

## How should the Phase Change optical disc survive?

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### 1. Abstract

As all results of the effort by a lot of researchers, technical experts who have been working for so many years, the phase change optical disc comes to the most general re-writable media in the world now. On the other hand, Viewing about its business, I think that it becomes to a serious condition.

When we cannot provide the appropriate application, which is suitable for the phase change disc, there is the big risk to be expelled by other kinds of recording media.

### 2. Introduction

I am not a professional researcher of the phase change recording, but already have engaged more than ten years in the development of the manufacturing equipments for phase change optical discs.

Last ten years, the technology for phase change optical discs made dramatic progress. It is so exiting and wonderful experience for me to have a relation such a scientific and engineering drama.

However, the phase change optical discs have used so many high-improved elements of technology, the appropriate application, which utilized the characteristic, have not found a right route in business yet and the business falls into the difficulties actually. Analyzing the cause of the difficulties on business, I examined what kind of countermeasure to be taken to vitalize the business of phase change optical disc.

### 3. The real value of the pre-recorded optical disc for the customer.

The optical discs are generally classified into three kind categories as bellow, Pre-recorded, Recordable and Re-writable disc

I feel that this is just classification based on the structure which is physical appearance. In other words, Pre-recorded disc is a kind of a PUBLICATION which has character, sound and image information and those are embedded on a reflection layer. The value has been recognized when the contents are possible to read by ODD (ODD ; Optical Disc Drive ). And business style is also same as a book or such kinds of information paper. Therefore, I want to classify pre-recorded disc as PUBLISHING.

In other words, pre-recorded disc, the shape is an optical disc but the added value is not in disc itself but in the contents. It has the shape of the optical disc only by chance.

My talking from the strong viewpoint of a copyright and a copy protection, the format specification of the pre-recorded disc should not have compatibility to a recording optical disc system.

If I use other words, even if not fault occurring in playback function, it seems to be safer to protect our business from an illegal copy making.

### 4 . Recordable optical disc

#### 4-1. double face of recordable optical disc

One face of recordable optical disc is value in personal purpose and another one is value which has been existence with the industrial or business purpose. The recordable disc which is represented by CD-R and DVD\*R (DVD\*R ; DVD-R and/or DVD+R ) for the personal purpose has already built up firm status instead of the cassette tape and videotape in this ten years. The biggest reason of this change is based on in the affinity with PC. All of the characters, the images and the sound information have been unified and generated from a person , what so many engineers were dreaming as the goal of engineering progress. The media realized the dream, and it dream is realized by using CD-R and DVD\*R

Now a day, the PC is as same as a notebook or the strongest tool of getting all of information about the art ,science, business and amusement. It already has been formed incorporated world which has no boundary between the provider and the beneficiary of the information from this world. This unified world has been possible to share all information only by using low price CD-R and DVD\*R. Even if it supposed for an illegal copy purpose, the media, which

penetrated rapidly like this into World Wide don't exist before. With this meaning, the optical disc is contributing to the people greatly.

On the other hand, the existence value in industrial and business market of the optical disc has small market compared with the personal market even recordable disc. In other words, the optical record system for industrial and business market has been deserted in other memory group as shown in Figure 1.

I think this Figure1 doesn't show each specification but show sufficiently understood as one kind of memory to have displayed ability, which all IT engineers usually feel. Recordable optical disc system which has attractive characteristics as un-alternative media makes its position in business use. However, most of the backup re-writable media (the magnetic tape and so on) takes such a problem, it has big market in professional use. So this logic for sale sounds doubtful and impromptu comic.

In other words, even if using BD capacity, the recording capacity is still skimpy for real business use and recording speed is also not enough to synchronize HDD ( HDD ; Hard Disc Drive ) or semiconductor memory. Anyhow the record -type optical disc has been recognized as halfway existence.

#### 4-2.business issue

The production of CD-R and DVD\*R expanded marvelously as shown in Table 2. The increasing of the production leads the dropping of the price and it makes the more increase of the demand. On the other hand, however, the tendency that the market has accepted only low price product becomes a main stream and the greater part of consumer accepts spreading such poor-quality goods as general.

#### 5. Why isn't a re-writable optical ( Phase Change ) disc accepted?

I say clearly that the re-writable optical disc business chance in the personal market is passing away in present business environment

Cause 1: Re-writable optical disc which is generally represented by CD-RW or DVD\*RW should consider personal market with the main market, the end user pricing is much higher compared with the recordable optical disc and had been loosening in the market share. (Table 2 for reference) Around the early stages of the business, the share of Recordable – Re-writable disc was about 10 percent but it is reducing now about 3 percent of recordable disc market scales.

