



HD DVD Production White Paper

Key Facts and Information to Help You Initiate Your HD DVD Production Business



SONIC USA • 101 Rowland Way • Novato • CA 94945 • Tel: 415.893.8000 • Fax: 415.893.8008

SONIC BURBANK • 3500 West Olive Avenue • Suite 730 • Burbank • CA 91505 • Tel: 818.823.4000 • Fax: 818.823.4004

SONIC EUROPE • 22 Warwick Street • London • W1B 5NF • UK • Tel: +44 20 7437 1100 • Fax: +44 20 7437 1151

SONIC PAC RIM • 4F Shirokanetakanawa Station Building • 1-27-6 Shirokane • Minato-ku Tokyo 108-0072 • Japan • Tel: +81 3 6408 2811



CONTENTS

Introduction	Page 3
Preparing for the Next Generation	Page 4
HD DVD Key Capabilities	Page 5
HD DVD Physical Specifications	Page 6
Disc Types	Page 7
HD DVD Technical Specifications	Page 8
Disc Categories	Page 8
HD DVD Standard Content	Page 8
HD DVD Advanced Content	Page 9
Region Coding	Page 11
Content Protection	Page 11
AACs Implementation Workflow	Page 12
HD DVD Production in Practice	Page 13
Project Planning	Page 13
Encoding	Page 13
Interactive Graphics Preparation	Page 15
Subtitle Production	Page 16
HDi Coding	Page 16
Authoring - HD DVD Standard Content	Page 17
Authoring - HD DVD Advanced Content	Page 18
Emulation and Quality Control	Page 20
Premastering	Page 20
Replication	Page 21
Packaging	Page 21
HD DVD Production Workflow - HD DVD Standard Content	Page 22
HD DVD Production Workflow - HD DVD Advanced Content	Page 23
Starting Your HD DVD Production Business	Page 24
Sonic - The Leader in Digital Media	Page 25
FAQs	Page 26
Appendix A - HD DVD Resources and Information	Page 27
Appendix B - HD DVD Glossary of Terms	Page 28
Acknowledgements	Page 29



INTRODUCTION

Congratulations! You've taken the first step to initiating your HD DVD production business. This white paper is a whistle-stop tour of the HD DVD format from its origins, through to why it's needed, what it is, how it works, how you author titles, and how you can add production services to your business. It often uses SD DVD-Video as a context. Therefore, a certain level of DVD knowledge is assumed.

Questions and Feedback

If you have any questions about the content of this paper, please contact your nearest Sonic representative using the information provided below. We appreciate any comments or feedback you provide. If you have any questions, or have any suggestions on how any areas could be improved, please email your comments in confidence to whitepaper@sonic.com.

About Sonic Solutions

Sonic Solutions is the leader in digital media software, providing a broad range of interoperable, platform-independent software tools and applications for creative professionals, consumers, and technology partners. Sonic's products include professional encoding and authoring systems used by Hollywood studios to create the most-advanced and highly interactive Blu-ray Disc, HD DVD, and SD DVD titles.

Sonic has been the leading provider of digital media creation technology since the inception of digital media itself. Following on from SonicStudio - Sonic's industry leading CD editing and mastering solution - Sonic was the first company to deliver a professional DVD-Video production workstation in 1996. Sonic's Scenarist system has now been used to release over 4 billion DVD titles. A founding member of the HD Authoring Alliance, an association of top authoring facilities worldwide, Sonic is dedicated to accelerating the development of the authoring skills, capacity, and technological infrastructure required to support the rapid adoption of HD DVD. Working together, the HDAA have helped design and refine the optimum HD DVD workflow resulting in industry leading products like Sonic Scenarist® and Sonic CineVision™.

For more information

Contact your regional Sonic representative for more information or visit the Sonic Web site www.sonic.com.

- U.S.A. (West) Terry Marshall - terry_marshall@sonic.com. Tel: +1.818.357.7825
- U.S.A. (East), Canada, & Latin America Brian Murphy - brian_murphy@sonic.com. Tel: +1.415.893.7832
- Europe, Middle East, & Africa Richard Linecar - richard_linecar@sonic.com. Tel: +44 20 7437 1100
- Pacific Rim Terry Marshall - terry_marshall@sonic.com. Tel: +1.818.357.7825

You can also contact your nearest Sonic reseller using our online reseller locator: www.sonic.com/reseller



PREPARING FOR THE NEXT GENERATION

Multi-level media market

Today's digital media market offers consumers a vast array of options for enjoying, sharing, and creating content, including cable/satellite transmission, the Internet, DVDs and CDs, and self-created digital video and photos. Empowered by digital technology, consumers are increasingly eager to use it on their own terms — to enjoy what they want, when they want it, where they want it. That presents both a challenge and an opportunity for the owners and distributors of content, as well as for the technology suppliers that serve them. Continued growth depends on constantly enhancing the consumer media experience with greater quality and interactivity while also enabling seamless play-anywhere convenience across all media platforms. With breathtaking image quality, sophisticated interactivity, Web connectivity, and dynamic content integration, HD DVD is ready for this challenge, offering all the next-generation ingredients required to thrive in a demanding multi-level media environment.

The value of HD DVD

In consumer markets like home video, success is driven by household penetration, and penetration is driven by value: providing a high-quality, reliable, and convenient experience for low cost. High value is what builds support from studios, manufacturers, retailers, and ultimately consumers.

It's been only a decade since the debut of DVD-Video, which offered compelling value and was rewarded with the most successful consumer electronics product launch of all time. Once again, the home video industry is on the verge of transformative change. This time the driver for technical innovation has been the promise of high definition picture, but high definition is just the start of what HD DVD has to offer. The combination of interactivity, connectivity, and dynamic content integration allows HD DVD to deliver excellent value, offering consumers an entertainment experience unlike any that has come before and creating new opportunities for the business, creative, and technical communities that serve the home video market.

For HD DVD, one aspect of value is higher image quality, which is increasingly important as HDTV sets become more and more popular. Another is the format's advanced interactivity, which allows far greater integration between the featured program — the "movie" — and associated controls and bonus features. Whether it's changing languages, viewing picture-in-picture content, or bringing up bonus features like synchronized storyboards, you can do it all without interrupting movie playback by going to a separate menu.

HD DVD also adds value to the media experience by keeping content fresh through Web connectivity and dynamic content integration. With HD DVD, synergy between the disc and the Web is available not only from the desktop but also from the set-top. That gives studios and other content publishers far greater opportunity to develop ongoing relationships with consumers through features such as unlocking bonus content, online commerce, and notification about sequels and other related products.

A seamless transition

While based on DVD-Video, HD DVD's advanced capabilities are enabled by new technology that requires a fresh look at the infrastructure, skill sets, and workflow involved in production. For businesses with a stake in existing optical media, contemplating changes to established processes in order to accommodate a brand-new format may seem less pressing than day-to-day concerns demanding immediate attention. But in the current competitive environment, there's no advantage to waiting before getting up to speed.

Sonic has been deeply involved in the HD DVD format since day one, both as a DVD Forum member and as a close partner with leading studios and consumer electronics manufacturers. Our HD DVD expertise is unsurpassed, and we've built it into industry-leading HD tools such as Scenarist® and CineVision™. At the same time, we've dedicated ourselves to providing existing and potential customers the information they need to transition smoothly to a high definition world. Through seminars and training, and also with documents such as this White Paper, we're helping the industry prepare for the future of optical media. Your opportunity to take advantage of what we have to offer begins on the following pages...



HD DVD KEY CAPABILITIES

Stunning picture and audio quality is only part of what the HD DVD format has to offer. The combination of HD video, interactivity, connectivity, and dynamic content integration is what enables HD DVD to deliver an entertainment experience unlike anything consumers have experienced before. HD DVD's key features include:

Menus over video

Menus, advanced interactivity, games, and player settings can all be accessed at any time without leaving the main video presentation and interrupting playback. For example, chapter menus can be viewed and the video content searched without leaving or stopping the main video presentation.

Picture-in-picture: On-screen commentaries and documentaries

Extra features, such as Directors commentaries or 'Making-of' documentaries, can be overlaid on top of the main video presentation to provide seamless playback of bonus footage and an enhanced viewer experience.

Information overlays

One or more layers of additional information can be added to enhance the viewing experience. Overlays can be switched on and off via a menu.

Interactive games

HD DVD's Advanced Interactivity capabilities (using the HDi standard) enable the creation of highly interactive games that can be played on top or outside of the main video presentation.

Integrated network connection

All HD DVD players feature a built-in network port for connecting players to users' home networks and the Internet. This connection can be utilized for downloading and displaying updated enhanced content, e-commerce opportunities, marketing communications, and downloading player firmware updates.

High Definition video and codecs

HD DVD supports a wide range of HD video resolutions including 720p, 1080i, and 1080p. The HD DVD specification features support for AVC (also known as H.264 and MPEG-4), VC-1, and MPEG-2 (MP@HL) video.

High Definition surround sound audio and codecs

HD DVD supports up to 7.1-channel surround sound. The HD DVD specification supports Linear PCM, DTS®-HD, Dolby® Digital Plus, and Dolby TrueHD (formerly known as MLP) audio.

Improved subtitle support

Whereas SD (Standard Definition) DVD offers support for only 2-bit subtitles, the HD DVD specification features support for 32-bit menu buttons and 8-bit subtitles enabling the inclusion of colorful and intricate button highlights and subtitles.

Enhanced content protection

The Advanced Access Content System (AACS) specification provides support for both digital and analog copy protection as well as copy control data to enable users to distribute the content to a variety of other multimedia devices, in accordance with custom rules defined by the content provider.



Fig. 1 - HD DVD's many features include pop-up menus and information overlays.

