JogAmp: 2D/3D & Multimedia across Devices

SIGGRAPH 2012 – Los Angeles Convention Center
August 7, 2012

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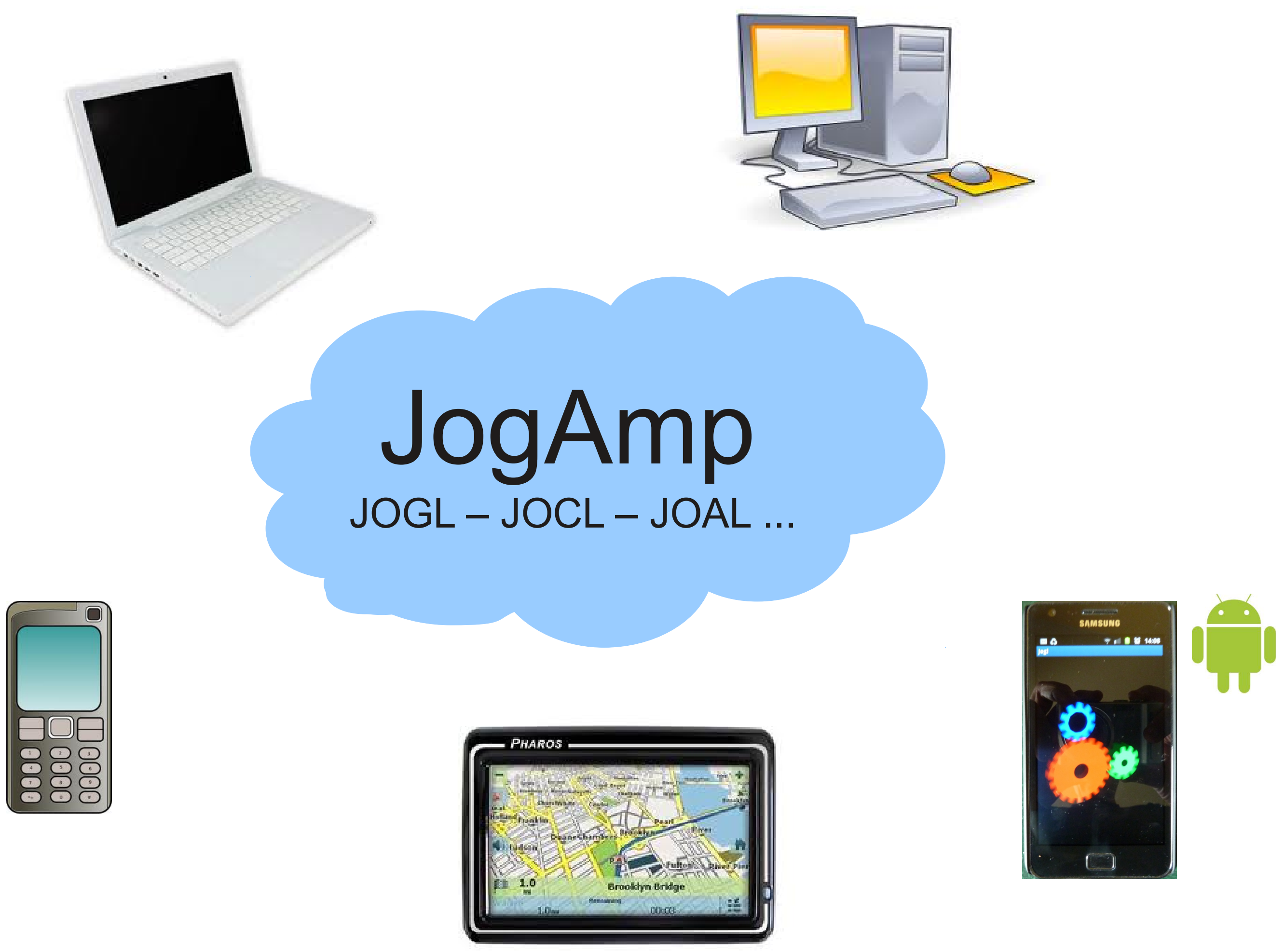
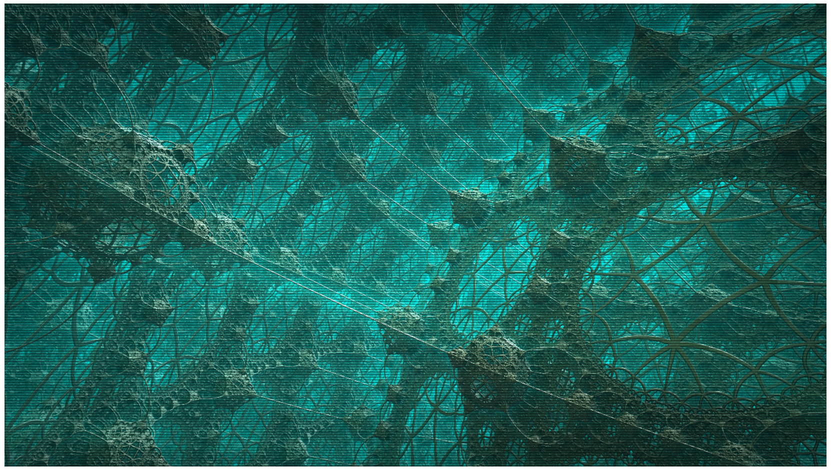
What is JogAmp?

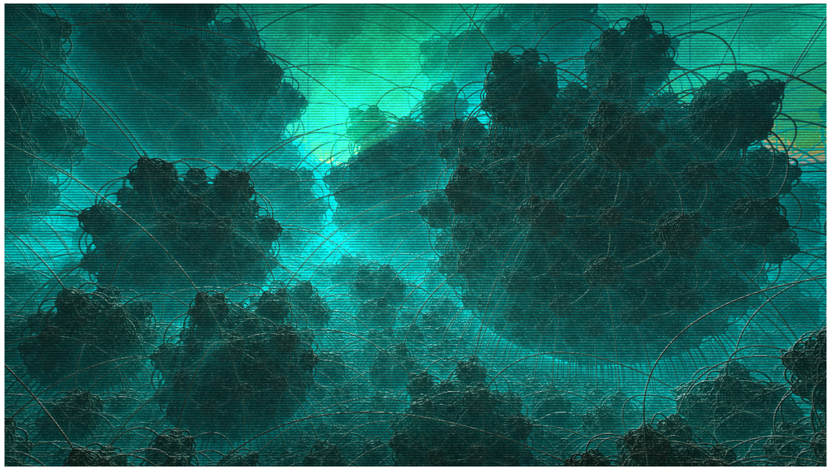


About US

- Open & Vendor Independent
- BSD License
- Java Graphics, Audio, Media & Processing High Performance Bindings
- One Stop Community Platform
  - SCM, Bugtracking, Build Server, Mailinglist/Forum,..
- Commercial Support
- http://jogamp.org

4096 bytes - *Hartverdrahtet*



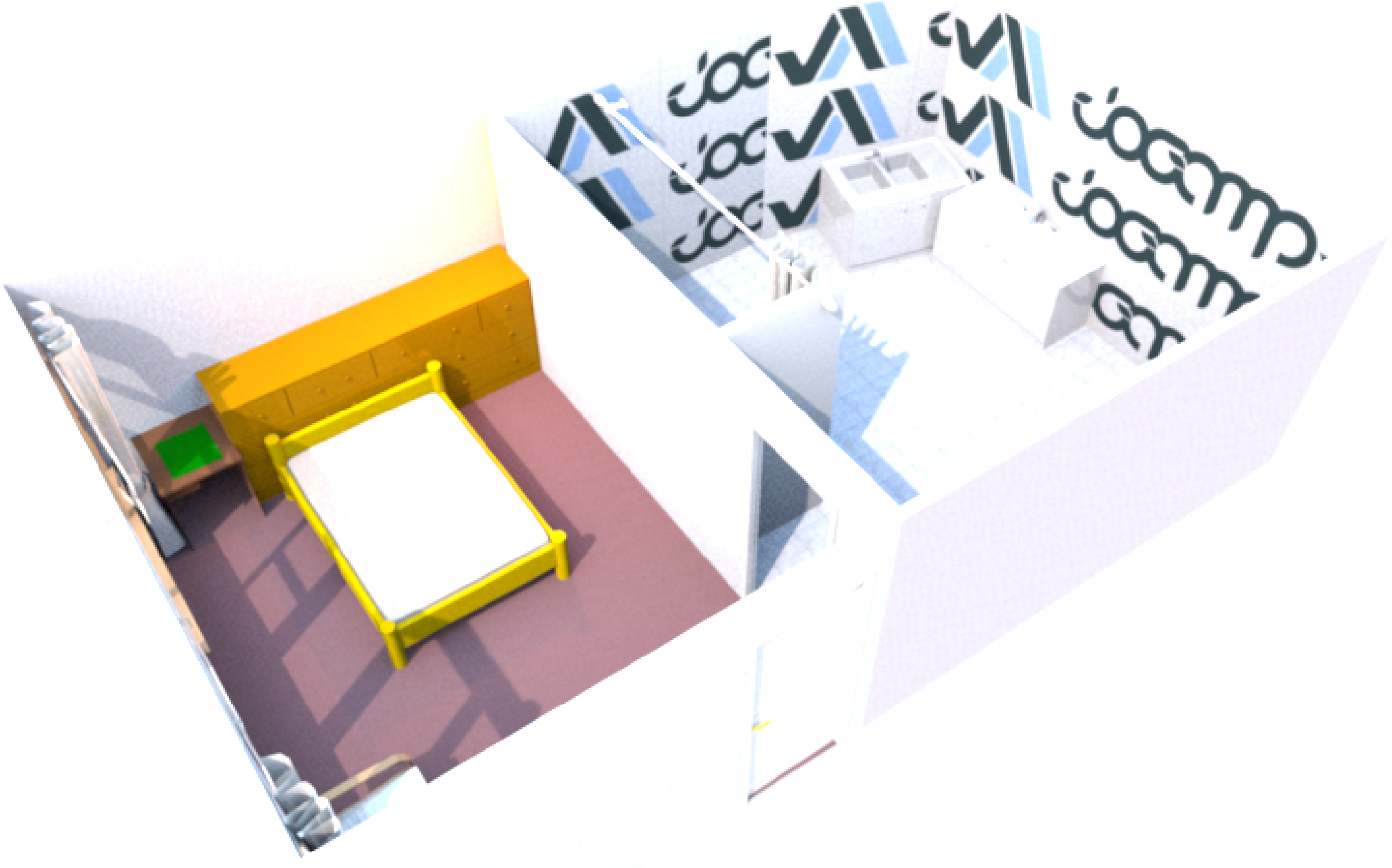


- "Demoscene" production developed with JOGL
- Total executable size including music+visuals must be <=4096 bytes (running length ~3 mins)
- *Hartverdrahtet* placed 1st at Revision 2012 (worlds biggest demoscene event)
- 1:1 JOGL port ofc with sourcecode available: http://copypastaresearch.tumblr.com/

