# THE NEXT GENERATION OF HOME ENTERTAINMENT


***Version 1.0***

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## 1.0 New Entertainment Experience

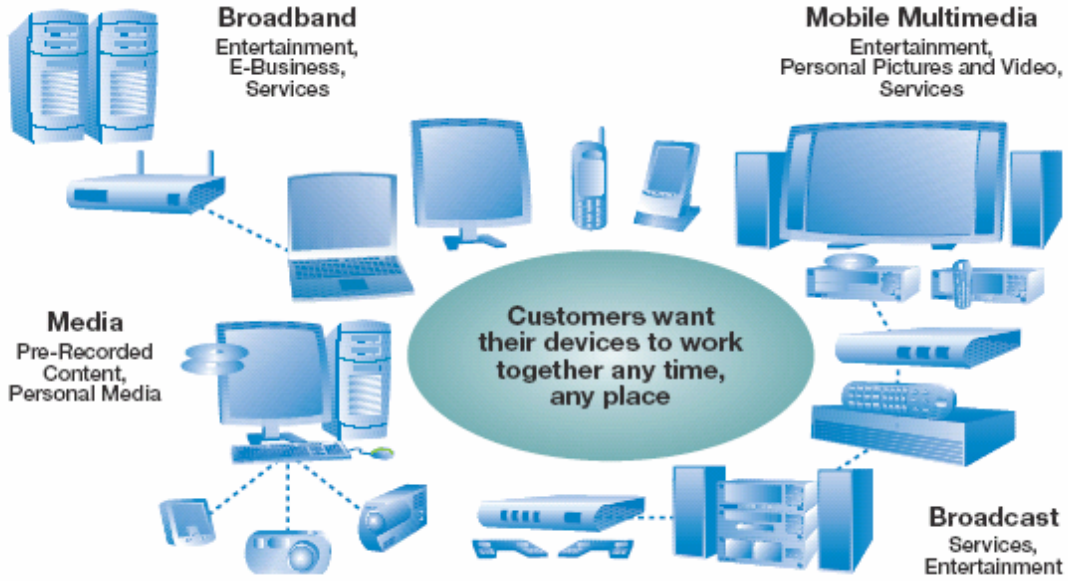
Electronic entertainment started with radio, took a quantum leap with television and high fidelity sound reproduction, then went into time warp mode with the videocassette recorder, allowing home viewers to create customized broadcast and movie schedules to enjoy at their convenience.

In the early 21st Century, the electronic entertainment experience is an immersive, end-to-end environment that has been extended to all corners of the home and beyond -- to vehicles, workplace and, thanks to shrinking mobile devices, as virtual fashion accessories attached to the body itself.

Essential elements of the emerging entertainment environment are high-speed broadband connectivity, high-definition (HD) visual displays, removable media such as DVD, and interoperable playback among a broad range of CE, PC and mobile devices. *(Slide 1)*

With consumer adoption of HD displays gaining momentum and high-speed Internet interactivity transforming every part of our culture -- from personal communications to popular entertainment – it remains for removable optical media, namely DVD, to exhibit a range of reproduction quality and functionality that is equal to elevated consumer expectations conditioned by high definition displays and broadband services.

***SLIDE 1: EPLEX: END-TO-END ELECTRONIC ENTERTAINMENT EXPERIENCE***




*SLIDE 1: The next generation of high-definition digital disc, HD DVD, must demonstrate a range of functionality that satisfies more demanding consumer expectations for versatility within the electronic entertainment environment growing around them. (Diagram courtesy of Digital Living Network Alliance)*

To satisfy the greatest number of stakeholders in both the industry and the consumer marketplaces as quickly as possible, thereby establishing itself as the de facto standard, the next generation of DVD needs to be fully interoperable with high definition displays and Internet connectivity, easily manufacturable, cost-efficient from beginning to end of the supply chain, and 100% consumer friendly, retaining the value of current DVD software and hardware.

It is with this world view of existing technology, emerging technology and consumer purchasing patterns that the DVD Forum -- an international organization of more than 240 companies, including suppliers of consumer electronics, PC hardware and software, and movie studios --- has established Version 1.0 Specifications for HD DVD as the next generation of a format that already has proved its global popularity and functionality.

HD DVD is the only next-generation format approved by the DVD Forum, which functions as the official international DVD standard development body for all technologies bearing the authorized DVD and HD DVD logos.

## 2.0 The DVD Generation

As a logical extension of optical disc technology, DVD was immediately familiar to mass-market consumers when it was launched in 1997, and quickly was embraced on its way to becoming one of the fastest-selling consumer electronics products ever.

Similarly, as a form factor, its physical properties established an instant comfort level for suppliers of optical disc replication lines, as well as for their customers, optical disc replication plants.

A DVD measures 120mm diameter and combines two 0.6mm substrates bonded together. The disc is scanned by a 650nm (nanometer)-wavelength red laser, with a track pitch of 0.74um, that a DVD player can read 10.08Mbps and a 3X ROM drive can read 30.24mbps.

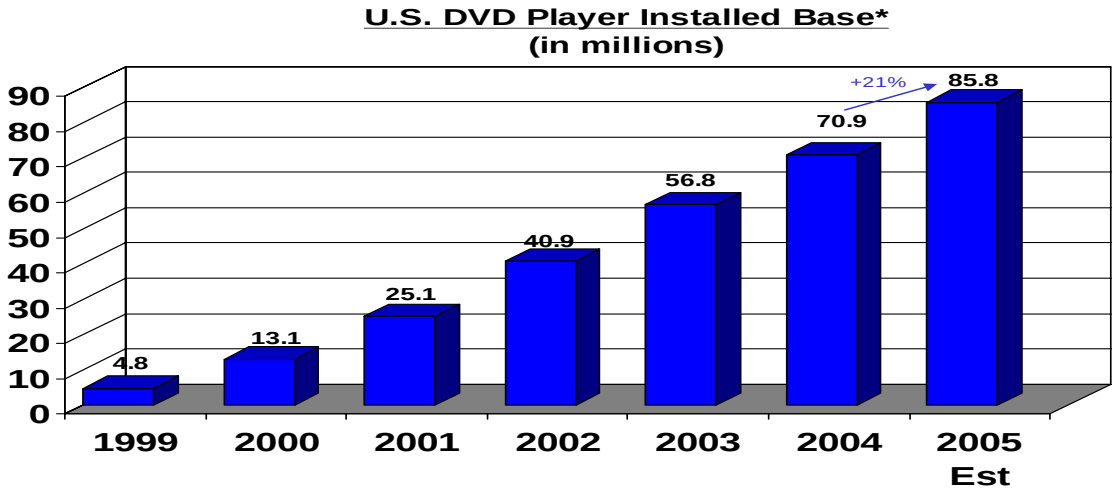
DVD's manufacturing simplicity and consistency assures easily sustainable quality control that will carry over to the next-generation HD DVD format.

### Popularity Leads to Market Saturation

In its first three years on the market, DVD surpassed the adoption rate of predecessors CD and VCR in their respective first three years of sales. DVD's growth trajectory since then has been continually impressive.

