

DVD Specifications Summary

DVD Digital Video Disc

(See also [http://www.DVDdemystified.com/dvdfaq.html])

DVD (commonly Digital Video Disc) (A DVD is the same physical size as a CD.) DVD stands for Digital Versatile Disc, by vote of the committee that controls the trademark DVD, the DVD Forum. [http://www.DVDForum.org] All capacities are given in commercial units (marketing MegaBytes): (e.g.: 1 GigaByte = 1 Billion Bytes; 1 MegaByte = 1 Million Bytes) rather than the older, larger computer based binary MegaBytes (1 MegaByte = 1,048,576 Bytes) Marketing Megabytes were invented because there are more marketing MegaBytes on a given disk (or disc) than there are binary MegaBytes on the same disk (or disc). This allows the advertised capacity to be given as a larger number.

NB: When you calculate the amount of storage you will need on a given CD or DVD (using the table below), be sure that the units you are using for the size (amount) of data you plan to record are given in commercial units (marketing MegaBytes) rather than computer units (binary MegaBytes). If you are not sure that the size (amount) of your data is given in commercial units, then add 10 (ten) percent to the size (amount) of data you plan to record. In all cases, you should leave yourself some headroom (of at least 5 percent) for last minute changes. (This can be reduced as you gain experience.) If, in addition to the normal headroom allowance, you are also uncertain of the (data size) units used, it is best to allow a total of 15 percent for headroom. [NB: nota bene, Latin, mark well]

Disc Type	Acronym	Media Type	Side A Top Layer	Side A Bottom Layer	Side B Top Layer	Side B Bottom Layer	Total Storage Capacity
120 mm (4 3/4 inch) DVD	DVD-R** (SS)	DVD Recordable	4.70 GigaBytes	Not Available	Not Available	Not Available	4.70 GigaBytes
	DVD-R** (DS)	DVD Recordable	4.70 GigaBytes	Not Available	4.70 GigaBytes	Not Available	9.40 GigaBytes
	ROM (DS/DL)	Read Only Memory	4.27 GigaBytes	4.27 GigaBytes	4.27 GigaBytes	4.27 GigaBytes	17.08 GigaBytes
	RW & RAM	ReWriteable Random Access Memory	4.70 GigaBytes	Not Available	4.70 GigaBytes	Not Available	9.40 GigaBytes
80 mm (3 1/8 inch) DVD	DVD-R** (DS)	DVD Recordable	1.46 GigaBytes	Not Available	1.46 GigaBytes	Not Available	2.92 GigaBytes
	ROM (DS/DL)	Read Only Memory	1.33 GigaBytes	1.33 GigaBytes	1.33 GigaBytes	1.33 GigaBytes	5.32 GigaBytes
	RW & RAM	ReWriteable Random Access Memory	1.46 GigaBytes	Not Available	1.46 GigaBytes	Not Available	2.92 GigaBytes
HD-DVD Future: ~2006 120 mm	DVD-R** (DS)	DVD Recordable	16+ GigaBytes	Not Available	16+ GigaBytes	Not Available	32+ GigaBytes
	ROM (DS/DL)	Read Only Memory	16+ GigaBytes	16+ GigaBytes	16+ GigaBytes	16+ GigaBytes	64+ GigaBytes
120 mm CD	All (SS/SL)	All (SS/SL only)	682* MegaBytes	Not Available	Not Available	Not Available	682* MegaBytes
80 mm CD	All (SS/SL)	All (SS/SL only)	194 MegaBytes	Not Available	Not Available	Not Available	194 MegaBytes

SS (Single Sided), DS (Double Sided), SL (Single Layer), DL (Double Layer), SS/SL (Single Sided / Single Layer), DS/DL (Double Sided / Double Layer), DS/SL (Double Sided / Single Layer per side), DS/ML (Double Sided / Mixed Layer; one side 1 layer, other side 2 layer), HD (High Density); Top Layer (Layer 1), Bottom Layer (Layer 0)

* CD capacities have always been advertised as 650 MegaBytes using the older computer based binary MegaByte (1,048,576 Bytes) size. Using the new commercial units (marketing MegaBytes) of 1 Million Bytes per MegaByte, a CD holds 682 MegaBytes. DVD capacities, however, are always stated in the new, smaller, marketing MegaBytes.

** DVD-R (Recordable) and CD-R are the equivalent of WORM (Write Once, Read Many) The DVD-R capacity listed above, of 4.7 GigaBytes per side, is for discs and DVD writers that conform to the new DVD-R standard (DVD-R 2.0). The older (DVD-R 1.0) capacity of DVD-R discs was 3.95 GigaBytes per side, for a total of 7.9 GigaBytes on a two sided disc.

DVD 16X

CD drives read at up to 40X speed. Music CDs are listened to at 1X. Listening to music at 2X or at an X other than 1X does not make sense, except for Alvin and the Chipmunks.

CD and DVD Xs do not always mean that the entire CD or DVD will be read at X times the normal speed. This is because CDs and DVDs are meant to be read at a Constant Linear Velocity (CLV), which means that a CD or DVD rotates faster when reading the shorter inner

tracks. Some high speed readers do not increase their rotational speed when reading the inner tracks. The rotational speed on these readers is a Constant Angular Velocity (CAV) (one rotation sweeps out an angle of 360 degrees).