Hartverdrahtet Visuals in a Nutshell

- Single fragment shader (fullscreen billboard)
- Zero polygons! Analytical estimated surface of multidimensional IFS (fractal) volume
- Implements real-time raytracing (sphere-tracing based) with global illumination features (e.g. ambient occlusion)
- Everything is generated per pixel on-the-fly (no precalc)
- Postprocessing pass finishes the look adding volumetric lighting, noise and analog distortions
- Complete fragment shader including the raytracer, fractal, camera pathes for 10 scenes and post-effects <1500 bytes

Sweet Home 3D / Java3D / Engines



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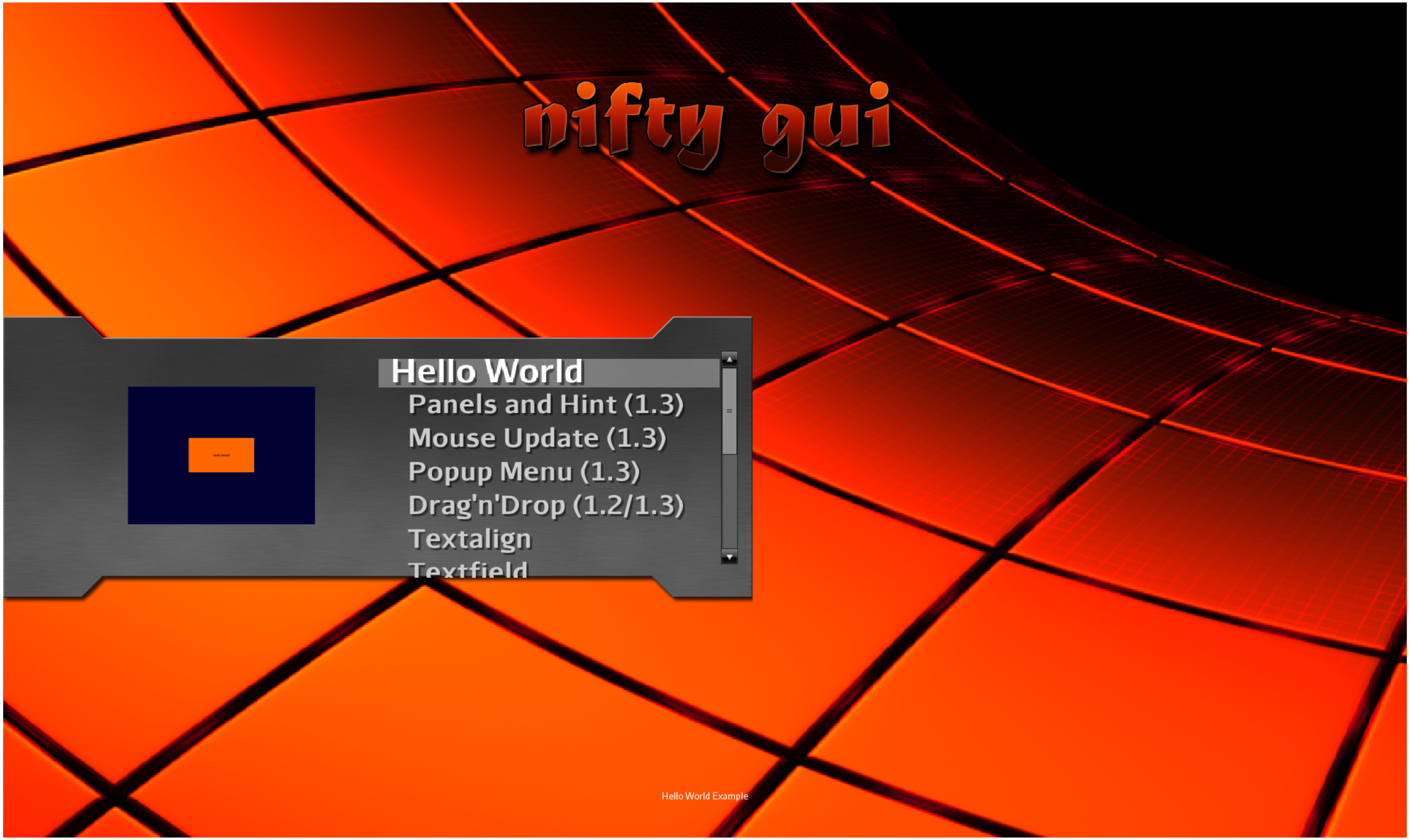
NiftyGUI / Engines



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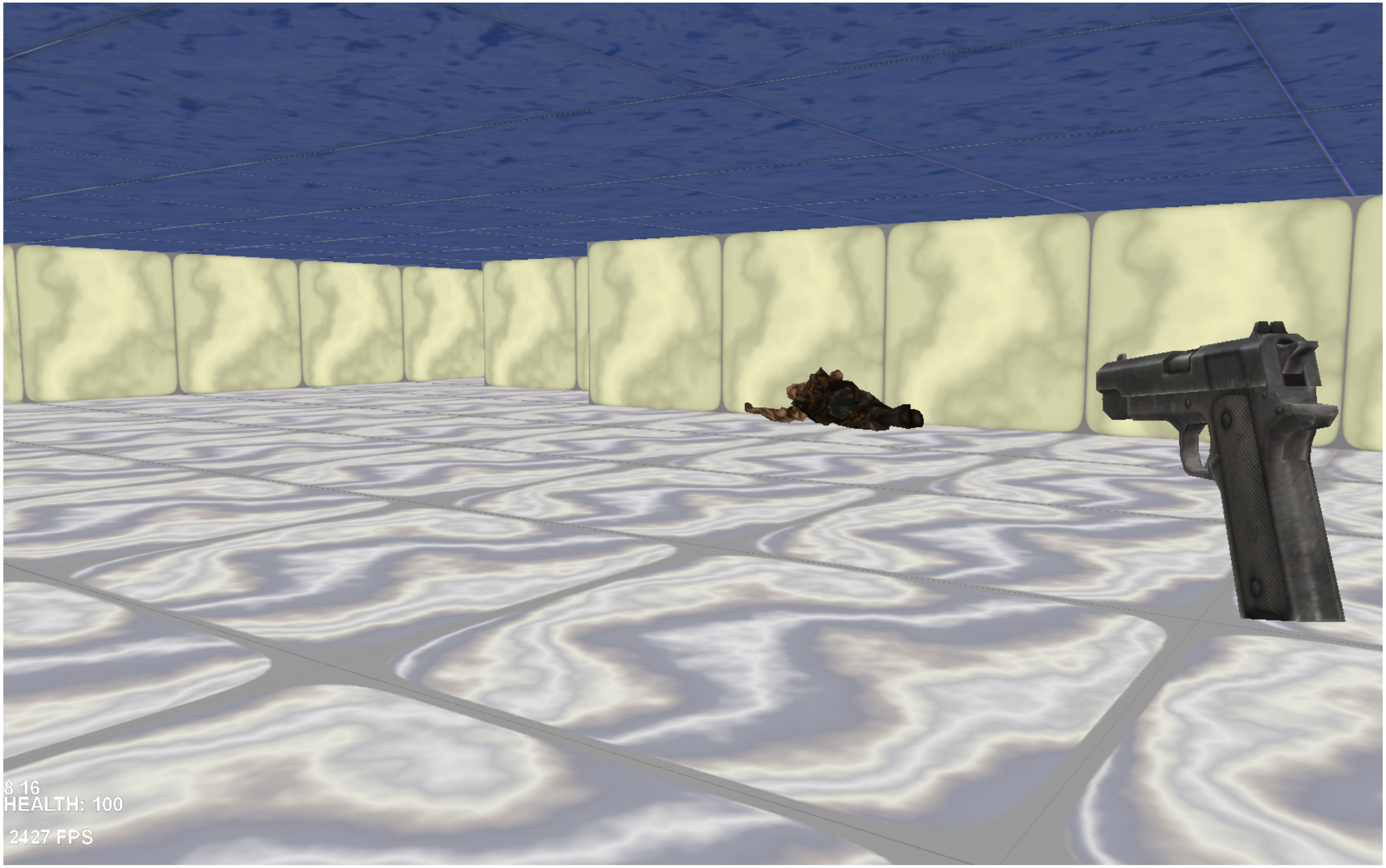
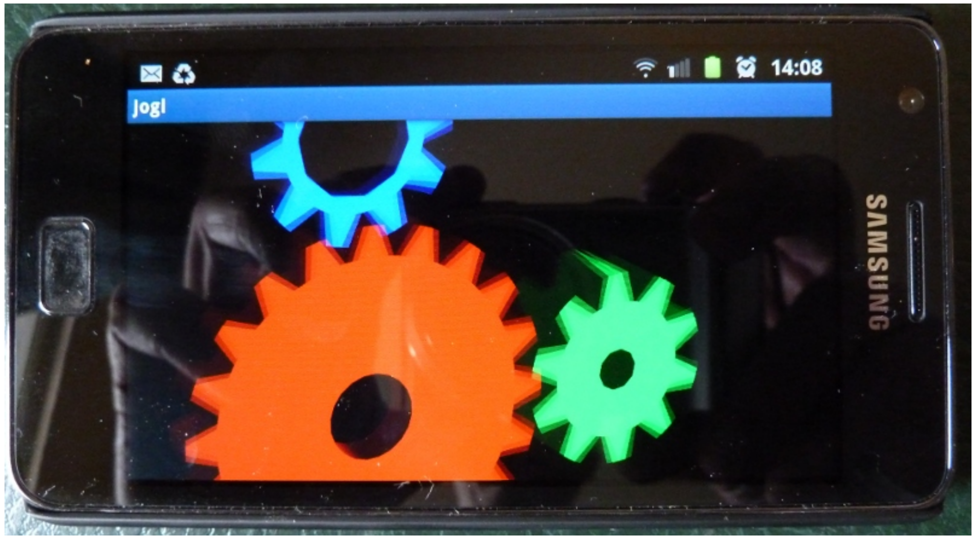
Tuer / Ardor3D / Engines

