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Optical Disc with Blu Ray Technology

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***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.

I. INTRODUCTION

Blu-ray or Blu-ray Disc (BD) is a digital optical disc data storage format. It was designed to supersede the DVD format, in that it is capable of storing hours of video in high-definition (720p and 1080p) and ultra high-definition resolution (2160p). The main application of Blu-ray is as a medium for video material such as feature films and physical distribution of video games for the PlayStation 3, PlayStation 4, and Xbox One. The name "Blu-ray" refers to the blue laser (specifically, a violet laser) used to read the disc, which allows information to be stored at a greater density than is possible with the longer-wavelength red laser used for DVDs. Blu ray name is the combination of "Blue" color of the laser and ray for the "optical" ray. The "e" in the blue is purposefully removed, according to the manufacturers, because an everyday word cannot be trademark in universe.

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 Disc 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.

High-definition video may be stored on Blu-ray discs with up to 2160p resolution (3840×2160 pixels), at up to 60 frames per second. DVD-Video discs had been limited to a maximum resolution of 480p (NTSC, 720×480 pixels) or 576p (PAL, 720×576 pixels).Besides the hardware specifications, Blu-ray is associated with a set of multimedia formats.

The BD format was developed by the Blu-ray Disc Association, a group representing makers of consumer electronics, computer hardware, and motion pictures. Sony unveiled the first Blu-ray disc prototypes 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. During the high definition optical disc format war, Blu-ray Disc competed with the HD DVD format. Toshiba, the main company that supported HD DVD, conceded in February 2008, releasing its own Blu-ray Disc player in late 2009. According to Media Research, high-definition software sales in the US were slower in the first two years than DVD software sales. Blu-ray faces competition from video on demand and the continued sale of DVDs. As of January 2016, 44% of U.S. broadband households had a Blu-ray player.

II. BLU RAY TECHNOLOGY

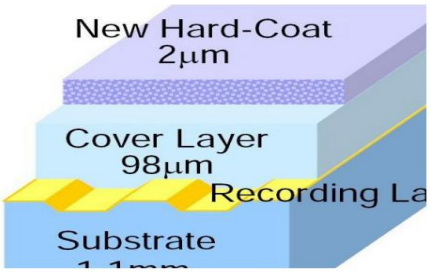
The technology utilizes a "blue" (actually blue-violet) laser diode operating at a wavelength of 405 nm to read and write data. Conventional DVDs and CDs use red and infrared lasers at 650 nm and 780 nm respectively. As a color comparison, the visible color of a powered fluorescent black light tube is dominated by mercury's bluish violet emissions at 435.8 nm. The blue-violet laser diodes used in Bluray Disc drives operate at 405 nm, which is noticeably more violet (closer to the violet end of the spectrum) than the visible light from a black light. A side effect of the very short wavelength is that it causes many materials to fluoresce, and the raw beam does appear as whitish-blue if shone on a white fluorescent surface (such as a piece of paper). While future disc technologies may use fluorescent media, Blu-ray Disc systems operate in the same manner as CD and DVD systems and do not make use of fluorescence effects to read out their data. The blue-violet laser has a shorter wavelength than CD or DVD systems, and this shrinking makes it possible to store more information on a 12 cm (CD/DVD size) disc. The minimum "spot size" that a laser can be focused is limited by diffraction, and depends on the wavelength of the 11 light and the numerical aperture (NA) of the lens used to focus it. By decreasing the wavelength (moving toward the violet end of the spectrum), using a higher NA (higher quality) dual-lens system, and making the disk thinner (to avoid unwanted optical effects), the laser beam can be focused much tighter at the disk surface. This produces a smaller spot on the disc, and therefore allows more information to be physically contained in the same area. In addition to optical movements, Blu-ray Discs feature improvements in data encoding, closer track and pit spacing, allowing for even more data to be packed in. *Principal of Operation*

