Blu-ray Disc

PHILIPS

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

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Session TS-7091

# Understanding Java™ Technology in Blu-ray Disc

## Java Technology: Quality interactivity for high-def movies

The old DVD format will be replaced by one capable of HDTV, giving better video and audio quality. By itself, this may not be enough for the format to succeed. Java technology gives Blu-ray Disc the competitive advantage of high quality interactivity, based on the proven Java platform. We'll describe the technical essentials for this new format.

# Agenda

What's Blu-ray Disc?

Why Java Technology on Blu-ray Disc?

BD-J's Basis—PBP and DVB-GEM

Graphics and UI

Security Aspects

Application Cache

Authoring

What's Next?

# Agenda

**What's Blu-ray Disc?**

Why Java Technology on Blu-ray Disc?

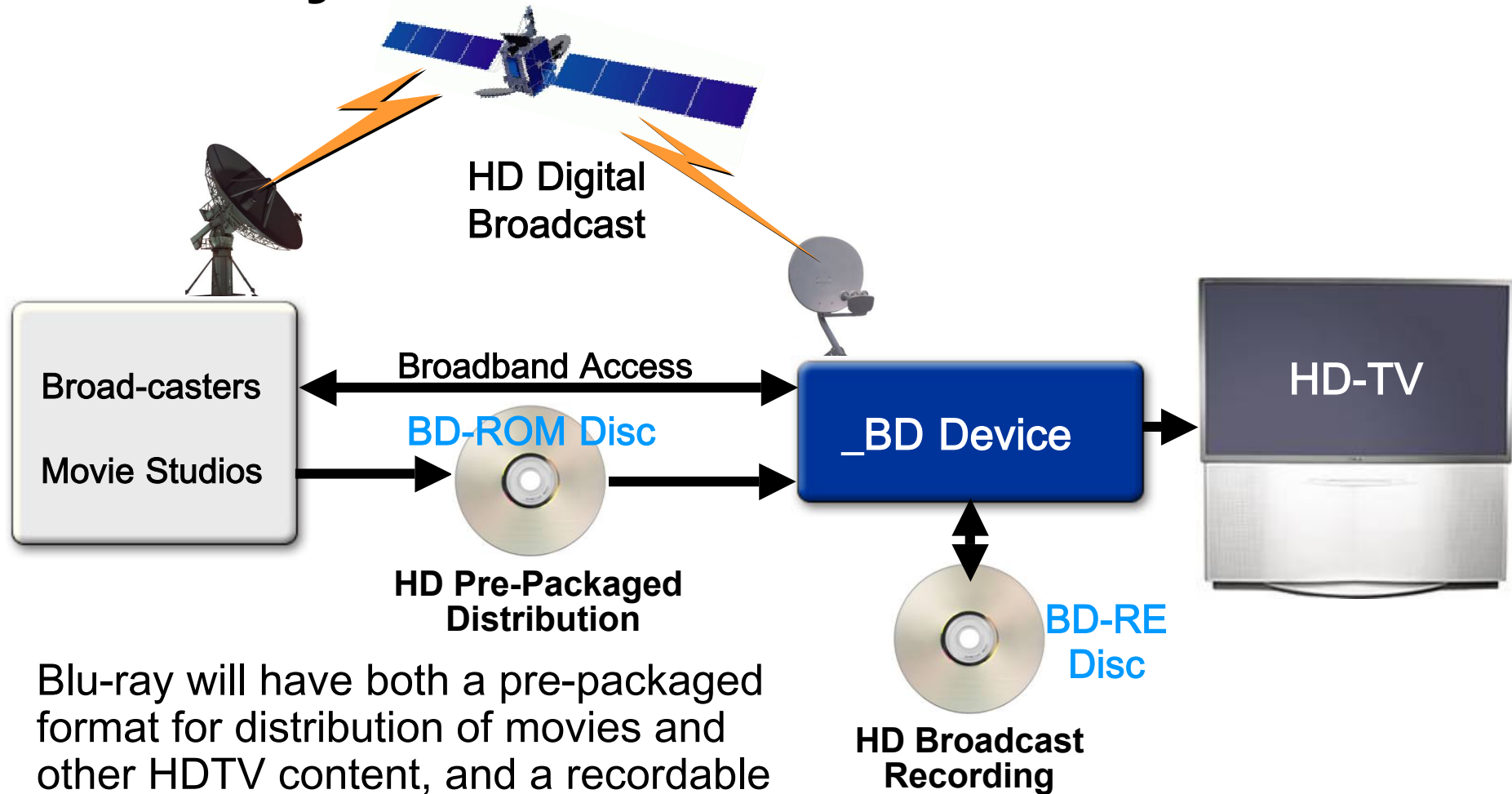BD-J's Basis—PBP and DVB-GEM

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# Blu-ray Context

HD Digital Broadcast

Broadband Access

Broad-casters

Movie Studios

BD-ROM Disc

HD Pre-Packaged Distribution

_BD Device

HD-TV

BD-RE Disc

HD Broadcast Recording

Blu-ray will have both a pre-packaged format for distribution of movies and other HDTV content, and a recordable format. Interaction with Java technology is supported, and internet connectivity is optional.

# What Does Blu-ray Provide?

- Blue laser gives more data capacity than legacy DVDs, which use a red laser
  - 25 GB on a single layer and 50 GB on a dual layer disc
  - 40 Mbps bitrate
- High definition 16x9 video, including
  - 1920x1080 at 59.94i, 50i, 24p
  - 1280x720 at 59.94p, 50p, 24p
- High quality audio
  - Dolby 5.1, 7.1, DTS 5.1, including lossless variants
- Java technology interactivity and optional access to Internet

# Blu-ray's Competitors

- Legacy DVD
- HD-DVD
  - Less capacity
  - HTML/ECMAscript interactivity (like ATVEF)
- EVD (Chinese)
  - Same capacity as legacy DVD, but more advanced CODECs for some level of HD quality
  - Future uncertain
- Holographic Versatile Disc
  - Being researched
  - Possibly 3.9 terabytes, 1 Gbit/s

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# Why Java Technology on Blu-ray Disc?

