**ABSTRACT**

Optical discs share a major part among the secondary storage devices. Blu-ray disc is a next generation optical disc format. The technology utilizes a blue laser diode operating at a wavelength of 405nm to read and write data. Because of the blue laser it can store enormous amount of data than was ever possible.

Data is stored on a BD in the form of tiny ridges on the surface of an opaque 1.1mm thick substrate. This lies beneath a transparent .1mm protective layer. With the help of Blu-ray recording devices it is possible to record up to 2.5 hrs of very high quality audio and video on a single BD.

Blu-ray also promises some added security, making ways for copyright protections. BD can have a unique ID written on them to have copyright protection inside the recorded streams.

Blu-ray Disc takes the DVD technology one step further just by using a laser with a nice color.

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**Introduction**

**Tokyo Japan, February 19, 2002: Nine leading companies announced that they have jointly established the basic specifications for a next generation large capacity optical disc video recording format called "Blu-ray Disc". The Blu-ray Disc enables the recording, rewriting and play back of up to 27 gigabytes (GB) of data on a single sided single layer 12cm CD/DVD size disc using a 405nm blue-violet laser.**

**By employing a short wavelength blue violet laser, the Blu-ray Disc successfully minimizes its beam spot size by making the numerical aperture (NA) on a field lens that converges the laser 0.85. In addition, by using a disc structure with a 0.1mm optical transmittance protection layer, the Blu-ray Disc diminishes aberration caused by disc tilt. This also allows for disc better readout and an increased recording density. The Blu-ray Disc's tracking pitch is reduced to 0.32um, almost half of that of a regular DVD, achieving up to 27 GB high-density recording on a single sided disc.**

**Because the Blu-ray Disc utilizes global standard "MPEG-2 Transport Stream" compression technology highly compatible with digital broadcasting for video recording, a wide range of content can be recorded. It is possible for the Blu-ray Disc to record digital high definition broadcasting while maintaining high quality and other data simultaneously with video data if they are received together. In addition, the adoption of a unique ID written on a Blu-ray Disc realizes high quality copyright protection functions.**

**The Blu-ray Disc 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, such as over 30GB on a single sided single layer disc and over 50GB on a single sided double layer disc. Adoption of the Blu-ray Disc in a variety of applications including PC data storage and high definition video software is being considered.**

**Concept of the format establishment :**

* **To realize the large capacity with 12cm disc**

- More than 2-hour high definition video recording

- High capacity of more than 4-hour recording by double layer technology.

* **To cope with digital broadcasting**

- High compatibility with digital broadcasting

- To prevent illegitimate duplication of contents

* **To enhance the Blu-ray Disc world**

- Adoption of the Blu-ray Disc in variety of media and applications

**Main Features of physical format:**

* **Large recording capacity up to 27GB:**

By adopting a 405nm blue-violet semiconductor laser, with a 0.85NA field lens and a 0.1mm optical transmittance protection disc layer structure, it can record up to 27GB video data on a single sided 12cm phase change disc. It can record over 2 hours of digital high definition video and more than 13 hours of standard TV broadcasting (VHS/standard definition picture quality, 3.8Mbps)

* **Easy to use disc cartridge:**

An easy to use optical disc cartridge protects the optical disc's recording and playback phase from dust and fingerprints

* **High-speed data transfer rate 36Mbps:**

It is possible for the Blu-ray Disc to record digital high definition broadcasts or high definition images from a digital video camera while maintaining the original picture quality. In addition, by fully utilizing an optical disc's random accessing functions, it is possible to easily edit video data captured on a video camera or play back pre-recorded video on the disc while simultaneously recording images being broadcast on TV.

* **Recording format:**

Like the DVD, the Blu-ray disc uses phase change recording. This must be good news for those who plan to make the new format compatible with its wildly popular predecessor. This recording format will also makes a two-sided disc easily realizable because both writing and reading can be executed by a single pickup.

* **Multiplexing:**

Blu-ray disc utilizes global standards like MPEG-2 Transport Stream compression technology for video and audio multiplexing. This makes it possible for a Blu-ray Disc to record high definition broadcasting and other data simultaneously with video data if they are received together. Data captured on a video camera while recording images being broadcast on TV can also be edited simultaneously.

**Main Features Of Logical format :**

* **Highly compatible with digital broadcasting :**

MPEG2 transport stream compression technology for video recording can record digital broadcasting including HDTV while maintaining its original picture quality.

