

4.7-Gbyte DVD-RAM Drive

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OVERVIEW: Rewritable 2.6-Gbyte DVD-RAM drives have been on the market since April, 1998. They have been sold mainly as PC peripherals. In 2000, Hitachi will start to ship 4.7-Gbyte DVD-RAM drives. This is the first product in GF-2000 series. It heralds the second generation of DVD-RAM products. These drives will be used for not only PC applications but also in consumer goods, such as camcorders and video player/recorders to realize the goal of digital convergence. This year 2000 is the start of this convergence. Retaining the legacy disk property, 4.7-Gbyte DVD-RAM will accelerate the transition from CD to DVD.

INTRODUCTION

THE most commonplace DVD format disks now available may be the DVD-video. More than 5,000 titles are now available for consumers to enjoying high-quality MPEG2 motion pictures. 1999 was a break through year for DVD-player sales to home consumers bringing its high-quality picture and 5.1 channel quality sound to home theaters at reasonable prices. It goes without saying that people have already embraced DVD, and this is just the beginning. DVD technology is not limited to only DVD-video, encompasses the entire digital world which can be revolutionized by the other DVD compatible media: DVD-ROM, DVD-R, DVD-RW, and DVD-RAM. All these DVD formats were invented to make a manifest digital world by establishing compatibility amongst them.

REWITABLE DVD AND DVD-RAM

Hitachi has been a leading proponent of DVD-RAM in the DVD forum because it is our belief that DVD-RAM can become a core technology used to realize the goal of digital convergence. As for PC applications, there is no doubt that DVD will be the successor to CD-ROMs, which have been used for a decade to distribute content. For the coming multimedia and Internet century, 650-Mbyte capacity seems inadequate to store various data such as pictures

and sound. To keep up with the capacity increases of hard disk drives (HDDs) gigabyte scale capacity will be mandatory for removable media. On the other hand, consumer products like digital cameras and video recorder/players, similar increases in capacity will be required for us to use DVDs to enjoy the same high-quality picture and sound on using those products. Suppose that we use the same media with PC and consumer products? This in itself is a great advantage for DVD. Since DVD-ROM media could then be the successor to CD-ROMs for data distribution. Rewritable DVD-RAM can be a media for us to make our own contents whose quality is fine enough on it. We can use DVD-RAM disks without worrying about compatibility issues. Establishing compatibility among DVD formats was a prime issue because each format was designed to be optimal for its application. Thanks to this compatibility, multi-read or -write products are possible with DVD (Table 1).

TRANSITION FROM 2.6 Gbyte TO 4.7 Gbyte

Hitachi has been shipping 2.6-Gbyte DVD-RAM drives since April 1998. Applications include: jukeboxes, security systems, document imaging, medical applications, PC peripherals, and others. We have been focusing on commercial and business equipment. However, consumer product applications

TABLE 1. DVD Formats

DVD format	Application	Category	Recording durability	Form factor
DVD-ROM	Content distribution	Read only	N/A	Diameter: 120 mm Thickness: 1.2 mm
DVD-R	Authoring	Write once	1 time	
DVD-RW	Consumer electronics	Rewritable	Approx. 1,000	
DVD-RAM	PC peripherals and consumer electronics	Rewritable	More than 100,000	

TABLE 2. 4.7-Gbyte DVD-RAM Key Features

Features
• DVD-RAM 2 × read/write (4.7 Gbyte)
• DVD-RAM 1 × read/write (2.6 Gbyte)
• Bare media recording
• DVD-ROM 6 × read
• CD-ROM 24 × read
• 2-Mbyte memory buffer
• SCSI-2
• Low-power consumption
• User-friendly tray loading
• Two-way (horizontal/vertical) installation
• Dust-proof enclosure

are indispensable to the realization of a DVD world.

Compared to 2.6 Gbyte, 4.7-Gbyte capacity is a good scale. It is the same capacity as DVD-ROM with single layer and corresponds to about 130 minutes pictures by using MPEG2 compression. Also, the 1.4-Gbyte capacity of 80-mm disks is suitable for use with the DVD disk video camera because of its 30-minute recording time with MPEG2 level quality per side- 60 minutes per disk. It can be said that the density of 4.7-Gbyte capacity disks can be a kind of threshold for recording a certain amount of content, as the 650-Mbyte CD-ROM capacity was the standard capacity established for recorded music. 4.7-Gbyte capacity rewritable media are suitable for use in various applications of digital data. For example, the VCR can be replaced because it will be possible for us to preserve digital pictures on DVD for more than 30 years without any degradation of the picture quality. This also applies to sound. There will no longer be the need for multiple disks to store a single opera.

