

The Blu-ray Disc Technology - *An Optical Storage Medium*

G. Naga Lakshmi^{#1}, K. Spandana^{#2}, Dr. S. Sai Satyanarayana Reddy^{#3}

^{#1} Asst. professor, Lakireddy Bali Reddy College of Engineering, Mylavaram, Krishna(dt),

^{#2} Asst. professor, Lakireddy Bali Reddy College of Engineering, Mylavaram, Krishna(dt),

^{#3} Professor, Lakireddy Bali Reddy College of Engineering, Mylavaram, Krishna (dt).

¹ nagalakshmi.g21@gmail.com, ² spandana.kalakoti@gmail.com, ³ saish90@gmail.com

Abstract: As technology becomes more advanced, the demand for compact disc units with a higher quality becomes greater. The thrust for an advanced format of data storage on optical disc led to revolutionary introduction of BLU-RAY DISC. Blu-ray Disc (BD) is name of a next-generation optical disc format jointly developed by the Blu-ray Disc Association (BDA), a group of leading consumer electronics and PC companies. The format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data. Blu-ray makes it possible to record over 2 hours of digital high-definition video (HDTV) or more than 13 hours of standard-definition video (SDTV/VHS ssssspicture quality) on a 27GB disc. There are also plans for higher capacity discs that are expected to hold up to 50GB of data. The Blu-ray Disc technology can store sound and video while maintaining high quality and also access the stored content in an easy-to-use way.

Keywords— Optical Disc, HDTV(High Definition TV), BDA(Blu-ray Disc Association).

I INTRODUCTION

The Blu-ray name is a combination of "blue," for the color of the laser that is used to read and write this type of disc., and "ray," for optical ray. The "e" in "blue" was purposefully left off, according to the manufacturers, because an everyday word cannot be trademarked.

In 1997, a new technology emerged that brought digital sound and video into homes all over the world. It was called DVD[3], and it revolutionized the movie industry. A current, single-sided, standard DVD can hold 4.7 GB (gigabytes) of information. That's about the size of an average two-hour, standard- definition movie with a few extra features. But a high-definition movie, which has a much clearer image, takes up about five times more bandwidth and therefore requires a disc with about five times more storage. As TV sets and movie studios make the move to high definition, consumers are going to need playback systems with a lot more storage capacity.

The industry is set for yet another revolution with the introduction of Blu-ray Discs (BD) in 2006. Blu-ray is the next-generation digital video disc. It can record, store and play back high-definition video and digital audio, as well as computer data. The Blu-ray Disc[1] is a technology platform that can store sound and video while maintaining high quality and also access the stored content in an easy-to-use way. This will be important in the coming broadband era as content distribution becomes increasingly diversified. The nine companies involved in the announcement will respectively develop products that take full advantage of Blu-ray Disc's large capacity and high-speed data transfer rate. They are also aiming to further enhance the appeal of the new format through developing a larger capacity. Blu-ray disc (BD) is appropriately named after the blue laser used to write the data. The first blue laser was developed in 1996 by Shuji

Nakamura (Nichia Corporation). In 2002, an alliance was formed, called the Blu-ray Disc Association, including the likes of Sony, Samsung, Sharp, Hewlett-Packard, and Royal Phillips. Adoption of the Blu-ray Disc in a variety of applications including PC data storage and high definition video software is being considered.

The advantage to Blu-ray is the sheer amount of information it can hold:

1. A single-layer Blu-ray disc, which is roughly the same size as a DVD, can hold up to 27 GB of data -- that's more than two hours of high-definition video or about 13 hours of standard video.

2. A double-layer Blu-ray disc can store up to 54 GB, enough to hold about 4.5 hours of high-definition video or more than 20 hours of standard video. And there are even plans in the works to develop a disc with twice that amount of storage.

