"BLU-RAY DISC TECHNOLOGY" A Safe Investment For Next Generation

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Abstract

Blu-ray is the next generation optical disc format for high definition video and high density data storage, the form factor of drive and media is identical to the CD/DVD formats. Compared to the DVD format the Blu-ray Disc has a 5 times higher density per recording layer. For the initial product release 2 layers are included. 4 and 8 layer versions which equal a max. Medium capacities of 200GB are planned by 2008.

Blu-ray Disc (BD) is an optical disc storage medium designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs.

The format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data. The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25GB on a single-layer disc and 50GB on a dual-layer disc. This extra capacity combined with the use of advanced video and audio codecs will offer consumers an unprecedented HD experience.

Blu-ray is currently supported by about 200 of the world's leading consumer electronics, personal computer, recording media, video game and music companies. The format also has support from all Hollywood studios and countless smaller studios as a successor to today's DVD format.

Current optical disc technologies such as DVD, DVD±R, DVD±RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a blue-violet laser instead, hence the name Blu-ray.

Keyword: BLU-RAY disc takes the DVD technology one step further, just by using a laser with a nice color.

1. Introduction

Blu-ray is the next generation optical disc format for high definition video and high density data storage, the form factor of drive and media is identical to the CD/DVD formats. The Blu-ray standard was jointly developed by a group of consumer electronics and PC companies, the Blu-ray Disc Association.

Blu-ray Disc is associated with a set of multimedia formats. Generally, these formats allow for the video and audio to be stored with greater definition than on DVD.

Groups of the world's leading consumer of BLU-RAY DISC are electronics, personal computer and media manufacturers including Apple, Dell, Hitachi, HP, JVC, LG, Mitsubishi, Panasonic, Pioneer, Philips, Samsung, Sharp, Sony, TDK and Thomson.

The first Blu-ray Disc prototypes were unveiled in October 2000, and the first prototype player was released in April 2003 in Japan. Afterwards, it continued to be developed until its official release in June 2006. As of June 2008, more than 2,500 Blu-ray Disc titles were available in Australia and the United Kingdom, with 3,500 in the United States and Canada.[4] In Japan, as of July 2010, more than 3,300 titles have been released.

Blu-ray is an optical disc format, similar to CD and DVD. Blu-ray's main advantage over CD and DVD formats is the 25 GB capacity of a single-layer single-sided Blu-ray disc: over five times that of a comparable DVD, and over 35 times that of a comparable CD.

The format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data. The standards for 12-cm optical discs, CDs,DVDs, and Blu-ray rewritable discs (BD-RE Standard) were established in 1982, 1996, and 2002,respectively. The recording capacity required by applications was the important issue when these standards were decided (See fig).

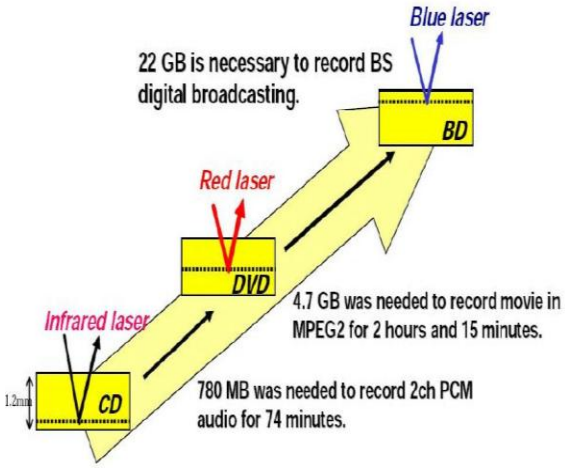

Figure 1 CD v/s DVD v/s BD

The requirement for CDs was 74 minutes of recording 2- channel audio signals and a capacity of about 800 MB. For DVDs, the requirement as a video disc was the recording of a movie with a length of two hours and fifteen minutes using the SD (Standard Definition) with MPEG-2 compression. The capacity was determined to be 4.7 GB considering the balance with image quality.

2. What is BLU-RAY?

Blu-ray (not Blue-ray) also known as Blu-ray Disc (BD), is the name of a new optical disc format jointly developed by the Blu-ray Disc Association (BDA), which succeeds the Blu-ray Disc Founders (BDF).

