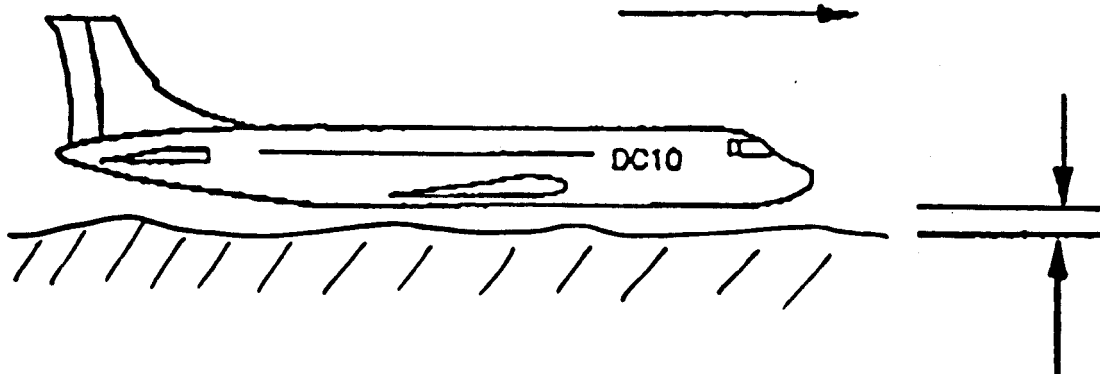


Database entries for: November 2004,
Volume 001 (37 entries)
Preliminary Release

PERSPECTIVES

on Science & Technology
on Science & Technology



2.54×10^{-8} meters

Hard Disk Drive Head Flyheight

Data Storage

The magnetic head in a hard disk drive flies extremely close to the magnetic recording disk. The standard unit of measure for this distance in the disk drive industry is in μ inches (10^{-6} inches). About 1 μ inch or 25.4 nanometers is a typical flyheight for today's (2002) hard drive heads. To put this in perspective for a standard nano-slider magnetic head, which is about 2 mm long, this would equate to a DC10 aircraft flying approximately 4 mm off the surface of the ground. The accuracy in altitude would be maintained to better than ± 0.2 mm during the entire flight.

Source: Unknown

Fred Thomas, Technologist –Ogden, Utah USA

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Section 1

Quantity: Magnetic flux density
Units: Gauss

1.0 x 10¹⁵ Gauss**Universe's Strongest Known Magnet?**

Physics/Astronomy

"The answer is the magnetar, a rare type of neutron star. Dr. Alaa Ibrahim, a scientist at NASA Goddard Space Flight Center, measured the magnetic field of a magnetar named SGR 1806-20. The field was a whopping 1,000,000,000,000,000 Gauss. That's the most magnetic object known. Luckily, SGR 1806-20 is parked safely 40,000 light years away from us. The magnetic field of a typical neutron star is over 100 trillion Gauss (that's 100,000,000,000). A neutron star is the core remains of a star at least eight times more massive than the Sun that exploded in a supernova event. Only about 10 have been discovered."

Website: Goddard Space Flight ..²⁵

Fred Thomas, Technologist - Ogden, Utah USA

Section 2

Quantity: Digital Capacity – Data Compression
Units: bytes

7.5 x 10⁸ bytes**Data Capacity of a Zip Disk (2004)**

Data Storage

Odlyzko Paper: Internet traffic ..¹⁹

Fred Thomas, Technologist - Ogden, Utah USA

1.3 x 10¹⁸ bytes**U.S. Internet Backbone Traffic (2002)**

Information Tech.

"Internet traffic continues to grow vigorously, approximately doubling each year, as it has done every year since 1997." There have been several myths as to the rate of Internet traffic doubling every 90 to 100 days, and these are just those myths except for a short period during 1995 and 1996 when this was true. It is estimated that traffic on Internet backbones in the U.S. during the year 2002 was somewhere between 0.96 and 1.68 exabytes (10¹⁸). About half this amount is traffic to websites, 21% for file sharing, with only about 1.5% consisting of email. Prior to the Internet the growth in data traffic annually was about 30% per year.

Odlyzko Paper: Internet traffic ..¹⁹

Fred Thomas, Technologist - Ogden, Utah USA

Section 3**Quantity: Mass
Units: kilograms**1.72 x 10⁵ kilograms**World's Largest Animals**

Animals/Zoology

"Blue whales are the largest animals of all time. Females grow to a length of 24 to 27 meters, weighing well over 100 tons (90,000 kg). The heaviest blue whale ever weighed was more than 190 tons (172,000 kg), and the longest ever measured was more than 33 meters. The largest land animal is the African elephant. They are the heaviest and second tallest land animals. Large bulls (males) weigh more than 13,000 pounds (5900 kg) and are 12 feet tall all the shoulder. Giraffes, which can grow to a height of 18 feet, are the tallest land animals. Large males weigh more than 4,000 pounds (1800 kg)."

