CD versus DVD: The Ultimate Portable Storage Battle

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CD versus DVD: The Ultimate Portable Storage Battle

Abstract
"In lieu of an abstract, below is the essay's first paragraph.

Over the years, changes in technology have contributed to shaping the way in which we live our lives. From the invention of the light bulb to that of the television set and computer, nothing remains the same once a technological advance has come about. Currently, another technological advance is preparing to change the way we live our lives. This new device is known as the DVD player and it is attempting to replace the CD player in the electronic multimedia world.

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Over the years, changes in technology have contributed to shaping the way in which we live our lives. From the invention of the light bulb to that of the television set and computer, nothing remains the same once a technological advance has come about. Currently, another technological advance is preparing to change the way we live our lives. This new device is known as the DVD player and it is attempting to replace the CD player in the electronic multimedia world.

Some people can remember back to when they used to listen to music on the radio and watch movies on the projector. Then came some enhancements that moved music onto vinyl records that were played with a needle. Movies eventually made their way onto VHS tapes and, at about the same time, music found its way to cassette tapes. Laser Discs came out bearing the weight of movies and offering somewhat better quality, but never got a strong hold in the movie industry. Around this time everything seemed fairly calm in the media industry until that one fateful day when the CD was introduced.

It was only about 13 years ago when the CD-ROM was introduced into the PC world. CD’s rapidly took over the software industry, as it was more practical to release a software package, or multiple packages, on one CD. This eliminated the need to monitor an installation (waiting to insert another floppy). Also, CD’s had a storage capacity equal to many hard drives of the time. Eventually, the CD-R and CD-RW emerged, making it possible for a user to create their own CD’s. This technology grew very quickly, as it gave users the chance to create their own CD’s to hold music or software. The CD-R gave users the chance to write their own CD’s while the CD-RW allowed them to write and re-write CD’s. This ability to reuse the same CD a couple of times was an excellent enhancement and made the write-able CD drives a little more economical. More recently, the DVD has entered the picture.

The DVD, otherwise known as the Digital Versatile Disk or Digital Video Disk, is preparing to change the way we think about movies, music, and software. The development of DVD technology started out in the hands of two separate groups. The Multimedia CD (MMCD), designed by Philips and Sony, and the Super Density (SD) disc, created by seven companies led by Toshiba, were the two possible technologies on the drawing board in December of 1995 when the two groups united to form the standard now known as DVD. From this point, DVD ran into many pitfalls, just as all new technologies do, on its way to becoming a viable contender against the CD. The next question is just how viable this new contender is.

The DVD industry had many problems which needed to be resolved before it could begin releasing and marketing this new technology. One of the main issues was with the motion picture industry. This problem delayed the shipping of DVD products from the summer of 1996 to the spring of 1997. The problem stemmed from political and technical disagreements over the amount of protection DVD technology offered against the illegal copying and distributing of the movies which it would hold. It wasn’t until October 29, 1996 that an agreement was made about the copy protection issues and work was finally able to resume on the development of the technology. This delay cost the DVD industry to lose a lot of potential profits since it was not able to release its new product in time for the Christmas buying season.

Marketing has increased greatly for the DVD since the delay, which pushed its release into 1997. As soon as the first DVD players began to appear in March 1997 for use with television, people began buying them as quickly as they could. This was due to the
idea that soon DVD’s would replace all “old” forms of multimedia in everyday life. At about the same time, Creative Labs released its first DVD upgrade kit.

What makes the DVD so popular is its enormous storage capacity, which opens the door to a world of possibilities. The DVD can hold a two-hour, full-motion movie with subtitle tracks, surround-sound audio, parental controls, and multiple languages. There is no CD that could even come close to this sort of capacity and capability, thus giving the DVD an easy shot at the dying CD. DVD’s offer better sound and video quality than even the VHS industry can provide. Could this mean that DVD’s could bring about not only the end to CD’s, but also to the VHS industry?

