



SIGGRAPH2005



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Using M3G

Mark Callow

Chief Architect





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Agenda

- Game Development Process
- Asset Creation
- Program Development
- MIDlet Structure
- A MIDlet Example
- Challenges in Mobile Game Development
- Publishing Your Content

M3G Game Demo



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EXTREME AIR SNOWBOARDING™ SUMEA



Copyright 2005, Digital Chocolate Inc.



Game Development Process

- Traditional Java Game

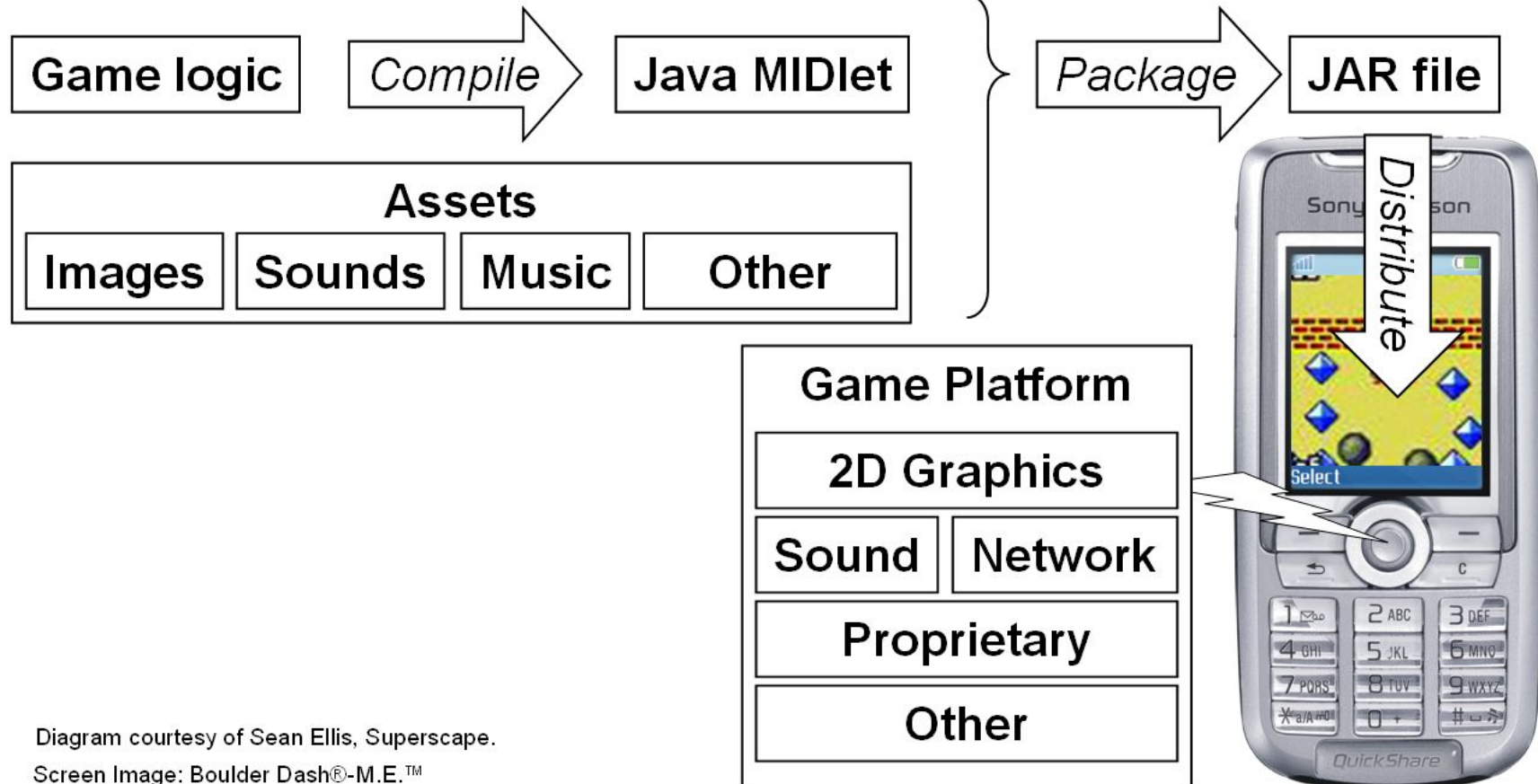


Diagram courtesy of Sean Ellis, Superscape.

Screen Image: Boulder Dash®-M.E.™



M3G Development Process

- How M3G Fits

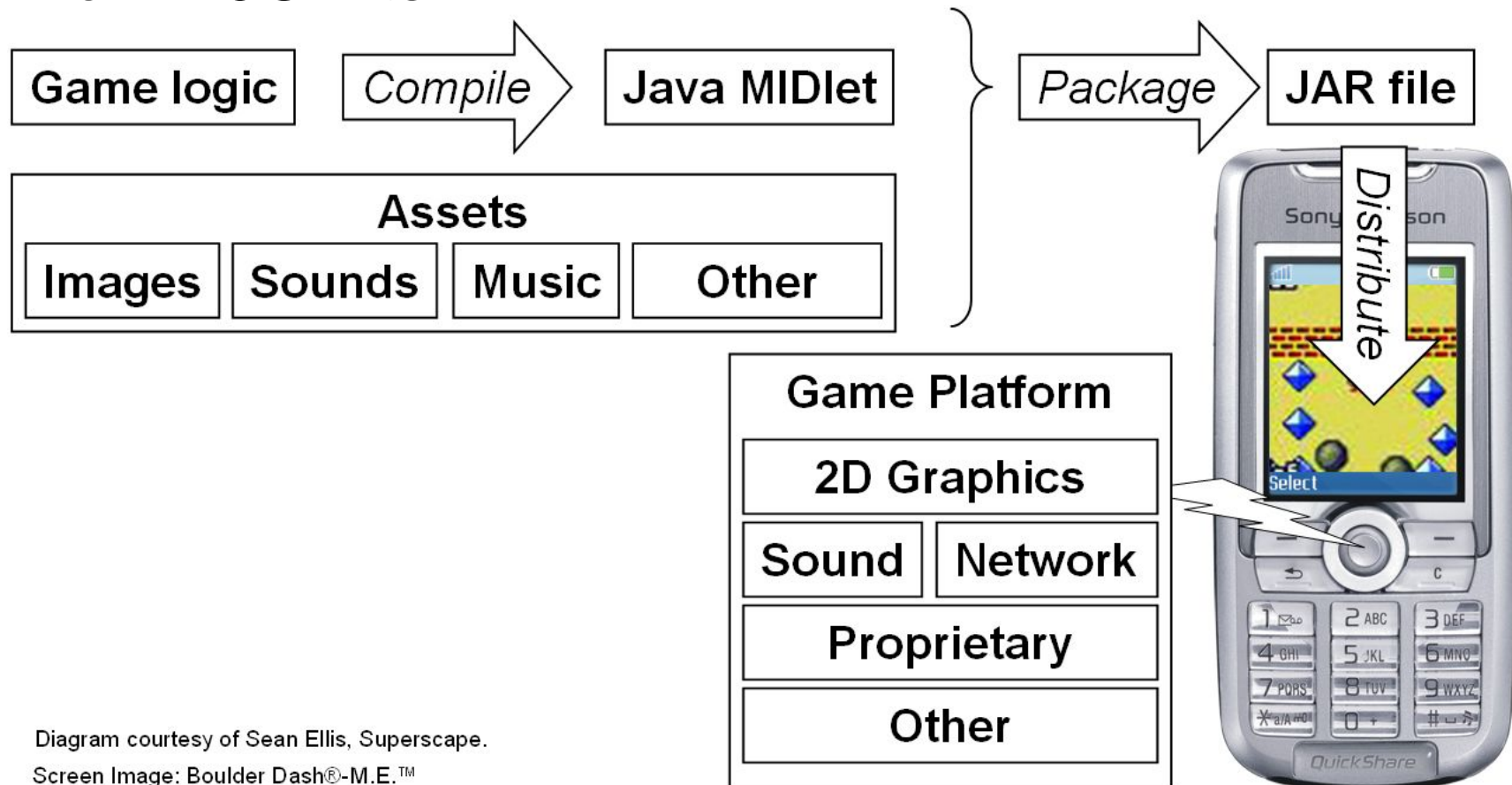


Diagram courtesy of Sean Ellis, Superscape.