Website: Smithsonian National Zoo²⁴

Fred Thomas, Technologist - Ogden, Utah USA

Section 4**Quantity: Distance
Units: meters**1.50 x 10⁻¹⁰ meters**Atoms**

Physics/Astronomy

"Atoms are 1 or 2 x 10⁻¹⁰ meters in radius. Now 10⁻¹⁰ meters is called an angstrom, so we say they are 1 or 2 angstroms (A) in radius. Another way to remember their size is this: if an apple is magnified to the size of the earth, then the atoms in the apple are approximately the size of the original apple."

The Feynman Lectures on Physics¹

Fred Thomas, Technologist - Ogden, Utah USA

2.54 x 10⁻⁸ meters**Hard Disk Drive Head Flyheight (2002)**

Data Storage

The magnetic head in a hard disk drive flies extremely close to the magnetic recording disk. The standard unit of measure for this distance in the disk drive industry is in μinches (10⁻⁶ inches). About 1 μinch or 25.4 nanometers is a typical flyheight for today's (2002) hard drive heads. To put this in perspective for a standard nano-slider magnetic head, which is about 2 mm long, this would equate to a DC10 aircraft flying approximately 4 mm off the surface of the ground. The accuracy in altitude would be maintained to better than ±0.2 mm during the entire flight.

Source: Unknown

Fred Thomas, Technologist - Ogden, Utah USA

7.5 x 10⁻⁵ meters**Human Hair**

Biology/Medicine

The human hair ranges in size from about 30 microns to about 200 microns in diameter. Objects much smaller than 30 microns are no longer visible to the naked eye. The average size human hair is about 75 microns in diameter.

Osmonics, Inc. Filtration Chart ²

Fred Thomas, Technologist - Ogden, Utah USA

1.27 x 10⁻⁴ meters**Human Fingerprint Depth**

Biology/Medicine

The human fingerprint has a depth of approximately 0.0127 mm or 0.0005 inches.

Nasa Tech Brief Article, Feb. 99 ⁶

Fred Thomas, Technologist - Ogden, Utah USA

2.92 x 10³ meters**Mount Ogden Summit, Ogden Utah**

Geology/Geography

Mount Ogden, which hovers over the city of Ogden, Utah in the USA, is 2917 meters (9570 feet) above sea-level. This makes it the 402nd highest peak in the State of Utah. The highest peak in that State being Kings Peak at 4,124 meters (13,528 feet) high. Mount Ogden is in the Wassatch Mountain Range which is a range of the Rocky Mountains in the western United States. Mount Ogden, as well as the City of Ogden, were named after Peter Skene Ogden, born in 1794, who was an experienced trapper and mountain man who explored and trapped the area in 1825 with a brigade of men from the Hudson's Bay Company.

Utah History Encyclopedia²³

Fred Thomas, Technologist - Ogden, Utah USA

8.56 x 10⁵ meters**US Library of Congress Book Shelves**

Humanities

The largest library in the world houses more than 115 million books (2003) stacked on 532 miles (856 kilometers) of shelves in its three buildings. The growing space problem at the library intensifies every day with 10,000 new items coming in every working day. Librarian of Congress James H. Billington says, "People think that everything goes on the Internet these days, but the amount of print material is increasing by 7 percent a year."

News Paper: Library Bursting..²²

Fred Thomas, Technologist - Ogden, Utah USA

6.380 x 10⁶ meters**Yangtze River**

Geography/Geology

The Yangtze River is Asia's longest river. It is the world's third longest river after the Nile and Amazon. It's 3,956-mile (6,380 kilometer) length starts in the Plateau of Tibet, the world's highest plateau and stretches to the South China Sea.

National Geographic News Service ³

Fred Thomas, Technologist - Ogden, Utah USA

1.000 X 10²⁰ meters**Our Galaxy**

Physics/Astronomy

The distance to the center of our galaxy is about 10²⁰ meters. This was determined by the study of many globular clusters of stars. It is found that there is a high concentration of such clusters in a certain part of the sky and that most of them are about the same distance from us. Coupling this information with other evidence, we conclude that this concentration of clusters marks the center of our galaxy.