The technical magic that is somewhat forgotten behind the commonplace uses of the DVD is very interesting. The DVD has its roots in the physical construction of a CD, but it is more advanced. The DVD can be seen as a revised version of the CD, as its technology is very similar. The DVD even looks a lot like its predecessor, the CD. A DVD is the same size, about 5.25 inches, as a CD, yet it is the physical side that can’t be seen with the naked eye that makes the DVD stand apart from the CD. The traditional CD technology uses “pits” that measure at least 0.83 microns long, while the DVD uses smaller “pits” that measure about 0.4 microns long. A CD also uses “tracks” that are spaced apart by about 1.6 microns while the DVD uses “tracks” that are spaced only about 0.74 microns apart. This difference between the DVD and CD technology is made possible because the DVD-ROM laser uses a shorter wavelength than that of the CD-ROM. This difference in physical technology allows for a 700% increase in storage space on the DVD in comparison to that of a CD. The total capacity of a DVD is about 26 times that of a CD as the maximum capacity for a DVD is about 17.0 Gb and the maximum capacity for a CD is only about 650 Mb.

Another physical characteristic of the DVD has also allowed for the development of its increased popularity over the CD. A DVD allows for the possibility of writing to both sides rather than just one side, like a CD. Adding a semitransparent gold layer atop the reflective silver-colored layer does this. Then, using a low-power laser beam, the gold layer can be read. To read the second layer, a simple increase in the power of the laser allows access to the silver layer. Having the ability to write to both sides of a DVD allows for a substantial increase in the storage capacity of the disc. This, along with the technological advances made possible by the use of a laser with a shorter wavelength, has given the DVD the upper hand against the CD industry in its capability.

The two main technical goals of the DVD have been to achieve a greater capacity and throughput than that of the CD. It seems as though the DVD has effectively achieved its goals. With storage capacity increases of about 26 times, the first goal has been achieved. The several different DVD “formats” have all boasted a throughput rate that is at least 8 times faster than the traditional CD. There are currently four main formats of the DVD and they are DVD-5, DVD-9, DVD-10, and DVD-18. DVD-5 allows for storage on a single-layer and single-side of a DVD disc. This format offers a total storage capacity of about 4.7 Gb. Even this, the simplest format, can hold about seven times more than the CD which has been in use for a few years now. DVD-9 allows for storage on two layers of a single-side DVD and boasts 8.5 Gb of storage. The DVD-10 format provides storage on a single-layer on both sides of a DVD. This creates a storage capacity of about 9.4 Gb. The final format is the DVD-18. This format allows for data storage on two layers on both sides of a DVD. This is the ultimate format as it allows a storage capacity of about 17 Gb.

The CD became even more popular when the first write-able CD was introduced. This CD advancement, known as the CD-R, took the industry by storm. It allowed people to “burn” their own CD’s. Not long after that, the CD-RW emerged, giving people the
ability to use the same CD a couple of times. It was only logical that, if a successor to the CD were to emerge, it too would give users the ability to create their own media using this new technology. The DVD-RAM gives the DVD industry the power to overcome the CD-R and CD-RW that have become commonplace in the computer world. Both the write-able CD drives and the DVD-RAM use phase change technology to read and write data.11

Three main points can be used to describe the phase change data recording on a CD and DVD. CD’s and DVD’s write and read data in almost the same way. For a CD, the first point is an amorphous phase. This phase uses a high-power infrared laser beam that selectively melts areas on a CD’s silvery layer. These burned areas are less reflective and are called “pits” while the more reflective, unburned areas are called “lands.” When a laser reads CD’s, pits scatter light and are recognized as 1’s while lands are read as 0’s. The second main point for a CD is the annealing phase. During this phase, to erase or rewrite a CD-RW or a DVD, the laser uses its “high-power” beam. To convert a pit into a land, the laser uses a “low-energy” beam that is only hot enough to re-crystallize the “pit” to its original state as a land. The final point for a CD is its infrared laser. Just as in a CD-ROM, an infrared laser is used. This laser measures about 780 nano-meters. The wavelength determines how small the pits can be and, therefore, dictates how much data the disc can hold.12

There are three points which can be looked at when comparing DVD’s and CD’s. The first point concerns the writing and reading of data. This point for the DVD is about the same as that of the CD. The only differences in the writing and reading process are that the DVD uses a laser with a shorter wavelength and data is read at a much higher speed. The second point is the red laser. DVD-RAM uses a red laser that has a wavelength of about 635-650 nano-meters to read and write data. This shorter wavelength creates smaller pits and lands and thus a more tightly packed spiral-recording groove. This gives DVD a storage capacity of 2.6 Gb per side. The third and final point for DVD’s is the ability to double data. DVD’s can be burned on both sides, thus allowing for the doubling of data. This is one feature that CD’s were never able to achieve. This makes it possible for each side to have a dual layer of data.