Screen Image: Boulder Dash®-M.E.™



Asset Creation

- Textures & Backgrounds

Expanded
game logic

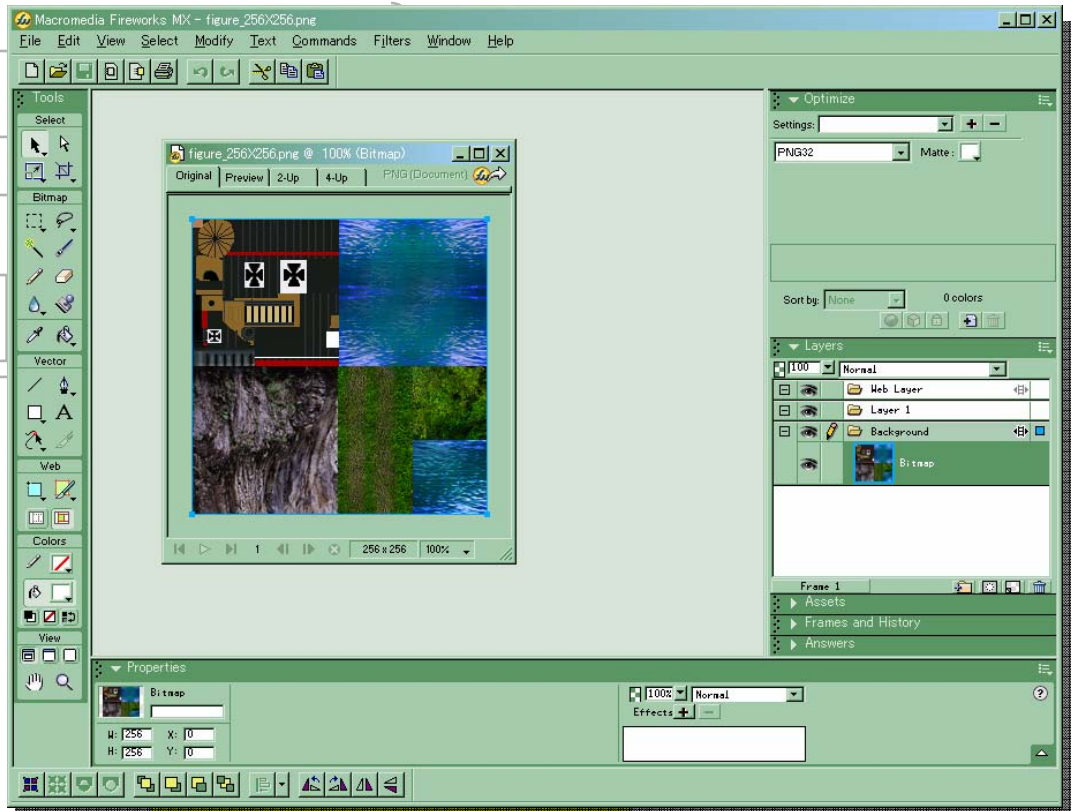


Assets
Images Sounds Music

Images

Image Editor with PNG output. E. g:

- Macromedia Fireworks
- Adobe Photoshop



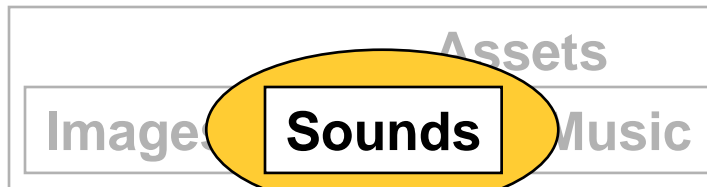
3D Graphics



Asset Creation

- Audio Tools

Expanded game logic

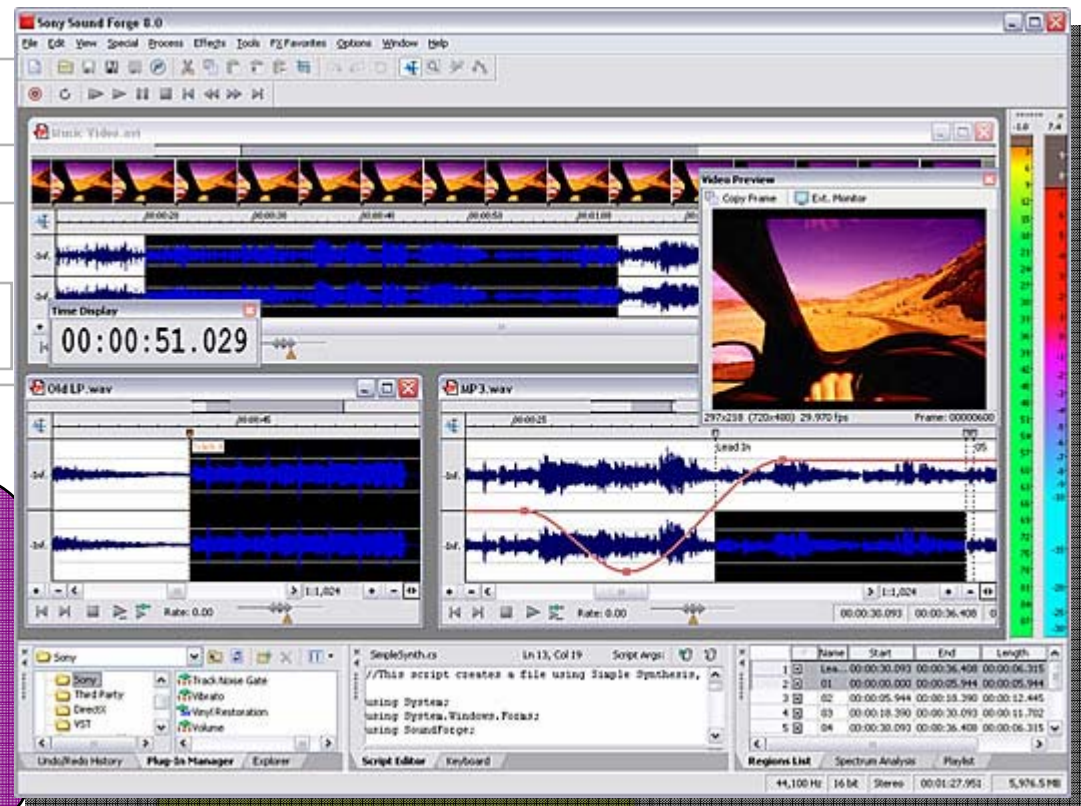


Audio Production Tool; e. g.