The Feynman Lectures on Physics ¹

Fred Thomas, Technologist - Ogden, Utah USA

Section 5**Quantity: Time – 1/Frequency and 1/Transfer Rate
Units: seconds**1.0 x 10⁻¹⁵ seconds**Ultrafast Laser Pulse**

Physics/Astronomy

1.0x10⁻¹⁵ is what is termed a femtosecond. That is a quadrillionth of a second. If one assumes the universe is 12 billion years old, a femtosecond compares to a second as 10 minutes compares to the life of the universe. Light, in one femtosecond, goes only far enough to traverse about 1,000 silicon atoms. In femtosecond or ultrafast laser pulse machining there is no melt phase. The material undergoes a transition directly to the vapor phase. This is because the light pulse has a duration so short that there isn't enough time for heat to propagate into the surrounding material.

Clark-MXR, Inc., Web Site ⁵**Author**1.25 x 10⁻¹² seconds**Aggragate U.S. Internet Rates (2002)**

Information Tech.

"The upper estimate for U.S. Internet backbone traffic at year-end 2002, 140 PB/month, is equivalent to only about 420 gigabits/s (52.5 GB/s) on average. Even if we make allowances for a considerably higher than usual 1.9 ratio of peak hour to average traffic on backbones, we find that it would take only 800 Gb/s (1.25 picoseconds per bit) of capacity to transport all the traffic on all U.S. backbones, and that much capacity can now comfortably fit on a single fiber!" From this simple calculation we can see why there is a telecom fiber glut in the U.S. presently. It is estimated that only about 5% of capacity is being consumed.

Odlyzko Paper: Internet traffic ..¹⁹

Fred Thomas, Technologist - Ogden, Utah USA

1.09 x 10⁻¹⁰ seconds**Oscillation of an Atomic Clock (2004)**

Physics/Astronomy

The first atomic clock, invented in 1948, utilized the vibrations of ammonia molecules. Today's atomic clocks are based upon the oscillations of the cesium 133 atom. A second is the duration of 9,192, 631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom. The duration of each oscillation/transition is hence 108.8 picoseconds or has an oscillation rate of over 9 gigahertz (GH). The U.S. standard is the NIST-F1, which went into service in 1999 and should neither gain nor lose a second in 20 million years.

Book: The Quantum Beat ...¹²

Fred Thomas, Technologist - Ogden, Utah USA

6.7 x 10⁻¹⁰ seconds**HDTV Video Data Rates**

Information Tech.

There are three standard formats for HDTV: a) 720p, 1280x720 pixels, progressive @ 24, 30 or 60 frames/sec. (fs), b) 1080i, 1920x1080 pixels, interlaced @ 60 fs and c) 1080p 1920x1080 pixels, progressive @ 24 or 30 fs. Where, interlaced is half of frame every 1/60th of a sec. and progressive is entire frame every 1/30th of a sec. . The highest data rates for 1080p are calculated as follows: 1920 x 1080 resolution, 24-bit color – 8-bit red, green and blue values and 30 progressive frames per second. Hence, the bandwidth required is 1920 x 1080 x 24 x 30 = 1.49 gigabits/sec. or 186 megabytes/sec.

Book: The Quantum Beat ...¹³

Fred Thomas, Technologist - Ogden, Utah USA

1.45 x 10⁻⁹ seconds**Magnetic Hard Drive Data Rates (2004)**

Data Storage

The minimum data transfer transition time for one user bit for a shipping magnetic hard disk drive is about 1.45 nanoseconds or a peak data rate of 86 megabytes/sec. (MB/s). The Cheetah 15K.3 magnetic storage hard drive from Seagate is presently the fastest performer in this data storage category. This drive uses 3 ½" diameter disks spun at 15,000 RPM. This products maximum data transfer rate at the disk's inner diameter (ID) is 52 MB/s while it's maximum rate at the outer diameter (OD) is 86 MB/s. The rate difference is due to the difference in linear velocity of a disk at the OD versus the ID for a constant RPM.

Seagate Cheetah Product Spec. ⁸

Fred Thomas, Technologist - Ogden, Utah USA

3.47 x 10⁻⁹ seconds**Super DLT Tape Data Rates (2004)**

Data Storage

The minimum data transfer transition time for one user bit for a Super DLT magnetic tape drive is about 3.47 nanoseconds or a peak native data rate of 36 megabytes/sec. (MB/s). The "SDLT 600" magnetic storage tape drive from Quantum is presently the fastest performer in the DLT tape technology family. This drive uses a ½" wide tape with a pivoting optical servo system for track following. Quantum Corporation invented Super DLT and the lower capacity and transfer rate DLT tape technologies. The present maximum capacity point for the Super4 DLT family is 300 GB native.