In 2004, Americans spent more than twice as much buying and renting DVD (more than $20 billion) as they did going to the movies (less than $10 billion), according to DEG: The Digital Entertainment Group. By 2006, says Warner Bros., more than 80% of U.S. homes could have a DVD player. (*Slide 2*)

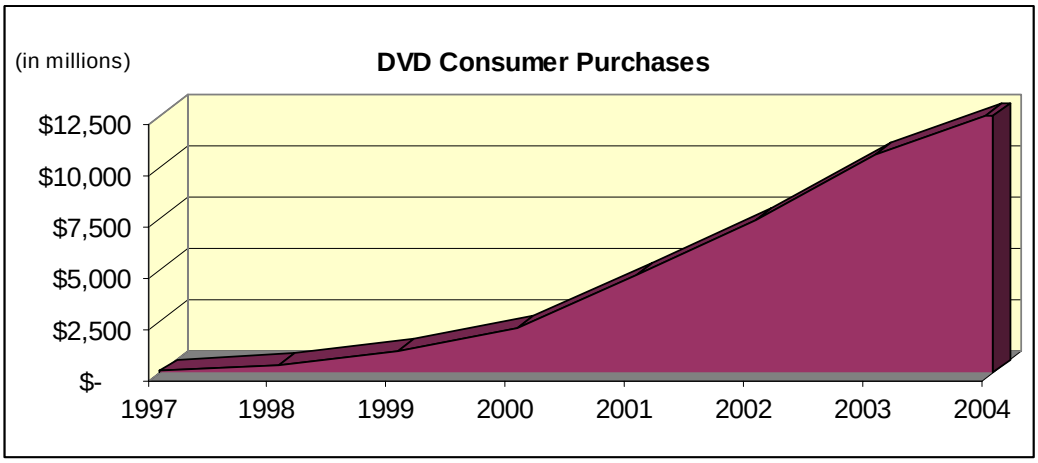
***SLIDE 2: DVD INSTALLED BASE IN U.S.***




*SLIDE 2: There is little room for future growth in standard-definition DVD, with more than 80% of U.S. homes expected to own a player by 2006. (Chart courtesy of Warner Bros.)*

That is an impressive track record, but its flip side is that the growth years for standard-definition DVD are behind it, as sales of players and prerecorded discs reach market saturation and the inevitable sales plateau. (*Slide 3*)

## *SLIDE 3: DVD CONSUMER GROWTH IN U.S.*




*SLIDE 3: Consumer purchases of DVD software in America are slowing as market penetration of DVD hardware reaches saturation. (Chart courtesy of Warner Bros.)*

It is time for the DVD industry at large to upgrade its technology, so it can renew market growth and keep pace with competing and complementary technologies.

Even though eight years into its life cycle may seem premature to some for standard definition DVD to be succeeded by the next generation of high definition DVD, today's optical discs begin to pale in side-by-side comparisons with the high definition TV images available through digital broadcasting.

## 3.0 The HD Generation

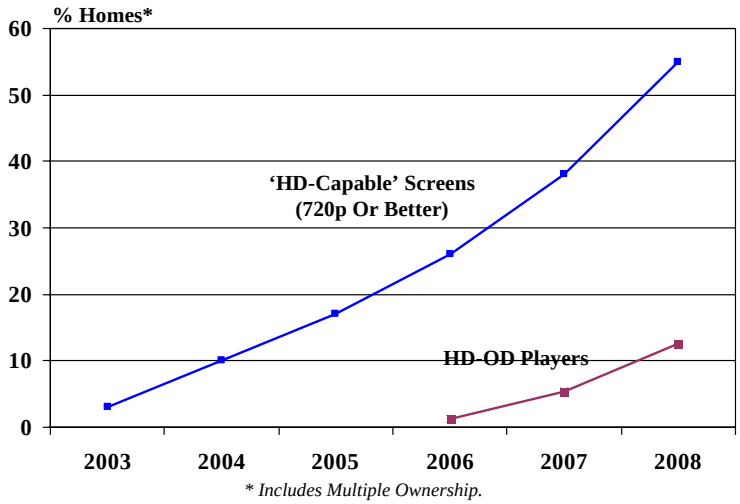
High Definition (HD) displays, the ultimate form of a general category called Digital Television (DTV), are capable of picture resolution dramatically sharper than that of standard definition (SD) television (NTSC, PAL, SECAM).

As HD display prices decline, and more high-definition programming is transmitted by broadcast, cable and satellite providers, there is a marked upturn in consumer purchases of HD displays.

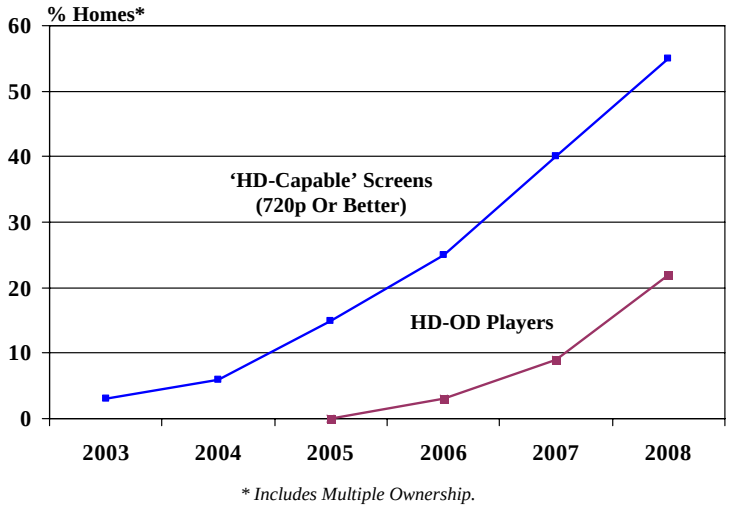
The fast rising tide of large-screen HD displays (often including HDTV receivers), particularly in America and Japan, makes it clear that standard definition DVD cannot provide the requisite quality that consumers quickly are beginning to expect in their 21st Century home theaters.

More than half of the homes in both America and Japan are expected to have an HD-ready display by 2008, a three- to four-fold increase compared with 15% to 20% of HD homes currently in both markets. *(Slides 4 and 5)*

## ***SLIDE 4: HDTV Outlook for Japan***




## ***SLIDE 5: HDTV Outlook for U.S.***




*SLIDES 4 & 5: Japan and America lead the world in consumer adoption of HD-capable displays, with both markets currently at 15% to 20% penetration, projected to increase to nearly 60% by 2006. (Charts courtesy of Understanding & Solutions)*

Japan is the world's leader today in HD broadcasting, with both terrestrial and satellite broadcasters vying to constantly add channels and more hours of programming in high definition.

Until HD arrived, DVD had been regarded as the universal benchmark of picture quality in the home. Once HDTV is in a home, it isn't long before the owner wants the images from a DVD player to equal the high definition picture quality delivered by TV stations.

Today's advanced display technology, combined with an Internet culture that demands interactivity in their digital devices, highlights the need for an equally advanced, high-density version of DVD … HD DVD.

There are features unique to HD that consumers are becoming accustomed to seeing and increasingly will expect in their DVD viewing as well.

**Picture Quality Measured in Pixels and Lines**

Picture resolution for HDTV is measured in pixels and lines, with 1920 (pixels) x 1080 (lines) the maximum density available. The higher the numbers, the better the clarity and detail of the picture. Therefore, so-called 1080i (for 1080 interlaced lines) or 1080p (for progressive scan of each full frame) yield the sharpest high-definition images.

Alternately, HD displays also are available with a resolution ratio of 1280 (pixels) x 720 (lines). (HD resolution is standardized throughout the world at 720p or better.)

At its upper limits, HDTV has the capacity for up to 1125 lines versus up to 625 lines for SD (depending on a particular world region's TV transmission technology). It's easy to see how a standard-definition DVD doesn't have enough picture density to maximize the image quality available on an HD screen.