Blu-ray Disc (BD) is an optical disc storage medium designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs. Conventional (pre-BD-XL) Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the industry standard for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for BD-XL re-writer drives.

While current optical disc technologies such as DVD, DVD±R, DVD±RW, and DVD-RAM rely on a **red laser** to read and write data, the new format uses a **blue-violet laser** instead, hence the name Blu-ray.

The Blu-ray disc's higher storage capacity is enabled by a blue laser that has a shorter wavelength than the standard red laser used in CD (780nm) and DVD (650nm) technology. Blu-ray disc utilizes a blue laser with a wavelength of only 405nm combined with a strong lens system with a numerical aperture of 0.85.

Blu-ray specifications call for a threefold increase in read speed over current DVD offerings. This leads to higher definition video and audio, of especial importance in HDTV applications. Multi-layering technology has been adapted to double the capacity of Blu-ray discs in standard consumer applications, and experimental versions have be displayed with up to a tenfold increase in storage space.

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.

Figure 2 BLU-RAY Logo

Blu-ray Disc specification has been finalized, engineers continue to work on advancing the technology. By 2005, quad-layer (128 GB) discs had been demonstrated on a drive with modified optics and standard unaltered optics. Hitachi stated that such a disc could be used to store 7 hours of 32 Mbit/s video (HDTV) or 3 hours and 30 minutes of 64 Mbit/s video (Cinema 4K). In August 2006, TDK announced that they had created a working experimental Blu-ray Disc capable of holding 200 GB of data on a single side, using six 33 GB data layers.

3. How Blu-ray Disc Work?

Blu-ray technology is based on blue lasers rather than the red lasers used with CDs and DVDs. The blue laser, used to read and write data, have a much shorter wavelength and a much sharper focus. Consequentially, the blue laser is able to record information in smaller pits. More of these smaller pits can thus be fitted on the disc surface, enabling much more information to be stored.

The laser used in Blu-ray Disc has a much smaller focus and is capable of recording data in much smaller pits, thus increasing storage capacity significantly. The data layer in a Blu-ray Disc is also

much closer to the laser lens, allowing for a substantial decrease in distortion when recording.

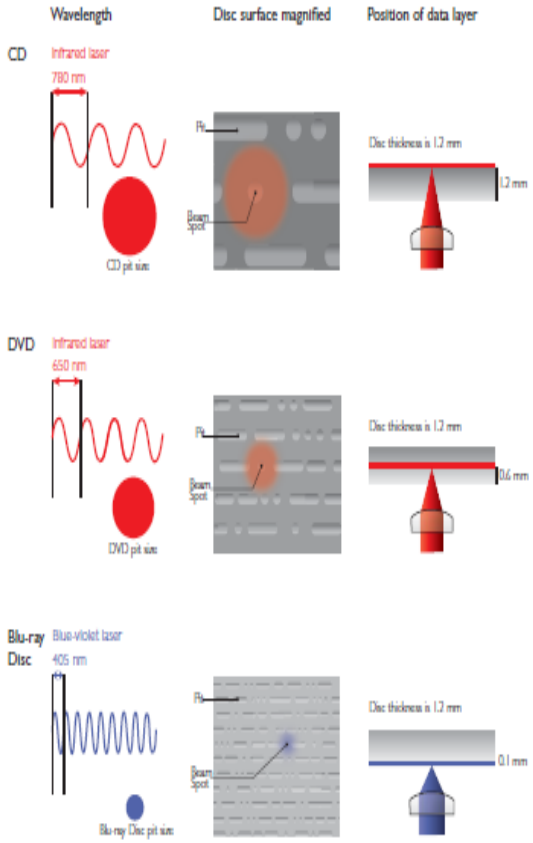

Figure 3 work of Blu-ray disc

4. Layer Storage in BLU-RAY DISC

According to the Blu-ray Disc specification, 1x speed is defined as 36Mbps. However, as BD-ROM movies will require a 54Mbps data transfer rate the minimum speed we're expecting to see is 2x (72Mbps). Blu-ray also has the potential for much higher speeds, as a result of the larger numerical aperture (NA) adopted by Blu-ray Disc.

The large NA value effectively means that Blu-ray will require less recording power and lower disc rotation speed than DVD and HD-DVD to achieve the same data transfer rate. While the media itself limited the recording speed in the past, the only limiting factor for Blu-ray is the capacity of the hardware.