DLT Tape Technology Website ⁹

Fred Thomas, Technologist - Ogden, Utah USA

3.57 x 10⁻⁹ seconds**LTO Tape Data Rates (2004)**

Data Storage

The minimum data transfer transition time for one user bit for a LTO (Linear Tape-Open) magnetic tape drive is about 3.57 nanoseconds or a peak native data rate of 35 megabytes/sec. (MB/s). The "Ultrium 3580" magnetic storage tape drive from IBM is presently one of these fastest performers in the LTO tape technology family. The LTO specification was jointly developed by three of the world's leading storage producers— IBM, Hewlett-Packard, and Seagate. The present maximum capacity point for the LTO family is 200 GB native.

IBM LTO Technology Website ¹⁰

Fred Thomas, Technologist - Ogden, Utah USA

4.46 x 10⁻⁹ seconds**Flash Memory Data Rates (2004)**

Data Storage

"With up to 2-Gbyte storage capacity, the latest DoK (Disk on Key) USB 2.0 flash storage devices from M-Systems deliver the highest capacity combined with the fastest read and write speeds. The embedded DoK T5 ARM processor runs the company's True Flash File System (TFFS) and maximizes the data throughput such that the 2-Gbyte DoK storage unit can read data at 23 Mbytes/s and write data at 15 Mbytes/s." This read transfer rates (23 MB/s) equivalent bit transition time is 4.46 nanoseconds. Pricing for this offering is at about \$0.23/MB.

Electronic Design Magazine²¹

Fred Thomas, Technologist - Ogden, Utah USA

4.92 x 10⁻⁹ seconds**Removable HD Data Rates (2004)**

Data Storage

The minimum data transfer transition time for one user bit for a removable hard disk (HD) is about 4.92 nanoseconds or a peak data rate of 24.5 megabytes/sec. (MB/s). The REV removable magnetic data storage drive from Iomega is presently the fastest performer in this data storage category. This drive uses 2 ½" diameter glass disks spun at 4200 RPM. This product's maximum data transfer rate at the disk's inner diameter (ID) is 12.7 MB/s while its maximum rate at the outer diameter (OD) is 25.4 MB/s. The rate difference is due to the difference in linear velocity of a disk at the OD versus the ID for a constant RPM.

Iomega REV Product Spec.⁶

Fred Thomas, Technologist - Ogden, Utah USA

4.92 x 10⁻⁹ seconds**USB Computer Interface Data Rate**

Information Tech.

USB 2.0 has a raw data rate at 480Mbps or 60 megabytes/sec., and it is rated 40 times faster than its predecessor interface, USB 1.1, which tops at 12Mbps. Originally, USB 2.0 was intended to go only as fast as 240Mbps, but then, the USB 2.0 Promoter Group increased the speed to 480Mbps in October 1999. USB is extendible to support up to 127 external devices; features hot-plug, unplug, and auto configuration; and supports a wide variety of devices. The bit rate time for 480 Mbps is

6

Fred Thomas, Technologist - Ogden, Utah USA

5.96 x 10⁻⁹ seconds**CCIR 601 or Studio Video Data Rates**

Information Tech.

Resolution - 720 x 486 x 29.97 frames per sec. (Fps), *Sample Size* - 8 bits per pixel, *Sampling* - 4:2:2 (or every two horizontal pixels = 2 Y : 1 Cr : 1 Cb). *Therefore: Luminance* (Y) 720 x 486 x 29.97 Fps = 10,487,102.4 bytes/sec. x 8 bits per byte = 83,896,819.2 bits/sec., *Chrominance R* (Cr) 360 x 486 x 29.97 Fps = 5,243,551.2 bytes/sec., x 8 bits/byte = 41,948,409.6 bits/sec., *Chrominance B* (Cb) 360 x 486 x 29.97 Fps = 5,243,551.2 bytes/sec., x 8 bits/byte = 41,948,409.6 bits/sec. *Total* = 20,974,204.8 bytes/sec. = 167,793,638.4 bits/sec. Roughly 20 MB/s or 160 Mb/s. Single bit time is hence 5.96 nanoseconds.