- ## HD video is not enough
  - ### Legacy 16x9 DVDs played at 480p look great to most people
    - Need DVI connector or component video
    - DVD Encoding is usually 720 x 480 x 30i or 720 x 576 x 25i
    - Movies are actually 24 frames per second
      - HDTVs can do "reverse 3:2 pulldown" to restore the original 24p video
  - ### S Video or Composite video (RCA jacks) is typical, and worse than DVI or component video
- ## To succeed, the format needs new features…
  - ### Services provided via broadband network connection
  - ### Interactivity with the movie viewing experience

# Limitation of DVD Interactivity

- Can't show menus over video
- Programming limited to 32 registers
  - 32 bits/register
- Very weak performance guarantees
  - For example, skipping to a sceen can take 100ms to 3s, depending on player
- Inflexible format
- Limited to standard definition
- No Internet connectivity

# Why Java Technology on Blu-ray Disc?

## Consumers and studios need more:

- Richer interaction
  - Viewers enticed by a richer interaction experience, which goes 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
  - BD should enable new ways of doing business with optical discs in terms of distribution models and making money

# Why Java Technology on Blu-ray Disc?

- The Blu-ray Disc Association (BDA) selected Java technology to be used as the platform for their advanced interactive application specification
  - A solid computer language is needed to achieve the desired features in a future proof way
  - Java technology was selected because:
    - Java technology has proven to be a technical sound solution in the mobile domain and in interactive television
    - Java technology offers flexibility in implementing new application features
    - Java technology has proven to work cross-platform in embedded devices
    - Java technology is networked and secure from its basis
- The Java specification for Blu-ray Disc is called BD-J

# Application Examples

- Studio-skinned A/V playback control
- Subtitle updates via Internet
- Download of new trailers
- Playing games from disc and on-line
- Digital magazines with graphics, text and A/V content that you can browse at your HD display
- On-line shopping from content authors web sites

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**BD-J's Basis—PBP and DVB-GEM**

Graphics and UI

Security Aspects
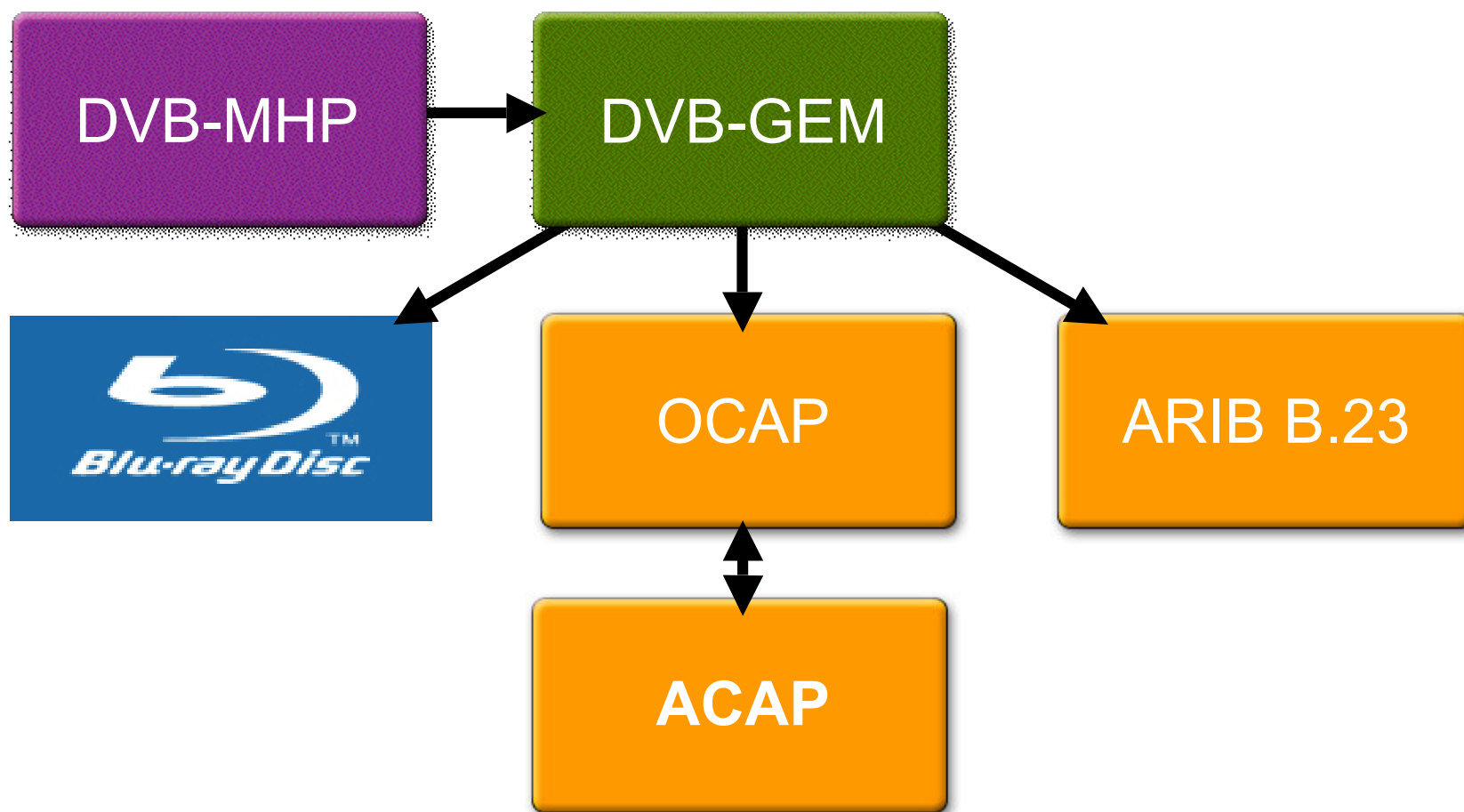
Application Cache

Authoring

What's Next?

