

## Background Information

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### **Bringing light to the DVD jungle**

By Ilona Maas, Product Manager at Memorex Products Europe

**The development of the DVD is reminiscent of the history of video recorders and tapes: The technology holds a wide variety of possibilities but the different formats are confusing for the consumer. An overview of the different standards and applications brings light to the intertwined DVD jungle.**

Whether in the office or at home: The more complex and powerful a software application, the more storage space is required for the ever-growing amounts of data. CD-R media with a maximum of 700 MB storage capacity have already become too small, so that the demand for a new form of storage is widely heard. From the Multimedia CD (MMCD) and the Super Disc (SD) a new standard emerged with the Digital Versatile Disc (DVD).

Compared to the existing media, the DVD offers the highest storage capacity: One-side recordable DVDs hold 4.7 GB or the equivalent content of about seven CDs respectively. If written on both sides a DVD can even store up to 9.4 GB – but this is only possible with a DVD-RAM. Thus these new media not only gain popularity with PC users but with music and movie enthusiasts alike. The latter are mostly interested in rewriteable DVDs that bridge the gap between the home entertainment sector and the computer sector. Instead of CDs, video tapes and mini discs, there will only be one format in the future: the DVD. Today, more movies are already being sold on DVD than on video tape

and the trend appears to be on the rise. According to forecasts the DVD is expected to surpass the CD as storage medium in the year 2002.

But the question about a uniform standard remains open. Currently there are three different formats for DVD recording. All three use their own recording technology and are only marginally compatible with each other so that each format requires a specific DVD blank.

### **The various formats**

#### **DVD-RAM**

Up until now, DVD-RAMs (DVDs with Random Access Memory) were primarily used for backup solutions and removable discs in the professional IT sector.

And the new generation will again be primarily used in this sector, because the discs provide a safe storage location for archived data: The disc comes well-protected in a plastic cover, can be overwritten up to 1000 times, and has a capacity of approximately 12 hours of recording time with video quality.

Conventional DVD players, however, cannot read data stored on DVD-RAM, which means that in Europe the DVD-RAM technology has not yet become widespread. And this is not projected to change too quickly in the near future, at least not in the consumer electronic sector. Even though Panasonic and Hitachi will be introducing CE devices to the European market starting in November, the lacking compatibility of the RAM media with other DVD recorders makes the format rather unattractive for the end user.

The history of DVD RAM started in 1998 in the test labs of Toshiba, Panasonic, Hitachi and Matsushita. Today, there are four different types of discs available.

Type 1 is packaged in a plastic cartridge out of which it cannot be taken, and can therefore only be used in specific drives. The DVD RAM's storage capacity with a one-side recording is 2.6 GB, on both sides, 5.2 GB. Type 2, on the other hand, offers only up to 4.7 GB storage capacity if recorded on both sides, but the disc can be taken out of its packaging and, according to the manufacturer, is compatible with newer DVD-ROM drives. The type 3 DVD-RAM comes in a regular CD jewel case without plastic cartridge and can store up to 4.7 GB of data. And finally there is a new generation of „all-rounders“, the type 4 DVD-RAM, which offers the highest double-side storage capacity with 9.4 GB and can be removed from the cartridge in which is delivered.

The recording of the data onto DVD-RAMs is done with a writing process known as „Wobbled Land and Grooves“. The laser beam follows alternately pre-pressed grooves and the plateaus, the so-called land, between them. The different height levels of the recorded data increase the distance between the juxtaposed data sections, and thus reduce the possibility of reading errors.

This allows a tighter arrangement of data tracks than with other writing procedures, as well as a significant increase in storage capacity.

As its recording process the DVD-RAM uses the Phase Change procedure, i.e., the laser heats the metal alloy of the writeable surface so that the atoms within the alloy crystallize and thus obtain a higher degree of reflection. This condition is maintained during the slow cooling process. A second laser action applies more heat to the alloy and shifts the atoms into a disordered state. A

quick cooling phase maintains this condition. The metal alloy's degree of reflection is now low. The sequence of areas with low and high degrees of reflection corresponds to the sequence of pits and lands.

The irony of technology: The more selective the DVD-RAM medium is with regards to the player, the most compatible is the DVD-RAM drive with regards to its reading and writing abilities. Besides DVD-RAMs, the drive accepts DVD-R media, DVD videos, as well as certain DVD-ROMs, CD-Rs and CD-RWs. For the writing process, the RAM drives are not limited to DVD-RAM media; they also accept DVD-Rs. Thus the DVD-RAM is the only drive that can write on two formats.

### **DVD-R and DVD-RW**

The DVD-R and DVD-RW format for drives and media was single-handedly developed by Pioneer. Nowadays, complete PC system manufacturers such as Apple, Compaq and Packard Bell use the DVD-R/-RW technology. Acer has decided to adopt the standard as well and plans to introduce a DVD-RW recorder to the market in November, 2001. In Japan Sony integrates DVD-RW drives in computer systems but so far favors the DVD+RW format for Europe. For the home entertainment sector, DVD-R recorders have been available since 1997, burners for the rewriteable DVD-RW variant were introduced in mid 2000 in Japan and are now available in the European market as well. Manufacturers see the future of the DVD-R and DVD-RW in the PC sector as well as for the hi-fi, film and photography sectors.

The easily writeable DVD-R, which is primarily used for archiving, has a storage capacity of 4.7 GB. The DVD-RW, which can be rewritten up to a thousand times, offers the same storage capacity. The recording time in standard video quality is two hours, in long play mode, three hours, and in extended play mode, four hours. In order to obtain high quality, the data recording time is one hour.