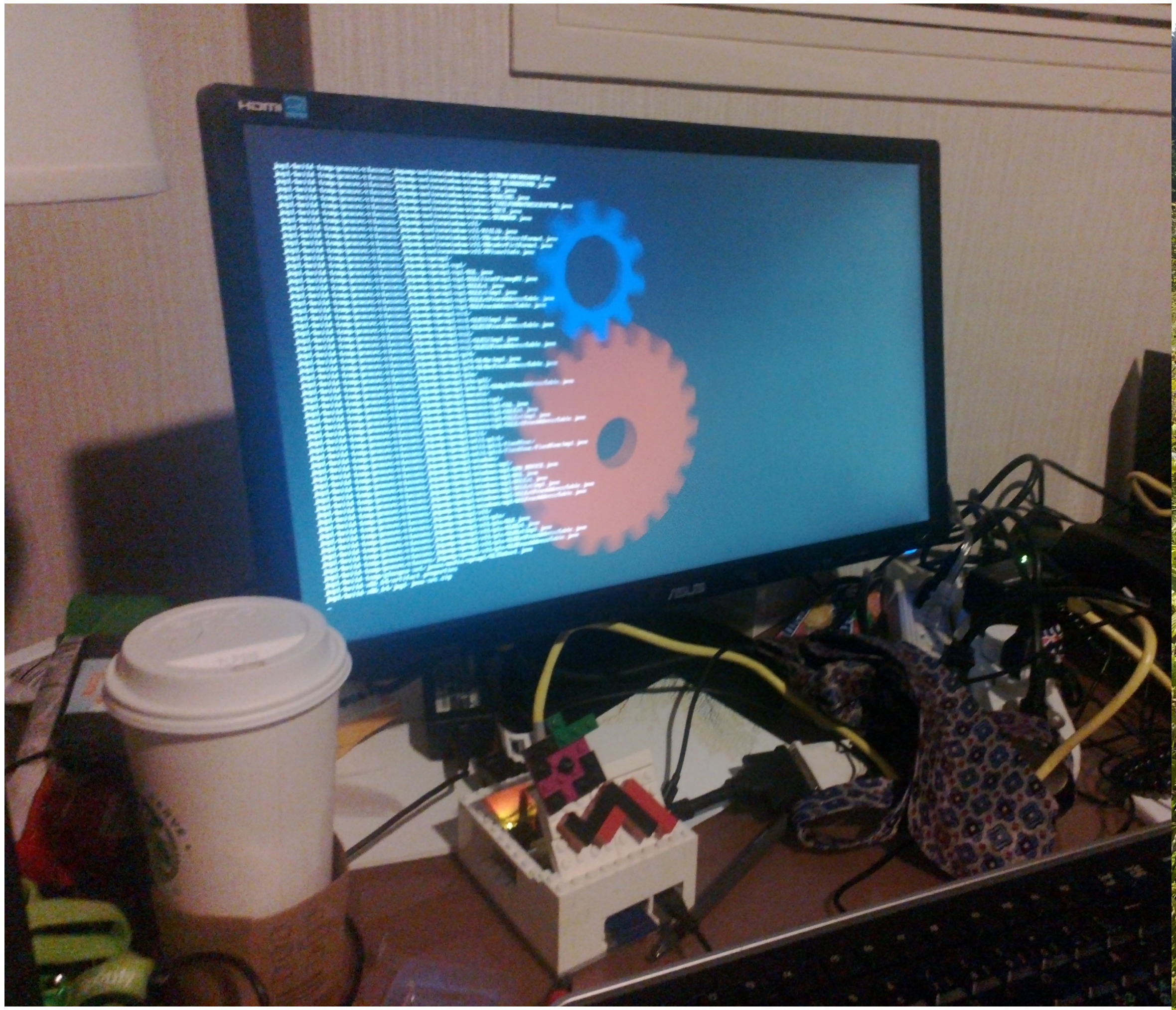


JOGL Android Binding

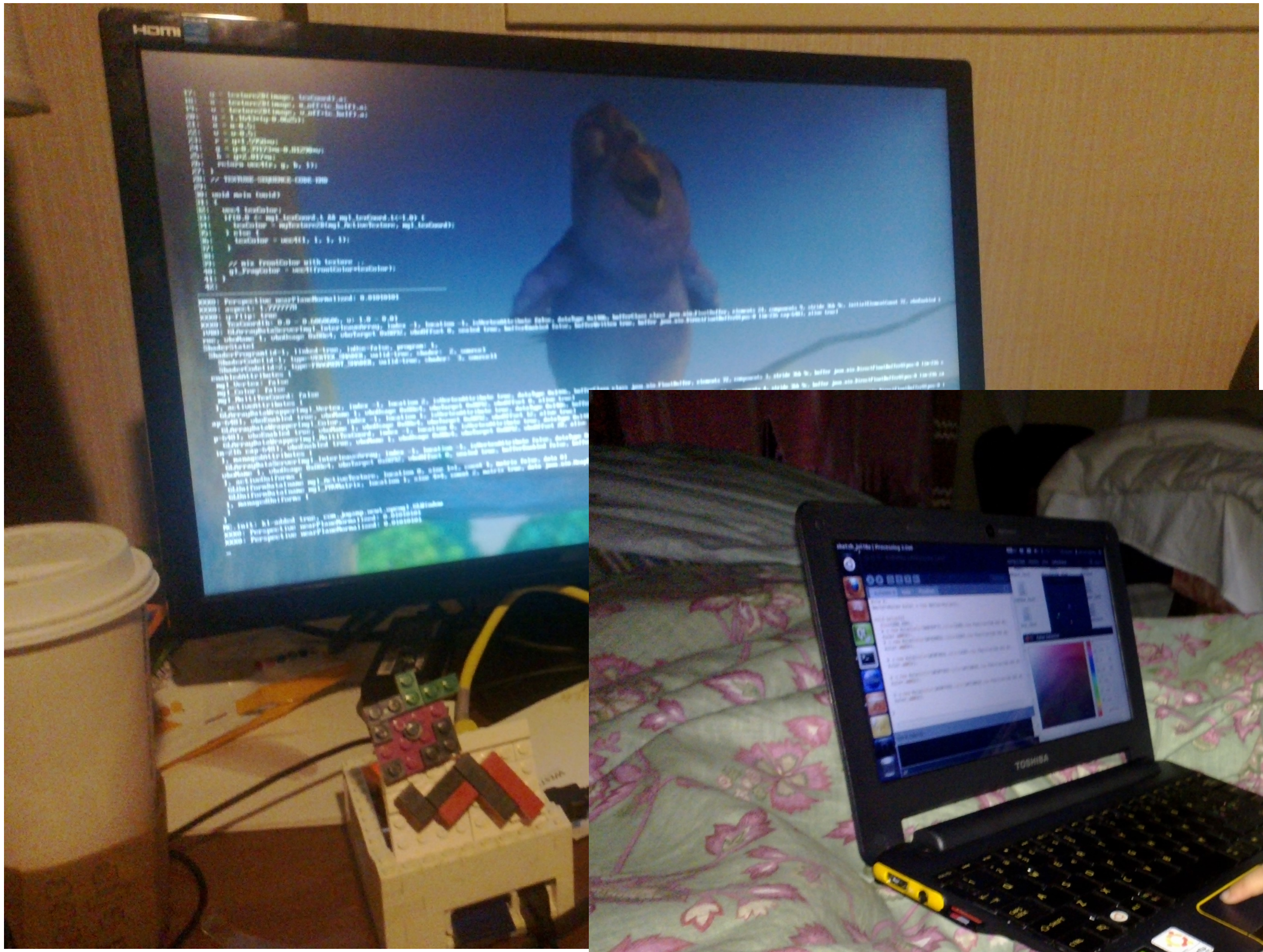
- http://www.youtube.com/watch?v=VHxtVT4tWjM

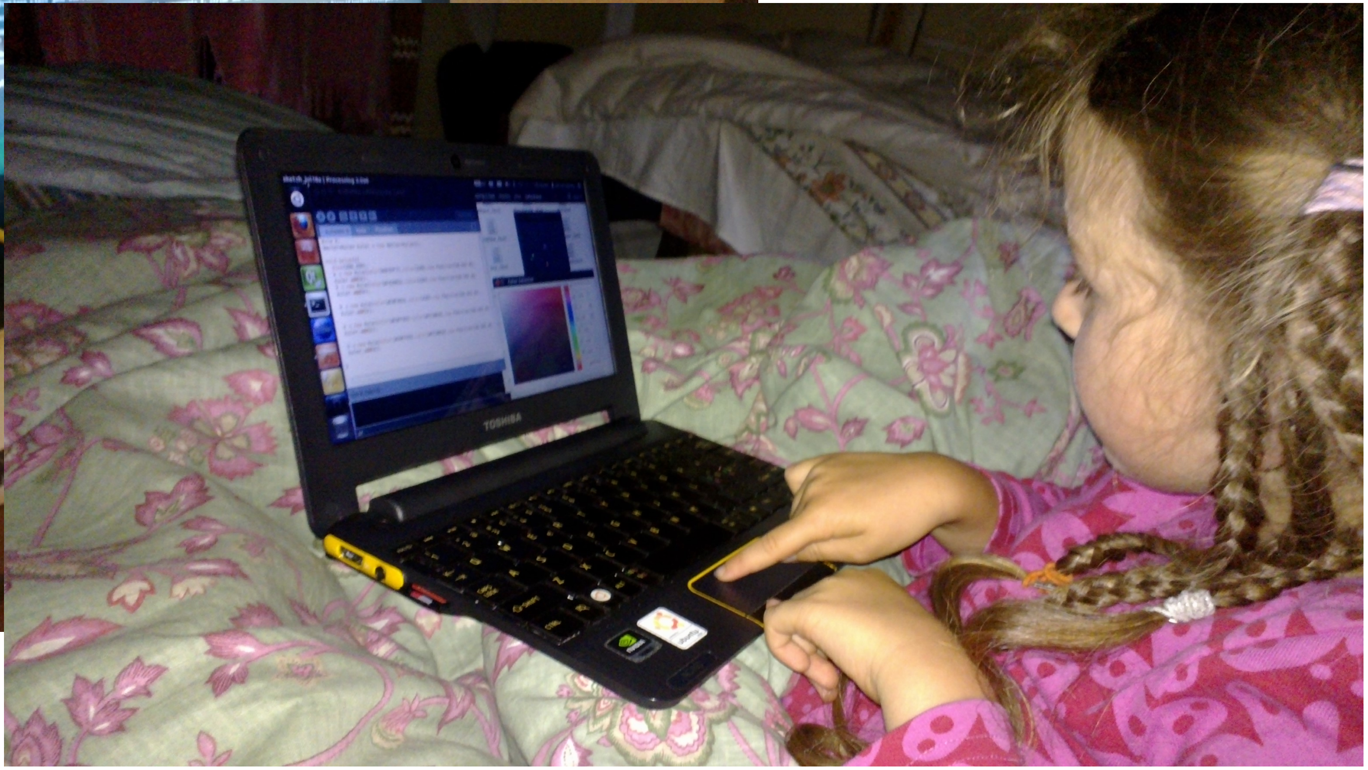


JOGL Embedded / R.-Pi



JOGL Embedded / ..