- Sony Sound Forge®

Commonly Used Formats:

- Wave, AU, MP3, SMAF



3D Graphics



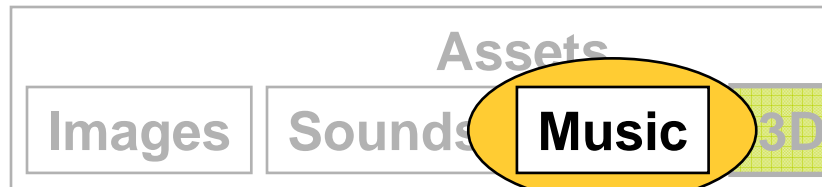
Asset Creation

- Music Tools

Expanded
game logic

Compile

Java

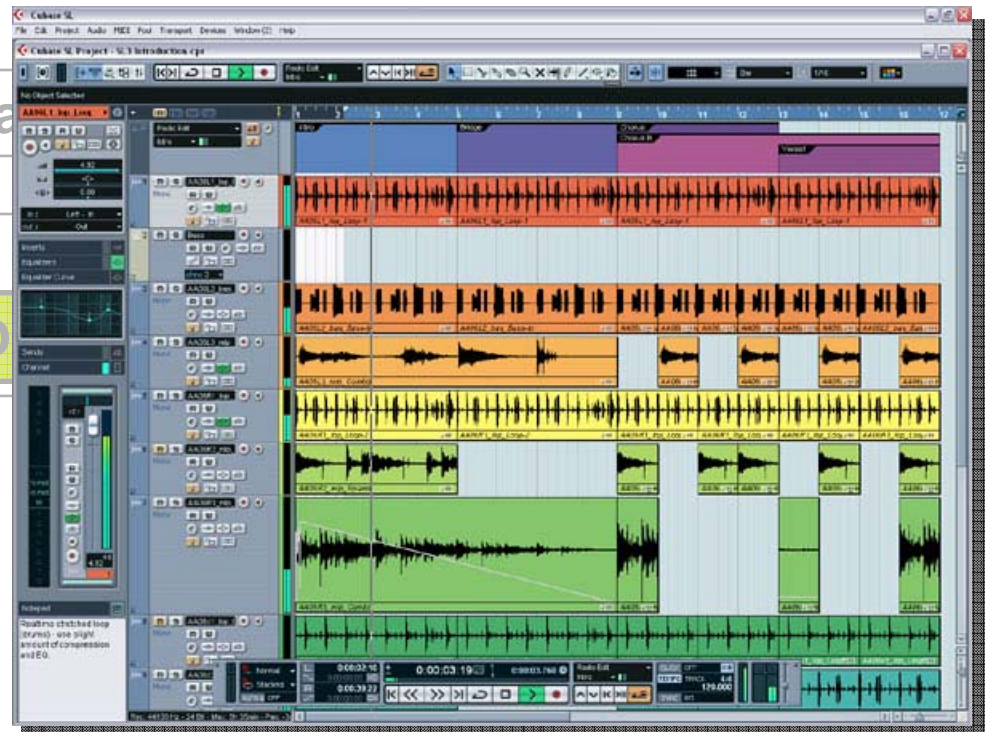


MIDI Sequencer; e. g.

- Steinberg Cubase

Formats:

- SMAF, MIDI, cMIDI, MFi



Proprietary

3D Graphics



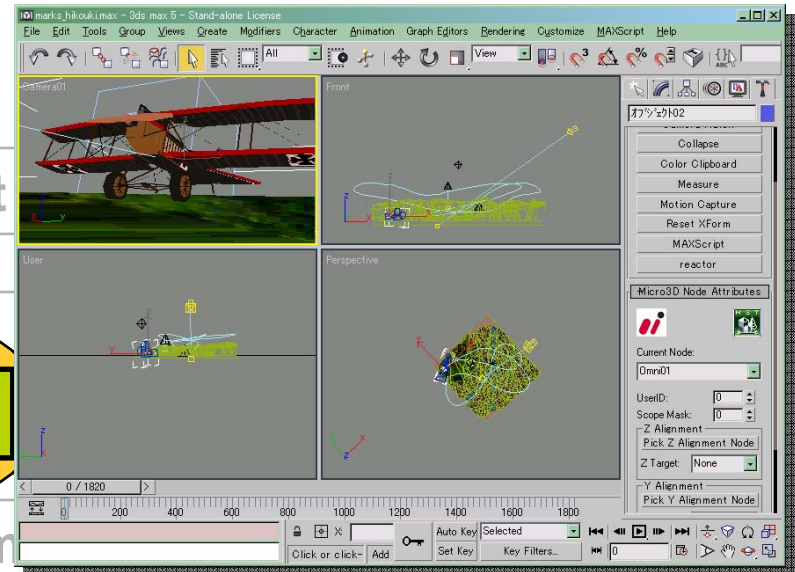
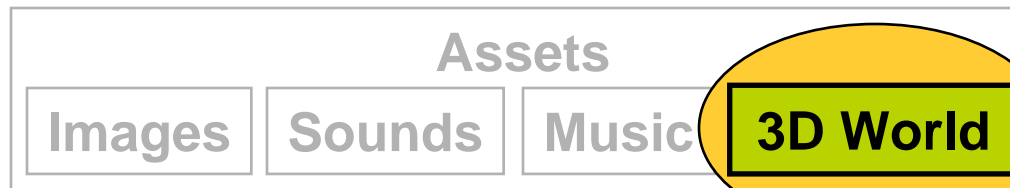
Asset Creation

- 3D Models

Expanded game logic

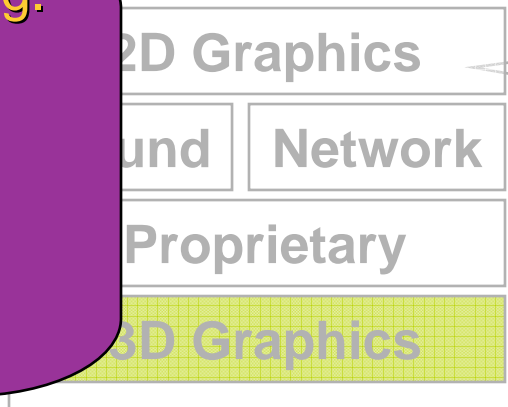


Java MIDlet



3d Modeler with M3G plug-in; e.g.

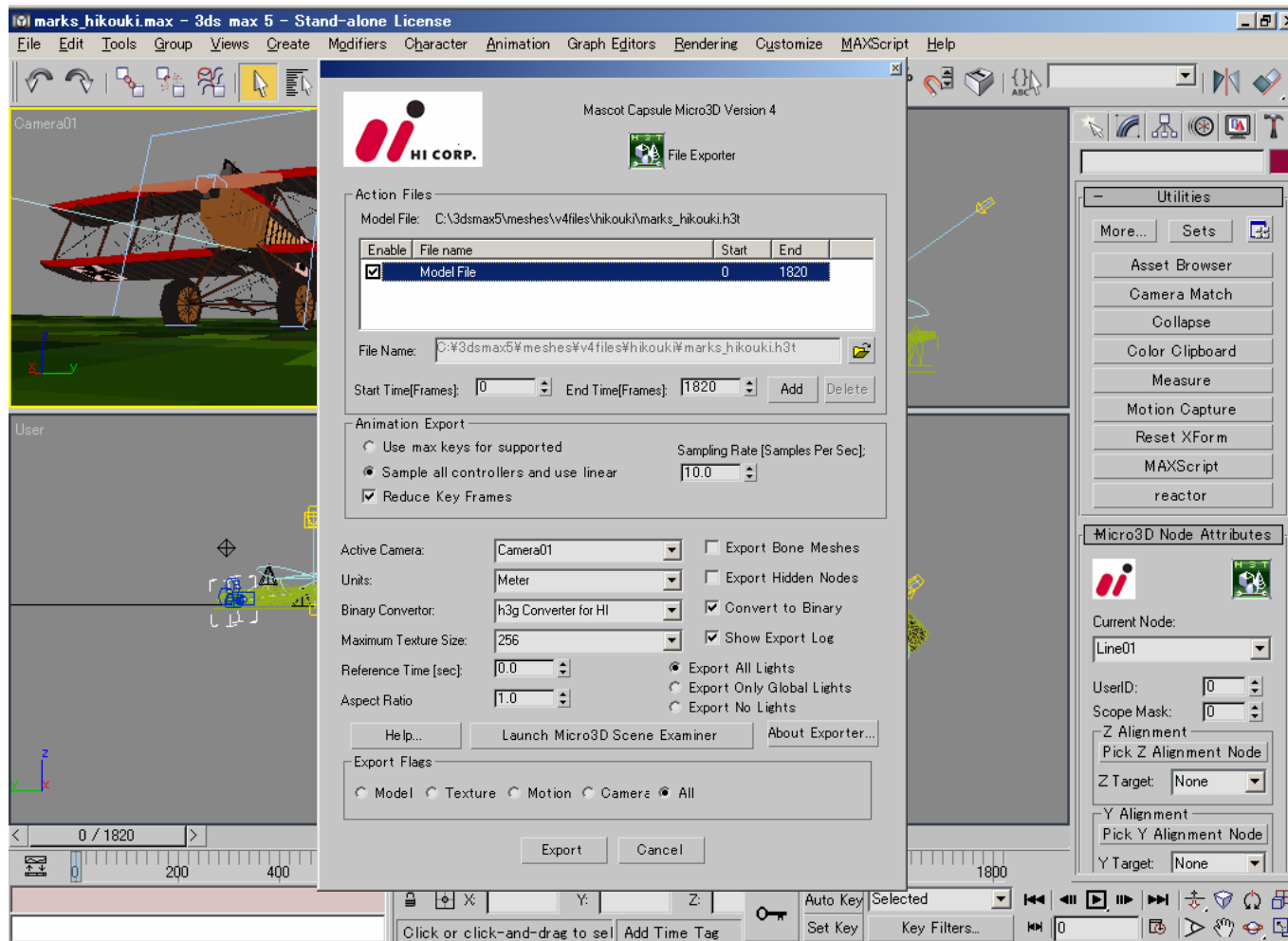
- Lightwave
- Maya
- 3d studio max
- Softimage|XSI



