



Blu-ray Disc Production White Paper

Key Facts and Information to Help You Initiate Your Blu-ray Disc 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



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INTRODUCTION

Congratulations! You've taken the first step to initiating your Blu-ray Disc production business! This white paper is a whistle-stop tour of the Blu-ray Disc 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, Blu-ray Disc is ready for this challenge, offering all the next-generation ingredients required to thrive in a demanding multi-level media environment.

The value of Blu-ray Disc

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 Blu-ray Disc has to offer. The combination of interactivity, connectivity, and dynamic content integration allows Blu-ray Disc 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 Blu-ray Disc, 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.

Blu-ray Disc also adds value to the media experience by keeping content fresh through Web connectivity and dynamic content integration. With Blu-ray Disc, 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

Blu-ray Disc'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.

Luckily, Sonic has been deeply involved in the Blu-ray Disc format since day one, both as a member of the Blu-ray Disc Association and as a close partner with leading studios and consumer electronics manufacturers. Our Blu-ray Disc 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 offered by the Sonic, 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...



BLU-RAY DISC KEY CAPABILITIES

Stunning picture and audio quality is only part of what Blu-ray Disc has to offer. The combination of HD video, interactivity, connectivity, and dynamic content integration is what enables Blu-ray Disc to deliver an entertainment experience unlike anything consumers have experienced before. Blu-ray Disc'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

Blu-ray Disc's Advanced Interactivity capabilities (enabled by the BD-J standard) enable the creation of highly interactive games that can be played on top or outside of the main video presentation.

Integrated network connection

Blu-ray Disc 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, ecommerce opportunities, marketing communications, and downloading player firmware updates. [Profile 2 players only]

High Definition video and codecs

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

High Definition surround sound audio and codecs

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

True Color Overlays and Subtitles

The Blu-ray Disc 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 management to enable users to distribute the content to a variety of other multimedia devices.

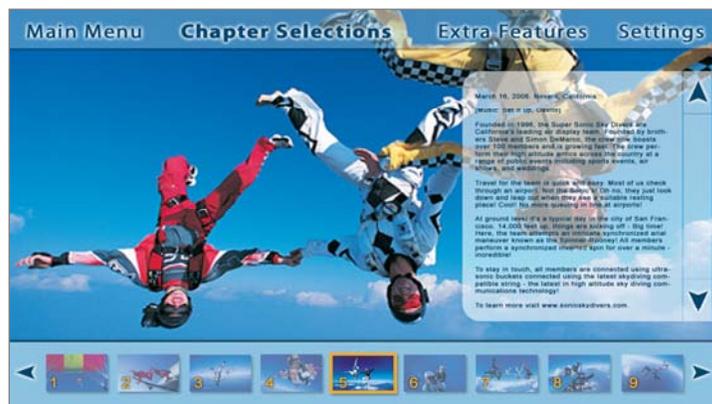


Fig. 1 - Blu-ray Disc's many features include pop-up menus and information overlays.

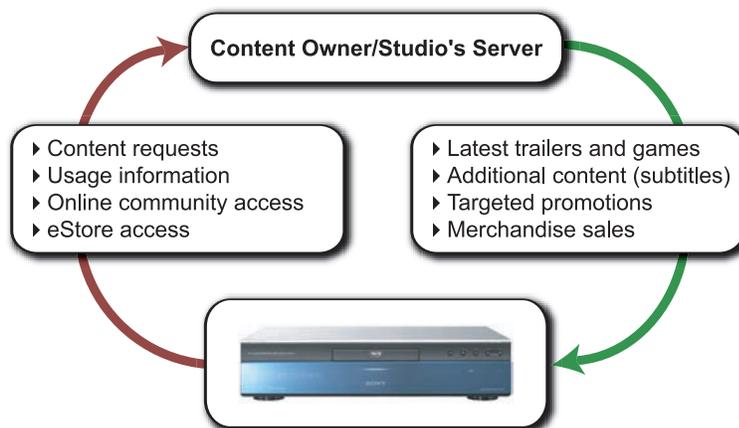


Fig. 2 - Network connectivity transforms Blu-ray Disc into a dynamic multimedia carrier.



BLU-RAY DISC PHYSICAL SPECIFICATIONS

Blu-ray Disc is next generation technology continuing the evolution of optical media that began with CD and DVD. Using a standard 12cm disc, Blu-ray Disc achieves radical increases in capacity with the use of a violet (also known as blue) laser, enabling more efficient use of physical space on the disc's surface. The Blu-ray Disc and DVD physical read-only specifications are compared below.

	DVD-ROM (Read-only)	BD-ROM (Read-only)
Disc diameter	120mm	120mm
Disc thickness	1.2mm (2 x 0.6mm)	1.2mm
Laser type	Red laser	Blue laser
Laser wavelength	650nm	405nm
Track pitch	0.74µm	0.32µm
Capacity (single-sided, single-layer) ¹	4.7GB	25GB
Capacity (single-sided, dual-layer) ¹	8.4GB	50GB
Capacity (max)	17GB ²	100GB ²
Approximate optimum playback time (single-sided, dual-layer) ³	4 hours (SD)	13 hours (HD)
Maximum data rate (data, 1x)	10.08 Mbps	53.95 Mbps
Maximum data rate (video)	9.80 Mbps	40.00 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 ⁴	24-bit/192 kHz (6 channels) ⁵ 24-bit/96 kHz (8 channels) ⁵

¹ Using base 10 whereby 1GB = 1 billion bytes

² Double-sided, double-layer

³ Assuming an average bit rate of 4.6 Mbps for SD DVD and 8.3 Mbps for BD-ROM

⁴ PCM Audio only

⁵ PCM, Dolby TrueHD, and DTS-HD only



DISC TYPES

The term 'Blu-ray Disc' covers a range of different disc types including read-only ROM discs containing interactive feature films, recordable discs, and re-recordable discs. A brief description of each disc type is provided below.

Blu-ray Disc

This is a generic term and brand used to describe all of the disc types covered by the Blu-ray Disc specification.

BD-ROM (Read-only)

Used for mass replication and distribution of interactive feature film titles, capacities range from 25GB (single-sided, single-layer) to 50GB (single-sided, dual-layer). Four-layer discs with a capacity of 100GB (double-sided, dual-layer) are also at the prototype stage (not in production at the time of writing).

BD-R (Recordable)

Used by desktop and laptop PCs for creating one-off BD titles or data back-up discs. Capacities range from 25GB (single-sided, single-layer) to 50GB (single-sided, dual-layer).

BD-RE (Re-recordable)

A re-recordable version of the BD-R disc used to record broadcast material in the living room, capacities range from 25GB (single-sided, single-layer) to 50GB (single-sided, dual-layer).

Twin Format Disc

Also known as a combination disc, this format is not approved by the Blu-ray Disc Association (BDA) and is currently unavailable. Developed by JVC, the twin format disc uses three layers to store both SD DVD and BD content enabling distribution of both formats on a single disc. The players are then able to read the relevant blue or red laser layer. The disc offers consumers the ability to purchase an SD DVD title now with the ability to use the disc in their new BD player when they upgrade without having to purchase a new HD title.

This paper deals specifically with the BD-ROM format. Therefore, for the sake of accuracy, this term will be used for the remainder of the paper.



BD-ROM TECHNICAL SPECIFICATIONS

The BD-ROM specification defines two standards – HDMV and BD-J. Therefore, a BD-ROM title can be one of three types - HDMV-only, BD-J-only, or an HDMV/BD-J combination disc (it's worth noting that only one mode can be active at one time). Before we delve into detail, here is a brief description of each mode:

- **HDMV** – High Definition Movie Mode. Think of HDMV as ‘DVD on steroids’. As well as featuring HD video and audio, HDMV titles include pop-up menus (on top of video), enhanced motion menus and slideshows, and animated buttons with selection and activation sounds. For an HDMV example, go down to your nearest retailer, a vast majority of commercial BD-ROM releases to date have been HDMV titles.
- **BD-J** – BD-Java. In BD-J, almost anything is possible. BD-J is a Java-based mode that enables a raft of Advanced Interactive features including script-to-screen, storyboard viewer, picture-in-picture director's commentary, and gaming to name a few.

Before focusing on each mode in detail, it's worth acquiring some rudimentary BD-ROM theory including a basic grasp of BD-ROM terminology and an overview of the BD-ROM data structure.

Some Useful BD-ROM Terminology

In order to understand the technical differences between each BD-ROM mode, and therefore the creative possibilities, it's important to have a basic understanding of BD-ROM terminology. Some of the common terms are defined below. SD DVD terminology is sometimes used to provide an analogous example.

- **Clip** – A discreet video and audio stream (including timing information) that is referenced by one or more Play Items. A Clip is similar to a VOB in SD DVD which is essentially a multiplexed file containing video and audio (and subtitles, but these aren't stored in Clips).
- **Play Item** – A continuous piece of video and audio content in a timeline that is made up of a single Clip or part of a clip. Play Items ‘point’ to Clips making it possible to use Clips more than once on a title without duplicating the video and audio file on the disc.
- **Movie Playlist** – Similar to a PGC (Program Chain) in SD DVD, a Movie Playlist is a list of play items with in and out times. A BD-ROM title can contain up to 2,000 Playlists.
- **Playlist Mark** – Similar to a Part of Title (PTT) in SD DVD, a Playlist Mark is an object in a Playlist that has a specific position (like a chapter point).
- **HDMV Movie Object** – Similar to a Title in SD DVD. A Movie Object can be one of two types – a Movie Title or Interactive Title. Movie Objects execute navigation commands like links to Playlists or other Movie Objects. The navigation commands can be simple ‘Jump’ commands or logical decisions based on the value of player parameters (similar to GPRMs in SD DVD). An HDMV title can include a maximum of 999 Movie Objects.
- **Movie Title** - A Movie Title is typically used for the playback of the main feature and includes interactive features like pop-up menus. Movie Titles support:
 - Sequential Titles – Simplest title type featuring a single playback path from start to end
 - Multi-path Titles – For example, credits in multiple languages, seamless multi-angle features, and multiple Playlists
 - Multi-title Disc – A disc where two different titles share clips or parts of clips. For example, a director's cut.
- **Interactive Title** - Interactive Titles can be used for a number of different authoring scenarios. One possible application is the use of multiple PlayLists based on a GPR value (GPRs are like SD DVD's GRPMs). This technique can be used to provide a customized playback order depending on the options selected by the viewer. For example, it would be possible to display credits in the viewer's native language depending on the language selected. Interactive Titles can also be used for extras such as biographies, commentaries, storyboards, and slideshows. In general, Interactive Titles are not “seek-able” on a timeline and chapters aren't used. This is because they have many branches and paths. For example, a browseable slideshow - where the user can navigate back and forth among the slides without interrupting the background audio – wouldn't have “seek-able” chapter points.



