

TOSHIBA SINGAPORE PTE LTD
COMPUTER SYSTEMS DIVISION
438B Alexandra Road #06-01, Alexandra Technopark, Singapore 119968
Tel: (65) 62709989 Fax: (65) 62751086
pc.toshiba-asia.com

14 July 2003

PC Bulletin PC/312/2003

Technology Updates Specifications of DVD-Media

The amount of information is increasing and so are the storage requirements of companies and individuals alike. More and more data of growing proportions comes our way with the necessity of being stored somewhere else besides our hard disk drives.

While CD-R and CD-RW is great for files up to 800MBs, anything more takes us into DVD territory where files of gigs and gigs can be stored, up to 17 GB for a double sided, dual layer disk. This is what will be discussed here: DVD formats for storing and archiving data. Several formats are available today; DVD-R, DVD-RW, DVD+R, DVD+RW, and DVD-RAM.

First however let's start with a little bit of history.

HISTORY

In the early 1990s, the search for a medium began allowing playback of media without any degradation such as vinyl discs or video tape. What was needed was a disc the same size as a CD but with much greater capacity.

Initial work began by several companies which included Toshiba, Time Warner, Sony, and Phillips. To prevent incompatibilities and a similar battle like that between BetaMax and VHS videotape, the DVD Consortium was formed by ten founding companies: Hitachi, JVC, Matsushita, Mitsubishi, Phillips, Pioneer, Sony, Thomson, Time Warner, and Toshiba. In late 1995, the DVD Consortium announced the DVD format as we know it today. Later the Consortium was replaced by the DVD Forum of which more than 200 companies are members.



Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

Copyright © Toshiba Singapore Pte Ltd 2003

THE THEORY: RECORDING A DISK

All DVD formats and media have one thing in common, and that is the way information is recorded on a disk, formats aside of course, which we will address later. Just like floppy disks and hard disk drives work on some magnetic principle, regardless of format (Fat32 or NTFS), the same is true of recordable media. All R disks (CD-R, DVD-R, and DVD+R) use a laser to record or 'burn' pits onto an organic dye within the CD.



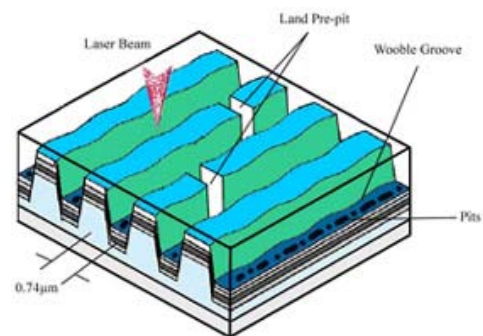
Once recorded, this process cannot be undone, erased or otherwise manipulated.

Similarly, all rewritable disks, such as CD-RW, DVD-RW use a laser to change the properties of a phase change material, usually made of a metallic compound, from a reflective state (crystalline) to a dull (amorphous) state.

These differences in the compound in the form of pits are interpreted as data by the computer. To erase the disk, different power is applied from the laser to return the phase change material back to its reflective state, thereby erasing it. This is the base of DVD recording; everything else builds on these principles with some variation to produce the different types of media available.

THEORY PART 2: FORMATS

You are watching an action movie and the sequence goes something like this: You are in a helicopter following a car driving on a twisting road in a valley with mountains on both sides of the highway. Now you have to keep your eyes on the mountains, on the left right movement of the road below, while keeping your eye on the target, the car below. This is what it is like for the laser in a DVD drive.



The laser has to follow the mountain range, which is called the *land*, while swerving left and right, referred to as the *wobble*. The road below is the *groove*, and the car corresponds to the *pits*.

Now let's add one more item, namely the dips in the road we are flying over. When writing DVD-RW, these are called *Land Pre-Pits*, and they are used to give a physical address where data will be written. What we have just described above is called *Wobble Groove* and *Land Pre-Pit* addressing, and this is what is used to record a DVD-RW.

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

For DVD-RAM things look only slightly different. There are no bridges or Land Pre-Pits. Instead there is a specific area on the disk where the addressing information is located for the data that is to be written. For DVD-RAM the format is called Wobbled Land Groove format.

The picture to the right demonstrates what the laser sees when recording a DVD-RW.

DVD-R

DVD-R is a write once media. It is very similar to CD-R as it uses the same principles to record and the same method, a laser permanently changing a dye. Also, both are permanent write once media. Just like CD-R, DVD-R enjoys the same read compatibility. DVD-R can be read in most DVD drives in computers and stand alone players on the market.