When a diode is forward biased, holes from the p-region are injected into the n-region, and electrons from the n-region are injected into the p-region. If electrons and holes are present in the same region, they may radioactively recombine that is, the electron "falls into" the hole and emits a photon with the energy of the band gap. This is called spontaneous emission, and is the main source of light in a light-emitting diode. Under suitable conditions, the electron and the hole may coexist in the same area for quite some time (on the order of microseconds) before they recombine. If a photon f exactly the right frequency happens along within this time period, recombination may be stimulated by the photon. This causes another photon of the same frequency to be emitted, with exactly the same direction, polarization and phase as the first photon. In a laser diode, the semiconductor crystal is fashioned into a shape somewhat like a piece of paper very thin in one direction and rectangular in the other two. The crystal is n-doped, and the bottom is p-doped, resulting in a large, flat pn

junction. The two ends of the crystal are cleaved so as to form perfectly smooth, parallel edges; two reflective parallel edges are called a Fabry-Perot cavity. Photons emitted in precisely the right direction will be reflected several times from each end face before they are emitted. Each time they pass through the cavity, the light is amplified by stimulated emission. Hence, if there is more amplification than loss, the diode begins to "laser".

Hard-Coating Technology

The entry of TDK to the BDF (as it was then), announced on 19 March 2004, was accompanied by a number of indications that could significantly improve the outlook for Bluray. TDK is to introduce hard-coating technologies that would enable bare disk (caddyless) handling, along with higher-speed recording heads and multi-layer recording technology (to increase storage densities).TDK's hard coating technique would give BDs scratch resistance and allow them to be cleaned of fingerprints with only a tissue, a procedure that would leave scratches on current CDs and DVDs.



Reasons For Selecting Blu-Ray Archiving Technology

Optical disk storage, like all forms of digital storage has a very important role in establishing and maintaining the accuracy, reliability and trustworthiness of electronic records. The main reasons for choosing optical blu-ray technology are:

1. Compliance

Blu-ray media offers a true WORM recording medium which can't be altered with software hacks or viruses. This is essential considering today's requirements for multi-year data retention periods and growing regulatory compliancy requirements for unalterable, non-erasable storage capabilities. Optical technology meets these requirements as part of its standard unlike media such as magnetic tape; the WORM (Write Once Read Many) BD-R physically prevents overwriting. With its long-term storage ability, the BD-R eliminates security risks because data migration is unnecessary. BDs have a serial number and an ID (recorded in the Burst Cutting Area (BCA)), making it easy to verify the authenticity of the media itself.

2. Capacity

Blu-ray Disc format is easily extendable (future-proof) as it includes support for multi-layer discs. This allows the storage capacity to increase the current 100-128GB/disc capacity to 200GB in the near future simply by adding more layers to the discs.

3. Compatibility

Optical media has industry standard formats; ISO 9660 and UDF (Universal Disk Format) which are supported on every operating system including Windows, Linux, UNIX and MAC OS X. This avoids the direct need for additional client software as data can still be read in a standard drive in a standard PC, yielding complete vendor Independence. The Blu-ray Disc™ is the de facto standard for large-capacity optical discs, and is supported by about 170 major corporations, assuring long-term readability.

4. Access

Blu-ray technology offers random access to any file on Blu-ray Discs. Unlike with Hard Disk storage, media is not spinning and less subject to physical damage, viruses, etc. Tape drives provide sequential access and recovery times are slow as the tape needs to spool to find the file.

5. Removability

Off-line management of very old information is not possible with magnetic hard disks as they can't be safely removed and stored long-term outside of the archive. Tape can be removed and stored off-line; however, tape needs periodic re-tensing to prevent tape adhering together and is like hard disk vulnerable to (electro) magnetic radiation. Blu-ray Discs can be safely removed and stored off-line, offering unlimited archive storage capacity.

6. Innovation

While maintaining all benefits of a standardized format, Blu-ray technology is available as a best-of- breed hybrid solution technology for organizations. Combining the removability and longevity of Blu-ray with direct access and speed of hard disk yields easy to deploy and maintain appliance type solutions.

7. Cloud & Blu-ray

Cloud storage has some advantages, but many companies choose for a mixed model to implement a secure, physical archive in place which is less susceptible to outages, network bandwidth and privacy breaches.

8. Green Technology

Blu-ray technology offers a sustainable archiving technology. Blu-ray media consume zero power when not being accessed, reducing power consumption, air conditioning needs and CO2 emission. As there is no need for frequent data migrations, less waste products will be generated by having to replace devices.

9. Long-Term /Longevity

Due to its advanced media lifetime of 50+ years , standardized format and removability, Blu-ray technology offers the possibility to build long-term infinite off-line media archives. Compared to magnetic tape and HDD, it is less likely to be affected by humidity, temperature and light, and resists changes over time.Unlike magnetic tape and HDDs, there is no contact between the optical pickup (OPU) and the disc, so it maintains excellent durability even after repeated reading and writing. Panasonic Blu-ray™ discs have an archival life of 50 or 100 years, in contrast to an HDD's 5 to 10-year and magnetic tape's 15-20-year archival life. This allows data to be stored for longer periods of time.