- **BD-J Object** – A self-contained BD-J application used to provide basic and advanced interactive features to the viewer. See *Focus on BD-J* below for more information.
- **Button Object Group (BOG)** – Describes the attributes (e.g. graphics) of buttons including the commands and logic to be executed in response to user interaction.
- **Display Planes** – Similar to the Background and Subpicture layers used in SD DVD, display planes are used to componentize the different elements on display - video output, overlay graphics, and interactive elements.
- **GPRs** – Similar to SD DVDs GPRMs (General Parameter Registers), GPRs are memory registers present in every BD-ROM player that can be used to store the viewer's input and used by authors to make navigation decisions. Authors have 4,096 32-bit registers at their disposal (a lot when compared to SD DVD's 16 16-bit registers).

To use a widely understood analogy, imagine your personal MP3 collection on your computer and imagine you store little snippets of your favorite bits of songs. Clips are analogous to the MP3 files, Play Items are like your MP3 snippets, and Playlists are a list of your favorite snippets queued up and ready to play.

The table below lists some useful BD-ROM terminology alongside its approximate SD DVD equivalent. Please see the definitions above for detailed descriptions.

SD DVD-Video	BD-ROM
Title	Title
VOB	Clip
PGC	Movie Object
Program	PlayList
Part of Title/Chapter Point	PlayListMark
Cell	PlayItem
GPRM	GPR
SPRM	PSR
UOP	UO
First Play	First Play
Top Menu	Title 0
Root Menu	n/a



BD-ROM Data Structure

Now that we have a basic grasp of some BD-ROM terminology, let's review where these pieces reside in the overall structure of a BD-ROM title. This will help us understand which components can be shared by HDMV and BD-J title components when we look at the two standards in more detail.

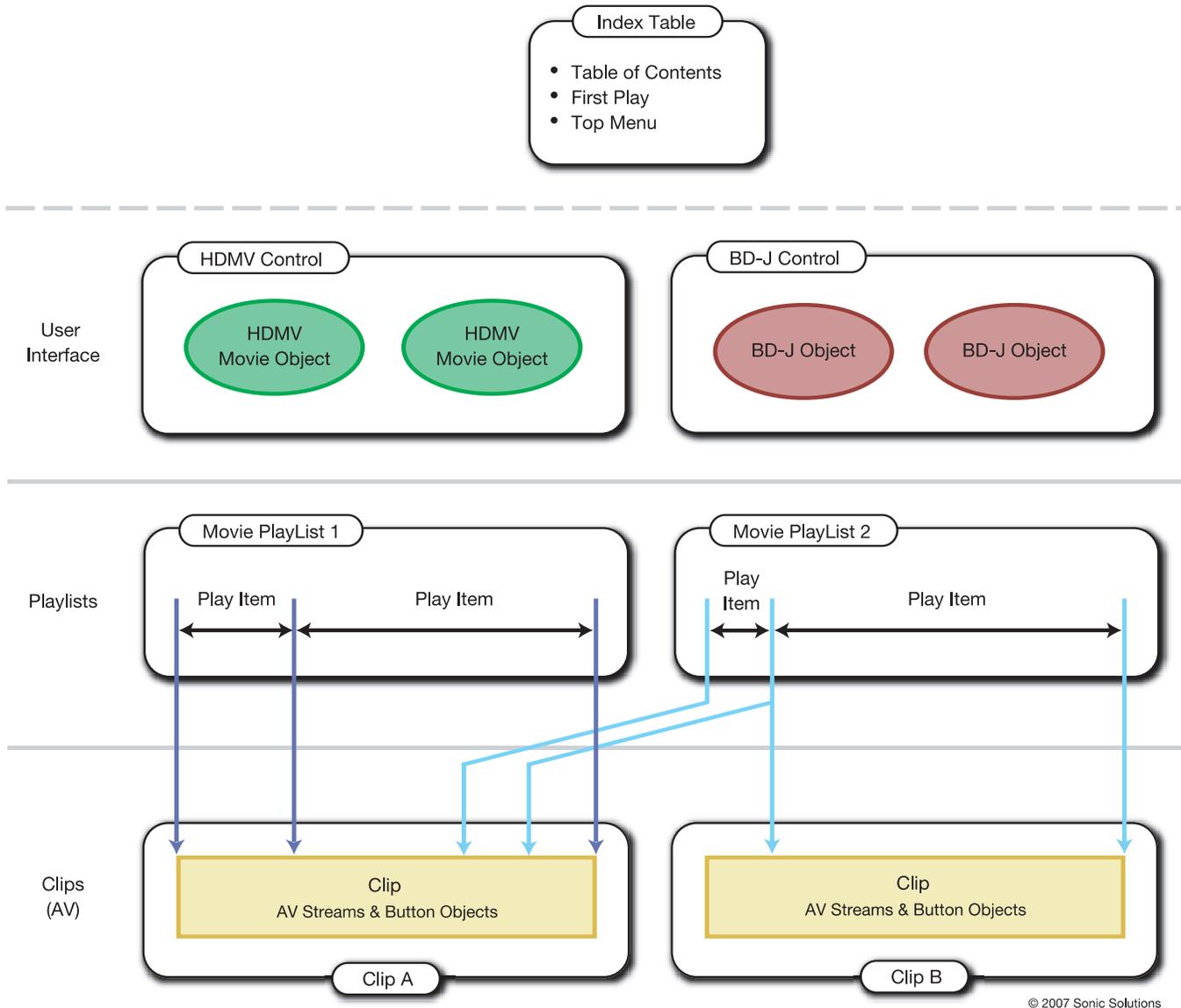


Fig. 3 - BD-ROM Data Structure

A few things worth noting

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

- **Index Table** – This is like a table of contents on a CD, it includes information on the disc contents. The first entry (First Play) tells the player what to do when the disc is first inserted – either load an HDMV or BD-J Object.
- **HDMV Movie Objects** – These can be a Menu or Movie. HDMV Movie Objects reference PlayLists in order to playback video and audio content.
- **BD-J Objects** – These are the BD-J equivalent to HDMV Movie Objects. BD-J Objects reference BD-J JAR files and applications. The nature and function of each object is determined by the design team.



- **Playlists, Play Items, and Clips** are available to both HDMV and BD-J control components. See *Some Useful BD-ROM Terminology* above for a description.
- **BD-J Access** - BD-J applications can access a majority of the components accessed by HDMV objects including video streams, audio streams, text subtitles, and presentation graphics.

Focus on HDMV

BD-ROM's High Definition Movie Mode, commonly known as HDMV, is often referred to as 'DVD on steroids'. The authoring paradigm is similar to SD DVD so experienced DVD authors will be able to use some of the skills and techniques they've acquired to smoothly transition to HDMV authoring.

What's possible with High Definition Movie Mode?

The HDMV specification enables a range of next-generation features when compared to SD DVD. These features are listed below.

- **High Definition video and audio** – The HDMV specification features support for 1080p video and 8-channel high resolution surround sound. A complete list of supported video and audio codecs is provided in the *Blu-ray Disc Physical Specifications* section above.
- **Interactive pop-up menus** – Unlike SD DVD which uses separate video and menu areas, it is possible to author interactive menus using BD-ROM's HDMV mode that appear on top of the main video presentation. This means there's no need to leave the main video presentation to view features like the chapter menus and player settings.
- **Enhanced Motion Menu Functionality** – HDMV titles use three separate display planes (as opposed to the two used by SD DVD). This enables the inclusion of enhanced menu graphics and improved interactivity and transitions between menu pages.
- **Multi-page menus** – The HDMV standard makes it possible to display multiple menu pages (e.g. multiple chapter menu pages) without interrupting video and audio playback. This is because the menu graphics and background video are separate (unlike SD DVD where they are the same stream).
- **Browseable slideshows** – As with motion menus, it is possible to display color graphics (including slideshow images) on top of a moving background and navigate around the graphics layer (slides) without interrupting the video and audio playback.
- **High resolution buttons and button sounds** – The HDMV specification supports button highlights with 8-bit color providing designers with a high level of design flexibility and the ability to create elaborate interactive menus. It is also possible to animate menu buttons using a series of images and add sounds that play when buttons are selected or activated.
- **High resolution subtitles** – Subtitles can be presented using individual graphics or a text file. Both are displayed in full color.
- **On-the-fly text subtitle rendering** – Subtitles that are rendered by the player using a text file can be used on HDMV titles saving disc space and bandwidth.
- **Subtitle effects** – Subtitles can be authored with frame accurate animation to include fade, wipe, and scroll effects.



HDMV Display Planes

BD-ROM's HDMV mode divides the final playback display into three component planes. Each plane is prepared inside the BD-ROM player before being mixed together and output as a video signal.