The total investment volume for the re-writable system manufacturing line is about 3 times compared with recordable system. However, if we talk about the re-writable disc price in the starting of its business, it had given about five times of price compared with the recordable disc price. It was incurred displeasure of the consumer.

Cause 2: The large kinds of ODD have not been able to use when high writing speed re-writable disc coming to the market. It is the cause why the customer disliked using re-writable optical disc.

Cause 3: Recordable optical disc successfully established its market as an archive for a sound, an image or a backup. On the other hands, re-writable optical disc could not establish the application which utilizes the re-writable characteristic clearly.

#### 6. The direction where the rewriting -type optical disc should go ahead

##### 6-1. Complement for HDD weak point.

The record capacity of HDD improved marvelously ( Table 3. ), but in the same time, the reliability of HDD has been declined remarkably. The RAID ( RAID ; Redundant Array of Independent Disks ) system is the technology which is indispensable to the large-scaled computer system, however there are some weak points as follows.

1. The system backup takes long time when using tape back up system.
2. If trouble occurred in such the large scaled HDD memory system, it is hard to recover in short time.

Therefore, the technology of backup system which is using HDD for the RAID system is remarkable recently. (Refer to Figure 4.) The characteristic of this system aimed for data recovery speed up of the total memory system which the problem occurred. However, when we think about reliability of ideal backup, there is some self-contradiction which HDD system trouble should be solved or at least minimized.

Using of HDD system also has some potential of same trouble. For this reason, the user usually generates tape backup data for fear of back up data total missing as same as before.

On the other hand, as user dislike the physical fragility of the tape back up system and expect substitution from the tape back up system to and about 8 percent of user examine in the introduction of back up system using optical system but the most of the user return to the tape record after all.

The biggest reason why the user chose again the tape back up system is caused by poor performance. I think the optical disc business chance especially for re-writing optical disc will exist in this self-contradiction when all memory was consisted of HDD and tape system.

#### 6-2. The re-organization of removable and re-writable phase change optical disc

The system which is proposed in section 6-1, should build the system using removable optical disc. Removable and re-writable phase change optical disc should be reasonable solution for building backup data system or archive system (we sometimes call " ODD library system"). By ODD library system which combines removable optical discs to one or several ODD units, the recording capacity can be expanded infinitely. Some libraries of the DVD specification are already proposed but the business size is not so big.

The reason is the DVD specification optical disc doesn't overtake the record capacity ratio to HDD and the transfer rate with HDD also. The big business chance should be coming with using re-writable optical discs of BD, HD DVD and UDO specification systems and building the function to emulate a tape backup system.

#### 6-3. The challenges to the home server business.

The environment that a home server is already accepted as the realistic business .

I think that there is a business chance coming again using such a next generation optical system to the personal market which was flicked away from the business before. The user who already used HDD recorder has good understanding and experience.

The recording capacity which has begun introducing to the home-use HDD recorder already exceeds 500 GB.

On the other hand, however, as the picture quality is improving, even if it loads 500 GB HDD, within 1 - 2 months, the capacity should have been finished up.

Therefore, I think that it is possible to get out of this bottleneck in using the system as it loads a re-writable optical disc within one package. The concept figure is shown in Figure 5.

Thinking about such the home server, user dose not require especially so high-speed response that I think it is possible to practically apply this kind of system to personal market as home server.

In other words, I think that the business chance will be coming by using the optical re-writable disc that has no physical fragility and bringing out the affinity with PC.

#### Conclusions

1. The ROM system using optical disc is same as Publishing in general and the blank media are just like copy paper.
2. The recordable optical disc has already established the successful position in personal market however its quality is sacrificed in the excessive competition market.
3. The re-writable optical disc development should head for the development to have adjusted to the true request of the user.
4. It is possible to realize the system to complement the weak point of HDD using re-writable optical disc, but no one has tried it.

