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2nd Edition

Making Your Own DVDs

By Stephen E. Godfrey



How to navigate the technology minefield,
beat the odds in the format wars,
& *still* get the job done !

DV
Studio
Technologies, LLC

Making Your Own DVDs

By Stephen E. Godfrey

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DECEMBER 2000



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Acknowledgements

(those to whom a debt of gratitude is owed)

The author wishes to recognize that without Dr. Ash Pahwa's editorial guidance, inspiration, and support, this project simply could not have been undertaken. Sincerest thanks, *Ashok-ji*.

Generous to a fault with their insights and support were industry colleagues Dana Berzin and Carl Laufer (Panasonic USA), Gordon Stephen and Robert Kwong (Panasonic Canada), Andy Marken (Marken Communications), Tatsuo Baba (Hitachi America), Andy Parsons (Pioneer USA), Stephen Inoue, Ferida Letafat, and Brian Lane (Spruce Technologies), David Habiger (Sonic Solutions), Rich Gadomski and Richard D'Ambrise (Maxell), and Larry Addison (Jim Henson's Creature Shop).

The continuing commitment to DV Studio Technologies by our foreign importer/distributors, particularly, Victor Wan (Accelerated Computech International), Richard Huang (LEADWave), Churhee Kwon (Neednet), Jack Okabayashi (AMAC/Matsushita Inter-Techno), Wally Dragich (IC Technology), and Bernard Yip (BernClare) is sincerely appreciated.

Deepest appreciation also to our partners at QPS, Inc., Raj Sharma and Pierre Abboud, for their unflagging support and dutiful reminders that the world *also* includes Macintosh users.

Mervin Kronfeld (Nortronics) demonstrated—fully unaware—what it was to be a “class-act” marketer. Brian Arbib (Bib) gave me the opportunity to do it *my* way—even when exchange rates were abominable. Bob Cohen (FutureVideo) enabled me to develop the requisite desktop publishing skills and encouraged the writer within. Lastly, Sue Bauman's conscientious efforts at proofreading and Lynn Englehardt's content review helped ensure that readers received a professional document.

SEG

Table of Contents

Introduction	<i>(why it was written & by whom)</i>	6
Chapter 1	The Paradigm Shifts To DVD	8
	<i>(what the implications are)</i>	
	• Penetration of Milestone Consumer Electronics Products....	9
	• Duplication & Distribution Cost Comparison.....	9
	• Video DVD vs. VHS Software Market Projections.....	10
	• Video DVD Player vs. VHS VCR Market Projections.....	10
	• How DVD Is Being Used.....	11
Chapter 2	DVD & MPEG Clarified	14
	<i>(what they really mean)</i>	
	• DVD Types.....	14
	• MPEG Types.....	15
	• MPEG Standards & Applications.....	16
Chapter 3	DVD Format	17
	<i>(why the extraordinary appeal)</i>	
	• DVD Advantages vs.VHS Tape & CD.....	17
	• DVD Capacity.....	19
	• DVD Capacity vs. CD Capacity.....	19
	• DVD-V General Specifications.....	19
Chapter 4	DVD Compatibility	20
	<i>(what works with what & why)</i>	
	• DVD Media Configurations.....	20
	• DVD Media & DVD Drive Compatibility.....	21
	• DVD Recorder Compatibility.....	23
	• The Economics of DVD Compatibility.....	24
	• Which Formats Are Right For You.....	24

Chapter 5	MPEG Compression/Decompression.....	26
	<i>(what it does & why)</i>	
	• Why MPEG Is Necessary.....	27
	• Playing Time Via MPEG.....	28
	• Calculating Playing Time vs. MPEG-2 File Size.....	28
Chapter 6	DVD Creation.....	30
	<i>(how it gets made)</i>	
	• DVD Authoring Software.....	30
	• DVD Creation Process.....	30
	• DVD Creation Time.....	31
	• Configuring Your DVD Creation System.....	32
	• For Your Own Good.....	34
Chapter 7	You're Ready For DVD.....	35
	<i>(if we've done our job well, you're empowered)</i>	
Appendix A	Resources Directory.....	36
	• Key DVD & MPEG Web Sites	
	• Periodicals	
	• Books	
	• Associations	
	• Trade Exhibitions	
	• Selected Manufacturers	
Appendix B	Manufacturer's Specifications.....	38
	• MPEG-2 Encoder/Decoder & DVD Authoring Packages	
	• DVD Drives	
	• DVD Authoring Software	
Appendix C	DVD-RAM Frequently Asked Questions.....	49
Appendix D	Glossary.....	63

Introduction

(why it was written & by whom)

A significant obstacle many seem to face is the ability to feel *confident* about navigating today's multimedia technology issues. After all, the decisions *are* consequential. You've probably got some sense of what you need to do—to archive (“burn”) your video footage (“content”) onto a permanent, compact, high-quality storage medium (like DVD). You're *hoping* the process will be efficient, relatively easy, and cost-effective. But, there's all that ominous business about *capacity* and *formats* and *compatibility*—plus a new crop of unfamiliar acronyms & technical jargon (MPEG, MUX, GOP, VBR, CBR, etc.). These are a few of the reasons why we created this book.

For those who fear they may have made a “career” out of guessing wrong in the format wars (8-Track vs. Cassette...Betamax vs. VHS...Selectravisision vs. Laser Disc...Amiga or Atari vs. Macintosh & PC...just to name a few), the reasons for this book will be even more obvious.

Cliché notwithstanding, you *do* need to know what you need to know. And, through this book, we offer our assistance.

A Few Words About Us

We're DV Studio Technologies, LLC, based in southern California's high-tech enclave, Orange County. Together with our corporate antecedents, we've been at the forefront of MPEG compression and digital optical storage applications development. Our products are marketed world-wide under our Apollo trademark and by various third-party entities to whom we are an OEM technology supplier. You can visit us whenever you like at www.dv-studio.com (incidentally, your feedback is *always* welcome).

Even Fewer Words About Me

Your wayward author is alleged to be DV Studio Technologies' Vice President of Marketing & Sales. It's also rumored that I've held senior management positions with Horita, Samsung, FutureVideo, Comprehensive Video, and Nortronics in the USA and Bib in the UK during the past two decades. Guilty on all counts. My email address is stephen@dv-studio.com.

Chapter 1

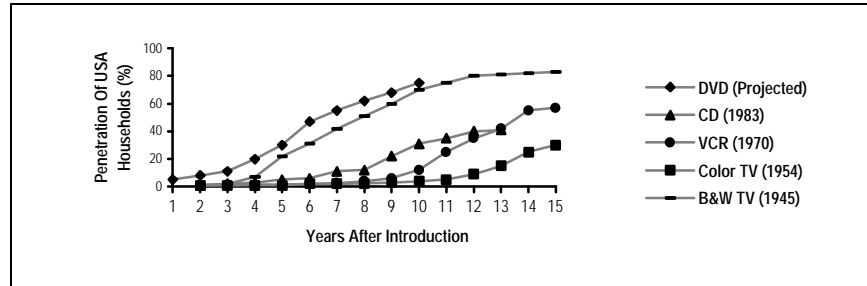
The Paradigm Shifts To DVD *(what the implications are)*

An important paradigm shift is occurring in our midst. It's very similar to one we experienced not so long ago—the transition from LP records and audiocassettes to CD. Remember how records seemed to vanish from dealer shelves almost overnight? And, how quickly pre-recorded audiocassette inventories shrunk? The hardware manufacturers who bet successfully on this shift (Panasonic, Sony, Pioneer, Yamaha, Hitachi, Philips, JVC, Toshiba, Ricoh, Samsung, etc.) were diligently re-tooling their assembly lines to produce a host of CD drives instead of turntables. Those who didn't (Garrard, BSR, Empire, etc.), well...

The reasons for this rapid transition were simple and fairly predictable—dramatically improved performance and capabilities via new technology, accompanied by economic incentives at virtually all levels.

VHS videotape reached this threshold some time ago. In fact, the shift from VHS to DVD-V as the standard home movie playback medium is occurring at a faster rate than that from vinyl records to CD. Figure 1 compares the penetration of milestone consumer electronics products over time since the year of introduction.

Figure 1 Penetration Of Milestone Consumer Electronics Products



The more visible reasons for the VHS to DVD transition are the inherent limitations of the medium. Unlike DVD, VHS provides utilitarian image quality, limited life span, no interactivity, and no random access.

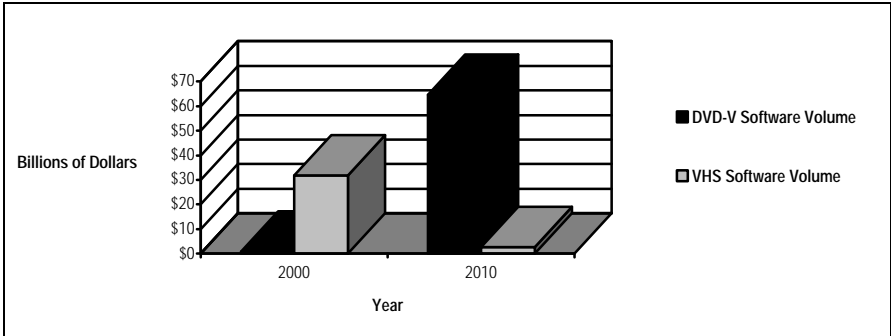
The less visible reasons are what might be called “industry factors”—the incentive amongst producers (read Hollywood) to abandon a comparatively expensive replication/distribution medium (read VHS tape) in favor of DVD, and the incentive amongst hardware manufacturers to abandon production of now mature products (read VHS VCRs).

A quick glimpse at the replication/distribution costs essentially tells the tale where economic incentives are concerned.

Figure 2 Duplication & Distribution Cost Comparison

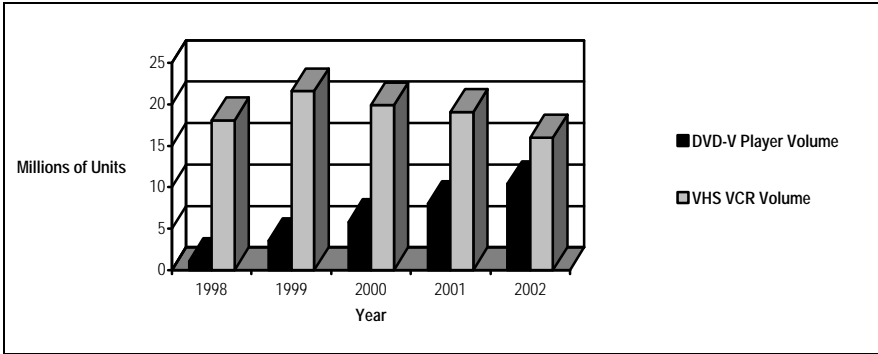
Media Type	Typical Duplication Cost	Typical Distribution Cost
VHS Tape	\$3.50 per tape	5 first class stamps per tape
DVD-V	\$1.00 per disc	1 first class stamp per disc

Figure 3 Video DVD vs. VHS Software Market Projections



As you may have noticed, since July 1999, virtually all theatrical motion pictures have been released simultaneously on VHS and on DVD-V. By December of 1999, over 5000 films had been released on the DVD format.

Figure 4 Video DVD Player vs. VHS VCR Market Projections



As VHS VCR production winds down and the existing machines wear out, what's to become of all that valuable content currently archived on videocassettes (which themselves deteriorate)?

The answer is simple: DVD. Fortunately, DVD does incorporate all those desirable attributes like interactivity, random access, broadcast-quality video, permanence, and quite a bit more as we shall see.

How DVD Is Being Used

So, who's making use of these powerful DVD capabilities and for what purpose? Actually, there are a wide variety of user profiles and most of the applications revolve around archiving. Typical users come from many fields:

- Advertising
- Broadcast/Cable TV
- Corporate Communications
- Education
- Government
- Home Entertainment
- Law Enforcement
- Legal
- Library
- Medical
- Military
- Presentation
- Training
- Wedding & Event Videography

These users actually have relatively similar needs. Let's take a look at two different examples—one industrial, one commercial.

1. Jim Henson's Creature Shop (Burbank, New York, London) is one of the world's pre-eminent character-building companies. They provide puppetry, animatronics, computer graphics, and special effects for motion pictures, television, advertising, and museums.

Problem: tons of video footage and still images which have accumulated over the years; locating the desired footage from an earlier project is a nightmare; the amount of storage space eaten up by the videotape archive is consequential; the aging tape is worrisome. And, they also need to

provide cost-effective copies of an interactive corporate portfolio to prospective clients.

Solution: organize the footage to be archived; create menus to index creatures/scenes/projects or other elements for efficient access (authoring); burn the content onto DVD; recycle the obsolete tape storage shelves. Incidentally, the DVD-ized corporate portfolio can now be played back on a DVD-equipped laptop at 30,000 feet or on a Video DVD player in a boardroom.

You'll probably recognize many direct parallels between the Henson Creature Shop's situation and other fields such as medicine (*"What we need is some kind of an interactive presentation showing various pre-op vs. post-op plastic surgery results from our archives."*), or the law (*"Find that segment of Mr. Smith's video deposition—it's somewhere on tape 2 or 3—where he takes the 5th Amendment."*).

On the commercial side...

2. The video duplication service or fast photo-finishing dealer has customers wondering if anything could be done to preserve and distribute the family's treasure trove of photos and video footage (birthdays, weddings, children's activities, scenes of loved ones no longer living, etc.)—all of which is irreplaceable.

Problem: the source material was shot under different conditions and is scattered about on different tapes (and formats); it's vulnerable to accidental erasure, re-recording, loss, and wear & tear; others in the family would like to be able to view the content at will and pass it down through their particular branch.

Solution: add DVD Creation to the firm's roster of business services; acquire the necessary equipment; organize the project's content elements; balance the brightness/contrast/hue/saturation for uniformity (during MPEG encoding); create menus to index event/individual/place or other

distinguishing elements; burn the content onto a DVD for each family member who wants one.

As you can see, the DVD archival application cuts across a wide variety of user profiles. In many respects, it's rather akin to data base management applied to visual content. Perhaps there are parallels to your situation here.