# 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
- BD-J includes DVB-GEM
  - GEM adds a new "packaged media profile"
    - Eliminates broadcast-specific features, like electronic program guide support
    - Internet connectivity is still optional
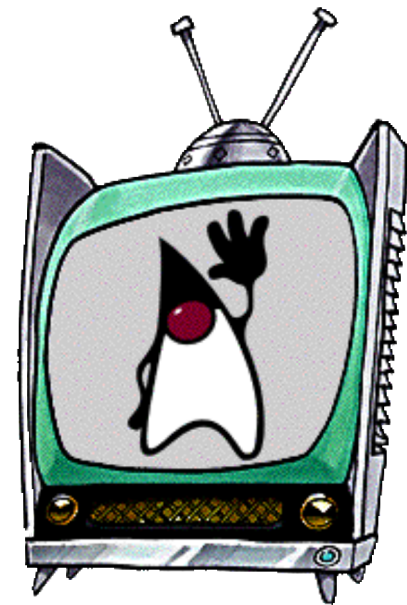
# Relationship of Standards

# Why Use GEM?

- It's a good match
  - DVB-GEM defines a Java programming environment for the same usage environment as BD-J and for the same kind of content
    - Movies and other A/V material for the living room

- Re-use of open standards saves costs and time in three ways:
  - Specification effort
  - Implementation effort
  - Test and verification effort

- Interoperability
  - Adopting of DVB-GEM allows interoperability of Java technology content across broadcast and packaged media

# GEM Includes Java TV™ API

- GEM includes subset for packaged media
- Includes:
  - javax.tv.xlet lifecycle API
  - Java Media Framework API players (javax.media)
    - Control video size, position
    - Select new media to present
  - Locators
    - Like URLs, they reference media
  - Service model
    - Service context, service selection
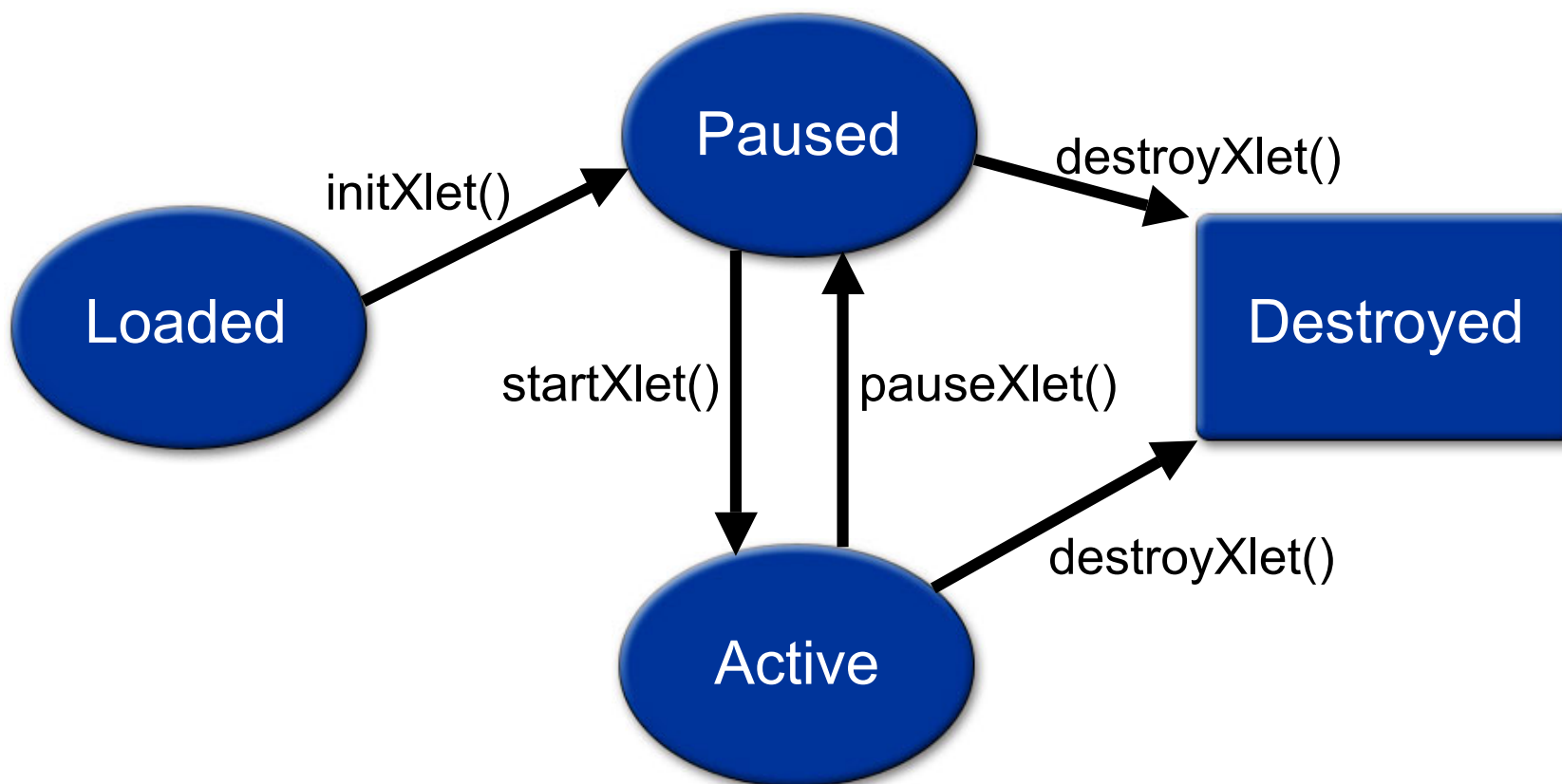    - A service maps to a BD-J Title

