 13, 2010). Moore's law is already dead, says Gordon Moore. techworld.com. Archived from the original on 6 July 2014. Recedaled 17 August 2014. It cannot continue forever. The exponential nature is that you push them out and ultimately disaster happens. ^ John C. McCallum (2017). Disk Drive Price (1955-2017). Archived from the original on the 11, 2017. Recedaled 15 July 2017. ^ b Gary M. Decad; Robert E. Fontana Jr. (July 6, 2017). See Future Cloud Storage Components and Projection Technology Trends. ibmsystemsmag.com. Table 1. Archived from the original on 29 July 2017. Recedaled 21 July 2014. ^ b Mellor, Chris (November 10, 2014). Kryder's legal crap: Race to UBER-CHEAP STORAGE IS OVER. theregister.co.uk. UK: Register. Archived from the original on 12 November 2014. Receptioned November 12, 2014. Thai floods of 2011 nearly double the cost of disk/GB capacity for a while. Rosenthal wrote: 'Technical difficulties migrating from PMR to HAMR, meaning that already in 2010 Kryder's pace has slowed significantly and is not expected to return to his trend in the near future. Flooding strengthens this.' ^ b Dave Anderson (2013). HDD Opportunities & Challenges, Now until 2020 (PDF). Seagate. Archived (PDF) from the original on 25 May 2014. Receptioned 23 May 2014. 'PMR CAGR slowed from a 40+% history down to ~ 8-12%' and 'HAMR CAGR = 20-40% for 2015-2020' ^ Plumer, Martin L.; et al. (March 2011). New paradigma in Magnetic Recording. Physics in Canada. 67 (1): 25–29. arXiv:1201.5543. Bibcode:2012arXiv1201.5543P. ^ Seagate Delivers Technology Achievement: First For Hard Drive Ships Using Next Generation Shingled Magnet Recordings (Press releases). New York: Seagate Technology plc. September 9, 2013. Archived from the original on 9 October 2014. Recedaled 5 July 2014. Magnet Shingled Technology is the First Step To Reaching Terabyte Hard Drive 20 by 2020 ^ Jake Edge (March 26, 2014). Support for closed magnetic recording devices. LWN.net. Archived from the original on 2 February 2015. Receded 7 January 2015. ^ Jonathan Corbet (April 23, 2013). LSFMM: Update storage technology. LWN.net. Archived from the original on 7 January 2015. Receded 7 January 2015. The 'shingled magnetic recording' (SMR) drive is a rotating drive that packs its tracks so closely that one track cannot be overwritten without destroying neighboring tracks as well. The result is that sparewritten data requires an overall rewriting of a close space track set; which is an expensive tradeoff, but higher storage density benefits—are deemed to be worth the cost in some situations. ^ Anton Shilov (December 18, 2015). Hard Drive with HAMR Technology Set to Arrive in 2018. Archived from the original on January 2, 2016. Receded 2 January 2016. Unfortunately, the mass production of a real hard drive featuring HAMR has been delayed for several times already and it is now turns out that the first HAMR-based HDD is due in 2018. ... HAMR HDDs will feature new architecture, need new media, completely redesigned read/write heads with lasers as well optical almost special fields (NFT) and some other unused components or mass mass Today. ↑ Shilov, Anton (November 5, 2019). Seagate: 18 TB HDD Due in First Half of 2020, 20 TB Drive to Ship by end of 2020. Reached on November 22, 2019. ↑ Mellor, Chris (August 28, 2019). How long before the SSD replaces the near-cute booster?. Reached on November 15, 2019. Seagate CTO Dr John Morris told analysts that Seagate has built 55,000 HAMR boosters and aims to get customers ready by the end of 2020. ↑ b Rosenthal, David (May 16, 2018). Speak longer at MSST2018. Reached on November 22, 2019. ↑ Shilov, Anton (October 15, 