III. DISC STRUCTURE

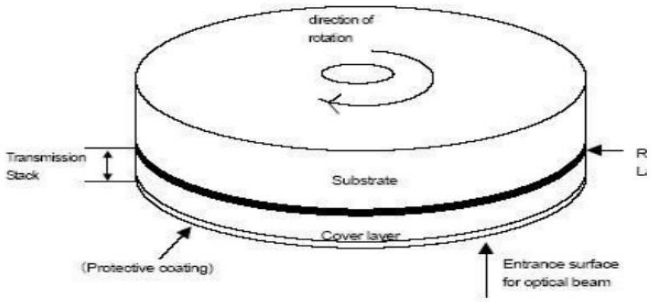
Configuration

One of the features that differentiate Blu-ray Disc from DVD recording systems is the position of the recording layer within the disc. For DVD, the recording layer is sandwiched between two 0.6-mm thick layers of plastic – typically polycarbonate. The purpose of this is to shift surface scratches, fingerprints and dust particles to a position in the

optical pathway where they have negligible effect - i.e. well away from the point of focus of the laser. Due to the injection molding process used to produce them, disc substrates suffer from stress-induced birefringence, which means that they split the single incident laser light into two separate beams. If this splitting is excessive, the drive cannot read data reliably from the disc. Consequently, the injection molding process has always been a very critical part of CD and DVD production another critical manufacturing tolerance, particularly for DVDs, is the flatness of the disc, because the laser beam becomes distorted if the disc surface is not perpendicular to the beam axis - a condition referred to as disc tilt. This distortion increases as the thickness of the cover layer increases and also increases for higher numerical To overcome these disadvantages, the recording layer in a Blu-ray Disc sits on the surface of a 1.1-mm thick plastic substrate, protected by a 0.1-mm thick cover layer. With the substrate material no longer in the optical pathway, birefringence problems are eliminated. In addition, the closer *proximity* of the recording layer to the drive's objective lens reduces disc tilt sensitivity. This only leaves the problem of surface scratching and fingerprints, which can be prevented by applying a specifically.

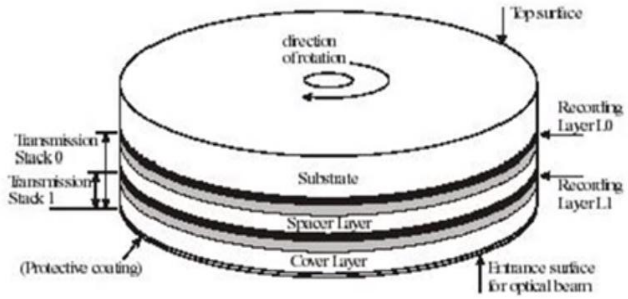
Single Layer Disc

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.



Dual Layer Disc

Figure shows the outline of a Dual Layer BD Read-Only disc. To improve scratch resistance, the cover layer can optionally be protected with an additional hard coat layer. The different layers are shown. A spacing layer is used to separate the two information discs. Also the different transmission stacks are shown.



BDXL

The BDXL format supports 100GB and 128GB write-once discs and 100GB rewritable discs for commercial applications. It was defined in June 2010.BD-R 3.0 Format Specification (BDXL) defined a *multi-layered disc* recordable in BDAV format with the speed of 2X and 4X, capable of 100/128 GB and usage of UDF2.5/2.6. BD-RE 4.0 Format Specification (BDXL) defined a multi-layered disc rewritable in BDAV with the speed of 2X and 4X, capable of 100GB and usage of UDF2.5 as file system.