Web White Paper on Video/Audio¹⁴

Fred Thomas, Technologist - Ogden, Utah USA

8.33 x 10⁻⁹ seconds**DVD Optical Storage Data Rates (2004)**

Data Storage

The read transition time for one user bit off of a ROM disk in the fastest DVD drives on the market today is about 8.33 nanoseconds or 120 megabits/second. Typically, you will see DVD speeds in groups of three numbers, for example: 2x1x8x. These speeds refer to the following functions of the DVD drive: *Writing to 'R' media x Writing to 'RW' media x Reading 'ROM' media* (R = Recordable, RW = ReWritable, and ROM = Read Only Memory.) 1X DVD transfer rate is defined as 1.25 megabytes/second (MB/s). Today's peak performance DVD+R/RW drives are rated at 4x2.4x12x or 5 MB/s - 3 MB/s - 15 MB/s.

Plextor DVD Product Specifications²

Fred Thomas, Technologist - Ogden, Utah USA

1 x 10⁻⁸ seconds**Flourescence & Phosphorescence**

Physics/Astronomy

Ten nanoseconds is the demarcation time for the latent irradiance emitted from a material, which defines whether the emission is fluorescent or phosphorescent. For example phosphorescence is luminance or the emission of light from a source, which is delayed by more than ten nanoseconds following excitation. Glow in the dark items phosphoresce. Fluorescence is where the wavelength-shifted emission continues only as long as the stimulus producing it is maintained. Hence, the 10 nanosecond demarcation time. Many substances fluoresce in ultraviolet light (black light) including detergents and cat urine.

The Photonics Dictionary¹⁶

Fred Thomas, Technologist - Ogden, Utah USA

1.6 x 10⁻⁸ seconds**CD Optical Storage Data Rates (2004)**

Data Storage

The read transition time for one user bit off of a ROM disk in the fastest CD drives on the market today is about 16 nanoseconds or 62.4 megabits/second. Typically, you will see CD speeds in groups of three numbers, for example: 2x1x8x. These speeds refer to the following functions of the CD drive: *Writing to 'R' media x Writing to 'RW' media x Reading 'ROM' media* (R = Recordable, RW = ReWritable, and ROM = Read Only Memory.) 1X CD transfer rate is defined as 150 kilobytes/second (KB/s). Today's peak performance CD/CDRW drives are rated at 52x32x52x or 7.8 MB/s – 4.8 MB/s – 7.8 MB/s (megabytes/sec)

Iomega CD Product Specifications ⁶

Fred Thomas, Technologist - Ogden, Utah USA

1.85 x 10⁻⁸ seconds**802.11 WiFi Data Rates (2004)**

Information Tech.

WiFi is a wireless networking technology for computers. Most WiFi works in the 2.4 Ghz frequency band. There are three standards, and they all begin with 802.11, the WiFi specification. The three variants are "b", "g", and "a", which gives us 802.11b, 802.11g, and 802.11a. What are the differences? Between b and g, the difference is speed. "a" is a 5Ghz band WiFi. The fastest WiFi currently works at 54 Megabits/sec. That's about 1000 times faster than a 54Kbps modem. This data rate converts to a single bit transition time of about 18.5 nanoseconds. "g" and "a" both work at this speed. "b" works at a relatively slower 11Mbps.

Book: The Quantum Beat ...¹³

Fred Thomas, Technologist - Ogden, Utah USA

2.78 x 10⁻⁸ seconds**Blu-ray Opt. Storage Data Rates (2004)**

Data Storage

The promised minimum data transfer transition time for one user bit for Blu-ray drives is about 27.8 nanoseconds or a peak data rate of 36 megabits/second (Mb/s) or 4.5 megabytes/sec. (MB/s). As the format name directly indicates, a newly developed blue laser diode (405 nm) has been adopted as the optical stylus, providing a storage capacity of 25 GB on a single-layered disc or 50 GB on a dual-layered disc with a 12 cm diameter (same size as CD and DVD). The Blu-ray disc is held in a cartridge. The peak write transfer rate for presently (08/04) shipping Blu-ray drives from Sony Corp. is 24 Mb/s or 3 MB/s.

Blu-ray Technology Website ⁷

Fred Thomas, Technologist - Ogden, Utah USA

3.7 x 10⁻⁸ seconds**MPEG-4 Compressed HDTV Video**

Information Tech.

Latest compression method standardized by MPEG group, designed specially for low-bandwidth (*less than 1.5MBit/sec bitrate*) video/audio encoding purposes. One of the best-known MPEG-4 encoders is DivX which since version 5 has been fully standard-compliant MPEG-4 encoder. Not complete.

Website ¹⁸

Fred Thomas, Technologist - Ogden, Utah USA

3.7 x 10⁻⁸ seconds**MPEG-2 Compressed HDTV Video**

Information Tech.