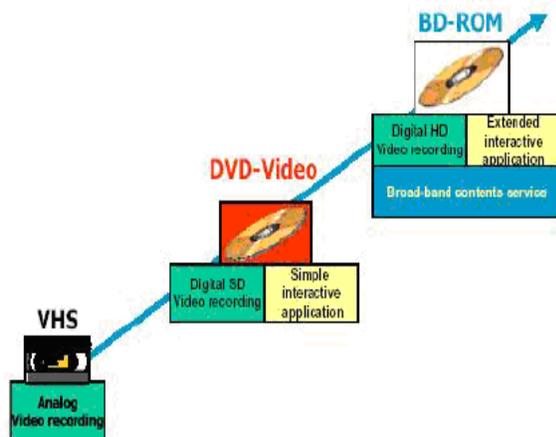


Fig. 1. Evolution of package media for movie application

II RELATED WORK

FIRST GENERATION

When the CD[6] was introduced in the early 80s, it meant an enormous leap from traditional media. Not only did it offer a significant improvement in audio quality, its primary application, but its 650 MB storage capacity also meant a significant leap in data storage and retrieval. For the first time, there was a universal standard for pre-

recorded, recordable and rewritable media, offering the best quality and features consumers could wish for themselves, at very low costs.

SECOND GENERATION

Although the CD was a very useful medium for the recording and distribution of audio and some modest data-applications, demand for a new medium offering higher storage capacities rose in the 90s. These demands lead to the evolution of the DVD[3] specification and a five to ten fold increase in capacity. This enabled high quality, standard definition video distribution and recording. Furthermore, the increased capacity accommodated more demanding data applications. At the same time, the DVD[7] spec used the same form factor as the CD, allowing for seamless migration to the next generation format and offering full backwards compatibility.

THIRD GENERATION

Now High Definition video is demanding a new solution[4]s. History proved that a significant five to ten time increase in storage capacity and the ability to play previous generation formats are key elements for a new format to succeed. This new format has arrived with the advent of Blu-ray Disc, the only format that offers a considerable increase in storage capacity with its 25 to 50 GB data capacity. This allows for the next big application of optical media: the distribution and recording of High Definition video in the highest possible quality. In fact, no other proposed format can offer the data capacity of Blu-ray Disc, and no other format will allow for the same high video quality and Interactive features to create the ultimate user experience. As with DVD, the Blu-ray Disc format is based on the same, bare disc physical form factor, allowing for compatibility with CD and DVD. The Blu-ray Disc specification was officially announced in February 2002. Blu-ray Disc recorders were first launched in Japan in 2003.

1982-First working CD player developed by Philips. Philips and Sony developed CD standard -12cm disk, 74minutes on a single spiral.

1983-First CD players sold

1985 -CD-ROM introduced -not popular at first. More powerful PCs lead to demand for multimedia, image processing and larger applications. Growth in sales brings prices down.

1990's - CD-R and CD-RW introduced - big success.

1996 -DVD introduced

1999 -DVD becomes main stream

2003-BD introduced

IV BLU-RAY DISC STRUCTURE

The Blu-ray disc overcomes DVD-reading issues by placing the data on top of a 1.1mm-thick polycarbonate layer. Having the data on top prevents birefringence and therefore prevents readability problems. And, with the recording layer sitting closer to the objective lens of the reading mechanism, the problem of disc tilt is virtually eliminated. Because the data is closer to the surface, a hard coating is placed on the outside of the disc to protect it from scratches and fingerprints.

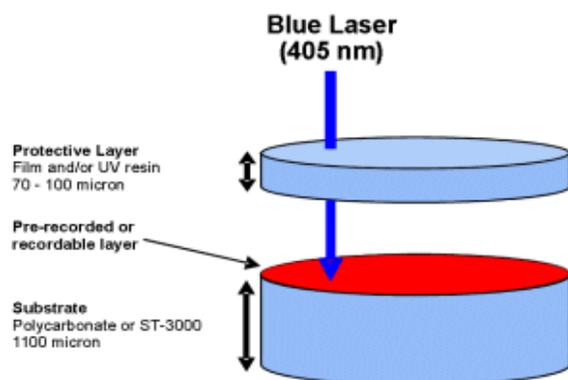


Fig. 2. Structure of Blu-ray Disc

The design of the Blu-ray discs saves on manufacturing costs. Traditional DVDs are built by injection molding the two 0.6-mm discs between which the recording layer is sandwiched. The process must be done very carefully to prevent birefringence.