These new applications are already possible by using the proven technologies of 2.6-Gbyte drives. The physical format of the disk will be preserved, that is the pre-pit land & groove structures and the matured pickup's optics used by 2.6-Gbyte drives will also be used by 4.7-Gbyte drives. This allows 4.7-Gbyte drives GF-2000 to be backward compatible with 2.6-Gbyte drives DVD-RAM media and the other 120-mm legacy disks: CD-ROM/R/RW and DVD-ROM/R. Our goal is to make DVD like what CD-R/RW drive is to CD-ROM drive (see Tables 2 and 3).

The keys to actualizing this transition from 2.6 Gbyte to 4.7 Gbyte are improving the structure of the media and the data-recording scheme. Data recording requires precision heat control during the recording process to make clear marks of the amorphous (Fig.

TABLE 3. Comparison of 2.6-Gbyte and 4.7-Gbyte Formats

Item	DVD-RAM	
Recording	Phase change	
Capacity (Gbyte)	2.6	4.7
Data transfer rate (Mbyte/s)	1.38	2.77
Disk diameter (mm)	120	
Disk thickness (mm)	0.6 × 2	
Laser wavelength (nm)	650	
Track pitch (μm)	0.74	0.615
Min. recording mark length (nm)	0.41	0.280
Recording method	Land/groove	
Sector length (kbyte)	2	
Error correction block	32	
Rotational control	ZCLV	
Defect management	PDL, SDL	
Cartridge	Option	
File system	UDF	

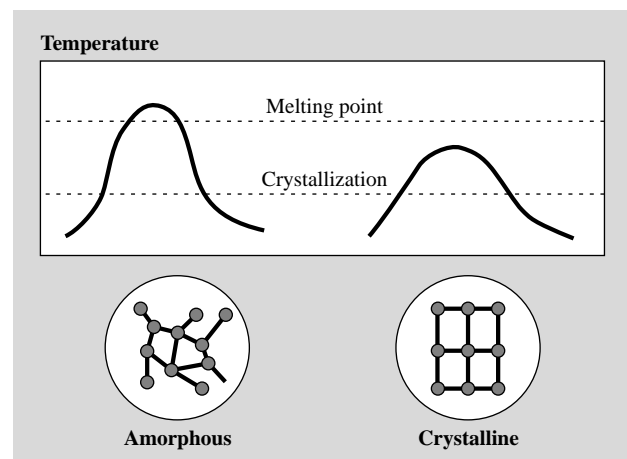


Fig. 1—Heat Profile for Recording.

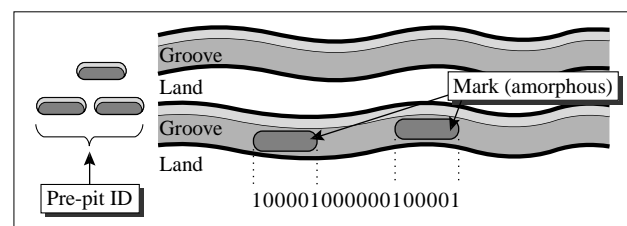


Fig. 2—Mark Edge Recording.

1). The edge recording process requires precision control of the mark edge location (Fig. 2). This control is possible only by using well-designed media heat structures and strict recording procedures.

EVOLUTION TO CONSUMER PRODUCTS

Since PCs are used now not only for business but also for home use, we see server use expanding from the networks to the home. Clearly, DVD is not only for business but for consumer use as well. Versatile disk DVD-RAMs are applicable to consumer products such as cameras and recorders. This year of 2000 will be the start of the DVD consumer product revolution.

The concept of a home network has already been demonstrated as the PC becomes firmly anchored to home use. However, it will take a few more decades to realize a full-blown home network. What is a home network expected to be? The answer is a network that interconnects consumer products into a single chain at home. This single chain is possible by using a single DVD compatible disk with all IT products. It will not be necessary to connect each home electronics device to a single bus when versatile DVD disk can be used on any home IT or AV product. Removability of DVDs makes it possible for us to enjoy DVD contents — purchased, i.e., through the Internet — on big home theater monitors, portable players, lap top PCs, and car navigation screens, wherever and whenever you want.