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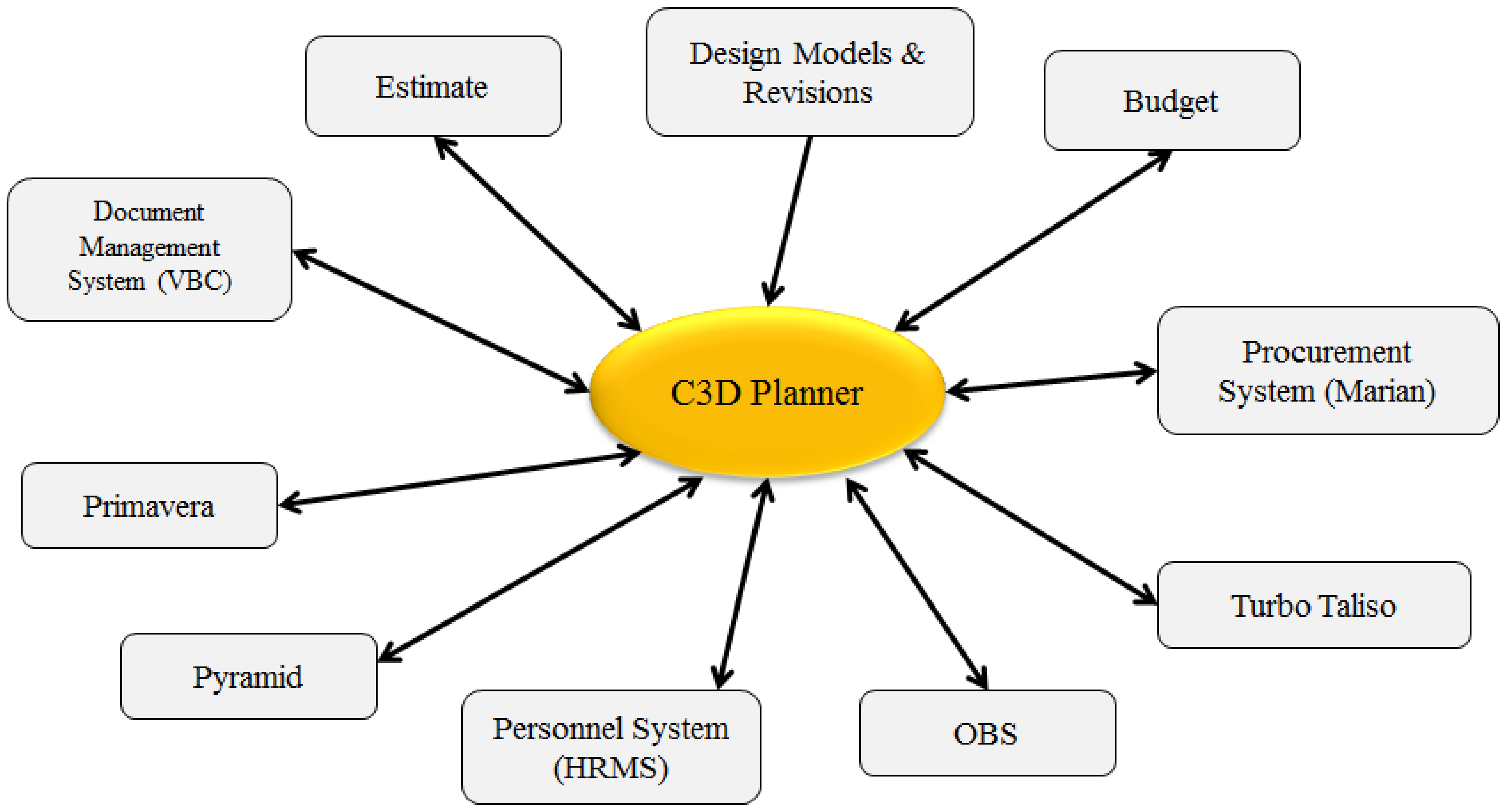
Cross Platform & Device: Use Case

C3D Visual Project Control

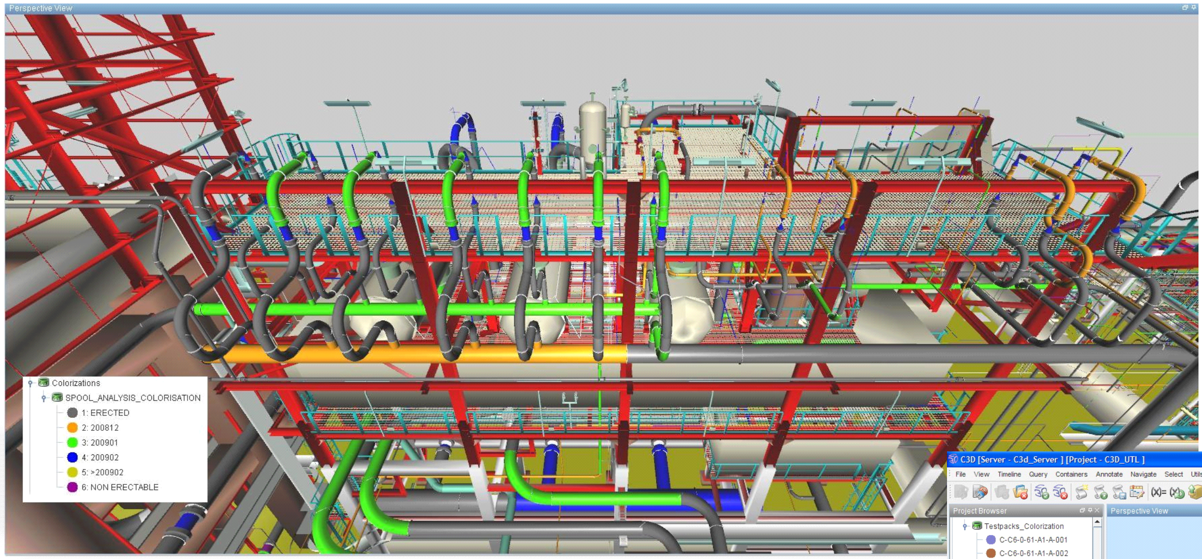
C3D Studio/Planner	C3D Viewer	C3D Mobile
Scenario Creation Data Integration ...	Model Visualization Project Progress Update 4D Animation Report Generation Design Review	BIM Model Visualization just-in-time progress update ...

http://c3d.com

C3D - Visual Project Controls

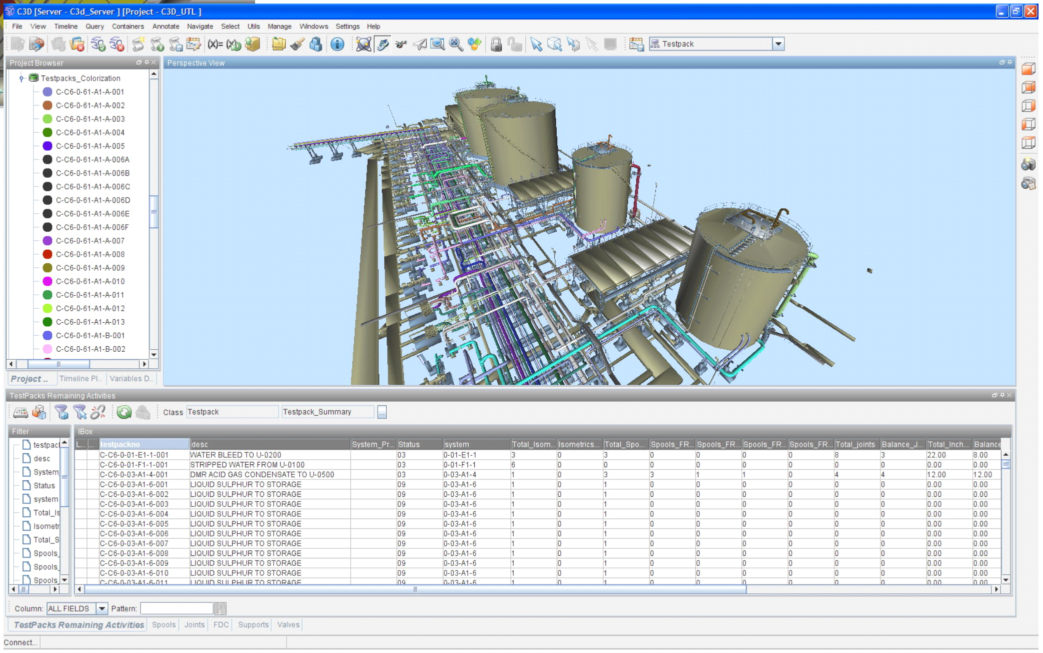

Estimate
Design Models & Revisions
Budget
Document Management System (VBC)
C3D Planner
Procurement System (Marian)
Primavera
Turbo Taliso
Pyramid
Personnel System (HRMS)
OBS

C3D - Visual Project Controls



- Colorizations
  - SPOOL_ANALYSIS_COLORISATION
    - ● 1: ERECTED
    - ● 2: 200812
    - ● 3: 200901
    - ● 4: 200902
    - ● 5: >200902
    - ● 6: NON ERECTABLE

Sample usecase: Colorize by Material Delivery Date, highlighting conflicts with plan...


C3D [Server - C3d_Server] [Project - C3D_UTL]
File View Timeline Query Containers Annotate Navigate Select Utils Manage Windows Settings Help
Testpack
Project Browser
Perspective View
Project .. Timeline Pl.. Variables D..
TestPacks Remaining Activities
Filter
IBox
TestPacks Remaining Activities Spools Joints FDC Supports Valves
Connect...