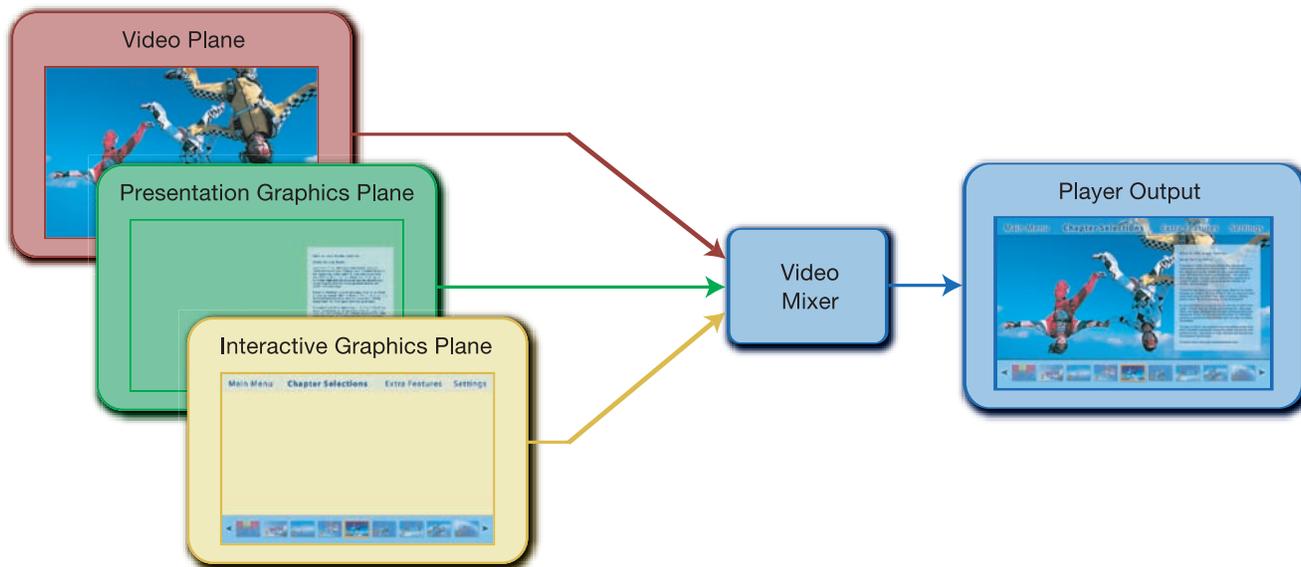


Fig. 4 - HDMV Display Planes

- **Video Plane** – Displays any video present in the Play Item being played.
- **Presentation Graphics Plane** – Displays any graphics and animations that aren't used by the viewer for interaction. For example, subtitles, trivia tracks, menu labels, and title bars that decorate the menu would be displayed by the Presentation Graphics plane.
- **Interactive Graphics Plane** – Displays any interactive buttons and animations used by the viewer to interact with the title. It's important to note that BD-J applications use their own graphics layer for user interaction so Interactive Graphics created for HDMV are not re-used in BD-J titles.

Focus on BD-J

BD-ROM's BD-J mode enables a majority of the next generation features described at the start of this paper. Common applications of BD-J include advanced picture-in-picture functionality (e.g. director's commentaries overlaid on top of the video), network connectivity (e.g. downloading updated content), and complex user interface design and animation. As BD-J uses a programming language – Java - the creative possibilities are almost endless. As a result, it's important to note from the outset that BD-J will require different engineers with different skill-sets to DVD authors. Unlike HDMV, DVD authors looking to transition to BD-J 'authoring', face a very steep learning curve that some will find insurmountable.

What is BD-J?

BD-J is a fully programmable application environment based on the Java platform. Using the Java subset designed for consumer electronics devices (J2ME – Java 2 Micro-Edition Personal Basis Profile 1.0) every BD-ROM player runs its own Java Virtual Machine - which is like a mini operating system - providing the required environment to launch and run Java applications.

BD-J enables interactive graphics content that can run over the top of the main video presentation. These individual applications could be a feature like a pop-up menu, informational text or graphics, or even a game. Unlike SD DVD which is relatively linear medium, BD-J titles are more akin to multimedia CD-ROM titles which are highly interactive and offer a high level of user interaction.



The number, nature, and architecture of the BD-J applications is determined by the team coding the title. For example, there could be one Java application for the whole disc (or for multiple discs in a set), or individual applications that are provided on a title-by-title basis.

It's important at this stage to appreciate the difference between Java and JavaScript. For the sake of simplicity, the only practical commonality between the two is the word "Java"! They are very different programming languages and being proficient in one doesn't mean you'll transition easily to the other. The technical differences between the two go beyond the scope of this paper. Suffice to say they're very different. (Incidentally, the HDi specification which enables advanced interactivity on the HD DVD format is partly based on JavaScript – another important reason for appreciating the difference between the two languages).

Java Powered Interactivity

Java is everywhere! To give you an idea of Java's capabilities, here are some existing applications of Java-powered technology:

- **Set-top Satellite/Cable TV Boxes** – This is probably the most BD-ROM-relevant application of Java as it uses both Java and MHP (see below for more information on MHP) to deliver interactive TV (iTV) to users via a TV screen and remote control. These technologies enable viewers to access interactive content on top of the video content. For example, Time Warner Cable and the BBC's BBCi service are Java-powered.
- **Advanced Web Interactivity** – Following widespread adoption of the Internet, it soon became apparent that there was a limit to the capabilities of HTML. As a result, Sun proposed Java as a way of adding interactivity to Web pages. Java is used extensively today for features such as online games, chat, and education. Is it also used extensively on the back-end to power the applications appearing on the Web.
- **Mobile Gaming** – If you're used to playing games on your mobile phone, the chances are you've been playing games programmed using Java.

What's possible with BD-J?

In BD-J, almost anything goes since you're effectively using a programming language to author a disc. Obviously there are audio, video and graphics limitations set by the player hardware, but content creators are free to combine the media in almost any fashion. The BD-J standard enables a range of next-generation features including:

- Picture-in-picture – Video presentations (such as 'making of' documentaries) over the top of the main video presentation
- Script and Storyboard viewers synchronized to the video presentation [not possible with HDMV]
- Interactive Games [not easily achieved with HDMV]
- Network Connectivity [not possible with HDMV] – The network connection can be used to access specific sites and can be used to access a range of dynamic content including:
 - Latest trailers and multimedia content (downloaded in the background)
 - Latest actor biographies
 - Additional audio or subtitle tracks
 - Any relevant marketing communications (e.g. a Star Trek convention near you!)
- Persistent Storage Utilization – BD-J is able to make use of the persistent storage available on all BD players [not possible with HDMV]
- Elaborate interactive pop-up menus [not easily achieved with HDMV]
- SD DVD-style 'Main Menus' with high resolution rollover states and button sounds



BD-J Display Planes

Like HDMV, BD-J also divides the final playback display into component planes. Each plane is prepared inside the BD-ROM player before being mixed together and output as a video signal.

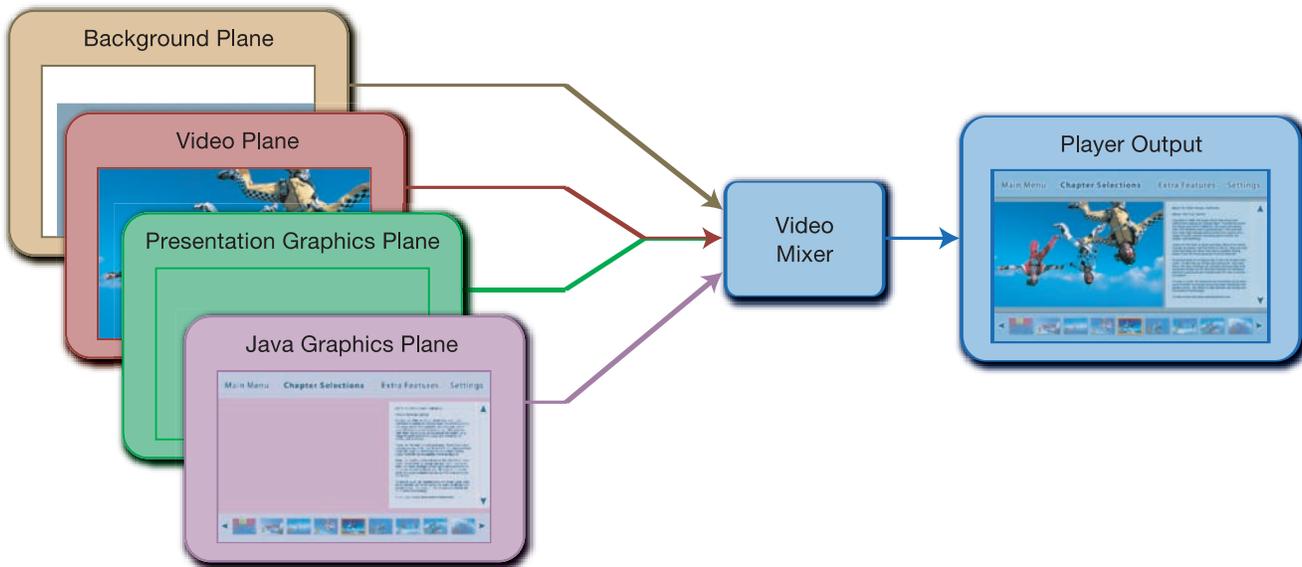


Fig. 5 - BD-J Display Planes

- **Background Plane** – Sits at the back behind the Video, Presentation Graphics, and Java Planes, and is capable of displaying a single color or image.
- **Video Plane** – Displays any video present in the Play Item being played. The configuration of this plane - including size and position - can be controlled by BD-J applications so the background plane can be revealed. However, it's worth noting that only two scaling ratios are supported – 25% and 50%.
- **Presentation Graphics Plane** – Displays any graphics and animations created during the authoring process (e.g. subtitles). As with the video plane, the configuration of this plane can be controlled by BD-J applications.
- **Java Graphics Plane** – Equivalent to the Interactive Graphics plane in HDMV mode, the Java layer displays the graphics and user interface components of BD-J applications. Image rendering is performed by standard Java Graphics packages – standard libraries that decode and display file formats like PNG and JPEG graphics. This just means you don't have to write your own graphics display libraries, you simply call pre-defined functions. In a similar way, fonts, which are vector based to allow easy scaling, are rendered using standard Java text packages.

