

DVD+RW Video

Compatibility and convergence



DVD + ReWritable

Compatibility and convergence

Introduction

When the DVD+RW format was defined, two key criteria to achieve were *compatibility* and *convergence* while maximizing performance levels.

Compatibility refers to the possibility to play back recorded DVD+RW discs on the DVD players and DVD-ROM drives that are currently in use and will reach some 160 million by the end of 2001. Not only does compatibility protect the interests of consumers who have already invested in DVD equipment, it also is simply what consumers expect.

Convergence is a key concept in the prevailing trend of overlapping in Consumer Electronics and PC applications. The discs must be able to be used in both CE and PC equipment. Therefore it is important that the level of performance is equally high for the very diverse requirements of *video recording* – like large file sizes and very demanding real-time requirements – and *data storage* where smaller files and data integrity are the main features.

Requirements

To achieve compatibility, it is necessary to have physical compatibility (i.e. the capability of existing DVD drives to read the information on the disc) as well as logical compatibility for video (i.e. the capability to interpret the information from the disc in order to reproduce the original video content). This document focuses on the video application format; physical compatibility is only briefly outlined (a fuller description can be found in "DVD+Rewritable and how it works", published August 1999).

The video format definition is based on the following basic requirements. It must allow:

- Real-time video recording and formatting
 - High performance playback on existing DVD-Video and DVD-ROM equipment
 - Interchangeability of recorded discs between CE and PC based DVD+RW recorders
- whilst retaining at least the functionality to:
- append
 - partially overwrite
 - update the menu
 - do basic editing

The DVD+RW Video recording format contains user-friendly features and combines a video recording function with the same high level of video and audio quality as offered by pre-recorded DVD-Video discs. The compatibility of both the rewritable disc and the recorder with other equipment, like DVD players and PCs, opens up opportunities for a wide range of new uses and applications.

Physical compatibility

Physical parameters endorsed by HP, MCC, Philips, Ricoh, Sony, Yamaha

	DVD+RW	DVD Video/ROM		
		single layer	dual layer	
wavelength	650 nm	650 nm	650 nm	} Same physical parameters
NA (reader)	0,6	0,6	0,6	
capacity	4.7 GB	4.7 GB	8.5 GB	
track pitch	0.74 micron	0.74 micron	0.74 micron	
min pit length	0.4 micron	0.4 micron	0.44 micron	
reflectivity	18-30%	45-85%	18-30%	
track cross	>0.10	> 0.10	> 0.10	
modulation	> 0.6	> 0.6	> 0.6	
I_3/I_4	>0.15	> 0.15	> 0.15	
asymmetry	-0.05-0.15	-0.05-0.15	-0.05-0.15	
DPD	0.5-1.1	0.5-1.1	0.5-1.1	} Same system margins
bottom jitter	<9%	<8%	<8%	
thickness	0.58-0.62	0.57-0.63	0.57-0.63	
radial deviation	0.7 degr.	0.8 degr.	0.8 degr.	

The physical DVD+RW disc parameters as defined in the table are the same as those of a single-layer pre-recorded DVD disc, only the reflectivity has a slightly different value, equal to dual-layer DVD discs. However, since DVD players should be capable of playing back both single and dual layer pre-recorded DVD discs, they can, in principle, also play back DVD+RW discs.