* **Best data structure for disc recording**

Achieving improvement of searching, easy editing functions and play a list playback functions by adapting logical data structure making the best use of random accessing.

* **File system for HDTV real time recording**

Adapting the file system which can achieve high bit rate recording and playback of HDTV and best use of disc space

1. **History of Blu‐ray Disc**

**1.1 First Generation**

**When the CD 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 giant 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.**

**1.2 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 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 spec used the same form factor as the CD, allowing for seamless migration to the next generation format and offering full backwards compatibility.**

**1.3 Third Generation**

**Now High Definition video is demanding a new solution. 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, 74 minutes 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 mainstream.**

**• 2003 ‐BD introduced**

**2. THE BLUE LASER**

**The laser used with the Blu‐ray disc has a wavelength of 405nm.Though the red and the green lasers were discovered much earlier, it was only in 1996 that the blue laser was discovered. Actually, the wavelength 405nm would correspond to the blue‐violet part of the visible light, in the spectrum. This achievement is attributed to the efforts of Shuji Nakamura of Nichia Corporation, Japan. The device utilizes a GaN diode as its laser source. The operating current is kept between 60mA and 70mA for optimum performance.**

**For writing into the disc, the power of the laser used is about 6mW. For reading from the disc, much lesser power is required, only about 0.7mW.The GaN source can give a power of about 65mW. So, it is an ideal choice for the laser source to be used with the Blu‐ray disc. Due to the much lower wavelength involved, the amorphous mark size (bit size) is small, leading to higher storage capacity on disc of the same size, about five to six times the capacity of a DVD.**

**A blue laser operates in the blue range of the light spectrum, ranging from about 405nm to 470nm. Most blue laser diodes use indium gallium nitride as the material to create the laser light, although the amount of indium included in the material varies. (Some blue laser diodes use no indium.) Some manufacturers create blue LEDs (light-emitting diodes), which create light in a manner similar to lasers with silicon carbide.**

**Blue laser beams have a smaller spot size and are more precise than red laser beams, which lets data on blue laser optical storage discs be stored more densely. The spot size of a laser beam is one determining factor, along with the materials in the optical disc and the way the laser is applied to the disc, in the size of the pits the laser makes on an optical disc. Laser beams with larger spot sizes typically create larger pits than those with smaller pit sizes. Blue lasers are desirable because blue light has the shortest wavelength among the visible light.**

**A blue laser operates at a shorter wavelength of about 405nm than a red laser at about 650nm. A nanometer (nm) is one-billionth of a meter, one-millionth of a millimeter, and one-thousandth of a micron. One inch is equal to about 25.4 million nanometers. A human hair is about 50,000nm wide.**

**Blue Laser Development**

**Shiju Nakamura is credited with inventing the blue diode laser and blue, green, and white LEDs. Nakamura was working at Nichia Chemical Industries in Japan when he developed the blue laser in 1995. It’s a technology many large corporations had been trying to develop for several years.  
 Nakamura had worked with LEDs and lasers for several years before tackling blue lasers in the late 1980s. Because most research at the time focused on using zinc selenide as the laser material, Nakamura decided to work with gallium nitride. He spent two years perfecting a technique for growing high-quality gallium nitride crystals, something other researchers had been unable to achieve.   
Finally, Nakamura had the materials necessary to create blue LEDs, which he did in 1993. He followed with green LEDs and a blue laser diode in the next few years. He says the biggest commercial use for blue lasers should be DVD players.**

**3. Different Formats of Blue‐ray Disc**

**BD‐ROM : A read only format developed for prerecorded content.**

**BD‐R : A write once format developed for PC storage.**

**BD‐RW : A rewritable format developed for PC storage.**

**BD‐RE : A rewritable format developed for HDTV recording.**

**4. Two Versions of Recording**

**4.1 One Time Recording**

**Making permanent changes to a disc. If we use BD‐R the material on the disc itself is changed forever. There is no way to get the material back into its old state. The recording material is crystalline in nature. As scan spot falls on the surface it changes to amorphous. We cannot change it back to crystal state.**

**4.2 Record Many Times**

**If we use a BD‐RW the material on the disc itself changes, but can be changed back again .We can do this as long as the material doesn’t get worn out. By heating up the crystals, they change form. Now when we quickly cool them, they stay in that form itself. That is the material is changed from crystal state to amorphous state.**