There are two types of DVD-R. One is for authoring and the other is for general use. The main difference is that DVD-R authoring drives and media contain another format that allows for reproduction of the media, along with other features; this is known as CMF, or cutting master format. It is only used when submitting titles for mass replication. General media does not contain this format as most of us do not need to produce 100,000 copies of grandma's birthday party. It is important to note that authoring media has to be recorded in an authoring drive and general media has to be recorded in a general drive.

DVD-R recording can be done in two ways, Disk-at-Once (DAO) and Incremental Recording. Disk-at-Once means that the disk is recorded all at once including lead in, lead out and the complete file system data. Incremental recording is achieved by writing data at different times instead of all at once. Additional files can be added until the disk is full or the job is finished. At this time, the disk must be finalized otherwise it cannot be read in DVD-ROM drives or players. Once a DVD-R disc is finalized, data can no longer be added to the disk.

Some discs and drives allow recording at 2x which allows complete recording of a full disk in about half an hour. DVD-R produces a highly compatible result and is available widely today. Further, double sided disks are on the way as well, and by the time you are reading this, so should 4x recording.

The life expectancy of DVD-R disks from major manufacturers such as Toshiba or Pioneer is about 100 years, so you know your data, once backed up, is safe.

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

DVD-RW

DVD-RW stands for DVD rewritable. DVD-RW is closely related to CD-RW since information is recorded sequentially. The capacity of DVD-RW is 4.7GB and can be recorded over and over about 1000 times. DVD-RW can be read in most DVD-ROMs and in some of the newer video players. To the laser, DVD-RW media has about 20% to 30% less reflectivity, so some video players will think it is a Dual Layer disk and attempt to read only the second layer and thus seems to get a bit "confused" when attempting playback. Just like CD-RW, DVD-RW can also be recorded in two methods; disk-at-once or incrementally. However, in both situations the disk has to be finalized, otherwise it cannot be read.

DVD-RW is a very effective way to test a compilation before making the final copy, if any errors are detected at this time, the disk can be erased and the project attempted once again. DVD-RW has a great price point, sometimes it is the same price as DVD-R, so if you know that the data is not needed permanently then DVD-RW is a great way to move a lot of data.

DVD+R

DVD+R is a derivative format for recording based on DVD+RW but it is recordable only once, as it uses a dye based medium that when exposed to laser it "burns" pits to store information. It has a capacity of 4.7 GB and it is not supported by the DVD Forum and therefore it bears a different logo. Just like DVD-R, a DVD+R disk requires finalization for the disk to be readable in any drive. The difference between DVD+R and DVD-R is at the recording stage, since the format of the disk during burning is different, still using the wobble land technique but at a different frequency than DVD-R. This is why a DVD-R disk cannot be recorded in a DVD+R drive and vice versa. Recording speeds of DVD+R are between 1x and 2.4x. Great claims have been made about compatibility in both players and drives, however to date no comprehensive testing has proved whether either media format is more compatible.

DVD+RW

DVD+RW is a re-writable DVD format of 4.7 GB on 12cm disks. The DVD+RW format is applicable to the writing method in a manner that prevents a DVD+RW disk from being written in a DVD-RW drive. Like all other re-writable media, DVD+RW uses a phase change material to record and erase data by going from a reflective state to a dull state. To record, a DVD+RW drive uses a High-Frequency Wobbled Groove recording format at 817 kHz. The drive's format can record sequentially or randomly as it supports Constant Angular Velocity (CAV) and Constant Linear Velocity (CLV) recording.

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

This means that with CAV, the speed of the CD stays constant no matter where data is written to it. This saves some time as the disk does not have to speed up and slow down all the time.

CLV recording, on the other hand, writes data in a spiral fashion thus as the laser moves outwards the speed of the CD is decreased thereby ensuring a constant transfer rate. DVD+RW can be recorded about 1000 times, and it has a life span of about 30-100 years before data degradation begins. Recording speed of the drives is anywhere from 1x to 2.4x, and it claims that it is highly compatible. However, one has to remember that the same reflectivity issues, 20%-30% less, that affect DVD-RW also affect DVD+RW.

DVD-RAM

DVD-RAM is a re-writable optical disk that is designed with the professional in mind. This medium behaves more like a floppy or a hard disk drive as it has ability to be recorded and erased over 100,000 times. DVD-RAM capacity is at 4.7 GB for single sided disks and 9.4 GB for double sided disks. The two sizes are split into 2 formats; Type 1 is double sided and is cartridge based, while Type 2 is single sided and can be removed from its cartridge.

DVD-RAM uses the same method of recording as the other re-recordable drives, namely the phase change material that changes from shiny to dull when exposed to different power laser. But this is where the similarities end. DVD-RAM was designed with computer use in mind and the metal alloy that compromises the disk allows for the much higher re-write capability of 100,000 instead of 1000 times.

