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Colliding Technologies

Norman Desmarais

The next generation of DVD media – high definition or HD -- has begun to ship. The players should appear on the market soon. High definition video requires a lot of storage space – much more than current-generation DVDs can provide. That's the main factor driving the change. Before you buy into high definition video, though, there are a few things you should know.

First, there are two competing standards: HD-DVD and Blu-ray. HD-DVD was developed by Toshiba and NEC and counts Universal Studios, Intel, and Microsoft among its supporters. Blu-ray was invented by Sony and has the endorsement of Disney, Fox, Apple, and Dell. Both technologies use media that looks identical to today's CDs and DVDs. They both use a 405-nanometer blue-violet laser instead of a red laser used in current CD and DVD drives. The blue-violet laser's shorter wavelength means that it can be tuned more finely to increase storage capacity.

However, that's where the similarities end. The two technologies are fundamentally different and incompatible with each other. Those who remember the Betamax vs. VHS wars of the 1970s will know what to anticipate in this new media war. Movie studios and hardware manufacturers will exert a strong influence; but it will all come down to consumer preference.

HD-DVD

HD-DVD has more similarities to today's technologies than Blu-ray. It uses a 12cm. diameter disc with a 1.2mm.-thick substrate sandwiched between two 0.6mm.-thick layers of transparent polycarbonate, just like a DVD. A reflective coating on one side of the substrate of a single-sided disc lets the reading mechanism interpret the pattern of microscopic "pits" and "lands" burned into a shallow spiral groove extending from the hub to the outside edge of the disc -- just as it does for any other optical disc. Because HD-DVDs use narrower width grooves (commonly referred to as track pitch) and smaller pits and lands, they can store three times more data than current DVDs.

HD-DVD's track pitch (groove) is about half that of a DVD (0.40 microns compared to 0.74 microns). The HD-DVD's pits are also close to half the size of a DVD (204 nanometers compared to 400 nanometers). These factors allow an HD-DVD to store 15GB of data on a single layer disc, compared to a DVD's 4.7GB-per-layer capacity. Adding another layer to the same substrate will double HD-DVD's capacity to 30GB. Manufacturers can also place two more layers on the other side of the disc for a storage capacity of 60GB.

The second factor in the technology is a higher-precision laser required to read the smaller grooves and pits and lands. Both HD-DVD and Blu-ray technology use a 405-nanometer wavelength blue-violet laser instead of the 780-nanometer red laser in CD drives and the 650-nanometer red laser in DVD drives. This permits an even tighter focus than existing technologies.

Both HD-DVD and Blu-ray will support two substantially more sophisticated video compression/decompression algorithms (codecs). They will support the DVD standard's MPEG-2 codec as well as MPEG-4 AVC (also known as H.264) and SMPTE VC1. This latter standard is based on Microsoft's Windows Media Video technology. As neither HD-DVD nor Blu-ray discs have the capacity to store an uncompressed, full-length movie in high definition, these codecs are essential for delivering high-definition video on disc. The more efficient HD-DVD codecs can reduce file size by two thirds, permitting a 15GB disc to hold 180 minutes of high-definition video.

HD-DVD Media

There are three different types of HD-DVD discs being released:

1. HD DVD-ROM (read-only media) for prerecorded content, such as movies, music, software, and games
2. HD DVD-R (one-time recordable discs) for video recording and data storage/backup
3. HD DVD-RW (rewriteable discs).

These discs will initially come only in a single-layer format, with double-layer rewriteable discs appearing later. Combination and twin-format media will probably be offered to ease the transition from DVD to HD-DVD. Combination or hybrid discs are single-sided dual-layered discs with HD- DVD content on one layer and DVD content on the other. Twirformat discs will carry HD-DVD content on one side of the disc and traditional DVD on the other.

Toshiba announced a double-sided, dual-layer hybrid ROM disc which consists of a dual-layer HD DVD-ROM side and a dual-layer DVD-ROM side. This hybrid disc can store 30GB of high-definition content on the HD DVD-ROM side and 8.5GB of standard-definition content on the DVD-ROM dual layer side.

Consumers will be able to play their movies in standard definition on their existing equipment and in high-definition when they upgrade their TVs and disc players. This will avoid having to buy the same content twice and may be a factor for movie studios not to adopt this technology.

Because HD-DVD discs are physically almost identical to current DVD discs, the same production lines can be used to produce both discs, saving the expense of building new factories. The hardware is also cheaper to make because of its similarity to DVD. Consequently, HD-DVD discs and players will probably be cheaper than their Blu-ray counterparts.

