Java™ Technology Goes to the Movies: Java Technology in Next-Generation Optical Disc Formats

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Learn about the dramatic capabilities Blu-ray Disc enables relative to today’s DVD technology and understand the Java platform essentials upon which Blu-ray Disc Java (BD-J) is based.
Agenda

What Is Blu-ray Disc?
BD-J Stack Overview
BD-J Technical Specifics
New Features of Blu-ray and BD-J
BD-J Authoring
Demo
Q&A
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What Is Blu-ray Disc?
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Blu-ray Disc—What Is It?

- Next revolution in optical storage solutions for consumer electronics/PC products/game consoles (PS3)
- Incredible audio/video quality

Blu-ray Disc: 1920 x 1080
DVD: 720 x 480
Analog Broadcast TV: 352 x 240

- Huge capacity
  - 25GB (single layer)/50GB (double layer)
  - Future capability to store 200GB (multi-layer)

Advanced Java Technology-Based Interactivity
Blu-ray Disc Delivers More Capacity

Full HDTV 1920 x 1080 Resolution with Advanced Video Codec (12Mb/s Video)

For Films
- HD Feature (132 min)
- Audio (3 languages)
- HD Bonus (95 min.)

For TV Programs
- SD Features (11 Hours)
- Audio (3 Languages)

Single Layer BD-ROM (25GB)

For Films
- HD Feature (3 Hours)
- Audio (3 Languages)
- HD Bonus (4.5 Hours)

For TV Programs
- SD Feature (23 Hours)
- Audio (3 Languages)

Dual Layer BD-ROM (50GB)
Blu-ray Disc: High-Definition Entertainment

Blu-ray will have both a pre-packaged format, for distribution of movies and other HDTV content, and a recordable format.
Attributes of Blu-ray Disc

**Best Quality from Large Capacity and High Bitrate**
- 25GB (single layer)/50GB (double layer)
- 40Mbps (4 times larger than DVD)
- “No compromise” on image and audio quality

**Broad Industry Support**
- Backed by most industry-leading CE and IT companies
- Backed by majority of movie studios and music labels

**Durable Discs**
- Hard Coat technology is resistant to scratches, fingerprints, marks, dust, etc.
- More “family friendly” than DVD

**Damage Resistant Even to Steel Wool**
Blue Lasers Enable Increased Capacity

**CD**
- 0.1 mm
- 780n
- 700 MB

**DVD**
- 0.6 mm
- 650n
- 4.7 GB

**Blu-ray Disc**
- 3.1 mm
- Optical Properties Irrelevant
- 405n
- 25 GB (5 x DVD)

Note: Single Layer Comparison

Blue Lasers Enable Increased Capacity
Key BD-ROM Features
Interactivity and Next-Generation A/V

Rich Interactivity

**Graphics:** High-Definition, true-color graphics with effects

**Navigation:** Highly flexible, supports wide variety of content

**Connectivity:** Supports many new use cases, i.e., content updates

Best Possible Quality Audio and Video

**Video:** High Def video up to 40Mbps, including 1920x1080@24p

**Audio:** Lossless multi-channel audio up to 24Mbps

**Subtitles:** High Definition with true-color
Key BD-ROM Features

Interactivity: One Platform/Two Modes

- **High-Definition Movie (HDMV)**—created from the ground-up to improve on DVD, while maintaining production continuity with DVD
- **Blu-ray Disc Java (BD-J)**—a fully programmable platform with network connectivity thereby enabling new types of interactivity
Overview of HDMV
Supports all DVD Features Including Multi-angle, Multi Story, etc.

• Key additional features offered by HDMV
  • Improved menu and subtitle image quality
    • High Definition with full color (8-bit palette) and transparency
  • Improved menu features
    • “Pop-up”: seamless menus that don’t interrupt movie playback
    • “Effects”: full color animated transitions and animated buttons
  • Support for new Applications
    • “Picture-in-Picture”: composite two independent video streams
    • “Audio mixing”: mix two independent audio streams together
Overview of Blu-ray Disc Java (BD-J)

- Fully programmable platform for highly interactive, updateable titles
- Supports all HDMV features
Why Does Interactivity Matter?