- Testpacks_Colorization
  - ● C-C6-0-61-A1-A-001
  - ● C-C6-0-61-A1-A-002
  - ● C-C6-0-61-A1-A-003
  - ● C-C6-0-61-A1-A-004
  - ● C-C6-0-61-A1-A-005
  - ● C-C6-0-61-A1-A-006A
  - ● C-C6-0-61-A1-A-006B
  - ● C-C6-0-61-A1-A-006C
  - ● C-C6-0-61-A1-A-006D
  - ● C-C6-0-61-A1-A-006E
  - ● C-C6-0-61-A1-A-006F
  - ● C-C6-0-61-A1-A-007
  - ● C-C6-0-61-A1-A-008
  - ● C-C6-0-61-A1-A-009
  - ● C-C6-0-61-A1-A-010
  - ● C-C6-0-61-A1-A-011
  - ● C-C6-0-61-A1-A-012
  - ● C-C6-0-61-A1-A-013
  - ● C-C6-0-61-A1-B-001
  - ● C-C6-0-61-A1-B-002

Class Testpack Testpack_Summary

Filter: testpac, desc, System, Status, system, Total_Is, Isometr, Total_S, Spools_, Spools_, Spools_

L...	...	testpackno	desc	System_Pr...	Status	system	Total_Isom...	Isometrics...	Total_Spo...	Spools_FR...	Spools_FR...	Spools_FR...	Spools_FR...	Total_joints	Balance_J...	Total_Inch...	Balance
		C-C6-0-01-E1-1-001	WATER BLEED TO U-0200		03	0-01-E1-1	3	0	3	0	0	0	0	8	3	22.00	8.00
		C-C6-0-01-F1-1-001	STRIPPED WATER FROM U-0100		03	0-01-F1-1	6	0	0	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-4-001	DMR ACID GAS CONDENSATE TO U-0500		03	0-03-A1-4	1	0	3	3	1	1	0	4	4	12.00	12.00
		C-C6-0-03-A1-6-001	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-002	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-003	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-004	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-005	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-006	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-007	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
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		C-C6-0-03-A1-6-009	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-010	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00
		C-C6-0-03-A1-6-011	LIQUID SULPHUR TO STORAGE		09	0-03-A1-6	1	0	1	0	0	0	0	0	0	0.00	0.00

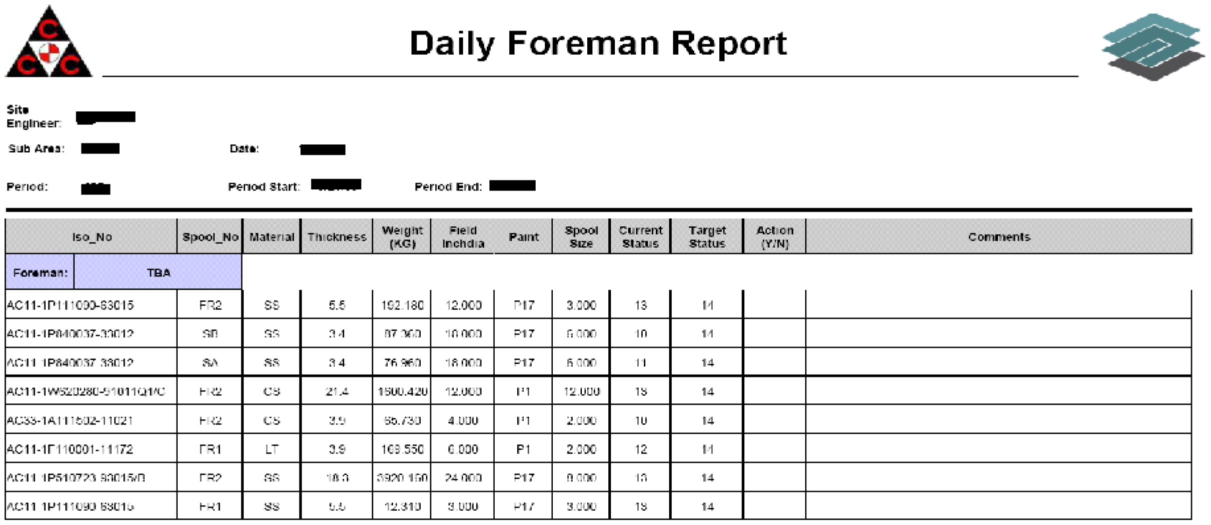
Column: ALL FIELDS Pattern:

Sample usecase: Visualize remaining activities to mark testpack as done

C3D - Visual Project Controls

Sample Usage: Generate Forman daily report and task list

C3D Mobile: Instead of a paper; generate a BIM model for each forman



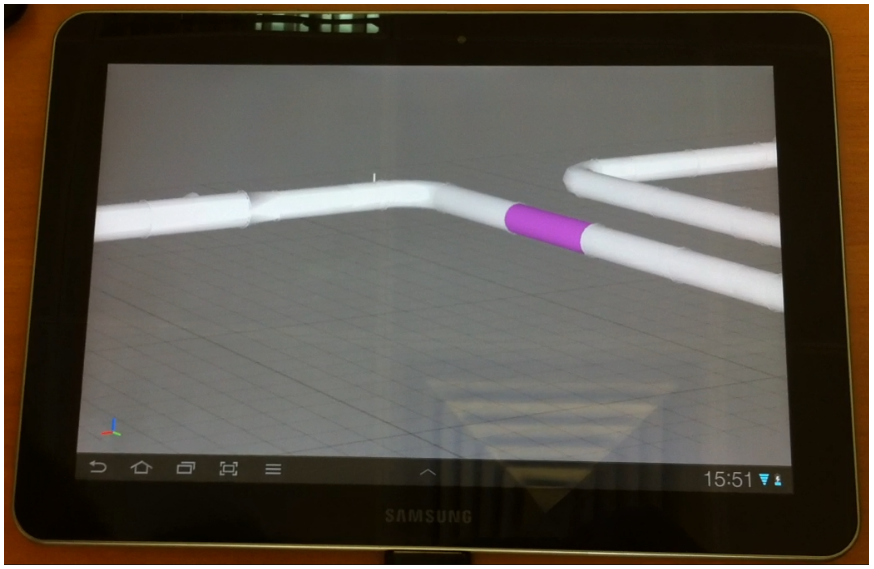
Daily Foreman Report

Site Engineer: [redacted]

Sub Area: [redacted]   Date: [redacted]

Period: [redacted]   Period Start: [redacted]   Period End: [redacted]

Iso_No	Spool_No	Material	Thickness	Weight (KG)	Field Inchdia	Paint	Spool Size	Current Status	Target Status	Action (Y/N)	Comments
Foreman:	TBA										
AC11-1P111090-63015	FR2	SS	5.5	192.180	12.000	P17	3.000	13	14		
AC11-1P840037-33012	SB	SS	3.4	87.360	10.000	P17	6.000	10	14		
AC11-1P840037-33012	SA	SS	3.4	76.960	18.000	P17	6.000	11	14		
AC11-1W520280-51011Q1/C	FR2	CS	21.4	1500.420	12.000	P1	12.000	13	14		
AC33-1A111502-11021	FR2	CS	3.9	65.730	4.000	P1	2.000	10	14		
AC11-1F110001-11172	FR1	LT	3.9	169.550	6.000	P1	2.000	12	14		
AC11-1P510723-93015/B	FR2	SS	18.3	3920.150	24.000	P17	8.000	13	14		
AC11-1P111090-63015	FR1	SS	5.5	12.310	3.000	P17	3.000	13	14		



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Why JogAmp on Java?

- Availability:
  - Java, OpenGL, OpenCL, OpenAL, ..
  - Multiple Vendors
    - OpenJDK / IcedTea
    - Oracle JDK
    - IBM J9, ..
    - PhoneME
    - JamVM
    - CacaoVM
    - Dalvik
  - x86, arm, ppc, sh4, ..
  - GNU/Linux, Android, BSD, Mac OSX, Solaris/OpenIndiana, MS Windows

Why JogAmp on Java?

- Managed Code
  - Common API for
    - Windowing
    - GLDrawable / GLContext / GLSL
    - I/O, Resource Handling (Texture, Code, ..)
    - Rendering
  - OpenGL Pipelining / Debugging / Trace
  - Access to vast number of API / Middleware

JogAmp Continuity / Usage

- Usage http://jogamp.org
    - Ardor3D
    - C3D Studio http://c3d.com
    - Elflight Engine
    - Processing
    - Gephi
    - NASA Worldwind
    - Java3D
    - ...