2014). TDK: HAMR technology can allow 15TB HDD already in 2015. Reached on November 15, 2019. ↑ Oliver, Bill (November 18, 2013). WD Demos Future HDD Storage Tech: 60TB Cakera Hard. Diarkibkan from the original on November 21, 2013. Reached on November 15, 2019. ... Seagate expects to start selling HAMR boosters in 2016. ↑ State of the Union: Seagate HAMR Hard Booster, Dual-Enabler mach2, and 24 TB HDD on Track. Anandtech.com. Diarkibkan from the original on February 20, 2019. Reached on February 20, 2019. ↑ Are Toshiba's Bit-Patterned Drives Changing hdd landscape?. PC magazine. August 19th, 2010. Diarkibkan from the original on August 22, 2010. Reached on August 21, 2010. ↑ Rosenthal, David (May 16, 2018). Speak longer at MSST2018. Reached on November 22, 2019. Seagate's most recent plan rejected hamr delivery into 2020, so they are now slipping faster than real time. Western Digital has despaired at HAMR and promises that the Microwave Assisted Magntic Recording (MAMR) is only a year out. BPM has dropped from both company-to-company plan. ↑ Mallary, Mike; et al. (July 2014). Head and Media Challenge for 3 Tb/in2 Magnik Microwave Assisted Recording. IEEE transaction on Magntik. 50 (7): 1–8. doi:10.1109/TMAG.2014.2305693. S2CID 22858444. ↑ Li, Shaojing; Livshitz, Boris; Bertram, H. Neal; Schabes, Manfred; Schrefl, Thomas; Fullerton, Eric E.; Lomakin, Vitaliy (2009). Microwave assisted magnetization reversal in composite media (PDF). The Letter of Fizik Gunaan. 94 (20): 202509. Bibcode:2009ApPhL.. 94t2509L. doi:10.1063/1.3133354. It was released (PDF) from the original on May 24, 2019. Reached on May 24, 2019. ↑ Mellor, Chris (September 3, 2019). Western Digital debuts 18TB and boosts mamr 20TB cakera. Reached on November 23, 2019. ... Microwave-aided magntic recording technology (MAMR) ... sample delivery needs to be paid towards the end of the year. ↑ Wood, Roger (October 19, 2010). Shingled Magnetic Recording and Two-Dimensional Magntic Recording (PDF). ewh.ieee.org. Hitachi GST. It was released (PDF) from the original on October 4, 2014. Reached on August 4, 2014. ↑ Coughlin, Thomas; Grochowski, Edward (June 19, 2012). Year of Destiny: HDD Capital Expenditure and Development from 2012-2016 (PDF). IEEE Santa Clara Valley Magnetics Society. It was released (PDF) from the original on 2 March 2013. Reached on October 9, October, ^ Bai, Zhaoqiang; Cai, Yongqing; Shen, Lei; Han, Guchang; Feng, Yuanping (2013). The crossing of the giant-magnetoresistance of all-Heusler with matched energy bands and Fermi surfaces. arXiv:1301.6106 [cond-mat.mes-hall]. ^ Recording of Perpendicular Magnicular Explained - Animation. Archived from the original on 6 October 2018. Recedaled 27 July 2014. ^ Promising New Hard Drive Technology. Receded December 1, 2019. ^ Seagate Initiates 16TB Hard Drive Shipping. Archived from the original on 9 November 2019. Reception on 9 November 2019. ^ Information technology – SCSI Appendix Series – 2 (SAS-2), INCITS 457 Draft 2, May 8, 2009, chapter 4.1 Overview of the type of direct access device, LBAs on logic units shall start with zero and shall conflict with the last logic block on the logic unit. ^ ISO/IEC 791D:1994, At Attachment Interface for Disk Drives (ATA-1), section 7.1.2 ^ LBA Count for Standard Disk Drive (LBA1-03 Documents) (PDF). IDEMA. June 15, 2009. Archived from the original on 22 February 2016. Rededevive 14 February 2016. ^ How To Measure Storage Efficiency - Part II - Tax. Blogs.netapp.com 14 August 2009. Archived from the original on 20 July 2011. Receded 26 April 2012. ^ Low level formatting. Archived from the original on June 4, 2017. Receded 28 June 2010. ^ b Storage Solutions Guide (PDF). Seagate. October 2012. Archived from the original (PDF) on 20 June 2013. Receded 8 June 2013. ^ MKxx33GSG MK1235GSL r1 (PDF). Toshiba. Archived from the original (PDF) on 22 November 2009. Receded 7 January 2013. ^ 650 RAMAC announcements. January 23, 2003. Archived from the original on 5 June 2011. Receptioned 23 May 2011. ^ Mulvany, R.B., Disk Storage Facility Engineering Design with Data Module. IBM JRD, November 1974 ^ Introduction to IBM Direct Access Storage Device, M. Bohl, publication of IBM SR20-4738. 1981. ^ CDC Product Line Card Archived June 5, 2011, at Wayback Machine, October 1974. ^ Apple Support Team. How OS X and iOS report storage capacity. Apple, Inc. Archived from the original on April 2, 2015. Receptioned March 15, 2015. ^ df(1) - Linux human site. linux.die.net. Archived from the original on 18 July 2015. Recedaled 18 July 2015. ^ Western Digital Settles Hard-Drive Capacity Lawsuit, Associated Press June 28, 2006. Fox News. March 22, 2001. Archived from the original on 24 May 2019. Receptioned 24 May 2019. ^ 26 October 2007 by Phil Cogar (26 October 2007). Seagate claims conclude, the settlement is announced. Bit-tech.net. Archived from the original on 20 March 2012. Receded 26 April 2012. ^ West Digital - Email Notice of Class Action Solution. Xtremesystems.org. Recerned on 26 April 2012. ^ Hard Drive Cost Per Gigabate. Backblaze. July 11, 2017. Archived from the original on 26 May 2019. Receptioned 26 May 2019. ^ Emerson Pugh, Lyle Lyle Johnson, IBM's John H. Palmer's 360 and early 370 MIT Press systems, 1991 ISBN 0-262-16123-0, advance letter 266. ↑ The fall in flash prices shook the HDD market, EETimes Asia, August 1, 2007. Archived February 1, 2008, at The Wayback Machine ^ In 2008 Samsung Archived Jun 16, 2011, at Wayback Machine introduced the SpinPoint A1 HDD 1 1 2009 1.3 inch but in March 2009 the family was listed as The End of Life Product and the new 1.3-inch model is not available in this size. Diarkibkan February 11, 2009, at the Wayback Machine ^ b Kearns, Dave (April 18, 2001). How to wean. Itworld. Diarkibkan from the original on February 20, 2010. Reached on November 26, 2010. ↑ Broida, Rick (April 10, 2009). Turning off Cakera Flakes Can Solve Damp PCs. Pcworld. Diarkibkan from the original on November 8, 2010. Reached on November 26, 2010. ↑ Speed Considerations. Seagate. Diarkibkan from the original on February 10, 2011. Reached on January 22, 2011. ↑ GLOSSARY OF BOOSTERS AND COMPUTERS. Seagate. Reached on August 4, 2018. ↑ Albrecht, Thomas R.; Arora, Hitesh; Ayanoor-Vitikkate, Vipin; Beaujour, Jean-Marc; Bedau, Daniel; Berman, David; Bogdanov, Alexei L.; Chapuis, Yves-Andre; Cushen, Julia; Dobisz, Elizabeth E.; Doerk, Gregory; He's Gao; Grobis, Michael; Gurney, Bruce; Hanson, Weldon; Hellwig, Olav; Hirano, Toshiki; Jubert, Pierre-Olivier; Kercher, Dan; Lille, Jeffrey; Zuwei Liu; Mate, C. Mathew; Obukhov, Yuri; Patel, Kanaiyalal C.; Rubin, Kurt; Ruiz, Ricardo; Schabes, Manfred; Lei Wan; Telaga, Dieter; et al. (2015). Bit-Patterned Magnetic Recordings: Theory, Media Fabrication, and Recording Achievements. IEEE transaction on Magntik. HGST, a Western Digital Company. 