#### Reference

- [1] The Start and Progress of the Phase-Change Optical Disc Workshop 1998

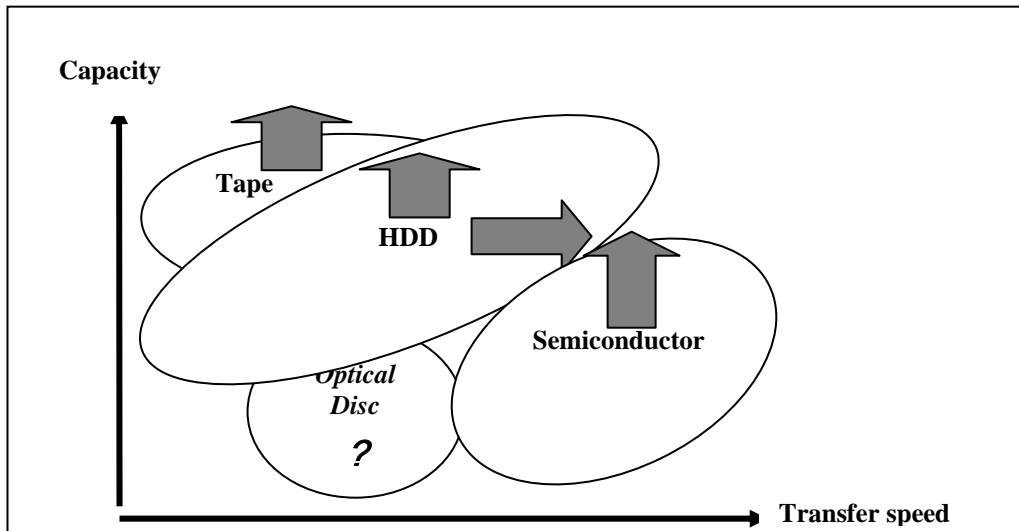


Figure 1. Memory performance map

Year	1998	1999	2000	2002	2004	2006	2008
Media							
CD-R	670,000	2,100,000	3,630,000	9,000,000	14,000,000	14,600,000	15,500,000
	1.5	1	0.65	0.36	0.15	0.19	0.17
CD-RW	11,000	43,000	150,000	310,000	370,000	430,000	480,000
	20	6	2.3	1.1	0.44	0.40	0.36
Volume ratio	0.016	0.02	0.04	0.034	0.026	0.029	0.031
Price ratio	13	6	3.5	3.1	2.9	2.1	2.1
DVD * R	-	(420)*	(1,230)*	84,900	2,770,000	3,800,000	5,800,000
	-	(40)*	(33)*	3.5	0.65	0.55	0.52
DVD*RW	-	13	375	20,000	260,000	330,000	450,000
	-	30	20	15	4	2.0	1.5
Volume ratio	-	-	-	0.23	0.09	0.09	0.08
Price ratio	-	-	-	4.2	6.1	3.6	2.9

DVD\*R= DVD-R, +R DVD\*RW=DVD-RAM, -RW, +RW \*: for authoring

Table 2. Recordable and Re-writable (Phase change disc) WW production (k piece) and price (USD)

HDD	Capacity	Price (HDD)	Optical Disc	Capacity	Price (Media)
1980-82y	400MB	3,000,000 yen	1980 -	650MB	3,000 yen
2005y	80GB	20,000 yen	2005y	50GB	3,000 yen
Ratio	×2000	÷ 1 5 0	Ratio	×77	÷1
Total performance ratio <b>300,000</b>			Total performance ratio <b>77</b>		