Demo: Export 3d Model to M3G



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Demo: M3G File Check



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The screenshot displays the M3GViewer3.0E application window. The main view shows a 3D model of a biplane on a flat green ground. The interface includes a menu bar (File, Display, Animation, Windows, Help), a toolbar, and a control panel at the bottom with playback buttons and a progress bar. The control panel shows 'current world time' as 0 [ms] and 'animation length' as 60667 [ms]. The 'loop' checkbox is checked. The status bar at the bottom indicates '0.0 f/s', 'File size 831423 byte', 'SceneGraph', and 'Perspective' view.

The SceneGraph Tree Viewer on the right shows a hierarchical tree structure:

- Image2D ID [12]
 - Appearance ID [37]
 - CompositingMode ID [14]
 - Fog ID [17]
 - PolygonMode ID [28]
 - Material ID [24]
- Camera ID [81]
 - AnimationTrack ID [10]
 - AnimationController ID [6]
 - KeyframeSequence
 - AnimationTrack ID [11]
 - AnimationController ID [6]
 - KeyframeSequence
- Light ID [82]
- Background ID [13]
- Camera ID [81]
 - AnimationTrack ID [10]
 - AnimationController ID [6]
 - KeyframeSequence
 - AnimationTrack ID [11]
 - AnimationController ID [6]
 - KeyframeSequence

The TreeViewer Information panel on the right shows the selected 'Light' node with the following settings:

- Node: Light
- Light Mode: AMBIENT
- Light Intensity: 1.000
- Light Color: 0xF7BFB9
- Light Attenuation:
 - Constant: 1.000
 - Linear: 0.000
 - Quadratic: 0.000
- Spot Light Stuff:
 - Angle [0, 90] <Degrees>: 45.000
 - Exponential [0, 128]: 0.000



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Demo: On a Real Phone





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Tips for Designers 1

- *TIP: Don't use GIF files*
 - *The specification does not require their support*
- *TIP: Create the best possible quality audio & music*
 - It's much easier to reduce the quality later than increase it
- *TIP: Polygon reduction tools & polygon counters are your friends*
 - Use the minimum number of polygons that conveys your vision satisfactorily



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Tips for Designers 2

- *TIP: Use light maps for lighting effects*
 - Usually faster than per-vertex lighting
 - Use luminance textures, not RGB
 - Multitexturing is your friend
- *TIP: Try LINEAR interpolation for Quaternions*
 - *Faster than SLERP*
 - *But less smooth*



Tips for Designers 3

- *TIP: Use background images*
 - Can be scaled, tiled and scrolled very flexibly
 - Generally much faster than sky boxes or similar
- *TIP: Use sprites as impostors & labels*
 - Generally faster than textured quads
 - Unscaled mode is (much) faster than scaled
- *LIMITATION: Sprites are not useful for particle systems*