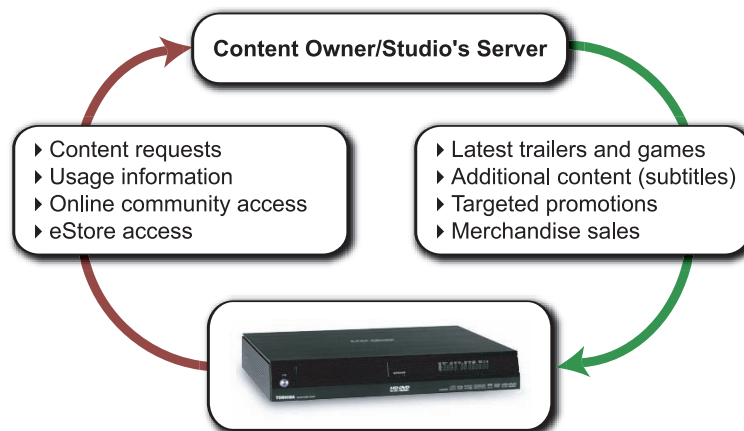


Fig. 2 - Network connectivity transforms HD DVD into a dynamic multimedia carrier.



HD DVD PHYSICAL SPECIFICATIONS

HD DVD is next-generation technology continuing the evolution of optical media that began with CD and progressed with DVD. Using a standard 12cm disc, HD DVD achieves radical increases in capacity with the use of a blue (or, more accurately, violet) laser, enabling more efficient use of physical space on the disc's surface. The SD DVD and HD DVD physical specifications are compared below.

	DVD-ROM (Read-only)	HD DVD-ROM (Read-only)
Disc diameter	120mm	120mm
Disc thickness	1.2mm (2 x 0.6mm)	1.2mm (2 x 0.6mm)
Laser type	Red laser	Blue laser
Laser wavelength	650nm	405nm
Track pitch	0.74µm	0.40µm
Capacity (single-sided, single-layer) ¹	4.7GB	15GB
Capacity (single-sided, dual-layer) ¹	8.4GB	30GB
Capacity (max)	17GB ³	90GB ⁴
Approximate optimum playback time (single-sided, dual-layer) ²	4 hours (SD)	8 hours (HD)
Maximum data rate (data, 1x)	10.08 Mbps	30.24 Mbps
Maximum data rate (video)	9.80 Mbps	29.40 Mbps
Video compression technology	MPEG-2 and MPEG-1	AVC (H.264), VC-1, and MPEG-2
Maximum picture resolution	720 x 480i (NTSC) 720 x 576i (PAL)	1920 x 1080p
Aspect Ratios	16:9 and 4:3	16:9 and 4:3
Audio compression technology	Dolby® Digital, DTS®, MPEG Audio, and LPCM.	Dolby Digital Plus, Dolby Digital, Dolby TrueHD, DTS-HD, DTS, LPCM, and MPEG Audio.
Maximum audio resolution	96 kHz, 24-bit	192 kHz, 24-bit
Maximum audio channel configurations	8 (7.1)	8 (7.1) ⁵

¹ Using base 10 whereby 1GB = 1 billion bytes

² Assuming an average bit rate of 4.6 Mbps for SD DVD and 8.3 Mbps for HD DVD

³ Double-sided, double-layer

⁴ Double-sided, triple-layer. Under development at time of writing.

⁵ More channels possible using DTS-HD extension stream technology



DISC TYPES

HD DVD-ROM (Read-only)

Used for mass replication, capacities range from 15GB (single-sided, single-layer) to 90GB (double-sided, triple-layer⁶).

HD DVD-R (Recordable)

Used by desktop and laptop PCs for creating one-off HD DVD titles or data back-up ROM discs. Capacities range from 15GB (single-sided, single-layer) to 60GB (double-sided, dual-layer).

HD DVD-RW (Re-recordable)⁶

A re-recordable version of the HD DVD-R disc, capacities range from 15GB (single-sided, single-layer) to 60GB (double-sided, dual-layer).

HD DVD-RAM (Rewritable)

Capacities range from 20GB (single-sided, single-layer) to 64GB (double-sided, dual-layer⁶).

HD DVD-5 and HD DVD-9

Using an existing red laser dual-layer DVD-ROM, the HD DVD title is distributed on a standard DVD-ROM disc and played back by the next-generation HD DVD player.

Twin Format Disc

Also known as a Combination Disc, the twin format disc can be used for distributing content to both Standard Definition and High Definition users using a single disc. The disc contains three layers in total and can be configured using either two layers for HD DVD (30 GB) and one layer for SD DVD (4.7 GB) or one layer for HD DVD (15 GB) and two layers for SD DVD (8.5 GB). The players are then able to read the relevant blue or red laser layer(s). SD users can also use the disc in their new HD DVD player when they upgrade without having to purchase a new HD DVD title.

⁶ Under development at time of writing.



HD DVD TECHNICAL SPECIFICATIONS

Disc Categories

The HD DVD specification defines two standards – Standard Content and Advanced Content. Therefore, HD DVD titles can be one of two categories:

- Category 1 Disc – Standard Content only
- Category 2 Disc – Advanced Content only

HD DVD Standard Content

Sometimes referred to as ‘DVD-Video on steroids’ the HD DVD Standard Content specification builds on the existing DVD-Video specification by adding extra functionality and features. A summary of these enhancements are listed below.

	SD DVD	HD DVD Standard Content
Video Title Sets	99	511
Titles	99	511
Commands per PGC	128	1023
Command lines per cell	1	8
Command lines per button	1	8
GPRMs (16-bit memory registers)	16	64
Subpicture resolution	2-bit	8-bit
Supported Video Codecs	MPEG-2 and MPEG-1	AVC (H.264), VC-1, and MPEG-2
Support Audio Codecs	Dolby® Digital, DTS®, MPEG Audio, and LPCM.	Dolby Digital Plus, Dolby Digital, Dolby TrueHD, DTS-HD, DTS, LPCM, and MPEG Audio.

Other Standard Content enhancements include:

- Menus (Video Manager Menus and Video Title Set Menus) can now contain multiple video, audio, and subpicture streams. This makes multilingual authoring much easier.
- The First Play is now a “true” PGC which means it can now contain video, audio, and subpicture content.
- The First Play may optionally be flagged as a “Language Menu”.
- The Resume Command area has been redefined to enable improved Resume functionality.
- Execution of Cell Commands is now seamless.
- “Jump to Title” may now jump to any Title in any Video Title Set, resulting in dummy Program Chains no longer being required for navigating between Video Title Sets.
- “Jump to PGC in System Space” may now call Menu Program Chains in other Video Title Sets.
- New Command: “Set Menu Description Language”.
- The player language may be overridden by the disc.
- New definition of SPRM 0: Current Menu Description Language.
- Player default is now stored in SPRM 21.
- Layer break transitions can now be seamless.



HD DVD Standard Content Data Structure

The Standard Content specification uses the same data structure as the Standard Definition DVD-Video specification: Program Chains (PGCs) for video, audio, and subtitles; Parts of Titles (PTTs) for chapter point navigation; Cells; and User Operations. However, the data is stored in a new HVDVD_TS folder on a finished disc (equivalent to the VIDEO_TS folder used on SD DVD titles). Figure 3 shows the contents of a typical HVDVD_TS folder (HD DVD Standard Content Volume).

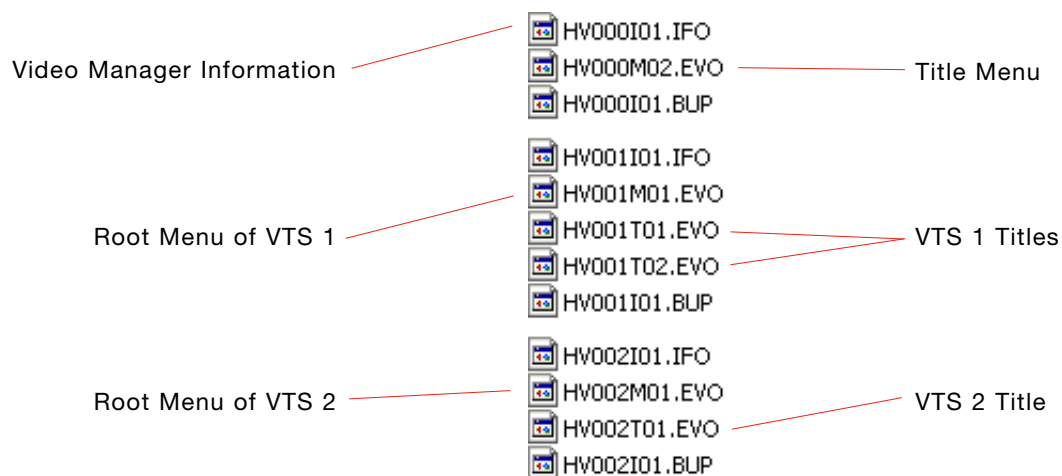


Fig. 3 - Contents of a typical Standard Content HD DVD Volume.

HD DVD Advanced Content

The Advanced Content specification is a crucial component of the HD DVD format as it enables a majority of the next-generation features listed in *HD DVD Key Capabilities* section.

What is HD DVD Advanced Content?

Based on the “HDi” standard co-developed by Microsoft® and Disney®, the interactive part of the Advanced Content specification is a combination of Web-based standards including XML, SMIL, ECMAScript, and XSL. HDi is used by HD DVD developers to create the applications that bring the range of next generation features to life.

The best starting point for understanding Advanced Content is existing top-tier standard definition Hollywood DVD titles. These titles commonly feature bonus material (typically stored on a second disc) accessible via PC playback and enabled by Sonic’s InterActual® technology. In actual fact, these titles were used as a starting point for defining the requirements for the HD DVD format. Featuring a range of extra interactive features, these SD titles present a variety of enhanced content around the main video presentation (often by resizing the video presentation). These InterActual-enabled features include script-to-screen, picture galleries (viewing storyboard sketches or pictures taken at the video shoot), exclusive Web-links only available via the enhanced title, and fun interactive games based around the theme of the title.

Advanced Content enables interactive content that is superimposed on the video content. This interactive content can include a range of features including pop-up menus, subtitles, interactive games – the possibilities are endless. Unlike SD DVD which is a relatively linear medium, HD DVD Advanced Content titles are more akin to multimedia CD-ROM titles which are highly interactive and offer a high level of user interaction. However, unlike CD-ROM, Advanced Content has full control over the video content and enables you to design a customized user interface, providing production professionals with full creative control.