The DVD-RAM represents the ideal portable storage when compared to the CD-R or CD-RW, which have held that distinction. The main problem is that the standards for this new technology have yet to come to rest. Yet another problem is the cost of this new technology. DVD-RAM drives are expected to run about $400-$80013 on the market. Another major hold back is that these drives will not necessarily be able to read DVD-ROM’s.14 Even with these drawbacks, the DVD will be a very powerful tool for archiving, backing up, and transferring data. With a fast write time of about 1.3 Mbps and read times of 1.2Mbps to 2.7 Mbps. These times easily surpass those of the CD-RW, which are about 300Kbps (4x) write time and 900Kbps (6x) read time.15

Today, movies are becoming more widely available on DVD. This has opened the door for yet another possible use of the DVD technology, and thus another possible victim of the DVD onslaught may be in sight. This new DVD feature is called Divx and it will make it possible to have one-time-use DVD’s. This can be very useful. It could revolutionize the movie rental industry. Divx stands for Digital Video Express and was developed by an R&D firm owned by Circuit City.16 The idea came from an important entertainment law firm by the name of Ziffren, Brittenham, Branca, and Fischer. This new technology would be based around a circuit and a system inside the DVD player that would allow for a two-day movie rental, for example, regardless of when the DVD was purchased. To go along with this example, additional rental periods could be purchased over a modem line connected to the DVD player. These Divx DVD’s are expected to sell for a reasonable
price of about $4.99.\textsuperscript{17} This technology could mean the end of the movie rental industry, as users would purchase rental times directly from the manufacturer.

This new technology could also have a use in the software industry. For example, if a company needed a piece of software for a certain project that would only last a couple of weeks, they could rent the software using the Divx system. A corporation could therefore have a library of all of the software they could possibly need and, when the time arose to use a certain piece of software, they could rent it for the time period in question. This would eliminate having to go and buy the software package at a much greater cost.

The part of the fight between the CD and the DVD that users should take a closer look at is that of the practicality and the cost. The DVD technology is much more advanced than that of the CD, which we have known for a few years. DVD allows for much greater amounts of data storage and an increased throughput. However, DVD's are somewhat unstable, at least in the market. A standard has not been completely set, as DVD technology seems to always be changing. It is very possible that the people who ran out to buy DVD players and become the first on their block to boast about the new technology in their home, could regret their hasty purchase if, and when, that technology is replaced. The biggest risk in the DVD industry is buying a DVD-RAM drive because this technology standard has some competition in development. DVD-RAM 1.0 is the first write-able DVD specification and a consortium of industry leaders announced it, including Hitachi, Matsushita Electric, and Toshiba.\textsuperscript{18} The main competition to the DVD-RAM is the DVD+RW, which is a 3 Gb standard backed by Hewlett-Packard, Philips, and Sony.\textsuperscript{19} This alternative to the DVD+RW is not due on the market until early 1999.\textsuperscript{20} The idea behind the DVD+RW is that it will be more closely related to the CD-RW standard, thus making it much easier for backward compatibility between the two.\textsuperscript{21} Until this fight cools down and the standard is set, buying a DVD-RAM is a very risky choice.

However, on the side of DVD, DVD-ROM drives can read not only DVD's but also CD's. For this reason, purchasing a DVD-ROM may not be that bad of an idea if your old drive has died or if it is time to upgrade your system. The software industry has not yet completely moved over to the technology of the DVD, but it is probably only a matter of time until it does. With the ability to store eight hours of movies or all of the following games--Wing Commander IV, Phantasmagoria, The 11th Hour, and Myst--on a single double-sided, double-layer DVD, why wouldn't the industry move towards DVD?\textsuperscript{22}

With all of the technical facts aside, DVD has enough to entice the kid in any of us. Certainly, "DVD is more than just a bigger bit bucket."\textsuperscript{23} Along with all of the technical facts, DVD includes the specs for MPEG2 video, which gives crisp, studio-quality 740-by-480-pixel images that can be compared with 320-by-240 pixel images from VHS tape.\textsuperscript{24} DVD also includes Dolby AC3 audio which delivers 5.1-channel, theater-quality surround sound in six different dimensions (five speakers plus a subwoofer) thus allowing for people to have a movie theater in their own home.\textsuperscript{25} Dolby AC-3 audio has five signal channels along with one non-directional signal channel for the subwoofer. Dolby AC-3 gives each channel its own data stream in contrast with Dolby Pro Logic which uses a matrix approach to encode the center and surround channels.\textsuperscript{26} The five channels that are assigned in this setup are the left, center, and right speakers in the front and to the left and right are surround speakers in the back, respectively. The quality of video and sound for movies alone should be enough to market DVD's successfully, once the standard is set.