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- Publishing Your Content



Program Development

- Edit, Compile, Package



Assets

Images Sounds Music World

Platform

Graphics

Network

Proprietary

Graphics



Traditional

- Wtk, shell, editor, make, javac

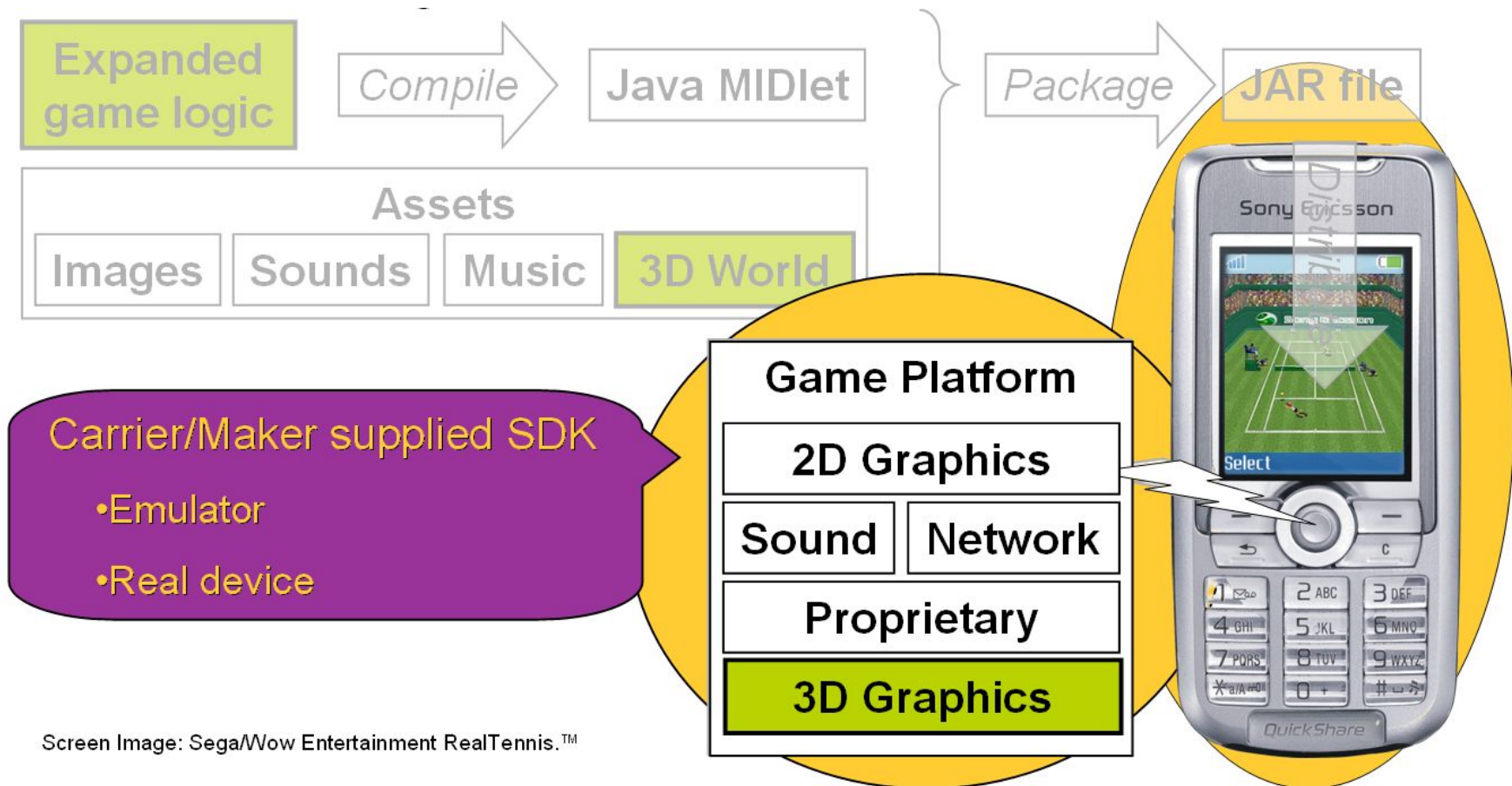
Integrated Development Environment

- Eclipse
- Borland JBuilder
- Sun Java Studio



Program Development

- Test & Debug



Screen Image: Sega/Wow Entertainment RealTennis.™



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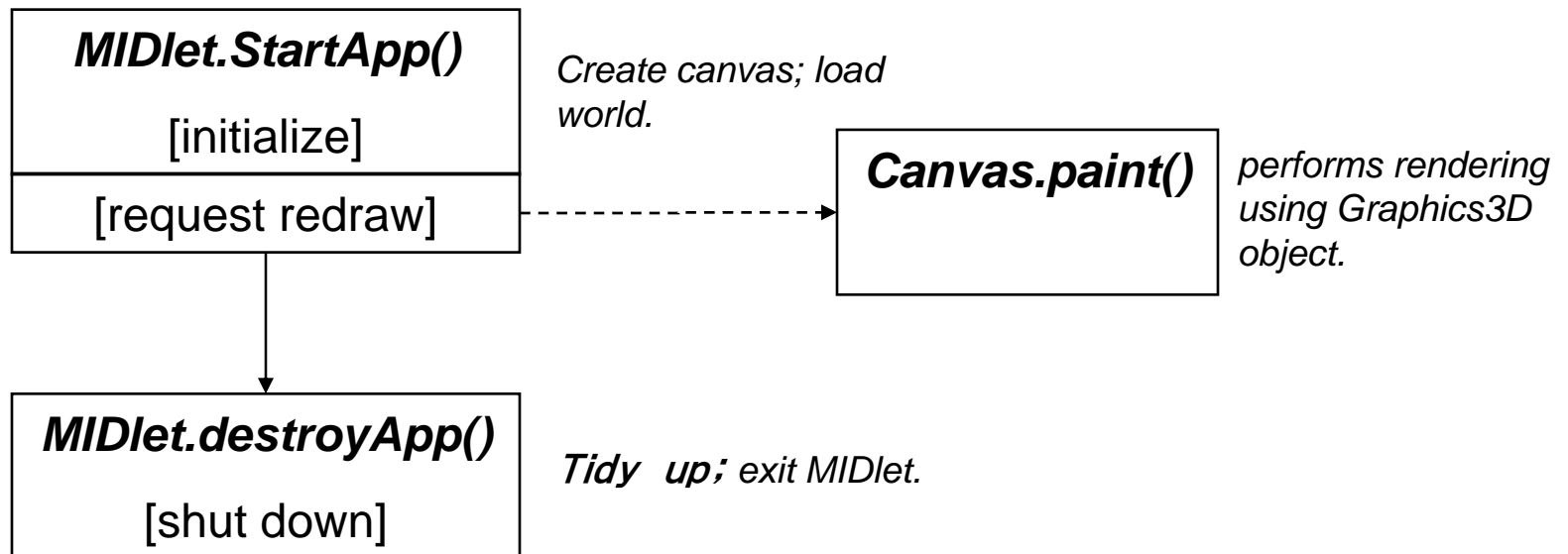
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The Simplest MIDlet

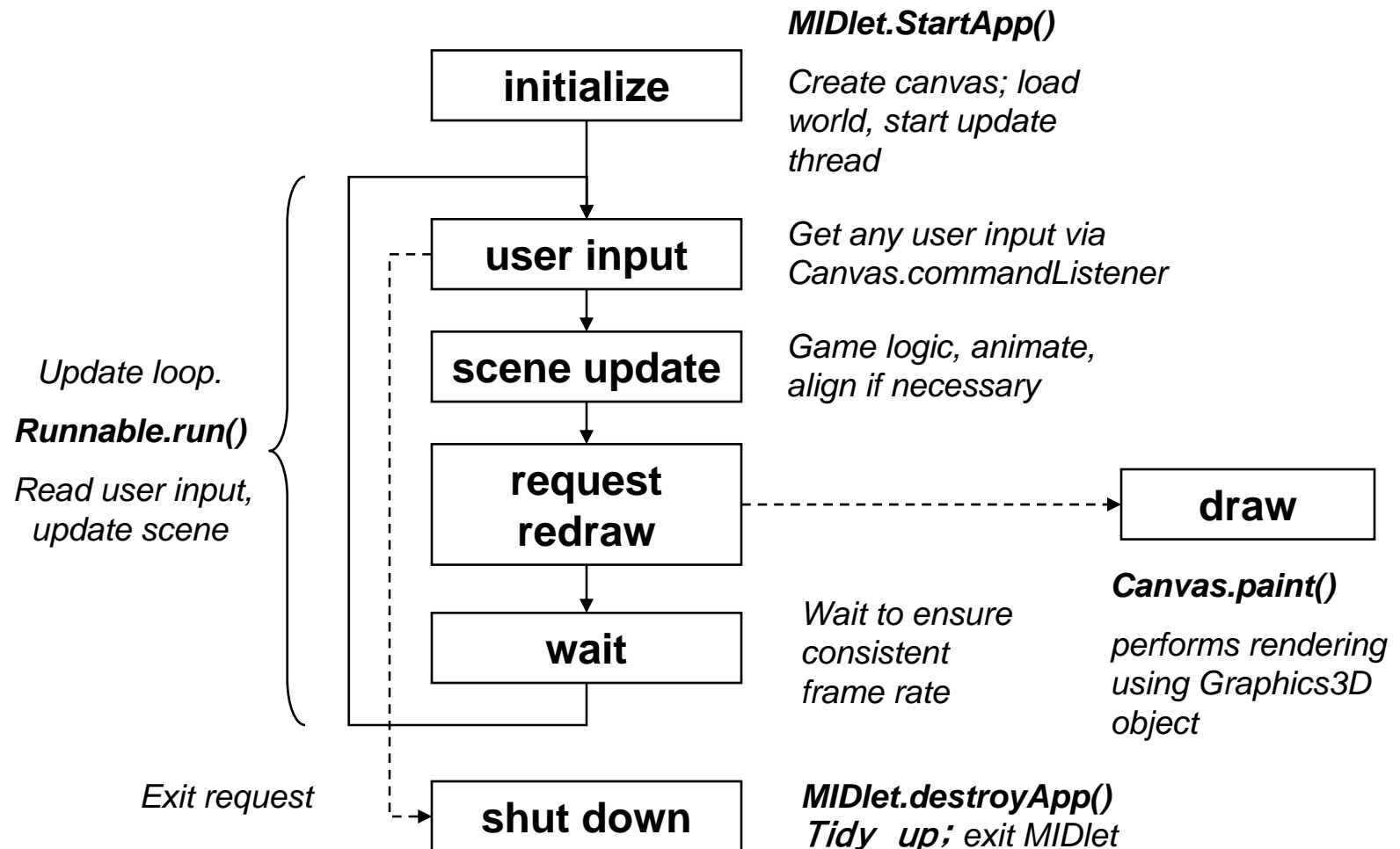
- Derived from MIDlet,
- Overrides three methods



- And that's it.