If we assume a maximum disc rotation speed of 10,000 RPM, then 12x at the outer diameter should be possible (about 400Mbps). This is why the Blu-ray Disc Association (BDA) already has plans to raise the speed to 8x (288Mbps) or more in the future.

Blu-ray discs can hold and play back large quantities of **high-definition video and audio**, as well as photos, data and other digital content.

In 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**. 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.

4.1 A Single Layer Disc

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**

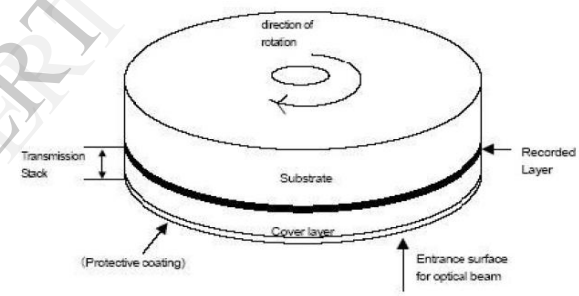

Figure 4 Single Layer Disc

4.2 A Double Layer Disc

A double-layer Blu-ray disc can store up to **50 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.

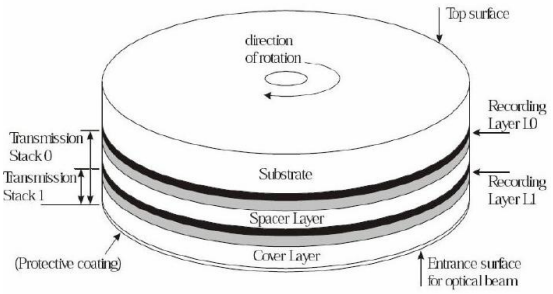

Figure 5 Dual Layer Disc

The Blu-ray format has received broad support from the major movie studios as a successor to today's DVD format. In fact, seven of the eight major movie studios (Disney, Fox, Warner, Paramount, Sony, Lionsgate and MGM) have released titles in the Blu-ray format. Many studios have also announced that they will begin releasing new feature films on Blu-ray Disc day-and-date with DVD, as well as a continuous slate of catalog titles every month.

5. Advantage of Blu-Ray Disc

5.1 Large Storage Capacity

Some of the popular storage devices that are available in the market include:

1. Analog Storage Technology
   1.1 VHS
2. Digital Storage Technology
   2.1 Floppy Disc
   2.2 Compact Disc (CD)
   2.3 Digital Versatile Disc (DVD)

Table 1: Blu-ray and DVD

Parameters	Blu-ray	DVD
Storage capacity	25GB (single-layer) 50GB (dual-layer)	4.7GB (single-layer) 8.5GB (dual-layer)
Laser wavelength	405nm (blue laser)	650nm (red laser)
Numerical aperture (NA)	0.85	0.60
Disc diameter Disc thickness	120mm 1.2mm	120mm 1.2mm
Protection layer Hard coating	0.1mm Yes	0.6mm No
Track pitch	0.32µm	0.74µm
Data transfer rate (data) Data transfer rate (video/audio)	36.0Mbps (1x) 54.0Mbps (1.5x)	11.08Mbps (1x) 10.08Mbps (<1x)
Video resolution (max) Video bit rate (max)	1920×1080 (1080p) 40.0Mbps	720×480/720×576 (480i/480p/576i) 9.8Mbps
Video codecs	MPEG-2 MPEG-4 AVC SMPTE VC-1	MPEG-2 - -
Audio codecs	Linear PCM Dolby Digital Dolby Digital Plus Dolby TrueHD DTS Digital Surround DTS-HD	Linear PCM Dolby Digital DTS Digital Surround - - -
Interactivity	BD-J	DVD-Video

5.1.1 BLU-RAY Vs VHS

VCRs don't support recording of HD video consumers that want to record in HD will need to upgrade their video recorders. Blu-ray recorders combined with hard drives offer a very flexible alternative for those that want to record HDTV. While HD-DVRs already allow consumers to record in HD, the amount of HDTV programming that can be recorded and archived is limited by the size of the hard drive. Blu-ray recorders will offer a solution to this problem as they allow consumers to record the video to Blu-ray discs and then free up the hard drive. This should make them popular among people that want to archive a lot of their HDTV recordings. The Blu-ray recorders will also offer a lot of compelling new features not possible with a traditional VCR:

1. Random access - instantly jump to any place on the disc
2. Searching - quickly browse and preview recorded programs in real-time
3. Create playlists - change the order of recorded programs and edit recorded video
4. Simultaneous recording and playback of video (enables Time slip/Chasing playback)
5. Automatically find an empty space to avoid recording over programs

6. Improved picture - ability to record high-definition television (HDTV)
7. Improved sound - ability to record surround sound (Dolby Digital, DTS, etc)

5.1.2 BLU-RAY v/s CD and DVD

Just as DVD meant a five to ten time increase in storage capacity compared to CD, Blu-ray Disc will increase DVD capacity by five to ten times. This is due, among other reasons, to the usage of a blue instead of a red laser and improved lens a specification, allowing for a much smaller focus laser beam which enables the recording of much smaller and higher density pits on the disc.

Due to the fact that the data layer on a Blu-ray Disc is placed much "closer" to the laser lens than in DVD (or even the HD-DVD proposal), there is less distortion resulting in significantly improved tolerances. Hence, more precision and ultra high storage densities are made possible.

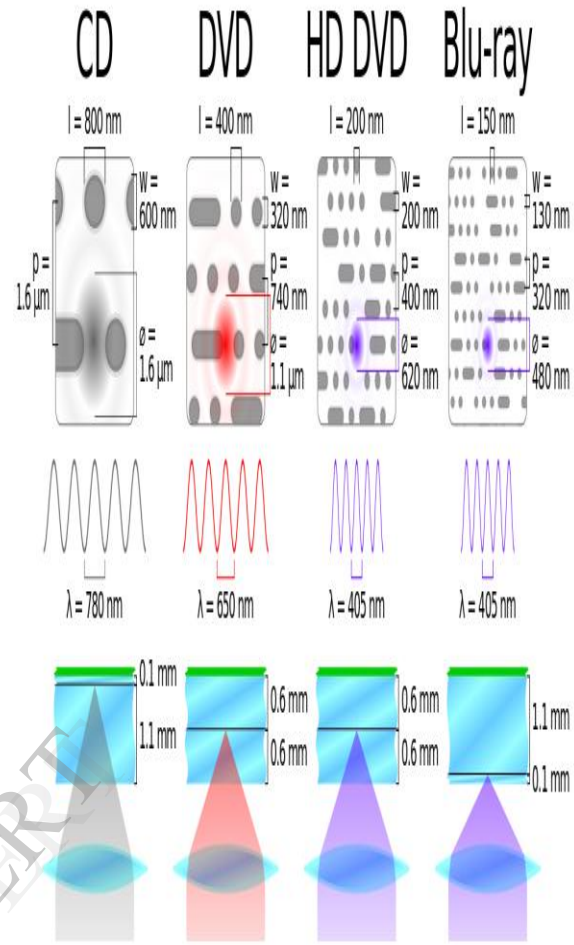

Figure 6 Work Comparison

