

DVD+RW: 2-WAY COMPATIBILITY FOR VIDEO AND DATA APPLICATIONS

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ABSTRACT

This paper discusses the 4.7-GB Digital Versatile Disc plus ReWritable (DVD+RW) system as a future replacement for the Video Cassette Recorder (VCR). It is shown that Digital Versatile Disc (DVD) discs can be recorded in a fully compatible manner with the existing DVD-Video standard and players. The compatibility issue is addressed from the perspective of the DVD-Video physical and logical formats.

INTRODUCTION

Since its market introduction in 1996, the Digital Versatile Disc has experienced a tremendous sales boost, with more and more people discovering the advantages of this high-capacity optical disc medium. DVD-Video, in particular, has attracted the public attention due to the superb audio and video quality it offers. Recordable DVD systems, on the other hand, have just entered the race for obtaining a status on the consumer electronics market.

One of the key features of a recordable DVD system must be its backward compatibility with the existing DVD-Video players. Several systems have been proposed, some of them making use of the Real-Time Video (RTV) recording specifications [4]. However, the Digital Versatile Disc plus Rewritable (DVD+RW) employs a different recording model while the recorded disc remains fully compatible with the existing standards [1, 2, 3]. This feature should be seen as the ability of the existing DVD-Video equipment and DVD-ROM drives to play back the DVD+RW media, irrespective of the type and brand of the DVD+RW recorder on which the disc was recorded. This 2-way compatibility on both the video consumer electronics and computer markets is illustrated in Fig. 1.

To achieve the compatibility depicted in Fig. 1, several issues related to the physical disc format and the recording technique had to be solved.

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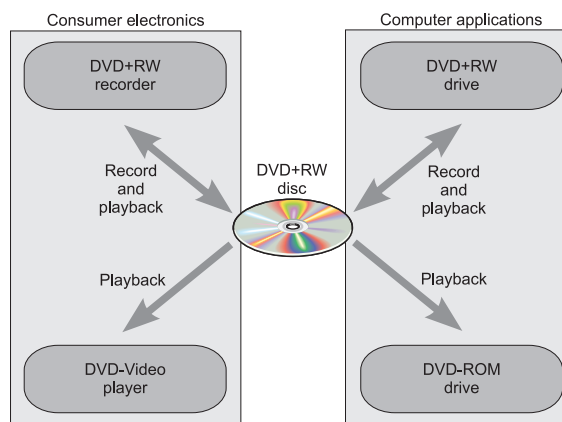


Figure 1 Playback and recording compatibility of the DVD+RW discs on the existing consumer markets.

PHYSICAL COMPATIBILITY

From the viewpoint of the physical disc format, a similar compatibility issue was previously solved for the Compact Disc Recordable (CD-R) and Compact Disc Rewritable (CD-RW) media. The DVD+RW disc uses the same phase-change recording materials as CD-RW (Ag-In-Sb-Te alloys, for example) and it also employs a wobbled groove arranged in a continuous spiral, which extends from the inner to the outer disc radius. Data is recorded as a series of marks embedded in the phase-change layer of the undulated groove.

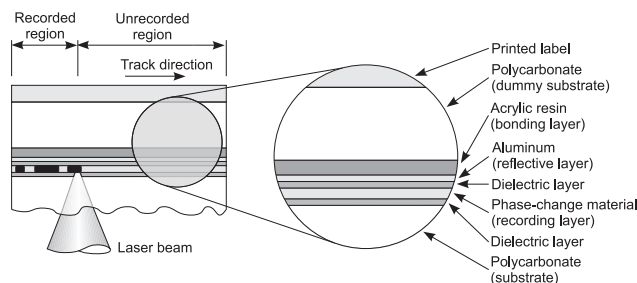


Figure 2 Cross section through a DVD+RW disc.

The groove, which does not disturb the readout process in read-only DVD systems, provides means for (i) radial tracking, (ii) addressing any location on the blank disc to correctly position the recording laser spot, and (iii) exact synchronization and alignment between old data blocks on disc and data to be newly written. The latter two issues are discussed with more details in [5].

The compatibility between DVD+RW and DVD-Video (or DVD-ROM) discs has been achieved by preserving the essential physical parameters [1] of the existing read-only media. An overview of several parameters is given in Table 1. It is important to remark that, due to the phase-change material, the DVD+RW reflectivity is equal to the reflectivity of the dual-layer read-only DVD disc. For the sake of comparison, recall that CD-RW media also exhibit lower reflectivity than read-only CDs.

Another physical compatibility issue regards the continuity of the data stream on the DVD+RW disc. Basically, it is always possible to insert a new data block between two existent ones as depicted in Fig. 3. Dummy areas are needed to account for the limited precision of inserting new data. However, the DVD+RW format allows for “lossless” linking, whereby bit-accurate positioning of the new data stream can be achieved [5]. This technique is illustrated in Fig. 4. Clearly, lossless recording leads to a disc which is compatible with the existing DVD-Video and DVD-ROM media.

Parameter	DVD+RW	DVD-Video, DVD-ROM	
		single layer	dual layer
Wavelength [nm]	650		
NA (player)	0.6		
Capacity [$\times 10^9$ bytes]	4.70	4.70	8.54
Track pitch [μm]	0.74		
Min. mark length [μm]	0.4	0.4	0.44
Reflectivity [%]	18...30	45...85	18...30
Track-cross modul. [%]	> 10		
RF modulation	> 0.6		
Asymmetry	-0.05...0.15		
Bottom jitter [%]	< 9	< 8	< 8
Thickness [mm]	0.58...0.62	0.57...0.63	0.57...0.63
Radial deviation [deg.]	0.7	0.8	0.8

Table 1 Several physical parameters of the DVD+RW, DVD-Video, and DVD-ROM discs.

LOGICAL COMPATIBILITY

The DVD-Video standard also includes specifications for the file system [2] as well as for the video format [3]. At this logical level, the compatibility is guaranteed by making use of a tape model while recording. As depicted in Fig. 5, this model allows for appending or insertion of a new video sequence, erasing the previously recorded video in the latter case. The tape model employs two recording sequences:

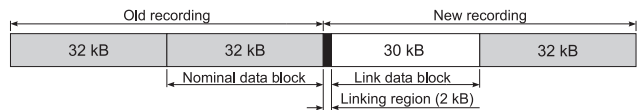


Figure 3 DVD recording with insertion of linking areas between old and new data blocks.

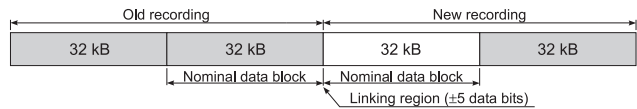


Figure 4 Bit-accurate DVD recording using DVD+RW disc format.

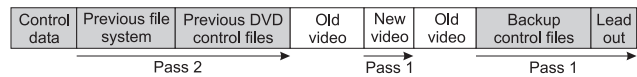


Figure 5 Double-pass insertion of a new video title according to the tape model.

during the first pass, the new video title is added, the DVD control files are backed up, and the lead out is written; during the second pass, the file system and the control files are updated. This double-sequence recording ensures the logical compatibility with the existing DVD standards [2, 3].

CONCLUSION

It has been shown that DVD+RW physical and logical disc formats fully comply with the existing read-only DVD specifications. It is therefore possible for the existing DVD-Video players and DVD-ROM drives to play back the newly developed DVD+RW disc, immediately after the latter has been recorded. Because the DVD-Video has already been successfully accepted by the consumer electronics market, it is expected that DVD+RW will replace the ubiquitous Video Cassette Recorder (VCR) by the end of this decade.

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