Chapter 2

DVD & MPEG Clarified *(what they really mean)*

Let's start with DVD and MPEG. They're the top of our acronym hierarchy and will be used throughout this book. Incidentally, to save you from having to flip back and forth to the Glossary, we've sought to put jargon explanations where they really belong—just *ahead* of the material which includes them.

To put it simply, DVD is the medium which will store your content and MPEG is what compresses the content sufficiently to fit.

- **DVD** is the acronym for Digital Versatile Disc, although it seems to have metamorphosed into Digital *Video* Disc in the minds of many. It's an audio/video/data storage system using 12 and 8 centimeter optical discs. It's capable of storing many times more content than a CD and comprises 5 different formats.
- **MPEG** is the acronym for Moving Pictures Expert Group. They are the international standards committee which developed the highly-sophisticated algorithms comprising the MPEG family of audio and video compression standards.

DVD Types

We'll begin with a closer examination of DVD and its various configurations and formats. These include:

- **DVD-ROM** (ROM = Read Only Memory) is the base format of DVD and (once created via the mass replication stamping process) standard DVD-ROM and DVD-V discs cannot be re-recorded. DVD-ROM can store virtually any form of digital data.
- **DVD-R** (R = Record) is a version of DVD upon which "content" may be recorded only one time via something you probably needn't concern yourself about called "dye sublimation recording technology."
- **DVD-RAM** (RAM = Random Access Memory) is a version of DVD upon which "content" can be recorded more than once via something else you needn't worry about, "phase-change recording technology."
- **DVD-V** (V = Video) is a version of DVD for storing high-quality audio/video content for playback using Read Only Memory (ROM). The video is compressed and encoded as MPEG-2 files. The audio may be MPEG Audio, Dolby Digital, or PCM. They are created by a mass replication stamping process.
- **DVD-A** (A = Audio) is a version of DVD for storing high-quality multi-channel audio content, via the MLP (Meridian Lossless Packing) data compression standard. It is expected to supersede the familiar audio CD.

MPEG Types

On the MPEG front, there are actually several standards which comprise the MPEG family. The one we'll be most interested in is MPEG-2. MPEG-1 is intended for applications where more modest video image quality is acceptable or cost-effective. MPEG-2, on the other hand, is capable of delivering the broadcast-quality image demanded by professional/industrial video users.

The full roster of MPEG standards include the following:

Figure 5 MPEG Standards & Applications

MPEG Standard	Typical Applications
MPEG-1	VHS-grade video (bit rate: 1-5 Mb per second); used for VideoCD, video games, Video On Demand, etc.
MPEG-2	High-grade video (bit rate: 5-20 Mb per second); used for DVD, HDTV Broadcast, Cable TV, Digital Satellite Systems, etc.
MPEG-3	Non-existent (merged into MPEG-2)
MPEG-4	Interactive video for internet/video conferencing (object-oriented)
MPEG-7	Video Databases (object-oriented)

We'll be returning to MPEG in Chapter 5 and explore it in greater detail. For now, our principal focus will be on DVD technology.

Chapter 3

THE DVD FORMAT *(why the extraordinary appeal)*

As formats go, what makes DVD so attractive? Many reasons, really. Rather than get ourselves bogged down with arcane engineering data (you can get *that* in Appendix B), let's examine DVD more from a user's perspective.

Figure 6 DVD Advantages vs. VHS Tape & CD

DVD Advantages Over VHS Videotape	DVD Advantages Over CD
Interactivity	Capacity
Random Access	
Broadcast-quality Video	
Permanence	
Versatility	

DVD's unique *interactivity* presents the creator and the viewer alike with a host of leading-edge functions which would simply not be possible in the analog realm. Since the audio/video in DVD is digital, it's feasible to have:

- Multiple Aspect Ratios (16:9 Letterbox & 4:3 Standard TV)
- Multiple Camera Angles (alternate views of a given scene)
- Multiple Story Lines (alternate segments or endings)
- Multiple Languages (alternate languages & subtitles)

- Multiple Zones (Regional Codes to define which areas of the world the content may be played back)
- Parental Control (MPAA movie rating system codes, password lockout)

Like CD, floppy disks, and hard drives, DVD provides quick *random* access to the content you're seeking. By contrast, magnetic tape offers only *sequential* access. (Remember lumbering forward/backward through the length of the tape until you *finally* arrived at the desired segment?)

The *video image quality* DVD is capable of supporting is broadcast-quality and light-years beyond the utilitarian (read mediocre) VHS-quality video image which is typical to VHS tape.

As with CD, DVD's *permanence* is one of its most important attributes. In magnetic media (tape, floppy disks, hard drives), this characteristic is called *retentivity* i.e., the degree to which the magnetic particles remain in their original recorded pattern over time. Magnetic media's retentivity is limited and the particles will eventually become random once again. Over time, particles of magnetic oxide do shed—particularly as a consequence of heavy use—and the media's backing and binder deteriorate. In color photographic media (motion picture or still), the dyes eventually fade over time (leaving you with no image). By contrast, the integrity of content archived onto DVD is virtually infinite (it'll probably outlive us). The legal department of one leading DVD equipment manufacturer authorizes its company personnel to declare 30 years as the archival life expectancy of DVD media. Given the predictably *conservative* nature of their advice, we may presume that the typical life span will be even longer. All of this makes DVD the ideal format for storing and archiving your video content.

Versatility is also a key factor in DVD's appeal. DVD can store:

- tons of data, or
- broadcast-quality video, or
- up to 6 channels of high-quality surround sound audio

DVD Capacity

On the *capacity* front, DVD provides a quantum leap—4 to 25 times more data—over its nearest alternative, CD, as you can see.

Figure 7 DVD Capacity vs. CD Capacity

DVD Capacity	CD Capacity
2.6 GB to 17 GB of data (varies by type & configuration)	680 MB of data (that's only .68 GB)
Up to 7 hours of broadcast-quality MPEG-2 video	Up to 74 min of VHS-quality MPEG-1 video
Up to 90 min of 6 channel surround sound audio	Up to 74 min of 2 channel (stereo) audio

DVD dramatically outperforms other formats at all levels. From this point forward, we'll focus our attention primarily on DVD's *video* applications.

Figure 8 DVD-V Specifications

DVD-V General Specifications	
Playing Time	up to 150 minutes per side
Video Standards	NTSC, PAL, SECAM
Video	MPEG-2 variable bit rate (VBR) or constant bit rate (CBR)
Video Bit Rate	3.5 Mb (megabits) per second (or higher)
Audio (NTSC)	Dolby AC-3 Audio (5.1 Channels), MPEG-1 Layer 2, PCM
Audio (PAL/SECAM)	MPEG-2 Audio, PCM

Chapter 4

DVD COMPATIBILITY

(what works with what & why)

Like CD before it, DVD was *intended* to be a universal format. Unfortunately, life, technology, and corporate strategies are rarely quite that simple. Without wishing to put *too* fine a point on it, competing manufacturer alliances have fought to establish their particular standard with the masses. This caused somewhat divergent DVD paths to be taken. Industry leaders have come to appreciate, however, that another VHS vs. Betamax-style format war is *not* what the market needs or wants.

Fortunately, the people in charge are well along in putting this right. For example, Panasonic Industrial Company's Mass Storage Marketing Division (they're responsible for Panasonic's new DVD-R and 4.7 GB DVD-RAM drives) and Matsushita Consumer Electronics Company (they're responsible for Panasonic's home DVD-V players) have seen to it that media burned on their new DVD-R drives will also playback on all 2nd generation (and newer) home DVD-V players and that their 4.7 GB DVD-RAM media will play back on 4th Generation (and newer) home DVD-V players. Other manufacturers are expected to follow suit.

DVD Media Configurations

At the beginning of this book, we learned that there are different types of DVD formats. This is also true with the media or discs. There are different configurations and capacities. *Double-sided* DVDs are actually two half-thickness discs which have been bonded together and contain data on both sides. *Double-layered* DVDs actually contain two layers of data at different depths on a given side.

The storage capacity based upon disc *configuration* is as follows:

Figure 9 DVD-V Configuration & Storage Capacity

DVD-V Configuration	Storage Capacity
1 side / 1 layer	4.7 GB
1 side / 2 layers	8.5 GB
2 sides / 1 layer	9.4 GB
2 sides / 2 layers	17 GB

Figure 10 DVD Media Type/Capacity/Cost

DVD Media Type	Capacity (Single side)	Capacity (Double side)	Cost Per Disc
DVD-R (Type I)	3.9 GB	N/A	\$30 - \$40
DVD-R (Type II)	4.7 GB	N/A	\$30 - \$40
DVD-RAM (Type I)	2.6 GB	5.2 GB	\$40+
DVD-RAM (Type II)	4.7 GB	9.4 GB	\$40+
DVD-ROM	4.7 GB	9.4 GB	\$1 - \$2 ❶
DVD-V (Video)	4.7 GB	9.4 GB	\$1 - \$2 ❶

NOTES

❶ Mass replication cost

DVD Media & DVD Drive Compatibility

As with DVD media, there are also different types of DVD drives. There are "burners" which write or *record* the data and "readers" which read or *playback* the data. Some do both. Fortunately, it's really not all *that* complicated. As a useful guide, the type of DVD drive which will be commonly used to *playback* the content will typically dictate which DVD format will be used for the application. So, let's examine the media-to-drive compatibility aspect next. The following chart will help us identify which DVD media may be used for record (write) or play (read) applications with the various DVD drive types.

Figure 11 DVD Media & Drive Compatibility

DVD Media & Drive Compatibility Chart						
DVD Drive → DVD Media ↓	DVD-R ❶ (Burner)	DVD-RAM (Type I) 2.6 / 5.2 GB	DVD-RAM (Type II) 4.7 / 9.4 GB	DVD-ROM (Type I) 1999 Models	DVD-ROM (Type II) 2000 Models	DVD-V (Video)
DVD-R (Type I) 3.9 GB	Record	Play ❷	Play ❷	Play ❷	Play ❷	Play ❸
DVD-R (Type II) 4.7 GB	Record	Play ❷	Play ❷	Play ❷	Play ❷	PLAY ❸
DVD-RAM (Type I) 2.6 / 5.2 GB	N/A	Rec/Play	Rec/Play	N/A	Play ❹	N/A
DVD-RAM (Type II) 4.7 / 9.4 GB	N/A	N/A	Rec/Play	N/A	Play ❺	PLAY ❻
DVD-ROM	N/A	Play	Play	Play	Play	N/A
DVD-V (Video)	N/A	Play ❷	Play ❷	Play ❷	Play ❷	Play

NOTES

Grey Areas = projected DVD compatibility universe (based upon industry forecasts & trends)

N/A = Not Applicable

❶ Recorder only

❷ Computer must have MPEG-2 decoder

❸ 2nd, 3rd, 4th Generation home DVD-V Players only

❹ 2.6 GB DVD-RAM (Type I) media only

❺ 4.7 GB DVD-RAM (Type II) media only

❻ 4th Generation & newer home DVD-V Players only using 4.7 GB DVD-RAM (Type II) media

If the intended playback devices are typical home DVD Video players (DVD-V), it's also helpful to understand how the player's "generation" relates to its DVD media compatibility. As you can see below, the industry really *is* taking steps to broaden DVD compatibility with each successive generation of hardware.

Figure 12 Home DVD-V Player Generation & Media Compatibility

DVD-V Player Generation	Date of Manufacture	DVD Media Compatibility
1 st	1997 to mid 1998	<ul style="list-style-type: none"> DVD-V only
2 nd	mid 1998 to mid 1999	<ul style="list-style-type: none"> DVD-V <i>many</i> models support DVD-R
3 rd	mid 1999 to 3 rd qtr 2000	<ul style="list-style-type: none"> DVD-V <i>most</i> models support DVD-R
4 th & newer	4 th qtr 2000 onward	<ul style="list-style-type: none"> DVD-V DVD-R DVD-RAM (Type II) 4.7 GB

DVD Recorder (burner, writer) Compatibility

Now, a quick re-cap from the DVD recorder side to bring us full circle...

Figure 13 DVD Recorder & Media Compatibility

DVD Recorder Type	Created Media Can Be Played Back On
DVD-R	<ul style="list-style-type: none"> DVD-RAM drives (with MPEG decoder) DVD-ROM drives 2nd, 3rd, 4th Generation Video DVD (DVD-V) players
DVD-RAM (Type I)	<ul style="list-style-type: none"> DVD-RAM (Type I & II) drives DVD-ROM (Type II) 2000 models (2.6 GB media only)
DVD-RAM (Type II)	<ul style="list-style-type: none"> DVD-RAM (Type II) drives DVD-ROM (Type II) 2000 models (4.7 GB media only) 4th Generation Video DVD (DVD-V) players (4.7 GB media removed from shell)

The Economics of DVD Compatibility

To help you put this all into perspective, let's take a look at the financial implications. The following DVD drive prices are fairly typical as of this writing (June 2000). While DVD-R drives from Pioneer have been priced in the \$4500-\$5000 range, the introduction new DVD-R models from Panasonic and Pioneer later this year is expected to lower prices almost by half—down to the \$2000-\$2500 range. The new generation of 4.7 GB DVD-RAM drives (from Panasonic, Hitachi, Toshiba) is expected to cost approximately \$500.

Figure 14 DVD Drive Price Levels

DVD Drive Type	Typical Price
DVD-R	\$4500 - \$5000 (current) \$2000 - \$2500 (projected)
DVD-RAM	\$400 - \$600
DVD-ROM	\$100 - \$125
DVD-V	\$199 - \$325

DVD-R and DVD-RAM media costs tend to be similar at \$30.00 to \$40.00 per disc. If past VHS pricing trends are a reliable guide, home DVD-V players in the \$99-\$249 range will probably be common and disc media will probably come in well below the cost of VHS tape. As economies of scale continue to work their magic on the manufacturing side, prices on all of these items will become progressively more attractive over time.

Which Formats Are Right For You

As you may have surmised, two specific media, burner, & player format combinations are particularly attractive.

- A. DVD-R burners with 2nd, 3rd, 4th Generation (and newer) home DVD-V players

This combination provides the broadest playback model compatibility—and prices are coming down dramatically.