# Example

Basic Xlet Lifecycle

GEM/Java TV API define the Xlet as the basic executable entity

Multiple xlets are permitted; each has its own ClassLoader

# Xlet State Model

# Xlet Skeleton

```java
public class MyXlet implements javax.tv.xlet.Xlet {
    public void initXlet(javax.tv.xlet.XletContext ctx)
        throws javax.tv.xlet.XletStateChangeException {
    }
    public void startXlet()
        throws javax.tv.xlet.XletStateChangeException {
    }
    public void pauseXlet() {
    }
    public void destroyXlet(boolean unconditional)
        throws javax.tv.xlet.XletStateChangeException {
    }
}
```

# Example

Disc Title Selection vs. Broadcast Service Selection

# Example—Title Selection
# Using Java TV/GEM APIs (Cont.)

```
import javax.tv.locator.Locator;

import javax.tv.locator.LocatorFactory;

import javax.tv.service.Service;

import javax.tv.service.SIManager

import javax.tv.service.selection.ServiceContext;

import javax.tv.service.selection.ServiceContextFactory;

import javax.tv.xlet.XletContext;

...

   private XletContext xletContext;  // Set on xlet startup
```

# Example—Title Selection
# Using Java TV/GEM APIs (Cont.)

```
    // Switch from "Fargo" to "The Big Lebowski" on disc

LocatorFactory fact = LocatorFactory.getInstance();

Locator titleII = fact.createLocator("... title 2 ...");

SIManager mgr = SIManager.createInstance();

Service sII = mgr.getService(titleII);

ServiceContextFactory f2 = ServiceContextFactory.getInstance();