IV. IMPLEMENTATION

The table below shows the technical specification of Blu-Ray

Recording Capacity	23.3 GB/25 GB/27 GB
Laser Wavelength	405 nm (blue-violet laser)
Media type	High-density optical disc
Encoding	Data encoding: CLV or Zoned CAV pits-and-lands with interleaved error correction code BDMV Video encoding: H.262/MPEG-2 Part 2 H.264/MPEG-4 AVC VC-1
Capacity	25 GB (single-layer) , 50 GB (dual-layer) , 100/128 GB (BDXL)
Block size	2 KB sector, 64 KB ECC-block
Read mechanism	405 nm diode laser, 36Mb/s
Write mechanism	405 nm diode laser at a speed of 16X media rate (as of July-2017)
Developed by	Blu-ray Disc Association
Dimensions	120 mm (4.7 in) diameter & 1.2 mm thickness

I FORMATS OF BLU RAY DISC

BD-ROM (read-only) - for pre-recorded content
BD-R (recordable) - for PC data storage
BD-RW (rewritable) - for PC data storage
BD-RE (rewritable) - for HDTV recording

II VARIANTS

Mini Blu-ray Disc

The "Mini Blu-ray Disc" (also, "Mini-BD" and "Mini Blu-ray") is a compact 8 cm (~3 in)-diameter variant of the Blu-ray Disc that can store 7.8 GB of data in its single layer configuration, or 15.6 GB on a dual layer disc. It is similar in concept to the MiniDVD and MiniCD. Recordable (BD-R) and rewritable (BD-RE) versions of Mini Blu-ray Disc have been developed specifically for compact camcorders and other compact recording devices.

Blu-ray Disc recordable

"Blu-ray Disc recordable" refers to two optical disc formats that can be recorded with an optical disc recorder. BD-Rs can be written to once, whereas BD-REs can be erased and re-recorded multiple times. The current practical maximum speed for Blu-ray Discs is about 12×. Higher speeds of rotation (10,000+ rpm) cause too much wobble for the discs to be written properly, as with the 20× and 52× maximum speeds, respectively, of standard DVDs and CDs. Since September 2007, BD-RE is also available in the smaller 8 cm Mini Blu-ray Disc size.

On September 18, 2007, Pioneer and Mitsubishi codeveloped BD-R LTH ("Low to High" in groove recording), which features an organic dye recording layer that can be manufactured by modifying existing CD-R and DVD-R production equipment, significantly reducing manufacturing costs. In February

2008, Taiyo Yuden, Mitsubishi, and Maxell released the first BD-R LTH Discs, and in March 2008, Sony's PlayStation 3 officially gained the ability to use BD-R LTH Discs with the 2.20 firmware update. In May 2009 Verbatim/Mitsubishi announced the industry's first 6X BD-R LTH media, which allows recording a 25 GB disc in about 16 minutes. Unlike with the previous releases of 120 mm optical discs (i.e. CDs and standard DVDs), Blu-ray recorders hit the market almost simultaneously with Blu-ray's debut.

BD9 AND BD5

The BD9 format was proposed to the Blu-ray Disc Association by Warner Home Video as a cost-effective alternative to the 25/50 GB BD-ROM discs. The format was supposed to use the same codecs and program structure as Blu-ray Disc video, but recorded onto less expensive 8.5 GB dual-layer DVD. This red-laser media could be manufactured on existing DVD production lines with lower costs of production than the 25/50 GB Blu-ray media. Usage of BD9 for releasing content on "pressed" discs has never caught on. After the end of the format war, major producers ramped up the production of Blu-ray Discs and lowered their prices to the level of DVDs. On the other hand, the idea of using inexpensive DVD media became popular among individual users. A lower-capacity version of this format that uses single-layer 4.7 GB DVDs has been unofficially called BD5. Both formats are being used by individuals for recording high definition content in Blu-ray format onto recordable DVD media. Despite the fact that the BD9 format has been adopted as part of the BD-ROM basic format, none of the existing Blu-ray player models supports it explicitly. As such, the discs recorded in BD9 and BD5 formats are not guaranteed to play on standard Blu-ray Disc players. *AVCHD and AVCREC* also use inexpensive media like DVDs, but unlike BD9and BD5 these formats have limited interactivity, codec types, and data rates.

IH-BD

The IH-BD (Intra-Hybrid Blu-ray) format includes a 25GB write-once layer (BD-R) and a 25GB read-only layer (BD-ROM) designed to work with existing Blu-Ray Discs.

4K Blu-ray (Ultra HD Blu-ray)

It's the latest generation of Blu-ray discs which, as the name suggests, supports Ultra HD – 4K. Besides much sharper pictures, it also adds all sorts of useful things like High Dynamic Range and new advanced audio systems like Dolby Atmos. Sadly, all this requires higher capacity discs, which is why a new format is required. That means Ultra HD discs won't play on a normal Blu-ray player, though you can play older Blu-ray discs on an Ultra HD player.