Some Useful BD-J Terminology

- **Java** – A platform independent programming language developed by Sun Microsystems.
- **BD-J** – A Java-based programming API created specifically for use on BD-ROM. BD-J is a set of APIs based on GEM (meaning all the relevant parts of GEM have been extracted, and additional APIs have been added, to form BD-J).
- **J2ME** – A set of Java APIs designed for consumer electronics devices (Java 2 Micro-Edition). Other sets include Java 2 Standard Edition and Enterprise Edition (neither of which are used by BD-J). J2ME is used in BD-ROM players, set-top cable receivers, and cell phones and is a subset of J2SE.
- **J2SE** – Another set of Java APIs (Java 2 Standard Edition) used on computers and by Web page applets (mini applications). J2SE is a subset of J2EE (Enterprise Edition).
- **MHP** – A Java-based programming API called Multimedia Home Platform. MHP provides a common platform for set-top box manufacturers that enables different boxes to function on the same network. It is used by some European broadcasters to enable the interactive functions available in digital broadcast and evolved into GEM.



- **GEM** – A Java-based programming API called Global Executable MHP. GEM is the worldwide version of the Multimedia Home Platform (MHP).
- **OCAP** – A Java-based programming API called OpenCable Application Platform used by some US broadcasters to enable the interactive functions available in digital broadcast. OCAP evolved from GEM which itself evolved from MHP.
- **Java Virtual Machine** – A stand-alone operating system that runs on consumer electronic devices to enable Java applications to function. Just as Word requires an operating system (like Windows) to run successfully, Java applications require a Java Virtual Machine environment.
- **Subset API** (like J2ME) – A subset is created by taking a runtime library and throwing out all of the calls you don't need to leave only the classes and methods required for a specific application (see below for an idiots guide!).
- **Persistent Storage** – The BD-ROM specification stipulates that all players must have at least 64KB of built-in flash memory (similar to a USB memory stick). This can be used to store small amounts of information about the viewer's Blu-ray Disc collection like their favorite bookmarks or high scores.
- **JavaScript** – The most important thing to know about JavaScript in the context of BD-J is that it is not the same as Java and, therefore, BD-J (despite the obvious similarities in their name). JavaScript is a simplified script-based language that is used for online applications such as picture management and online mapping sites. Incidentally, it is also the basis of HDi, the standard used by HD DVD for Advanced Interactivity.

A Few Notes on Java and BD-J

Java Language Interchangeability – A common and understandable misconception people who are new to Java have involves the interchangeability of different flavors of Java. For example, programmers fluent in JavaScript often assume they can easily transfer their knowledge to Java/BD-J programming. While JavaScript experience is obviously an advantage, there is a significant learning curve to climb to become equally proficient in Java/BD-J. Another popular misconception involves the interchangeability of J2SE applets created for the Web and Java/BD-J programs. This isn't as easy as you might initially think as J2SE and J2ME are significantly different.

Java Application Security - Because BD-J is a full programming language, some kind of authentication scheme is required to avoid potentially damaging applications (like viruses) running on players. BD-J uses the existing Java 2 security model to authenticate BD-J applications. Once loaded, applications can request permission to read and write to the player's storage media, use the network connection, access files on the BD-ROM disc, select other titles on the BD-ROM disc, and control other BD-J applications.

BD-J Idiots Guide

Hang on a minute, you've lost me, what does that all that mean in layman's terms?

Back to Basics - Think of Blu-ray players as mini computers. As with all computers, they consist of hardware (processor, memory etc.), a software operating system, and applications that run on the operating system.

The BD-J 'Operating System' – The operating system used on Blu-ray Players is a Java Virtual Machine. Think of this as being the Windows equivalent for Blu-ray Players.

BD-J Applications: Interactive Features - Now consider interacting with a BD-ROM title, for example, accessing a pop-up menu. When you request the pop-up menu, what's actually happening is an application is being launched. You then use that application to control the content (e.g. choose to skip to a chapter). It's the same when you change audio streams – it's all handled by BD-J applications.

J2ME - Think of a programming language (Java) as any other spoken or written language (like English). Imagine Java is the full English dictionary – it contains a massive number of words that aren't all used that regularly. Therefore, other dictionaries exist that are smaller versions of the full dictionary. These smaller subset dictionaries exist because not all the words in the main dictionary are required. It's inefficient to have them as part of the subset's vocabulary. J2ME is a subset, and BD-J's superset, of the Java programming API. They contain the set of instructions that are specifically needed for the application it is intended for.

Still confused? Fear not, contact your nearest expert using the details in the Introduction to this paper and they'll be able to answer all your questions and tell you where your nearest seminar is being held.



Region Coding

The BD-ROM specification defines three regions:

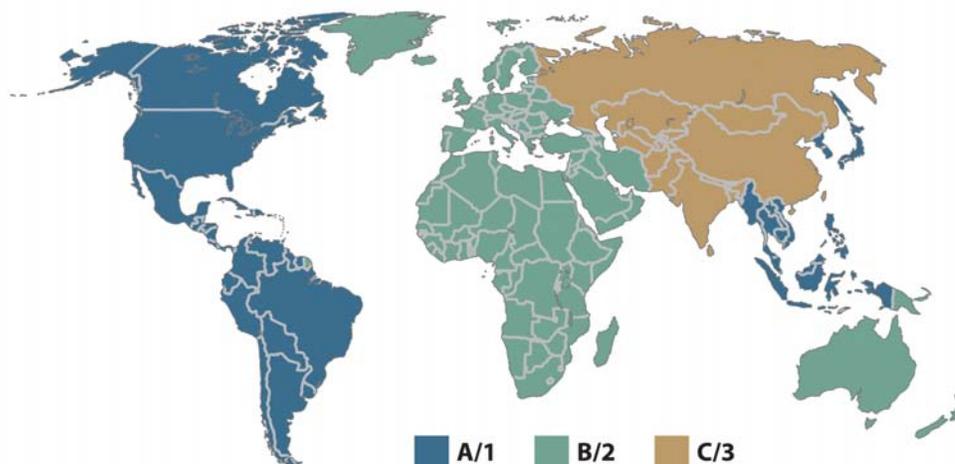


Fig. 6 - BD-ROM Regions

Region Code	Area
A/1	North America, Central America, South America, Korea, Japan, Taiwan, Hong Kong, and South East Asia.
B/2	Europe, Greenland, French Territories, Middle East, Africa, Australia, and New Zealand.
C/3	India, Nepal, China, Russia, Central, and South Asia.

Player Profiles

The BD-ROM specification defines two player profiles – Standard and Full. The differences are shown in the table below.

Feature	Standard Profile	Full Profile
HDMV Support	✓	✓
BD-J Support	✓	✓
Storage	256MB (optional)	1GB
Network Connectivity	✗	✓
Picture-in-picture	✗	✓

Having two types of player on the market requires consideration when authoring as some features may only be available on Full Profile players. This topic is covered in more detail in the *BD-ROM Production in Practice* section.

Standard Profile 'Sunset' Clause – Standard Profile players will, at some point in the future, no longer be manufactured or sold. At that point in time all players will have to be Full Profile. Although this will obviously simplify the production requirements in the long term, there will still be a significant proportion of early adopter Standard Profile players in the market that will require consideration.



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 base level Content Protection solution for BD-ROM. AACS provides an advanced, robust, and renewable method for protecting audiovisual 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 you might come across:

- **AACS** – Advanced Access Content System. The content protection technology used by the Blu-ray Disc 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. Samsung BD-P1000 and Playstation 3) 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 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.



In addition to the standard protection offered by AACS, the BD-ROM specification also features two further security measures: BD+ and ROM-Mark.

BD+

BD+ (pronounced 'BD Plus') is an additional security layer unique to BD-ROM that uses a Virtual Machine (VM) to process and decode BD+ protected content. The use of a Virtual Machine enables content owners to include unique title-specific content protection on their titles. In layman's terms, BD+ works by deliberately corrupting the playback streams and using the BD+ Virtual Machine to 'uncorrupt' the streams prior to display.

ROM-Mark

ROM-Mark is another additional security layer unique to BD-ROM. ROM-Mark works by inserting invisible data (similar to an analog watermark) that is designed to prevent the casual direct copying of protected titles. ROM-Mark is an analog level mechanism that prevents unauthorized replication of titles by requiring special machinery at the mastering stage. BD-ROM titles used for broadcast can also use ROM-Mark to prevent copying and replication of broadcast content.