- B. DVD-RAM (Type II) 4.7 GB Drives & 4th Generation (and newer) home DVD-V players

This combination is also price attractive, but offers less home DVD-V playback model compatibility at this time. In this application, the DVD-RAM disc is first removed from its plastic shell (enclosure) and then inserted into the DVD-V player. A hinged “trap door” on the back edge of the disc shell easily swings open to make this possible. DVD-RAM discs without the plastic shell are also expected to become available.

Chapter 5

MPEG COMPRESSION/DECOMPRESSION

(what it does & why)

Let's shift gears now and return to our *other* first tier acronym, MPEG...

To refresh your memory, MPEG is the acronym for Moving Pictures Expert Group, the international standards committee which developed this family of extremely sophisticated audio and video compression algorithms. To use desktop publishing as a metaphor, think of MPEG as being to *full motion* images what JPEG is to *still* images. The types of MPEG compression we'll be most concerned with are the following:

- **MPEG-1 Layer 2** is the audio compression standard used for 2 channel (stereo) format.
- **MPEG-2** is the video compression standard used for high-quality video applications such as DVD and television broadcasting.

To a non-engineer, compressing/decompressing may seem to mean about the same as encoding/decoding. And it nearly does. The reality is that there are various incompatible compression/decompression methods or "codecs" in existence. In MPEG applications, the *means* of compressing and decompressing broadcast-quality audio/video signals is to *encode*, store, and *decode* them as MPEG files.

- **Codec** (a contraction of coder/decoder) is a proprietary method for encoding and decoding a signal. It may be either hardware-based or software-based.

Why MPEG Is Necessary

So, why do we even need a codec like MPEG? Well, someday in the future, we probably won't. At the current state of technology, however, MPEG is the best means available for accomplishing the task. There are two principal reasons for this:

1. *Uncompressed* digital video requires approximately 30 megabytes per second and 200 GB for 2 hours of video content. Currently, hard drives can provide approximately 5 megabytes per second (maximum) and about 30 GB of storage.
2. High-quality, full-motion digital video (and audio) signals incorporate an extraordinary amount of information and necessarily require huge amounts of storage space to contain them.

The problem, therefore, is in cramming *enough* of it (sufficient playing time) onto a digital storage medium—even one with DVD's extraordinary capacity—to be a commercially viable proposition. The *solution* is to digitize the audio/video information and condense or compress the file size down to more manageable proportions. This is where the exceptional MPEG family of standards comes in.

MPEG offers several important advantages over other codecs. These include:

- *Cross-platform*—it can be used on PC, Macintosh, Unix, CD-I, 3DO, VideoCD, & Internet applications. May be used with either hardware or software decoders (software decoders, however, are often not real-time & tend to be far more taxing on the CPU).
- *Full Motion Video*—supports full 25 frame (PAL/SECAM) & 30 frame (NTSC) per second frame rates.
- *Scalable*—image may be user-sized up to full screen.

Playing Time Via MPEG

The playing time of broadcast-quality video and stereo audio content which can be burned onto a DVD-R or DVD-RAM disc is a consequence of the rate of data transfer (bit rate) and the capacity of the disc media. Using typical audio and video bit rates for professional/industrial video applications, the approximate playing times are shown below.

Figure 15 DVD Media & Disc Capacity vs. Playing Time

Media Type	Disc Capacity	Typical Playing Time
DVD R (Type I)	3.9 GB	100 Minutes
DVD-R (Type II)	4.7 GB	120 Minutes
DVD-RAM (Type I)	2.6 GB	60 Minutes
DVD-RAM (Type II)	4.7 GB	120 Minutes

Notes

Video settings: 5 Mb/sec Transfer Rate; Constant Bit Rate; 720 x 480 resolution; MPEG-2 Encoding/Decoding
Audio settings: 224 Kb/sec Transfer Rate; 48 kHz sampling; MPEG-1 Layer 2 Encoding/Decoding

Calculating Playing Time vs. MPEG-2 File Size

If you wish to *precisely* determine playing time vs. the MPEG-2 file size for your projects the following example will enable you to understand and use the formula.

Figure 16 DVD Playing Time & File Size Formula

Selected video transfer rate:	5 megabits per second
Selected audio transfer rate:	224 kilobits per second
5 megabits of video =	5,000,000 bits
224 kilobits of audio =	+ 224,000 bits
Total	5,224,000 bits per second
5,224,000 ÷ 8 (the number of bits per byte) = 653,000 bytes per second	
653,000 x 60 seconds = 39,180,000 bytes of data per <i>minute</i> of video	

The following chart will provide the exact calculations for video playing time.

Figure 17 MPEG-2 File Size vs. Video Playing Time Calculations

Video Minutes	Formula Calculation	MPEG-2 File Size & Storage Requirement
15	39,180,000 x 15	587,700,000 bytes (0.58 GB)
30	39,180,000 x 30	1,175,400,000 bytes (1.18 GB)
60	39,180,000 x 60	2,350,800,000 bytes (2.36 GB)
90	39,180,000 x 90	3,526,200,000 bytes (3.53 GB)
120	39,180,000 x 120	4,701,600,000 bytes (4.71 GB)

As you may have surmised, *raising* the audio/video transfer rate improves image quality, increases the file size, and requires more storage capacity. *Lowering* it does just the opposite on all counts. As we said, the transfer rates used in these examples are fairly typical for professional applications.

Chapter 6

DVD Creation

(how it gets made)

The DVD disc creation process includes several phases. Naturally, the very first phase of *any* project is to determine the intended “look” and functionality of the finished DVD. While this may be an opportunity to satisfy your own creative impulses, it’s always prudent to ensure that client expectations are well understood.

DVD Authoring Software

DVD Authoring software is what enables you to actually create the polished “look and feel” of your DVD. It’s somewhat akin to video post-production. The various commercially available software packages provide different levels of functionality and ease of use. For example, Apollo Expert DVDer’s authoring software is designed for direct dubbing or archiving of video content onto DVD. Spruce Technologies’ DVD Virtuoso and Sonic Solutions’ DVDit! are intuitive and highly regarded choices where multiple backgrounds, menus, and buttons are required. Simulation software, such as REALmagic’s DVD Station, makes it possible to emulate a “virtual DVD” of your content for testing and assessment purposes—before the disc is actually burned.

DVD Creation Process

Since this book was intended to demystify DVD & MPEG technologies (not to function as an “owner’s manual”), detailed step-by-step procedures and system settings used in a typical DVD creation project are beyond its scope. Instead, we’ll explore the path the video and audio signals typically take on their journey from your original source to the finished DVD disc. Seen from this perspective, the process incorporates several phases, including:

Figure 18 Typical DVD Creation Signal Path

Signal Input ↓	Analog video and/or audio signals (from VTR, camcorder, or live video feed) are routed to MPEG-2 encoder card (such as Apollo Expert DVDer).
MPEG Encoding ↓	Analog audio/video signals are digitized & compressed into MPEG-2 files & written to the hard drive. The signals may be encoded separately or "MUX'ed" (multiplexed) together into a single file.
DVD Authoring ↓	The buttons & menus are created; MPEG-2 files are imported into the Authoring software & converted to VOB files in Audio_TS & Video_TS folders.
DVD Simulation (option) ↓	Simulation of your "virtual" DVD for testing, review, & assessment is now possible when using a product like REALmagic DVD Station.
File Conversion ↓	Audio_TS & Video_TS folders converted to a UDF file (Universal Disc Format).
DVD Burning	UDF file is routed to DVD-RAM or DVD-R burner for recording onto the DVD disc.

DVD Creation Time

The time necessary to burn video content onto a DVD is dependent upon several factors. One of the most important is whether or not the MPEG encoding is "real time." In real-time encoding (like that provided by Apollo Expert DVDer), the time increment is equal to the running time of the content. Therefore, 2 hours of video footage will take 2 hours to encode. Those encoders (often software-based encoders) which are unable to perform this task in real time are consequently far less efficient. The chart below will help you visualize these time factors. The original content (videotape) length is equal to X (in the formula) and equal to 2 hours (in the example).

Figure 19 DVD Creation Process Time Increment

Process	Formula	Example
MPEG Encoding (non-real time)	Varies by CPU speed & MPEG software	Varies by CPU speed & MPEG software
MPEG Encoding (real time)	1X	2 hours
MPEG Decoding (for review)	1X	2 hours
DVD Authoring	2X	4 hours
File Conversion	.5X	1 hour
DVD Burning	.5X	1 hour
Total	5X	10 hours

Configuring Your DVD Creation System

In order to create your own DVDs, the correct equipment is necessary. The system you configure will probably comprise something similar to the following:

- **Video/Audio Source**
 - VTR, Camcorder; live video feed (S-Video connection recommended); DV footage via Firewire connection
- **Computer**
 - PC Running Windows 2000 or Windows NT (4.0) & available PCI slot
- **MPEG-2 Encoder/Decoder**
 - DV Studio Technologies Apollo Expert Plus (hardware-based)
 - DV Studio Technologies Apollo d2d (software-based)
 - QPS *Que!* D2D (software-based)

- **DVD Authoring Software**
 - For straight content archiving: Apollo Expert Plus software (included in Apollo Expert Plus package) or Apollo d2d software
 - For multiple menus & button creation: Spruce Technologies DVD Virtuoso; Spruce Technologies SpruceUP; or Sonic Solutions DVDit!
- **DVD Simulation Software (optional)**
 - REALmagic DVD Station
- **DVD Burner & Media**
 - DVD-R burner from Pioneer or Panasonic (plus media), or
 - DVD-RAM (Type II) 4.7 GB drive from QPS, Panasonic, Hitachi, Toshiba (plus media)
- **DVD Player**
 - For DVD-R media: 2nd, 3rd, 4th Generation (or newer) home DVD-V players or,
 - For DVD-RAM 4.7 GB (Type II) media: 4th Generation or newer DVD-V players from Panasonic; Hitachi; Toshiba; others; or
 - Any of the various compatible devices shown on the DVD Media & Drive Compatibility chart (see Figure 11)

For Your Own Good

A few words of advice to protect yourself...

- Determine which DVD format best suits playback compatibility requirements and your budget (you'll probably be using either DVD-R or DVD-RAM 4.7 GB).
- Know your MPEG encoder/decoder's capability (if you're doing long projects, you'll prefer one which works in real-time or very close to it).
- Know *who* you're buying from (you'll want to source your equipment from reputable, knowledgeable, factory-authorized resellers—or directly from the manufacturer's own web site, if feasible).

Chapter 7

You're Ready For DVD

(if we've done our job well, you're empowered)

We trust that the knowledge and insights you've gleaned from these pages has given your confidence a *boost*—and *minimized* your anxiety—about harnessing DVD and MPEG technologies. If DVD is right for your application, you probably know it by now and are preparing to move forward. When the time comes, we *do* hope you'll look with favor upon DV Studio Technologies and our range of Apollo-branded products.

In the appendices which follow, we've sought to provide resources to further empower and guide you. These include:

Figure 20 **Appendices**

Appendix	Content
A	Resources Directory
B	Manufacturer's Specifications
C	DVD-RAM Frequently Asked Questions
D	Glossary

We sincerely wish you every success with your DVD projects.

Appendix A Resources Directory

- **Key DVD & MPEG Web Sites**

www.dvdforum.org

www.mpeg.org

- **Periodicals**

AV Video & Multimedia Producer

DCC

Digital Video

Digital Imaging

Emedia

Government Video

New Media

Presentations

Replication News

TapeDisc Business

TV Technology

Videography

Video Systems

Videomaker

Wedding & Event Videography

www.avvmmp.com

www.dccmag.com

www.dv.com

www.digitalimagingmag.com

www.emediapro.net

www.gvmag.com

www.newmedia.com

www.presentations.com

www.replicationnews.com

www.m3online.com

www.tvtechnology.com

www.videography.com

www.videosystems.com

www.videomaker.com

www.weva.com

- **Books**

Digital Video: An Introduction To MPEG-2

by Mitchell, Pennebaker & Fogg

DVD Demystified by Jim Taylor

Video Demystified by Jack Keith

ISBN: 0412087715

ISBN: 0070648417

ISBN: 187870723X

- **Associations**

DVD Association

International Television Association

Law Enforcement Video Association

www.dvda.org

www.itva.org

www.leva.org

- **Associations** (continued)

Open DVD Association www.opendvd.org
Society of Motion Picture & Television Engineers www.smpte.org
Wedding & Event Videography Association www.weva.com

- **Trade Exhibitions**

AES www.aes.org
CES www.cesweb.org
Comdex www.zdevents.com/comdex
Digital Hollywood www.digitalhollywood.com
DV Expo www.dvexp.com
DVD Pro www.dvdpro.net
Government Video Expo www.gvmag.com
Infocomm www.infocomm.org
NAB www.nab.org
NAMM www.namm.org
PC Expo www.pcexpo.com
Replitech www.replitech.com
ShowBiz Expo www.showbiz.reedexpo.com
Siggraph www.siggraph.org
Videomaker Expo www.videomaker.com
Wedding & Event Video Expo www.weva.com

- **Selected Manufacturers**

Blossom Technologies www.blossomvideo.com
DV Studio Technologies www.dv-studio.com
Hitachi www.hitachi.com/storage/products/dvd
Maxell www.maxell.com
Panasonic www.panasonic.com/industrial_oem
Pioneer www.pioneerusa.com
QPS www.qps-inc.com
Realmagic www.realmagic.com
Sonic Solutions www.sonic.com
Spruce Technologies www.spruce-tech.com
Toshiba www.toshiba.com

Appendix B Manufacturer's Specifications

Note: the following information has been provided by the manufacturer. Specifications and availability are subject to change without notice.