ServiceContext sc = getServiceContext(xletContext);


sc.select(sII);
```
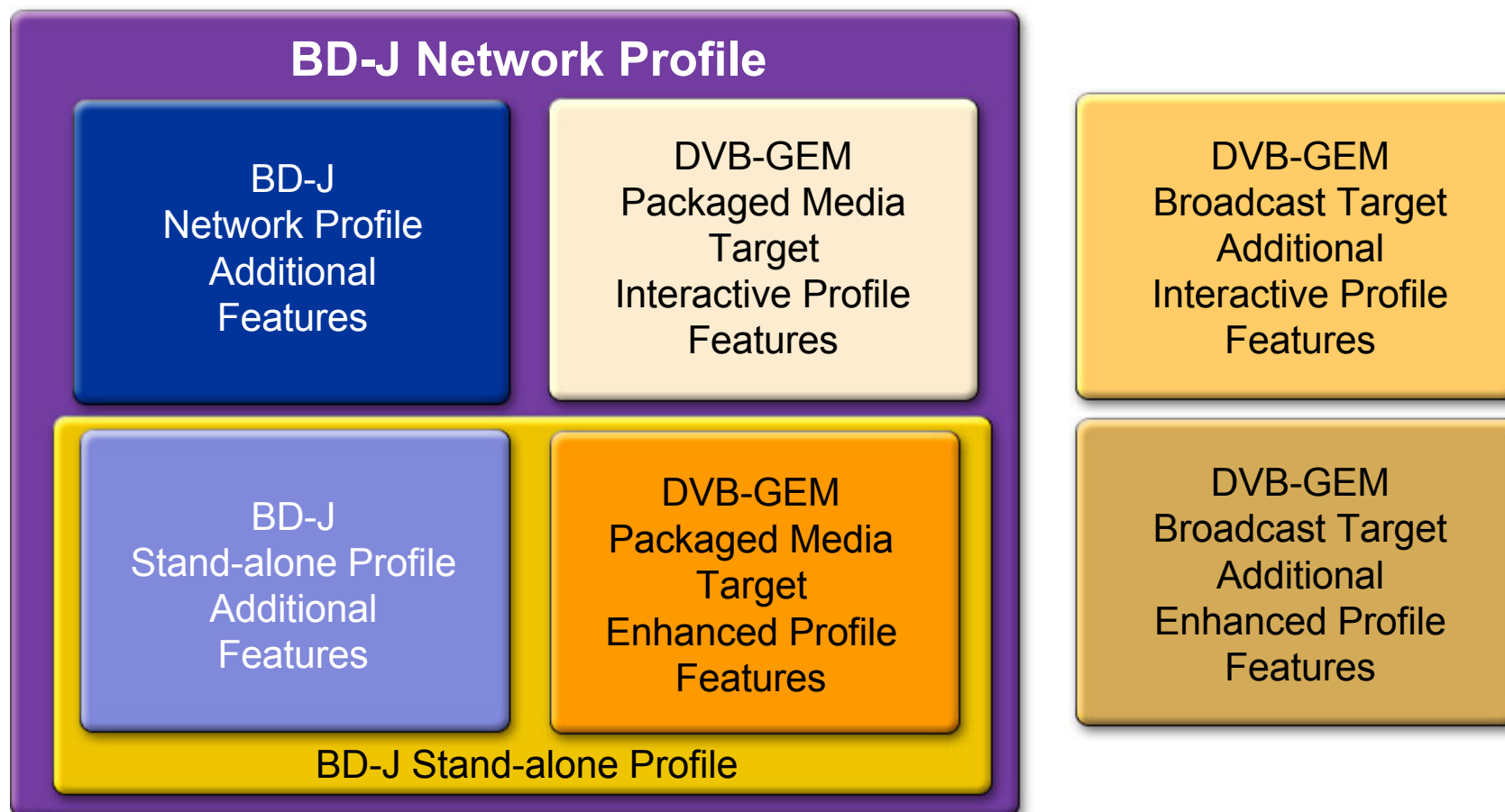
# Example—Broadcast Service Selection in OCAP/MHP

```
    // Switch from "ESPN 8" to "LinkTV"

LocatorFactory fact = LocatorFactory.getInstance();

Locator titleII = fact.createLocator("... service 2 ...");

SIManager mgr = SIManager.createInstance();

Service sII = mgr.getService(titleII);

ServiceContextFactory f2 = ServiceContextFactory.getInstance();

ServiceContext sc = getServiceContext(xletContext);


sc.select(sII);
```
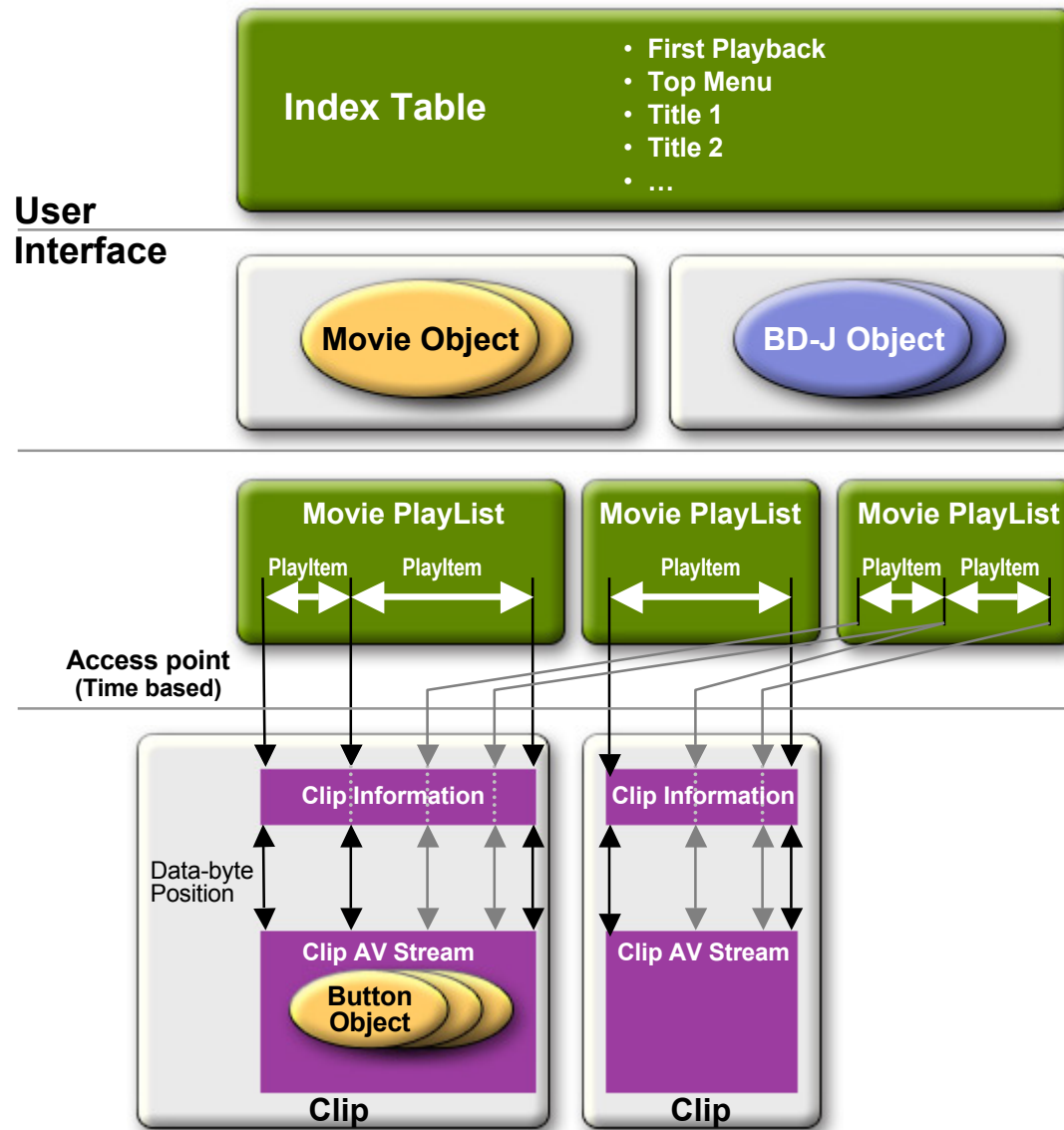
# Does an Xlet Survive Service Selection?

- This is defined by GEM

- A table entry determines answer
  - "Service-bound" flag allows survival
  - Xlet must be present in both services to survive

- Details of table layout different for BD, MHP, OCAP

# Relation With DVB-GEM Packaged Media

## BD-J Network Profile

BD-J
Network Profile
Additional
Features

DVB-GEM
Packaged Media
Target
Interactive Profile
Features

DVB-GEM
Broadcast Target
Additional
Interactive Profile
Features

BD-J
Stand-alone Profile
Additional
Features

DVB-GEM
Packaged Media
Target
Enhanced Profile
Features

DVB-GEM
Broadcast Target
Additional
Enhanced Profile
Features

BD-J Stand-alone Profile

# Simplified Structure of BD-ROM



**Index Table**
- First Playback
- Top Menu
- Title 1
- Title 2
- …

**User Interface**

Movie Object

BD-J Object

Movie PlayList — PlayItem  PlayItem
Movie PlayList — PlayItem
Movie PlayList — PlayItem  PlayItem