AACS Implementation Workflow

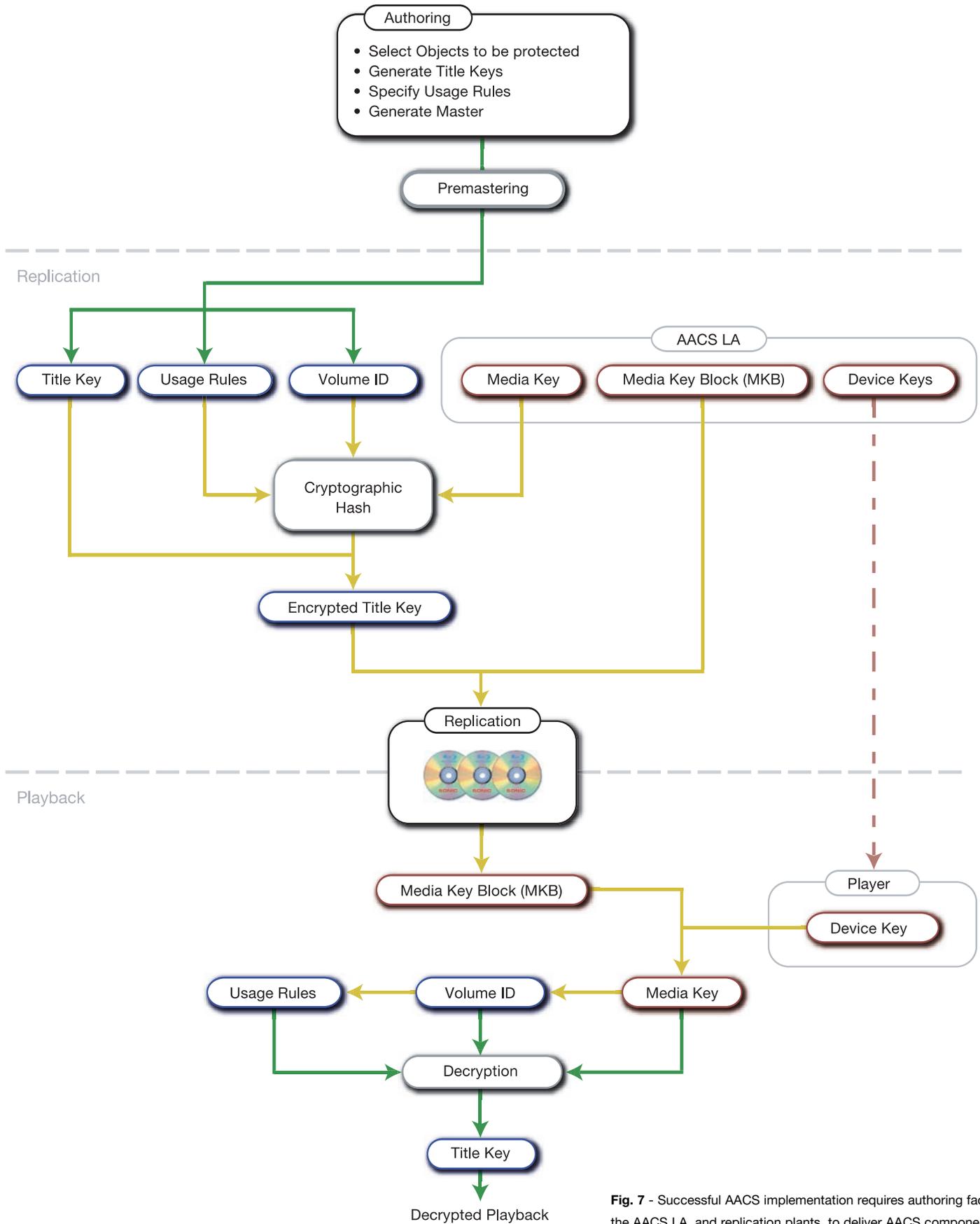


Fig. 7 - Successful AACS implementation requires authoring facilities, the AACS LA, and replication plants, to deliver AACS components.



BD-ROM PRODUCTION IN PRACTICE

Project Planning

As with most projects, planning and preparation is everything. The check list below is by no means exhaustive but provides you with an indication as to the kind of new issues you will need to consider when planning a BD-ROM title.

- What kind of features does the client need or want?
- What kind of interactive features are required?
- Are any advanced features like script-to-screen or image galleries required?
- Can the features be achieved using BD-ROM's HDMV mode or are the extra capabilities of BD-J required?
- Will there be any networked content such as updatable video content or games?
- Are any of the interactive features synchronized to the main video content?
- Do the BD-J coders require a rough encode (but timecode accurate) version of the video?
- What other elements do the BD-J coders need to start development?
- What kind of subtitles are required?
- Should the subtitles be individual graphics or text based? Text-based subtitles have the advantage of being 'out-of-mux' so might be used on projects with a large number of languages without using bandwidth for subtitles that aren't being displayed.
- What resources are required to achieve everything above?
- How many BD-J coding experts and creative artists are required?
- Player profile considerations – It's important to take into consideration the capability of the viewer's platform and provide a graceful alternative for features that require Full Profile capabilities, for example, when the user is unable to access online content due to lack of a network connection.

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 transferred to BD-ROM. However, the new video and audio codecs do offer new capabilities that surpass those used for SD DVD so it will obviously be important to familiarize yourself with those before tackling any encoding for BD-ROM.

The most important weapon in your encoding armory will be the encoder you choose. Here are some issues to consider when assessing a BD-ROM encoding solution:

- **Quality** – Obviously you want an encoder that provides you with the best possible quality for your money (although the set-up and equipment used in your workflow will also play a part in determining the quality you achieve). As well as viewing the encoder's output for yourself, a quick way of judging the quality of an encoder is to find out who is using it and for what kind of productions. 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's important that you can offer the services your clients request. Therefore, you'll need an encoder that's capable of encoding all three video codecs – AVC, VC-1, and MPEG-2.
- **Format Compliance** – BD-ROM supports the AVC, VC-1, and MPEG-2 video codecs and DTS®-HD, Dolby® Digital Plus, Dolby Digital TrueHD, and LPCM audio codecs. The BD-ROM specification contains strict guidance on the video and



encoding parameters supported, for example, the supported frame rates. It is also very specific about the parameters used for the Primary- and Secondary-video streams used in BD-J titles. There are even specific requirements for the way the encoded data is structured. Therefore, it is important to use an encoding tool that features not only the highest possible encoding quality but also strict specification compliance to ensure that all your encodes are legal for the target format. This function is often found under a 'target application' setting and ensures that every parameter you select 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, you should also aim to achieve the highest possible quality. This requires a workflow that is uncompressed and, therefore, preferably tapeless. Bouncing your edit to tape – a technique commonly used for SD DVD encoding – is no longer ideal if you are looking to achieve optimum encode quality from your NLE. This is because all HD tape formats feature some degree of compression when recording to tape. There are a number of ways of achieving a tapeless workflow. 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 file type. Alternatively, you can capture your HD source using one of a range of HD capture solutions available today. Either method will ensure you're providing your encoder with the highest possible quality input which will ultimately yield the best possible quality. Also, make sure your encoder features flexible support for different media types like QuickTime®, AVI, Image Sequence, and raw YUV as it's very unlikely that your source will always be the same.
- **Post-encode Tools** – For a professional compressionist, the real work starts when the encode has completed. Make sure you have a tool that provides the post-encode toolset you need. For example, the kind of professional features most compressionists demand as standard include HD-SDI output for encode QC, a professional timeline with all the information you need to review your encode, A/B switching to compare the encode with the source, QC efficiency tools for speedy scanning a completed encode, and segment-based re-encoding for fine tuning any sections you're not happy with.

✓ 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 as well as built-in video processing technology from Digital Vision that can be deployed segment-by-segment when re-encoding. 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 shouldn't have any major problems transferring their skills to BD-ROM production. However, there are a few new challenges and issues to be aware of when designing interactive graphics for BD-ROM. These include:

Design Environment

- **Design Resolution** – Graphics will need to be prepared for the chosen HD resolution, typically either 1920x1080 or 1280x720. Note that individual graphical elements such as button animations and pop-up menus 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 BD-ROM.
- **Canvas Settings** – Make sure your graphics will be seen on HD displays and can be used by viewers.
 - Title Safe Area – A good rule of thumb to use is 15% around all edges. This means that for a 1920x1080 image, a design area of 1632x918 is available.
 - Action Safe Area – It's best to leave 8% around all edges. Therefore, for a 1920x1080 canvas, an action area of 1766x933 is available.
- **Color Palette (IG/PG)** – The BD-ROM specification supports 256 (8-bit) color images for Interactive Graphics and Presentation Graphics in HDMV titles. All images must be delivered as indexed ARGB (Alpha, Red, Green, and Blue color information) and are limited to a single alpha value per color (sometimes referred to as “color-transparency pairs”). This requirement differs from the standard PNG format which includes an alpha value for every pixel. Despite the removal of some of SD DVD's design restrictions, there are still some limitations designers will need to consider:
 - One of the 256 colors has to be transparent so, in reality, designers have a 255 color palette at their disposal. Designs use 256 colors as well as transparent pixels will be interpreted as 257 colors images and rejected.
 - Each Interactive Graphics page has its own 8-bit color palette. This means that designers are restricted to 256 colors per page. A good Photoshop plug-in like Scenarist Designer PS will process full color graphics and deliver the required palette automatically.
 - Page In and Out effects can have their own frame-specific palette.
 - Each Presentation Graphic page has its own palette.
- **Color Palette (BD-J)** – The BD-J specification supports 32-bit images (24-bits of color and 8-bits of alpha) so, if you're designing specifically for BD-J use, you can use true color when designing and exporting.
- **Photoshop Practice and Layer Discipline** – If you're using a Photoshop plug-in like Scenarist Designer PS, which automatically processes your graphics for use in a BD-ROM authoring tool, you need to make sure you order and name your Photoshop layers in a way the plug-in can understand and interpret. While this requires an investment of time upfront, the efficiencies gained throughout the rest of the process easily make up for it.
- **Dividing up Interactive Elements** – Because of the color and memory restrictions on the IG and PG plane, ask yourself if any of the design elements – particularly for traditional 'main' menus – can be moved to the background video plane where the color restrictions are lifted.
- **Dithering Considerations** – In order to adhere to the palette limitations in the BD-ROM specification, any BD-ROM design tool, like Scenarist Designer PS, will use dithering to optimize the available color palette. Therefore, try to avoid using gradients, tints, and excessive anti-aliasing, especially in conjunction with photographic images as the graphics may not appear as you'd like after they've had their palette reduced and the graphics have been dithered. If you want complete control, design an interface with only 256 colors so that the palette algorithm leaves your graphics untouched.

Button Design and Animation

- **Button States** – Instead of creating a single subpicture image whose different colors and transparencies are subsequently programmed by the author - the common workflow for SD DVD - designers are free to create images for each button state (normal/unselected, selected, and activated).
- **Button Animation: Interactive Graphics In and Out Effects** – It's possible to achieve the In and Out Effects listed below within the BD-ROM authoring environment. This means that these effects can be achieved by providing authors with a single graphic and a set of instructions on the desired animation.



- Move: A graphic can move across the screen by providing start and end coordinates and a specified time within which to complete the animation.
 - Crop/Wipe: It's possible to crop a graphic by specifying a start and end cropping size and a time period within which to complete the animation. This effect is typically used to create a wipe effect.
 - Fade (Palette Animation): It's possible to change the color of a graphic by providing a start and end palette. The authoring tool will interpolate between the two and automatically create the desired animation.
- **Other Button Animations** – It's possible to animate buttons in both HDMV and BD-J using a one of the methods described below. For BD-J, the suitability of each method is beyond the scope of this paper but, suffice to say, you should liaise with your BD-J experts to ensure you're delivering what they need.
 - **Method 1 (HDMV and BD-J):** Designers are able to animate buttons by delivering a series of still images. Naturally the length and frame-rate of the animation will affect the number of graphics used and the amount of player memory used to buffer and playback the animation. It's common to use an application like Adobe® AfterEffects™ to set-up an animation and then export a series of PNG files, one for each frame of the animation.
 - **Method 2 (BD-J only):** You can animate graphics in BD-J using a single graphic and programming any required animation using BD-J code. For example, you could use code that, in layman's terms, says "move this image from point (x) to point (y) in (z) seconds and resize it to size (a) x (b)".

