

High Definition Movies: HD-DVD vs. Blu-ray Disc

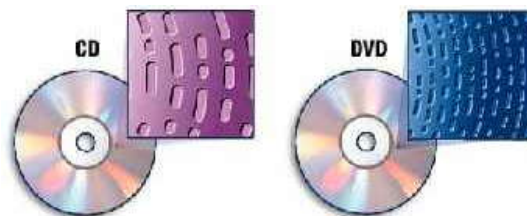
Working in the video game industry, I get a front-row seat in the high-def movie war currently raging. Both Sony's PlayStation 3 and Microsoft's Xbox360 support high definition resolutions for their video games. The PlayStation3 will also play Blu-ray movies right out of the box and it's no secret that Sony's business plan for Blu-ray Disc depends on heavy market penetration of the PlayStation3. On the flip side, Microsoft has started selling an add-on drive for the Xbox360 that will allow it to play HD-DVD movies and Microsoft is part of the HD-DVD consortium.



Quick primer on how DVDs work

As I'm sure most of you know, digital optical discs such as CDs and DVDs work by having a laser "read" data off the disc. The data is contained in small pits etched onto a layer of plastic. A reflective coating (usually aluminum) is applied and then the layer is lacquered. Since a DVD is comprised of several layers, each one follows this process and then all the layers are cured together.

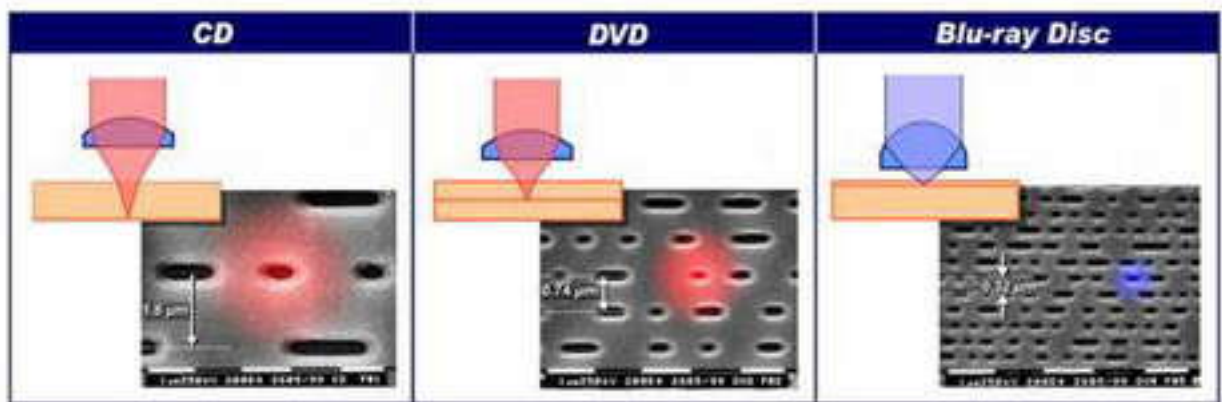
The pits are aligned in a groove and spiral out from the center of the disc, kind of like the opposite of an old vinyl record. For discs that are dual-layer, the second layer spirals from the outside-in so the laser doesn't have to move back to the center of the disc to start reading the second layer.



Think of the disc surface as low points (the pits) and high "plateaus", called "lands". To figure out if the laser is reading a one or a zero, it doesn't look to see if it's reading a pit or a land. Instead, it looks for the transition going from a pit to a land or from a land to a pit. Each

time it detects a transition, it marks that as a “1”. If there is no transition, it assumes that is a “0”. From there, the raw binary data is processed several times to yield the actual data. Most of this processing has to do with trying to ensure that the data is accurate even if there are minor scratches or smudges on the disc surface. In the case of movies, this data gets processed some more to go through the copy-protection scheme and then decompress the data to finally yield the actual image to be rendered on the screen.

This methodology has been used for CDs, DVDs, and the new high-def movie formats use it as well. The only physical difference between all three is that with each generation, they’ve made the pits and the grooves smaller and narrower so that more data can be packed onto the disc. But, in order to read the smaller pits, they’ve had to come out with lasers of higher and higher frequency (and make them cheap enough for consumer products). CDs use an infrared laser, DVDs red (which is higher frequency), and the new formats use a blue laser (which is a still higher frequency).



Why does it matter what frequency the laser is? In order to detect the changes on the surface of the disc, the laser needs to be diffracted, or “bent”. On a DVD, the pits are too small to diffract the infrared laser used on a CD. Likewise, the pits on the new high-def movie formats are too small to be diffracted by the red lasers used on DVDs.

Then what is the difference between the two new High-def formats?

The answer is very little. At the end of the day, both discs are simply digital storage devices. They both support the exact same video encoding standards (MPEG-2, MPEG-4 and VC1, among others) and the same audio standards (Dolby and DTS, among others). And, most movies for both will be encoded at the same size and frame rate: 1920x1080 at 24 frames per second (fps). In both cases, the player will shrink the image for 720p (which has a resolution of 1280x720) and up-convert the frame rate if the TV requires 30 fps or 60 fps display (some newer HDTVs can natively display 24 fps). As a side note, because of this encoding, you will be very hard-pressed to notice a difference between 1080i or 1080p for either format.

Ironically enough, both formats also use the exact same wavelength blue laser (405nm). So where does the difference come in? It has to do with the numerical aperture of the lenses used to

focus the laser and the thickness of the disc surface. Blu-ray's setup allows it to focus the laser "tighter" which in turn allows the discs to have a higher density. That translates to 25GB of data per layer versus only 15GB per layer for HD-DVD. Newer Blu-ray discs and all current HD-DVD discs are dual layer so that's a total of 50GB and 30GB of storage, respectively. Both formats support more than two layers so even higher storage capacity is possible, but most players will only read two.