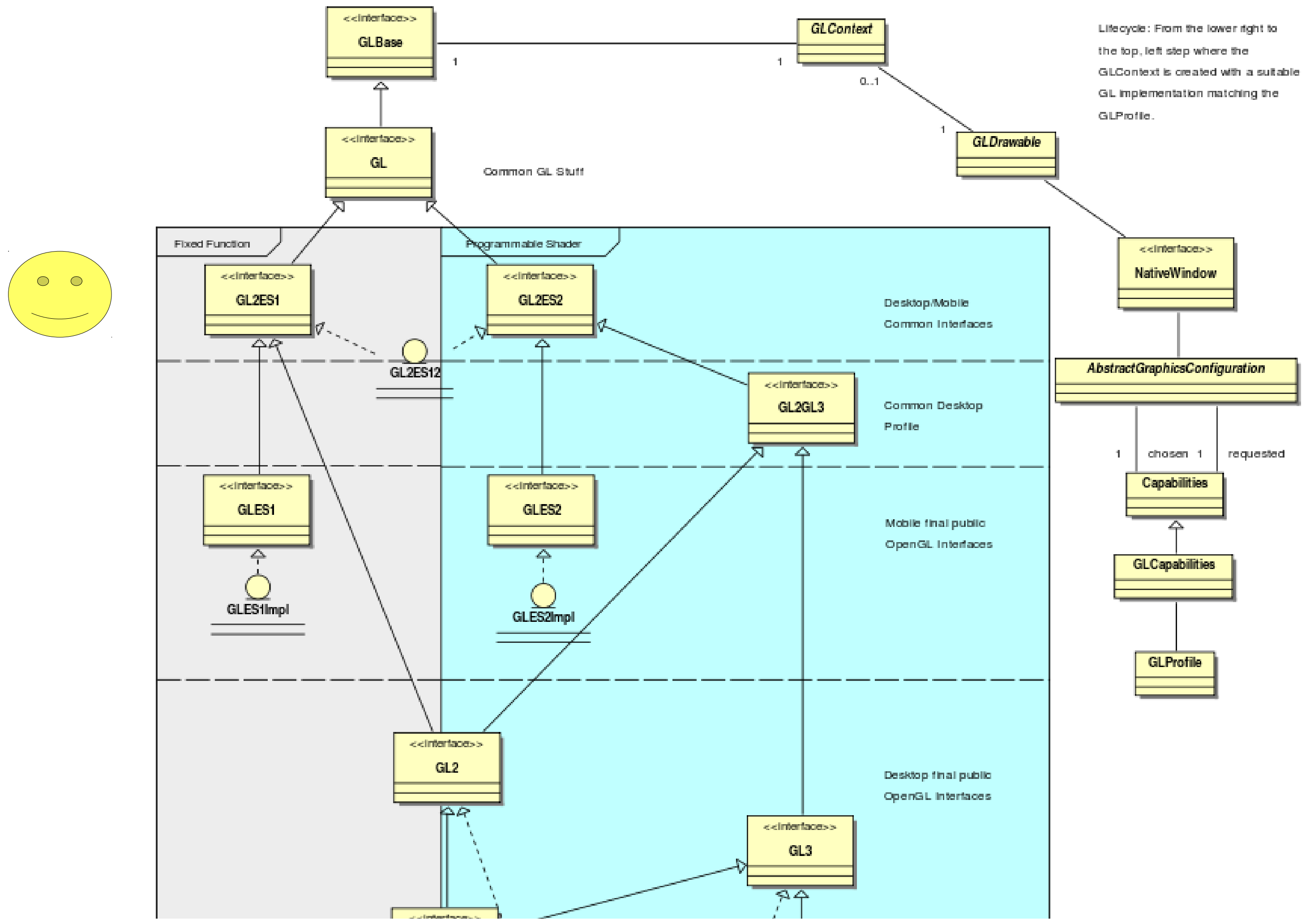
JogAmp Continuity / Maturity

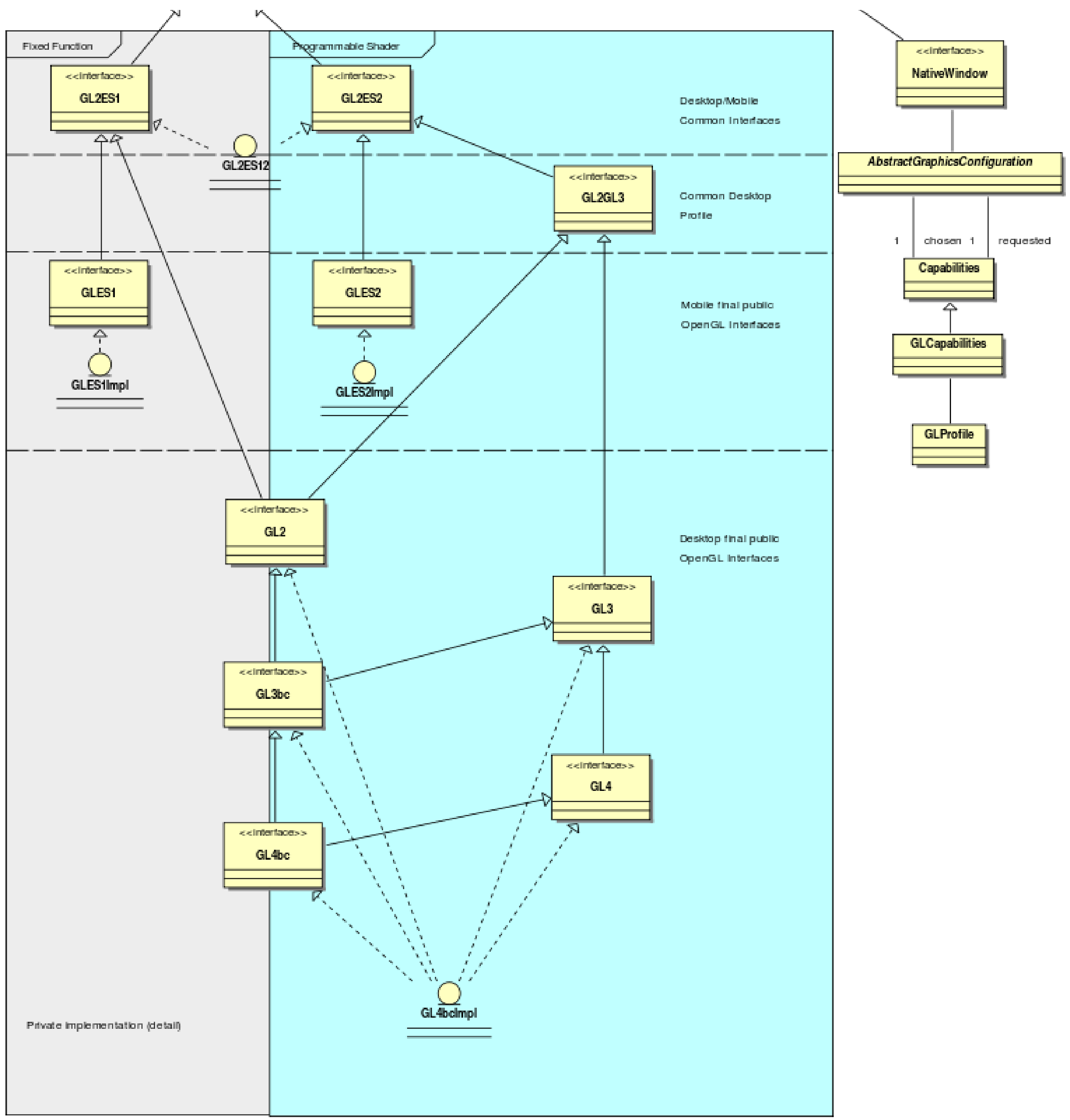
- Maturity
  - Version 1
    - JSR-231
  - Version 2
    - OpenGL Profiles (ES 1+2, GL 2 + 3 + 4)
    - Windowing Toolkit Abstraction
    - Continuity Build/Test Server http://jogamp.org/chuck/
    - 86 GlueGen + 278 JOGL Unit Tests
- Community Effort
  - Ports [FreeBSD, ARM-HF, ..]
  - Engine & Device Support
  - Bug Entries, Test Cases & Fixes
  - Code Reviews, Communication & General Help

JogAmp Deployment

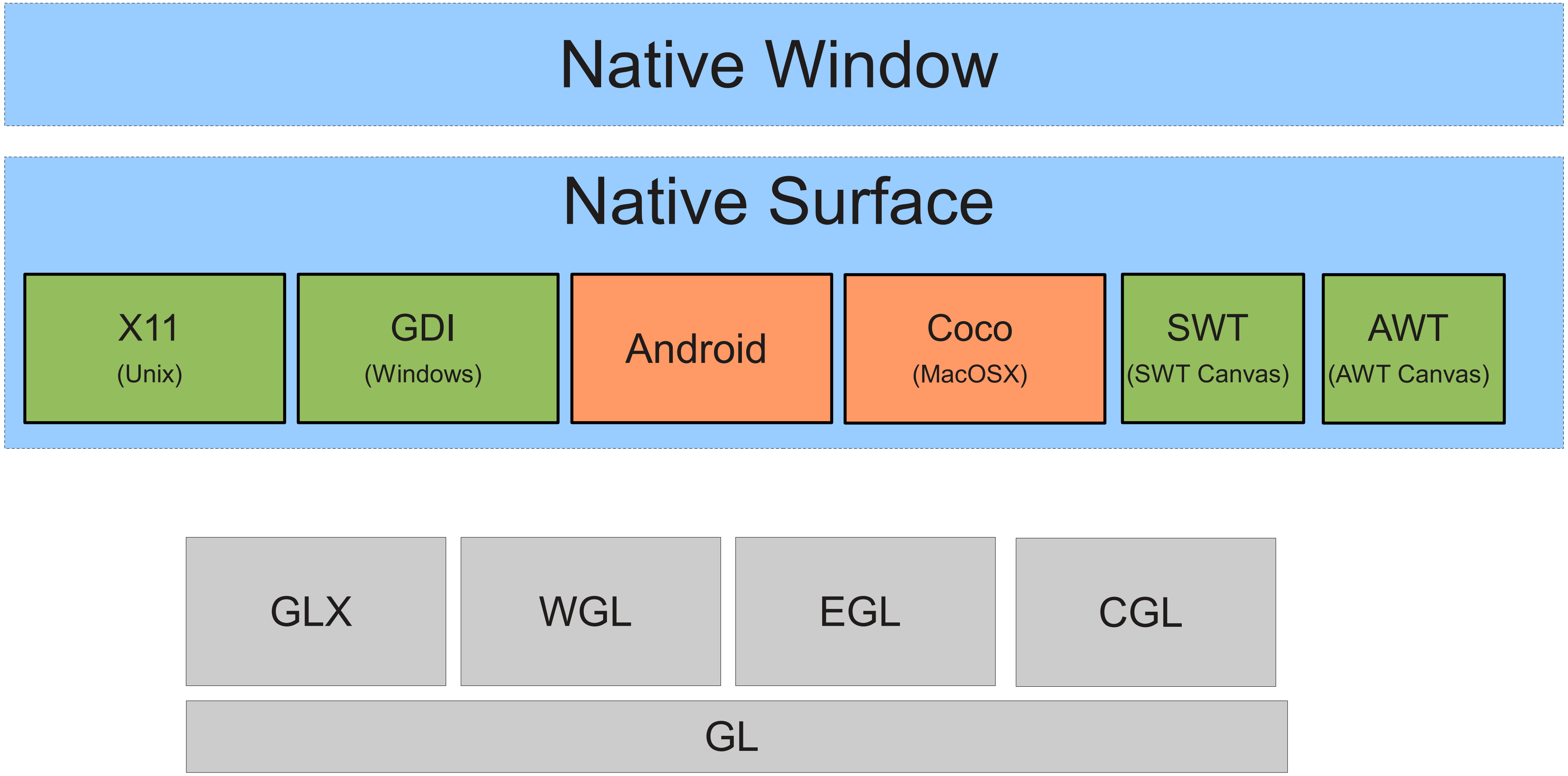
- Preinstalled Bundles
  - Modularized JARs
  - Android APKs (modular, or all-in-one)
  - Maven
- Online / Cached
  - Automatic Native-JAR loading support
  - Applet
    - Classical
    - JNLP
  - Webstart (JNLP)

OpenGL Profiles




Fixed Function
Programmable Shader
<<interface>> GL2ES1
<<interface>> GL2ES2
GL2ES12
Desktop/Mobile Common Interfaces
<<interface>> GL2GL3
Common Desktop Profile
<<interface>> GLES1
<<interface>> GLES2
GLES1Impl
GLES2Impl
Mobile final public OpenGL Interfaces
<<interface>> GL2
Desktop final public OpenGL Interfaces
<<interface>> GL3
<<interface>> GL3bc
<<interface>> GL4
<<interface>> GL4bc
GL4bcImpl
Private implementation (detail)
<<interface>> NativeWindow
AbstractGraphicsConfiguration
1
chosen
1
requested
Capabilities
GLCapabilities
GLProfile

Windowing Toolkits



2011 – 2012 Enhancements

- GLMediaPlayer
  - Uses OpenMAX on Android via ICS's MediaPlayer / libstagefright
  - Uses libav/libffmpeg where available
    - Missing [OpenAL] audio output
  - Missing native implementation for Win32 / OSX
- Graph API for Curve & Text rendering via GPU
  - Experimental UI
- Mobile Bindings (Android Intel/ARM, Linux ARM)
- Stability
- NEWT AWT / SWT Enhancement
- Documentation & Tutorials
- ***Higher Community Participation***