The presence in HD displays of digital multi-channel surround sound adds an immersive sensory dimension that moves the home theater experience that much closer to the movie theater experience.

Inherent in the HD specification is a screen with dimensions proportioned in the cinema-like aspect ratio of 16:9 (16 units wide by 9 units high). For movies and other programs originating in a widescreen format, that means no pan-and-scan where the camera only lets you see one actor in the frame at a time. For sports, it means seeing the entire outfield in baseball all at once. Even programs originating in the legacy aspect ratio of 4:3 can be digitally reformatted by the user to fill the entire 16:9 screen proportion.

The picture-in-picture (PIP) feature available on some SD televisions is readily found on HD displays**,** permitting the viewer to monitor a secondary signal from a DVD player or other source.

On an HD channel, a PIP secondary image using a standard-definition DVD as the signal source will present a literal side-by-side comparison for the viewer of an HD picture and a legacy DVD picture that could prompt the HD consumer to wonder, “What’s wrong with this picture?” That, in itself, will be an incentive for an HD owner to upgrade to an HD DVD player.

**Trend to Larger and Flatter Screens**

By 2007, industry estimates are that flat panel TVs will be in 25% of homes worldwide, with the average screen size 27 inches and up, according to Consumer Electronics Association (CEA).

The larger the average screen size becomes, the more consumers will take note of picture information and want the recorded images displayed on their screens to be as vivid as TV channel images transmitted in high definition.

As broadcasters continue to add high definition programs and channels, viewers will look for more opportunities to enjoy the peerless picture quality only HD can deliver. It is during this period of HD broadcast development that HD DVD is

perfectly poised to satisfy consumer demand for a much broader choice of programs than will be offered by TV networks.

Digital TV data services emulate the kind of interactivity commonly associated with the Internet, where the viewer can purchase movie tickets, shop, order programs on demand that range from feature films to news clips.

## 4.0 The Broadband Generation

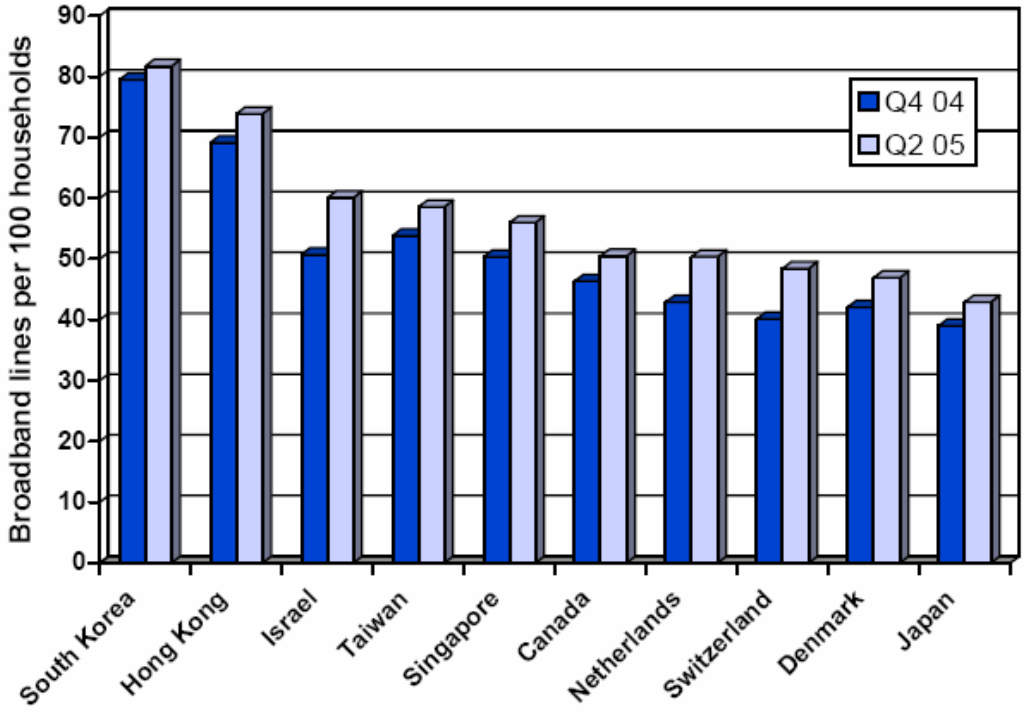
High speed connectivity – commonly called broadband -- that enables “always-online” access to the World Wide Web is fast becoming a standard household utility for a significant percentage of the world’s population. The connection is supplied by a cable (modem), phone (DSL), wireless connection, or satellite Internet service provider (ISP).

Broadband lines total approximately 180 million globally, according to research firm Point Topic Ltd. In the past year, says the company, Europe has shown one of the fastest growth rates in new broadband lines.

Both Japanese and American governments are pushing ahead with aggressive efforts encouraging the installation of broadband connections.

Number one in the world in terms of broadband penetration of households is South Korea, at more than 80%, while Japan rounds out the top 10 broadband world markets with more than 40% household penetration. *(Slide 6)*

*SLIDE 6: Top 10 Broadband Countries by Household Penetration (Dec. 31, 2004 to June 30, 2005)*




*SLIDE 6: Broadband is becoming a standard household utility for communications, entertainment and information among the major world markets. Broadband penetration rates in the top 10 countries range from more than 40% to above 80%. (Source: Point Topic Ltd.)*

In its multi-dimensional role as a thoroughfare of communication, information and entertainment – ultimately including high-definition images -- broadband is a cornerstone of the electronic entertainment environment.

As new consumer electronics technology, such as HD DVD, enters mainstream consumer usage, an inherent part of its versatility and broad appeal is to offer not only standalone operation, but it can function as a gateway to the Internet.

## 5.0 Broadband + HD + DVD = HD DVD

As an extension of the DVD format, HD DVD is the ideal and most practical way to take advantage of state-of-the-art HD technology, and to provide consumers with a broad assortment of high definition movies and other programs.

The baseline capacity of current standard-definition, DVD-ROM is measured at 4.7 gigabytes (Gbytes), for a DVD 5, which can hold up to approximately two hours at the optimum data rate. In addition, there are configurations with higher data capacities, as indicated in gigabytes (Gbytes) by their designations of DVD 9 (approx. 4 hours), DVD 14 (approx. 6 hours) and DVD 18 (approx. 8 hours).

The array of standard DVD choices has proved more than sufficient to contain on a single disc at least one feature-length movie plus extra content that adds value to a home entertainment library. The unique capabilities of DVD have enabled the format to not only thrive as a distribution medium for movies and other entertainment forms, but to extend the movie experience with original, behind-the-scenes productions created exclusively for DVD and the home audience.

Even allowing for the considerable capacity needed to render high-density images, HD DVD builds on DVD’s singular ability to offer not only extended recording and playback times but an extensive menu of user-selected options that deliver a total multimedia experience.

**An Easy Upgrade Path from DVD to HD DVD**

As with DVD, HD DVD consists of two 120 millimeter (mm)-diameter substrate layers each 0.6mm thick bonded together. Sharing DVD's basic structure means it also shares a time-tested, reliable manufacturing process – from authoring to mastering to replication -- allowing HD DVD's yields to be optimized even in the initial stages of the production cycle, improving its marketability and cost efficiency over formats not based on the underlying DVD specification.

The upgrade path from DVD to HD DVD for media makers is affordable, flexible and intuitive. It also is immediate, with a short learning period for provider or consumer.