Logical compatibility for video

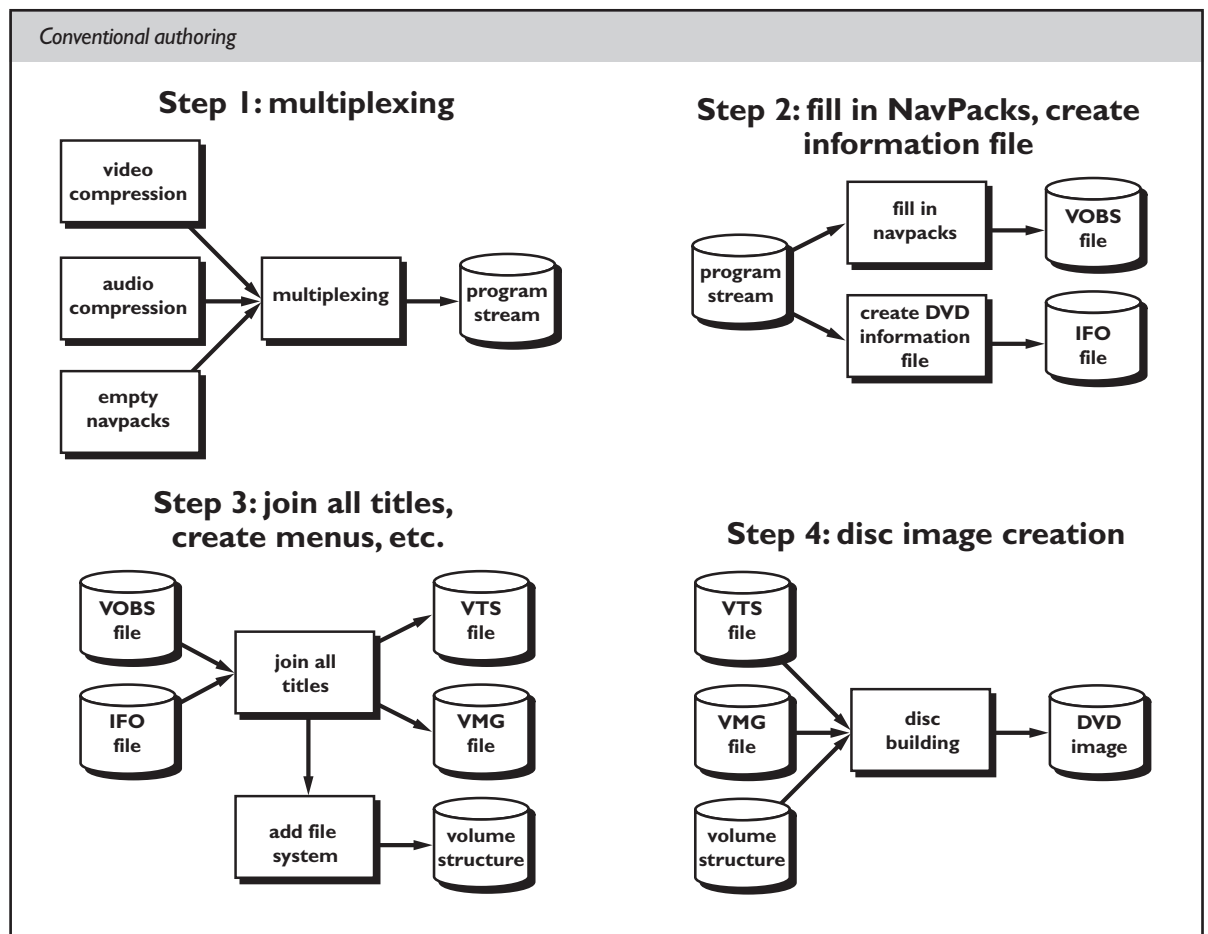
To understand the challenge of real-time recording and formatting in a DVD-Video-compatible format, it is important to first understand the conventional processes involved in professional authoring of DVD-Video.

Conventional authoring

Professional DVD authoring is usually done in a number of sequential steps.

Step 1 Step 1 contains a number of passes: (1) investigating the complexity of the video in order to optimize the variable bitrate encoding, (2) encoding of video and audio and (3) once quality inspection of all the coded assets has been completed, the elementary streams are multiplexed together with empty navigation packs into an MPEG2 Program Stream. Navigation packs include data search information that is used by DVD-Video players to perform forward and backward searches at various speeds. References point to past and future navigation packs. Short distance pointers are available at a resolution of half a second; for longer distances the intervals between the target points get bigger. In this way a range between plus and minus two minutes is covered. Because of the variable bit rate of the video stream, the distance between the navigation packs varies.

Step 2 As soon as the full allocation of the data in the MPEG2 Program Stream is known, the data search pointers and other elements of the navigation packs can be filled in. The result of this is a so-called Video Object Set (VOBS) file plus an additional file that contains information about the content and layout of the VOBS file.



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Step 3 Next, the content of the VOBS and information files is integrated with disc level DVD-Video information (“video manager information”) and interactive menus. Also, the file system information is generated in this step.

Step 4 Finally, all information generated thus far is used to build the final DVD disc image. Usually pre-recorded DVD-Video discs contain interactive menus that provide access to various parts of the disc (e.g. main movie, background info, theatrical trailer or various chapters of a movie). They are added in this stage.