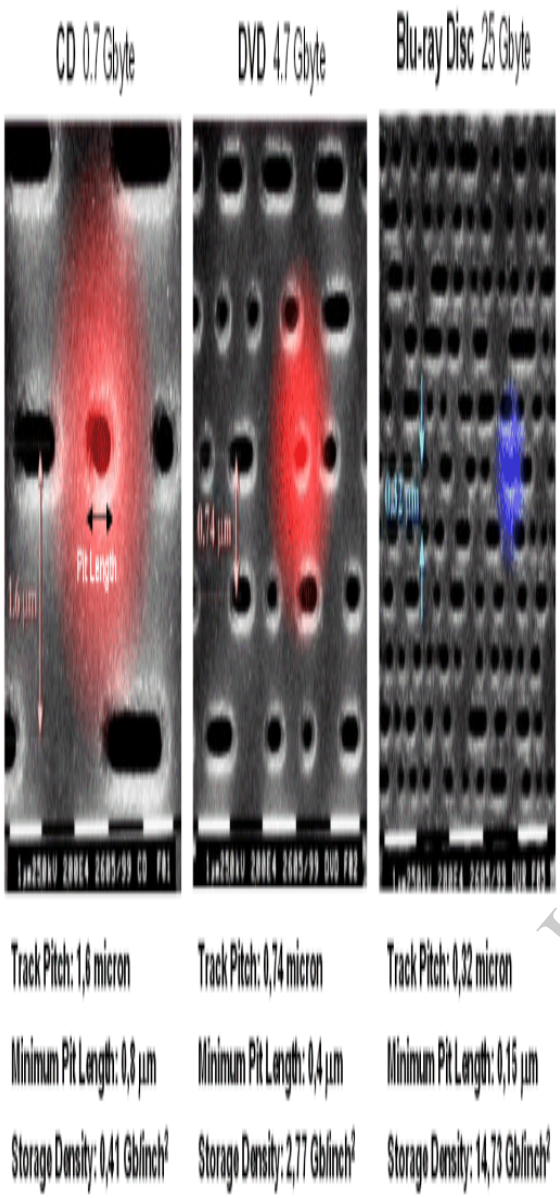

Figure 7 Storage Comparison

As a result of Blu-ray Disc being manufactured as a single substrate disc comparable to CD, but unlike DVD (and the HD-DVD proposal), the manufacturing process does not involve the bonding of two substrates, resulting in less production material, a shorter production time and hence lower production costs per disc.

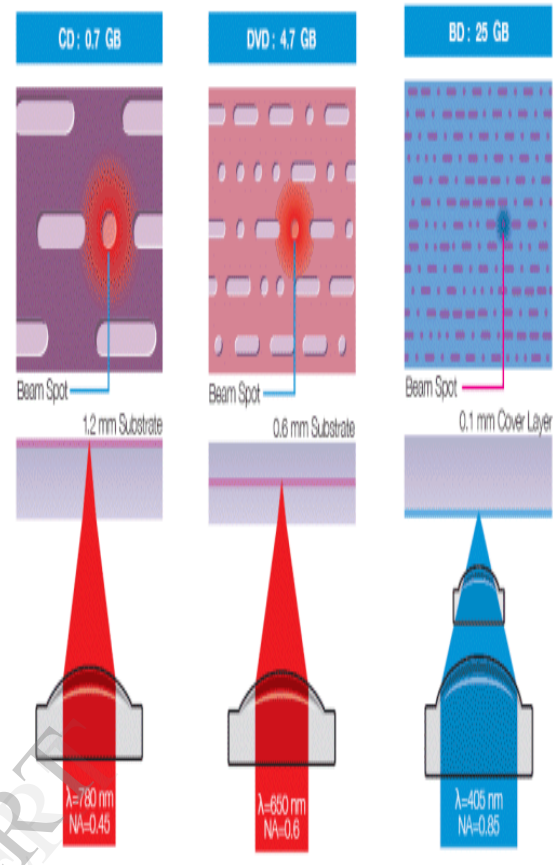

Figure 8 High capacity contributions

Blu-ray Disc has the same physical characteristics as DVD and CD, and like its predecessors, it also does not require a cartridge. This makes it possible to create Blu-ray Disc products that are backwards compatible with CD and DVD, allowing for a seamless transition to the new technology. Likewise, the technology is perfectly suitable for integration in small form factor equipment, like notebook computers.

5.2 High Resolution Video

Some discs are handled extensively, for example, 8cm discs that are constantly placed in and out of the Camcorder in external environments. To protect from potential damage, all Verbatim Blu-ray discs benefit from the Hard Coat protective layer, which was developed originally by Verbatim. This layer protects from fingerprints, dust, scratches, static and water.