A More Interesting MIDlet





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MIDlet Phases

- Initialize
- Update
- Draw
- Shutdown



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Initialize

- Load assets: world, other 3D objects, sounds, etc.
- Find any objects that are frequently used
- Perform game logic initialization
- Initialize display
- Initialize timers to drive main update loop



Update

- Usually a thread driven by timer events
- Get user input
- Get current time
- Run game logic based on user input
- Game logic updates world objects if necessary
- Animate
- Request redraw



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Update Tips

- *TIP: Don't create or release objects if possible*
- *TIP: Call `system.gc()` regularly to avoid long pauses*
- *TIP: cache any value that may not change every frame; compute only what is absolutely necessary*



Draw

- Usually on overridden paint method
- Bind Graphics3D to screen
- Render 3D world or objects
- Release Graphics3D
 - ...whatever happens!
- Perform any other drawing (UI, score, etc)
- Request next timed update



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Draw Tips

- *TIP: Don't do 2D drawing while Graphics3D is bound*



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Shutdown

- Tidy up all unused objects
- Ensure once again that Graphics3D is released
- Exit cleanly
- Graphics3D should also be released during `pauseApp`



MIDlet Review

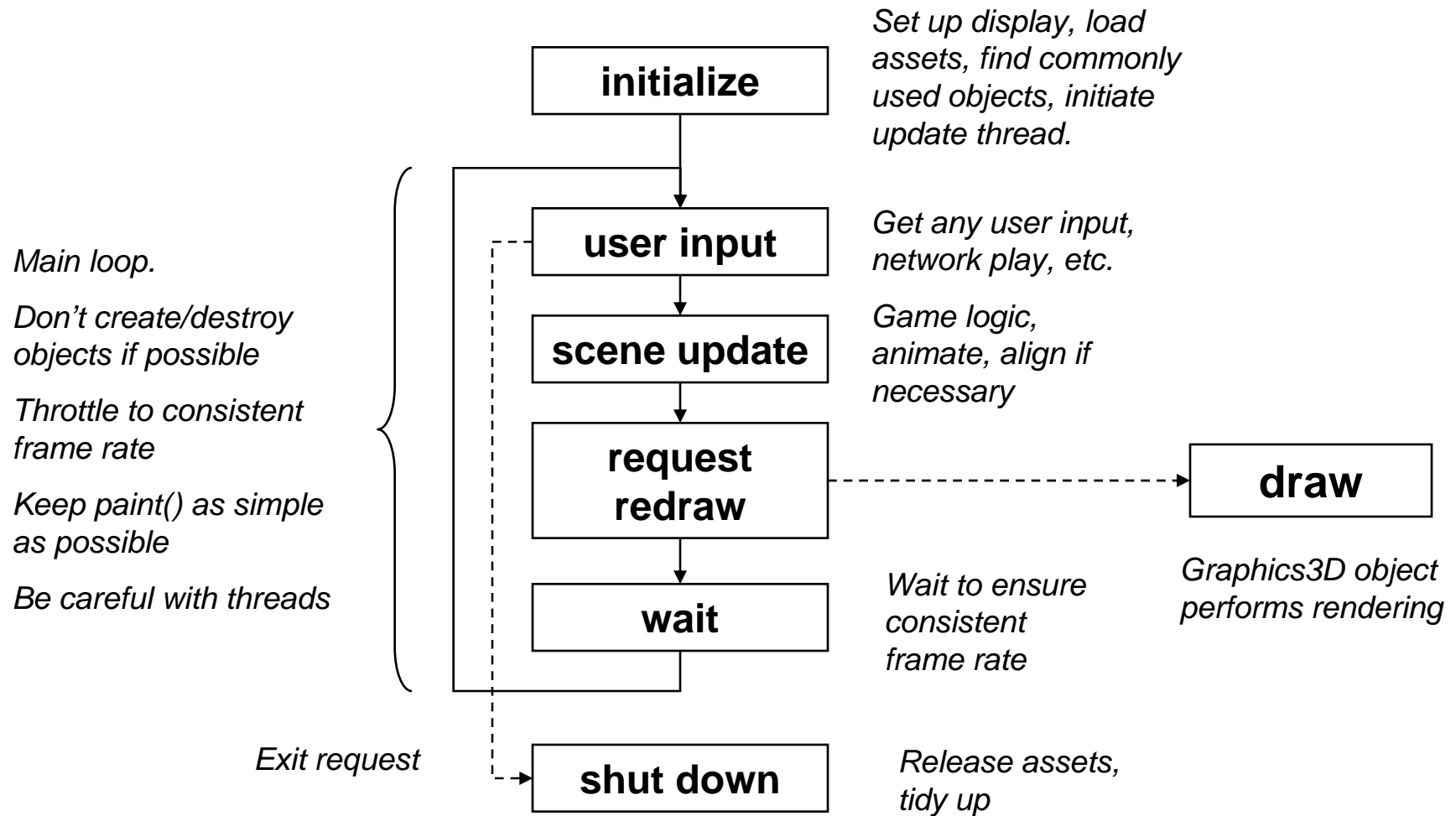


Diagram courtesy of Sean Ellis, Superscape



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Demo: UsingM3G MIDlet



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***UsingM3G* MIDlet**

- Display Mesh, MorphingMesh and SkinnedMesh
- Meshes loaded from .m3g files
- View can be changed with arrow keys
- Animation of individual meshes can be stopped and started.
- Animation can be stopped and started with a button push.
- Displays frames per second.



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UsingM3G Framework

```
import java.io.IOException;
import javax.microedition.lcdui.*;
import javax.microedition.midlet.*;

public class Cans extends MIDlet implements CommandListener {
    Command cmdExit = new Command("Exit", Command.SCREEN, 1);
    Command cmdPlayPause = new Command("Ctrl", Command.SCREEN, 1);
    private TargetCanvas tcanvas = null;
    Thread renderingT = null;
    private String Filename = "/coffee.m3g";

    public void startApp() {
        if (tcanvas == null)
            init();

        renderingT = new Thread(tcanvas);
        renderingT.start();
        tcanvas.startPlay();
    }
}
```

UsingM3G Framework



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```
public void pauseApp() {
    if (tcanvas.isPlaying)
        tcanvas.pausePlay();
    renderingT.yield();
    renderingT = null;
}

public void destroyApp(boolean u) {
    pauseApp()
    tcanvas = null;
}
```

UsingM3G Framework



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```
synchronized public void commandAction(Command c,
                                         Displayable d)
{
    if (c==cmdExit) {
        notifyDestroyed();
        return;
    } else if (c==cmdPlayPause) {
        if (tcanvas.isPlaying)
            tcanvas.pausePlay();
        else
            tcanvas.startPlay();
    }
}
```



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UsingM3G Initialization

```
// From class Cans
public void init() {
    Display disp = Display.getDisplay(this);
    tcanvas = new TargetCanvas(Filename);
    if (tcanvas.hasException)
        notifyDestroyed();
    tcanvas.setCommandListener(this);
    tcanvas.addCommand(cmdExit);
    tcanvas.addCommand(cmdPlayPause);
    disp.setCurrent(tcanvas);
}
```



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UsingM3G Initialization

```
class TargetCanvas extends Canvas implements Runnable
... // instance variable declarations elided
public TargetCanvas(String m3gFile)
{
    try
    {
        fileName = m3gFile;
        g3d = Graphics3D.getInstance();
        Load();
        w = getWidth();
        h = getHeight();
        cameraManip = new CameraManip(gWorld);
    }
    catch(IOException e)
    {
        System.out.println("loading fails:"+fileName);
        hasException = true;
    }
}
```



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Loading the 3D data

```
// class TargetCanvas
void Load() throws IOException {
    loadObjs = Loader.load(fileName);
    if (loadObjs==null)
        throw new RuntimeException("M3g file error");

    /* find the world node */
    for (int i=0; i<loadObjs.length; ++i) {
        if (loadObjs[i] instanceof World) {
            gWorld = (World)loadObjs[i];
            hasWorld = true;
            break;
        }
    }

    if (!hasWorld)
        throw new RuntimeException(
            "World node not found; incorrect m3g file?");
}
```