Real-time recording and formatting

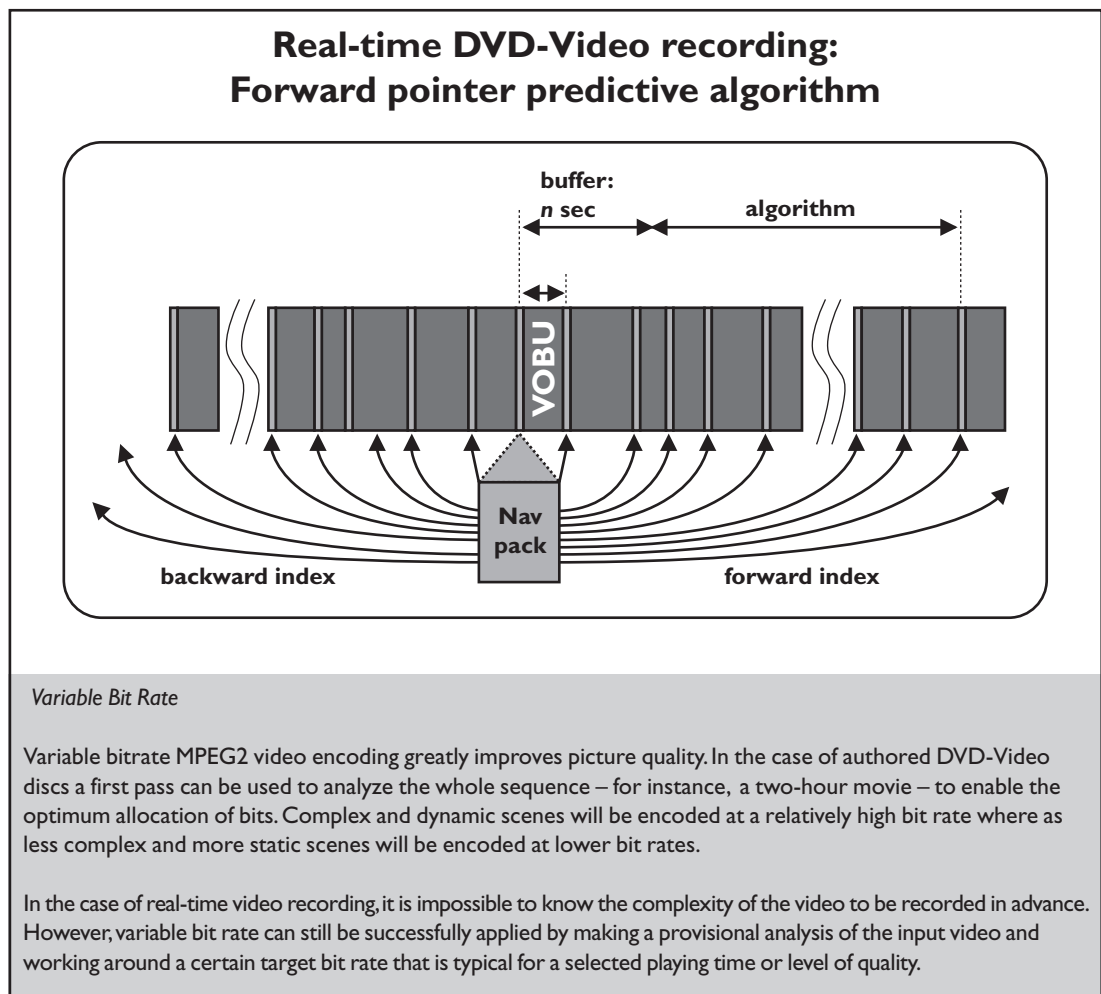
Three specific constraints have to be overcome to realize real-time DVD-Video-compatible recording and formatting:

(1) Forward references (2) Minimum recording speed of optical drives (3) Menus as bitmaps

1. Forward references

Forward references are used in the so-called navigation packs that are included once or twice a second in the MPEG2 Program Stream. In the case of real-time VBR recording backward search pointers can accurately be filled in, but forward search pointers are a problem.

As we saw earlier, in conventional DVD authoring a time consuming extra pass is needed to determine the forward references. The DVD+RW Video format correctly fills in only a number of short distance forward pointers and applies a special algorithm for the longer distance forward pointers. This means that even with regular DVD players, the user can perform forward and backward searches on a real-time recorded DVD+RW Video disc without losing the advantage of VBR.