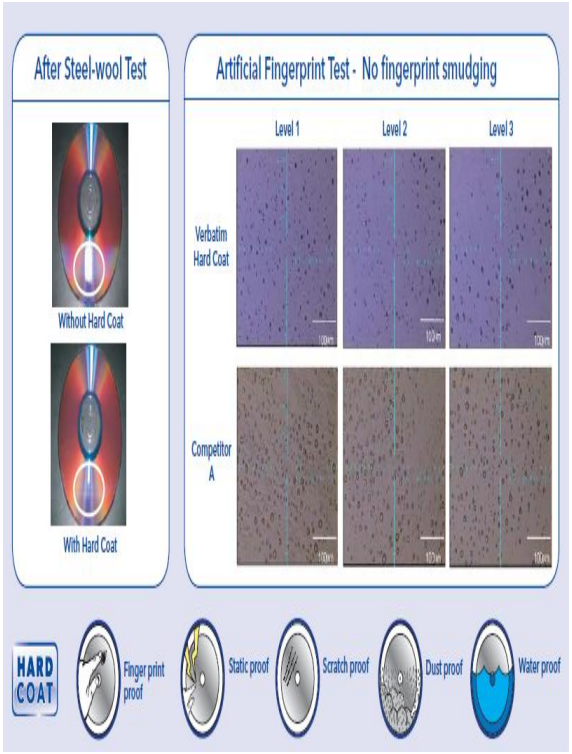

Figure 9 Reason of High Resolution Video

5.3 The Incredible Data Capacity

The Blu-ray Disc is an optical disc format that was created to meet the needs of high-definition video by storing a huge amount of data. The Blu-ray Disc has the same dimensions as CD and DVD discs, with a 12-cm diameter, but it features an amazing data storage capacity.

While a DVD disc stores up to 4.7 GB (gigabytes) of data on one side, the Blu-ray Disc can hold as much as 25 GB on a single side, giving it more than five times the storage capacity.

Because each recording layer of a single-side, dual-layer Blu-ray Disc is capable of storing 25 GB of data, the total capacity is an astonishing 50 GB per disc. In other words, one Blu-ray Disc can store as much data as ten DVD discs.

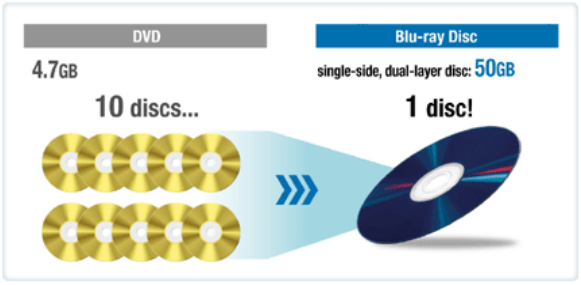

Figure 10 More Data Storage capacity in Blu-ray disc

5.4 Fast Read and write in Blu-ray Disc

First generation Blu-ray drives are PC-type and support single- and dual layer media Blu-ray media with 25 and 50GB capacity, they are read/write compatible with CD- and DVD technologies. Future drive generations will support 100GB and 200GB Blu-ray media and still CD&DVD. Writeable Blu-ray media are sector based and apply defect management as well as advanced error correction.

Read/Write transfer rate in the first generation Blu-ray drives is 9MB/s (= 2x Blu-ray speed), the road map includes 18MB/s and 36MB/s transfer rates. Media types ROM, R and Re are supported.

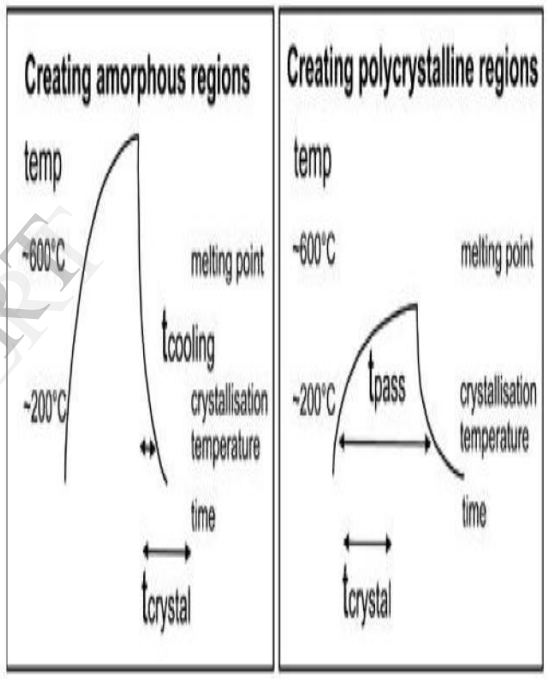

Figure 11 Graph showing writing & rewriting on crystals

6. Disadvantages of Blu-Ray Disc

Trustworthiness of Blu-ray technology also hasn't been proven yet. If archive and backup companies are to invest in Blu-ray as a storage technology, they would like some real evidence that the data stored on a BD will stay intact for a very long time.