- **MPEG-2 Encoder/Decoder Card & DVD Authoring Software Package**

DV STUDIO TECHNOLOGIES APOLLO EXPERT PLUS

Specifications

Video

Real time MPEG-2 encoding:	Yes
MPEG-2 decoding (playback):	Yes
MPEG-2 broadcast quality:	ITU-R BT 601 standard video
Video Bit Rate:	2 to 25 Mbps
4:2:0 & 4:2:2 Chroma Sampling:	Yes
GOP Structure:	I, IB, IBBP (4:2:0); I, IP, IB (4:2:2)
Resolution (Horizontal):	720, 704, 352
Resolution (Vertical):	NTSC 480, PAL 576 (4:2:0) NTSC 512, PAL 608 (4:2:2)

Motion Estimation Search Ranges

Horizontal:	plus/minus 202 pels
Vertical:	plus/minus 62 pels
Variable Bit Rate (Single Pass):	Yes
Constant Bit Rate:	Yes
Inverse Telecine:	Yes
Multilayer Motion Estimation:	Yes
Error Masking:	Yes
Optimal Bit Allocation:	Yes
Frame Control:	I only, IP, IB, IBBP
Video Hue Control:	Yes
Video Saturation Control:	Yes
Video Brightness Control:	Yes
Video Contrast Control:	Yes
Video File Formats:	MPV, .MPG, .M2V
Picture User Data Insertion:	Yes

	Main Level @ Main Profile:	Yes
	Main Level @ Professional Profile:	Option
	Frame Rates – NTSC:	29.97 fps
	Frame Rates – PAL:	25 fps
	Frame Rates – Film:	Video Conversion 23.976 fps
	Video Filtering @ Encoding:	Yes
DVD Authoring		
	Inputs (Video):	MPEG-2 file
	Inputs (Audio):	.WAV, MPEG-1 Layer 2, or AC3
	Output:	VOB file
	Menus:	None or Single Level
	Maximum Buttons on Menu:	32
Audio		
	CD/DAT quality stereo:	Up to 48 kHz 16 bit
	Audio Sampling:	32, 44.1, 48 Khz
	Audio Gain Control Encode:	Yes
	Audio Volume Control Decode:	Yes
	Audio Mute Function Decode:	Yes
	MPEG-1 Layer 2:	Yes
	PCM:	Yes
	Audio File Format:	.MPA, .PCM, .M2A, .WAV
Physical		
	Bus:	32 bit PCI 2.1 slot
	Size & Dimensions:	PCI Half
	Video Input:	Composite (CVBS), S-Video (Y/C)
	Audio Input:	Analog Stereo
	Video Output:	Composite (CVBS), S-Video (Y/C)
	Audio Output:	Analog Stereo

Also see www.dv-studio.com

- **MPEG-2 Encoder Software & DVD Authoring Software Package**

DV STUDIO TECHNOLOGIES APOLLO d2d

- Converts DV Footage into DVD

Specifications

Input

Stored File Input:	AVI; DV
Live Data Input Sequences:	4:2:0; YUV (progressive or interlaced)

Video Parameters

Frame Rates Supported:	30 fps (NTSC); 29.97 fps (NTSC); 25 fps (PAL)
------------------------	-----------------------------------------------

Output

Maximum Total Bit Rate:	15 Mbps (9.8 Mbps for DVD-ready version)
-------------------------	------------------------------------------

Quantization & Rate Control

Bit Rate Type:	Constant Bit (CBR); Single Pass Variable Bit (VBR); Constant Q
----------------	----------------------------------------------------------------

General

Number of frames in a GOP:	User Defined
I/P Distance:	User Defined
Number of GOPs in a sequence:	User Defined
Search Range:	User Defined

Also see www.dv-studio.com

- **DVD Drives**

HITACHI GF-2000 DVD-RAM Drive

HITACHI GF-2050 DVD-RAM Drive

- Rewritable DVD-RAM Drive for computer storage applications
- Backward compatible to read DVD-ROM / R, CD-ROM / R / RW
- Reliability ensured by embedded defect management
- Data Transfer Rate 2.7 MB/s (DVD-RAM disc)

Specifications

Total Capacity:	4.7 GB / side & 2.6 GB / side
Data Transfer Rate (Max)	
DVD-RAM:	2.7 MB/s
DVD-ROM:	8.3 MB/s
CD-ROM:	3.6 MB/s
Access Time (Typical)	
DVD-RAM:	210 ms
DVD-ROM:	165 ms
DVD-R:	190 ms
CD-ROM:	140 ms
Rotational Speed	
DVD-RAM:	3,250 rpm (4.7 GB / side)
DVD-ROM:	4,710 rpm (single layer discs) / 5,180 rpm (dual layer discs)
CD-ROM:	9,450 rpm
Burst Transfer Rate (GF-2000):	33.3 MB/s max. (UDMA 33)
Burst Transfer Rate (GF-2050):	16 MB/s max.
Interface (GF-2000):	Enhanced IDE (ATAPI)
Interface (GF-2050):	Ultra-SCSI
Buffer Memory:	2 MB
Compatible Formats	
DVD-RAM (Read/Write):	4.7 GB per side capacity & 2.6 GB per side capacity
DVD-ROM (Read Only):	DVD-ROM (single or dual layer, single or double sided)
DVD-R (Read Only):	3.95 GB / side (disc at once)
CD-ROM (Read Only):	CD-ROM; CD-R; CD-RW; CD-ROM-XA; CD-I; Audio CD (CD-DA); Photo CD
	Multi-session; CD Extra; CD Text

Operating & Storage Conditions

Ambient Temperature (Operating):	5° - 45° C (41° - 113° F)
Ambient Temperature (Storage):	-30° - 60° C (-22° - 140° F)
Relative Humidity (Operating):	15%~85% (non-condensing)
Relative Humidity (Storage):	10%~90% (non-condensing)
Data Error Rate:	10 ⁻¹²
Drive Dimensions (W x H x D):	146 x 41.3 x 201 mm
Weight:	1.2 kg approximate

Also see www.hitachi.com/storage/products/dvd

PANASONIC SW-9501-S/T DVD-R Drive

Specifications

Interface type:	SCSI
Transfer speed:	10MB/s (Sync) 5MB/s (Async)
Drive Type:	Stand alone
Size:	190 × 60 × 270 mm (H x W x D)
Weight:	2500 gr
Disc Loading:	Tray (Bare disc only)
Orientation:	Horizontal
Power Requirements:	100V-240V 50-60Hz AC
Connectors:	SCSI; half pitch 50p X 2; AC-inlet
Support Media & Speed	
Read:	DVD-ROM (DVD-5 & 9) 1X CLV DVD-R (3.95GB and 4.7GB) 1X CLV
Write:	DVD-R 4.7GB (Version 2.0 650 recording media) 1X CLV (11.08 Mbps) 650 nm
Laser wave length for DVD-R writing:	650 nm
Writing mode:	Disc at once. Incremental writing will be supported after completion of Logical Specification V2.0
Spin-up time	
DVD-5:	less than 12 sec (excluding disc loading time)
DVD-R (Blank):	less than 15 sec
Access time:	300 ms typical; random access with 4.7GB disc (at Read mode) including latency & command overhead
Environmental Conditions	

Temperature (Operation):	5~40°C
Temperature (Storage):	-30~60°C
Humidity (Operation):	10 to 90 % (without condensation)
Humidity (Storage):	8 to 95 % (without condensation)
Vibration (Operation-Reading):	1.96 m/s ² [p-p] 5 to 300 Hz
Vibration (Operation-Writing):	0.98 m/s ² [p-p] 5 to 300 Hz
Vibration (Storage):	19.6 m/s ² [p-p] 7 to 300 Hz
Shock (Operation-Reading):	49m/s ² [0-p] 11ms half sine wave
Shock (Operation-Writing):	4.9m/s ² [0-p] 11ms half sine wave
Shock (Storage):	490m/s ² [0-p] 11ms half sine wave
Altitude (Operation):	-305 to 3050 m
Altitude (Storage):	-305 to 15250 m

MTBF: 100,000 h or more

Also see www.panasonic.com/industrial_oem/computer/storage

PANASONIC LF-D291N (SCSI) DVD-RAM Drive

PANASONIC LF-D211N (ATAPI) DVD-RAM Drive

- 4.7 GB DVD-RAM Drive
- Based upon 4.7 GB DVD-RAM Book Version 2.0
- Read/Write compatible with 2.6 GB DVD-RAM
- Read compatible with DVD-ROM/DVD-R
- Read compatible with CD-ROM

Specifications

Interface LF-D291N:	SCSI-2
Interface LF-D211N:	ATA/ATAPI-4
Data Capacity DVD-RAM:	4.7 GB / 9.4 GB; 2.6 GB / 5.2 GB
Data Capacity DVD-ROM:	4.7 GB (single); 8.5 GB (dual)
Data Transfer Rate (synchronous):	10 Mbyte/sec (SCSI)
Data Transfer Rate (asynchronous):	5 Mbytes/sec (SCSI)
Data Transfer Rate (PIO Mode 4):	16.6 Mbytes/sec (ATA/ATAPI-4)
Data Transfer Rate (Ultra DMA Mode 2):	33.3 Mbytes/sec ((ATA/ATAPI-4)
Data Transfer Rate (sustained)	
DVD-RAM (2.6 GB):	1,385 Kbyte/sec
DVD-RAM (4.7 GB):	2,770 Kbytes/sec
DVD-ROM:	Max 8,310 Kbytes/sec (6X)
CD-ROM:	Max 3,600 Kbytes/sec (24X)
Error Rate DVD-RAM & DVD-ROM:	Less than 10 ⁻¹²
Power Requirements:	DC+5V, DC+12v

Environmental Temperature (Operating): 5~45°C
 Environmental Temperature (Storage): -20~50°C
 Relative Humidity (Operating): 10~80%
 Relative Humidity (Storage): 5~90%
 Dimensions: 146.0 (W) x 41.3 (H) x 196 (D) mm
 Also see www.panasonic.com/industrial_oem/computer/storage/dvd-ram

PIONEER DVR-S201 DVD-R DRIVE

- Writing on DVD-R disc (3.95 / 4.7 GB) at 1x speed
- Reading on DVD-ROM / DVD-R at 2x speed
- SCSI-2 (Fast) interface
- 6.75 M Bytes Buffer for writing
- Tilt compensation mechanism & Power calibration scheme for precision writing
- Tray loading
- Wide range Power supply (AC 100 to 240 V)
- Firmware upgrade capability through the SCSI interface

Specifications

Product form:	Sub-system
Disc (Write):	DVD-R (3.95 GB & 4.7 GB)
Write Speed:	1X
Writing Methods:	Disc at once; Incremental write
Interface:	SCSI-2
Loading System:	Tray
Disc Format	
Read:	DVD-ROM single layer / dual layer (parallel / opposite) DVD-R (disc at once & multi border)
Write:	DVD-R (Ver.1.0/1.9)
Disc Size:	DVD-ROM 120mm / 80mm (adapter is required for 80 mm disc); DVD-R 120 mm
Writing Method:	Disc at once; Incremental writing (32 KB Linking loss)
Data Transfer Rate	
Read DVD-ROM (Sustained):	2630 Kbytes / sec 1.9X CLV
Read DVD-ROM (Burst):	10.0 Mbytes / sec Synchronous
Read DVD-R (Sustained):	2860 Mbytes / sec 2.0X CLV
Read DVD-R (Burst):	10.0 Mbytes / sec Synchronous

Write DVD-R (Sustained):	1430 Kbytes / sec 1.0X CLV
Write DVD-R (Burst):	10.0 Mbytes / sec Synchronous
Data Buffer Capacity	
Read:	448 Kbytes
Write:	6.75 Mbytes
Access Time	
DVD-ROM:	600 m sec
DVD-R:	600 m sec
Random Seek Time	
DVD-ROM:	500 m sec
DVD-R:	500 m sec
Full Stroke Seek Time	
DVD-ROM:	1300 m sec
DVD-R:	1300 m sec
Initializing Time	
DVD-ROM:	40 sec (Max)
DVD-R:	40 sec (Max)
Stop Time	
DVD-ROM:	10 sec (Max)
DVD-R:	10 sec (Max)
Loading/Unloading Time:	Less than 4 sec
Acoustic noise:	Less than 40 dB(A)
Dimensions:	198 mm x 65 mm x 254 mm (7 11/16" x 2 9/16" x 10")
Net Weight:	2.8 kg (6 lbs 3 oz)
Also see www.pioneerusa.com	

QPS *QUE!* QPDVDGF1000FPC DVD-RAM FIRE DRIVE (PC)

QPS *QUE!* QPDVDGF1000FEM DVD-RAM FIRE DRIVE (Macintosh)

- IEEE-1394 (FireWire) Interface
- PC & Mac Versions
- Rewritable DVD-RAM Drive for Data Storage & DVD/MPEG-2 Write/Playback
- 5.2 GB Total Capacity
- 16.6 MB/s Maximum Transfer Rate
- Advanced Caching for Enhanced Read/Write System Throughput
- 4.7 GB / 9.4 GB Capacity Available Soon

Specifications

Interface:	IEEE-1394 (FireWire)
Type:	External
Total Capacity	
DVD-RAM:	2.6 GB (single sided discs); 5.2 GB (double sided discs)
Data Transfer Rate	
DVD-RAM:	1.38 MB / sec
DVD-ROM/R:	2.76 MB / sec
CD-ROM:	1.20 MB / sec – 3.0 MB / sec
Burst Transfer Rate:	16.6 MB / sec
Access Time	
DVD-RAM:	200 ms
DVD-ROM/R:	200 ms
CD-ROM:	120 ms
Buffer Memory:	1 MB
Compatible Formats:	DVD-RAM; DVD-R; DVD-ROM; CD-ROM; CD-R; CD-RW; CD-Extra; CD-Audio
Ambient Temperature	
Operating:	5° - 45° C (41° - 113° F)
Storage:	-30° - 60° C (-22° - 140° F)
Relative Humidity	
Operating:	15% - 85% (non-condensing)
Storage:	10% - 90% (non-condensing)
Mean Time Between Failures (MTBF):	100,000 power-on hours
Data Error Rate:	10 ¹²
Dimensions (W x H x D):	146 mm x 41.3 mm x 208 mm
Weight:	1 kg approximately
Also see www.qps-inc.com	

- **DVD Authoring Software**

SONIC SOLUTIONS DVDit!

Available as a bundled product, DVDit! LE is now used with some of the world's leading video products as a way to create fun, exciting, simple-to-use DVD titles.