What is HD DVD Advanced Content?

The Advanced Content specification enables a range of next generation features including:

- Interactive pop-up menus
- SD DVD-style ‘Main Menus’ with high resolution rollover states and button sounds
- Picture-in-picture – Video presentations (such as ‘making of’ documentaries) over the top of the main video presentation
- Script and storyboard viewer synchronized to the video presentation
- Interactive games



- Network connectivity
 - Latest trailers and multimedia content (downloaded in the background)
 - Latest actor biographies
 - Relevant marketing communications (e.g. a Star Trek convention near you!)

Note: It is not possible to create these features in Standard Content.

Some Useful Advanced Content Terminology

As with all new technology, HD DVD brings a range of new terminology to the table. Here's a quick run down of some terms that will become common place in HD DVD authoring circles.

- **HDi** – Co-developed by Microsoft and Disney, HDi is the name of the declarative Markup language used to drive the Advanced Applications. HDi was originally known as iHD (you may still see it referred to by this name).
- **Playlist files** – An XML file that defines the structure of an HD DVD title. It describes the Titles on the disc and the attributes of any video, audio and subpicture tracks, as well as information about any Advanced Applications that should be loaded. Even if a title only has audio and video (and no Advanced Applications) all Advanced Content HD DVD titles must have a Playlist.
- **Advanced Applications** – An Advanced Application is a collection of Markup pages, Script files, Resources (such as image, sound, and font files) and a Manifest file. The Advanced Content on a disc, found in the ADV_OBJ directory, consists of one or more Advanced Applications.
- **Manifest files** – An XML document that defines an Advanced Application. It lists the Script files that need to be loaded, the first Markup page to be presented, the resources that will be used, and the area of the screen where it will appear.
- **Markup pages** – An XML document which defines how graphics will be laid out – just like a web page. Markup pages also define how buttons behave and how elements might animate.
- **Script files** – Written using a programming language that is built from ECMAScript, this language is unofficially referred to as 'HDiScript' and is similar to JavaScript and ActionScript. Many aspects of HD DVD Advanced Content require HDiScript. For example, it is only possible to access persistent storage or interact with the network and control video using HDiScript. Script also makes it possible to create interactive games and complex menu navigation; things that aren't possible or are extremely difficult to achieve when just using Markup and the timing mechanisms provided by XPath.
- **XPath** – A query language that describes how to locate specific items, such as elements and attributes, in an XML document. XPath treats an XML document as a hierarchical tree.
- **XML** (Extensible Markup Language) – Enables information to be encoded and transferred between applications in a format that all components (sometimes including humans!) can understand. XML files are used for some of the components (e.g. Markup Pages) that make up an Advanced Content Application.
- **Advanced Subtitle Applications** – As well as enabling 8-bit subpicture streams for subtitling, the HD DVD Advanced Content specification also supports Advanced Subtitle Applications. These are written using HDi (with some restrictions on interactivity) and allow 24-bit images and animation in subtitles. In addition, they are a text-based alternative for creating subtitles that use fonts supplied on the disc. At the time of writing, the use of Advanced Subtitle Applications is low since playback consistency across a variety of players is not a known quantity. Graphics-based subtitles are considered to provide a more consistent playback experience.
- **Primary and Secondary Video Objects** – Multiplexed video and audio files that are used for either the main video and audio presentation (primary video objects) or as a substitute or replacement for the main presentation (secondary video objects).
- **Persistent Storage** – The HD DVD specification stipulates that all HD DVD players must have at least 128MB of built-in flash memory. This is optionally expandable and is used to store downloaded content (e.g. trailers, games, additional advanced applications) or information about the viewer's HD DVD collection – favorite bookmarks, high scores, frame grabs of video etc.



Region Coding

Region codes are not currently part of the HD DVD specification but, at the time of writing, there are ongoing discussions about the possibility of them being added.

Content Protection

As a result of the proliferation of multimedia playback devices (mobile devices, home video servers etc.), the industry's emphasis has shifted from preventing consumers from copying packaged media titles to allowing consumers to copy and view their purchases on multiple devices. As a result, terms like 'managed copy' and 'content protection' are the new industry buzz words.

Developed by leading IT and media companies, AACS (Advanced Access Content System) has been adopted as the Content Protection solution for HD DVD. AACS provides an advanced, robust, and renewable method for protecting audio-visual content across multiple platforms. Key AACS features include:

- **Robust Content Protection** – Advanced encryption algorithms and keying provide enhanced content protection.
- **Managed Copying** – Limiting the output and recording of protected content to a list of approved methods, formats, resolutions, devices, device outputs, etc.
- **Cross-platform Capable** – AACS protection can be applied to multiple formats and multimedia carriers.
- **Renewable/Revocable Licenses** – The ability to renew and revoke licenses for playback devices whose keys have been compromised.

Some Useful AACS Terminology

As with all new technology, AACS brings a range of new terminology to the table. Here's a quick run down of some terms that will become common place in authoring circles.

- **AACS** – Advanced Access Content System. The content protection technology used by the HD DVD format.
- **AACS LA** – AACS Licensing Administrator, the body responsible for administering the AACS scheme and technology.
- **AES** (Advanced Encryption Standard) Cipher – The encryption algorithm used by AACS. The algorithm uses 128-bit data blocks and 128-bit length keys compared to the 40-bit encryption keys used by CSS – the protection technology used by SD DVD.
- **ICT** – Image Constraint Token. A flag used to specify the output resolution of a player's analog outputs. The ICT can be used to down-convert the analog output of a player to prevent the creation of high definition pirate copies. The ICT doesn't affect digital outputs like HDMI.
- **HDCP** – High-Bandwidth Digital Content Protection.
- **Device Keys** – Keys used to decrypt the Media Key Block. Each model of playback device (e.g. Toshiba HD-XA2, Xbox 360) has its own unique Device Key.
- **Media Key Block** – Provided by the content owner, the MKB (along with the Media Key) enables devices to decrypt protected content. The AACS LA can revoke player licenses by distributing an updated Media Key Block that causes compromised devices to generate an incorrect decryption key.
- **Media Key** – Provided by the content owner, the Media Key is provided along with the Media Key Block and enables devices to decrypt protected content.
- **Title Key** – A title-specific random key selected and inserted by a licensed authoring facility.
- **Volume Identifier** – A random identifier inserted by licensed authoring facilities on replicated titles as a safeguard against bit-for-bit copies being made by consumer recorders.

PC Playback

For PC playback, an extra level of protection is used to prevent the signal from being intercepted and copied as it travels through the host PC's bus on its way to the playback hardware. Commonly known as 'protected path', an additional Bus Key is used to encrypt the signal on transmission. The Bus Key is then used to decrypt the protected signal when it arrives at the playback hardware device.



AACS Implementation Workflow

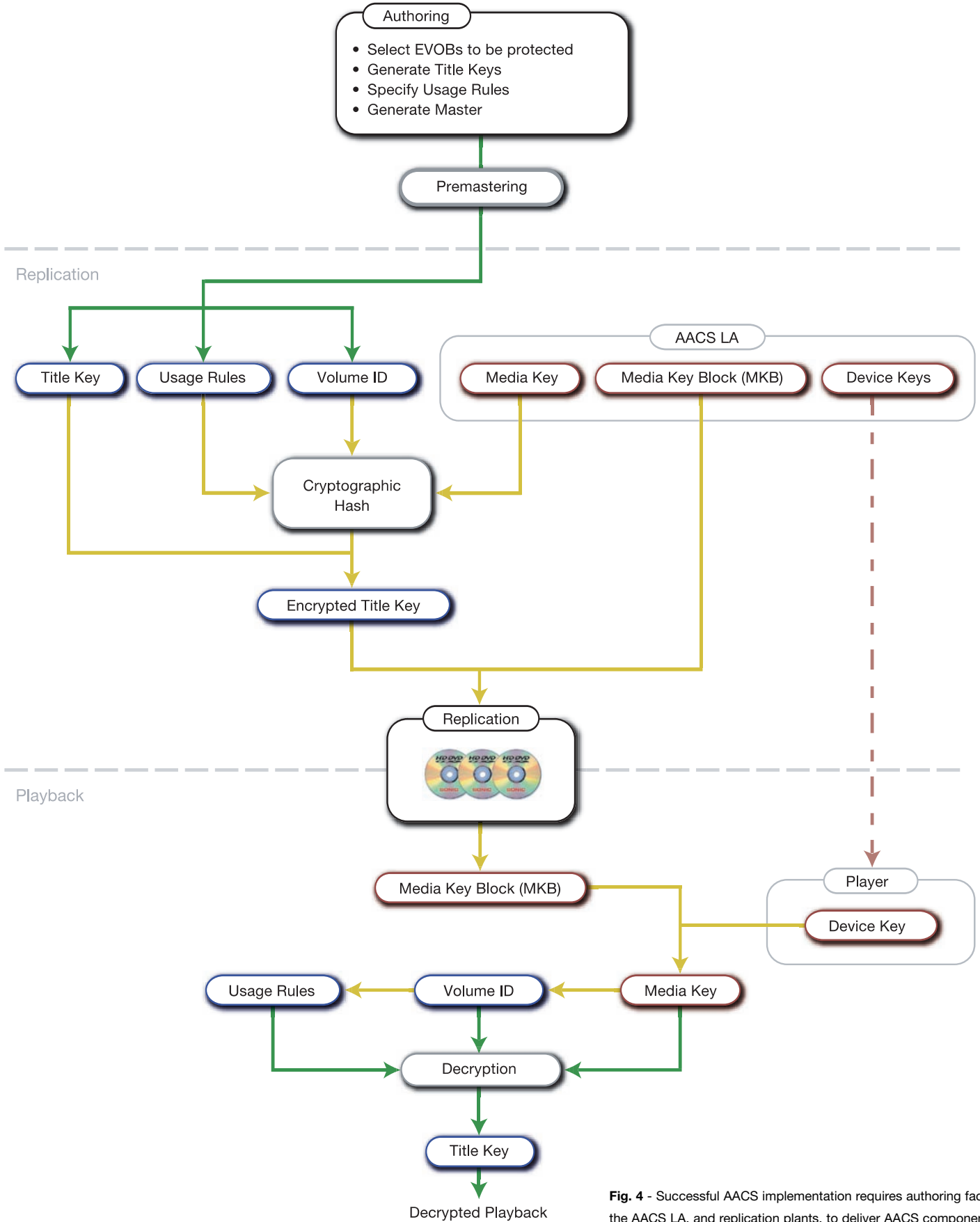


Fig. 4 - Successful AACS implementation requires authoring facilities, the AACS LA, and replication plants, to deliver AACS components.