1. The two discs are molded.

2. The recording layer is added to one of the discs.

3. The two discs are glued together.

Blu-ray discs only do the injection-molding process on a single 1.1-mm disc, which reduces cost. That savings balances out the cost of adding the protective layer, so the end price is no more than the price of a regular DVD. Blu-ray has a higher data transfer rate -- 36 Mbps (megabits per second) -- than today's DVDs, which transfer at 10 Mbps. A Blu-ray disc can record 25 GB of material in just over an hour and a half.

CONSTRUCTION

Discs store digitally encoded video and audio information in pits -- spiral grooves that run from the center of the disc to its edges. A laser reads the other side of these pits -- the bumps -- to play the movie or program that is stored on the DVD. The more data that is contained on a disc, the smaller and more closely packed the pits must be. The smaller the pits (and therefore the bumps), the more precise the reading laser must be.

This Blu-ray disc uses a red laser to read and write data. Blu-ray uses a blue laser [5] (which is where the format gets its name). A blue laser has a shorter wavelength (405 nanometers) than a red laser (650 nanometers). The smaller beam focuses more precisely [2], enabling it to read information recorded in pits that are only 0.15 microns (μm) (1 micron = 10^{-6} meters) long -- this is more than twice as small as the pits on a DVD. Plus, Blu-ray has reduced the track pitch from 0.74 microns to 0.32 microns. The smaller pits, smaller beam and shorter track pitch together enable a single-layer Blu-ray disc to hold more than 25 GB of information -- about five times the amount of information that can be stored on a DVD.

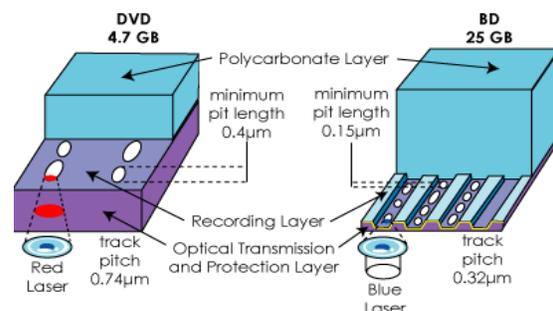


Fig. 3. Construction of Blu-ray Disc

The minimum pit length of a BD is 0.15 microns which is more than twice as small as the pits on the DVD which is at minimum 0.4 microns. Also the track pitch of the BD is 0.32 microns which is more than twice as small as that of the DVD which is 0.74 microns. This small pit & reduced track pitch enables the accommodation of a data of about 25 GB on a single sided Blu-Ray disc[8] which is almost 5 times that of a single sided traditional DVD.

APPLICATIONS

Recently, the digital HD broadcast started, and PDP and liquid crystal displays with large and high picture quality screens are spreading for home use. The recording of HD[10] digital broadcasts and HD packages with BD-ROM are considered to accelerate this tendency and expected to be the trigger factors for the rapid spread of HD.

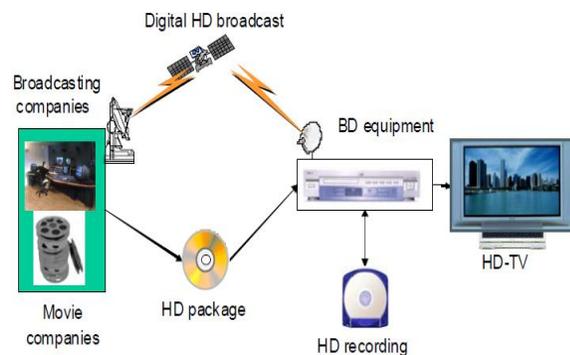


Fig. 4. The driving force to promote HD

RECORDER CHARACTERISTICS



Fig. 5. Recorder of Blu-ray Disc

- Over two hours of HDTV can be placed on a single layer BD, which correlates to over 13 hours for standard TV[9].
- The transfer rate is 36 megabits per second

- At 1x speed, it takes approximately 1.5 hours to record an entire single layer BD
- Recorder Cost: \$1,500 - \$2,500; BD Cost: \$26
- Now available in Indian and overseas markets.