Spec Awareness

- **Avoid Common Design Mistakes** – There are a few common pitfalls that are easily avoided when you start designing for BD-ROM:
 - BOG Overlaps: Make sure no BOGs overlap as this will cause authoring and multiplexing problems.
 - Minimum Graphic Size: Make sure no elements are less than 8 pixels wide or high.
- **Buffer considerations** – Before any graphics can be displayed, they need to be loaded into the BD-ROM player's buffer for rendering. There are separate buffers for Interactive and Presentation Graphics known as 'decoded object buffers'. The Interactive Graphics 'decoded object buffer' is 16MB, while the buffer for Presentation Graphics is 4MB. For BD-J graphics the buffer size is 45.5MB (5MB of which can be used for audio), but all graphics are rendered as 32-bit images, thus they take up more buffer space. There is also a separate 'coded object buffer' which holds the entire encoded stream. The composition segment is copied to the 'composition buffer'. There are separate size limits for the composition and coded object buffers. Overloading the player buffers will result in the BD-ROM player displaying an error message. Therefore, remember at all times that you need to try and conserve memory. Design the graphics as if they're destined for a web page.
- **Display Sets** – Each Display Set is limited to 16MB.
- **Performance considerations** – Remember that all graphics have to be read from the disc, loaded into memory, and then passed to the buffer to be displayed. The more efficient you can be in your design, the better the performance of your title. Even if you have room in the player's memory and graphics buffer, using large graphics may result in slow playback performance. For those authors and designers who have tried using multiple tiled pages for SD DVD menus, you'll be aware of the impact slow interactivity can have on the viewing experience.
- **Memory considerations** – Every BD-ROM player has a minimum 64MB of RAM. For BD-J, this memory is used for storing components including images, sound clips, and BD-J Objects/applications. For Profile 2 players, this limit increases to 80MB. You need to ensure that your graphics don't overload the available memory. You can achieve this by being thrifty with your design and also, wherever possible, reusing graphics for multiple instances. This is probably the least important hardware consideration, when compared to the buffer and performance considerations.

Spec Awareness

- **Design-to-Authoring Workflow and Communication** – Although a good set of workflow-focused applications - like Sonic Scenarist - will ensure that as much information as possible (like button position and state) is passed to the authoring tool, there will be some information - like animation behavior and In and Out effects - that will need to be communicated to authors manually. You will need to establish an efficient way of sharing these design attributes to ensure the finished title behaves in the exact way you envisaged at the design stage.



- **BD-J coding workflow** – Graphic designers will be used to working with SD DVD authors to design and refine menu graphics and subtitles. With BD-ROM there's a whole new set of colleagues to work with – BD-J coders. BD-J 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 way of working together that suits you both and ensures your workflow is as efficient as possible.

✓ 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.
Learn more: www.sonic.com/go/designer
- **Adobe® Photoshop®** – Adobe Photoshop is the de facto standard for production and design houses worldwide. The latest versions feature all the capabilities you require to design Interactive Graphics for BD-ROM. 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 for BD-ROM.
- **Adobe After Effects™** – Adobe After Effects is commonly used by SD DVD Motion Menu designers, and can be adapted for use in a BD-ROM workflow.
Learn more: www.adobe.com

SCENARIST
DESIGNER



Subtitle Production

There are two subtitling options available to BD-ROM authors: text-based and image-based. Both methods use the Presentation Graphics plane to display subtitles so the PG display considerations and limitations described in other parts of this paper are relevant to subtitles also. As with other production decisions your selection will be determined by weighing up the production requirements (and associated costs) against the benefits of each method.

- **Text-based Subtitles** – Unlike SD DVD, it's possible to display subtitles on a BD-ROM title by providing players with a text and OpenType font file. The BD-ROM player uses these two files to render the required subtitles as and when they're required. As text-based subtitles are 'out-of-mux', this method has the advantage of using less disc space and bandwidth than image-based subtitles, making it possible to deliver a large number of different languages without affecting the bandwidth available for the video and audio. It also provides the potential for viewer customization. For example, you can provide viewers with a subtitle style menu where they can select the appearance of the subtitles (size, color, position etc.). There are a few important issues to consider when choosing this text-based subtitling method:
 - Required player power - Text-based subtitles require more player CPU power to render than their image-based counterparts.
 - Font inclusion – In order to make sure the text is displayed consistently across all players, the title will need to include any fonts used on the disc. Licensing and distributing any font files will require the permission of the font owner.
 - Font treatment – There isn't currently any provision for stroke, outline, or drop shadow implementation so, in the worst case scenario, subtitle text could get lost and disappear into the background image.

As a result, at the moment, authors are advised to release early titles using image-based subtitles until there is wide spread support by player manufacturers and industry consensus on implementation of text-based subtitles. It is anticipated that we'll start seeing text-based subtitles on BD-ROM titles in the coming months.



- **Image-based Subtitles** – All BD-ROM-ready subtitle houses will be able to provide pre-rendered graphics with an associated script file specifying the timing and position of each subtitle. As a result, the workflow for adding image-based subtitles to a BD-ROM title is very similar to the workflow used for SD DVD. You simply select the file provided and leave the authoring application to interpret the incoming data and add the subtitles to the selected movie. Image-based subtitles have the advantage of displaying consistently across all players as, once the images have been multiplexed into the title, the player can't change them. The main disadvantage of image-based subtitles is their bandwidth efficiency. Image-based subtitles are 'in-mux' meaning all languages are multiplexed into the final stream read by the player. This means that bandwidth that could have been used for improving the video and audio encoding quality is used for multiple streams of subtitles that aren't ever all viewed at the same time.

BD-J Coding

BD-J coding is required for the creation of highly interactive, updateable BD-ROM titles. BD-J applications are a combination of BD-J code, Video, Graphics, Font, and Sound files (see *Technical Specifications* for detailed information). BD-J coders will be at the center of any BD-J 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 BD-J coders should bear in mind when embarking on their first BD-J title.

- **Skill requirements** – Experience with Java is a distinct advantage when considering writing BD-J code. Experience with MHP and/or GEM are also a bonus but not vital (it is rare to find someone with MHP or GEM experience). Of course, coding experience in other languages will certainly be useful as undoubtedly, some knowledge and/or theories transfer across to BD-J. SD DVD authors with zero coding experience will have greater challenges and it would be advisable to undertake basic courses in code writing in Java before attempting to write BD-J.
- **Workflow integration** – BD-J 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, a BD-J coder – especially one responsible for coding menus – needs to have an overview of all of the content on the title and how it all fits together and works with the applications being developed. BD-J coders will therefore need to work closely with content authors. Similarly, BD-J 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 BD-J applications.
- **Application architecture** – Designing a BD-J application is no different to designing and building a website or other computer program. A BD-J 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 BD-J application or multiple smaller applications that communicate with each other.
- **Hardware considerations** – Just like graphic designers, BD-J coders need to be aware of the BD-ROM player's hardware limitations such as the 45MB image memory limit (used for all applications and resources). Therefore, it is vital that coders are able to write efficient BD-J code to ensure they make the maximum use of the available memory.
- **Code templates and library** – Over time, BD-J coders will build a library of BD-J 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 BD-J content that has been developed. It is the responsibility of the BD-J coder to ensure that applications are compatible with the range of BD-ROM 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 BD-J 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 BD-J coders have completed and tested their code, they pass their work to the BD-ROM authors who combine all of the BD-J applications with other BD-ROM elements and multiplex the finished title.



✓ Kit Check: BD-J Coding Tools

- **Sonic Scenarist®** – Scenarist BD Edition is the world’s first WYSIWYG BD-J creation tool providing BD-J coders and authors with a unique drag-and-drop BD-J creation environment. Scenarist also includes additional technical white papers, example code, and reference materials for BD-J programming. It also features a BD-J playback environment with logging and debugging capabilities.
Learn more: www.sonic.com/go/scenarist
- **Eclipse** – Eclipse is one of the leading Integrated Development Environments (IDE) available for Java. Scenarist BD-J is a plug-in for Eclipse which provides BD-J developers with an ideal development environment for the creation of all types of BD-J Application code.
Learn more: www.eclipse.org

Authoring - HDMV

HDMV authoring isn’t too dissimilar to authoring for Standard Definition DVD. The author imports all of the multimedia content which is combined/authored to create movies and interactive menus, and then the title is brought to life by programming any required interactivity. For any authors considering transferring their skills to HDMV authoring, here are some quick practical notes to consider:

- **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 mastering.
- **Authoring software and paradigm** – SD DVD authors will feel instantly at home in an HDMV authoring tool like Sonic Scenarist. The authoring paradigm is similar to that of SD DVD with interactive elements and audio visual content being compiled and then combined and programmed to form a smooth interactive experience. The main differences between HDMV and SD DVD authoring include the specification differences (new rules and terminology), the additional capabilities (interactive graphics and their animation), and the application of AACS content protection.
- **Spec awareness and data structure** – Any authors familiar with the SD DVD specification and associated terminology will be able to convert their knowledge fairly easily as a lot of the principals are similar.
- **Navigation commands** – The HDMV specification features a range of new commands and rules that authors will need to familiarize themselves with. Some of the authoring restrictions (e.g. number of commands on a button) have also been lifted when compared to SD DVD so you will need to learn the specification features in order to utilize them and maximize the interactivity of your BD-ROM titles.
- **In- and out-of-mux content** - Similar to SD DVD, an HDMV stream - known as a BDAV stream – can contain a single stream that contains all the video, audio, and graphics required for the player to display the interactive content. In addition, HDMV also supports something called ‘out-of-stream’ multiplexing which involves a second additional stream containing additional content like menu and slideshow graphics, additional audio, and subtitles. Although, on the face of it, this capability sounds like a great feature in helping to optimize the in-mux bandwidth, there is one important caveat to consider: all out-of-mux content must be loaded into the player buffer before the playback of the multiplexed BDAV stream starts (to avoid the player having to read from multiple areas on the disc). It is common practice for Interactive Graphics to be authored out-of-mux to ensure they are available as soon as the video playback commences (in-mux Interactive Graphics take a few seconds to become available which isn’t desirable from a user’s perspective). The disadvantage of out-of-mux Interactive Graphics is the delay caused while the player loads them (often resulting in the player displaying an hour glass/ticking clock/progress bar animation for a few seconds).

