In the Name of God

**BLU-RAY**

**How Blu-ray Discs Work**

In 1997, a new technology emerged that brought digital sound and video into homes all over the world. It was called DVD, and it revolutionized the movie industry.

The industry is set for yet another revolution with the introduction of Blu-ray Discs (BD) in 2006. With their high storage capacity, 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.

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.

Blu-ray is the next-generation digital video disc. It can record, store and play back high-definition video and digital audio, as well as computer data. The advantage to Blu-ray is the sheer amount of information it can hold:

* 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.
* 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.

**Building a Blu-ray Disc**

Blu-ray discs not only have more storage capacity than traditional DVDs, but they also offer a new level of interactivity. Users will be able to connect to the Internet and instantly download subtitles and other interactive movie features. With Blu-ray, you can:

* 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 or reorder 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

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

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

Each Blu-ray disc is about the same thickness (1.2 millimeters) as a DVD. But the two types of discs store data differently. In a DVD, the data is sandwiched between two polycarbonate layers, each 0.6-mm thick. Having a polycarbonate layer on top of the data can cause a problem called birefringence, in which the substrate layer refracts the laser light into two separate beams. If the beam is split too widely, the disc cannot be read. Also, if the DVD surface is not exactly flat, and is therefore not exactly perpendicular to the beam, it can lead to a problem known as disc tilt, in which the laser beam is distorted. All of these issues lead to a very involved manufacturing process.

**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.

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

1. The two discs are molded.
2. The recording layer is added to one of the discs.
3. The two discs are glued together.

Blu-ray discs only do the injection-molding process on a single 1.1-mm disc, which reduces cost. That savings balances out the cost of adding the protective layer, so the end price is no more than the price of a regular DVD.

Blu-ray also has a higher data transfer rate -- 36 Mbps (megabits per second) -- than today's DVDs, which transfer at 10 Mbps. A Blu-ray disc can record 25 GB of material in just over an hour and a half.

**The Name**

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

**On Guard**

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.  **Formats**

Unlike DVDs and CDs, which started with read-only formats and only later added recordable and re-writable formats, Blu-ray is initially designed in several different formats:

* 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

**References:**

http://www.blu-ray.com/info/

http://electronics.howstuffworks.com/blu-ray.htm

http://www.blu-raydisc.com/