DVDit! Standard Edition (SE) builds on the technology offered with DVDit! LE and is available either as an upgrade or stand-alone. DVDit! SE offers multiple menus, integrated video transcoding and chapter point placement (coming in version 1.2).

DVDit! Professional Edition (PE) builds on DVDit! SE, adding features previously found only on authoring systems costing five to ten times as much. Multi-language, motion menus and an integrated timeline allow you to really explore the DVD universe.

DVDit! LE Includes:

- Single menu support - Create simple interactive titles with drag-and-drop ease.
- Integrated DVD-R support - Write your DVD files directly to disc.
- Drag-and-drop menu creation
- Real-time preview

DVDit! SE Adds:

- 10 menu support - Quickly create nested DVD titles
- Integrated video transcoding - DVDit! SE automatically converts your video to the correct format for DVD.
- Slideshow Creator - Creating stunning presentations has never been easier. (Version 1.3)
- Includes chapter point editor for instant access to any scene (Version 1.2)

DVDit! PE Adds:

- Multiple audio streams - Different, simultaneous sound tracks, including multiple languages, can be placed on the same DVD disc.
- Video timeline for cuts-based editing - Integrated video trimming and simple editing make last-minute content changes fast and efficient.
- Subtitle generator - An integrated character generator makes it easy to add captions and subtitles, without using additional applications. (Version 1.3)
- eDVD™ support - Make DVDs that play in your browser and link to the web.

Also see www.sonic.com

SPRUCE TECHNOLOGIES DVD VIRTUOSO

Available directly from DV Studio Technologies for use with Apollo Expert Plus.

DVDVirtuoso is an entry-level DVD authoring software designed to work in conjunction with MPEG-2 encoding solutions such as DV Studio Technologies Apollo Expert DVDer. It provides all the tools needed for authoring simple DVD titles in-house. With an easy-to-use interface that provides professional results, DVDVirtuoso enables preview, proofing and delivery of DVDs with menus, chapters, subtitles, and other interactive features. The resulting DVD titles will playback on any set-top player, as well as in DVD-ROM players.

Also see www.spruce-tech.com

Appendix C

DVD-RAM Frequently Asked Questions

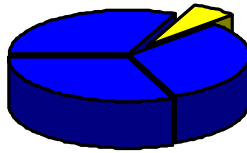
Courtesy of Andy Marken, Marken Communications & Panasonic Industrial Co.

What is the difference between DVD-Video, DVD-ROM, DVD-R, DVD-RW & DVD-RAM?

- **DVD-Video:** Discs that contain movies which can be played using DVD players that plug into TV sets and on desktop PCs equipped with a DVD-RAM or DVD-ROM drive and the hardware or software to decode digital audio and video.
- **DVD-ROM:** A read-only disc that can be used like a CD-ROM disc to store computer programs and data such as multimedia encyclopedias, games, reference material, etc. DVD-ROM discs have a capacity of up to 17 GB. When used with hardware and software MPEG-2 (Moving Picture Experts Group) decoders, a DVD-ROM drive can play DVD-Video movie titles, as well as interactive titles that feature MPEG-1 or -2 full-motion video.
- **DVD-R:** A write-once disc with a capacity of 4.7GB that can be played in any DVD-ROM drive. DVD-R drives continue to be relatively expensive, and are therefore initially intended for DVD content producers.
- **DVD-RW:** This is a re-recordable DVD standard that allows users to stream data sequentially to the disc. The drive technology was developed primarily to provide video, content and streaming Web solutions providers with an economical 4.7GB "work in progress" re-recordable storage solution.
- **DVD-RAM:** Rewritable DVD drives are in high demand for their ability to provide fast, random access, widespread application potential and more than 100,000 write/rewrite cycles. Used to store data, audio and digital video in the highly-portable DVD disc format, both bare disc and cartridge-based media are highly reliable and provide very low cost 4.7GB per side storage.

What is the status of the DVD-RAM standard?

The DVD Forum approved the DVD-RAM standard in July 1997, following a three-month evaluation of drive and media compatibility. More than 20 personal computer and storage media manufacturers from around the world took part in this evaluation. Today, nearly 230 members of the DVD Forum have endorsed the standard. Manufacturers who support the DVD-RAM format produce more than 94% of the DVD-ROM drives sold worldwide. These manufacturers are committed to making their DVD-ROM drives read compatible with DVD-RAM media. These drives are available; DVD players and DVD recorders, are expected to be available by the end of 2000



Source: Dataquest

 DVD-ROM Manufacturers Supporting DVD-RAM

The DVD-RAM standard is being implemented as an international standard. Manufacturers have been shipping hardware and media since the first quarter of 1998. Today, eight manufacturers offer drives, more than 25 companies offer internal and external storage subsystems and 12 companies produce media. (A number of other companies will announce product later this year.) In addition, more than 100 software products, as well as vertical and horizontal market systems and subsystems, have tested and endorsed the technology.

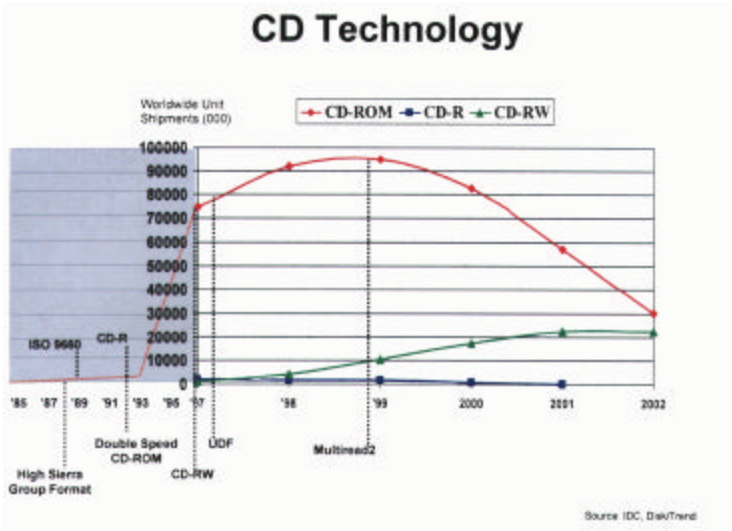
How are the standards selected and enforced?

First, consider the DVD Forum's mission ..."establish a 'single, best' DVD format for each of the DVD applications and encourage DVD acceptance across entertainment,

consumer electronics and IT industries.” Never before has such an energetic (cooperative, competitive) program been undertaken to deliver a full range of products to the buying publics.

For rewritable DVD, each DVD Forum member presented its proposal. The DVD Forum’s Working Group reviewed all proposals and alternatives. The resulting standard incorporates the “best of breed” recommendations put forth by a number of different members, rather than a proposal from just one or two members.

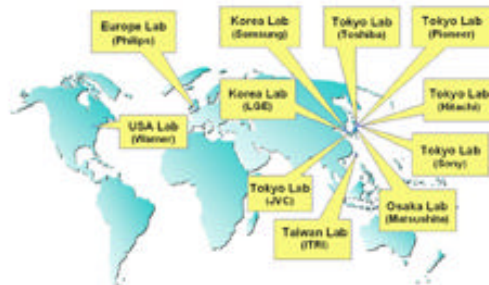
To meet the needs of the computer and consumer electronics manufacturers, as well as the needs of the content developers, the DVD Forum standards were based on common platform solutions, rather than proprietary formats. This was the same approach used to create the DVD-ROM, DVD-R, DVD-RW, DVD-Video, and DVD-Audio standards.



Today, the DVD Forum has eight separate working groups developing standards. The groups include:

- Working Group 1 DVD-Video
- Working Group 2 DVD-ROM
- Working Group 3 File Format
- Working Group 4 DVD-Audio
- Working Group 5 DVD-RAM
- Working Group 6 DVD-R/DVD-RW
- Working Group 9 Copy Protection
- Working Group 10 Prof. Apps

To enforce the standards and ensure consumers that the products they purchase are fully DVD Forum-compliant, a number of Class A Format Verification Labs have been established around the world. Currently, 11 labs have been accredited by the Forum—six in Japan, two in Korea and one each in the U.S. Taiwan and Europe. Only products that have been tested and verified by one or more of these labs can carry the DVD logo.



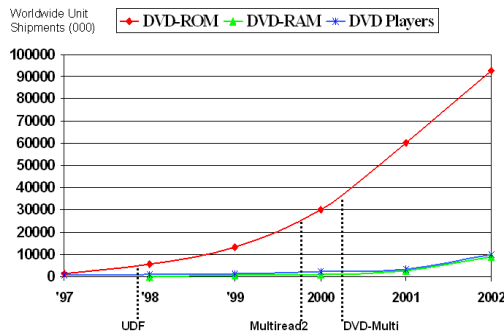
Why hasn't DVD-RAM taken off as rapidly as initially projected?

Next to the Internet, DVD has been the most successful technology introduced in the past 10 years. In less than four years, the DVD Forum has established the majority of the technical, testing and interchange guidelines for the industry. The establishment of a single set of open specification and application guidelines has

never been attempted in any industry, let alone one as diverse and competitive as the storage industry.

Many people cite the universal acceptance of CD technology and question the strength and future of DVD technology. However, CD technology is 25 years old. As you can see in the chart below, acceptance languished for more than 10 years. CD standards were established in an ad hoc fashion. They were designed to assist product sales and media interchange going forward, rather than protecting consumers' earlier storage investments.

DVD Technology



Source: IDC, DiskTrend

The key DVD standards were established before the first drive or piece of media was sold to the consumer. The majority of the other key specifications were developed and approved in less than two years. Because of this, as you can see in the chart above, marketplace acceptance has been phenomenal.

Why is there so much excitement and interest surrounding DVD?

- Video and audio quality are noticeably better than the quality of VHS tape or CD
- 4.7GB single-sided DVD-RAM provides 7X the capacity of CD technology

- DVD-RAM provides more than 100,000 read/write cycles, compared to only 1,000 for CD-RW
- Interactive menus make movies more enjoyable to watch
- The discs are archival and do not fade after time or repeated viewing, as do VHS tapes
- Media cost is low enough to compete with VHS. While prices are currently a bit higher, they are expected to come down dramatically as more DVD products are made available. For example: One discounter sells *Star Trek: Insurrection* on VHS for \$12.45, on DVD for \$20.99, and on Laserdisc for \$27.98. 4.7GB DVD-RAM currently has an SRP of less than \$30, making it a very cost-effective storage solution from the outset
- A copy protection scheme was developed which gave the Hollywood studios the confidence to release digital versions of their movies.
- DVD players currently cost a little more than VHS decks, at the time of this writing.

How do I translate 9.4GB double-sided capacity?

One double-sided disc allows you to store as many as:

- 9,400 full-colored digital pictures (640x480, 24 bit/pixel)
- 420 minutes of MPEG-2 compressed DSS satellite quality video (at 3Mbps)
- 240 minutes of MPEG-2 compressed high- quality video
- more than 15 hours of CD-quality audio (44.1kHz, 16bit)
- more than 800,000 documents or 16 4-drawer filing cabinets
- a stack of telephone books more than 95 stories tall

How do I translate today's 4.7GB single-sided disc or cartridge capacity?

- 4,700 full-color pictures (640x480, 24 bit/pixel)
- 210 minutes of compressed MPEG-2 DSS satellite-quality video
- 120 minutes of compressed MPEG-2 high-quality video
- 7+ hours of CD-quality audio
- 400,000+ documents or 8 four-drawer filing cabinets

What is being done to ensure DVD-RAM readability in all types of DVD devices?

Recently, the DVD Forum announced the DVD-Multi standard which will provide consumers with a clear identification that the device they purchase will read all DVD Forum standard-compliant media. All of the leading DVD companies—Panasonic, Hitachi and Toshiba—made a commitment to implement DVD-RAM readability as rapidly as possible when each of the standards were developed and approved. Today, a growing number of DVD-ROM drives read DVD-RAM media. Consumer devices such as home recorders and camcorders with DVD-RAM have been announced which provide media interchange.

Why are there two rewritable standards (DVD-RAM, DVD-RW)?

The DVD-RAM standard was developed as a convergence medium to meet the requirements of the computing and entertainment industries. DVD-RW was developed with a very narrow focus to meet the needs of the content development industry in the preparation of materials for mass DVD-ROM production.

DVD-RAM:

- Random access read/write, just as with a hard drive
- Comprehensive Defect Sector Management (DSM) support to ensure randomly written data is only placed in useable areas of the media and that data is accurately recovered during the read, write processes
- 100,000 rewrite cycles

DVD-RW

- Sequential re-recording in a streaming fashion, similar to tape
- 1,000 rewrite cycles for write, test, modify, re-record applications

Who owns DVD-RAM technology and licensing?

Because of the desire to produce an industry-wide standard, the format is the result of the efforts of a number of companies. No single company owns DVD-RAM technology. Rather, several companies own patents to the technology. These organizations have assigned the license evaluation and review to a neutral third party.

To simplify the licensing process, the DVD Format/Logo Licensing Corp. was formed. The organization is responsible for DVD format and logo licensing as well

as production, maintenance and issuance of DVD Format Books. In addition, it handles all trademark registration and maintenance of DVD logos and guards against pirate manufacturers, non-compliant products and incorrect usage of the DVD logos.

Do existing DVD-ROM drives read DVD-RAM discs?

Forum members felt ROM-reading RAM media requirements were important at the outset. However, the DVD-ROM specifications were finalized first and products began shipping before the DVD-RAM specifications were finalized. Once the DVD-RAM technical discussions were finalized, the Forum went back and made recommended modifications to the DVD-ROM standard to ensure media readability.

Many of the latest DVD-ROM drives do read RAM discs supplied in jewel cases or single-sided cartridge-based media which can be removed from the protective cartridge for use in ROM drives. Other ROM drive manufacturers are scheduling the introduction of drives that provide this compatibility with DVD-RAM discs. Drive manufacturers that produce an estimated 94% of the DVD-ROM drives delivered provide, or will soon provide, DVD-RAM read-capable drives.

What about being able to read DVD-RAM media in DVD players and DVD recorders?