- Consumers and Studios want:
  - Richer interaction
    - Viewers enticed by a richer interactive experience far beyond the limited menus of DVD-Video
  - Special features
    - Studios want to include many special features and games to clearly distinguish titles
    - Studios want to update the viewing experience with fresh content produced after the disc is sold
  - New business models
    - Blu-ray will enable new revenue streams through innovative content and services
Why Java Technology for Blu-ray Disc?

- The Blu-ray Disc Association (BDA) selected Java technology to be used as the platform for their advanced interactive application specification.

  - Java technology was selected because:
    - Java technology has proven to be a technically sound solution in the mobile domain and in interactive television (MHP/OCAP).
    - Java technology has proven cross-platform technology support in embedded devices.
    - Java technology provides an open-ended platform for content development with secure network support.

- The Java specification for Blu-ray Disc is called BD-J.
New Capabilities Enabled by BD-J

- Far richer consumer experience
  - Freedom of UI design
  - Studio-skinned A/V playback control
- Dynamic content updates via broadband
  - Download of new trailers
  - Additional subtitle options
  - Add-on bonus materials
- New forms of added content
  - Playing games from disc and on-line
  - Live events
  - On-line shopping
Limitations of Legacy DVD Content

- No support for menus over video
- Programming limited to 32 registers
  - 32 bits/register
- Very weak performance guarantees
  - For example, skipping to a screen can take 100ms to 3s, depending on player
- Inflexible format
- Limited to standard definition
- No Internet connectivity
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BD-J’s Basis—DVB-GEM

- The DVB-GEM specification is the global “common core” of interactive television
  - Multimedia Home Platform (MHP)
    - Cable, Satellite, and Terrestrial in Europe, parts of Asia, Australia
  - OpenCable Application Platform (OCAP)
    - US Cable
  - ATSC ACAP and ARIB B.23
    - Terrestrial in US and Japan
  - China and Brazil national DTV standards (in progress)
- BD-J is based on DVB-GEM
  - GEM adds a new “packaged media target”
    - Eliminates broadcast-specific features, like electronic program guide support
    - Internet connectivity is still optional
Relationship of Digital TV Standards

DVB-MHP → DVB-GEM

OCAP

ARIB B.23

ACAP
GEM Java Technology Stack Components

- For all devices:
  - Connected Device Configuration (CDC) 1.0 or 1.1 (JSR-36/218)
  - Foundation Profile (FP) 1.0 or 1.1 (JSR-46/219)
  - Personal Basis Profile Specification (PBP) 1.0 or 1.1 (JSR-129/217)
    - May be implemented on Personal Profile (PP) 1.0 or 1.1 (JSR-62/216)
  - Java TV™ 1.1 (JSR-927)

- Networked devices also require:
  - Add Java Secure Socket Extension (JSSE) for CDC 1.0 or SecOp for CDC/FP 1.1
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BD-J Basics—Relation With DVB-GEM Packaged Media

BD-J Live Profile (Profile 2)
- BD-J Live Profile
- Additional Features
- DVB-GEM Packaged Media Target Interactive Profile Features

BD-J Video Profile (Profile 1)
- BD-J Video Profile
- Additional Features
- DVB-GEM Packaged Media Target Enhanced Profile Features

DVB-GEM Broadcast Target
- Additional Interactive Profile Features
- Additional Enhanced Profile Features

BD-J Video Profile (Profile 1)
BD-J Basics
Two BD-ROM Profiles

- Two profiles for BD-ROM players:
  - Profile 1: BD-VIDEO—without network connectivity
  - Profile 2: BD-LIVE—with network connectivity
    Additional applications for network connectivity include:
    - Downloading games
    - Downloading subtitles or audio streams
    - Downloading trailers
    And more and more
BD-J Basics:
BD-ROM Disc Directory Structure