A good rule of thumb is to reduce the X speed by 25 percent. A 16X DVD drive would transfer an entire DVD movie at about a 12X fast forward speed and would therefore read about 4 GigaBytes in about 1 / 6 hour (10 minutes) at a data rate of about 25 GigaBytes per hour. Restoring a 250 GigaByte Database with 10 of the

16X DVD drives would require about 1 hour. In a short time the DVD drives should approach the CD drive cost of 50 US dollars each, so that 40 of the DVD drives would cost about 2 thousand US dollars. Restoring a 1 TeraByte database with 40 of the 16X DVD drives would require 1 hour. A 10 TeraByte database would require 10 times as many drives (400) to restore the 10 TeraByte database in the same time (1 hours). When restoring files, some time is required to create catalog entries. For large files this is less of a problem.

DVD Multimedia

6 channel (theater quality surround sound) (5.1, Dolby AC-3) / 96 KHz audio / 24 bit audio, 8 language tracks, 32 subtitle tracks, and about 135 minutes (long enough to accommodate 94% of all movies) of high quality video (720 horizontal pixels) on each of 4

layers. DVDs support runtime editing so that all ratings of a movie are on the same DVD; 'R' rated scenes can be skipped, without interruption, as the DVD is played. The file format is ISO 13346 UDF (Universal Disc Format), which harmonizes all CD recording standards including ISO 9660. [N.B. (Optical disc is spelled with a 'c' as in music disc. Magnetic disk is spelled with a 'k' as in

narrow disk.) [For a DVD with a two layer side, to reduce inter-layer crosstalk, the minimum pit length of both layers is increased from .40 um to .44 um. This results in longer (and therefore fewer) pits for more effective reading of the data.] See also [http://www.DVDdemystified.com/dvdfaq.html]

Blue Light Special (Blu-Ray)

A future technology, 3rd generation blue lasers [sort of a blue light special, as blue-purple light has a wavelength about half that of red light], called Blu-Ray, is planned to yield an approximately 100

GigaByte DVD ROM for HDTV. (Approximately 25 GigaBytes per layer with 2 layers per side.) The single side single layer capacity is planned to be approximately 27 GigaBytes. The media will be the same size as a DVD but will otherwise be incompatible. To create a drive that can read and write DVDs and Blu-Ray discs,

it will be necessary to build in separate read and write mechanisms for DVDs and for Blue-Ray discs. And, possibly a third mechanism to maintain compatibility with CDs. Blu-Ray will have copy protection features in addition to those found on DVDs and CDs.

DVD Audio

DVDs can be used to record audio only, with no video. In addition, DVD audio includes various still images. DVD audio is different than the audio that is used as part of DVD video.

The DVD audio standard is for up to 6 channels, a sampling rate of 48, 96, or 192 KHz, and a sample size of 16, 20, or 24 bits. With 24 bit samples taken at a 192 KHz rate, this provides a 96 KHz frequency response and a 144 dB dynamic range. DVD audio can also provide for a lossless audio

compression of about 2 to 1 which would have a playing time of 120 to 140 minutes for two-channel 192 KHz / 24 bit recordings for a single layer. Each DVD disc can have up to 4 layers, 2 layers per side.

DVD audio includes various still image modes for synchronized lyrics, navigation, etc. DVD audio allows up to 16 still graphics per track (or slightly more, depending on the compression ratio) and a set of limited transitions.

The audio used in DVD video can also be used without the video. This produces a stereo, DVD quality, play time of over 55 hours at 192 Kilobits per second (compressed) for a single

layer and over 200 hours for a 4 layer DVD disc. Lower quality sound can be recorded as computer files on a DVD for much longer play times. At a compressed audio rate of 16 Kilobits per second (in the low range of telephony quality), this is 9 million seconds, 150 thousand minutes, 2,500 hours, 100 days, 15 weeks, or 3 months of audio on a 4 layer DVD disc. (Each of the 24 T-1 telephony voice channels carries 64 Kilobits per second; 8 thousand 8 bit audio (sound or volume) samples per second.) See also AES (Audio Engineering Society) [http://www.AES.org]

Bit Fade and Copying

Like all storage and communications media, CD and DVD discs have the property that bits stored on them fade. Every day, some of the stored bits fade away. CDs and DVDs have an error correcting code (ECC) that can correct (replace) the lost bits. Eventually, there are too many lost bits to be corrected. This is the basis for the estimated lifetimes of CD

and DVD media. Rather than an estimate, ANSI/AIM (Association for Information and Image Management [http://www.AIIM.org] / American National Standards Institute [http://www.ANSI.org]) MS59-1996 media error monitoring and reporting standard, which complements the ANSI X3.131, media error hardware interface, provides a means of directly counting the number of bad bits (the raw error rate) on a given CD or DVD. This gives a disc-by-disc

reading on when to copy the data on the disc, and indicates exactly which discs will actually last (protect the data for) the disc's projected lifetime (up to 100 years). Until commercial, end user implementations of MS59 are available for checking discs, many users are following a practice of copying CDs and DVDs every five years, regardless of the nominal warranty period.