Table 3. Total performance comparison

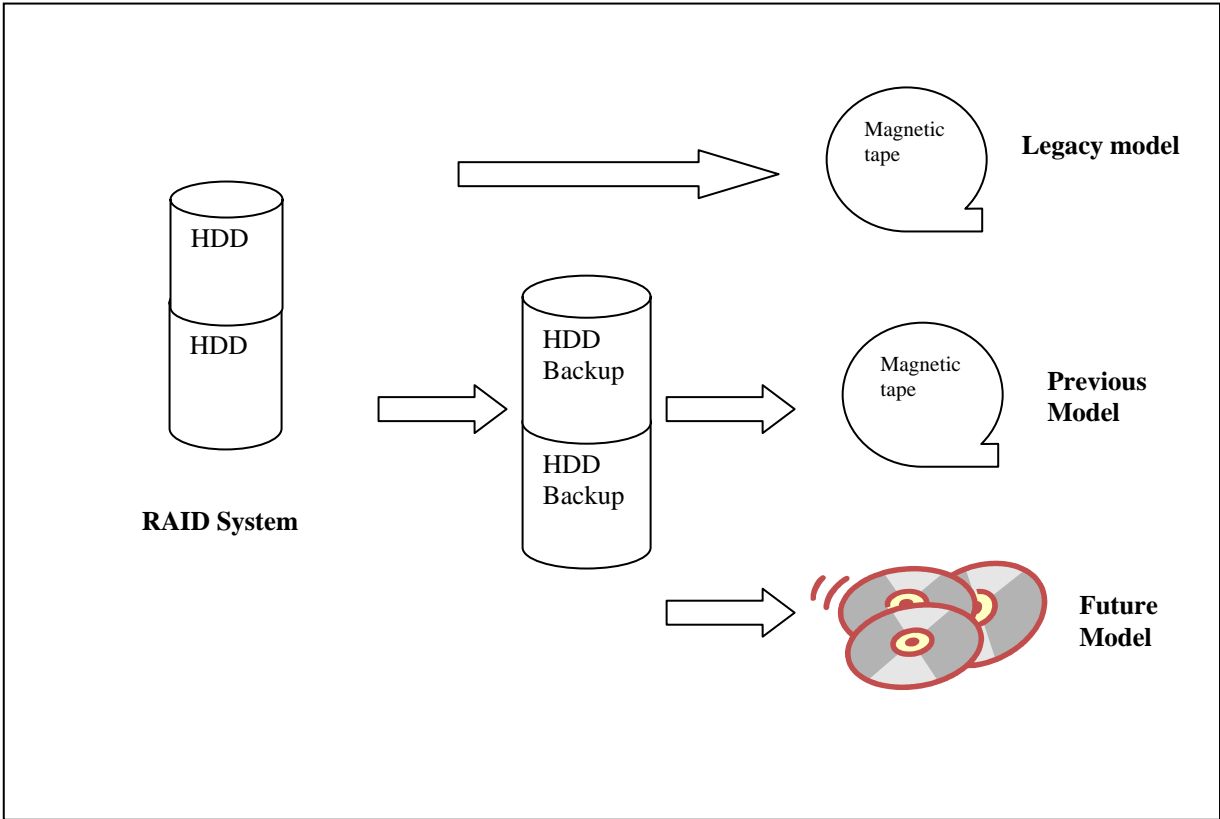


Figure 4. Back up system hierarchy

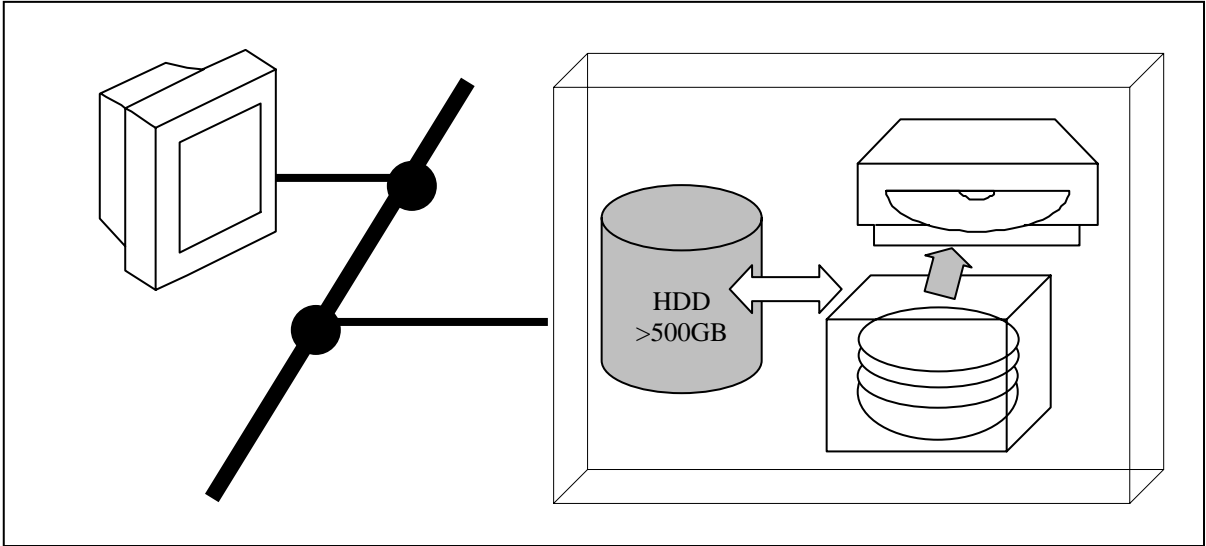


Figure 5. Optical network server/archive image