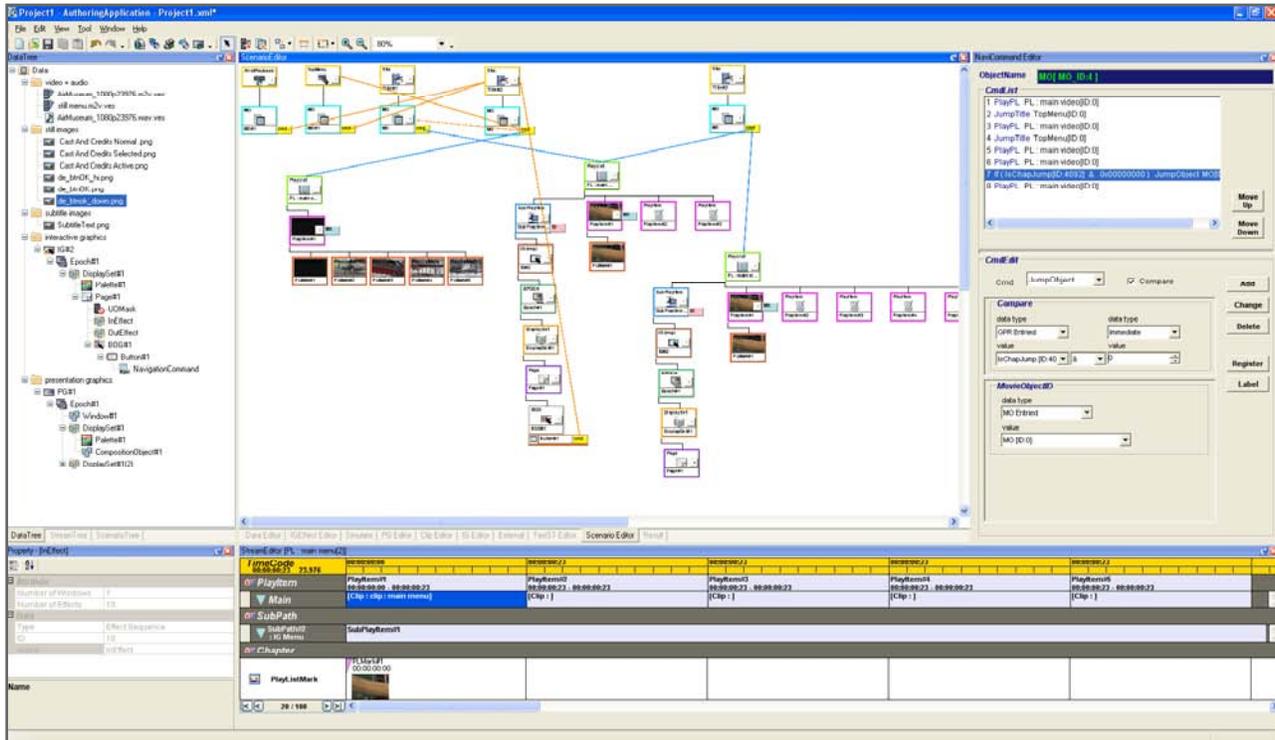
In summary, a seasoned professional DVD author with the relevant training and materials should be up to speed on HDMV authoring within a couple of days.



✓ Kit Check: HDMV Authoring Tools

- **Sonic Scenarist** – Scenarist BD Edition provides authoring professionals with spec-level access to the entire HDMV specification and also features seamless BD-J integration for fully featured BD-ROM creation. Using an authoring interface and environment familiar to Scenarist users, authors can author BD-ROM titles today using techniques and terminology developed over years of SD DVD authoring.

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



Authoring - BD-J

At the time of writing the majority of the 'authoring' of BD-J titles is handled by the BD-J coder. BD-J coders are responsible for creating the BD-J applications used on a title to enable the advanced interactive elements. The compiled BD-J Objects (BDJO's) are then taken by the author (typically the same person responsible for the creation of other title elements) to create and multiplex the finished BD-ROM title.

- **Author's role** – BD-ROM authors will start a project with a range of assets, these will include video, audio, subtitle files, Interactive Graphics, Presentation Graphics, and the BD-J elements known as BD-J Object Files (BDJO). An authoring program like Sonic Scenarist is then used to create the various different title elements like the Movie Playlists, Clips, and Presentation Graphics as well as placeholders for the BDJO files. Once the BDJO files are received from the BD-J coders, authors simply have to drag-and-drop the compiled BDJO files into the placeholders to integrate them into the BD-ROM title. When complete, the title is multiplexed and passed to quality control for testing. It's possible that some QC errors will be reported to the BD-J coding team before updated BDJOs are passed to the author for re-authoring. However, there may be some QC errors that can be fixed in the authoring program.

Assisted by training and a professional support service, a professional SD DVD author will be able to begin adding BD-J content to BD-ROM titles within a day. Please note that coding BD-J is another matter and requires extensive Java coding experience and knowledge.



✓ Kit Check: **BD-J Authoring Tools**

- **Sonic Scenarist®** – Scenarist BD Edition provides authoring professionals with an intuitive way of laying out the various components of their BD-ROM titles. As well as comprehensive support for the HDMV specification, Scenarist also includes the world's first drag-and-drop BD-J creation environment, seamlessly integrated with Scenarist Designer PS for fast and easy BD-J creation. Integrating BD-J content with Scenarist is a simple drag-and-drop process.
Learn more: www.sonic.com/go/scenarist

Emulation and Quality Control

The role and responsibilities of the BD-ROM 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 found need to be accurately reported to the relevant people to ensure a fast and efficient turnaround is achieved.

For any SD DVD QC specialist looking to transfer their skills to BD-ROM, there are a few new pieces of knowledge that will aid smooth transition to the new format.

- **Format theory and specifications** - Obviously there is some new technical theory to become accustomed with in order 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's 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 mis-diagnosed.
- **Workflow knowledge** – Understanding who does what in the creation workflow will ensure you report any errors to the correct person. For example, errors with any BD-J applications could be reported to a number of different coders depending on which part of the title isn't behaving correctly.

✓ 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 BD-ROM 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 BD-J 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

At the time of writing, the CMF (Cutting Master Format) standard for BD-ROM premastering had not been finalized. Up to this point, authoring houses have been successfully delivering proprietary BD CMF masters to BD-ROM replication plants. All BD-ROM authoring tools, like Sonic Scenarist, are capable of delivering the required BD CMF image and associated data and will no doubt be updated to support the final CMF protocol as and when it is approved by the Blu-ray Disc Association.

The CMF standard adds 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 de facto standard for the premastering medium for BD-ROM. Your premastering workflow will obviously depend on the capabilities of the authoring program you choose. Sonic Scenarist is able to deliver the required CMF files directly to a medium of your choice. With continually falling prices, some authoring houses are using removable hard disks to transfer their masters to replication facilities. At the same time, 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

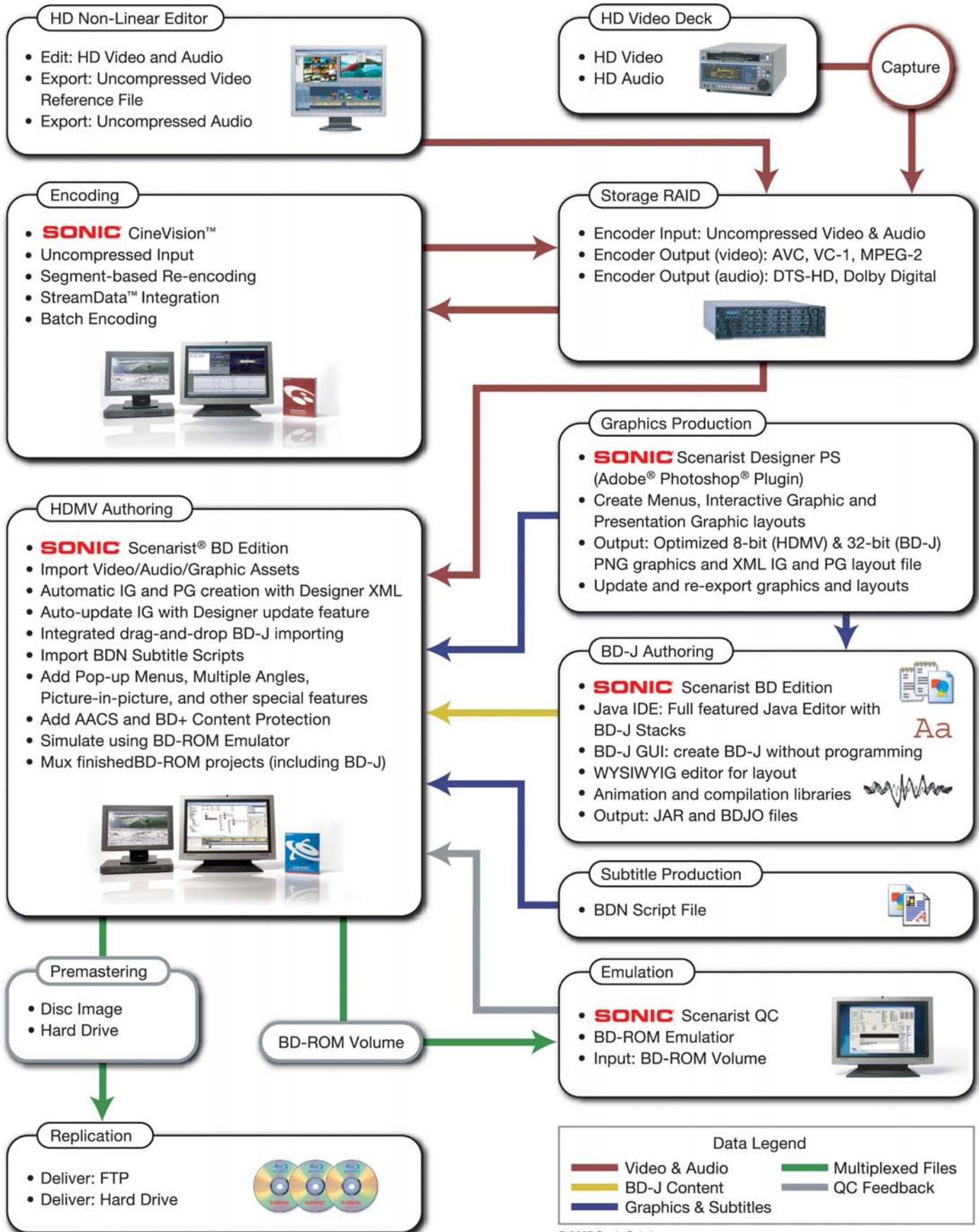
Blu-ray Disc's physical differences to the standard definition DVD format – different substrate and cover layer thicknesses – and different manufacturing processes mean that a new mastering and replication system is required to manufacture Blu-ray Discs.