III VARIATIONS

1) High Fidelity Pure Audio (BD-A)

High Fidelity Pure Audio (HFPA) is a marketing initiative, spearheaded by the Universal Music Group, for audio-only Blu-ray optical discs. Launched in 2013 as a potential successor to the Compact disc, it has been compared with DVD-A and SACD, which had similar aims.

2) AVCHD

AVCHD was originally developed as a high definition format for consumer tapeless camcorders. Derived from the Blu-ray Disc specification, AVCHD shares a similar random access directory structure but is restricted to lower audio and video bitrates, simpler interactivity, and the use of AVC-video and Dolby AC-3 (or linear PCM) audio. Being primarily an acquisition format, AVCHD playback is not recognized by all devices that play Blu-ray Disc. Nevertheless, many such devices are capable of playing AVCHD recordings from removable media, such as DVDs, SD/SDHC memory cards, "Memory Stick" cards, and hard disk drives.

3) AVCREC

AVCREC uses a BDAV container to record high definition content on conventional DVDs. Presently AVCREC is tightly integrated with the Japanese ISDB broadcast standard and is not marketed outside of Japan. AVCREC is used primarily in set-top digital video recorders and in this regard is comparable to HD REC.

4) BLU RAY 3D

The Blu-ray Disc Association (BDA) created a task force made up of executives from the film industry and the consumer electronics and IT sectors to help define standards for putting 3D film and 3D television content on a Blu-ray Disc. On Dec.17, 2009 the BDA officially announced 3D specs for Blu-ray Disc, allowing backward compatibility with current 2D Blu-ray players. The BDA has said, "The Blu-ray 3D specification calls for encoding 3D video using the "Stereo High" profile defined by Multiview Video Coding(MVC), an extension to the ITU-TH.264 Advanced Video Coding (AVC) codec currently supported by all Blu-ray Disc players. MPEG4-MVC compresses both left and right eye views with atypical 50% overhead compared to equivalent 2D content, and can provide full 1080p resolution backward compatibility with current2 Blu ray Disc Players. This means the MVC(3D) stream is backward compatible with H.264/AVC(2D) stream, allowing older2D devices and software to decode stereoscopic video streams, ignoring additional information for the second view.

Sony has released a firmware upgrade for PlayStation 3 consoles that enables 3DBlu-ray Disc playback, when playing in 3D mode on PlayStation 3 the high-def audio Dolby TrueHD or DTS-HD will be downgraded to standard Dolby Digital or DTS due to HDMI 1.3 not having enough bandwidth. They previously released support for 3D gaming on April 21, 2010

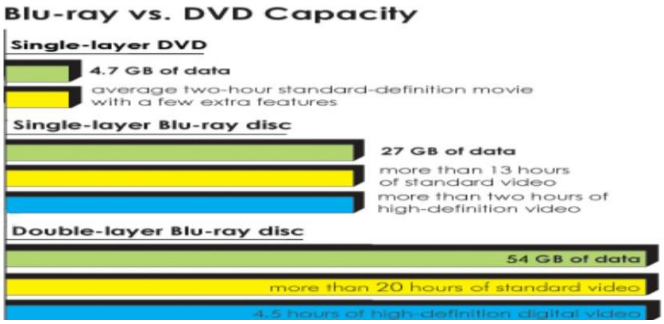
V. COMPARISION OF STORAGE TECHNOLOGIES

I Blu-Ray Vs Other Storage Devices

The storage capacity of different digital storage technology varies a lot. A Usually used version of floppy disc has a capacity of 1.44MB while that of a CD is 700 MB & for DVD it is 4.7 GB. Also they have varying shell lives out of these DVD has the maximum. A DVD is very similar to a CD, but it has a much larger data capacity. A standard DVD holds about seven times more data than a CD does. This huge capacity means that a DVD has enough room to store a full length, MPEG-2-encoded movie, as well as a lot of other information. DVD can also be used to store almost eight hours of CD quality music per side. DVD is composed of several layers of plastic, totaling about 1.2 millimeters thick. Each layer is created by injection molding polycarbonate plastic.

II Comparison of BD and DVD

A disc in the DVD format can currently hold 4.7 gigabytes of data. Unlike DVD technology, which uses red lasers to etch data onto the disc, the Blu-ray disc technology uses a blue-violet laser to record information.



The blue-violet laser has a shorter wavelength than the red lasers do, and with its smaller area of focus.