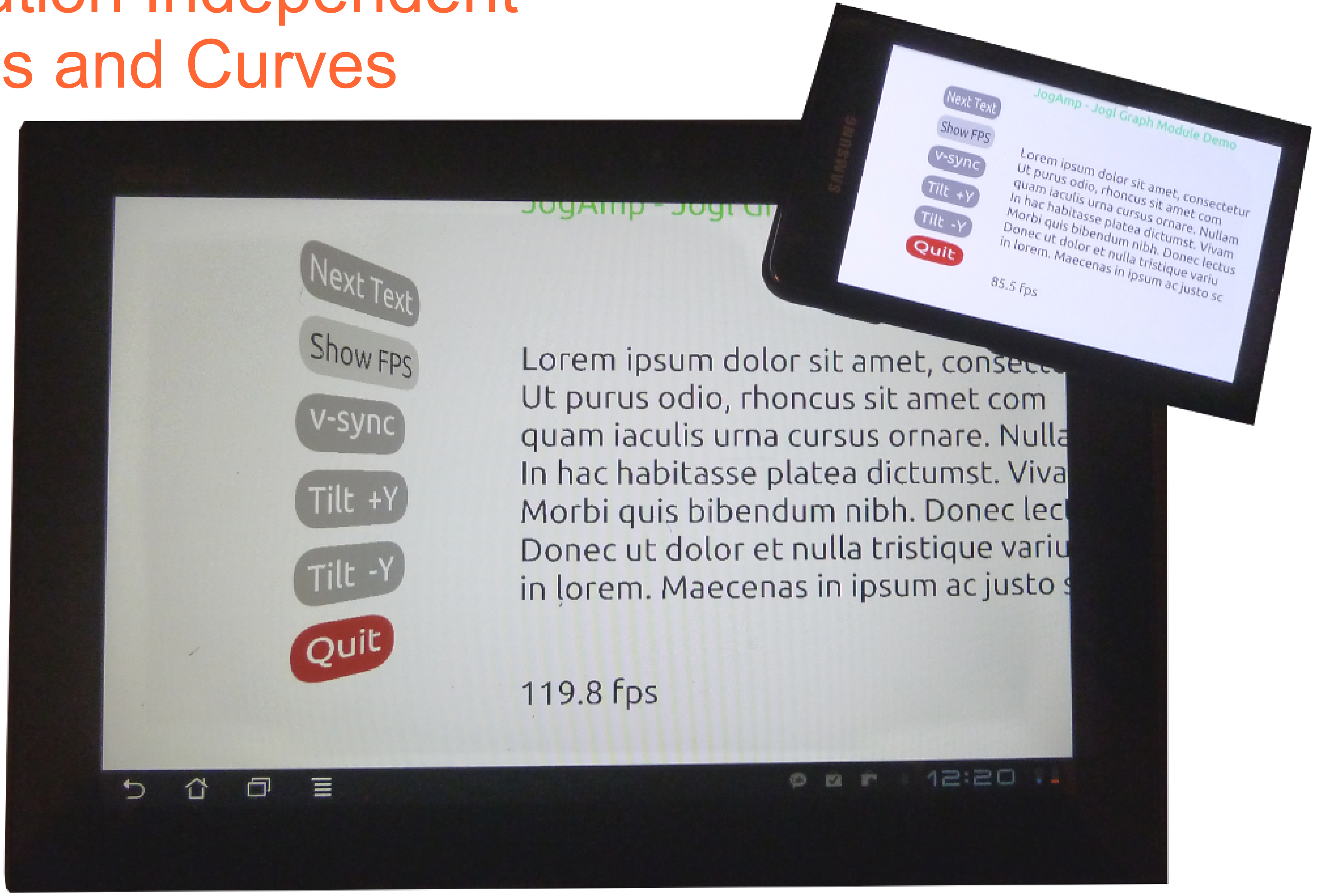
NEWT

- Seamless integration w/ native Windowing System
  - Multithreaded Access to Window Surface
  - Lock free event handling
  - Transparency, decoration and offscreen control
  - Screen Mode API (fullscreen, resolution & rotation)
  - X11, Win32, OSX, Android, OpenKD, .. implementation
  - AWT and SWT integration via native re-parenting
  - Desktop & Mobile

JOGL Android Binding

- Why?
  - Short Development Cycles
  - No device specific development
  - Supports NEWT (Multitouch, Surface, ...)
  - Same code compiled for all – almost Android agnostic.
- Deployment:
  - adb install jogl.apk
  - adb install myFancyapplication.apk
  - Manual Daisy Chained ClassLoader, if desired.

Graph API
Resolution Independent
Shapes and Curves



Lorem ipsum dolor sit amet, consectetur
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quam iaculis urna cursus ornare. Nullam
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Morbi quis bibendum nibh. Donec lectus
Donec ut dolor et nulla tristique variu
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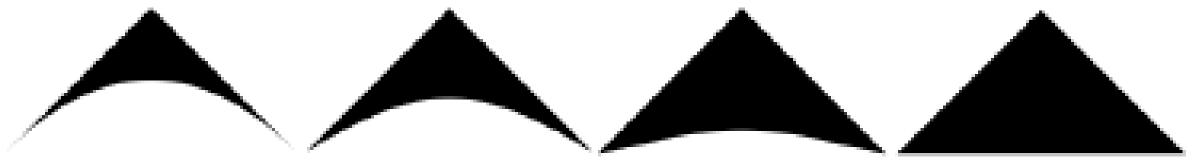
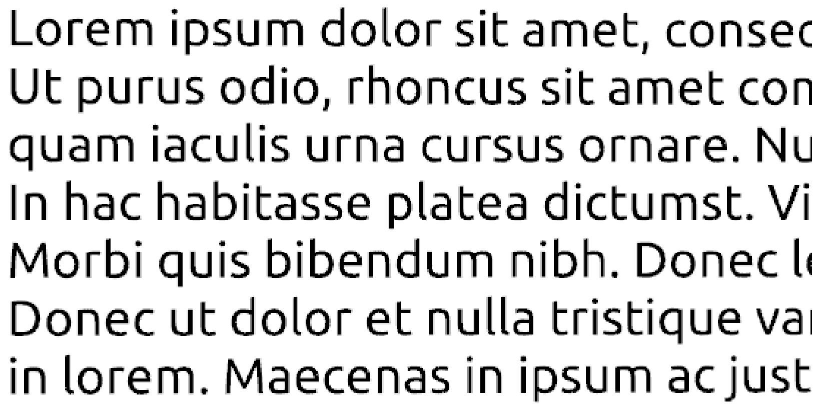
Resolution Independent Curve Rendering API

- Based on Paper:
  - R Santina, “Resolution Independent NURBS Curve Rendering using Programmable Graphics Pipeline”, presented in GraphiCon2011.
- **NOT** Loop/Blinn
- Patent Free
- Can Render Bezier, Bsplines, NURBS



Resolution Independent Curve Rendering API

- Why?
  - Resolution Independent Text Rendering
  - GPU based - Fast
  - Seamless integration into Renderer (Scenegraph,...)
  - New User Interface – across devices
  - http://jogamp.org/deployment/jogamp-current/jogl-test-applets.html
  - http://www.youtube.com/watch?v=Rqsu46ifMaw


Lorem ipsum dolor sit amet, consec
Ut purus odio, rhoncus sit amet con
quam iaculis urna cursus ornare. Nu
In hac habitasse platea dictumst. Vi
Morbi quis bibendum nibh. Donec l
Donec ut dolor et nulla tristique va
in lorem. Maecenas in ipsum ac just

JOGL Graph API

- Outline → OutlineShapes → GLRegion
- Renderer
  - RegionRenderer
  - TextRenderer (same as RegionRender)
    - Helper methods for texts and fonts.

```
outline.addVertex(x, y, z, w, onCurve);
 ….
 outlineShape.addOutline(outline);
 outlineShape.addOutline(outline2);
 region = GLRegion.create(outlineShape, getRenderModes());
 region.render(gl, outlineShape,...);
```

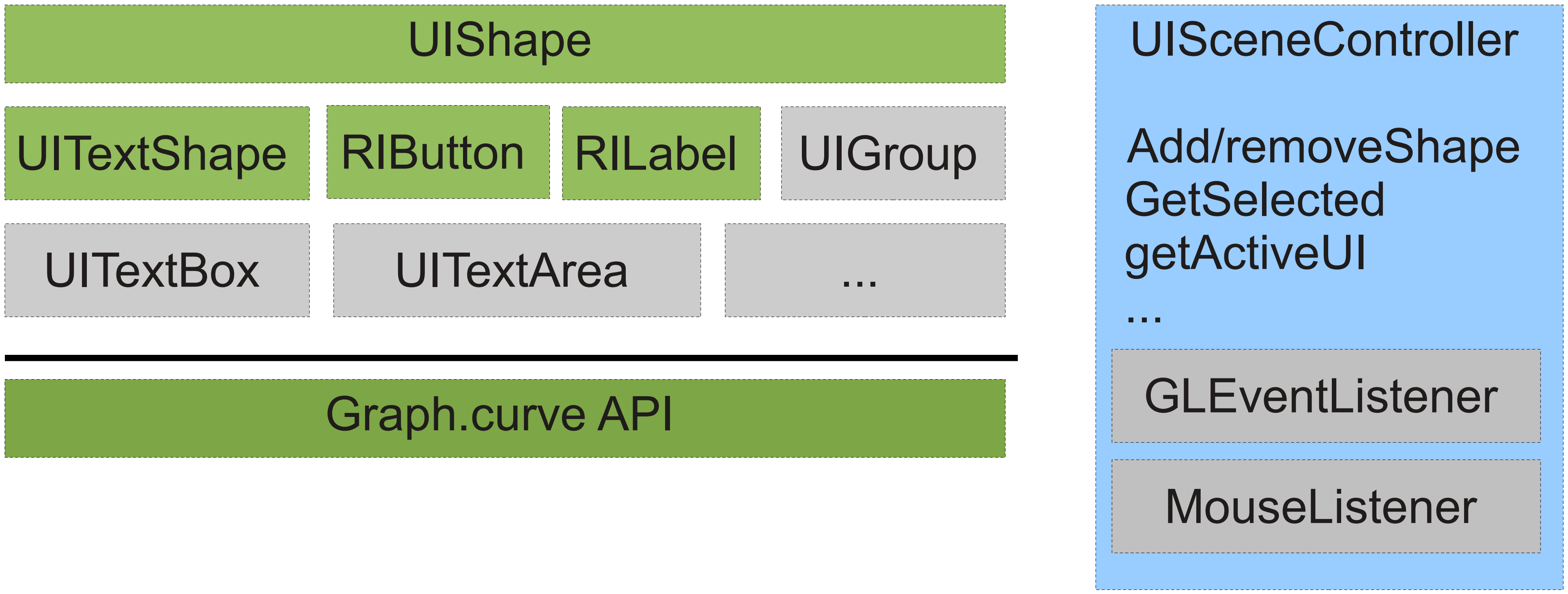
JOGL Graph API

- Initializing:
  - Read Outlines (from font, svg, application, ...)
  - Modified Constrained Delaunay Triangulation
  - Generate Region
- Rendering:
  - VBO buffers
  - Realtime manipulation – weights
  - Transformation....

GPU based Resolution Independent UI

- Abstracted from the windowing toolkit
- Support multithreading
- Seamless integration into
  - A native window (HUD)
  - A custom Scenegraph (2D plane within 3D)
- High Quality rendering
- Super Fast

JOGL Graph.UI API



UI Requirements *(WIP)*

- Generic UI Rendering
  - Rendering shall be performed using native rendering TKs (JOGL, ..)
  - Render primitives on an offscreen 2D plane to be
    - integrated into a custom 3D scenegraph
    - rendered as a HUD.
- Generic User Input
  - Input events should be delegated from the custom scenegraph to the UI input module.