2. Minimum recording speed of optical drives

Due to the physical properties of the recording material, all optical drives have a minimum speed at which recording has to take place. For all recordable DVD discs, this minimum speed is above 10 Mbit per second. Therefore, recording either has to take place at the minimum speed – resulting in a recording time of one hour – or go through a process in which the video content is first buffered, then written to the disc each time the buffer is full. The buffered writing is even more necessary for VBR recording, because optical drives cannot adapt the writing speed quickly enough to follow the bitrate variations.

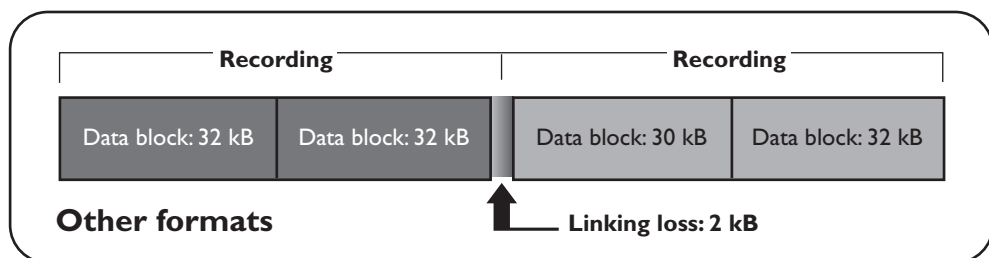
In itself this buffered recording is not a problem but, up to now, optical recording systems have needed some empty space between recordings in order to re-synchronize read and write clocks. This is referred to as “lossy linking”. Existing DVD-Video players however require a continuous MPEG datastream and thus are not capable of handling these “linking losses”. Therefore, “lossless linking” was developed as a unique feature for DVD+RW, allowing “stop and go” recording at lower bit rates while maintaining compatibility with existing drives.

lossless linking

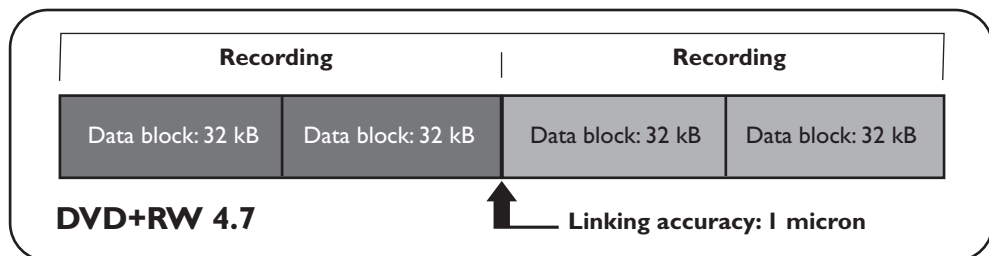
In conventional optical recording drives the write/pause operation causes a rather big area (usually one sector = 2 kbytes) to be corrupted due to poor linking accuracy at the border between two contiguously written pieces of information. This linking loss makes the disc incompatible with existing read-only devices like DVD-Video players and DVD-ROM drives. The DVD+RW Video format, however, ensures the video stream is recorded contiguously.

Writing contiguous blocks of variable bitrate video is achieved by applying lossless linking, that is, suspending and continuing the writing process without the linking loss. For lossless linking, it is imperative to write any data block in the correct position at a high degree of accuracy – within a single micron.

Lossy linking



DVD+RW Loss less linking



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3. Menu updates

In accordance with the DVD standard, menu information must be stored in still images (bitmaps). Updating would require retrieval of information such as text from the still images, but from a bitmap this is impossible. To overcome this, not only is the menu image recorded but also the underlying information is stored in a “private file” on the disc.

menu picture

A menu picture consists of an MPEG coded still video background picture with a bitmap overlay (sub-picture) containing the textual information. In the example the key frames are also included in the MPEG picture. A highlighted edge around one of the key frames indicates the current selection. The highlight can be moved by pressing the up and down arrows of the remote control unit. Pressing OK will start playback of the highlighted recording.