**Access point (Time based)**

Clip Information

Clip Information

Data-byte Position

Clip AV Stream

Button Object

Clip AV Stream

Clip

Clip

# BD-J's Java Platform: Personal Basis Profile™

- GEM requires a Java platform
  - GEM came from MHP, which pre-dates the Java Community Process
  - GEM/MHP is based on dated specifications, but **permits** implementations based on Personal Basis Profile
  - GEM and MHP are migrating to PBP
- BD-J requires Personal Basis Profile
  - JSR 129

# Personal Basis Profile

- Built from the Connected Device Configuration and Foundation Profile

- Includes AWT, but no widgets

- Foundation provides io, lang, weak references, math, net, permissions, code signing, text, util, jar, generic collection framework

- Basis adds AWT (without widgets), beans runtime, xlet lifecycle model, inter-xlet communication (somewhat like RMI)

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BD-J's Basis—PBP and DVB-GEM

**Graphics and UI**
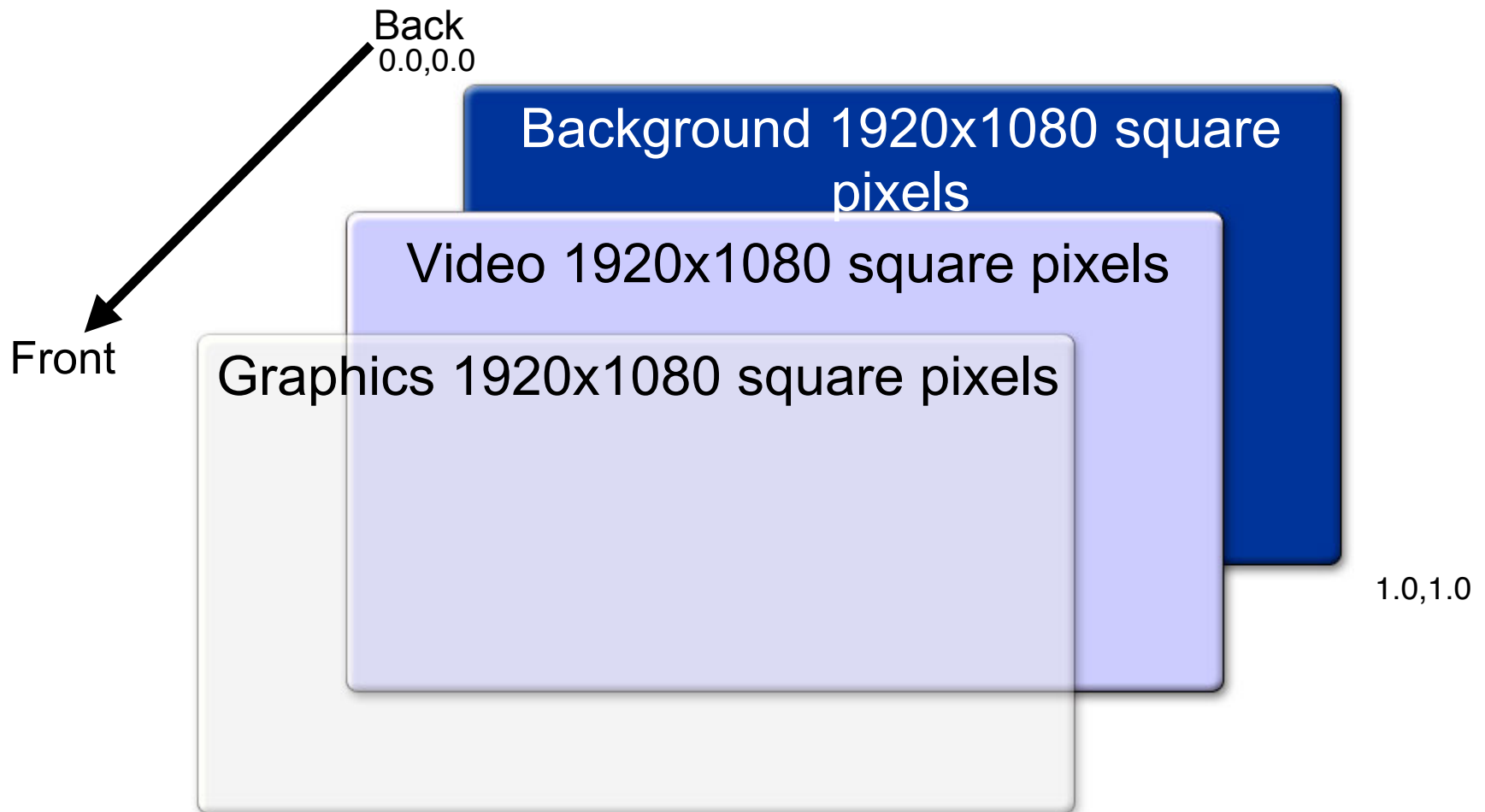
Security Aspects

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What's Next?