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Loading the 3D Data (Cont.)

```
meshController =
    (AnimationController)gWorld.find(meshControllerId);
morphingMeshController =
    (AnimationController)gWorld.find(morphingMeshControll
erId);
skinnedMeshController =
    (AnimationController)gWorld.find(skinnedMeshControlle
rId);

    /* Clean up after the loading process. */
    System.gc();
}
```




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TargetCanvas *run* method

```
public void run()
{
    for(;;) {
        long start, elapsed;
        start = System.currentTimeMillis();
        handleInput();
        repaint(); // Request paint()
        elapsed = System.currentTimeMillis() - start;
        // if (want to measure true frame rate)
        // Unfriendly to system!!
        //renderTime += (int)elapsed;
        // else {
        renderTime += (elapsed < 50) ? 50 : (int)elapsed;
        try {
            if (elapsed < 50) Thread.sleep(50-elapsed);
        } catch (InterruptedException e) { }
        //}
    }
}
```



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TargetCanvas *paint* method

```
synchronized protected void paint(Graphics g)
{
    if(loadObjs == null) return;
    g.setClip(0, 0, w, h);
    try
    {
        g3d.bindTarget(g);
        g3d.setViewport(0, 0, w, h);
        render();
    } finally { g3d.releaseTarget(); }

    g.setColor(0xffffffff);
    g.drawString("fps: " + fps, 2, 2, g.TOP|g.LEFT);
}
```

TargetCanvas *render* method



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```
void render()
{
    if (isPlaying) {
        frameCount++;
        fps = (int)((1000*frameCount) / renderTime) ;
        /* update the scene */
        gWorld.animate((int)renderTime);
    }
    g3d.render(gWorld);
}
```



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Receiving Key Presses

```
protected void keyPressed(int keyCode) {  
    int action;  
    switch (keyCode) {  
        case KEY_NUM1: animState ^= MESH_ANIM; break;  
        case KEY_NUM2: animState ^= SKINM_ANIM; break;  
        case KEY_NUM3: animState ^= MORPHM_ANIM; break;  
        default: {  
            action = getGameAction(keyCode);  
            switch (action) {  
                case DOWN: keyState |= DOWN_PRESSED; break;  
                case LEFT: keyState |= LEFT_PRESSED; break;  
                case RIGHT: keyState |= RIGHT_PRESSED; break;  
                case UP: keyState |= UP_PRESSED; break;  
                default: break;  
            }  
        }  
    }  
}
```



HandleInput method

```
protected void handleInput()
{
    int start = 0, end;
    int keyState = getKeyStates();
    int deltaX = 0, deltaY = 0;

    /* Stop & start animation of individual objects by setting
     * active interval on AnimationControllers.
     */
    if (meshController != null) {
        end = (animState & MESH_ANIM) != 0 ? 0 : 1;
        meshController.setActiveInterval(start, end);
    }
    if (skinnedMeshController != null) {
        end = (animState & SKINM_ANIM) != 0 ? 0 : 1;
        skinnedMeshController.setActiveInterval(start, end);
    }
    if (morphingMeshController != null) {
        end = (animState & MORPHM_ANIM) != 0 ? 0 : 1;
        morphingMeshController.setActiveInterval(start, end);
    }
}
```



HandleInput method (Cont.)