HD DVD PRODUCTION IN PRACTICE

Project Planning

As with all projects, planning and preparation is critical. The check list below provides an overview of the kinds of new issues you will need to consider when planning an HD DVD title.

- What kind of features does the client require?
- What kind of interactive features are needed?
- Are any advanced features such as script-to-screen or image galleries required?
- Can the features be achieved in Standard Content or are the extra capabilities of Advanced Content required?
- Will there be any networked content such as updatable trailers or games?
- Are any of the interactive features synchronized to the main video content?
- Do the HDi coders require a timecode-accurate, rough encode of the video?
- What other elements do the HDi coders need to start development?
- What resources are needed to achieve the above requirements?
- How many HDi coding experts and creative artists are needed?

Video and Audio Encoding

- Where is the video and audio source coming from (tape or hard disc)?
- What codec(s) does the client wish to use?
- Bit budgeting – How much space is there for the video and audio assets?

At the end of the planning stage, you should have

- A rough storyboard of the title describing the structure and navigational design
- A list of all required tasks including associated assets that will be required
- A schedule mapping out the development timeline for the interactive content

Encoding

A majority of the techniques and theories established for SD DVD production can be easily applied to HD DVD. The new video and audio codecs, however, offer new capabilities that surpass those used for SD DVD and it will be important for compressionists to familiarize themselves with the codecs before undertaking any encoding for HD DVD.

The most important tool in your encoding suite will be the encoder you select. Here are some issues to consider when assessing HD DVD encoding solutions:

- **Quality** – The encoder you chose will obviously need to provide the best possible quality for the cost (it is important to note however that the set-up and equipment used in your workflow will also play an important part in determining the resulting quality). In addition to viewing the encoder's output directly, a quick way to determine the quality of an encoder is to find out who is using it and for what kind of work. For example, because high-end feature film releases are subject to numerous quality control procedures, the encoders used for these major releases are obviously worth considering.
- **Codec Support** – It is important that facilities are able to offer their customers their codec of choice. Therefore, an encoder that is capable of encoding all three video codecs – AVC, VC-1, and MPEG-2 – is required.
- **Format Compliance** – HD DVD supports AVC, VC-1, and MPEG-2 video codecs and DTS®-HD, Dolby® Digital Plus, Dolby TrueHD, and LPCM audio codecs. The HD DVD specification contains strict guidance on the video and encoding parameters that are to be used (e.g. supported frame rates, resolution etc) and is also very specific about the parameters to be used for the Main and Sub video streams used when authoring Advanced Content titles. There are also specific requirements on how the encoded data is to be structured at stream level. For these reasons, it is important that you select an encoding tool that not only provides the highest possible encoding quality, but also one that adheres to the strict stream compliance requirements of the HD DVD format. This will ensure that all encodes are legal for the target format. This function is often found under a 'target application' setting and ensures that every selected parameter is legal for use on the chosen target format.



- **Built-in Video Processing** – When encoding for SD DVD, the point at which the encode quality is determined comes after the basic encode has completed, when compressionists pick through the completed encode and select segments to re-encode (assuming a good encoder is used of course). With HD encoding, as a result of the increased resolution and subsequent image quality provided, that point of quality control has moved further up the video mastering and encoding workflow. This means that the preparation (processing and filtering) of the source video is crucial in determining the encode quality. Therefore, look for an encoder with built-in video processing. It's also crucial to have access to the same video processing technology on a segment level when re-encoding following the completion of the base encode.
- **Workflow** – As well as ensuring your encoded streams are legal, compressionists should also aim to achieve the highest possible quality. This requires a workflow that is uncompressed and, therefore, preferably tapeless. Bouncing an edit to tape – a technique commonly used for SD DVD encoding – is no longer ideal if one is looking to achieve ultimate encode quality from an NLE system. The reason for this is that all HD tape formats feature some degree of compression when recording to tape. There are a number of ways of achieving a tapeless workflow, and ultimately, your solution will be customized to suit your existing equipment and available budget. For example, you can export a reference file pointing to an uncompressed edit in your NLE's timeline. All professional encoders should support this method. Alternatively, you can capture your HD source using one of a range of HD capture solutions available today. Either method will ensure that you are providing your encoder with the highest possible quality input which will ultimately yield the best quality. Also, since it is unlikely that video source material will always be provided in the same source format, it is important to select an encoder that features flexible support for different media formats such as QuickTime®, AVI, Image Sequence, and raw YUV.
- **Post-encode Tools** – For a professional compressionist, the real work starts once the base encode is complete. Therefore, it is important that the chosen encoder provides the necessary post-encode toolset. For example, most compressionists will demand professional features such as HD-SDI output for encode QC, a professional timeline containing all of the information needed to review the encode, A/B switching for comparing the encoded content with the source, QC efficiency tools for speedy scanning of a completed encode, and segment-based re-encoding for fine tuning any sections that are unsatisfactory.

✓ Kit Check: Encoding Tools

- **Sonic CineVision™** – Sonic's CineVision encoder provides compressionists with detailed access to every available parameter in all three video codecs. It also features exclusive legalization technology that ensures that every parameter set is legal for the chosen target format. Once the encode is complete, compressionists can use CineVision's exclusive segment-based re-encoding technology to improve selected areas of the encode. In tandem, ExpressQC™ can be used to search and mark any segments that are statistically less similar to the source file.

Learn more: www.sonic.com/go/cinevision



✓ Kit Check: HD Capture Tools

The following capture solutions are recommended for use with the Sonic CineVision encoder.

- **AJA Xena LH:** www.aja.com
- **BlackMagic DeckLink HD2:** www.blackmagic-design.com
- **BlueFish444 HD|Fury:** www.bluefish444.com



Interactive Graphics Preparation

Designers accustomed to creating graphics for SD DVD should not encounter any major problems transferring their skills to HD DVD production. However, there are a few new challenges and issues that need to be considered when designing interactive graphics for HD DVD. These include:

- **Resolution** – Graphics will need to be prepared at the chosen HD resolution - typically either 1920 x 1080 or 1280 x 720. Note that individual graphical elements for Advanced Content (i.e. all graphics that aren't full background layers) should be designed to be as small as possible to save memory. Therefore, try to avoid producing graphics that use large transparent areas. Techniques used for Web graphic design can be applied to graphic design for HD DVD Advanced Content.
- **8-bit subpicture menu overlay preparation for Standard Content** – Instead of creating a single subpicture image whose colors and transparencies are subsequently programmed by the author (the common workflow for SD DVD), designers are able to create three full color layers for each button state – normal (unselected), selected, and activated. Photoshop® files can then be imported directly into the Sonic Scenarist® authoring application which automatically generates the color and transparency settings without the author having to worry about a single setting.
- **Graphic animation for Advanced Content** – Graphics can be animated in Advanced Content using one of two methods. The first involves using a single graphic and programming animation using HDi code. For example, an author could use HDi code that, in simple terms, says “move this image from point (x) to point (y) in (z) seconds and resize it to size (a) x (b)”. This method would require a single graphic and would typically be used for pop-up menu animation. Another method involves creating multiple graphics for each frame of the animation and displaying each graphic at the appropriate time to achieve the desired animation. This method would typically be used for button animations. Although the suitability of each method is beyond the scope of this document, it is important to point out that close communication must be maintained with the HDi team to ensure that they receive all of the elements they require to do the job.
- **HDi coding workflow** – Graphic designers will be used to collaborating with SD DVD authors to design and refine menu graphics and subtitles. HD DVD also requires that authors work closely with a new set of colleagues – HDi coders (don't be afraid, they don't bite!). HDi coders will require graphics to test their code and will also be the main source of any feedback in terms of required changes. You'll need to establish a new way of working together that suits both groups to ensure the most efficient workflow.
- **Pixel buffer considerations** – Before any graphics can be displayed, they need to be loaded into the HD DVD player's pixel buffer for rendering. The pixel buffer can hold about 4.1 million pixels which is approximately equivalent to two full 1920 x 1080 screen images. Overloading the pixel buffer will result in the HD DVD player displaying an error message.
- **Performance considerations** – It is important to remember that all graphics must be read from the disc, loaded into memory, and then passed to the pixel buffer to be displayed. Efficient design will result in a better performing title. Even if there is space to spare in the player's memory and pixel buffer, using large graphics may result in slower play back performance. Designers and authors who have tried using multiple tiled pages for SD DVD menus will be aware of the impact slow interactivity can have on the viewing experience.
- **File Cache considerations** – Every HD DVD player has a 64MB file cache. Similar to computer RAM, the file cache is used for storing all graphics, fonts, text, etc. that are used by applications. To ensure that graphics don't overload the available memory, designers and authors need to be thrifty in their design and wherever possible, reuse graphics for multiple instances. This is probably the least important hardware consideration when compared to pixel buffer and performance considerations.



✓ Kit Check: Graphics Production

The following solutions are currently used by most high-end production houses.