51 (5): 1–42. arXiv:1503.06664. Bibcode:2015ITM.... 5197880A. doi:10.1109/TMAG.2015.2397880. S2CID 33974771. ↑ Solomon Reed Cod - Introduction. Diarkibkan from the original on July 8, 2011. ↑ Mueler, Scott (February 24, 2019). Home Micro PC Library Tools Volume I: Cakera Keras. Macmillan Computer Publishing. Diarkibkan than the original on May 24, 2019. Reached on May 24, 2019. ↑ Cakera Lasak Booster for Commercial Air Computer Systems (PDF). It was originally released (PDF) on May 4, 2012. ↑ Grabianowski, Ed (May 29, 2009). How To Recover Lost Data from Your Hard Cakera. HowStuffWorks. Pp. 5-6. Diarkibkan from the original on November 5, 2012. Reached on October 24, 2012. ↑ Everything You Know About Cakera Is Wrong. Storagemojo.com 22, 2007. Diarkibkan than the original on May 24, 2019. Reached on May 24, 2019. ↑ Eduardo Pinheiro; Wolf-Dietrich Weber; Luiz André Barroso (February 2007). Trend Failure in the Large Cakera Booster Population (PDF). Google Inc. It was released (PDF) from the original on January 5, 2010. Reached on December 26, 2011. ↑ Investigation: Is Your SSD More Trustworthy Than Hard-Nosed? - SSD confidence study length Tom, 2011, final words ^ b Hard Drive and Statistics. Receptioned November 24, 2019. ^ Anthony, Sebastian. Use SMART to predict exactly when the hard drive is dead. ExtremeTech. Archived from the original on 31 August 2015. Receptioned 25 August 2015. ^ Reliable user hard disk as enterprise hardware. Alphr. Archived from the original on 11 September 2015. Receptioned 25 August 2015. ^ Beach, Brian (December 4, 2013). Enterprise Drive: Facts or Fiction?. Backblaze. Archived from the original on 18 August 2015. Receptioned 25 August 2015. ^ Donnell, Deirdre O. Seagate introduced the world's first 16TB Exos HDD and IronWolf NAS drivers. Notebookcheck. ^ BarraCuda en BarraCuda Pro schijven's hard intervention | Seagate Nederland. Archived from the original on 6 May 2019. Reception on 9 November 2019. ^ 16 TB MAMR Hard Drives in 2019: Western Digital. Archived from the original on 24 May 2019. Receptioned 24 May 2019. ^ Enterprise-class versus Desktop class Hard Drive (PDF). Intel. Archived (PDF) from the original on 3 August 2016. Receptioned September 25, 2013. ^ b Seagate Cheetah 15K.5 Data Sheet (PDF). Archived (PDF) from the original on 28 December 2013. Receded December 19, 2013. ^ Martin K. Petersen (30 August 2008). Linux Data Integrity (PDF). Oracle Corporation. Archived from the original (PDF) on 9 January 2015. Recedaled 23 January 2015. Most disk drives use the 512-byte sector. [...] Enterprise driver (Parallel SCSI/SAS/FC) supports 520/528 bytes of 'fat' sector. ^ b Gary M. Decad; Robert E. Fontana Jr. (May 15, 2018). A Ten Years (2008-2017) Landscape Storage LTO Tape Media, HDD, NAND (PDF). Receptioned 23 November 2019. ^ Shilov, Anton (May 3, 2019). PC Delivery Hard Drives Predictably down Nearly 50% in 2019. Receptioned 22 November 2019. According to Nidec data, sales of hard drive units declined by around 43% from 2010 to 2018, up from around 650 million units in 2010 to 375 million units in 2018. And it looks like sales will continue to drop in the coming years. Nidec recently revised its HDD transmission forecast down from 356 million drives to 309 million drives in 2019, which will drop further to 290 million units in 2020. ^ Hard Drive Results 2018. Forbes. Archived from the original on 26 May 2019. Receptioned 26 May 2019. ^ Anton Shilov (March 2, 2016). Hard Drive Delivery Down nearly 17% in 2015. Archived from the original on 7 July 2016. Recedaled 5 July 2016. ^ Force Series Gen.4 PCIe MP600 2TB NVMe M.2 SSD. www.corsair.com. Receded on 6 March 2020. ^ Intel Optane SSD 900P Series study. StorageReview.com March 16, 2018. Archived from the original as at 31 December 2018. Recedaled 20 February 2019. ^ b Bianca Schroeder; Raghav Againsetty; Arif Merchant (February 22, 2016). Lightning Reliability in Production: The and Unexpected (PDF). Receptioned November 25, 2019. ^ You will not be able to afford the 30TB SSD record setting. Bgr.com. 20 February 2018. Archived from the original on 10 April 