Cross-device readability was one of the early requirements the DVD Forum worked toward when the standards were established. DVD players, DVD recorders and set-top boxes are being introduced this year. The media is available either in jewel cases or with special protective cartridges. To use the media in DVD players or recorders, the disc is removed from the jewel case or cartridge and played. Manufacturers have varying introduction and production schedules for these devices. By the end of 2000, there will be a wide range of economical consumer devices available from a number of different manufacturers.

Why don't DVD-RAM drives write to CD-R and CD-RW media?

Because of the cost/consumer benefit/reliability issue, the Forum chose not to add CD-R/CD-RW write capabilities. They did, however, provide read capability to protect the user's storage investment in older technology. To add this write capability would have required the addition of a second laser system in the drive.

This would increase the cost to the consumer and add to the complexity of the drive. Ultimately, the complexity becomes a drive reliability issue and the costs must be passed along to the consumer. The price of today's CD-RW drives are so low that buyers are better off buying CD-RW drives for low-capacity storage requirements and DVD-RAM for higher capacity/ performance storage requirements. However, there is nothing to prohibit any manufacturer from adding this capability in the future.

The Forum's objective was to develop the next generation of storage while protecting the consumer's earlier investment. As a result, to-day's DVD-RAM drives and the next-generation drives read all current CD format media.

Can I produce my own movie with DVD-RAM and can I make multiple copies?

Yes. With today's new DVD camcorders and video players consumers can create a very professional quality video on a DVD-RAM disc. The video can be edited on the computer and the video can be played on a television set. In addition, users can produce multiple copies of the video to share with others.

Can I copy Apple's QuickTime as well as Microsoft's Netshow and Windows Media Player videos onto DVD-RAM media and then play them back on my DVD player or recorder?

Your ability to play back videos from the media will depend on what media formats the respective players support.

Does the DVD-RAM standard support video recording? When will systems be marketed?

DVD-RAM is a physical standard that can be used to store any digital file. Whether it is a video file or computer data file, DVD-RAM will store it ... reliably. The recordable system is expected to be available from various manufacturers this year.

Now that economical MPEG-2 video encoding and decoding cards and software are available, DVD-RAM drives can record digital video data. These products are already available from a wide range of suppliers who have tested the compatibility of their products with DVD-RAM. The industry is providing a wide range of competitively priced, easy-to-use video production solutions for consumers and professionals. With today's DV Camcorders, an encoder card, widely available

software and a DVD-RAM drive, anyone can produce their own high-quality movie--complete with titling and special effects.

Is copy protection ensured?

Content providers are already producing and delivering copy protected content.

With the new 4.7GB drives, can I copy a DVD movie?

Almost all DVD movies are encrypted with copy protection. Decryption keys are stored in the normally inaccessible lead-in area of the disc. If you copy the contents of an encrypted DVD to a hard drive or to the DVD-RAM drive, the keys will not be copied. If you try to play the VOB files, the decoder will request the keys from the drive and will fail. You may get the message "Cannot play copy-protected files."

How will output quality be, compared to other solutions?

With the increased implementation of integrated voice, data and images, video quality is a major consideration. By implementing MPEG-2 standards at the outset, video quality was designed to be better on a DVD disc than on conventional videotape or even a laserdisc. Picture quality from a DVD disc is nearly 500 lines of horizontal resolution--twice that of videotape and 20% better than laserdisc.

Because of its random access capabilities, DVD-RAM makes it possible for users to instantly access any location on the disc, repeat a segment over and over, and even pause indefinitely. This makes it possible for developers to produce very complex, interactive videos and multimedia presentations. Since the read/write mechanism never comes in contact with the media, picture and sound quality won't degrade from repeated usage. In addition, MPEG-2 conserves storage space enabling more than 70 minutes of full-screen, full-motion, high-quality video and audio to be stored on a 2.6GB disc and 140 minutes on a 4.7GB disc.

Have DVD-Video, -ROM licensing agreements been established?

The DVD Forum acts as the interim agent for distribution of the entire format books and logo license agreements. Licensing of DVD-related patents are handled by the individual respective companies. All of the major patent holders have agreed on a single licensing pool for the convenience of users and promotion of the DVD formats.

When will 4.7GB DVD-RAM be available?

Now. Second-generation 4.7GB DVD-RAM drives and media began shipping to computer manufacturers at the end of last year. Consumer add-in/add-on subsystems will appear in retail in the July timeframe. 4.7GB DVD-RAM drives are compatible with current 2.6GB DVD-RAM media. Newer DVD-ROM drives also read the new 4.7GB DVD-RAM media. The use of land-groove recording and phase-change media will allow manufacturers to progress very rapidly on the capacity road map. Higher-capacity formats have already been tested, proven and demonstrated.

Was new technology used to achieve 4.7GB DVD-RAM?

4.7GB and higher capacities have been achieved by using existing technologies. Capacities and performance have been enhanced with improved media and disc writing techniques. In addition to enhancing the performance and capacity of the drives, the manufacturers made certain users could continue to read data stored on CD and DVD media.

Does the DVD-RAM standard include pro-visions for an 80mm disc?

Not at the present time. The DVD Forum does feel this media must be supported when it becomes available. In addition to the present 4.7GB Book 2.0 standard, the Forum is finalizing Book 2.1, which will be released later this year. Book 2.1 will include 80mm DVD-RAM disc support.

What is the status of DVD-R standards?

The DVD Forum finalized the 3.95GB DVD-R format standard in 1997. Content development systems began shipping in early 1998 to content developers. The DVD Forum also issued the 4.7GB DVD-R version 1.9 draft standard in 1999. 4.7GB DVD-R drives and media have recently entered the market. The 4.7GB DVD-R version 2.0 standard is expected to be finalized by the DVD-Forum within the next several months.

Can DVD-R media be played on a RAM drive? Can a RAM disc be read by a DVD-R Drive?

Both 3.95GB and 4.7GB DVD-R media can be read by today's DVD-RAM drives. In addition, DVD-RAM drives will read CD-ROM, CD-R, CD-Audio, CD-Video, CD-RW, and DVD-ROM media.

What about DVD-RAM media availability?

Jewel case, disc and cartridge-based 2.6GB, 5.2GB, 4.7GB and 9.4GB media have been announced and are available from a number of firms including CMC Magnetic, Eastman Kodak, Fuji-Film, Imation, JVC, Maxell, Mitsubishi Chemical, Panasonic, Ritek, TDK, Teijin, and Toray. Check with your local computer store or mail order company for media.

What happens when the media is damaged?

DVD-RAM incorporates a very comprehensive Defect Sector Management (DSM) technology. It is very similar to the technology used with your hard drive to ensure data is not written to a defective sector of the media.

Most scratches to the media may cause minor channel data errors that can be easily corrected. To protect data that is stored on the media, all responsible manufacturers warn users to handle the media carefully and to return the disc to its protective case when not in use. This is also why DVD-RAM manufacturers developed special optional cartridges to protect vital data, even when the media is handled in a careless manner.

It is a common misconception that a scratch will be worse on a DVD disc than on other removable rotating media because of higher storage density achieved. DVD data density is physically four times that of older CD technology, so it is true that a scratch can affect more data. However, DVD error correction is also ten times better. Sophisticated algorithm schemes conceal and/or minimize errors caused by major scratches.

Is a cartridge necessary for DVD-RAM media?

No. Single-sided 4.7GB DVD-RAM media is available from multiple sources as a bare rewritable disc and in a removable cartridge. Similar to cartridges used in other optical technology, the cartridge is designed to protect mission-critical data when the media is removed from the drive for storage or shipment. To meet the requests of a growing number of consumers, DVD-RAM discs in jewel cases are also being produced and will undoubtedly be used increasingly.

The value of your data will determine whether or not you use a cartridge. The cartridge is recommended when you want maximum data protection.

In many ways, the removable media cartridge can be thought of in the same manner as a floppy or tape cartridge...for media/data protection, storage, archiving or shipment. If the user prefers the added data protection and uses the cartridge media but also wants to use the single-sided media in a DVD-ROM drive, DVD player or DVD recorder; the media can be easily removed from the cartridge for playback. Regardless of the type of single-sided media used, the disc should be returned to the jewel case or cartridge for added protection when shipped or stored.

Because there is no "safe side" for placing double-sided media outside the cartridge, double-sided media cannot be removed from the cartridge. It is similar to that of floppy media, other removable optical and magnetic disks, and magnetic tape systems that require cartridges for data integrity protection. In large DVD library applications where media is seldom handled bare media is often used.

What is the status of DVD Forum membership?

Matsushita, Toshiba, Hitachi, JVC, Pioneer, Kodak, Mitsubishi, Philips, Thompson Multimedia and Sony formed the DVD Forum (originally the DVD Consortium) in 1995. In 1997, membership opened to all interested companies, including consumer electronics and computer/peripherals manufacturers as well as content developers. To date, nearly 230 organizations (including DV Studio Technologies, LLC) have become members of the DVD Forum to support the industry-wide standards.

In addition, seven new companies--IBM Corporation, Industry Technology Research Institute of Taiwan, Intel Corporation, LG Electronics Inc., NEC Corporation, Samsung Electronics Co., Ltd. and Sharp Corporation--became members of the DVD Forum's Steering Committee last year, increasing the membership from 10 to 17.



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Appendix D

Glossary

2:2 Pulldown: The process of transferring 24 frame per second film to PAL or SECAM video by repeating each film frame as 2 video fields. The resulting video runs approximately 4% faster than the original film.

3:2 Pulldown: The process of transferring 24 frame per second film to NTSC video by repeating one film frame for 3 video fields and the next film frame as 2 fields. (Also see Telecine.)

4:1:1: The component digital video format with 1 C_b sample and 1 C_r sample for every 4 Y samples; 4:1 horizontal downsampling with no vertical downsampling. This is equal to a subsampling of chroma by a factor of 2 compared to luma. Chroma is sampled on every line, but only for every 4 luma pixels.

4:2:0: The component digital video format used by DVD with 1 C_b sample and 1 C_r sample for every 4 Y samples; 2:1 horizontal downsampling and 2:1 vertical downsampling. Every other line is sampled with 1 set of chroma samples for each 2 luma samples on a line. This is equal to a subsampling of chroma by a factor of 2 compared to luma.

4:2:2: The component digital video format where there is 1 C_b sample and 1 C_r sample for every 4 Y samples; 2:1 horizontal downsampling and 2:1 vertical downsampling. This allocates the same number of samples to the chroma and the luma signals.

4:4:4: The component digital video format used in high-end applications where Y, C_b , and C_r are sampled equally.

8/16 Modulation: The form of modulation block code used by DVD to store channel data on the disc.

AAC: The acronym for Advanced Audio Coder. An audio encoding standard for MPEG-2 (not backward compatible with MPEG-1 audio).

AC-3: The former name of the Dolby digital audio encoding system. Supersedes AC-1 & AC-2.

Acronym: A word formed from the initial letters of other words.

ADPCM: The acronym for Adaptive Differential Pulse Code Modulation. A compression technique which encodes the difference between one sample and the next (variations are known as *lossless* and *lossy*).

AES: The acronym for Audio Engineering Society, an industry standards group.

AES/EBU: A digital audio signal transmission standard for professional applications established by the Audio Engineering Society and the European Broadcast Union. A consumer adaptation of this standard for the consumer market is known as S/P DIF.

AGC: The acronym for Automatic Gain Control. A circuit design which boosts the amplitude of an audio signal to provide adequate recording levels.

Aliasing: An artifact or distortion in the reproduction of digital audio or video that occurs when the signal frequency is more than twice the sampling frequency. The resolution is insufficient to distinguish between alternate reconstructions of the wave form, thereby admitting additional noise which was not present in the original signal.

Analog/Analogue: A signal of theoretically infinitely variable levels. (Antonym of digital.)

Angle: In DVD-Video, a unique view of a scene, usually recorded from a specific camera angle. DVD-Video has provision for different angles to be selected while a scene is being viewed.

ANSI: The acronym for American National Standards Institute.

Antonym: A word opposite in meaning to another word.

Artifact: An unnatural effect produced by some external action or agent which was not present in the original video or audio signal. Various factors can introduce artifacts into a signal, including: transmission errors; analog signal noise; data read-out errors; analog signal crosstalk; digital compression, and film-to-video transfer. Most artifacts which are attributed to digital compression of DVD have other origins. Digital compression artifacts always occur in the same manner in the same location. Possible MPEG artifacts include video noise, mosquitoes, and blocking.

Aspect Ratio: The width-to-height ratio of a video image. The standard television aspect ratio is 4:3 (1.33:1); i.e., the horizontal size is a third wider than the vertical size. HDTV and wide-screen DVD use an aspect ratio of 16:9 (1.78:1) which approximates the 1.85:1 and 2.35:1 ratios commonly used for motion pictures.

ATAPI: The acronym for Advanced Technology Attachment Packet Interface. An interface between a computer and its various internal peripherals, including DVD-ROM drives. ATAPI provides the command set for controlling devices connected via an IDE interface.

ATSC: The acronym for Advanced Television Systems Committee. An advisory committee which develops information to assist the Federal Communications Commission in establishing an advanced broadcast television (ATV) standard for the USA.

ATV: The acronym for Advanced Television. Television with significantly better audio and video than standard television.

Authoring: In DVD-Video, the process of creating, collecting, formatting, and encoding audio/video content material. For DVD-ROM, the process of creating multimedia software.

Autoplay (i.e., automatic playback): A feature commonly found on DVD players which automatically causes playback of a suitably encoded disc.

Bandwidth: Commonly used to refer to the amount of information carried in a signal. Actually, the range of frequencies (i.e., the difference between the highest and the lowest frequencies) carried by a circuit or signal. Where digital signals are concerned, the more technically correct term is data rate.

BCA: The acronym for Burst Cutting Area. The circular section near the center of a DVD where ID codes and various manufacturing codes can be inscribed, typically in bar code.

Bit: A binary digit. The smallest representation of digital data. May be on/off, 1/zero, no/yes. Eight bits comprise one byte.

Bitmap: An image made up of a two-dimensional grid of pixels. Each frame of digital video information can be considered a bitmap, although some color information is usually shared by more than one pixel.

Bit Rate: The volume of data measured in bits over time. (Synonym of data rate.)