It is also the case with private contents taken by disk camera (Fig. 3). Application of DVD-RAM to both IT and consumer electronics (CE) are enabled by its recording durability of over 100,000 overwritings. DVD-RAM is the only media with this level of recording durability among the rewritable DVD format disks. Because of the versatility of DVDs there will be no boundary between IT products, like

PCs/servers, and CE products, like video recorders/players and camcorders. This versatility will not be limited to IT and CE products. Starting with the 2.6-Gbyte drives, DVD-RAM was used in various other applications such as jukeboxes, security systems, medical and document imaging, and data backup.

DVD-ROM drives with DVD-RAM readability — which can be used as a DVD player — will have a key role in the future. For example, a physician can store a patient's lifetime medical records on a disk to aid in diagnosis of future medical problems. That data could be used to refill a prescription when necessary. The patient does not necessarily need a PC to see the doctor's prescription. As watching a movie by a player, he can see his own medical data. Another example is security personnel can identify visitors on a TV monitor equipped with a DVD player. The versatility of DVD will make these kinds of things possible.

DIGITAL CONVERGENCE

The examples given above of the coming digital convergence of IT and CE are just a small part of what we can expect now. Combined with other storage devices like hard disk drives (HDDs), the evolution of DVD-RAM into other applications such as set-top boxes, servers with backup, etc., will be possible. The reasons for DVD's suitability to this application are its removability and compatibility. All the other removable disks did not have this versatility, a reason why they just stayed computer peripherals.

Another advantage of DVD is its 120-mm size, which enables the drive to maintain readability of the

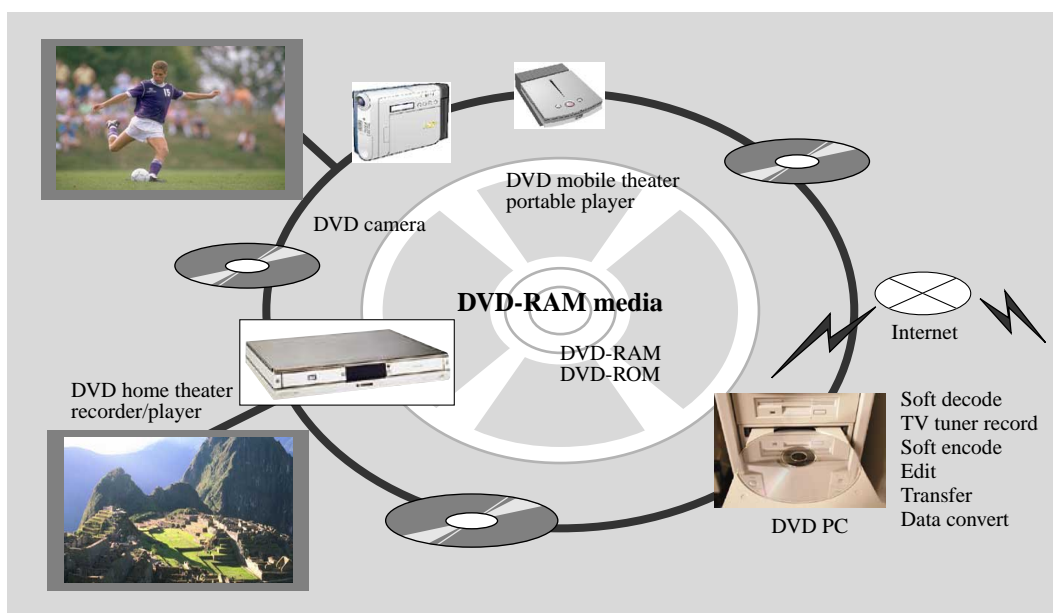


Fig. 3—Compatibility of DVD.