Thanks to advanced encoding technology, the use of a blue laser combined with data rates up to 3 times faster than standard DVD results in an HD DVD with up to 3 times the capacity of DVD. The use of a red-laser at the higher data rates on a 9Gbyte disc yields a two-hour HD DVD-Video.

HD DVD users will benefit not only from state-of-the-art picture quality, but from features and functionality much more advanced than what consumers are familiar with on current DVD. Multiple audio and video streams, up to 7.1-channel surround sound, plus graphical interfaces that are more user-friendly and Internet-like are just some of the enhancements HD DVD brings home.

## 5.1 How High Def Differs from Standard Def DVD

HD DVD's 405nm (nanometer)-wavelength blue-violet laser translates into a smaller laser spot aimed on the disc's surface that can read the more densely packed data stored on the disc. The 650nm red laser used in standard DVD players also can read HD DVD 9, a configuration that yields two hours of high density pictures and multi-channel sound on a single disc, using advanced codecs AVC or VC-1. *(Slide 7)*

Significantly, the cost to produce HD DVD/9 is expected to be roughly comparable to a standard definition DVD 9, a major advantage of extending the legacy DVD format into the realm of HD.

The "pits" marked on the disc surface that contain audio, video and data streams are tinier on an HD DVD than on DVD. Along with more efficient encoding, that allows for more capacity as well as more playback and recording time at the higher data transfer rates required for high-definition images.

## ***SLIDE 7: HD DVD and DVD Specifications***

| | STANDARD DEFINITION | HIGH DEFINITION | | | |
|---|---|---|---|---|---|
| | **DVD-Video** | **HD DVD-Video (HD DVD-9)** | **HD DVD-Video (HD DVD-ROM / Read-Only)** | **HD DVD-Video Recording (HD DVD Recordable)** | |
| **Disc Type** | **DVD-ROM (Read-Only)** | **3X DVD-ROM (Read-Only)** | HD DVD-ROM (Read-Only) | HD DVD-R (Recordable) | HD DVD-Rewritable (Recordable) |
| **Disc Diameter** | **120 mm** | **120 mm** | 120 mm | 120 mm | 120 mm |
| **Disc Structure** | **0.6 mm x 2 Substrates** | **0.6 mm x 2 Substrates** | 0.6 mm x 2 Substrates | 0.6 mm x 2 Substrates | 0.6 mm x 2 Substrates |
| **Capacity**<br>**(Single-Sided, Single Layer)**<br>**(Single-Sided, Dual-Layer)** | <br>**4.7 Gbytes**<br>**8.4 Gbytes** | <br>**8.4 Gbytes** | <br>15 Gbytes<br>30 Gbytes | <br>15 Gbytes | <br>20 Gbytes<br>32 Gbytes<br>(Under Development) |
| **Playback Time***<br><br><br>**Recording Time*** | **4.7 Gbytes**<br>**SD Resolution**<br>**132 minutes**<br><br>**8.4 Gbytes**<br>**SD Resolution**<br>**238 Minutes** | **8.4 Gbytes**<br>**HD Resolution**<br>**120 Minutes** | 15 Gbytes<br>HD Resolution<br>Over 4 Hours<br><br>30 Gbytes<br>HD Resolution<br>Over 8 Hours | 15 Gbytes<br>HD Resolution<br>Over 4 Hours | 20 Gbytes,<br>HD Resolution<br>Over 5.5 Hours<br><br>32 Gbytes<br>HD Resolution<br>Over 8.4 Hours |
| **Laser Wavelength** | **650 nm (Red Laser)** | **650 mm (Red Laser)** | 405 nm (Blue Laser) | 405 nm (Blue Laser) | 405 nm (Blue Laser) |
| **Compression Technology** | **MPEG-2** | **MPEG-4 AVC / VC-1 / MPEG-2** | MPEG-4 AVC / VC-1 / MPEG-2 | MPEG-4 AVC / VC-1 / MPEG-2 | MPEG-4 AVC / VC-1 / MPEG-2 |
| **User Bit Rate** | **30.24 Mbps** | **30.24 Mbps** | 30.24 Mbps | 30.24 Mbps | 30.24 Mbps |
| **Track Pitch** | **0.74 µm** | **0.74 µm** | 0.40 µm | 0.40 µm | 0.34 µm |

*SLIDE 7: Sharing the same physical disc structure with standard definition DVD, HD DVD's greater picture density and data capacity result from the shorter wavelength of blue laser, the smaller track pitch and the higher bit rate. Using a red laser with a 9Gbytes disc still allows for a two-hour HD DVD.*

## 6.0 Advantages of HD DVD

HD DVD is notable for many special features, including the same physical structure as DVD, which affords consumers compatibility with existing libraries, and extensive potential for data or run time capacity through the most advanced encoding methods available.

### 6.1 Saving Space & Optimizing Quality Through Video Compression

A fundamental difference between HD DVD-Video and DVD-Video is the advanced encoding used to deliver high definition video information. These are called video codecs.

The legacy video encoding used on standard DVD-Video is MPEG-2. More advanced video encoding, such as AVC (MPEG-4 Part 10, H.264) and VC1, use lower bit rates to deliver comparable HD quality. They are space-saving forms of compression that achieve high definition sharpness even with standard DVD as a signal source.

In addition to their being used in HD DVD, the above advanced codecs also now can be used in standard-definition DVD-Video.

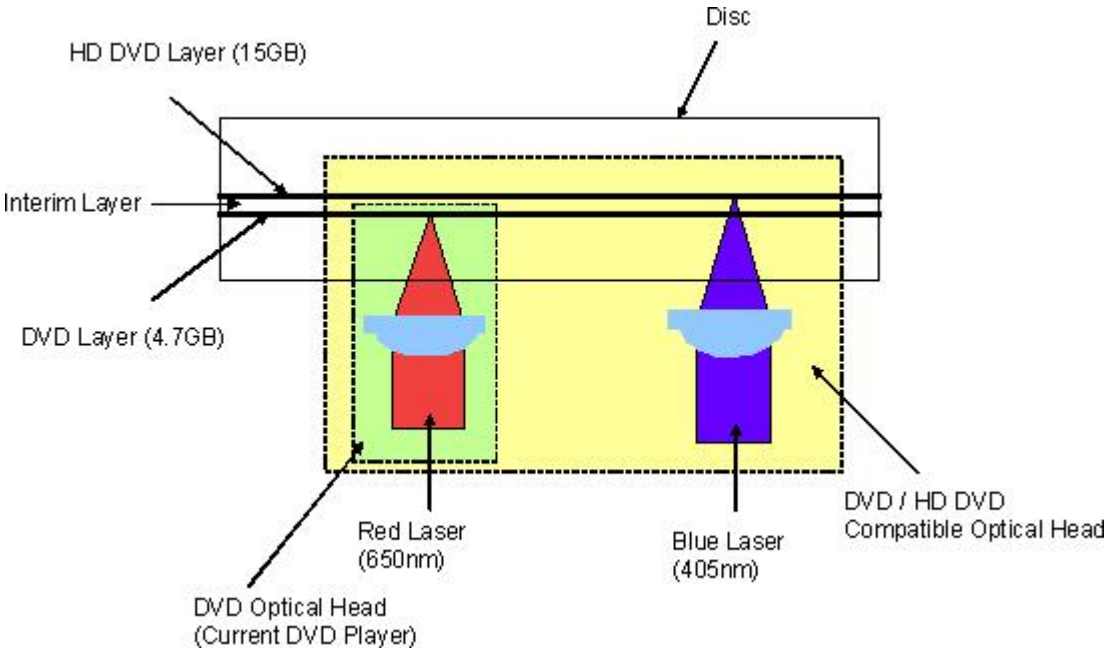
## 6.2 Backward Compatibility

Just as makers of DVD players prefer to position them in the market as versatile, multi-format machines compatible with CD, VCD and DVD, the individual manufacturers of HD DVD players want to make their next-generation product also as convenient and competitive as possible. For that reason, not due to mandatory specifications, they are designing many of their models to play all of the previous formats as well.