Bits Per Pixel: The number of bits used to represent the color or intensity of each pixel in a bitmap. One bit allows only two values (black & white), two bits allows four values, etc. (Synonym of bit depth or color depth.)

Bitstream: Digital data, typically encoded, designed to be processed sequentially and continuously.

Bitstream Recorder: A device capable of recording--but not necessarily processing--a stream of digital data.

Block: In MPEG video, an 8 x 8 matrix of pixels or DCT values representing a small chunk of luma or chroma. In DVD MPEG-2 video, a macroblock comprises six blocks (4 luma, 2 chroma).

Blocking: The occasional blocky appearance of compressed video. Occurs when the compression ratio is high enough that the averaging of pixels in 8 x 8 blocks becomes visible.

B Picture/B Frame: One of three picture types used in MPEG video. B Pictures are bi-directionally predicated, based upon both the previous and the following pictures. B pictures typically use the least number of bits and do not propagate coding errors since they are not used as a reference by other pictures.

BPS: The acronym for Bits Per Second. A unit of data rate.

Brightness: The intensity of an image or pixel, independent of color, along the axis from black to white.

Burst: A short segment of the color subcarrier in a composite video signal which is inserted to help the composite video decoder regenerate the color subcarrier.

B-Y, R-Y: The general term for color-difference video signals carrying blue and red color information where brightness (Y) has been subtracted from the blue and red RGB signals to create B-Y and R-Y color-differenced signals. (Same as C_b , C_r .)

Byte: A unit of data or data storage space comprising 8 bits, commonly representing a single character.

Caption: A textual representation of the audio information in a video program. Usually intended for the hearing impaired and also provide additional text to identify the person speaking, off-screen sounds, etc.

CAV: The acronym for Constant Angular Velocity. Rotating disc systems in which the rotation speed is kept constant and the pickup head travels over a longer surface as it moves away from the center of the disc. The same amount of information is provided in one rotation of the disc. (Antonym of CLV.)

C_b, C_r: The components of digital color-difference video signals carrying blue and red color information, where brightness (Y) has been subtracted from the blue and red RGB signals to create B-Y and R-Y color-difference signals. (Same as B-Y, R-Y.)

CBR: The acronym for Constant Bit Rate. Data compressed into a stream with a fixed data rate. The amount of compression is varied to match the allocated data rate. As a result, quality may suffer during high compression periods. The data rate remains constant while the quality level is permitted to vary. (Also see VBR.)

CD: The acronym for Compact Disc, an optical digital storage format developed by Philips & Sony.

Cell: In DVD-V, a unit of video anywhere from a fraction of a second to hours long. Cells permit the video to be grouped for sharing content amongst titles, interleaving for multiple angles, etc.

CES: The acronym for Consumer Electronics Show; a trade exhibition.

CGMS: The acronym for Copy Guard Management System. A method of preventing copies or controlling the number of sequential copies which may be made.

Chapter: In DVD-V, a division of a title. Technically, a "part of title" or PTT.

Chroma: The non-linear color component of a video signal, independent of the luma.

Chroma Subsampling: Reducing color resolution by taking fewer color samples than luminance samples.

Chrominance: The linear color component (hue & saturation) of a video signal, independent of luminance.

Clamping Area: The area near the inner hole of the disc where the drive grips the disc in order to spin it.

Closed Caption: Text captions for video which are not normally visible. In the USA, the NTSC Closed Caption Standard requires that all television sets with screens larger than 13" include circuitry for decoding and displaying caption information stored on line 21 of the video signal. DVD-V can provide closed caption data, but the subpicture format is preferred due to its versatility. (Antonym of Open Caption which is a permanent or visible part of the picture.)

CLV: The acronym for Constant Linear Velocity. A rotating disc system wherein the head moves over the disc surface at a constant velocity, thereby requiring the motor

to vary the rotation speed as the head travels in and out. The further the head is from the center of the disc, the slower the rotation. CLV's advantage is that the data density remains constant providing optimal use of the surface area. (Antonym of CAV.)

Codec: The abbreviation for coder/decoder. Circuitry or software which encodes and decodes a signal.

Component Video: A video system containing three separate color component signals. These may be either red/green/blue (RGB) or chroma/color difference (YUV) in either analog or digital form. The MPEG-2 system used for DVD is based upon color difference component digital video. Component video connectors are typically found on professional and higher-end industrial video equipment.

Composite Video: An analog video signal in which the luma and chroma are combined via frequency multiplexing along with burst and sync. Composite video connectors are typically found on consumer and low-end industrial video equipment; often color coded yellow.

Compression: The process of removing redundancies in digital data to reduce the amount of information which must be transmitted or stored. *Lossless* compression removes only enough redundancy so the original data can be recreated exactly as it was. *Lossy* compression sacrifices additional data to achieve greater compression.

Constant Data Rate: Same as Constant Bit Rate. (See CBR.)

Contrast: The range of brightness between the darkest and lightest elements of an image.

Control Area: The part on the lead-in area of a DVD which contains 1 ECC block (16 sectors) repeated 192 times. The repeated ECC block contains information about the disc.

DAC: The acronym for Digital-To-Analog Converter. Circuitry which converts digital data to analog data.

Data Area: The physical area of a DVD disc between the lead-in and the lead-out (or middle area) which contains the stored data content of the disc.

Data Rate: The volume of data measured over time or the rate at which digital information can be conveyed. Typically expressed as bits per second (kbps = thousand, mbps = million, gbps = billion). Digital audio bit rate is typically computed

as the number of samples per second multiplied by the bit size of the sample (e.g., the data rate of uncompressed 16 bit, 48 kHz stereo audio is 1536 kbps). Digital video bit rate is typically computed as the number of bits per pixel multiplied by the number of pixels per frame multiplied by the number of frames per second (e.g., a DVD movie prior to compression is typically $12 \times 720 \times 480 \times 24 = 99.5$ mbps). Compression lowers the data rate.

Decode: The deterministic process whereby the process of encoding is reversed. (Antonym of encode; also see deterministic.)

Decoder: Circuit or software used by DVD to recreate information which was previously compressed (encoded) via MPEG-2 and/or Dolby Digital. (Antonym of Encoder.)

Delta Picture/Delta Frame: A video picture based upon changes from the picture after it or before it. MPEG P pictures and B pictures are Delta Pictures. (Antonym of Key Picture.)

Deterministic: A process whose outcome does not depend upon chance (e.g., a given input will always produce the same output).

Digital: A set of discrete numeric values used by a computer. (Antonym of Analog.)

Digitize: The process of converting analog information into digital information via sampling.

Directory: The part of a disc which indicates the files which are stored on the disc and where they are located.

Disc Key: A value used to encrypt and decrypt a title key on DVD-V discs.

Disc Menu: The main menu of a DVD-V disc from which titles are selected. Sometimes referred to as system menu or title selection menu.

Dolby Digital: A perceptual coding system for audio developed by Dolby Laboratories commonly used to encode audio for DVD-V. It is also the mandatory audio compression standard for 525/60 NTSC discs.

Dolby Pro Logic: A technique of extracting surround audio channels from a matrix-encoded audio signal. It is a decoding technique only.

Dolby Surround: A standard for matrix encoding surround-sound channels in a stereo signal by applying a set of defined mathematical functions when combining

left and right channels with center and surround channels. The center and surround channels can be extracted by a Dolby Pro Logic decoder which applies the inverse mathematical functions. A Dolby Surround Sound decoder uses additional processing to create a center channel. The process is essentially independent of the recording or transmission format. Both Dolby Digital and MPEG audio compression systems are compatible with Dolby Surround audio.

DSP: The acronym for Digital Signal Processor. A digital circuit which can be programmed to perform digital data manipulation tasks such as decoding.

DTS: The acronym for Digital Theatre Sound. A perceptual audio-coding system developed for use in Cinemas; competitor to Dolby Digital and an optional audio track format for DVD-V.

Duplication: The reproduction of media, such as DVD, via a stamping process. (Also see Replication.)

DVD: The acronym for Digital Versatile Disc (alternatively, Digital Video Disc); an audio/video/data storage system using 12 and 8 centimeter optical discs. DVD comprises 5 different formats (DVD-A, DVD-R, DVD-RAM, DVD-ROM, DVD-V).

DVD-A: (A = Audio) The acronym for a version of DVD for storing high quality multi-channel audio content. Uses Meridian Lossless Packing (MLP) as the data compression standard. It is expected to supersede the familiar audio CD.

DVD-R: (R = Record) The acronym for a version of DVD upon which content may be recorded only one time via dye sublimation recording technology. DVD-R recording drives (or "burners") used to record DVD-R discs tend to be much more expensive than DVD-RAM burners.

DVD-RAM: (RAM = Random Access Memory) The acronym for a version of DVD upon which content can be recorded more than once via phase change recording technology.

DVD-ROM: (ROM = Read Only Memory) The acronym for the base format of DVD and confirms that (once recorded) standard DVD ROM (and DVD-V) discs cannot be *re-recorded*. DVD-ROM can store virtually any form of digital data.

DVD-V: (V = Video) The acronym for a version of DVD for storing high quality audio/video content for playback using Read Only Memory (ROM). The video is

compressed and encoded as MPEG files. The audio may be MPEG Audio, Dolby Digital, or uncompressed PCM.

Dynamic Range: The difference between the softest and the loudest sound in an audio signal.

Dye Sublimation: An optical disc recording technology which uses a high-powered laser to burn readable marks into a layer of organic dye. (Alternative to Phase Change.)

EBU: The acronym for European Broadcast Union.

Encode: To transform data for storage or transmission, typically in such a way as to reduce complexity and/or eliminate redundancy. (Antonym of Decode.)

Encoder: A circuit or software program which encodes and typically compresses audio and/or video signals; converts multi-channel audio to stereo matrixed audio; converts digital video into analog video. (Antonym of Decoder.)

Field: A set of alternating scan lines in an interlaced video picture. A top (odd) field and a bottom (even) field make up a frame of video.

File: A collection of data stored on a disc in groups of sectors.

Firewire: Apple Computer's original name for what became IEEE 1394 standard for digital data transmission between audio/video devices.

Fps: The acronym for Frames Per Second. A measure of the rate at which pictures are shown for a motion video image.

Frame: The piece of a video signal containing the spatial detail of one complete image, i.e., the complete set of scan lines. In interlaced video, a frame comprises 2 fields.

Frame Rate: The frequency of discrete images, usually measured in fps (frames per second). In film the frame rate is 24, in PAL/SECAM television the frame rate is 25, in NTSC television the frame rate is 30.

GB: The acronym for gigabyte (1,073,741,824 or 2^{30} bytes).

GBps: The acronym for billions of bytes per second.

GOP: The acronym for Group Of Pictures. In MPEG video, one or more I Pictures followed by P Pictures and B Pictures. A GOP is an atomic unit of MPEG access. GOPs are limited in DVD-V to 18 frames for NTSC and 15 frames for PAL/SECAM.

Hue: The color of light or a pixel. The property of color determined by the dominant wavelength of light.

Hz: Abbreviation of hertz, a unit of frequency measurement. The number of cycles or repetitions per second.

IEEE: The acronym for International Electrical and Electronics Engineers. An electronics standards body.

IEEE 1394: A standard for the transmission of digital data between external audio/video devices. (Also known as Firewire.)

Interframe: Something which occurs between multiple frames of video. (Antonym of Intraframe.)

Interlace: A video scanning system wherein alternating lines are transmitted, so that half a picture is displayed each time the scanning beam moves down the screen. An interlaced frame comprises 2 fields.

Intraframe: Something which occurs within a single frame of video. (Antonym of Interframe.)

I Picture/I Frame: In MPEG video, an intra picture which is encoded independent from other pictures. Transform coding is used without motion compensation, resulting in only moderate compression. I Pictures provide a reference point for dependent P Pictures and B Pictures and allow random access into the compressed video stream.

JPEG: The acronym for Joint Photographic Experts Group.

KB: The acronym for kilobyte (1024 or 2^{10} bytes).

Kbps: The acronym for thousands of bits per second.

Key Picture/Key Frame: A video picture containing the entire content of the image (intraframe encoding), rather than the difference between it and another image (interframe encoding). (Antonym of Delta Picture.)

KHz: The abbreviation of kilohertz (1 thousand hertz or cycles).

Layer: The plane of a DVD disc on which information is recorded in a pattern of microscopic pits. Each substrate of a disc can contain one or two layers. The first layer (closest to the surface) is Layer 0; the second layer is Layer 1.

Lead In: The physical area 1.2 mm or wider which precedes the data area on a disc. Contains sync control sectors and control data including disc keys and other information.

Lead Out: On single layer discs or PTP dual layer discs, the physical area 1mm or wider toward the outside of the disc following the data area. On OTP dual layer discs, the physical area 1.2 mm or wider at the inside of the disc following the recorded data area (read from the outside toward the inside on the second layer).

Legacy: A term used to describe a hybrid disc which can be played in both a DVD player and a CD player.

Letterbox: The process or form of video where black horizontal mattes are added to the top and the bottom of the image display area to create a frame in which to display video in an aspect ratio different from that of the display. The letterbox method preserves the entire video picture. DVD-V players can automatically letterbox a widescreen picture for display on a standard 4:3 television.

Level: In MPEG-2, levels specify parameters such as resolution, bit rate, and frame rate.

Linear PCM: A coded representation of digital data which is not compressed. Linear PCM spreads values evenly across the range from highest to lowest, as opposed to nonlinear (companded) PCM which allocates more values to more important frequency ranges.

Lines of Horizontal Resolution: A common but subjective measurement of the resolution of an analog video system, measured in half cycles per picture height. Each cycle is a pair of lines, one white and one black. The measurement is usually made by viewing a test pattern to determine where the black and white lines blur into gray. The resolution of VHS video is typically gauged at 240 lines, whereas DVD is typically 500 to 540 lines. Since the measurement is relative to the picture height, the aspect ratio must be taken into account when determining the number of vertical units (roughly equivalent to pixels) that can be displayed across the width of the display. For example, an aspect ratio of 4:3 multiplied by 540 lines equals 720 pixels.