NEC was the first to announce an HD-DVD disc drive for the PC; but has not yet announced a ship date for its HD-DVD Multireader HR-1100A. Toshiba's HD-A1 went on sale in March for \$499. The company also announced that its next Qosimo notebook PC will be the first to feature an HD-DVD drive. It will play HD-DVD discs and read and write CDs and DVDs. Microsoft is expected to introduce an external HD DVD drive that will turn the Xbox 360 into a high-definition DVD player. Sony's PlayStation 3, on the other hand, will come with a Blu-ray drive capable of playing high-definition movies and games.

Fewer movie studios have joined the HD-DVD camp than the Blu-ray one; but HD-DVD manufacturers promise to have movies available soon after the appearance of Toshiba's players.

Blu-ray

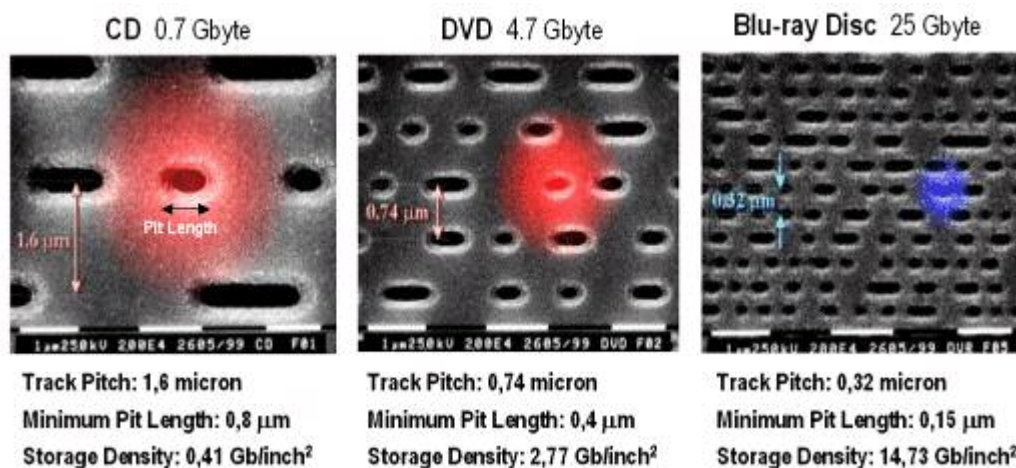
Blu-ray technology diverges more drastically from current optical-disc technologies because Blu-ray's engineers decided to start fresh rather than build on an existing technology with its limitations. They began by dealing with the optical disc's problem of birefringence, a condition which causes the polycarbonate layer to refract the laser into two separate beams. When the beams diverge too far, the disc becomes unreadable.

The engineers moved the substrate on top of the polycarbonate closer to the laser. They also protected it with a thin (98 microns) transparent outer layer to virtually eliminate birefringence. However, the protective layer is so thin that the substrate becomes extremely vulnerable to scratches, dust, and fingerprints. Enclosing the Blu-ray disc in a protective cartridge was deemed too clumsy for the worldwide market; so Blu-ray disc manufacturers may coat the outer layer with an even thinner layer of TDK's super-tough Durabis 2 coating. (TDK began shipping discs treated in this manner in December, 2005.)

Most of the other differences with Blu-ray technology relate to increased precision. A BD-ROM will have a much tighter track pitch than that of an HD-DVD: 0.32 microns, compared to 0.40 microns. This will require a laser with a larger lens aperture to gather more of the reflected light to resolve greater detail. Both HD-DVD and Blu-ray use a 405-nanometer wavelength blue-violet laser; but Blu-ray drives will be equipped with a 0.85 numerical aperture lens, compared to the 0.65 numerical aperture lenses on HD-DVD drives or 0.60 for DVD lenses.

The Technology at a Glance:

	DVD	HD-DVD	Blu-ray
track pitch	0.74 microns	0.40 microns	0.32 microns
pit size	405 nanometers	204 nanometers	150 nanometers
laser wavelength	650 nanometer, red	405 nanometer, blue-violet	405 nanometer, blue-violet
lens aperture	0.6	0.65	0.85
storage, single layer	4.75 GB	15 GB	25 GB
storage, double layer	8.5 GB	30 GB	50 GB
codec	MPEG2	MPEG-4 AVC; SMPTE VC1	MPEG-4 AVC; SMPTE VC1



Blu-ray Media

Just as with HD-DVD, Blu-ray discs will come in three formats:

1. BD-ROM (prerecorded Blu-ray discs),
2. BD-R (recordable media), and
3. BD-RW (rewriteable media).

Blu-ray's tighter track pitch, more finely-tuned laser, and lens with a larger aperture mean that a Blu-ray disc will be able to store nearly twice as much data as an HD-DVD disc. A single-layer Blu-ray disc will be able to store 25GB of data. Dual-layer discs will hold double that capacity.