- **Scenarist® Designer PS** – Specifically designed for BD-ROM and HD DVD graphic designers, Scenarist Designer PS takes the hassle out of designing for the new formats. Featuring automatic graphics optimization and palette generation and integrating seamlessly with the Scenarist authoring workgroup, Scenarist Designer PS enables a fast and efficient production workflow.
- **Adobe® Photoshop®** – Adobe Photoshop is the standard for production and design houses worldwide. The latest versions feature all the capabilities you require to design interactive graphics for HD DVD. The file format (PSD) is also the most common multi-image format supported by authoring programs enabling the seamless importing of layered PSD files for multiple graphics.
- **Adobe ImageReady™** – Adobe ImageReady can be used to simulate any animated sequences designed for Advanced Content.
- **Adobe After Effects™** – Adobe After Effects is commonly used by SD DVD Motion Menu designers, and can be adapted for use in an HD DVD workflow.

Learn more: www.adobe.com

Subtitle Production

When producing an HD DVD Standard Content title, there's only one option – a sequence of images (one for each subtitle) accompanied by a script file which describes the subtitles display information (including the start and end time).

For HD DVD Advanced Content titles, there are other options:

- **8-bit subpicture preparation (Standard and Advanced Content)** – All HD DVD-ready subtitle facilities will be able to provide pre-rendered graphics with a subtitle script file. They will typically provide 8- or 32-bit PNG graphics as these image formats are able to include transparency in addition to color information. The authoring application will then use the script file to import each subtitle graphic and carry out any necessary color reduction.
- **Advanced Subtitle Applications (Advanced Content only)** – An Advanced Subtitle Application is a special category of Advanced Application that allows the use of 24-bit graphics with animation. These are authored in a similar way to Advanced Applications.

Completed subtitle files (for both Standard and Advanced Content) are passed on to the HD DVD author for inclusion in the title.

HDi Coding

HDi coding involves the creation of Advanced Applications for HD DVD Advanced Content. Advanced Applications are a combination of Manifest, Markup, Script, Graphics, Font, and Sound files (see the *Technical Specifications* section for detailed information). HDi coders will be at the center of any Advanced Content title production as, in a similar way to their SD DVD authoring counterparts, they create the interactive features that bring the title to life. As a result they will need to be in close contact with all of the other production departments – compressionists, graphic designers, authors, and quality control personnel.

There are a few issues that all HDi coders need to bear in mind when embarking on a new project.

- **Skill requirements** – Experience with an ECMAScript language such as JavaScript is a distinct advantage when considering writing HDi code for HD DVD Advanced Content. Experience with CSS (Content Style Sheets) in HTML, XPath, and SMIL are also a bonus but not vital (it is rare to find someone with XPath and SMIL experience). A basic understanding of XML is also important. Of course, coding experience in other languages will certainly be useful as, undoubtedly, some knowledge and/or theories transfer across to HDi. SD DVD authors with zero coding experience will find conversion a greater challenge. It would be advisable to undertake basic courses in code writing in the above languages before attempting to write HDi.
- **Workflow integration** – HDi coders need to be an integral part of the production workflow. In the same way that the SD DVD author takes all the disparate elements of a project and combines them together, an HDi coder – especially one



responsible for coding menus – needs to have an overview of all of the content on the HD DVD and how it all fits together and works with the applications being developed. HDi coders will thus need to work closely with HD DVD authors. Similarly, HDi coders will need to work closely with graphic designers to ensure that all graphics are delivered in a format that can be quickly and easily integrated into the Advanced Applications.

- **Application architecture** – Designing Advanced Content is no different to designing and building a website or other computer program. An HDi coder needs to consider memory usage, run-time performance, disk-space usage, load times, as well as user interface and user experience issues when building their applications. Coders need to decide whether to use one monolithic Advanced Application or multiple smaller applications that communicate with each other.
- **Hardware considerations** – Just like graphic designers, HDi coders need to be aware of the HD DVD player's hardware limitations such as the 64MB file cache memory limit (used for all applications and resources). Therefore, it is vital that coders are able to write efficient HDi code to ensure they make maximum use of the available memory.
- **Code templates and library** – Over time, HDi coders will build a library of HDi code that, if well written, can be repurposed on subsequent titles. It is important to be aware of any suitable code that has been used on previous titles and also to write new code in such a way that it can easily be reused on future projects.
- **Quality assurance** – An essential part of the coding process is testing the Advanced Content that has been developed. It is the responsibility of the HDi Coder to ensure that applications are compatible with the range of HD DVD players available. They must also ensure that applications are robust and handle any error conditions gracefully. Pairing up a coder with a QA Tester is an effective way of producing high quality HD DVD Advanced Content. A typical workflow might include authoring a title with a minimal set of video objects so that the entire project can be burned onto a DVD-ROM for testing. Once this cut down version has been checked, the author can move on to incorporating the rest of the video content.

Once the HDi coders have completed and tested their code, they pass their work to the HD DVD author who combines all of the Advanced Content elements and multiplexes the finished title.

✓ Kit Check: HDi Coding Tools

- **Sonic Scenarist®** – Sonic Scenarist's Advanced Content Authoring application provides HDi coders with technical white papers, example code and reference materials for HDi programming. It also features an HDi playback environment with logging and debugging capabilities.
Learn more: www.sonic.com/go/scenarist
- **Microsoft® Visual Studio Web Developer** – Microsoft Visual Studio is one of the leading Integrated Development Environments (IDE) available and will provide any HDi developer with an ideal development environment for the creation of all types of HD DVD Advanced Content code.
Learn more: <http://msdn.microsoft.com/vstudio>
- **Microsoft HD DVD Interactivity Jumpstart Kit** – Additional resources and tools for budding HDi coders.
Learn more: <http://www.microsoft.com/windows/windowsmedia/forpros/hddvd/default.aspx>

Authoring - HD DVD Standard Content

HD DVD Standard Content authoring is very similar to authoring for Standard Definition DVD. For a comprehensive run down on the differences between SD DVD and HD DVD Standard Content, see the *Technical Specifications* section. Here are some quick practical notes for anyone considering authoring HD DVD Standard Content titles:

- **Author's role** – As with SD DVD, the author starts with the raw assets (graphics, subtitles, video, and audio), assembles them into menus and movies, and authors all of the relevant navigation to create a functional title. The finished title is then multiplexed and passed to quality control for a full QC sweep. Any errors found by QC will then be fed back to the author who makes the relevant changes prior to final QC and premastering.
- **Authoring software and paradigm** – SD DVD authors will feel instantly at home in any HD DVD Standard Content authoring tool. The authoring paradigm is almost identical to that of SD DVD. The only differences involve the authoring of menu button behavior, the use of the new commands available in the HD DVD Standard Content specification, and the application of any AACS content protection.



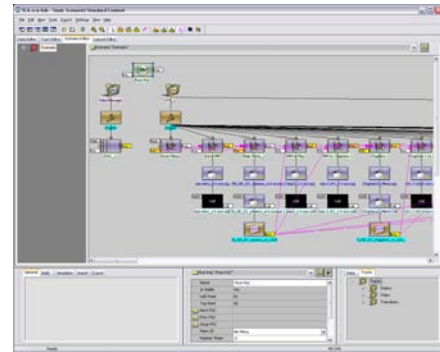
- **Data structure** – Any authors familiar with any SD DVD terminology – menu domains, first play, pre-commands, cell commands etc. – will know exactly where they stand with HD DVD Standard Content. Apart from the new commands, like enhanced Resume functionality, all SD DVD knowledge will transfer seamlessly to HD DVD Standard Content.
- **Navigation commands** – HD DVD Standard Content includes a number of new commands with which authors will need to become familiar. Since some of the SD DVD authoring restrictions (e.g. number of commands on a button) have been lifted, authors will need to learn the new specification features in order to get the most out of them and maximize the interactivity of titles.

In summary, a seasoned professional SD DVD author with the relevant training materials should be up to speed on HD DVD Standard Content within a day.

✓ Kit Check: HD DVD Standard Content Authoring Tools

- **Sonic Scenarist** – the Sonic Scenarist Standard Content Authoring application provides authoring professionals with cell-level access to the entire Standard Content specification. Using an interface instantly recognizable to Scenarist users, you can author HD DVD titles today using techniques and terminology developed over years of SD DVD authoring.

Learn more: www.sonic.com/go/scenarist



Authoring - HD DVD Advanced Content

At present, the authoring of HD DVD Advanced Content titles is split between the HDi coding specialists and the traditional DVD author. While an HDi coder is responsible for creating the Advanced Applications used on a title, it is the author that brings all of the finished elements together and creates the finished HD DVD title. Some brief practical notes for anyone considering authoring HD DVD Advanced Content titles are provided below. Those in need of more in-depth information should contact their nearest Sonic representative (contact details are provided in the introduction of this paper).

- **Author's role** – Advanced Content authors will start a project with a range of assets that include Advanced Applications (a collection of Markup pages, Script files, and resources such as Graphics), Subtitles (8-bit subpicture or Advanced Subtitle Applications), Video, and Audio. An authoring program like Sonic Scenarist is then used to lay out the various title elements. Starting with the main video stream, all of the other title elements, one by one, are added to the authoring timeline including Main audio, Sub-video/audio (for picture-in-picture), Advanced Applications (e.g. pop-up menus), and Subtitles. Some basic navigation (like first play and 'end actions' for the end of movies) can also be programmed but a majority of the interactivity (like menu navigation) is prepared by the HDi coders in the form of Advanced Applications. When complete, the title is multiplexed and passed to quality control for testing. It is possible that some errors will be reported to the HDi coding team, which will require HDi code changes. Other errors can sometimes be resolved within the authoring program.
- **Authoring software and paradigm** – SD DVD authors won't find the new authoring environment too foreign as there are a number of similarities with SD DVD authoring. For example, there are still Titles (a self-contained video presentation with accompanying audio and subtitles) and the timeline interface used for laying out Titles will be instantly familiar. There are, however, a number of new rules and concepts that will need to be learned, the details of which go beyond the scope of this paper.
- **Data budgeting** – SD DVD authors will be accustomed to managing both the capacity and bandwidth of SD DVD. Although these limitations still exist for HD DVD (albeit with larger numbers) there is also another hardware limitation that requires close attention – the data budget. This involves managing the loading and emptying of the 64MB memory available on every HD DVD playback device. Depending on the content of the Advanced Applications, it may not be possible to make them all available at once. Therefore, careful management of their availability is required to ensure a seamless experience for the viewer.