**Now, if we want to erase the BD‐RW, we have to make sure that we lose all the data. So we want to get rid of that amorphous state. By heating up the material again, but this time taking more time and less heat, the material gradually wants to take its old form again, and thus the information is erased. This state is called the crystalline state.**

**So, by very quickly heating it and very quickly cooling it, give the crystal another state (Amorphous state) which thus contains the data and by very quite slowly heating it and cooling it, we can give the crystals their old form back (crystalline state) which contains no more data. It’s a constant change of phases. And so it is called as phase change recording.**



**Data is stored in the form of grooves, on an optical disc. Next to the grooves, there are lands. Lands are the borders between the grooves. Grooves and lands have a sinus form. This is called a wobbled groove. In the groove, pits are formed to store data.**

**5. Blu‐ray Disc Structure**



**The structure of the BD is as shown. The 0.1mm transparent cover layer is made of a spin‐coated UV resin. It is formed by sandwiching a transparent layer between a protective coating and a bonding layer. This layer offers excellent birefringence. Beneath, there is a layer of Antis layer acts as a heat sink, dissipating the excess heat during the write process. A spacer layer made of ZnS‐SiO2 comes next. Then, the recording layer made of Ag, In, Sb, Te, Ge comes. Grooves are formed on this layer for recording reflective layer of Ag alloy falls beneath and finally a plastic substrate comes.**

**The key features of the technology are introduced as follows:**

**Highly flat and smooth cover layer:**

**At the high speed recording rate involved, the linear velocity of the disc reaches 20m/s or more and as a result accurate focus control becomes difficult. Various experiments showed that flatness and smoothness of the transparent cover layer have a marked influence on the focus control capability. This end is achieved by using the spin coating method for obtaining the transparent cover layer. Thus stable record ability at high speed recording is secured.**

**Phase change film for high speed recording:**

**The phase change film should have high re-crystallization speed to enable direct recording at the high linear velocities involved. A recording layer made of Ag, In, Sb, Te, Ge meets this purpose.**

**Super advanced rapid cooling structure:**

**The excess heat from the LASER irradiation causes distortion of the recorded mark edge. So, to diffuse the remaining excess heat, a transparent di‐electric film of high thermal conductivity, for example, AlN is used.**





**6. Basic Blu‐ray Disc Characteristics**

**6.1 Large Recording Capacity**

**The Blu‐ray disc enables the recording, rewriting and playback of HD video unto 27 GB of data on a single sided single layer. It is enough to put 2.5 hours of HDTV recording on it. It also can record over 13 hours of standard TV broadcasting using the VHS/ standard definition picture quality.**

**6.2 High Speed**

**It has a data transfer rate of 36 Mbps. Because of this high speed transfer rates it can also record the data in very little time. In a perfect environment it would take about 2.5 hours to fill the entire BD with 27 GB of data. More than enough transfer capacity for real time recording and playback.**

**6.3 Resistant to Scratches and Fingerprints**

**The protective layer is hard enough to prevent accidental abrasions and allows fingerprints to be removed by wiping the disc with a tissue.**

**7. How does Blu-ray disc work?**

**Description of how this technology works**

Blue lasers have a wavelength of 405 nanometers, shorter than that of red lasers, which have a wavelength of around 650 nanometers and are used for reading and writing DVD and CD discs. The shorter wavelength means that the laser can register smaller dots on a disc and more data can be stored. As a result, blue laser technology has been adopted for the development of next-generation optical discs.

1. Using double infrared frequency to create the wavelength for blue light.

2. A blue laser operates in the blue range of the light spectrum, ranging from about 405nm to 470nm.

3. Most blue laser diodes use indium, gallium nitride as the material to create the laser light.

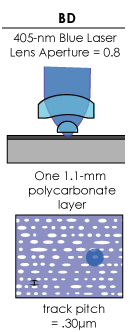
**4. Blue laser beams have a smaller spot size and are more precise than red laser beams, which lets data on blue laser optical storage discs be stored more densely.**

**5. The spot size of a laser beam is one determining factor, along with the materials in the optical disc and the way the laser is applied to the disc, in the size of the pits the laser makes on an optical disc.**