As a result, legacy formats will be playable on most next-generation HD DVD players to accommodate consumers who wish to retain the full value of existing DVD and CD libraries for many years to come.

For that reason, not due to mandatory specifications, in addition to hardware that can play a variety of optical disc formats, one way to achieve backward compatibility on the discs themselves is illustrated in *Slide 8*, with the Twin Format HD DVD.

***SLIDE 8: Twin Format HD DVD***



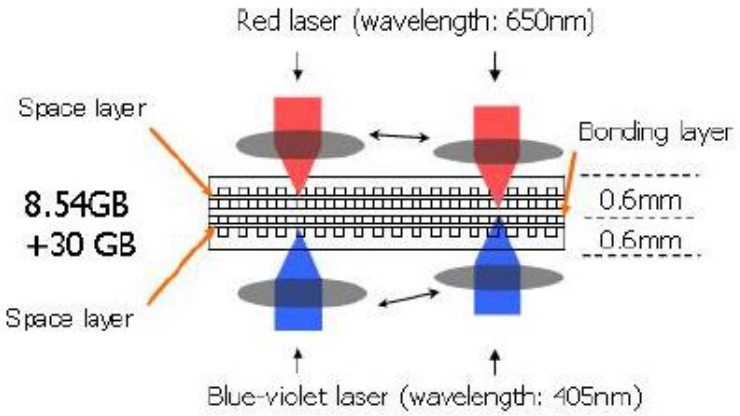

*SLIDE 8: In a single-sided, dual-layer Twin Format HD DVD, the red laser in a standard definition DVD player reads DVD-5 layer, and the blue laser in an HD DVD player passes through the lower DVD layer to read the 15Gbytes HD upper layer.*

The uniquely symmetrical disc structure of HD DVD enables unique configurations. DVDs designated as “Combination” and “Twin Format” are expressly designed so the DVD-ROM side (or layer) can be played in legacy DVD players currently on the market.

Combination discs are double-sided, comprised of two 0.6mm discs, with HD DVD and DVD on flip sides. (*Slide 8A*)

Twin Format discs are single-sided, with one layer of HD DVD and one layer of DVD. Consumers with standard DVD players can buy these backward compatible discs and use them as fully functional, so by the time they are ready for an HD DVD player, they will own a built-in library of HD programs.

*SLIDE 8A: Combination Format HD DVD*




*SLIDE 8A: The double-sided, dual-layer HD DVD-ROM/DVD-ROM disc bonds together a 0.6mm thick dual-layer HD DVD-ROM disc with 30Gbytes capacity, and a 0.6-mm thick dual-layer DVD-ROM disc with an 8.4Gbytes capacity. The disc has a structure as simple as that of current dual-layer DVD-ROM discs. More than fifty percent of DVD-ROM discs on the market are dual-layer versions.*

## 6.3 HD DVD Configurations

As *Slides 9 and 10* illustrate, HD DVD comes in several configurations that make it suitable for a wide variety of applications and bit budgets.

[NOTE: Capacity is computed on average bit rate of 8 to 12Gbytes]

1) Single-side, single-layer 15Gbytes HD (approx. 4 hours)
2) Single-side, dual-layer 30Gbytes HD (approx. 8 hours)
3) Single-side, dual layer 15Gbytes HD (approx. 4 hours) + 4.7Gbytes SD (approx. 2 hours)
4) Double-side, single-layer 15Gbytes HD (approx. 4 hours) + 4.7Gbytes SD (approx. 4 hours) or 8.4Gbytes SD (approx. 8 hours)
5) Double-side, dual-layer 30Gbytes HD (approx. 8 hours) + 4.7Gbytes SD (approx. 4 hours) or 8.4Gbytes SD (approx. 8 hours)

A maximum capacity of 60 Gbytes is possible by combining two 30Gbytes substrates back to back that could deliver approximately 16 hours of HD programs.

***SLIDE 9: HD DVD Formats at a Glance***

**HD DVD-ROM**
(Read-Only)

- Single-sided
  30Gbytes (dual-layer)
  15Gbytes (single-layer)
  9Gbytes (single-layer)
- Double-sided
  60Gbytes (dual-layer) [1]
  30Gbytes (single-layer) [1]

**HD DVD-R**
(Recordable)

- Single-sided 15Gbytes (single-layer)
- Double-sided 30Gbytes (single-layer) [1]

**HD DVD-Rewritable**

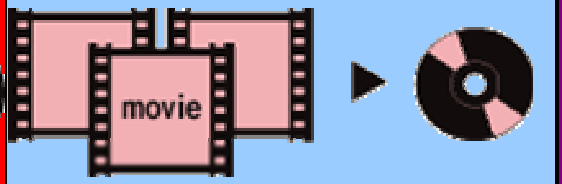
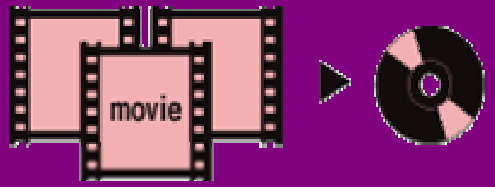
- Single-sided
  20Gbytes (single-layer); 32Gbytes (dual-layer) [2]
- Double-sided
  40Gbytes (single-layer) [1]

[1] Under development for manufacturing

[2] Under development; not yet approved by DVD Forum

*SLIDE 9: HD DVD read-only, recordable and rewritable media will be available in a variety of configurations to satisfy the specific needs of user groups and applications.*

***SLIDE 10: HD DVD Menu of ROM Configurations:***

| 1 | DVD   | | | | HD DVD   | | | | HD DVD SD DVDCombination Format   | | | | HD DVD/ SD DVD Twin Format   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disc Configuration | DVD 5 | DVD 9 | DVD 14 | DVD 18 | 3X DVD ROM | HD 15 | HD 30 | HD 45 * | 1 | 2 | 3 | 4 | |
| Capacity (GB) | 4.7Gbytes | 8.5Gbytes | 13.5Gbytes | 17Gbytes | 4.7Gbytes<br>8.4Gbytes | 15 Gbytes | 30Gbytes | 45Gbytes | 15Gbytes HD + 4.7Gbytes SD | 15 Gbytes HD + 8.5Gbytes SD | 30Gbytes HD + 4.7Gbytes SD | 30 Gbytes HD + 8.5 Gbytes SD | 15Gbytes HD + 4.7Gbytes SD |
| No. of Sides | 1 Side | 1 Side | 2 Sides | 2 Sides | 1 Side | 1 Slide | 1 Side | 1 Side | 2 Sides | 2 Sides | 2 Sides | 2 Sides | 1 Side |
| No. of Layers | 1 Layer | 2Layers | 2 Layers + 1 Layer | 2 Layers + 2 Layers | 1 Layer<br>2 Layers | 1 Layer | 2 Layers | 3 Layers | 1 Layer + 1 Layer | 1 Layer + 2 Layers | 2 Layers + 1 Layer | 2 Layers + 2 Layers | 2 Layers |
| Optical Pickup (Laser Type) | Red Laser | Red Laser | Red Laser | Red Laser | Red Laser | Blue Laser | Blue Laser | Blue Laser | Blue Laser + Red Laser | Blue Laser + Red Laser | Blue Laser + Red Laser | Blue Laser + Red Laser | Red Laser + Blue Laser |
| Format Capacity (Hrs) | SD 2 Hrs | SD 4 Hrs | SD 6 Hrs | SD 8 Hrs | 1 Hr<br>2 Hrs | HD 4 Hrs | HD 8 Hrs | HD 12 Hrs | HD 4 Hrs + SD 4 Hrs | HD 4 Hrs + SD 8 Hrs | HD 8 Hrs + SD 4 Hrs | HD 8 Hrs. + SD 8 Hrs. | SD 2 Hrs + HD 4 Hrs |