COMPARISON

While current optical disc technologies such as CD, DVD, DVD-R, DVD+R, DVD-RW and DVD+RW use a red laser to read and write data, the new format uses a blue laser instead, hence the name Blu-ray. The benefit of using a blue laser is that it has a shorter wavelength (405 nanometer) than a red laser (650nanometer), which means that it's possible to focus the laser beam with even greater precision. This allows data to be packed more tightly on the disc and makes it possible to fit more data on the same size disc. Despite the different type of lasers used, Blu-ray Disc Recorders will be made compatible with current red-laser technologies and allow playback of CDs and DVDs.

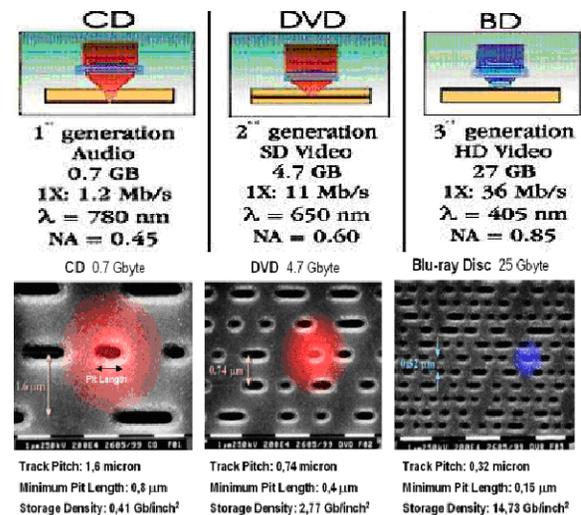


Fig. 6. Comparison of Storage techniques

V CONCLUSION

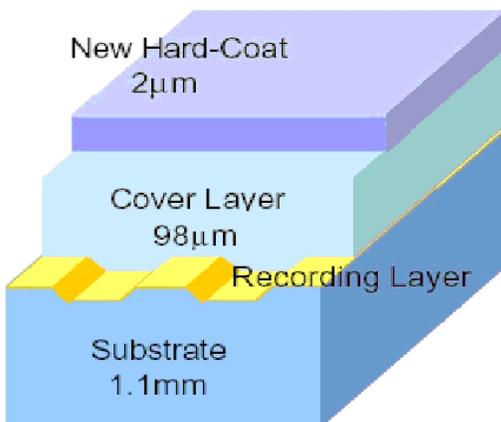
Expect the BD to become more prevalent once the HDTV market establishes its presence. Audio and video will reach higher qualities with larger storage space. Look for BD with more

than two layers as the technology is further refined. Blu-ray is technically superior, but expensive. As with any electronic item, the prices can fall faster than a shooting star. By this technology, we are sure to get benefited as higher storage can unleash a plethora of applications that enrich our lives in one way or other.

It would definitely take a considerable time for the Blu-Ray disc to hit the market & completely takeovers the DVD share hold. Because of the low level compatibility (BD readers able to read both the DVD's and the CD's), the task might become a little simpler. But, the high cost of the reader might hinder its quick development. Anyways soon or later this mass storage optical device is going to replace the DVD & let the user experience a world high quality & disc space (Quality & Quantity ensured) with high level of security and privacy ensured.

VI ENHANCEMENT

Error rates increased in reading and writing after the original BD suffered scratches and fingerprints. For protection, the prototype BD was enclosed in a case. The case increased the size of the disc drive A hard coat was derived of an ultraviolet-curable resin that has a scratch resistance similar to the DVD. An artificial fingerprint reagent is placed on the disc surface to resist fingerprint oils.



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