Digital TV relies on a compression and encoding scheme known as MPEG-2 to fit its stunning images into a reasonable amount of bandwidth. In each image, the MPEG-2 software records just enough of the picture without making it look like something is missing. In subsequent frames, the software only records changes to the image and leaves the rest of the image as-is from the previous frame. MPEG-2 reduces the amount of data by about **55 to 1**. Hence, the 1.5 gigabit/sec. (Gb/s) data rates for highest resolution HDTV (1920 x 1080) can be reduced to about 27 Mb/s or 3.4 megabytes/sec. This bit time is 37 nanoseconds.

""How stuff works" Website ¹⁸

Fred Thomas, Technologist - Ogden, Utah USA

6.48 x 10⁻⁷ seconds**T1 Digital Line/Service Data Rates**

Information Tech.

“A digital transmission link with a capacity of 1.544 Mbps (193 KB/sec.). T1 uses two pairs of normal twisted wires, the same as found in most residences. T1 normally handles 24 voice conversations, each one digitized at 64 Kbps. But, with more advanced digital voice encoding techniques, it can handle more voice channels. T1 is a standard for digital transmission in the United States. T1 lines are used to connect networks across remote distances. Bridges and routers are used to connect LANs over T1 networks. There are faster services available.” This data rate translates to a bit time of 648 nanoseconds.

Pcpages Website²⁰

Fred Thomas, Technologist - Ogden, Utah USA

7.09 x 10⁻⁷ seconds**CD Quality (Native) Audio Data Rates**

Information Tech.

CD quality native (uncompressed) audio data rates may be calculated as follows: *Sample Size* - 16 bit (2 byte) data representation, *Channels* - 2 channels, *Sampling Rate* - 44,100 Samples Per Second. *Therefore: One Channel* - 2 bytes per sample x 44,100 samples per second = 88,200 bytes per second. *Total Data Rate* - 88,200 bytes per second x 2 channels = 176,400 bytes per second. *Total Bit Rate* - 176,400 bytes per second x 8 bits per byte = 1,411,200 bits per sample or 1.41 Mb/s (0.17 MB/s). This converts to 0.709 microseconds per bit of CD audio information transmitted.

Web White Paper on Video/Audio¹⁴

Fred Thomas, Technologist - Ogden, Utah USA

2 x 10⁻⁶ seconds**Floppy Disk Drive Data Rates**

Data Storage

The minimum data transfer transition time for one user bit for a Double Density (1.44 MB) 3.5" floppy disk drive is about 2 microseconds or a data rate of 500 kilobits/sec. (Kb/s) or 62.5 kilobytes/sec. (KB/s). The original single density floppy drive data rates were half this rate. Floppy technology uses a flexible plastic film media (disk) with a magnetic recording layer coated on the plastic film. The drives motor rotates this disk at 300 RPM. Floppy drives have no servo information for implementing actuator data track following and rely totally on drive part tolerances for location of the read/write head relative to the data tracks on the disk.

Mitsumi Floppy Specification¹¹

Fred Thomas, Technologist - Ogden, Utah USA

5 x 10⁻³ seconds**Hummingbird Wing Beat Time**

Biology/Medicine

Hummingbirds can only be found in the Americas, where we have over 330 species of them. Many of these hummingbirds differ drastically, from their size to their agility. Also, hummers flap their wings at unusual speeds. Sometimes covering more than 200 beats per second. Their wings vibrate on the upstroke and the downstroke which produces a kind of humming sound. The sound varies from species to species as does the frequency. Notably, the larger hummingbirds have less beats per second, meanwhile the smaller species have recorded up to 200 beats/sec. Hence, the beat time can be as short as 5 milliseconds.

Encyclopedia of Birds¹⁵

Fred Thomas, Technologist - Ogden, Utah USA

4.73 x 10¹⁴ seconds**Big Bang of the Universe**

Physics/Astronomy

The Big Bang Theory is the dominant scientific theory about the origin of the universe. According to the big bang, the universe was created sometime between 10 billion and 20 billion years ago from a cosmic explosion that hurled matter and in all directions. 4.73 x 10¹⁴ seconds is the equivalent of 15 billion years. In 1927, the Belgian priest Georges Lemaître was the first to propose that the universe began with the explosion of a primeval atom. His proposal came after observing the red shift in distant nebulae by astronomers to a model of the universe based on relativity.