**In development; not yet approved by the DVD Forum*

*SLIDE 10: The versatile variety of DVD and HD DVD configurations offer both content providers and consumers a wide choice of packaged media options that range from a single movie with some extras on a DVD5 to several movies in high definition on an HD DVD 30 and the same movie in both High Definition and Standard Definition on a Combination or Twin Format disc. A maximum capacity of 60 Gbytes is possible by combining two 30Gbytes substrates.*

## 7.0 Special Features of HD DVD

Here's a close-up look at the various aspects of technology that set HD DVD apart from DVD and other optical disc formats.

## 7.1 Advanced Content

For instant connectivity and communication, the Internet is the place to be. For rich content, high-definition images, multi-channel soundtracks, graphical animation, seamless interactivity, and portable convenience in data storage, HD DVD discs are optimum.

Through a new technology dubbed Advanced Content *, users will discover on HD DVD-Video a seamless and intuitive form of interactivity that is a notable improvement over standard definition DVD. *(Slide 11)*

Advanced Content offers a clean, DVD-optimized design that enables content authors to create highly compelling, user-friendly and value-added content as easily as creating a web page. By using a combination of XML and ECMA script, content authors can tap a wide range of web-based programmers to quickly develop content.

Advanced Content uses an open standards-based format, and is similar in structure to a web page: it has a markup element that defines the user interface, and may include a programmed script portion for more complex logic. However, Advanced Content goes beyond HTML by offering animation and frame/field accurate timing, which eliminate many of the common requirements for scripting.

DVD-Video offers single video and audio streams, requiring the user to toggle, for example, between a movie's native soundtrack and a second, separate commentary track, on which the dialogue and musical score are inaudible.

* During its developmental stages, Microsoft's code name for Advanced Content was iHD.

**Seamless and Immersive Interactivity**

With three video decoders in a HD DVD-Video player and with the additional audio components, HD DVD is capable of very compelling scenarios.

For instance, during a football game recorded on HD DVD-Video, an icon could appear on the screen to indicate a sports commentary is available. Unlike the DVD-Video experience, where a menu screen must first be selected by the user before the movie starts playing, the HD DVD-Video user will be able to start a commentary from the main video in the middle of the film, without stopping it or switching to another menu.

After the user selects the icon onscreen, the sports commentator could appear onscreen and walk across the football field while drawing plays right on top of the action as the game continues playing seamlessly. For added effect, the cheering of the stadium crowd could be heard mixed in with the sports commentator's voice. The user could control the volume of the commentator's voice so it is louder than the ambient noise from the stadium.

Additionally, games could be incorporated into the football video. For instance, the user could select a button on the remote and graphical images of football defenders could appear on the screen. As the wide receiver catches the football, the user could control the graphical defender to tackle the wide receiver that appears on the screen, accumulating points as the user comes in contact with the wide receiver.

The user would have the ability to save the points for later game-playing sessions while watching the movie by utilizing the HD DVD-Video player's mandatory "persistent storage" feature. As the user accumulates points and reaches various levels, bonus features could be unlocked, such as special

locker-room footage of players soaked in champagne after winning the championship.

The viewer could utilize the HD DVD-Video player's mandatory Ethernet jack to connect to the home network or Internet. There, he could either post the top scores or download additional footage in the form of trailers of future football games that are coming out, or additional commentaries available on future football game releases.

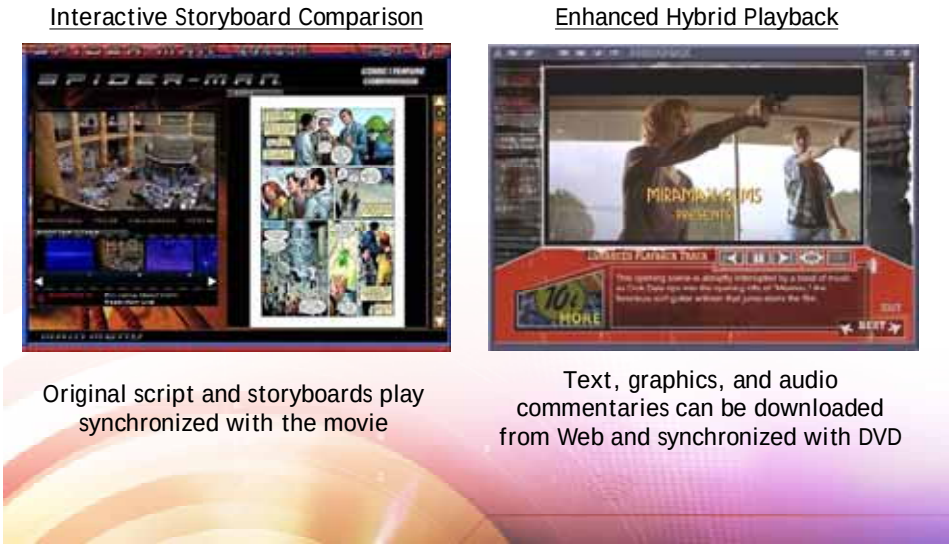
***SLIDE 11: Advanced Content***


*SLIDE 11: Disc content can be seamlessly integrated with a website, as the screen shots here of a fishing trip illustrate, where the viewer can both learn about the sport and at the same time, order fishing gear through the Internet. (Courtesy of The Richard Diercks Co.)*

A prerecorded disc can be linked to a website to be constantly updated, where rich graphics and full-motion video is on the disc itself, along with a template, while new data online, such as cost, availability and new models in a product line, is merged with the disc to create a complete experience marrying the best of both optical disc and online worlds.

Another example of how HD DVD can interact with the Internet is that movies already in the possession of consumers can be synchronized with website content dedicated to that movie to create seamless filmmaker commentaries that are not embedded on the disc itself. In addition, movie studios can host real-time, online chats between home viewers and stars or directors, who comment and answer questions as the movie is playing. *(Slide 12)*

***SLIDE 12: Web Connectivity***




*SLIDE 12: HD DVD web interactivity allows home library discs to be synchronized with live online commentaries. (Courtesy of Sonic Solutions/Interactual)*

***SLIDE 13: Live-action Commentary***


*SLIDE 13: A commentator can be seen onscreen as part of the main action with HD DVD Advanced Content authoring tools.*

There are other examples of how viewers will benefit from content developed through Advanced Content authoring tools.

**Transaction Options Embedded in Entertainment Programs**

In a sportscast, the analyst can be seen on screen, as part of the action, drawing diagrams on the field during the actual plays in a game. *(Slide 13)*

Using see-through menus that pop up during a feature film, the viewer can click the cursor on an object in the movie – such as a sports car in a James Bond film – to learn more about it and even purchase it.