Two different types of DVD-R media are currently available: The **DVD-R(A)** media – „A“ stands for „Authoring,, – are designed for professional use, and, due to their high price, are rather unattractive to the end user. **DVD-R(G)** („General,,) are intended for home use, and, at an average price of 15 Euro, affordable for everybody. The only difference between the two media types is a slightly bigger laser wavelength for the general DVD-Rs, which is supposed to prevent the copying of movies.

Similar to the DVD-RAM the DVD-R uses the Phase Change process for data storage and the „Wobbled Land and Grooves,, writing process. The DVD-RW, however, uses two other writing modes. The Restricted Overwrite Mode requires a pre-formatted medium and by reducing unwritten sections offers a better writing performance. In the Sequential Recording Mode, on the other hand, the recorder creates a so-called Border Out Area at the end of each writing session, which designates a temporary stop. Newly recorded data receives a new Border Out Area while the previously written section is ignored by other drives. For video data, the DVD-R/-RW format includes an extended cutting command set, the Video Recording Format (VRF). This format allows the user to edit the recorded sequences, for example, to cut commercials out

of the recordings. By applying the VRF technology, however, a large portion of the DVD player compatibility is forfeited. In general, DVD-R/-RW media are compatible with most conventional DVD players, DVD-ROM drives and CE devices. With older PC and CE devices, however, the DVD-R/-RW format shows high reading failure rates.

On the hardware level, the DVD-R/-RW format only has limited compatibility. A DVD-R burner will only write DVD-R media. The recorder is more flexible, however, when it comes to reading: Besides its own DVD-R and DVD-RW formats, it will run DVD videos and DVD-ROMs, as well as certain DVD+RW media.

## **DVD+RW**

Blanks with a „+“ extension have been developed by the DVD+RW Alliance, which includes the inventors of the Multimedia CD: Sony, Phillips, Yamaha, Mitsubishi, Ricoh and Thomson. In the meantime Dell, Hewlett Packard and Memorex have joined this consortium.

With its MP5120A-DP DVD+RW burner, Ricoh is currently the pioneer in the European market. Since the beginning of October, 2001, this recorder has been available for 900 Euro. HP is introducing a new DVD+RW burner to the market as well. Additional devices are planned by Yamaha and Philips. For the consumer electronic sector Phillips, Yamaha and Thomson have developed a DVD+RW burner that works like a regular DVD player but includes a recording function as well. The recorder had its first big appearance at the IFA 2001 in Berlin, Germany, where it was introduced at a price of approximately 2000 Euro.

One significant advantage of the DVD+RW format is the compatibility between PC and consumer devices. All media that have been recorded with the DVD+RW technology can be played and edited on any +RW device – regardless if the player is connected to the TV or built into the PC.

DVD+RW media with a storage capacity of 4.7 GB offer a recording time of up to five hours with a quality equal to that of a conventional video tape. To obtain a significantly better image quality the recording time should not exceed four hours, while true high-end quality is only available with a recording time of one hour. The user can adjust the desired recording quality on the device.

DVD+RW blanks with 4.7 GB are currently available for about 18 Euro. The target group for DVD+RW burners as well as DVD-R and DVD-RW burners includes primarily TV and video users.

DVD+RW burners can read all formats except DVD-RAM. But there are other limitations as well: DVD-R or DVD-RW run in a DVD+RW burner only if they can also be read by a DVD-ROM device at the same time. DVD+RWs are compatible with any already installed DVD players and CE devices. For models older than five years, the estimated reading failure range amounts to only about 30 percent and is thus significantly lower than that of the competitive product DVD-R/DVD-RW.

All DVD+RW media, as well as CD-R and CD-RW media, are writeable.

Another advantage compared to the competitors is offered by the DVD+RW drive with regard to the recording process. With DVD-RW technology, the blank CD must be formatted prior to recording, which may take an estimated 90 minutes for a 4.7 GB medium at regular DVD speed. The DVD+RW burner, on the other hand, creates a basic format in just two minutes and then formats in the background during the writing process. For someone who wants to spontaneously record a TV show, this method would be more suitable – with a DVD-RW burner it would be possible only if one has preformatted media readily available at all times. If a DVD+RW has been preformatted once for two minutes it will maintain its format status even if it is rewritten.

Another advantage is the so-called lossless linking. This depicts a function which allows users to add or delete data to and from an already written and ejected DVD+RW disc at any time without creating any gaps between the

previously and newly recorded data. Thus the DVD+RW player has good technological chances to replace the video recorder before long.

The writing mode of the DVD+RW burner is the „High Frequency Wobbled Groove“ method. The substrate layer of the medium contains a pressed-in sinus-shaped and high frequency data track. Data is only stored in the recessed section (groove) between two of these data tracks. Other than with other DVD media, it is thus possible to write the blank with a constant angular velocity (CAV) or with a constant linear velocity (CLV). The CAV method also allows non-linear video recordings on fragmented DVD+RW media.

## **The future**

According to market observers, DVD media have already become the heir apparent to the compact disc. VHS tapes will vanish from consumers' living rooms as soon as video enthusiasts acquire a taste for them and become interested in creating an easily accessible archive of all of their previously produced films. With the DVD burner and TV card, movie lovers can finally get their favorite movie in its entirety on one medium. But DVD will also find followers in the professional and semi-professional sector, for example for the creation of company and advertising videos.

The enthusiasm for DVD recording is reduced, however, when it comes to copying movies onto DVD. A special security system and a country code in the DVD burner make sure that DVDs can only be read if the DVD's regional code matches the recorder's country code. The purpose is not only to prevent illegal copying but also the playing of movies outside of its sales region. This security measure concerns all formats – regardless of which technology might emerge from the DVD jungle.