Packaging

For the purposes of packaging, BD-ROMs are physically identical to SD DVD. Therefore there are no new packaging requirements. However, content owners will no doubt wish to differentiate their BD-ROM product which will result in a new range of BD-ROM packaging. Bearing in mind the price delta between SD DVDs and BD-ROMs, renewed packaging is also required to provide consumers with a perceptible difference in value.



BD-ROM PRODUCTION WORKFLOW





STARTING YOUR BD-ROM PRODUCTION BUSINESS

Adding BD-ROM production services to your facility's offerings will require a range of new skills and resources. Below are some key questions that are designed to help you identify, as well as fill, any gaps in your planning as you embark on your new BD-ROM venture.

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 available in the introduction of this white 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 BD-ROM order?
- **Production capacity** – What kind of titles do we need to produce? What are our clients' requirements? HDMV or BD-J? 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 BD-ROM, enabled by BD-J, will be familiar to Web professionals experienced with Java programming.
- **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 BD-ROM production solution.
- **Workflow** – Are the systems in place to handle the large amount of data and assets required by BD-ROM titles? The nature and number of assets required for BD-ROM production can be very different to those used for SD DVD production. The workflow is also very different. Where might production bottle necks occur and how can they be minimized?

Next steps to BD-ROM production

- 1.Contact Sonic for a free consultation** – If you have any outstanding questions about initiating your BD-ROM 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 BD-ROM format, production tools, and any seminars scheduled near you. Also see the appendix for links to useful BD-ROM 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 BD-ROM business. You can find your nearest Sonic reseller using our online reseller locator: www.sonic.com/reseller.
- 4.Book a demo** – See BD-ROM production in action at your nearest Sonic demo suite. Book your personal demonstration today via the 'Book a Demo' link on the Scenarist Web site: www.sonic.com/go/scenarist
- 5.BD-ROM production seminars** – Get hands-on BD-ROM production experience and an opportunity to ask our BD-ROM specialists any burning questions. Contact your nearest Sonic representative to find out when our seminar tour is next near you.

✓ Kit Check: Hardware Requirements Checklist

- | | |
|------------------------|---|
| ✓ HD Video Deck | ✓ HD Encoding System – Sonic CineVision |
| ✓ HD Capture Equipment | ✓ HD Authoring System – Sonic Scenarist |
| ✓ HD-ready network | ✓ HD Emulation System |
| ✓ HD-capable PCs HD | ✓ Premastering Hardware |
| ✓ Non-linear Editor | |



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 the next major format transition and deliver cutting edge technology from Hollywood to Home to further enable the enjoyment of digital media.

Sonic HD Authoring Alliance

Although the BD-ROM format is relatively new to consumers, Sonic and the HD Authoring Alliance have been busy creating titles for over two years. The HDAA is a Sonic-sponsored association of top authoring houses worldwide. The HDAA is dedicated to accelerating the development of the authoring skills, capacity, and technological infrastructure required to support the rapid adoption of Blu-ray Disc. Working together, the HDAA have helped design and refine the optimum BD-ROM 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 BD-ROM 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 Blu-ray Disc players playback existing standard definition DVDs?

Although this isn't part of the Blu-ray Disc specification, consumer demand will be such that it is expected that all Blu-ray Disc players and drives will playback existing SD DVD titles.

3. What's the point of making BD-ROM titles 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 BD-ROM orders on the horizon, why shouldn't I just sit back and wait until they're secured before investing in BD-ROM production kit?

Don't! BD-ROM 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 will be too late to acquire these new skills and you could loose out to a competitor who is better prepared to deal with clients demands.

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

The BD-ROM specification does include support for standard definition resolutions. In fact, it's common for the picture-in-picture content to be standard definition.

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

Yes, connecting the BD-ROM 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' stand for 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 BD-ROM specification support Region Coding?

Yes, the region configuration is different to SD DVD though. See the *Technical Specifications* section for more information.

9. Does the BD-ROM specification support 44.1 kHz PCM Audio?

No. At the time of writing the BD-ROM specification does not support 44.1 kHz audio.

10. 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.

**11. Does BD-ROM support seamless multi-angle and multi-story?**

Yes, as with SD DVD, BD-ROM supports seamless multi-angle and multi-story.

12. I can code using JavaScript, does that mean I can write BD-J code?

Unfortunately not, JavaScript and Java are very different programming languages. There's no doubt that having JavaScript experience will benefit anyone looking to write Java but it would be incorrect to assume the skills are transferable.

13. Do Dual Layer BD-ROM titles pause when the laser changes layers (like SD DVDs)?

No. BD-ROM players are able to playback multiple layers titles without interrupting the video playback.

14. SD DVD players have 16 x 16-bit GPRM registers that I use for programming interactivity, what's the BD-ROM equivalent?

All BD-ROM players have 4096 x 32-bit GPR registers which can be used for authoring interactive features like quizzes.

15. I heard that AACS has been hacked so what's the point in using it?

Wrong! AACS has not been hacked. The keys for certain HD DVD titles on certain HD DVD playback devices have been compromised. This does not mean that the protection system as a whole has been hacked. On the contrary, the AACS content protection system is able to respond to such security breaches by updating subsequent titles with new AACS encryption.

Can't find the answer to your question? email whitepaper@sonic.com



APPENDIX A - BLU-RAY DISC RESOURCES AND INFORMATION

Blu-ray Disc Format Information

- **AACS LA** - Licensing Authoring responsible for administrating AACS use.
<http://www.aacsla.com>
- **Bluboard** – A useful resource for BD-J application development.
www.blueboard.com/bluray
- **Blu-ray Disc Association** – The official body behind the definition and specification of the BD-ROM format.
<http://www.blu-raydisc.com>
- **Blu-ray.com** – A great resource for everything related to Blu-ray Disc.
<http://www.blu-ray.com>
- **DVD Demystified** – A great one-stop guide for anyone new to SD DVD and BD-ROM.
<http://www.dvddemystified.com>
- **Emedia Blu-ray Disc FAQ** – A comprehensive list of BD-ROM FAQs from emedia.
<http://www.emedialive.com/Articles/ReadArticle.aspx?ArticleID=11392>
- **OCAP Primer** – A good introduction to the OCAP standard used by some digital broadcasters in the U.S.A.
<http://www.ctam.com/ocap/basics.htm>
- **Sonic Solutions** – The leading supplier of BD-ROM encoding and authoring tools. Products include Sonic Scenarist and Sonic CineVision.
<http://www.sonic.com>
- **Sony Pictures** – Some great information from one of the leading studios releasing BD-ROM titles.
<http://www.sonypictures.com/homevideo/bluray>
- **Wikipedia** – An overview from the communal encyclopedia site (beware of enthusiastic inaccuracies!).
http://en.wikipedia.org/wiki/Blu-ray_Disc

BD+ and ROM Mark Information

- **Blu-ray.com** – An overview of BD-ROM security.
http://www.blu-raydisc.com/assets/downloadablefile/5th_japan_05-13343.pdf
- **Cryptography.com** - A good introduction to BD+.
<http://www.cryptography.com/technology/spdc/bluray.html>

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>

BD-ROM Production Tools

- **Sonic CineVision** – The leading Hollywood-standard cinematic encoder, providing everything you need to create encodes for the Blu-ray Disc format.
<http://www.sonic.com/go/cinevision>
- **Sonic Scenarist** – The industry's leading BD-ROM production system used by Hollywood studios to deliver their BD-ROM productions.
<http://www.sonic.com/go/scenarist>
- **Eclipse** – One of the leading Integrated Development Environments (IDE) available for Java.
<http://www.eclipse.org>

Is your site missing? email whitepaper@sonic.com



APPENDIX B - BLU-RAY DISC GLOSSARY OF TERMS

AACS - Advanced Access Content System, the content protection system used by BD-ROM.

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.

AVC - Advanced Video Codec. Also known as MPEG-4 part 10 and H.264.

Button Object Groups - Also known as BOGs, Button Object Groups are used to enable the Interactive Graphics available in HDMV's Interactive Graphics display plane.

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.

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 (see above).

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)

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 (see above). AVC is one part of the MPEG-4 specification.

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.

Page - A component of an HDMV menu that is built up of different Button Object Groups (BOGs)

Persistent Storage - The 64KB (minimum) of built-in player memory.

Pixel Buffer - A part of the Blu-ray player's memory that renders graphical elements before they're displayed.

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.

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.

StreamData™ - A metadata file format designed to pass chapter point information between BD-ROM 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.

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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