**BDMV**
- **index.bdmv**
  - Index Table
- **MovieObject.bdmv**
  - Movie Objects
- **PLAYLIST**
  - Contains all PlayLists (.mmmmmpls)
- **CLIPINF**
  - Contains all Clip Info (.clipi)
- **STREAM**
  - Contains all Clips (.m2ts)
- **AUXDATA**
  - Contains font/audio data
- **META**
  - Contains all XML metadata (optional)
- **BDJO**
  - Contains all BD-J objects
- **JAR**
  - Contains all BD-J JARs
- **BACKUP**
  - Contains backup files
BD-J Basics
Simplified Structure of BD-ROM
BD-J Basics: BD-ROM Application Layer Structure

Index Table
- TopMenu
- Title #1 (HDMV)
- Title #2 (BD-J)
- ...

BD-ROM Resident System Software
- Module Manager
- Key Event Handler
- Navigator

Movie Module
- Movie Object

BD-J Module
- BD-J Object
- Application Manager

BD-ROM Resources
- Playback Control Engine
- Player Registers

AMT for Title #2
- Xlet #1
- Xlet #2 (autostart)
- Xlet #3

JAR file for Title #2
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BD-ROM/BD-J
New Format Features

- Application cache
- Plane model
- Picture-in-picture
- Frame accurate animations
- Audio-mixing
- Local storage
- Multi-disc application lifecycle
- Security aspects
Application Cache to Guarantee Seamless A/V Playback

Title#1
Title#2

Player’s Cache Memory
(Storing JAR files for BD-J applications)

Read Application (table)

BD

Java Application Manager

Java Heap and Native memory

classloader
Plane Model—BD-J Graphics and UI

- BD-J includes the HAVi UI device model and widget set
  - Includes an extended device model with five planes
  - Includes a customizable widget set aimed at remote control usage
    - org.havi is from GEM
  - Extended for BD supported resolutions
  - Extended for BD A/V control keys
Plane Model
Five independent full High-Definition Graphics Planes enabling high-quality, visually-rich High-Definition presentations

- Interactivity Graphics Layer
- Subtitle Graphics Layer
- Secondary Video Layer
- Primary Video Layer
- Background Layer (BD-J)
Picture-in-Picture

PiP enabling new application images such as “video” director’s commentary and bonus video preview

- Provides the ability to present two video streams simultaneously

- Both HDMV and BD-J can control PiP
- MPEG-4 AVC/VC-1/MPEG-2 can all be used for PiP video
  - PiP video can be luma keyed
Frame Accurate Animations: Synchronizing gfx to Video

- “Loose” video sync: Callback
  - Trigger API: org.dvb.dsmcc, org.davic.media
  - Mapped to on-disc timecodes
  - No guarantees on exact video frame on which the graphics will appear

- “Tight” video sync: Frame-accurate animation
  - In org.bluray package
  - Based on timecodes (javax.media.Time)
  - Provides guarantees for exact frames
Frame Accurate Animation Model

- AWT Component with sequence of images and start-time displays a new image each frame
Synchronized Frame-Accurate Animation

private org.bluray.SyncFrameAccurateAnimation faa;

void animationLoop() {
    int frame = 0;
    for (;;) {
        Graphics g = faa.startDrawing(frame); // can block
        ... draw the contents of the frame, using g;
        faa.finishDrawing(frame++);
    }
}
BD-J Interactivity

BD-Java incorporates support for Frame Accurate Animations enabling new types of applications where dynamic graphics interact with objects in the video

Example:

User has target on object

User hits target, graphic overlay of explosion shown

Graphic overlay follows video object as it travels across screen
BD-ROM/BD-J Audio Mixing
Audio Mixing Enables New Audio Applications