Since HD DVD players have “persistent storage,” where data collected by the user is retained in player memory, high scores can be recorded when playing HD DVD-Video games. When the user achieves a certain score, certain bonus content on the disc will be unlocked.

Using combination HD DVDs, with standard definition DVD on one side and high-definition DVD on the flip side, allows the user to purchase on disc and have the capability of using that disc on their HD DVD-Video player in the main home theater room and to also play it back while they are in the car, in the kid's room or kitchen.  Thus, one disc provides playback on legacy DVD players, while still offering the high quality and interactivity of HD DVD-Video discs.

## 7.2 Advanced Access Content System (AACS) Protects IP, Adds Value for Rights Holders

The  Advanced Access Content System (AACS), a mandatory technology in HD DVD specifications for both Prerecorded Video and Recordable Video, is state-of-the-art AES cryptography featuring 128-bit “broadcast” encryption key management . AACS was developed as a versatile copy protection and digital rights management (DRM) system by IT, CE and content companies that include Disney, IBM, Intel, Matsushita, Microsoft, Sony, Toshiba, and Warner Bros.

In the wake of the Content Scrambling System (CSS) used in DVD-Video having been decrypted, then widely distributed illegally over the Internet, AACS carefully is designed in part as a moving target for hackers. It provides both proactive and reactive expiration for software HD DVD players, as well as revocation -- reinforced by enhanced robustness -- for hardware HD DVD players.

Among its chief attributes is that it enables authorized use, deters unauthorized copying and redistribution through casual and broad distribution channels, and effectively repairs holes in copy protection by revoking and renewing security keys.

At the same time, versatile AACS allows multiple forms of user access that afford owners of intellectual property new opportunities to extract aftermarket revenue streams from a specific title even when it already is part of a home library.

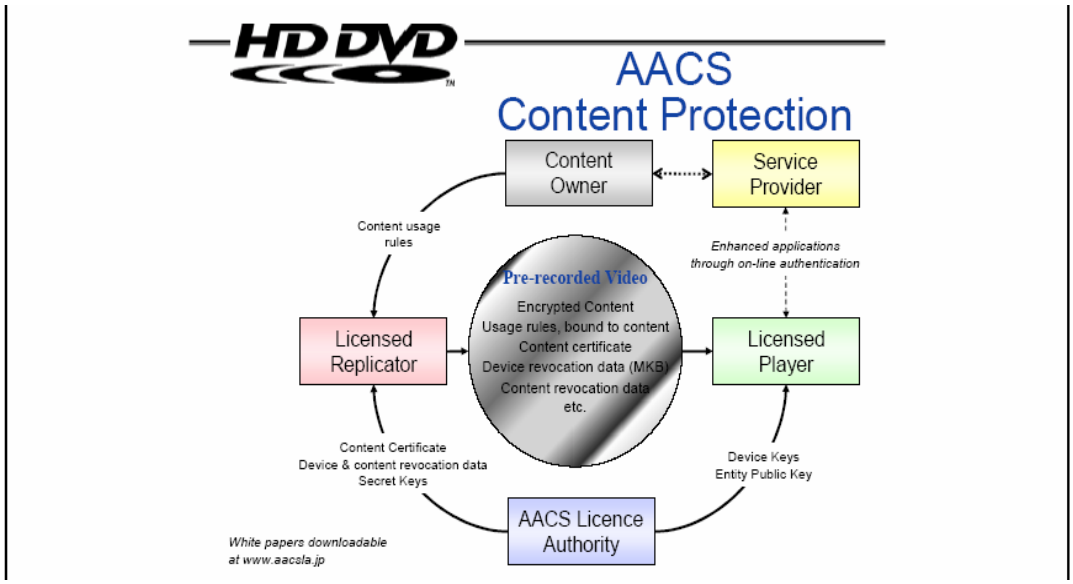
### Advantages of Revocation

AACS content verification and revocation protocol includes a signed replicator ID issued by the AACS License Administrator (AACS LA). Device revocation data on the disc is in the form of a Media Key Block that enables compliant HD DVD players. Embedded on a disc’s digital content certificate is a theatrical mark and a consumer mark, either of which can prevent playback of an unauthorized copy.

Verification data cannot be copied and bit for bit copies cannot be made. *(Slide 14)*

Should the hardware's media key be compromised by a hacker, AACS LA can provide a new MKB to the replicator that will revoke the media key and render the player unusable for future discs.

***SLIDE 14: Content Protection***




*SLIDE 14: The Advanced Access Content System (AACS) specification is a robust cryptography and digital rights management system designed to protect and authorize the use of high definition and other forms of digital content. In combination with Media Key Blocks (MKB) that are renewable, a device key can revoke a disc from being played on a compromised CE or PC player.*

As part of its "revocable" key design, AACS offers "renewable" encryption to content providers. A common key that is shared among a specific type of software HD DVD player expires after a set time period, and an updated version of the software player, with a different key, is made available to users for download. The original software player version eventually becomes unusable.

Adding to the heightened security level of AACS, the device identifier key is different for consumer electronics hardware than for software-based PC devices. Various versions of the same movie can be released in the marketplace, each version containing a different device key.

**Managing Digital Rights**

Preventing illegal copying is just one of the value propositions AACS brings to HD DVD. It also functions as a content management system, enabling both set-top and PC functionality, plus consumer flexibility in using HD DVD drives across a range of devices.

Whether in a home network or with mobile devices, AACS facilitates new revenue streams for content providers through authorized storage and content transfer transactions, such as burning content on recordable HD DVD.

AACS also enables interoperability among various devices, while ensuring the rights of both license-holders and consumers are protected and fairly served.

## 7.3 Film Grain Technology

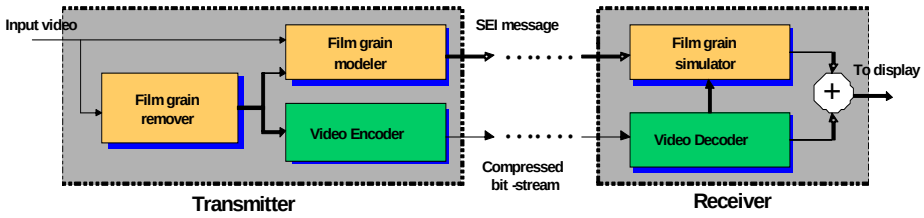
An encoding process unique to HD DVD, Film Grain Technology (FGT) enables a movie studio to use a lower video encoding data rate for a given picture quality level. Individual results will vary and depend on the content of the particular clip, and FGT is optional for studios (but it is mandatory for players to support it).

Since less data is needed to encode the video, there is more room on the disc for bonus and other additional content. In addition, since video encoded with FGT requires a lower data rate, it is more efficient for streaming video to an HD DVD player from the Internet. *(Slide 15)*

But Film Grain Technology is not merely a matter of saving bits for more efficient encoding. It is another quality assurance method that delivers to viewers the best possible picture resolution for filmed entertainment at home.

## ***SLIDE 15: Film Grain Encoding***

- **Transmitter:**
  - **Remove the film grain for more efficient encoding.**
  - **Model the film grain and send parameters in H.264 SEI (Supplemental Enhancement Information) message.**
- **Receiver:**
  - **Simulate film grain according to SEI parameters.**
  - **Re-insert film grain to decoded images prior to display.**




*SLIDE 15: Through the use of Film Grain Technology, movie studios can use a lower video encoding rate and still achieve the same picture quality as at a higher bit rate. (Courtesy of Thomson)*

In general, there is a trend that using FGT on AVC High Profile yields an increase in quality versus not using FGT on AVC High Profile. A greater increase in quality is achieved at the lower bit rates versus higher bit rates (i.e., it is not linear).