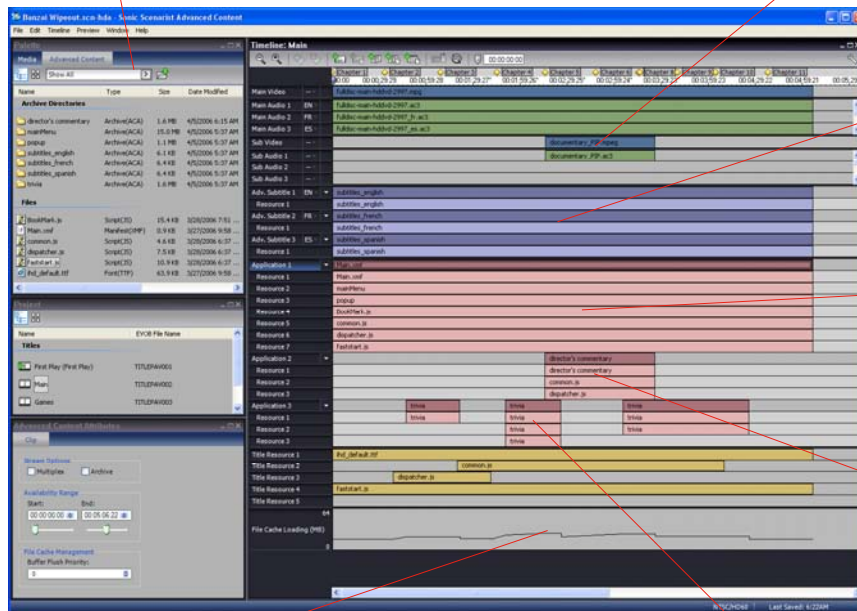


- **Data structure** – HD DVD Advanced Content uses applications to control playback and provide interactivity. Consequently, unlike Standard Content, the command areas and data structure familiar to SD DVD authors (e.g. pre- and post-commands) are no longer used. The Advanced Content specification does however feature dedicated ‘End Actions’ for each Title, similar to the post-commands used in SD DVD.

Assisted by thorough training and a professional support service, a professional SD DVD author will be able to begin HD DVD Advanced Content authoring within a few days.

Advanced Content Applications Source Bin - Contains all ACAs for the title.

Picture-in-picture Video and Audio used by director's commentary.



Advanced Subtitle Applications

Pop-ups menus etc.
Available for the entire duration of the title.

Director's Commentary - Available for a time-limited period.

Player Cache Monitor - Track the status of the HD DVD Player's cache.

Trivia Track - Available for a time-limited period.

Fig. 5 - Sonic Scenarist provides a familiar timeline-based authoring environment for authoring HD DVD Advanced Content

✓ Kit Check: HD DVD Advanced Content Authoring Tools

- **Sonic Scenarist®** – Sonic Scenarist Advanced Content Authoring provides authoring professionals with an intuitive way of laying out the various components of their HD DVD Advanced Content titles. The Advanced Content timeline enables easy positioning of Primary and Secondary Video/Audio, Advanced Applications, and Advanced Subtitles.

Learn more: www.sonic.com/go/scenarist



Emulation and Quality Control

The role and responsibilities of the HD DVD Quality Control (QC) specialist are similar to those of SD DVD. As with SD DVD, their main duties include:

- **Stream quality assurance** – Checking every video, audio, and subtitle stream to ensure they are all playing back without any errors or drop-outs.
- **Interactivity checks** – Accessing and executing every available interactive feature to ensure the title functions as specified, and any errors or potential problems are reported to the user in a user-friendly fashion.
- **QC reporting** – Any problems need to be accurately reported to the relevant people to ensure fast and efficient turnaround times.

For any SD DVD QC specialist looking to transfer their skills to HD DVD, there are a few new pieces of knowledge that will facilitate a smooth transition to the new format:

- **Format theory and specifications** – Obviously, some new technical theory must be learned to quickly and accurately diagnose any errors. Understanding how the format works in terms of interactivity will enable quick diagnosis of any errors that are found. It is also important to understand the technical limitations of the format (e.g. maximum video bit rates and new video buffer models) in order to ensure any suspected errors aren't incorrectly diagnosed.
- **Workflow knowledge** – Understanding who does what in the creation workflow will ensure you report the error to the correct person. For example, errors within Advanced Applications could be reported to a number of different coders depending on the part of the Advanced Content that is behaving incorrectly. Memory management problems may be something the author can fix without involving the coding team.

✓ Kit Check: Emulation and QC Tools

Quality Control specialists should look for an emulation solution that has the following key features.

- **Precise player emulation** – It is vital that any emulation tool mimics HD DVD player behavior exactly.
- **HD-SDI output** – In order to QC the video streams, it is important to have the best possible signal path to your HD video monitor.
- **Title debugging** – A tool that enables you to step through HDi code will help you locate the precise location of any problems.
- **Player feedback** – It is important to be able to see 'inside the player' to view all player settings and the status of any internal hardware such as memory and video buffer status.

Premastering

Premastering Data Format

The DVD Forum has specified CMF 2.0 (a subset of DDP 3.0) as the preferred format for transferring HD DVD masters between the authoring facility and replication plant. All HD DVD authoring tools, like Sonic Scenarist, should support CMF 2.0 and/or DDP 3.0 output as standard. CMF 2.0 and DDP 3.0 add metadata to the disc image which is used during replication to identify the content protection settings as well as information about target media and layer types (single/dual-layer).

Premastering Medium

Unlike SD DVD which almost solely relies on DLT for master transfer (until the arrival of PlantDirect™ from Sonic), there is currently no standard for the premastering medium for HD DVD. Using Sonic's PlantDirect premastering technology it is possible to deliver the required DDP or CMF files on a medium of your choice. With continually falling prices, some authoring houses are using removable hard disks to transfer their masters to replication facilities. Others are performing a data backup of the DDP/CMF file set, and delivering that to the plant. Some facilities are taking advantage of the increasingly common high bandwidth fibre-based 'pipes' that are now available, and transferring their masters over a network connection.



Replication

As described above, authoring facilities are currently delivering HD DVD masters (CMF 2.0 or DDP 3.0 Images) using either hard drives or a network connection. By definition of the relevant specifications (DDP or CMF for HD DVD) tape streaming media like DLT is no longer be used. The industry is currently trying to agree on alternate media which will serve as the “de facto” data exchange media. One proposal has been WORM discs (Write Once, Read Multiple) which offer high data security and are rewritable. Stay tuned for updates in this area.

HD DVD’s physical similarities to the standard definition DVD format mean that it’s possible to upgrade existing mastering and replication systems to manufacture HD DVD titles. HD DVD production lines may have to be upgraded with a new LBR (Laser Beam Recorder) but the replication path may stay the same.

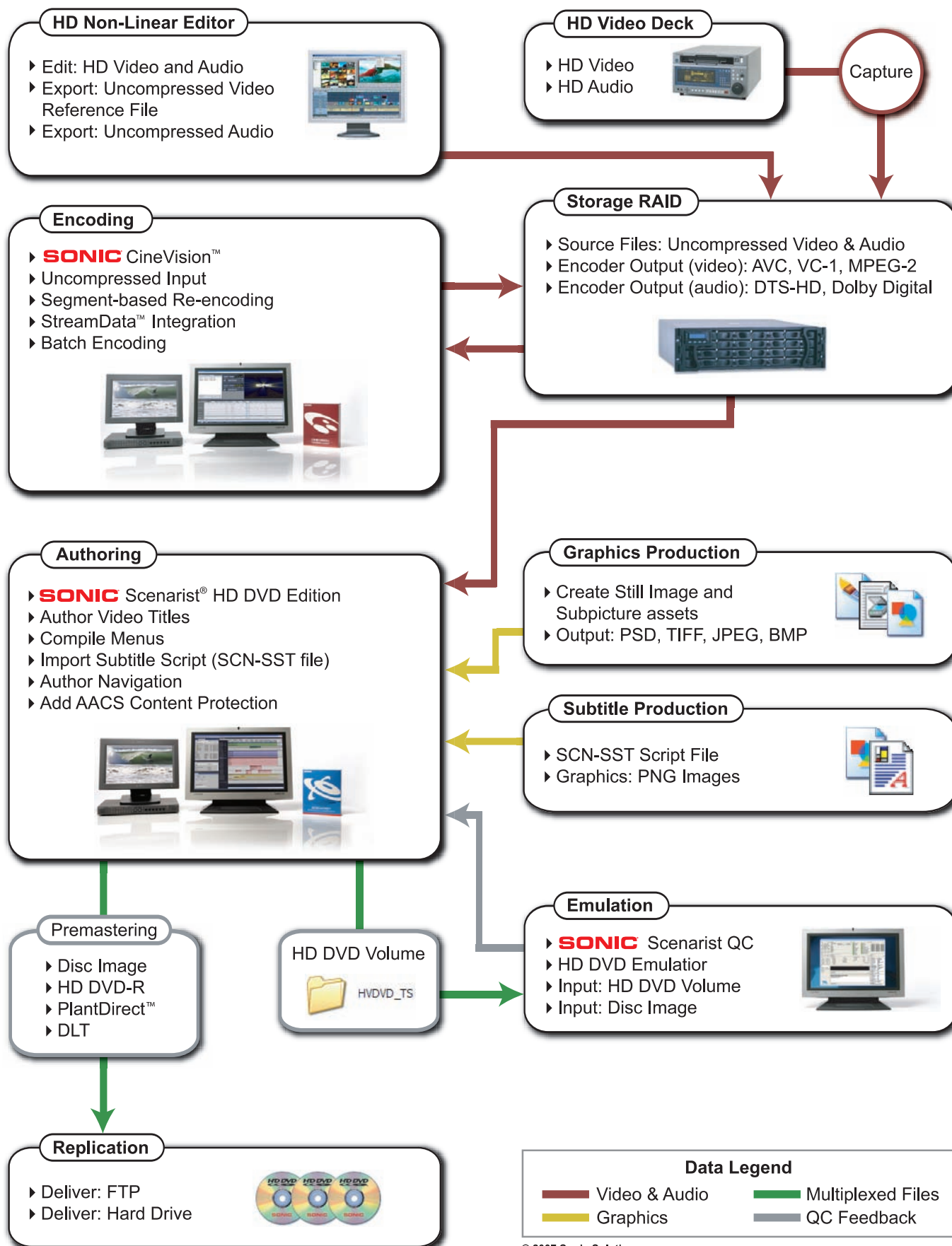
AACS encryption keys and content certificates are currently issued manually by the AACS LA. At the time of writing, the AACS workflow is in the process of being streamlined and refined in preparation for increased demand.