The technology is proven, but that's no guarantee of a smooth migration. The technology is yet to be standardized.

7. Blu-ray Disc Handling and Storage

A few guidelines for handling and storage of BDs are:

1. Handle a BD by its outer edges, by the center hole, or center-hub clamping area.
2. Avoid flexing or dropping the disc or exposing it to direct sunlight, excessive cold, heat, or humidity.
3. Handle only when being used and do not eat, drink or smoke close by.
4. Discs should be stored in jewel cases or video boxes (rather than sleeves). Since cases do not contact disc surfaces, they provide better protection against dust, debris, scratches, light, and rapid humidity changes.
5. Once discs are placed in their cases, additional protection can be provided by keeping them in a closed box, drawer or cabinet.
6. For long-term storage, it is prudent to follow disc manufacturer instructions as well as the various international standards for preserving optical media.

The vast majority of archived media's time is spent in storage, so the surrounding environmental conditions can have a large effect on the archiving process. Although recommended storage conditions are available from the manufacturer, the recommended conditions are typically between 5° C and 30° C with a non-condensing relative humidity between 8 percent and 50 percent. As storage times increase, the storage temperature and relative humidity should migrate towards the lower end of the recommended spectrum.

8. Conclusion

With a capacity of about 30 gigabytes of data, compared with 4.7 GB for today's DVDs, the new disks promise a richer-than-ever digital experience. Video games will acquire photorealistic graphics and far more elaborate story lines. And TV viewers will be able to store hours of high-definition TV permanently on low-cost disks. If product-development plans at Japanese electronics companies pan out, the first commercial machines are expected to appear in late 2003. And because all of the new machines will be recorders, not just players, analysts expect consumer adoption to be swift.

Considerations should be that Blu-ray media:

1. Is not a single source technology.
2. Has a data archive life greater than 50 years.
3. Has a high access speed.
4. Is highly durable.
5. Is a highly stable media.
6. Constitutes ―green‖ storage technology.

	Generation 1	Generation 2	Generation 3
Capacity	30 GB	60 GB	120 GB
Transfer Rate	8 MB/s	12 MB/s	18 MB/s
RPM	2000 RPM	3000 RPM	3600 RPM
Avg Seek Time	25 msec	25 msec	25 msec
Numerical Aperture	0.7	0.7	0.85
Media Layers	1	2	2
Encoding	1,7	1,7	ML
Sector Size	8KB	8KB	8KB
SCSI Transfer Rate	80 MB/s	80 MB/s	80 MB/s
Load Time	5 seconds	5 seconds	5 seconds
Unload Time	3 seconds	3 seconds	3 seconds
MSBF	750,000	750,000	750,000

Figure 12 Fast Generation Technology in Blu-ray Disc

The nine companies behind this new and improved medium are Hitachi, LG, Matsushita, Philips, Pioneer, Samsung, Sharp, Sony and Thomson. In addition to actively promoting the new format throughout the industry, the nine plan to begin licensing the new format as soon as specifications are completed. It is hoped that the licensing will begin very soon.

Blu-ray is very cool technology. It takes the DVD-Technology one step further, basically by just using a smaller laser with a nice color. It is to be seen whether the world is ready for Blu-ray Discs, Recorders and Players.

There is a new technology in town – Blu-ray Disc. It creates a whole new world for those who simply will not settle for second best. New unmatched standards in high definition deliver more pictures, more sound – and an entertainment experience that will keep you glued to your seats.

9. Appendices

1. GB Giga Byte
2. BD Blu-ray Disc
3. LD Laser Diodes
4. CD Compact Disc
5. VHS Video Home System
6. NA Numerical Aperture

7. DVD Digital Versatile Disc
8. AOD Advanced Optical Disc
9. BDF Blu-ray Disc Founders
10. BD R Blu-ray Disc Recordable
11. BD RW Blu-ray Disc Rewritable
12. AVC Advanced Video Coding
13. BDA Blu-ray Disc Association
14. HDTV High Definition Television
15. MPEG Motion Pictures Experts Group
16. AACS Advanced Access Content System
17. HD-DVD High Definition Digital Versatile Disc

10. References

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[11]http://www.blu-raydisc.com/Assets/Downloadablefile/BD-R_physical_specifications-18326.pdf
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