NASA Website¹⁷

Fred Thomas, Technologist - Ogden, Utah USA

Section 6**Quantity: Area – Areal Density of Data Storage
Units: meter²**1.0 X 10⁻⁷ meter²**DVD Channel Bit Area**

Data Storage

Single layer DVD-ROM media (4.7 GB on a 120 mm disk) has a channel bit equivalent area of 0.1 μm². This equates to an areal density of xxx Gbits/in². About 42.3% of this native capacity is available for user data on the media due to encoding overhead such as error correction (ECC) and data formatting. The user bit area is hence 0.23 μm². This equates to an areal density of xxx Gbits/in². One will note both these areas are still significantly smaller than the area of the DVD diffraction limited airy laser spot (r_{airy}= 0.66 μm), which is 1.37 μm². This data packing efficiency increase is due to RLL encoding of data.

DVD–Philips Consumer Electronics ⁴**Fred Thomas, Technologist - Ogden, Utah USA**4.5 X 10⁻⁷ meter²**CD Channel Bit Area**

Data Storage

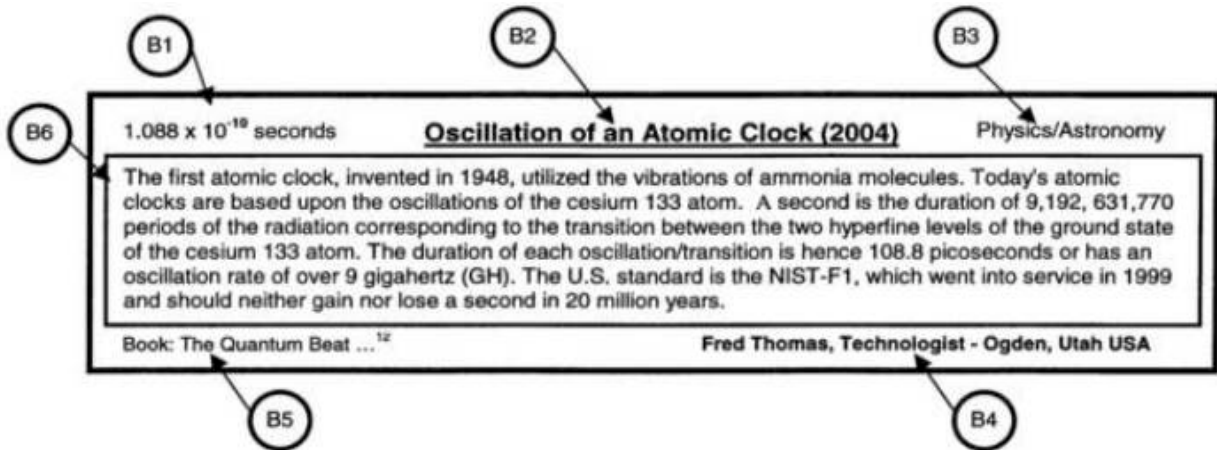
CD-ROM media (mode1, 74 min, 682 MB on a 120 mm disk) has a channel bit equivalent area of 0.45 μm². This equates to an areal density of xxx Gbits/in². Only 28.4% of this native capacity is available for user data on the media due to encoding overhead such as error correction (ECC) and data formatting. The user bit area is hence 1.58 μm². This equates to an areal density of xxx Gbits/in². One will note both these areas are still significantly smaller than the area of the CD diffraction limited airy laser spot (r_{airy}= 1.06 μm), which is 3.53 μm². This data packing efficiency increase is due to RLL encoding of data.

DVD–Philips Consumer Electronics ⁴**Fred Thomas, Technologist - Ogden, Utah USA**

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- 17) www.liftoff.msfc.nasa.gov/academy/universe/b_bang.html
- 18) www.electronics.howstuffworks.com/hdtv2.htm Further note: MPEG-2 can produce video bit rates as high as 100 megabits/second.
- 19) A. M. Odlyzko. Internet traffic growth: Sources and implications, *Optical Transmission Systems and Equipment for WDM Networking II*, B. B. Dingel, W. Weiershausen, A. K. Dutta, and K.-I. Sato, eds., Proc. SPIE, vol. 5247, 2003, pp. 1-15.
- 20) Here's how a lot of people define a T1 line:. (n.d.) Retrieved Sept. 15, 2004, from <http://www.pcpages.com/telecominfo/>
- 21) D. Bursky, (Sept. 6, 2004). USB Keyfob Packs 2 Gbytes Of Nonvolatile Storage. *Electronic Design Magazine*. Retrieved September 19, 2004 from <http://www.elecdesign.com/Articles/ArticleID/8642/8642.html>
- 22) C. Hartman. Library of Congress Bursting at Seams, Durham (N.C.) Herald-Sun, August 30, 2003.
- 23) A.K. Powell, *Utah History Encyclopedia*, University Press, 1994, University of Utah, Salt Lake City, UT.
- 24) Animal Records, Retrieved October 10, 2004 from Smithsonian National Zoological Park website: <http://nationalzoo.si.edu/Animals/AnimalRecords/>
- 25) C. Wanjek, Science Question of the Week: What's the strongest magnet known in the Universe?, Retrieved October 10, 2004 from Goddard Space Flight Center website: <http://www.gsfc.nasa.gov/scienceques2003/20040206.htm>
- 26)