**6. Laser beams with larger spot sizes typically create larger pits than those with smaller pit sizes.**

**How Blu-ray reads Data**

**The Blu-ray disc overcomes DVD-reading issues by placing the data on top of a 1.1-mm-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**

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**8. Comparisons**

**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 (650 nanometer), 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. The following diagram shows the comparison between different storage Techn.**



**9. Blu-ray Disc and HD-DVD**

**The HD‐DVD format, originally called AOD or Advanced Optical Disc, is based on much of today’s DVD principles and as a result, suffers from many of its limitations. The format does not provide as big of a technological step as Blu‐ray Disc. For example, its pre‐recorded capacities are only 15 GB for a single layer disc, or 30 GB for a double layer disc. Blu‐ray Disc provides 67% more capacity per layer at 25 GB for a single layer and 50GB for a double layer disc.**

**Although the HD‐DVD format claims it keeps initial investments for disc replicates and media manufacturers as low as possible, they still need to make substantial investments in modifying their production equipment to create HD‐DVDs. But what’s more important is that HD‐DVD can be seen as just a transition technology, with a capacity not sufficient for the long term. It might not offer enough space to hold a High Definition feature along with bonus material in HD quality and additional material that can be revealed upon authorization via a network. When two discs are needed, this will degrade the so‐called cost benefit substantially. It is even possible that the HD‐DVD specification will be followed up by a renewed version of the technology within a few years, requiring media manufacturers to upgrade their existing production lines again, and consumers to replace their existing playback/recording equipment. On the other hand, the Blu‐ray Disc format was designed to be a viable technology for a period of at least 10 to 15 years.**

**Also on the application layer, the HD‐DVD format incorporates many compromises. As the capacity is not likely to be sufficient to encode a full‐length feature plus additional bonus materials using the MPEG‐2 format, different and stronger encoding formats need to be used. Although Blu‐ray Disc offers these advanced codec as well, the disc has such high capacity that publishers can still use the MPEG‐2 encoding format at bit rates up to 54 Mbit/sec. As MPEG‐2 is the de‐facto standard used in almost any industry involved in digital video (DVD, HDTV, digital broadcast), many authoring solutions are available. Chances are high that a full line MPEG‐2 encoding suite is already available, which can be used with no or minor adaptations to encode High Definition content for Blu‐ray Disc. But perhaps the most important factor for the success of Blu‐ray Disc is its overwhelming industry‐wide support. Almost all consumer electronics companies in the world (combined market share of about 90%) and the world’s two largest computer companies support the Blu‐ray Disc format.**

**This ensures a large selection of Blu‐ray Disc players, recorders, PC drives,**

**Blu‐ray Disc equipped PCs and blank media will become available. A competing format will not have the manufacturing power to penetrate the market in a level even approaching that of Blu‐ray Disc.**

**10. Advantages**

**The main advantages of the Blu‐ray disc are**

* **More storage capacity on a disc of the same size**

**The data storage capacity on a Blu‐ray disc is 27GB on a single layer and 54GB on dual layer, which is about five to six times the capacity of a DVD. It would mean about 2.5 hours of HDTV video and about 13 hours of SDTV video**.

* **High data transfer rate.**

**The basic data transfer rate in Blu‐ray disc is about 36Mbps which is about three times that of a DVD and thirty times that of a CD.**

* **Available in different versions like ROM, R and RE**

**The BD is available in different versions like the ROM (write once), R (read only), RE (rewritable).**

* **Backward compatible**

**The BD drives are designed to be backward compatible, i.e. CDs and DVDs work equally well with the BD drives.**

* **Strong content protection**

**The features of the content protection system are**

**• Format Developed with Input from Motion Picture Studios.**

**• Strong Copy Protection.**

**• Renewability with Renewal Key Block and Device Key.**

**• Enhanced Encryption Algorithm: AES 128 bit.**

**• Physical Hook against Bit by Bit Encrypted Content Copy.**

**• Title‐based Expandable Content Control File.**

**• Production Process Control Works against Professional Piracy.**

**• Public Key Based Authentication in PC Environment.**

* **Compatible with analog and digital transmission**

**The BD fares well with analog as well as digital transmission. It offers the only means to the recording and reproducing of digital HDTV video. Format for encoding analog signals also, called SESF (Self Encoded Stream Format) is also incorporated into the BD.**