Packaging

For the purposes of packaging, HD DVDs are physically identical to their well-established SD cousins. Therefore, there are no new packaging requirements for HD DVD. However, content owners will no doubt wish to differentiate their HD DVD product from its SD equivalent which will result in a new range of HD DVD packaging. Bearing in mind the price delta between SD DVDs and HD DVDs, renewed packaging is also required to provide consumers with a perceptible difference in value. For example, initial HD DVD releases have used a red translucent jewel case with different dimensions to SD DVD packaging.

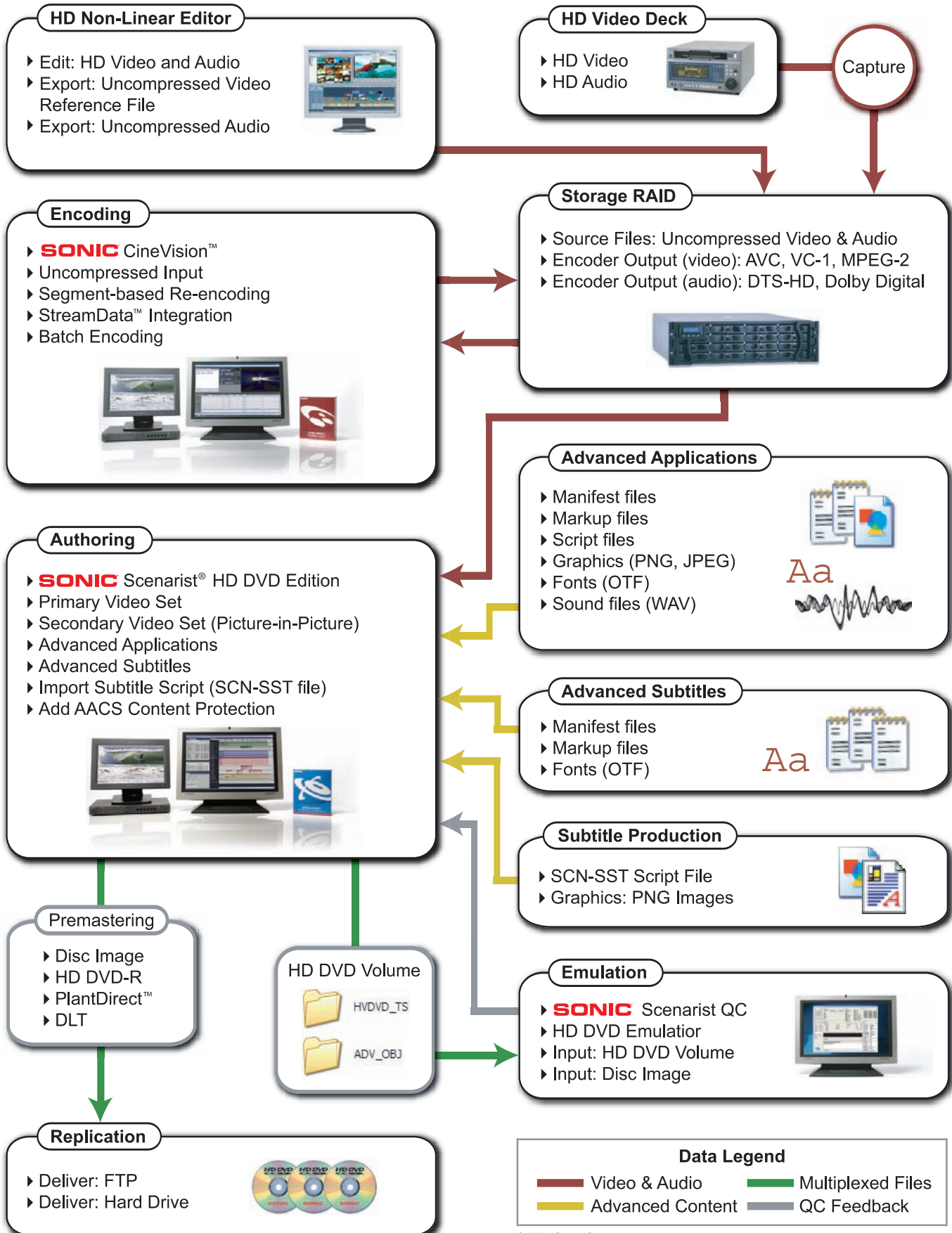


HD DVD PRODUCTION WORKFLOW - HD DVD STANDARD CONTENT





HD DVD PRODUCTION WORKFLOW - HD DVD ADVANCED CONTENT





STARTING YOUR HD DVD PRODUCTION BUSINESS

Adding HD DVD production services to a facility's offerings will require a range of new skills and resources. Below are some key questions that are designed to help identify, as well as fill, any gaps in planning for a business looking to initiate their HD DVD production business.

Questions to ask

- **Knowledge** – Do we know everything we need to know in order to proceed and make informed business and purchase decisions? Do we understand the format and the new production challenges it presents? If not, contact your nearest Sonic representative or reseller for an in-depth consultation (contact details are in the introduction of this paper).
- **Production requirements** – When does my production workflow need to be operational? How much time do we need between acquiring our production tools and taking our first HD DVD order?
- **Production capacity** – What kind of titles do we need to produce? What are our clients' requirements? Standard Content or Advanced Content? What kind of demand will we experience now and in twelve months? Is our workflow scalable and able to easily handle any increase in demand?
- **Personnel and expertise** – Do we possess the expertise we require and in the correct quantity? If not, how do we acquire it? Training or hiring? The advanced capabilities of HD DVD, enabled by HDi, will be familiar to Web professionals versed in languages such as JavaScript, HTML, SMIL, and XML.
- **Equipment** – Do we have all of the equipment we require? What new equipment do we need? HD production generally requires more processing power and hard disc storage than SD production as well as HD playback equipment. Contact your nearest Sonic reseller for a fully integrated HD DVD production solution.
- **Workflow** – Are the systems in place to handle the large amount of data and assets required by HD DVD titles? The nature and number of assets required for HD DVD production can be very different to those used for SD DVD production. The workflow is also very different. Where might production bottlenecks occur and how can they be minimized?

Next steps to enabling your HD DVD production business

- 1.Contact Sonic for a free consultation** – If you have any outstanding questions about initiating your HD DVD business, please contact us using the contact details in the introduction of this paper.
- 2.Learn more** – Visit Sonic's Web site for more information on the HD DVD format, production tools, and any seminars scheduled near you. Also see the Appendix for links to useful HD DVD resources.
- 3.Contact Sonic's Professional Resellers** – Sonic's network of professional resellers are located worldwide and are on hand to answer any questions you may have and offer assistance in initiating your HD DVD business. You can find your nearest Sonic reseller using our online reseller locator found on our Web site (www.sonic.com/reseller).
- 4.Book a demo** – See HD DVD production in action at your nearest Sonic demo suite. Book your personal demonstration today via the link on the Scenarist Web site: www.sonic.com/go/scenarist
- 5.HD DVD production seminars** – Get hands-on HD DVD production experience and an opportunity to ask our HD DVD specialists any burning questions. Contact your nearest Sonic representative to find out when our seminar tour is next near you.



SONIC - THE LEADER IN DIGITAL MEDIA

Powering professional digital media creation

Sonic Solutions (NASDAQ: SNIC; www.sonic.com) is the leader in digital media software, providing a broad range of interoperable, platform-independent software tools and applications for creative professionals, business and home users, and technology partners. Sonic's products range from advanced DVD authoring systems and interactive content delivery technologies used to produce the majority of Hollywood DVD film releases, to the award-winning Roxio®-branded CD and DVD creation, playback and backup solutions that have become the premier choice for consumers, prosumers and business users worldwide.

Sonic products are globally available from major retailers, online at Sonic.com and Roxio.com, and are bundled with PCs, after-market drives and consumer electronic devices. Sonic's digital media creation engine is the de facto standard and has been licensed by major software and hardware manufacturers, including Adobe, Microsoft, Scientific-Atlanta, Sony, and many others. Sonic Solutions is headquartered in Marin County, California.

Managing format transition

Sonic has been the leading provider of digital media creation technology since the inception of digital media itself. With SonicStudio, Sonic's professional CD Audio editing and mastering system, Sonic quickly earned a reputation for leading technological innovation that saw it become the de facto standard for CD Audio mastering. In 1996, Sonic was the first company to deliver a professional DVD-Video production workstation and Sonic's Scenarist system has now been used to release over 4 billion DVD titles. In fact, more than 80% of your home library is powered by Sonic technology truly making Sonic First in DVD. The next natural step for Sonic's digital media revolution was to pass its technological know-how to home users by offering the world's first PC home authoring solution – Sonic DVDit®. With the addition of technology from InterActual® and Roxio, Sonic is uniquely positioned to enable to the next major format transition and deliver cutting edge technology from Hollywood to Home to further enable to enjoyment of digital media.

Sonic HD Authoring Alliance

Although the HD DVD format is relatively new to consumers, Sonic and the HD Authoring Alliance have been busy creating HD DVD titles for over two years. The HDAA is a Sonic-sponsored association of top authoring facilities worldwide. The HDAA is dedicated to accelerating the development of the authoring skills, capacity, and technological infrastructure required to support the rapid adoption of HD DVD. Working together, the HDAA have helped design and refine the optimum HD DVD workflow resulting in industry leading products like Sonic Scenarist® and Sonic CineVision™.