Further, DVD-RAM includes ECC error correction which is favored in data applications. The random access time of DVD-RAM is also much faster than its competitors. This makes it ideal for data warehousing facilities and governments.

	DVD-RAM	DVD-RW	DVD-R	DVD+R	DVD+RW
Capacity (Single Sided/ Double Sided)	4.7GB/9.4GB	4.7GB/-	4.7GB/-	4.7GB/-	4.7GB/-
Data Transfer Rate (Basic spec.)	22.16Mbps	11.08Mbps	11.08Mbps	11.08Mbps	11.08Mbps
Record speed	1x-2x	1x-2x	1x-2x-4x	1x-2.4x	1x-2.4x
Writing Cycle	Approx. 100,000	Approx 1,000	1	1	Approx. 1,000
AV-PC Compatibility (VR mode)	Yes	No	No	No	No
Reflectivity	30-55%	18%-30%	45%-85%	45%-85%	18%-30%

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

While on the topic of DVD-RAM, it is important to note that there are some formatting factors which need to be addressed. DVD-RAM discs can be used by set-top recorders and video cameras, to record video; this is called DVD-VR. The benefit of DVD-VR as a format is that it can store video in real time and also allows some manipulation such as removing commercials while recording or watching TV and adding another video segment to the video once it is recorded. Two hours of video can be recorded in standard mode and up to six hours in a customized setting, where the settings are in the producers' hands.

DVD-VR also allows entering titles for separate chapters and providing a visual table of contents. This makes the unit behave like videotape recorders or VCRs but with great enhancements. Imagine how difficult it would be to insert a video segment in the middle of what is already on tape. This format is making headway in professional video cameras, that are affordable, to deliver studio quality digital video.

SUMMARY

The DVD recording industry has given us the possibility to move data that only a couple of years ago would have cost tens of thousands of euro. All the different formats available today have a clear mission—to be easily available and useful. The DVD Forum has provided us with standards that ensure compatibility at a great price point. The next generation of drives, called DVD multi drives, will be able to read and write DVD-R DVD-RW and DVD-RAM, assuring a greater range of functionality. Toshiba introduced the first notebook, the Satellite 5200, with DVD-Multi drive (DVD-RAM) early 2003.

Toshiba also offers two other products with DVD-R/-RW & DVD-Multi drives, the Satellite A10-S440 and Satellite 2450-A750 respectively. At the same time writing speeds will increase while media prices will drop. Inexpensive digital storage is finally here, regardless of application.

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

GLOSSARY

ASPI	Short form for Advanced SCSI Programming Interface developed by Adaptec INC. It is a software layer that allows communication to SCSI and Atapi devices, such as DVD-R drives.
Authoring	When dealing with DVD media, such as audio, video or data, it is the process of creating, formatting and ensuring the data conforms to specification in order for the writing process to complete successfully.
Burn	Street term for writing data to a medium such as a DVD-RAM or DVD-R.
CAV	Constant Angular Velocity of the information track resulting in variable, radius-dependent bit rates.
CLV	Constant Linear Velocity of the information track achieved by variable angular velocity using higher rotational drive speeds on the inner tracks and lower speeds on the outer tracks resulting in a constant scanning velocity and bit rate.
Channel	An individual or discrete audio track. In the case of 5.1 Dolby Digital, there are six discrete channels. This is stored in the MPEG-2 stream.
DVD Forum	An international consortium of manufacturers dedicated to setting standards for the use of the DVD format. The organization also distributes information and works on developing new formats such as DVD-MULTI.
DVD Video	MPEG-2 format video content stored on DVD disks in a specific format to allow play back on stand-alone players. It includes high quality sound streams.
DVD-ROM	DVD read only media used to distribute any type of digital information.
ECC	Mathematically determined Error Correction Code specified in the standards that represents data and is recorded with that data to enable limited correction of read errors.
Finalization	Action in which lead-in and lead-out areas are recorded that must be performed at the end of a recording operation if the disc is to be readable in a conventional drive. Also known as closing a DVD or CD.
Layer	An area on the DVD where data is stored in a series of pits. DVD disks can have one or two layers, each storing 4.7GB.
MPEG-2	A compression algorithm system developed for delivering digital broadcasts, on DVD, HDTV, satellite and so forth.

Disclaimer

Toshiba Singapore Pte Ltd makes no representations or claims, either expressed or implied, with respect to this PC Bulletin. Toshiba reserves the right to make changes in the specifications at any time without notice and without obligation of Toshiba Singapore Pte Ltd to notify any person of such changes. All information, statements, technical information, and recommendations in this bulletin are believed reliable, but the final accuracy of material is not guaranteed.

Copyright © Toshiba Singapore Pte Ltd 2003