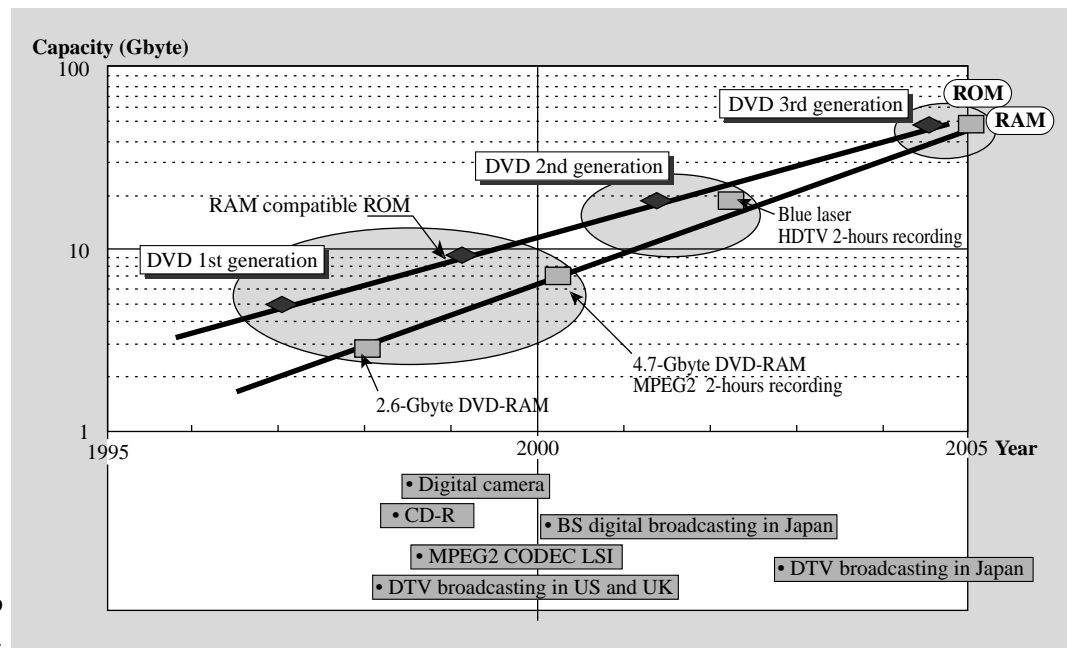


Fig. 4— DVD Evolution.

legacy disk. Discussion is now starting of the next generation DVD with an over 20-Gbyte capacity media format. Even in the evolution toward larger capacity the factors of compatibility, versatility, and legacy disk property protect will be the keys to keeping DVD the de facto standard media. Gigabyte capacity on 120-mm diameter, 1.2-mm thick, inexpensive plastic disk is significant. By applying new technologies, such as shorter wavelength laser diodes, and without changing key factors of the media, DVD can retain its status of de facto standard (Fig. 4).

From the business point of view, the evolution of DVD in consumer products will also be very important to the PC application of DVD. PCs are now used as intelligent business tools. Using PCs we can get information through Internet, store it, and exchange it with others. The current state of HDD capacity seems to be enough for PCs to store this information. However, the ability to pass that information flow from PCs to CEs is reliant on CE application of DVD technology. By having CE applications for DVD, PCs can become more attractive business and commercial tools (Fig. 5).

CDs were the first media to use 120-mm disks. They have been used for PCs and CE products. It was the de facto standard media in PC and CE applications. DVD is the successor to CD. Transitioning from CD to DVD is now going on. DVD is the best media for processing digital data. Digital data flow like HDTV broadcasting is becoming a reality in some advanced countries. DVD, the media for 21st century.

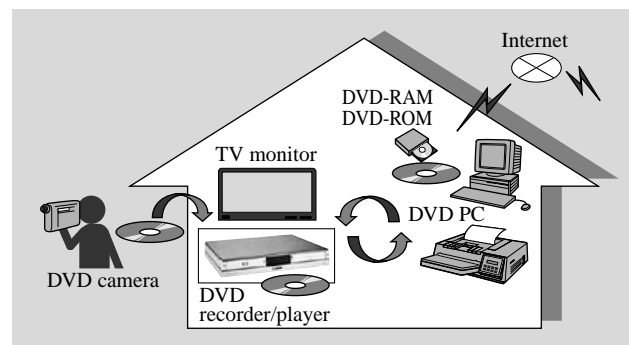


Fig. 5— Data Flow into the Home.

CONCLUSIONS

Together with keeping DVD-RAM a standard technical media, it is necessary to keep DVD applicable to evolutionary applications, to keep it user-friendly, and to make it the de facto standard media in the next century.

ABOUT THE AUTHOR



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