Sony expects to begin shipping its BDP-S1 Blu-ray Disc player and the VAIO RC desktop computer in July. The player will be priced around \$1,000 or \$2,300 with the VAIO PC. The company planned to begin shipping 25GB BD-R (write once) and BD-RE (rewritable) discs in April for about \$20 and \$25 respectively. The 50GB BD-R and BD-RE dual-layer discs will come in subsequent months for about \$48 and \$60 respectively. The BD player is designed to deliver 1920x1080p (progressive scan) output. It will also have an analog component output for 1080i (interleaved scan) so people who own HD-capable televisions without HDMI can enjoy Blu-ray discs.

The BWU-100A, an internal Blu-ray Disc drive for computer use, will support recording of 25GB and 50GB BD-R (write once) or BD-RE (rewritable) discs at 2X maximum speed. It will only take about thirty minutes to burn a full 25GB disc. The drive will also support recording of standard single layer 4.7GB DVD+R/+RW, Double/Dual Layer 8.5GB DVD+R, DVD-RAM and CD-R/-RW media. Panasonic plans to start selling a Blu-ray high-definition disc player in September for under \$1,500 and expects to sell five million players in the first year. Samsung and Pioneer also expect to have players available soon.

Sony Pictures' Home Entertainment division recently announced it will be shipping eight movies on BD-ROM discs beginning on May 23 with an additional eight titles being released in June. Industry analysts expect close to 100 titles to be available from all of the Blu-ray Disc supporting studios by the end of the year. They will span from recent hits to classic favorites.

Copyright Protection

Sony is banking on its PlayStation 3 game console to boost the installed base for the Blu-ray format. However, the company delayed PlayStation 3's release until early November because it is still trying to finalize the copyright protection technology and other standards for the Blu-ray DVD disc. Both Blu-ray and HD-DVD will use a new copy-protection scheme called Advanced Access Content System (AACS). A consortium of companies that includes Intel, Microsoft, Sony, Toshiba, Warner Brothers, and Disney developed AACS specifically for high definition optical discs. AACS encrypts the content which can only be unlocked with dynamic "keys" with which all BD and HD-DVD players will be equipped. Unlike DVD's voluntary implementation, Blu-ray Disc's copy protection mechanism is mandatory and will be governed by strict licensing procedures.

The AACS consortium also moved, in January 2006, to require hardware manufacturers to down-convert (to 960x540 resolution) any HD content sent to a display device over an analog connection. This will further impede copying of high-definition content. The consortium believes that as soon as the video signal is converted to analog their encryption is useless. However, the consortium's action will make any HDTVs without HDMI ports virtually useless.

HDTV

It's not enough to buy into either the HD-DVD or Blu-ray format to get the full high definition experience. You'll also need a high definition television (HDTV). It is important to note that all HDTVs are digital but not all digital televisions are high definition. This is important because manufacturers are gradually moving from analog to digital sets, as the federal government requires all television stations to convert to digital broadcasts by April 7, 2009.

HDTV monitors or "HD-ready" sets can display HDTV through an external tuner such as a cable or satellite set-top box. Integrated HDTVs, which have the tuner built in, will be more expensive. An HDTV should support a minimum of 780 progressively scanned lines (780p) or 1080 interleaved lines (1080i). Full resolution HD video will require a display of 1920x1080p. The higher resolution renders a better picture. Panasonic plans to release a Blu-ray player at the same time as its new 103-inch flat screen TV. Panasonic expects the set to cost several times more than its 65-inch Plasma TV priced at \$10,000.

Converting to HD video is currently an expensive proposition. Unless you're an early adopter who has to be the first one in your neighborhood to have the latest technology, you may want to wait until the consumer market settles on a format. HD video players also face stiff competition from other kinds of consumer recording and display devices. These include hard-drive recorders such as Tivo, video delivered on demand over broadband and cellular networks to PCs and TVs, portable chip-based storage cards, and, eventually, Internet Protocol Television (IPTV).

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