Comparison of CD, DVD and BD specification

Parameter	CD	DVD	BD
Disk diameter	120 mm	120 mm	120 mm
Disk thickness	1.2 mm	1.2 mm	1.2 mm
Laser wavelength	780 nm	650 nm	405 nm
Numerical aperture	0.45	0.60	0.85
Minimum pit length	0.83 um	0.4 um	0.138 um
Data rate	1.2 Mb/sec	11 Mb/sec	36 Mb/sec
Number of sides	one	-----	one or two
Number of data layers	One	-----	One or two
Data capacity	~680 MB	4.7 GB (1L) 8.5 GB (2L) 1.7 GB (2L/2S)	27 GB

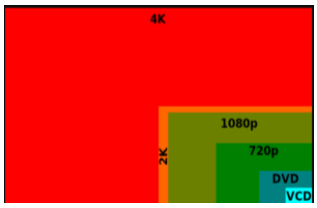
The digital information is etched on the discs in the form of microscopic pits. These pits are arranged in a continuous spiral track from the inside to the outside. Using a red laser, with 650 nm wavelength, we can only store 4.7 GB on a single sided DVD. TV recording time is only one hour in best quality mode, and two, three or four hours with compromised pictures. Data capacity is inadequate for nonstop backup of a PC hard drive. The data transfer rate, around 10 Mbps, is not fast enough for high quality video.

III 4K vs. UHD

The simplest way of defining the difference between 4K and UHD is this: 4K is a professional production and cinema standard, while UHD is a consumer display and broadcast standard. To discover how they became so confused, let's look at the history of the two terms.

The term "4K" originally derives from the Digital Cinema Initiatives (DCI), a consortium of motion picture studios that standardized a spec for the production and digital projection of 4K content. In this case, 4K is 4,096 by 2,160, and is exactly four times the previous standard for digital editing and projection (2K, or 2,048 by 1,080). 4K refers to the fact that the horizontal pixel count (4,096) is roughly four thousand. The 4K standard is not just a resolution, either: It also defines how 4K content is encoded. A DCI 4K stream is compressed using JPEG2000, can have a bit rate of up to 250Mbps, and employs 12-bit 4:4:4 color depth.

Ultra High Definition, or UHD for short, is the next step up from what's called full HD, the official name for the *display* resolution of 1,920 by 1,080. UHD quadruples that resolution to 3,840 by 2,160. It's not the same as the 4K resolution made above — and yet almost every TV or monitor you see advertised as 4K is actually UHD. Sure, there are some panels out there that are 4,096 by 2,160, which adds up to an aspect ratio of 1.9:1. But the vast majority is 3,840 by 2,160, for a 1.78:1 aspect ratio.



The relative image size of 4K vs. 1080p — except that 4K should be labelled UHD, or 2160p.

Clarity between Standard HD and 4K UHD

VI. BD APPLICATIONS

-High Definition Television Recording
-High Definition Video Distribution
-High Definition Camcorder Archiving
-Mass Data Storage
-Digital Asset Management and Professional Storage
-Play Station 3
-Play Station 4

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.

High Definition Television Recording

High Definition broadcasting is vastly expanding in the U.S. 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.

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.

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 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 converted and recorded on 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 disc can be safely stored for many years, without the risk of tape wear.

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 5-10 x 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 led 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 5-10 x 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.

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 audiovisual assets that need to be instantly retrieved in a random 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.

Play station 3

The Play station 3 will be the first Blu-ray accessible player. The first BIu-Ray recorder was unveiled by Sony and was introduced to the Japanese market.JVC and Samsung Electronics announced Blu-ray based products at IFA in Berlin, Germany.

Sony has announced that the PlayStation 3 will be shipped with a Blu-Ray drive, but possibly just a read-only one. Sony's machine will also support BD-ROM pre-recorded media, which are expected to be available in early 2006.

Play Station 4

PS4, fully named as PlayStation 4, is a home video game console developed by Sony Interactive Entertainment, formerly Sony Computer Entertainment. Announced as the successor to the PlayStation 3 during a press conference on February 20, 2013, it was launched on November 15, 2013 in North America, and November 29, 2013 in Europe, South America and Australia, and February 22, 2014 in Japan. It competes with Nintendo's Wii U and Microsoft's Xbox One, as part of the eighth generation of video game consoles.