```
if ((keyState & DOWN_PRESSED) != 0) {
    deltaY -= DELTA;
}
if ((keyState & LEFT_PRESSED) != 0) {
    deltaX += DELTA;
}
if ((keyState & RIGHT_PRESSED) != 0) {
    deltaX -= DELTA;
}
if ((keyState & UP_PRESSED) != 0) {
    deltaY += DELTA;
}
if (deltaX != 0 || deltaY != 0)
    cameraManip.rotate( deltaY, deltaX, 0 );
}
```



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Why Mobile Game Development is Difficult

- Application size severely limited
 - Download size limits
 - Small Heap memory
- Small screen
- Poor input devices
- Poor quality sound
- Slow system bus and memory system



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Why Mobile Game Development is Difficult

- No floating point hardware
- No integer divide hardware
- Many tasks other than application itself
 - Incoming calls or mail
 - Other applications
- Short development period
- Tight budget, typically \$100k – 250k



Memory

- Problems
 - ① Small application/download size
 - ② Small heap memory size
- Solutions
 - Compress data ①
 - Use single large file ①
 - Use separately downloadable levels ①
 - Limit contents ②
 - Get makers to increase memory ②



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Performance

- Problems
 - ① Slow system bus & memory
 - ② No integer divide hardware
- Solutions
 - Use smaller textures ①
 - Use mipmapping ①
 - Use byte or short coordinates and key values ①
 - Use shifts ②
 - Let the compiler do it ②



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User-Friendly Operation

- Problems
 - Button layouts differ
 - Diagonal input may be impossible
 - Multiple simultaneous button presses not recognized
- Solutions
 - Plan carefully
 - Different difficulty levels
 - Same features on multiple buttons
 - Key customize feature



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Many Other Tasks

- Problem
 - Incoming calls or mail
 - Other applications
- Solution
 - Create library for each handset terminal



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Publishing Your Content

- Can try setting up own site but
 - it will be difficult for customers to find you
 - impossible to get paid
 - may be impossible to install MIDlets from own site
- Must use a carrier approved publisher
- Publishers often run own download sites but always with link from carrier's game menu.
- As with books, publishers help with distribution and marketing



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Publishing Your Content

- Typical end-user cost is \$2 - \$5.
- Sometimes a subscription model is used.
- Carrier provides billing services
 - Carriers in Japan take around 6%
 - Carriers in Europe have been known to demand as much as 40%! They drive away content providers.
- In some cases, only carrier approved games can be downloaded to phones
 - Enforced by handsets that only download applets OTA
 - Developers must have their handsets modified by the carrier



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Publishers

- Find a publisher and build a good relationship with them
- **Japan:** Square Enix, Bandai Networks, Sega, Namco, Infocom, etc.
- **America:** Bandai America, Digital Chocolate, Jamdat, MForma, Glu Mobile (formerly Sorrent)
- **Europe:** Digital Chocolate, Superscape, Glu Mobile (formerly Macrospace), Upstart Games



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Other 3D Java Mobile APIs

Mascot Capsule Micro3D Family APIs

- Motorola iDEN, Sony Ericsson, Sprint, etc.)
 - `com.mascotcapsule.micro3d.v3` (V3)
- Vodafone KK JSCL
 - `com.j_phone.amuse.j3d` (V2), `com.jblend.graphics.j3d` (V3)
- Vodafone Global
 - `com.vodafone.amuse.j3d` (V2)
- NTT Docomo (DoJa)
 - `com.nttdocomo.opt.ui.j3d` (DoJa 2, DoJa 3) (V2, V3)
 - `com.nttdocomo.ui.graphics3D` (DoJa 4) (V4)

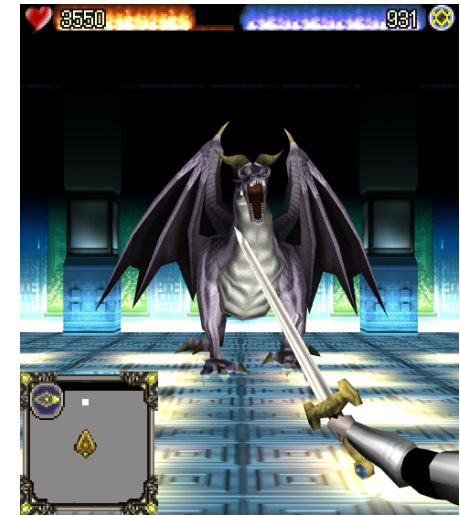
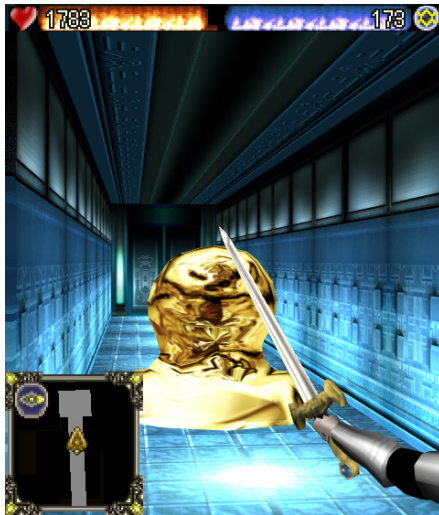
Mascot Capsule Micro3D Version Number

Mascot Capsule V3 Game Demo



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DEEP LABYRINTH[®] DELUXE EDITION



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Summary

- Use standard tools to create assets
- Basic M3G MIDlet is relatively easy
- Programming 3D Games for mobile is hard
- Need good relations with carriers and publishers to get your content distributed



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Exporters

3ds max

- Simple built-in exporter since 7.0
- www.digi-element.com/Export184/
- www.mascotcapsule.com/M3G/
- www.m3gexporter.com

Maya

- www.mascotcapsule.com/M3G/
- www.m3gexport.com

Softimage|XSI

- www.mascotcapsule.com/M3G/

Cinema 4D

- www.c4d2m3g.com

Lightwave

- www.mascotcapsule.com/M3G/

Blender

- www.bight.ca





SDKs

- Motorola iDEN J2ME SDK
 - idenphones.motorola.com/iden/developer/developer_tools.jsp
- Nokia Series 40, Series 60 & J2ME
 - www.forum.nokia.com/java
- Sony Ericsson
 - developer.sonyericsson.com/java
- Sprint Wireless Toolkit for Java
 - developer.sprintpcs.com
- Sun Wireless Toolkit
 - java.sun.com/products/j2mewtoolkit/download-2_2.html



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SDKs

- VFX SDK (Vodafone Global)
 - <http://via.vodafone.com/vodafone/via/Home.do>
- VFX & WTKforJSCL (Vodafone KK)
 - http://developers.vodafone.jp/dp/tool_dl/java/emu.php



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IDE's for Java Mobile

- Eclipse Open Source IDE
 - www.eclipse.org
- JBuilder 2005 Developer
 - www.borland.com/jbuilder/developer/index.html
- Sun Java Studio Mobility
 - www.sun.com/software/products/jsmobility
- Comparison of IDE's for J2ME
 - www.microjava.com/articles/J2ME_IDE_Comparison.pdf



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Other Tools

- Macromedia Fireworks
 - <http://www.macromedia.com/software/fireworks/>
- Adobe Photoshop
 - <http://www.adobe.com/products/photoshop/main.html>
- Sony SoundForge
 - <http://www.sonymediasoftware.com/products/showproduct.asp?PID=961>
- Steinberg Cubase
 - http://www.steinberg.de/ProductPage_sb4b2a.html?Product_ID=2124&Langue_ID=4
- Yamaha SMAF Tools
 - <http://smaf-yamaha.com/>



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Publishers, Japan

- Square Enix
 - <http://www.square-enix.com/jp>
- Bandai Networks
 - <http://www.bandai-net.com/>
- Sega
 - <http://www.sega.co.jp/>
- Namco
 - <http://www.namco.com>
- Infocom
 - <http://www.infocom.co.jp/>



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Publishers, America

- Bandai America
 - <http://www.bandai.com/>
- Digital Chocolate
 - <http://www.digitalchocolate.com/>
- Jamdat
 - <http://www.jamdat.com>
- MForma
 - <http://www.mforma.com/>
- Glu Mobile
 - <http://www.glumobile.com/>



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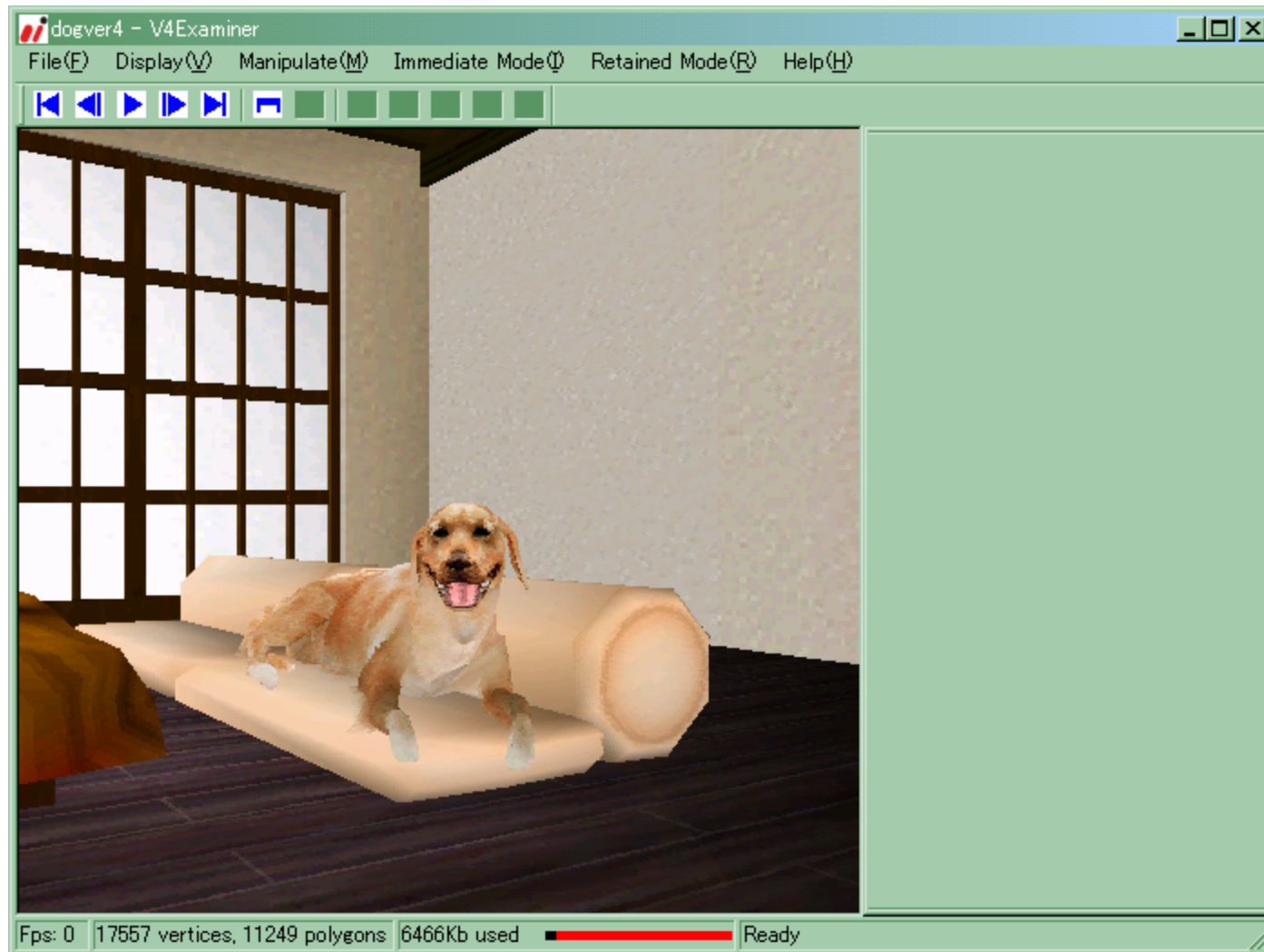
Publishers, Europe

- Digital Chocolate
 - <http://www.digitalchocolate.com/>
- Superscape
 - <http://www.superscape.com/>
- Glu Mobile
 - <http://www.glu.com>
- Upstart Games
 - <http://www.upstartgames.com/>



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InuTomo (Dog Friend) Demo





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Thanks: HI Mascot Capsule Version 4
Development Team, Koichi Hatakeyama,
Sean Ellis, JSR-184 Expert Group