2019. Recedaled 20 February 2019. ^ Circuit Breaker. Samsung launched the world's largest SSD with 30TB of storage. The Verge. Archived from the original on 27 January 2019. Recedaled 20 February 2019. ^ Advantages. Nimbus data. Archived from the original as at 31 December 2018. Recedaled 20 February 2019. ^ Scalable SSD. Nimbus data. Archived from the original as at 31 December 2018. Recedaled 20 February 2019. ^ Samsung launched the world's largest SSD with 30TB of storage. The Verge. Archived from the original on 27 January 2019. Recedaled 20 February 2019. ^ Advantages. Nimbus data. Archived from the original as at 31 December 2018. Recedaled 20 February 2019. ^ McGrath, Dylan (February 20, 2019). Toshiba Claims NAND Top Capacity. Receptioned November 24, 2019. ^ Bedford, Tom (December 4, 2018). Seagate reveals the world's largest HDD 16TB, and is most ludicrous 16TB. Alphr. Archived from the original on 24 December 2018. Receded December 24, 2018. ^ Coughlin, Tom (June 7, 2016). NAND 3D Enables Greater User SSDs. forbes.com. Archived from the original on June 16, 2016. Recedaled 4 July 2016. ^ Seagate Backup plus external Hard Drive Review (8TB). storagereview.com. Archived from the original on 25 July 2015. Recedaled 20 July 2015. ^ ^ Back Up Your Important Data to an External Hard disk drive | Happy Biometrics | Product Information and Reviews on Biometric Safety Devices -. Biometricsecurityproducts.org. 26 July 2011. Archived from the original on 25 May 2012. Receded 26 April 2012. ^ Western Digital My Passport, 2 TB. hwigroup.net. Archived from the original on 5 October 2013. Receded 11 January 2014. An example of an external hard disk drive that has been installed overdrawn without its enclosure that cannot be used internally on a laptop or desktop because of the interface embedded on its printed circuit board ^ Sebean Hsiung (May 5, 2010). How to bypass the USB controller and use as a SATA drive. datarecoverytools.co.uk. Archived from the original on 15 September 2014. Receded 11 January 2014. Read more Mueller, Scott (2011). Upgrade and Repair PC (20th ed. Enquiry. ISBN 978-0-7897-4710-5. Messmer, Hans-Peter (2001). Much Needed PC Hardware Book (4 ed.). Addison-Wesley. ISBN 978-0-201-59616-8. Kheong Chn, Sann (2005). Introduction to HDD, modeling, detection and decoding for magnetic recording channels (PDFs). Eleventh-Extended International Conference on Telecommunications. Receded 10 January 2020. The external link of the Hard Drive prompted the WikipediaDefinitions sister project from Wiktionary Media from Wikimedia Commons News from Wikinews Textbooks from Wikibooks Resources from Wikiversity This article uses external links not in accordance with Wikipedia's policies or guidelines. Please improve this article by removing the external links, and change useful links where corresponding to footnote references. (July 2020) (Learn how and when to remove this template message) Hard Drive Encyclopedia Video shows open HD working Average looking for computer disk timeline timeline: 50 Years HDD Hard Drive from inside: Track and Zone. How difficult is it? Hard drive hacking - hardcore software modifications, in eight sections, go as far as linux content boot on a regular HDD controller board Hiding Data in Hard Drive Service Area, February 14, 2013, by Ariel Berkman Rotary Acceleration Feed Forward (RAFF) Information Sheet, Western Digital, January 2013 PowerChoice Technology for Hard Disk March 2010 Shingled Magnetic Recording (SMR), HGST, Inc., 2015 The Road to Helium, HGST, Inc., 2015 Research Paper on the use of magnetic photocoductor perspectives in magneto-optical data storage. Reemption