Once again, there is another point of caution. To be able to play DVD's on your computer, you must, of course, purchase and install a DVD-ROM drive. However, in addition to the drive you must also purchase and install a PCI card that is an MPEG2 decoder. This is a costly addition to the DVD package, but it is worth it. The alternative to
this solution would be an MPEG2 decoding software package. The only problem with this is that it will slow the performance of the machine and thus produce video that is not of the highest possible quality for DVD. For the software to work at a quality anywhere close to that of the PCI card, you must have at least a Pentium II 350Mhz.

MPEG2 is a form of encoding necessary for high-quality video images. The MPEG1 compression is used in many software titles, but that was not a good enough compression for the quality that DVD required. MPEG2 and MPEG1 compression have the same basic idea behind them which allows for an easy understanding of the two: “The system identifies which portions of a video segment are unchanged from frame to frame, and it stores only the data describing the differences between frames.” 27 This adds a little light to the mysterious compression technology which makes the quality of DVD video equivalent to that of the master copy of the movies which the producers hold. DVD also allows for MPEG2 audio in addition to the Dolby AC-3 audio format that it supports.

MPEG2 audio is very similar to that of the Dolby AC-3 standard, but it can also add a left-center and a right-center channel. This means that MPEG2 audio supports a 7.1 channel configuration. This audio format can be seen as being more powerful because it is backwards compatible with stereo and Dolby Pro Logic playback systems as well as with the 5.1 and 7.1 configurations. 28 It seems, though, as if it will depend on where the DVD is coming from for which sound format it will use. DVD’s from the European market will most likely use the MPEG2 audio format, while those coming from the USA and Japan will use the Dolby AC-3 format. This difference is mainly due to the movie industry. If a movie is released on DVD in the USA, it may still be playing in theaters in Europe. If both countries used the same specification, there would be no way of stopping illegal copies of the movies from finding their way to the other country and cutting off box office revenues. 29

I feel that DVD’s are definitely a technological advancement that will be very useful in the computer industry. The only thing that makes me a little apprehensive is that it is not “proven” yet. CD’s have been around since about 1985, whereas DVD’s have only been around since about 1995. Of course, I realize that DVD’s have the potential for being around for just as many or maybe even more years than the CD has been. However, I feel that the DVD should not have been released as soon as it was. Most of these articles spoke of the maximum potential of the DVD as a 17 Gb storage capacity that can hold about eight hours of movies. This is a fantastic feat, but only a few of the articles explain that the double-sided, double-layer CD is needed for this capability and, at the time articles were written, this version of the DVD had not yet been released. DVD is definitely the successor to the CD, and I feel that it could revolutionize the media industry by finally standardizing media into one form.

Currently, tapes and CD’s are used for music and VHS tapes and laser discs are used for movies. Finally, all music and movies could be on one form of disc: The DVD. Even movie rentals and software distribution could be revolutionized by this new technology. DVD’s are set to become the ultimate portable storage; there is no doubt. What other device can boast 17Gb of storage space? From CD-R’s and CD-RW’s to Zip disks and Jaz disks, nothing can hold as much. The reason why write-able CD’s never took the title as the ultimate portable storage is because CD’s could only be written to once. Then, CD-RW’s came along. This allowed for one or two rewrites on a CD, but that is not enough. The ability to reuse a DVD will make it the ultimate portable storage.
Endnotes

3. Kelly
4. Kelly
7. Web
8. Jerome
10. Web
12. Somerson
14. Somerson
15. Somerson
17. Dvorak
19. Knorr
21. McLaughlin
22. Kelly
23. Kelly
24. Kelly
25. Kelly
26. Poor
27. Poor
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