VII ADVANTAGES

- ✓ Record high-definition television (HDTV) without any quality loss.
- ✓ Instantly skip to any spot on the disc.
- ✓ Record one program while watching another on the disc.
- ✓ Create playlists.
- ✓ Edit programs recorded on the disc.
- ✓ Automatically search for an empty space on the disc to avoid recording over a program.
- ✓ Access the Web to download subtitles and other extra features.
- ✓ Blu-ray discs are better armed than current DVDs. They come equipped with a *secure encryption system* - a unique ID that protects against video piracy and copyright infringement.
- ✓ Blu-ray has a *higher data transfer rate - 36 Mbps*.
- ✓ Do not have the problems of birefringence and disc tilt.
- ✓ 4k UHD has four times as many pixels as 1080p

VIII DISADVANTAGES

Cost

To commit to the Blu-ray experience, expect to shell out more cash. Blu-ray players cost more than standard and HD-DVD counterparts, even though prices have dropped steadily since the technology first appeared on the market in 2003. One nice feature of these players is their backward-compatibility, so your DVD collection will not become obsolete. Blu-ray movies also generally cost $5 to $10 more than regular DVDs. Additionally, if you have Blockbuster or Netflix subscriptions that include receiving DVDs through the mail, expect to pay a few more dollars per month if you want those DVDs in Blu-ray format.

Capacity

While Blu-ray discs offer more storage space on a disc than standard DVDS (about 25 GB on a single-layer disc and 50 GB on a dual-layer disc), this only amounts to about four to nine hours of high-definition content. Multiple layers are added to increase space up to 500 GB, but at the date of

publication, this innovative feature is not on the public market. This extra space packs in better picture quality and clarity, but offers nothing spectacular in the amount of content on a disc.

Movie Availability

Available Blu-ray titles are growing slowly as the technology shows signs of a promising and lucrative future. While the DVD format quickly replaced VHS, the transition to Blu-ray is slow-going and titles are more difficult to find than standard DVDs, especially if you wish to rent movies. Also, once titles do become available, there are likely a legion of fans waiting to pounce when they make their Blu-ray debut.

DRM

Although Blu-ray offers a nice picture and high-definition experience crisp beyond comparison, the Digital Rights Management limits the availability of certain features. The goal of DRM is to protect against pirating of copyrighted films, an act stemming from the use of home computers to copy media illegally. This is important for Blu-ray because HD content does not lose quality with each copy made like standard content does. DRM also leads Blu-ray players to regularly schedule firmware updates to protect against the latest copyright infringement threats.

CONCLUSION

Existing CD and DVD players and recorders will not be able to use Blu-Ray discs. New Blu-Ray players will need infra-red, red and blue lasers if they are also to play all kinds of CD and DVD recordings. Blu-ray disc has been a consistent road map to emerging disc technologies. Blu-ray 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. It's very likely that the technology will be adopted as the next generation optical disc format for PC data storage and replace technologies such as DVD+-R, DVD+-RW, and DVD-RAM.

FUTURE ENHANCEMENTS

With few data storage mediums, there seems to be a higher risk that they may not be compatible with new devices of coming decades.

All optical discs, like CDs, DVDs and blu-ray discs are of similar standards and are readable in the same disc devices. Optical storage is forward compatible, which means that you can read old disks with newer devices. An average user replaces his/her computer every 4 years, but until now you have always been able to read older optical discs. Our experience shows that all fifteen-year-old CD-Rs are very well readable with the newest blu-ray readers.

Blu-ray discs are a solid choice if you need to protect data against accidental deletion, computer viruses, hackers and water damages. Blu-ray discs are also easy to transport if you need to send them to a remote location. If costs are important, blu-ray writers and discs are very affordable, compared to other data storage solutions. Last but not least, blu-ray discs are suitable for long term data archiving, since they last at least 50 years and are predictably forward compatible with the newest devices.

It is believed that the Ultra HD Blu-ray specification, as well the ITU specification for the HEVC UHD encoding, used by Ultra HD Blu-ray, include extensibility provisions that are intended to allow certain potential future enhancements, such as support for 2160p resolution 3D video, to be added in a future version of the specification. The goal would be to allow future players and discs to support these advanced capabilities while allowing such advanced future disc releases to still be playable on the first generation of Ultra HD Blu-ray players as well as allowing advanced future Ultra HD players to play all pervious and current generation Blu-ray discs.

References

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