Professional advice from industry experts

If you have any questions relating to the contents of this paper or need further information on initiating your HD DVD production business, please don't hesitate to contact us using the details below.

- U.S.A. (West) Terry Marshall - terry_marshall@sonic.com. Tel: +1.818.357.7825
- U.S.A. (East), Canada, & Latin America Brian Murphy - brian_murphy@sonic.com. Tel: +1.415.893.7832
- Europe, Middle East, & Africa Richard Linecar - richard_linecar@sonic.com. Tel: +44 20 7437 1100
- Pacific Rim Terry Marshall - terry_marshall@sonic.com. Tel: +1.818.357.7825

You can also contact your nearest Sonic professional products reseller at: www.sonic.com/go/reseller



FAQs

1. What resolution is considered High Definition?

'HD' is standardized throughout the world at 720p or higher. However, you will find some purists who argue that true HD is 1080 and higher.

2. Will the new HD DVD players play back existing standard definition DVDs?

Although this isn't part of the HD DVD specification, consumer demand will be such that it is expected that all HD DVD players will playback existing SD DVD titles.

3. What's the point of making HD DVDs when there aren't any high definition displays to view them on?

The penetration and projected adoption rates of HD displays is often understated and leads to the popular misconception above. At present, approximately 20% of homes in America and Japan are equipped with an HD display. However, by 2008, over 50% of homes are expected to be HD-ready. That amounts to a doubling in HD-ready homes over the next two years. (Source: *DVD Forum HD DVD White Paper version 1.0 – The Next Generation of Home Entertainment*)

4. I've got some HD DVD orders on the horizon, why shouldn't I just sit back and wait until they're secured before investing in HD DVD production kit?

Don't! HD DVD production requires SD DVD authors to acquire a wide range of new skills including learning new video codecs and programming advanced interactivity. If you wait for the first job it may be too late to acquire these new skills and you could loose out to a competitor who is better prepared to deal with a client's needs.

5. Does HD DVD support traditional PAL and NTSC Standard Definition resolutions or does my video content have to be HD?

The HD DVD specification does include support for standard definition resolutions. In fact, it's common for the picture-in-picture content (also known as secondary video) to be standard definition, in addition to some of the bonus content.

6. What if the user doesn't want to connect their player to the Internet, will the player still work?

Yes. Connecting the HD DVD player to the Internet is optional. It's the job of the production team to ensure that the playback experience when not connected is satisfactory. It's also their job to make the network content so compelling that the viewer can't resist plugging in to enjoy the extra features and content!

7. What does the 'i' and 'P' represent when describing the video resolution and what does it mean?

'i' = Interlaced. Interlaced video divides every frame into odd and even horizontal lines. It then alternately displays all the odd and even lines in turn so, for each frame, you're either viewing all of the odd or all of the even lines. The system was developed for CRT (Cathode Ray Tube) displays (traditional TVs) that have to physically scan every line. Interlacing the video helped reduce the technical challenges involved in broadcasting and displaying smooth video playback.

'P' = Progressive. Progressive video displays a complete frame for every frame of video (like watching a series of full still images). All non-CRT displays (such as Plasma and LCD displays) are able to display progressive video more easily than their CRT counterparts.

8. Does the HD DVD specification support Region Coding?

No. At the time of writing the HD DVD specification does not support Region Coding.

9. Does the HD DVD specification support 44.1 kHz PCM Audio?

No. At the time of writing the HD DVD specification does not support 44.1 kHz audio.

10. What's the advantage of using an Advanced Subtitle Application over the more familiar script-and-image method?

Advanced Subtitle Applications provide more playback flexibility as it's possible to allow the viewer to adjust display attributes (size, style etc.). It's not possible to adjust subtitles that use individual images for each subtitle.

11. Is it possible to author once and output to both HD DVD and Blu-ray Disc?

Due to the technical differences between the two formats, it is not currently possible to author a single project and output to both formats.



APPENDIX A - HD DVD RESOURCES AND INFORMATION

HD DVD Format Information

- **AACS LA** - Licensing Authoring responsible for administrating AACS use.
<http://www.aacsla.com>
- **DVD Demystified** – A great one-stop guide for anyone new to SD DVD and HD DVD.
<http://www.dvddemystified.com>
- **DVD Forum** – The official body behind the definition and specification of the HD DVD format.
<http://www.dvdforum.org>
- **HD DVD.org** – HD DVD player and title reviews
<http://www.hddvd.org/hddvd>
- **HD DVD Promotional Group** – The group tasked with promoting the HD DVD format.
<http://www.hddvdprg.com>
- **HD DVD Promotional Group Europe** – The group tasked with promoting the HD DVD format in Europe.
<http://www.hddvdeurope.com>
- **Microsoft** – One of the many HD DVD backers describes the HD DVD authoring process to the Microsoft Developer Network
http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnwmt/html/introduction_to_hd_dvd_authoring__codz.asp
- **Peter Torr's HDi Blog** – A useful HDi code source from a Microsoft employee.
<http://blogs.msdn.com/ptorr>
- **Sonic Solutions** – The leading supplier of HD DVD encoding and authoring tools. Products include Sonic Scenarist and Sonic CineVision.
<http://www.sonic.com>
- **Toshiba** – One of the main HD DVD backers provides some great overview information on the HD DVD format.
<http://www.toshibahddvd.com>

High Definition Information

- **HD glossary of terms** – If you're new to high definition, this is a useful list of the common terminology you're likely to hear.
<http://www.highdef.org/library/glossary.htm#m>

HD DVD Production Tools

- **EditPad Pro** – IDE for HDi code development.
<http://www.editpadpro.com>
- **Microsoft Visual Studio Web Developer** – An IDE tool for HDi code development.
<http://msdn.microsoft.com/vstudio>
- **PSPad** – A free IDE for HDi code development.
<http://www.pspad.com>
- **Sonic CineVision** – The leading Hollywood-standard cinematic encoder, providing everything you need to create video and audio streams for the HD DVD format.
<http://www.sonic.com/go/cinevision>
- **Sonic Scenarist** – The industry's leading HD DVD production system used by Hollywood studios to deliver commercial HD DVD titles.
<http://www.sonic.com/go/scenarist>

Is your site missing? email whitepaper@sonic.com



APPENDIX B - HD DVD GLOSSARY OF TERMS

AACS - Advanced Access Content System, the content protection system used by HD DVD.

Advanced Application - A collection of Markup pages, Script files, Resources and a Manifest file.

Advanced Content - One of two HD DVD specifications defined by the DVD Forum. Advanced Content enables a majority of the new capabilities in the HD DVD format. See *Technical Specifications* section for more information.

Advanced Subtitle Application - A text-based alternative for subtitling that renders subtitles on the HD DVD player.

AVC - Advanced Video Codec. Also known as MPEG-4 and H.264.

Copy Management - Also referred to as 'Managed Copy', Copy Management is a feature in AACS that enables the legal copying of media to different formats (e.g. to an iPod).

Dolby® Digital Plus - A new HD audio codec developed by Dolby.

Dolby TrueHD - Audio codec formerly known as MLP (see below).

DTS®-HD - A new HD audio codec developed by DTS.

ECMAScript - Scripting programming language often referred to unofficially as 'HDiScript' and is similar to JavaScript and ActionScript.

JavaScript - A specific implementation of ECMAScript (see above) used by Web applications to enable advanced Web interactivity.

H.264 - An alternative name for AVC (see above).

HDi - The declarative Markup language used to drive HD DVD Advanced Content Applications.

iHD - The old name for HDi

InterActual® - A division of Sonic responsible for enabling the enhanced interactivity found on major feature DVD feature film releases.

Linear PCM - Audio format that uses Pulse Code Modulation, a form of uncompressed audio (CD Audio used PCM audio)

Manifest File - An XML document that contains information about a particular Advanced Application.

Markup Page - An XML document which conforms to the standards (schemas) for HDi. It contains styling and timing information.

MLP - Meridian Lossless Packing (now known as Dolby TrueHD). An audio compression system capable of lossless compression of Linear PCM audio.

MPEG-4 Part 10 - An alternative name for AVC.

NLE - Non-Linear Editor, a computer-based editing system (e.g. Avid Nitris).

OTF - Open Type Font, a file that describes the display properties of a particular font.

Persistent Storage - The 128MB (minimum) of built-in player memory.

Pixel Buffer - A part of the HD DVD player memory that renders graphical elements before they're displayed.

PlantDirect™ - Exclusive Sonic technology that enables authoring facilities to write SD DVD and HD DVD masters to a medium of their choice (e.g. hard drive).

Playlist File - An XML file that defines the structure of an HD DVD title.

Primary and Secondary Video Objects - Multiplexed video and audio files that are used for either the main video presentation (primary video objects) or secondary video streams like picture-in-picture (secondary video objects).

QC - Quality Control, the process of testing a finished title.

Roxio® - A Division of Sonic responsible for delivering digital media creation technology to home users and technology partners.

Script File - Written using a programming language that is built from ECMAScript.

Sonic - The leading supplier of encoding and authoring tools for next-generation format production.

Standard Content - One of two HD DVD specifications defined by the DVD Forum. An extension of the DVD-Video format. See *Technical Specifications* section for more information.

StreamData™ - A metadata file format designed to pass chapter point information between HD DVD production systems.

Subpicture - Typically used to display button highlights and subtitles, subpictures layers displayed on top of the presentation video in an SD DVD or HD DVD title.

VC-1 - Also known as the SMPTE 421M video codec standard, VC-1 is video compression technology developed by Microsoft.

Web-enhanced - Multimedia technology that makes use of an active Internet connection by enabling two-way communication between the viewer and provider.

XPath - A query language that describes how to locate specific items, such as elements and attributes, in an XML document.

XML - Extensible Markup Language – enables information to be encoded and transferred between applications in a format that all components can understand.



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