For motion picture content, the increase in quality varies and is content dependent, although even content that does not have strong, visible film grain may benefit significantly. When pausing the content, the quality increase is more easily measured and the results are more consistent across the various clips. At a constant quality, using FGT reduces the necessary bit rate up to 20% on average (depending on content).

## 7.4 Full Menu of Audio Reproduction Options

The DVD Forum has approved several audio codecs to be used in sound reproduction for HD DVD. Hardware providers will support all these options, so software providers can choose any for their production needs:

- Dolby Digital+ Lossy (5.1-channel compressed, enhanced 7.1-channel)
- DTS HD Lossy (5.1-channel compressed, enhanced 7.1-channel) and multi-channel lossless
- MPEG Audio
- Dolby Tru HD, MLP (Meridien Lossless Packing; 2x compressed linear PCM)

### *SLIDE 16: Audio Streams*


*SLIDE 16: Up to three audio streams can be mixed simultaneously on HD DVD. (Courtesy of The Richard Diercks Co.)*

HD DVD player outputs can have coaxial cable and optical connection for optimum digital surround sound playback through 5.1-channel, 6.1-channel or 7.1-channel systems. *(Slide 16)*

HD DVD has the ability to play the commentary track and simultaneously play the HD movie soundtrack into one multi-channel stream, where the viewer can independently vary the volumes of either to comfortable listening levels. Unlike with current DVD, this allows both the film soundtrack and the additional commentary both to be heard.

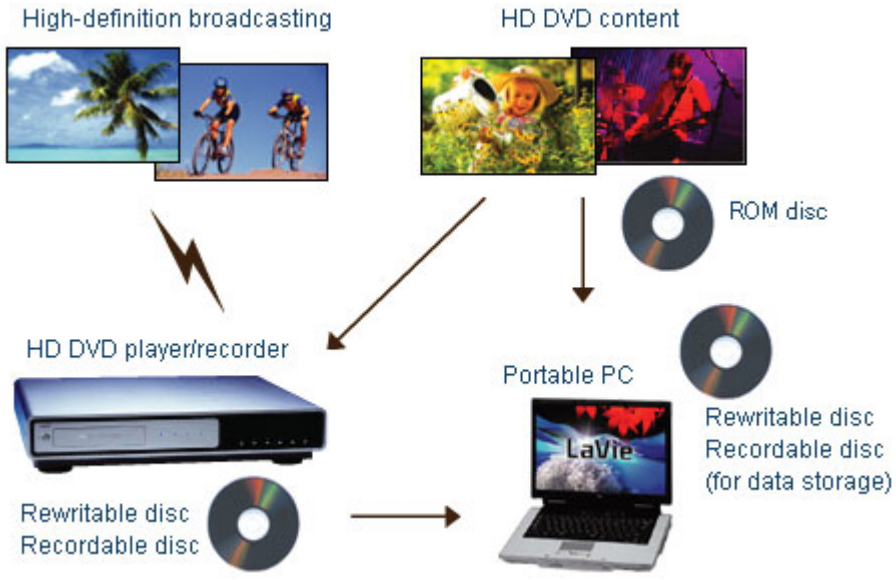
## 7.5 Recording Capabilities

HD DVD-RW discs are re-writable and can be used to record 20 Gbytes per side for re-writable versions.

Prototype HD DVD Player (Courtesy of Sanyo)

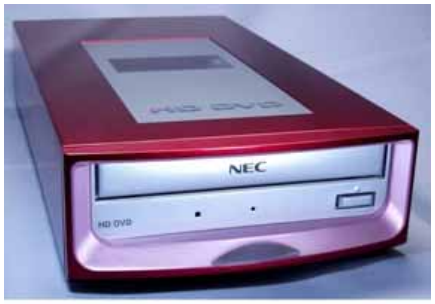
**HD DVD-R** discs are write-once recordable discs with a capacity of 15Gbytes per side. Hitachi Maxell, Mitsubishi/Verbatim and Ricoh have verified the manufacturability on existing lines of the discs.

### *SLIDE 17: HD DVD Recording*




*SLIDE 17: With a bit rate as high as 29mbps, HD DVD recordable and rewritable discs can store and display HDTV images at full resolution.*

The DVD Forum has defined the standard for a single-sided, single-layer HD DVD-Rewritable disc with 20Gbytes capacity that can accommodate about 5.5 hours of HD content. Additional capacity is expected to be available in the forthcoming single-sided, dual-layer disc. *(Slide 17)*




*HD DVD Drive (Courtesy of NEC)*

Interactive program guides also afford the viewer maximum flexibility in finding and programming favorite shows and channels, for recording on write-once or rewritable HD DVD discs. Because ideal bit rates for optimal HD transmissions throughout the world are 15 to 25Mbps for MPEG 2, and HD DVD runs at a bit rate as high as 29mbps, high-definition images can be recorded and played back at the highest resolution available for home viewing.

The high-density capacity of HD DVD recordable will be particularly appealing to consumers as the amount of data stored on home media servers and hard drives increases exponentially – to as much as six times current capacity by 2010, according to consulting company The Diffusion Group -- and users look for ways to download selected content to convenient, robust physical media that easily can be transported.

## 8.0 Summary

As digital displays steadily replace legacy television sets throughout major world markets, both suppliers and end users of consumer electronics, information technology and programming are ready for the next generation of packaged and recording media.

The new format of choice needs to take full advantage of, and add value to, the state-of-the-art quality and functionality of high definition (HD) technology.

The worldwide popularity of the eight-year-old DVD format sets the stage for introducing to the market the most convenient, familiar and obvious successor: HD DVD.

HD DVD shares enough fundamental similarities with the base format to achieve economies of scale in disc manufacturing even before a critical mass of players is installed. Yet, it also improves enough on standard definition (SD) DVD to make it worthwhile for program suppliers to reissue catalog titles as well as first-run feature films, and to revive consumers' interest in quickly amassing a library of their favorite entertainment.

**Added Value of Backward Compatibility**

In fact, home viewers can begin collecting HD DVD programs without having to own an HD DVD player. Combination and Twin Format discs take different design approaches to offer consumers backward compatibility, where the same disc and movie can be played either on a legacy player or, when it arrives in the home, a new HD player.

As with DVD players, many HD models , even though it is not a mandatory specification, also will play existing CD, VCD and DVD discs.

In addition to HD-quality images, advanced content with unprecedented levels of web connectivity and user interactivity, and multiple audio streams that can be mixed and separately adjusted in volume by the user, HD DVD uses constantly improving video codecs to pack many hours of high definition data, and many more hours of standard definition data, onto a 12-centimeter disc. Including formats under development and yet to be approved by the DVD Forum, HD DVD is capable of containing 45Gbytes on a single disc.

The robust AACS encryption system of content protection leverages renewable and revocable media keys to keep rights holders always a step ahead of device hackers and pirates. It is a major improvement over the Content Scrambling System (CSS) that years ago was decrypted and illegally distributed worldwide.

All of the attributes of HD DVD have converged at just the right time to allow allied industries and the consumer public to continue deriving value from the most successful format in history – DVD – while adding rich new layers of value in the form of the next most successful format. Welcome to the World of HD DVD.