VHS vs. BetaMax all over again?

With the previous two formats that battled it out for consumers, VHS and BetaMax, there was a clear difference in quality. The old magnetic tape formats "wrote" the analog waveform that was used by the cathode-ray tube to display the image. Within the design of TVs, there is a lot of leeway in what type of signal can be displayed. Some of the parameters that can be changed include the horizontal and vertical timing of the beam that draws the image (which affects the resolution and frame rate), and brightness and color signals. BetaMax had a higher bandwidth and could therefore be better in all those areas.



With the new high-def movie formats, the encoding formats are identical and the only practical difference is how much each disc can hold. So, in-and-of-itself, there is no difference. It would be like asking if a 100GB hard drive on your PC would store your Excel spreadsheet in a "higher quality" format than your 80GB hard drive. Of course, the answer is it wouldn't make a difference, as long as the drive had space.

Which gets us to where there could potentially be a quality difference. Each compression format allows the movie studio to make trade-offs between picture quality and data size. They can encode the movie high-quality, but then it will take up more space, or they can encode it low-quality to make it take up less space. Note that they don't make the picture size smaller to save space (it's still the same size and frame rate mentioned above), but instead degrade the "frequency response" of the pixels. It's kind of like taking two pictures, one with really high quality film and one with cheap film - the pictures are the same size, but one just looks better. If a studio wanted to compress the movie at the highest picture quality and the movie is really long, there might not be enough room on the disc for all the bonus materials that movie-buffs love.

With Blu-ray, this is unlikely to be an issue given its larger storage capacity. But with HD-DVD, there might be a problem. At that point, the studio has two options: either reduce the quality of the picture, or add a second disc with the bonus material. Other than cost, there really isn't a downside to the second option since people are already familiar with multi-disc sets. However,

there is always the possibility that the studio might cheap-out and try to cram everything on one disc.

Now, for those of you who might have read some of the very first head-to-head comparison tests of movies that were released on both Blu-ray and HD-DVD, you might have noticed that almost universally, reviewers rated the HD-DVD movies better. The reason is that the first-generation Blu-ray discs were only single-layer (so there was less space) and used MPEG-2 (which is an older, less efficient compression algorithm compared to MPEG-4 and VC-1). Newer Blu-ray discs don't have these handicaps anymore since the manufacturing process has been smoothed out.

What about players and movies?



Generally, HD-DVD players are cheaper than Blu-ray players. That's because the optics are similar to conventional DVDs. This in turn allows them to be backwards-compatible with regular DVDs almost by default. Blu-ray, on the other hand, has different optics so not only is there the extra cost of it just being new and different, but it has to be even more complicated to make it backwards-compatible.

Blu-ray movies are also more expensive to manufacture. HD-DVD discs can be pressed on the same equipment as regular DVDs with only a few modifications. This is because HD-DVD discs and DVD discs use the same type of plastic and place the tracks of data at the same depth inside the disc. Blu-ray discs require different tooling because they place the data much shallower, which in turn requires them to add a special coating to increase their scratch-resistance.

Right now, studios are releasing movies for both for about the same price. However, if it ever comes down to a price war, HD-DVD will probably be cheaper unless the Blu-ray studios want to cut their margins.

Speaking of studios, currently more studios are supporting the Blu-ray format. As of right now, the following major studios are supporting Blu-ray: Paramount, Warner Brothers, Disney, Fox, MGM and Sony. The major studios supporting HD-DVD are: Paramount, Warner Brothers and Universal Studios. However, keep in mind that studios will always gravitate to whatever platform has the most consumers.

Which brings us to, which format is selling better? Before last Christmas' holiday shopping season, HD-DVD clearly had an edge. They released players in late summer (over a month before the Blu-ray players) and were usually half the price. However, Sony's business plan is kicking into place and they claim to have sold a million PlayStation3 units since it's release in November. If that number is true, there are now about five times as many Blu-ray players as HD-DVD players in the hands of consumers.

Mitigating that is the fact that the attach-rates for HD-DVD are much higher. "Attach-rates" refers to how many movies the average console owner buys. Right now, people who own HD-DVD players buy almost five times as many movies as owners of Blu-ray players. The #1 selling high-def movie is "Batman Begins" which is only available on HD-DVD. The #2 selling high-def movie is "Superman Returns" which is available on both formats, but has sold more on HD-DVD. But since the launch of the PlayStation3, that trend is shifting and for the first time, sales of Blu-ray movies are outpacing sales of HD-DVD movies.



One thing that may push this battle decisively towards one camp or the other is if one of them can get a killer app. In the video game and software business, "killer app" is a term used to describe a program or game that is so hotly demanded by consumers that it actually drives sales of hardware. In this battle, the killer app would be a movie that people just have to have, no matter what. Perhaps something like the Star Wars franchise being an exclusive to one format.

So which one should you buy?

I wish I could give you a clear-cut answer. If you had asked me a few months ago, I would have said that HD-DVD would be the winner. However, the launch of the PlayStation3 has started to tip the balance of power towards Blu-ray Disc and Microsoft has not been able to sell as many HD-DVD add-on drives for the Xbox360 to keep up. But then again, Microsoft has more money than most countries and if they decide that HD-DVD is an important battleground for them, well you only have to look at what they've done with operating systems, web browsers, office productivity software, servers, etc., etc.

So my safe recommendation is to see what happens over the course of the year. But if I had to pick one, I'd say Blu-ray (with a HUGE disclaimer: your results may vary).