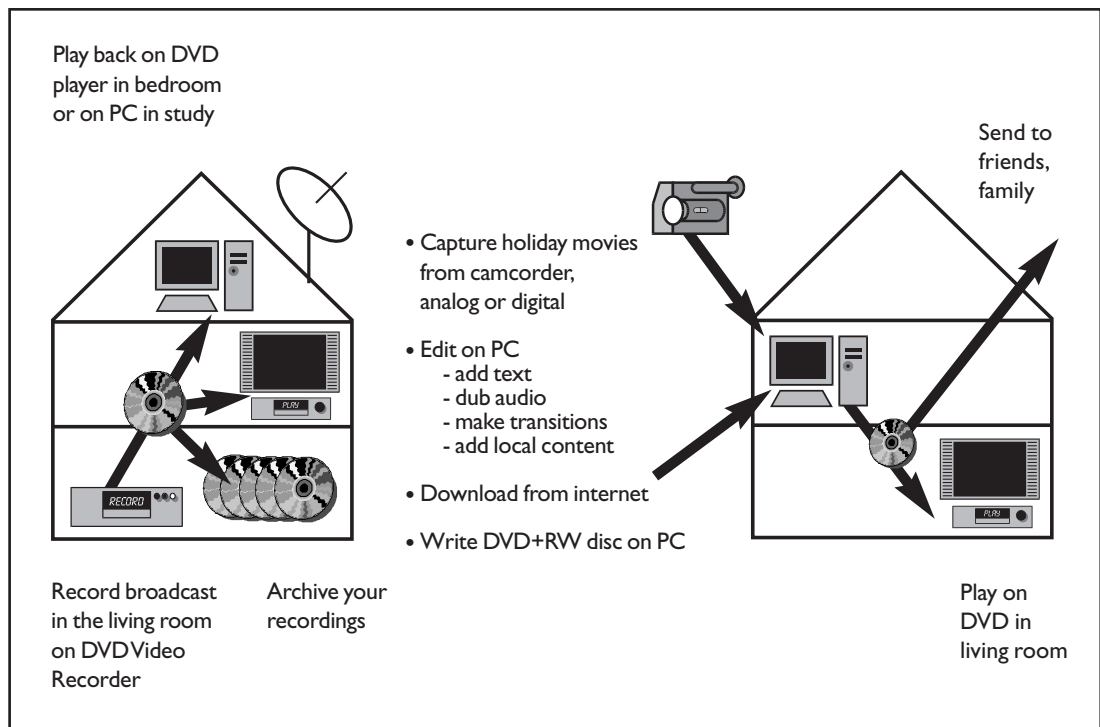
DVD+RW Video discs contain one or multiple menu pages with information about the recording – playing time, program name, date and time of recording, quality level (e.g. standard play, long play) and a key frame representing a recording. The DVD+RW Video recorders will generate or update the menu immediately after a recording has been completed.

Two-way compatibility

DVD+RW Video Recorders offer two-way compatibility: pre-recorded DVD-Video discs can be played on DVD-Video Recorders, while recorded DVD+RW-Video discs can be played not only on the same recorder but also on existing DVD-Video players. This two-way compatibility is a unique feature of the DVD+RW Video format.

By way of example, this two-way compatibility allows consumers to make a broadcast recording in the living room on a DVD-Video Recorder and to play it back on a DVD-Video player in the bedroom. The disc can also be played back on the PC in the study.

But the compatibility goes further. Consumers can capture their holiday video movies from a digital or analogue camcorder on a PC. Using a video-editing program on the PC, the raw material can be converted into a professionally looking movie. Text, pictures and local content can be added. Audio dubbing is also possible and smooth transitions between scenes can be created. The final result can be written on a DVD+RW Video disc on the PC's DVD+RW writer and then be played on the DVD-Video player in the living room or sent to family or friends, owning a DVD-Video player, who can then enjoy it, too. Of course, video from a camcorder can also be recorded directly on the DVD-Video Recorder.



Using the DVD+RW Video recording format allows changes to be made to the contents of a recorded disc without having to go through the whole process again. Video sequences can be added or replaced. Using the same DVD+RW Video recording format, both original recordings and changes can be made with the recorder in the living room as well as with the PC.

The unique advantage of DVD+RW is that it offers compatibility not only with a selected number of future products, but across the park of existing DVD players and drives.

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Philips Disc Systems

Building SFF7
P.O.Box 80002
5600 JB Eindhoven
The Netherlands

Philips Media Relations

Jeannet Harpe
Building SFF6
P.O.Box 80002
5600 JB Eindhoven
The Netherlands
phone +31 40 273 56 77
fax +31 40 273 27 29

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