# BD-J Graphics and UI

- BD-J includes the HAVi UI device model and widget set
    - 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
- BD-J includes new classes for frame accurate animation
    - Accurate synchronization with video frames

# BD-J HAVi HD Device Configuration

Back
0.0,0.0

Front

Background 1920x1080 square pixels

Video 1920x1080 square pixels

Graphics 1920x1080 square pixels

1.0,1.0

# Example

Using HAVi Widgets

# Example—HAVi Widgets

```
import java.awt.Container;

import org.havi.ui.HGraphicButton;

import org.havi.ui.event.HActionEvent;

import java.awt.event.ActionEvent;
```

# Example—HAVi Widgets (Cont.)

```
...

Container cont = ...;

HGraphicButton button = new HGraphicButton(...);

button.addHActionListener(new HActionListener() {

    public void actionPerformed(ActionEvent evt) {

        ...

    }

});

cont.add(button);
```

# Synchronizing to Video

- "Loose" video sync: Callback
    - Trigger API: org.dvb.dsmcc
    - Implemented by "DSM-CC stream events" in MHP
    - Mapped to on-disc timecodes
- "Tight" video sync: Frame-accurate animation
    - In org.bluray package
    - Based on timecodes (javax.media.Time)

# Example

Trigger API
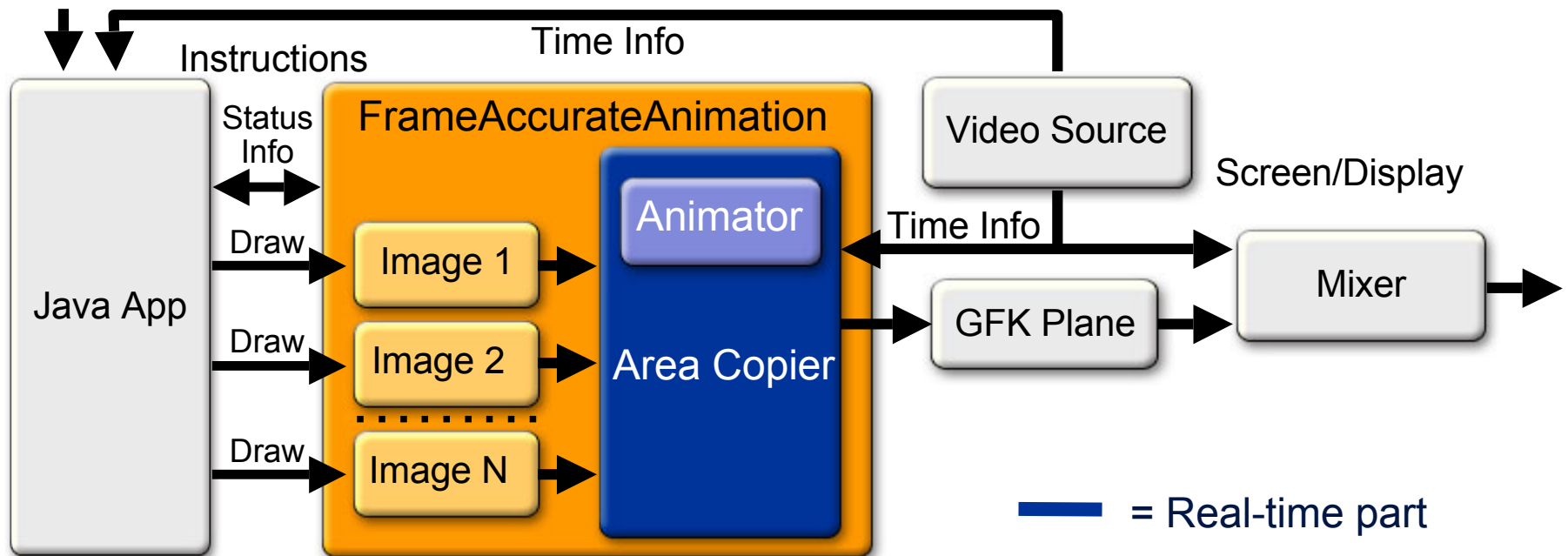
# Example—Trigger API

```
import org.dvb.dsmcc.ServiceDomain;

import org.dvb.dsmcc.DSMCCObject;

import org.dvb.dsmcc.DSMCCStreamEvent;

import org.dvb.dsmcc.StreamEvent;

import org.dvb.dsmcc.StreamEventListener;
```

# Example—Trigger API

```
ServiceDomain sd = ... get attached service doimain ...;

DSMCCObject dir = sd.getMountPoint();

dir.synchronousLoad();

DSMCCObject obj = new DSMCCObject(dir, "lightweight_triggers");

obj.synchronousLoad();

DSMCCStreamEvent se = new DSMCCStreamEvent(obj);

se.subscribe("the_dude_abides",new StreamEventListener() {

    public void receiveStreamEvent(StreamEvent evt) {

        ...

    }

});
```

# Frame Accurate Animation Model

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

# Example

Xlet-Synchronized

Frame-Accurate Animation

# Synchronized Frame-Accurate Animation

```
private org.bda.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++);

    }

}
```

# DEMO

Bouncing Balls

# Putting It
# All Together:

Sample Application Screen...

Video Playback

Buttons

Directors Pointer

> Virtual Theatre <

> SYNCHRONIZATION <
Server time is 16:10 (event starts at 16:00)
Your client time is 16:10 CET

> Exit THE EVENT <

Director: Hi, I'm John…

Actor1: Nice to meet you!…

Actor2: Blah Blah Blah Blah Blah

Director: Have a look at the red pointer (on the video) …

Director: Blah Blah Blah Blah

Actor2: Blah Blah Blah Blah Blah

Actor1: Blah Blah Blah Blah Blah
…

**Steps of the Tea Ceremony**
In the music of Guzheng, the master lights the incense and washes her hands. Then she starts the whole process and invites the guests to appreciate both the tea and the tea ware. The tea ceremony emphasizes the porcelain ware from Jinde Town and the dark-red enameled pottery from Yixing.