* **Higher disc life**

**In the case of ordinary discs, the disc life is less fir the rewritable versions, as re‐writing is done repeatedly to one area of the disc most probably, the inner perimeter. This limits the disc life. But, the BDFS(Blu‐ray Disc File Structure is designed so as to avoid this problem, by using a system that uses free disc spaces with equal frequency.**

**11. The Blu-ray Impact**

**Blu-ray is expected to challenge DVD's run as the fastest selling consumer-electronics item in history. If that happens, the impact would be too big for the major players to discount. For example, the number of films sold on DVD more than doubled last year to over 37 million. In addition, almost 2.4 million DVD players were bought in the past year. As Blu-ray is not compatible with DVD, its success could upset the applecart of many players. If the new format turns out to be much popular, the demand for DVD players could come down drastically. Notwithstanding the challenge to DVD makers, the new format is seen as a big step in the quest for systems offering higher data storage. It is expected to open up new opportunities for broadcasting industry. Recording of high-definition television video—an application in which more than 10GB of storage space is filled up with just one hour of video—will get a major boost. Conversely, the format could take advantage of the spread of high-definition television. As Blu-ray Disc uses MPEG-2 Transport Stream compression technology, recording for digital broadcasting would become easier. Its adoption will grow in the broadband era as it offers a technology platform to manage stored content. But the real action will begin when the companies involved develop products that take full advantage of Blu-ray Disc's large capacity and high-speed data transfer rate. As that happens, Blu-ray will move beyond being a recording tool to a variety of applications. Adoption of Blu-ray Disc in PC data storage is already being considered.**

**12. Applications**

* **High Definition Television Recording**
* **High Definition Video Distribution**
* **High Definition Camcorder Archiving**
* **Mass Data Storage**
* **Digital Asset Management and Professional Storage**

**The Blu‐ray Disc format was designed to offer the best performance and features for a wide variety of applications. High Definition video distribution is one of the key features of Blu‐ray Disc, but the format’s versatile design and top‐of‐the‐line specifications mean that it is suitable for a full range of other purposes as well.**

**12.1 High Definition Television Recording**

**High Definition broadcasting is vastly expanding in the US and Asia. Consumers are increasingly making the switch to HDTV sets to enjoy the best possible television experience. The Blu‐ray Disc format offers consumers the ability to record their High Definition television broadcasts in their original quality for the first time, preserving the pure picture and audio level as offered by the broadcaster. As such it will become the next level in home entertainment, offering an unsurpassed user experience. And since the Blu‐ray Disc format incorporates the strongest copy protection algorithms of any format or proposal to date, the format allows for recording of digital broadcasts while meeting the content protection demands of the broadcast industry.**

**12.2 High Definition Video Distribution**

**Due to its enormous data capacity of 25 to 50 GB per (single sided) disc, the Blu‐ray Disc format can store High Definition video in the highest possible quality. Because of the huge capacity of the disc, there is no need to compromise on picture quality. Depending on the encoding method, there is room for more than seven hours of the highest HD quality video. There is even room for additional content such as special features and other bonus material to accompany the High Definition movie.**

**Furthermore, the Blu‐ray Disc movie format greatly expands on traditional DVD capabilities, by incorporating many new interactive features allowing content providers to offer an even more incredible experience to consumers. An Internet‐connection may even be used to unlock additional material that is stored on the disc, as there is enough room on the disc to include premium material as well.**

**12.3 High Definition Camcorder Archiving**

**As the market penetration of High Definition TV sets continues to grow, so does the demand of consumers to create their own HD recordings. With the advent of the first HD camcorders, consumers can now for the first time record their own home movies in a quality level unlike any before. As these camcorders are tape‐based, consumers cannot benefit from the convenience and direct access features they are used to from the DVD players and recorders. Now, the Blu‐ray Disc format, with its unprecedented storage capacity, allows for the HD video recorded with an HD camcorder to be seamlessly transferred to a Blu‐ray Disc. When the HD content is stored on a Blu‐ray Disc, it can be randomly accessed in a way comparable to DVD. Furthermore, the Blu‐ray Disc can be edited, enhanced with interactive menus for an even increased user experience and the disc can be safely stored for many years, without the risk of tape wear.**