- **“Secondary Audio”** provides the ability to present two audio streams simultaneously (for stream applications like director’s commentary)

- **“Interactive Audio”** provides the ability to present multiple LPCM audio simultaneously (for game sounds)

### Secondary Audio

<table>
<thead>
<tr>
<th>Secondary Audio</th>
<th>DD+</th>
<th>DTS-HD (LBR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sampling</strong></td>
<td>48kHz</td>
<td>48 kHz</td>
</tr>
<tr>
<td><strong>Channel</strong></td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>Bit Rate</strong></td>
<td>256Kbps</td>
<td>256Kbps</td>
</tr>
</tbody>
</table>

![Diagram showing audio mixing](image)
Local Storage

Local Storage Provides Persistent Storage for Updating Titles

- “Virtual Package” used to provide update during playback
- Organizes downloaded A/V material

BD-ROM DISC

ROOT

BDMV

Index.bdmv
MovieObject.bdmv

PLAYLIST

00000.mpls
00001.mpls

CLIPIN

01000.clpi
01001.clpi

STREAM

01000.m2ts
01001.m2ts

AUXDATA

Virtual Package

ROOT

BDMV

Index.bdmv
MovieObject.bdmv

PLAYLIST

00000.mpls
00001.mpls
00002.mpls

CLIPIN

01000.clpi
01001.clpi
01002.clpi

STREAM

01000.m2ts
01001.m2ts
01002.m2ts

AUXDATA

Replacing

Appending

Appending

Appending
Multi-Disc Lifecycle

BD-J Applications Can Run Between Disc

- A series of related disc titles can offer applications, e.g., games to collect items during video play, that can run across these discs
- A Studio’s disc catalogue application or enhanced search application can offer navigation across all Studio’s discs, even ones that are not yet bought by the user
Security Aspects

• BD-J uses the Java platform security model
  • Signed applications can get more permissions

• Signing is based on JAR file signing
  • Linked with BD copy protection scheme

• Permissions are required for:
  • Read/Write access to local storage
  • Using the network connection
  • Title selection of other titles on the BD-ROM disc
  • Control of other running BD-J applications
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Blu-ray Disc Java Authoring

- A range of BD content authoring toolsets will be required in the marketplace

- Flexibility to choose authoring style and tool best suited to task
  - Advanced content will often be developed directly by Java programmers for performance and flexibility
  - Graphically-oriented tools for creative professionals (non-programmers) will be preferred by the studios to leverage existing staff

- Current tools simply multiplex existing BD-J xlets into BD-ROM format (i.e., Sonic Scenarist, Sony Blu-print)
IDE-based Tools

- Target: Java programmer
- Typically integrated with Eclipse or NetBeans
- Most flexible, but requires highest skill level
- Examples
  - MediaHighway Development Kit (NDS)
  - Vision Workbench (Vidiom)
  - Osmosys SDK 2.0
GUI-based Tools

- Target: Creative Professional
- Generally timeline-based paradigm (like Macromedia Director)
- Good mix of flexibility and rapid development
- Examples:
  - Cardinal Studio
  - Alticast AltiComposer 2.0
HTML/XML Markup Tools

- Target: Creative Professional, Web Developer
- Use appropriate XML or HTML markup language with embedded browser or XML rendering xlet
- Once markup environment is defined, very rapid deployment of new applications
- Markup environment can be enhanced as desired
- Examples:
  - Espial and Pontegra browsers
  - Sofia Digital Browser Platform
  - Icareus iTV Integrator
DEMO
For More Information

• Blu-ray disc: http://www.blu-raydisc.com
  • See Technical info, public specifications
• DVB-GEM/MHP/OCAP/Java TV™:
  • http://www.dvb.org
  • http://www.mhp.org
  • http://www.interactivetvweb.org
  • Official Specs available from ETSI: http://www.etsi.org
• Java TV™ API Forum
  • http://forum.java.sun.com/forum.jspa?forumID=36
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