Animations

Text Display

Online Chat

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# 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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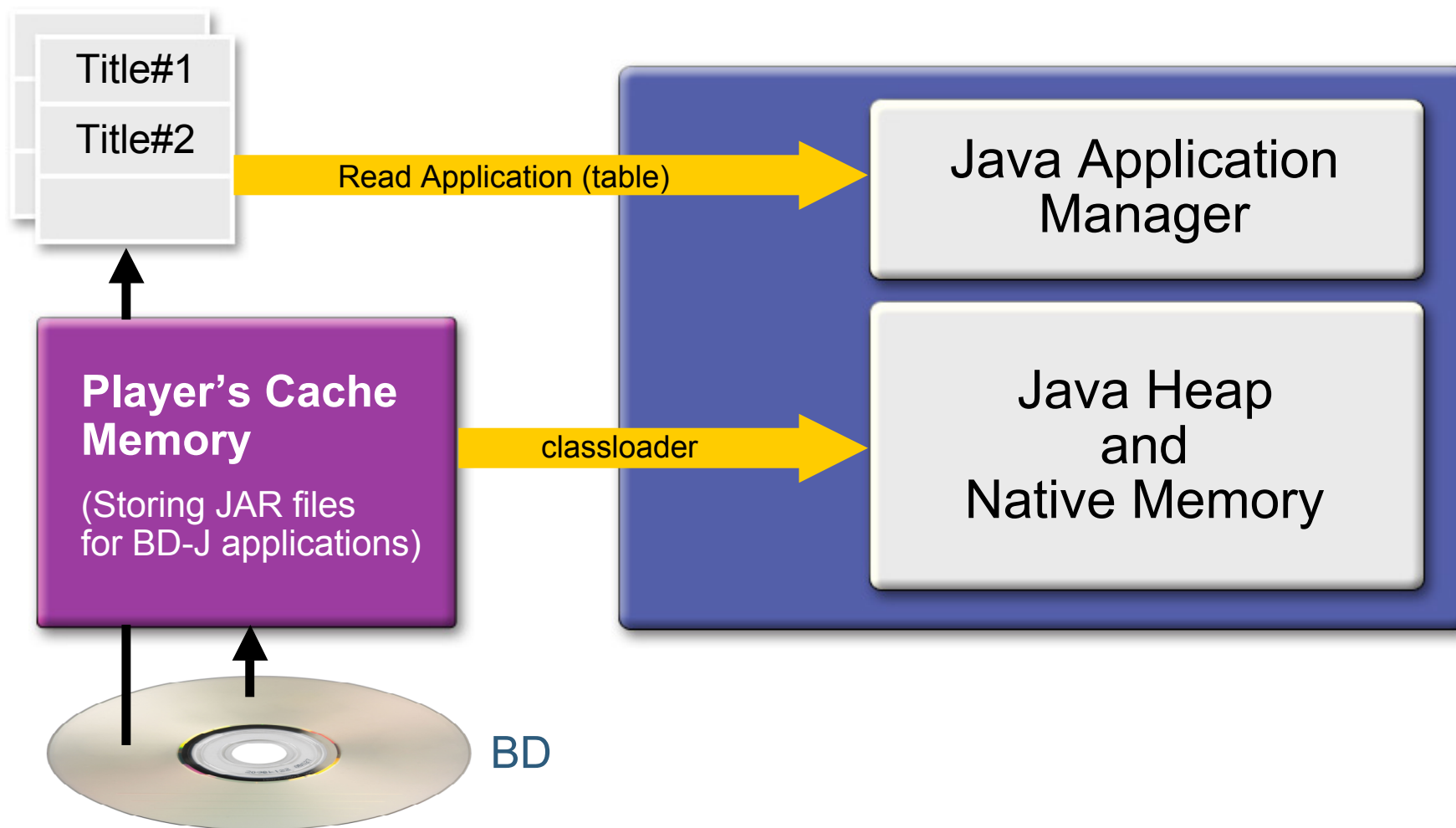BD-J's Basis—PBP and DVB-GEM

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What's Next?

# Application Cache to Guarantee Seamless A/V Playback



Title#1

Title#2

Read Application (table)

Java Application Manager

Player's Cache Memory

(Storing JAR files for BD-J applications)

classloader

Java Heap and Native Memory

BD

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# A Word About Authoring…

- Some content may be written directly in Java programming language
  - For example, video game-like enhancements

- Most content will probably be written with high-level tools
  - APIs are mostly low-level
  - Most discs within a genre are very similar

- Opportunities exist in tool building
  - T-commerce suites
  - Content presentation engine
  - Toolchains built to authoring workflow

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**What's Next?**

# What's Next?

- We believe BD-J is a great application format that increases the potential of the BD-ROM format specification

- BD-J and Blu-ray have many advantages
  - For example, Java technology interactivity!

- Players should be in stores in 2006

# Summary

- Blu-ray Disc is a HDTV replacement for DVD, offering more storage capacity and advanced CODECs

- BD-J is the advanced interactive format for BD-ROM, the pre-packaged Blu-ray Disc format

- BD-J is based on Personal Basis Profile and DVB-GEM

- It is extended with BD specific features, including title selection and frame-accurate animation

- The future of BD-J will be interesting to follow

# For More Information

- Blu-ray disc: http://www.blu-raydisc.com
  - See technical info, public specifications

- DVB-DVB-GEM:
  - http://www.dvb.org
  - http://www.mhp.org
  - Official Specs available from from ETSI: http://www.etsi.org

- Personal Basis Profile (PBP):
  - JSR 129 under http://www.jcp.org/

# DEMO

# Q&A

# Submit Session Evaluations for Prizes!

## Your opinions are important to Sun

- You can win a $75.00 gift certificate to the on-site Retail Store by telling Sun what you think!

- Turn in completed forms to enter the daily drawing

- Each evaluation must be turned in the same day as the session presentation

- Five winners will be chosen each day (Sun will send the winners email)

- Drop-off locations: give to the room monitors or use any of the three drop-off stations in the North and South Halls

Note: Winners on Thursday, 6/30, will receive and can redeem certificates via email

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