**12.4 Mass Data Storage**

**In its day, CD‐R/RW meant a huge increase in storage capacity compared to traditional storage media with its 650 MB. Then DVD surpassed this amount by offering 4.7 to 8.5 GB of storage, an impressive 5 to 10 times increase. Now consumers demand an even bigger storage capacity. The growing number of broadband connections allowing consumers to download vast amounts of data, as well as the ever increasing audio, video and photo capabilities of personal computers has lead to yet another level in data storage requirements. In addition, commercial storage requirements are growing exponentially due to the proliferation of e‐mail and the migration to paperless processes. The Blu‐ray Disc format again offers 5 to 10 times as much capacity as traditional DVD resulting in 25 to 50 GB of data to be stored on a single rewritable or recordable disc. As Blu‐ray Disc uses the same form factor as CD and DVD, this allows for Blu‐ray Disc drives that can still read and write to CD and DVD media as well.**

**12.5 Digital Asset Management and Professional Storage**

**Due to its high capacity, low cost per GB and extremely versatile ways of transferring data from one device to another (because of Blu‐ray Disc’s extremely wide adoption across the industry), the format is optimized for Digital Asset Management and other professional applications that require vast amounts of storage space. Think of medical archives that may contain numerous diagnostic scans in the highest resolution, or catalogs of audio visual assets that need to be instantly retrieved in a random access manner, without the need to “restore “data from a storage carrier. One Blu‐ray Disc may replace many backup tapes, CDs, DVDs or other less common or proprietary storage media. And contrary to network solutions, the discs can be physically stored in a different location for backup and safekeeping.**

**13. Challenges**

**High cost**

**The technology is not that popular and hence, the price of the BD recorders and players available in the market is very high**.

**HD-DVD**

**The HD‐DVD (High Definition DVD) based on the Advanced Optical System championed by Toshiba and NEC is the primary rival to BD in the market. Though its data storage density is lower, it has lower manufacturing costs also, which may prove challenging to the Blu‐ray disc.**

**14. Conclusion**

**In conclusion the Blue-ray Disc 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. Blue lasers have a shorter wavelength, which means the laser beam can be focused onto a smaller area of the disc surface. In turn, this means less real estate is needed to store one bit of data, and so more data can be stored on a disc. This will be important in the coming broadband era as content distribution becomes increasingly diversified. Companies involved in the development will respectively make products that take full advantage of Blue-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, such as over 30GB on a single sided single layer disc and over 50GB on a single sided double layer disc. Adoption of the Blue-ray Disc in a variety of applications including PC data storage and high definition video software is also being considered. There is a lot of talk about blue-laser-based systems being focused around high-definition television, which has heavy data needs. But Blue-ray Disc groups are also considering development of write-once and read-only formats for use with PCs.**

**Prototype blue-laser-based optical disc systems have been around for more than a year. However, one problem has hampered development of commercial systems: cost. A sample blue-laser diode currently costs around $1000, making consumer products based on the parts unrealistic. However, Nichia, the major source for blue lasers, is expected to begin commercial production this year and the price of a blue-laser diode is expected to tumble once the company begins turning them out in volume. The DVD forum may or may not invite the blue-ray light into is era but the 27GB disc is not far off in practically disturbing the DVD wave.**

**15. REFERENCES**

**Research Papers:**

1. **“Wobble-address format of the blu-ray disc”. By S. Furumiya, S. Kobayashi, B. Stek, H. Ishibashi, T. Yamagami, and K. Schep: Presented at ISOM/ODS Hawaii, July 2002.**
2. **“Millipede”- Nanotechnology Entering Data Storage”, By P. P. Vettiger, G. Cross, M. Despont, U. Drechsler, U. Dürig, B. Gotsmann, W. Häberle, M. A. Lantz, H. E. Rothuizen, R. Stutz, and G. K. Binnig:**
3. **“34 GB Multilevel-enabled Rewritable System using Blue Laser and High NA Optics”. By H. Hieslmair, J. Stinebaugh, T. Wong, M. O’Neill, M. Kuijper, and G. Langereis: Published at ISOM/ODS Hawaii, July 2002.**

# ****Websites:****

[**http://www.licensing.philips.com/**](http://www.licensing.philips.com/)

[**http://www.almaden.ibm.com/st/disciplines/storage/**](http://www.almaden.ibm.com/st/disciplines/storage/)

[**http://www.bluraydisc.com/**](http://www.bluraydisc.com/)

[**http://www.blu-raytalk.com/**](http://www.blu-raytalk.com/)