Lossless Compression: Compression techniques which enable the original data to be recreated without loss. (Antonym of Lossy Compression.)

Lossy Compression: Compression techniques which achieve very high compression ratios by permanently removing data while preserving as much significant information as possible. Lossy compression includes perceptual coding techniques which attempt to limit the data loss to that which is least likely to be noticed by human perception. (Antonym of Lossless Compression.)

Luma (Y'): The brightness component of a color video image. (Also known as monochrome, grayscale, black & white.)

Luminance (Y): Loosely, the sum of RGB tristimulus values corresponding to brightness.

Master: In optical disc replication, the metal disc used to stamp replica optical discs.

Mastering: The process of replicating optical discs by injecting liquid plastic into a mold containing a master.

MB: The acronym for megabyte (1,048,576 or 2^{20} bytes)

Mbps: The acronym for millions of bits per second.

MHz: The abbreviation of megahertz (1 million or 10^6 hertz).

Mosquitoes: A term for fuzzy dots which can appear around sharp edges (high spatial frequencies) after video compression. (Also known as Gibbs Effect.)

Motion Compensation: In MPEG, the process of analyzing previous or future frames to identify blocks which have not changed or have only changed location. Motion vectors are then stored in place of the blocks. This process is very computation intensive and can cause visual artifacts when subject to errors.

MPEG: The acronym for Moving Pictures Expert Group, the international standards committee which developed the MPEG family of audio and video compression systems.

MPEG-1: The codec developed for VideoCD, video games, Video-On-Demand, etc.; has low data rate (1-5 Mb per second bit rate)

MPEG-1 Level 2: The codec developed for audio compression used for 2 channel (stereo) Dolby Surround sound format.

MPEG-2: The codec developed for DVD, HDTV Broadcast, Cable TV, Digital Satellite Systems, etc. (5-20 Mb per second).

MPEG-3: A codec which has since been merged into MPEG-2.

MPEG-4: The codec developed for interactive video used for internet/video conferencing; object-oriented.

MPEG-7: The codec developed for video databases; object-oriented.

Multimedia: Information stored in more than one form (video, animation, sound, text, still images).

Multiplexing: Combining multiple signals or data streams into a single signal or stream.

Mux: The abbreviation of multiplex.

Mux_rate: In MPEG, the combined rate of all packetized elementary streams (PES) of one program. In DVD, the mux_rate is 10.08 Mbps.

NAB: The acronym for National Association of Broadcasters, a trade organization.

NAMM: The acronym for National Association of Musical Merchants, a trade organization.

Noise: Irrelevant, meaningless, or erroneous information added to a signal by the recording or transmission medium or by an encoding/decoding process. An advantage of digital formats over analog formats is that noise can be completely eliminated, although new noise may be introduced by compression.

NTSC: The acronym for National Television Systems Committee (USA). The 525 line/60 fields per second television standard used in USA, Canada, Mexico, Japan, South Korea, Taiwan, and other countries. (Incompatible alternative to PAL and SECAM.)

OSTA: The acronym for Optical Storage Technology Association.

Overscan: The area at the edges of a television tube (CRT) which is covered to hide possible video distortion. Covers approximately 4-5% of the picture area.

Pack: A group of MPEG packets in a DVD-V program stream. Each DVD sector (2048 bytes) contains 1 pack.

Packet: A low level unit of DVD-V (MPEG) data storage containing contiguous bytes of data belonging to a single elementary stream such as video, audio, control, etc. Packets are grouped into packs.

PAL: The acronym for Phase Alternate Line, the 625 line/50 field television standard used in most of Europe (excluding France), Australia, New Zealand, South Africa, and many other countries. (Incompatible alternative to NTSC; similar to SECAM.)

Parental Management: A feature of DVD-V which prohibits programs so encoded from being viewed (or substitutes different scenes within a program) depending upon the parental level set in the player.

Part Of Title: In DVD-V, a division of a title representing a scene. Also known as a chapter. Parts of Titles are numbered from 1-99.

PCI: The acronym for Presentation Control Information. A DVD-V data stream containing details of the timing and presentation of a program (aspect ratio, angle change, menu highlight, selection information, etc.)

PCM: The acronym for Pulse Code Modulation. An uncompressed, digitally coded representation of an analog (typically audio) signal. The waveform is sampled at regular intervals and a series of pulses in coded form (typically quantized) are generated to represent the amplitude.

PEL: An abbreviation of pixel.

Phase Change: A technology for re-writable optical discs using a physical effect in which a laser beam heats a recording material to reversibly change an area from an amorphous state to a crystalline state, or vice versa. Continuous heating just above the melting point creates the crystalline state for erasure, while high heat followed by rapid cooling creates the amorphous state or mark. (Alternative to Dye Sublimination.)

Picture Stop: A function in DVD-V where a code indicates video playback should stop and a still image be displayed.

Pixel: The smallest picture element of an image (one sample of each color component). A single dot in the array of dots which make up a picture. (Abbreviated as pel.)

P Picture/P Frame: In MPEG video, a predicted picture based upon differences from previous pictures. P Pictures and I Pictures provide a reference for following P Pictures or B Pictures.

Premastering: The process of preparing data in the final format to create a DVD disc image for mastering. Includes creating DVD control and navigation data, multiplexing data streams together, generating error-correction codes, and performing channel modulation. Often includes the process of encoding video, audio, and subpictures.

Presentation Data: DVD-V information such as video, menus, and audio presented to the viewer.

Progressive Scan: A video scanning system which displays all lines of a frame in one pass. Alternative to Interlace Scan.

RAM: The acronym for Random Access Memory.

Raster: The pattern of parallel horizontal scan lines which make up a video picture.

Reference Picture (Reference Frame): An encoded frame which is used as a reference point from which to build dependent frames. In MPEG-2, I Pictures and P Pictures are used as references.

Regional Code: A code identifying one of 6 world regions for restricting DVD-V playback. A seventh code is for universal playback.

Regional Management: A mandatory feature of DVD-V to restrict the playback of a disc to a specific geographical region. Each player and DVD-ROM drive includes a single regional code and each disc side can specify in which regions it is allowed to be played. A disc coded for universal playback can be played in players in all regions.

Replication: The mass reproduction of media (in optical media, by stamping).

Resolution: A measurement of relative detail of a visual display. In digital video, typically the number of horizontal pixels by the number of vertical pixels. In analog video, the number of lines of horizontal resolution over the number of scan lines.

RGB: The acronym for Red/Green/Blue. The video information in the form of red, green, and blue tristimulus values. The combination of three values representing the intensity of each of the three colors can represent the entire range of visible light.

ROM: The acronym for Read Only Memory.

RPM: The acronym for Revolutions Per Minute; a measurement of rotational speed.

R-Y; B-Y: The general term for color-difference video signals carrying red and blue color information, where the brightness (Y) has been subtracted from the red and blue RGB signals to create R-Y and B-Y color-difference signals. (Same as B-Y, R-Y and C_b , C_r .)

Sample: A single digital measurement of analog information. A "snap shot" in time of a continuous analog waveform.

Sample Rate: The number of times a digital sample is taken, measured in samples per second, or Hertz. The more often samples are taken, the better a digital signal can represent the original analog signal. Sampling theory states that the sampling frequency must be more than twice the signal frequency in order to reproduce the signal without aliasing. DVD PCM audio allows sampling rates of 48 and 96 kHz.

Sample Size: The number of bits used to store a sample. Also called resolution. In general, the more bits allocated per sample, the better the reproduction of the original analog information. Audio sample size determines the dynamic range. DVD PCM audio uses sample sizes of 16, 20, or 24 bits.

Sampling: The process of converting analog information into digital representation by measuring the value of the analog signal at regular intervals, called samples, and encoding these numerical values in digital form. Sampling is often based on specified quantization levels. Sampling may also be used to adjust for differences between different digital systems.

Saturation: The intensity or vividness of color.

Scan Line: A single horizontal line traced out by the scanning system of a video display unit. NTSC video has 525 scan lines, of which about 480 contain actual picture. PAL and SECAM video has 625 scan lines, of which about 576 contain actual picture.

Scanning Velocity: The speed at which the laser pickup head travels along the spiral track of a disc.

SCSI: The acronym for Small Computer Systems Interface. An electronic interface and command set for attaching and controlling internal or external peripherals (such as a DVD drive) to a computer.

Seamless Playback: A feature of DVD-V where a program can jump from place to place on the disc without any interruption of the video. Allows different versions of a program to be put on a single disc by sharing common parts.

SECAM: The Acronym for *Sequential Couleur Avec Memoire* (French) (in English: sequential color with memory). A television standard using 625 lines/50 fields commonly used in France, most former French colonial possessions, the former USSR and Warsaw Pact countries, and elsewhere. (Incompatible alternative to NTSC; similar to PAL.)

Sector: A logical or physical group of bytes recorded on the disc (the smallest addressable unit). A DVD sector contains 38,688 bits of channel data and 2048 bytes of user data.

Signal-to-Noise Ratio: The ratio of pure signal to extraneous noise (tape hiss, video interference). Signal-to-Noise ratio is measured in decibels (dB). Analog recordings nearly always have some noise. Digital recordings with proper filtering techniques and without compression have no noise.

SMPTE: The acronym for Society of Motion Picture and Television Engineers. An international research and standards organization. Developers of SMPTE time code for marking time location in audio and video content.

SNR, S/N: The abbreviations for Signal-to-Noise Ratio.

Stamping: The process of replicating optical discs by injecting liquid plastic into a mold containing a master or stamper.

Stream: A continuous flow of data, usually digitally encoded, designed to be processed sequentially. Also called a bit stream.

Subpicture: Graphic bitmap overlays used in DVD-V to create subtitles, karaoke lyrics, menu highlighting effects, etc.

Substrate: The clear polycarbonate plastic disc onto which data layers are deposited or stamped.

Subtitle: A textual representation of the spoken audio in a video program. Subtitles are often used with foreign languages and do not serve the same purpose as captions for the hearing impaired. (See Subpicture.)

Surround Sound: A multichannel audio system using speakers in front and behind the listener to create a surrounding envelope of sound and to simulate directional audio sources.

S-Video: A video interface standard which provides separate luma and chroma signals. Picture quality is above that of composite video and below that of component video. Also known as Y/C. Typical connector is 4-pin miniDIN fitting.

Sync: A video signal (or component of a video signal) containing information necessary to synchronize the picture horizontally and vertically. Also, specially formatted data on disc which helps the readout system identify the location and specific data structures.

Synonym: A word with the same meaning as another word.

Syntax: The rules governing construction or formation of an orderly system of information. In MPEG video encoding, the syntax defines how data and associated instructions are used by a decoder to create video pictures.

System Menu: The main menu of a DVD-V disc from which the various titles may be selected. Also known as disc menu or title selection menu.

Telecine: The process (and equipment) used to transfer film to video. The telecine system performs 3:2 pulldown by projecting film frames in the proper sequence to be captured by a video camera.

Time Code: Information recorded with audio or video to indicate a position in time; expressed in hours, minutes, seconds, frames. Longitudinal Time Code (LTC) is recorded as an analog audio signal on a separate track and may be recorded ("post-striped") after the video has been shot. Vertical Interval Time Code (VITC) is recorded in part of the vertical blanking interval (see VBI) of each video field as the video is being shot and cannot be post-striped without dubbing down another tape generation. "SMPTE time code" generally refers to LTC used in NTSC video. In PAL and SECAM video, LTC is commonly referred to as "EBU time code."

Title: The largest unit of a DVD-V disc, other than the entire volume of side. Typically a movie, television program, music album, etc. A disc can hold up to 99 titles which can be selected from the disc menu.

Title Key: A value used to encrypt and decrypt user data on DVD-V discs.

Track: The continuous spiral channel of information recorded on a disc. Also, a distinct element of audio or video information.

Transfer Rate: The speed at which a certain volume of information is transmitted from a device such as a DVD drive to a host such as a computer. Usually measured in bits per second or bytes per second.

Tristimulus: A three-valued signal which can match nearly all colors of visible light in human vision. The human eye has three types of photoreceptors. RGB and YCbCr are tristimulus.

UDF: The acronym for Universal Disc Format. A standard developed by the Optical Storage Technology Association to create a practical subset of the ISO/IEC 13346 recordable, random access file system and volume structure format.

User Data: The data recorded on a disc independent of formatting and error-correction overhead. Each DVD sector contains 2048 bytes of user data.

VBI: The acronym for Vertical Blanking Interval. The scan lines in a television signal which do not contain picture information. The lines are present to allow the electron scanning beam to return to the top and are used to contain auxiliary information such as closed captions or vertical interval time code (VITC).

VBR: The acronym for Variable Bit Rate. Data which can be read and processed at a volume that varies over time. A data compression technique which produces a data stream between a fixed minimum and maximum rate. A constant level of compression is generally maintained with the required bandwidth increasing or decreasing depending upon the complexity of the data being encoded. The data rate is kept constant while the quality is permitted to vary. (Also see CBR.)

Video CD: An version of CD based upon MPEG-1 video and audio. Playback quality is similar to VHS videotape. The common home movie playback format in mainland China.

Video Manager (VMG): The disc menu. (Also known as title selection menu.)

Video Title Set/VTS: A set of one to ten files holding the contents of a title.

VOB: The abbreviation of Video Object. A small physical unit of DVD-V data storage usually a GOP.

VSDA: The acronym for Video Software Dealers Association, a trade organization.

WEVA: The acronym for Wedding and Event Videography Association, a trade organization.

Widescreen: A video image wider than the standard 4:3 aspect ratio. When used in conjunction with DVD or High-definition television applications, usually refers to 16:9 aspect ratio.

Y: The luma component of video brightness, independent of color.

Y/C: A video signal in which the brightness of (luma or Y) and color (chroma or C) signals are separated. (Also known as S-Video.)

YCbCr: A component digital video signal containing 1 luma and 2 chroma components. Also known as 4:2:0.

YPbPr: A component analog video signal containing 1 luma and 2 chroma components. Also known as YUV or Y,B-Y,R-Y.

YUV: Typically, any form of color-difference video signal containing 1 luma and 2 chroma components. Technically, YUV is applicable only to the process of encoding component video into composite video.



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