Writing a “Perspective Block”



“Perspective Block” Element Breakdown

B1: Magnitude/Unit Entry. This is the number (magnitude) with “appropriate units” which quantifies the subject of the “Perspective Block” (B6). It is a three (3) digit exponential number (base 10) with a decimal point after the first digit. The list of quantities and their “appropriate units” will continue to grow. At this point in time that list includes the following twenty (22) quantities:

Quantity	Appropriate Units	Quantity	Appropriate Units
Distance	meters (m)	Area – Areal Density of Data Storage	meter ²
Time – 1/Frequency and 1/Transfer Rate	seconds (s)	Acceleration	meters/second ²
Mass	kilograms (kg)	Pressure – Stress - Modulus of elasticity	pascal (newtons/meter ²)
Electrical current	ampere (A)	Energy - Work	joule (N•m) (J)
Temperature	kelvin degrees (k)	Digital capacity – Data compression	bytes
Luminance	candela/meter ² (cd/m ²)	Power	watts
Density	kilograms/meter ³ (kg/m ³)	Speed - Velocity	meters/second (m/s)
Magnetic flux density	Gauss (G)	Electrical potential	volts (watt/ampere) (V)
Viscosity	pascal-second (Pa•s)	Electrical capacitance	farads (A•s/V) (F)
Jerk	meters/second ³ (m/s ³)	Electrical inductance	henery (V•s/A) (H)
Thermal conductivity	watt/meter•kelvin (W/m•K)	Force	newtons (kg•m/s ²) (N)

B2: Block Title. Subject of “Perspective Block.” Short and interesting, not more than 35 characters. If the entry is technology based and time sensitive, include the year of known validity for the block in the title. Example: Magnetic Hard Drive Data Rates (2004).

B3: Field of Endeavor. Field of science or technology that this “Perspective Block” entry is related to. Present list of fields includes:

- Physics/Astronomy
- Biology/Medicine
- Chemistry/Chem. Eng.
- Architecture/Civil Eng.
- Materials
- Mechanical/Mech. Eng.
- Humanities
- Information Tech.
- Geology/Geography
- Electro-Optics/Photonics
- Transportation
- Automation
- Tribology
- Animals/Zoology
- Data Storage
- Weather/Meteorology
- Nano Science/MEMS
- Aviation/Space
- IC & Electrical Arts
- Defense/Lethal Arts
- Other

Obviously there is some overlap, chose the best and most comfortable fit for your topic.

B4: Contributor. Name and affiliation of “Perspective Block” contributor. That is you. No greater than 55 characters. Some examples:

Joe Jackson, Mechanical Engineer, XYZ Corp.
 Bill Boggle, Noble Laureate – Physics, Boston MA, USA
 Yiping Yen, Prof. of Architecture, Peking Uni., China
 Amy Appleton, 8th Grade Student, Seattle WA, USA

B5: Informal Reference. The source of information provided in the “Perspective Block” (B6). In this filed a short summary reference is placed. This “informal reference” can be no longer than 26 characters. Some examples:

Scientific Amer. 10/1997
 XYZ Corp. Website
 Laser Focus World Mag.
 UofM Physics Dept. Website

These “informal references” are followed by a footnote, which directs the reader to the formal or standard academic reference for the source. It is critical you provide this information with your “Perspective Block” submission.

Formal References to published literature and electronic/web-based documents should also be provided for your “Perspective Block” entry. Private communications or unpublished reports should be treated as references also. Further information on how to write a “formal reference” is provided in a short PDF file at the website.

B6: Perspective Block Text. This is the text of the block entry. There is no hard and fast rule here. Length is limited to about 100 -110 words. Make it interesting and provide some perspective relative to the quantity being described. Conversion into other sets of units for the quantity is encouraged, especially, if those units are more standard to the science or technology than that provide for in the “Unit Entry” field. Remember to put quotation marks around text taken directly from your Reference (B5).

Handwritten "Perspective Block" Note Form

Magnitude/Unit entry: _____ x 10⁻⁻⁻⁻ _____ (list)

Block Title: _____

Field of Endeavor (list): _____

Contributor: _____

"Perspective Block" Text:

Informal Reference: _____

Formal Reference:

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