Wade Walker
Austin, Texas

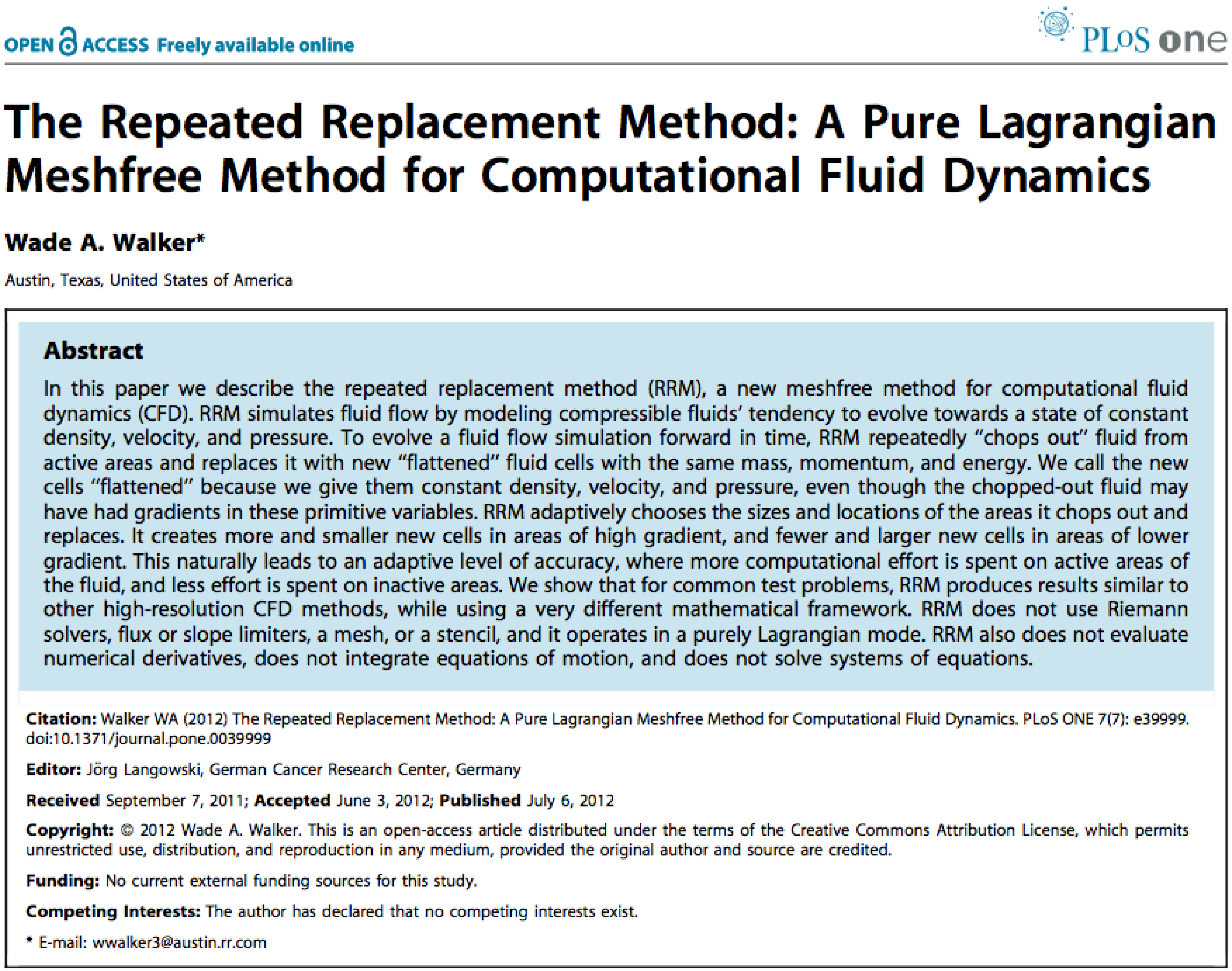
Using JOGL and Eclipse RCP in fluid dynamics research

My research

- Computational fluid dynamics
- Computational elastodynamics
- Soliton formation and interaction

- Lots of coding (simulator is ~25KLOC)
- Animated graphical display
- Requires interaction with the graphics to help invent and refine the algorithms

Just published in PLoS ONE



OPEN ACCESS Freely available online

PLoS one

The Repeated Replacement Method: A Pure Lagrangian Meshfree Method for Computational Fluid Dynamics

Wade A. Walker*

Austin, Texas, United States of America

Abstract

In this paper we describe the repeated replacement method (RRM), a new meshfree method for computational fluid dynamics (CFD). RRM simulates fluid flow by modeling compressible fluids' tendency to evolve towards a state of constant density, velocity, and pressure. To evolve a fluid flow simulation forward in time, RRM repeatedly "chops out" fluid from active areas and replaces it with new "flattened" fluid cells with the same mass, momentum, and energy. We call the new cells "flattened" because we give them constant density, velocity, and pressure, even though the chopped-out fluid may have had gradients in these primitive variables. RRM adaptively chooses the sizes and locations of the areas it chops out and replaces. It creates more and smaller new cells in areas of high gradient, and fewer and larger new cells in areas of lower gradient. This naturally leads to an adaptive level of accuracy, where more computational effort is spent on active areas of the fluid, and less effort is spent on inactive areas. We show that for common test problems, RRM produces results similar to other high-resolution CFD methods, while using a very different mathematical framework. RRM does not use Riemann solvers, flux or slope limiters, a mesh, or a stencil, and it operates in a purely Lagrangian mode. RRM also does not evaluate numerical derivatives, does not integrate equations of motion, and does not solve systems of equations.

Citation: Walker WA (2012) The Repeated Replacement Method: A Pure Lagrangian Meshfree Method for Computational Fluid Dynamics. PLoS ONE 7(7): e39999. doi:10.1371/journal.pone.0039999

Editor: Jörg Langowski, German Cancer Research Center, Germany

Received September 7, 2011; **Accepted** June 3, 2012; **Published** July 6, 2012

Funding: No current external funding sources for this study.

Competing Interests: The author has declared that no competing interests exist.

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Research vs. production code

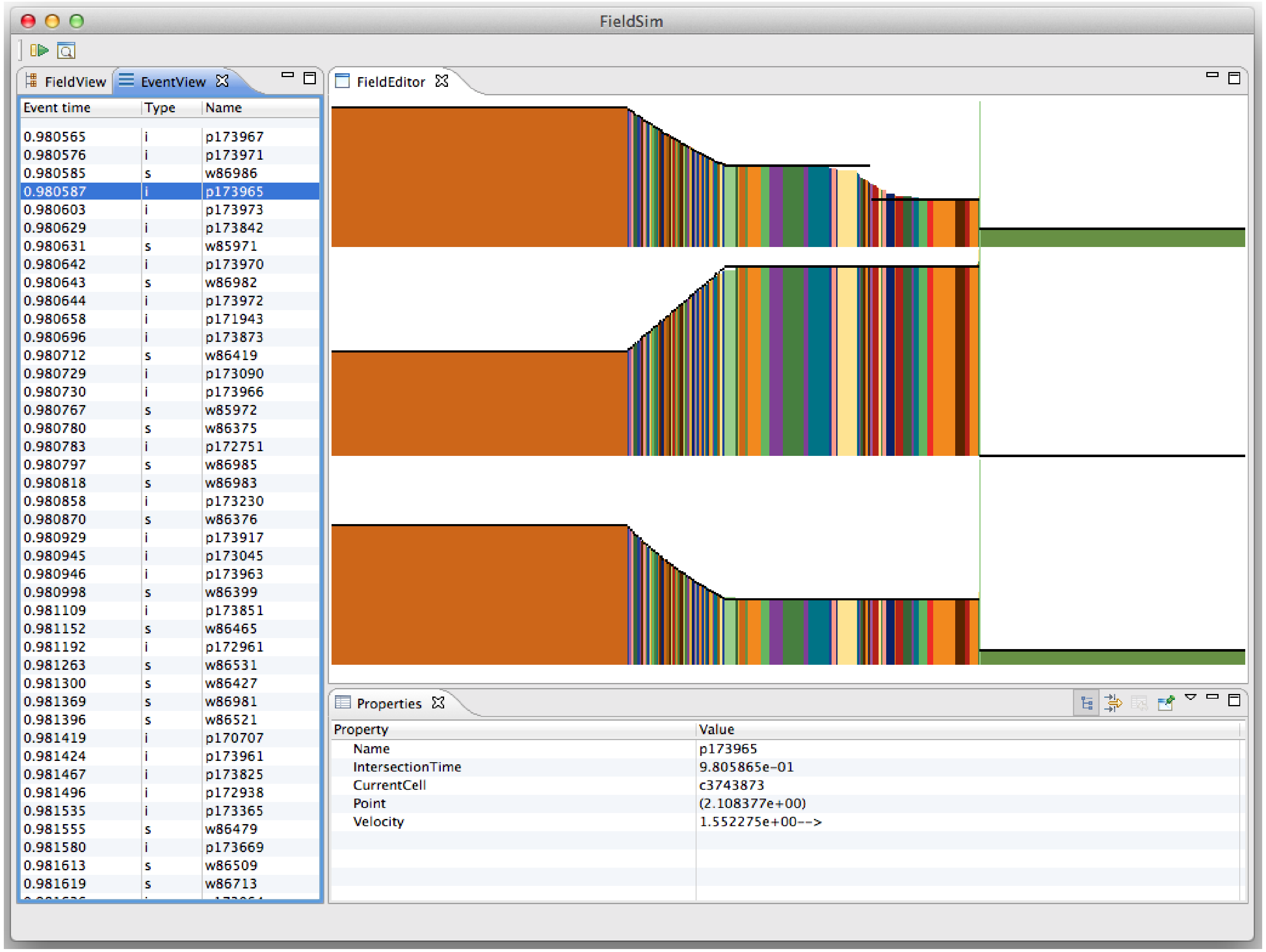
- Exploratory code, not production code
- Constantly changing and trying new things
- Need flexibility and interactivity

- Java provides garbage collection
  - Good for apps that are constantly being changed
- Eclipse RCP provides app framework
  - Good for writing workbench-like GUI apps
- But how to render interactive graphics?

Why JOGL?

- Easy hardware-accelerated graphics in Java
- Cross-platform (my simulator runs unaltered on Windows, Mac, and Linux)
- Runs fast, gives good interactivity
- Supported by great guys ☺

Demo simulator



Event time	Type	Name
0.980565	i	p173967
0.980576	i	p173971
0.980585	s	w86986
0.980587	i	p173965
0.980603	i	p173973
0.980629	i	p173842
0.980631	s	w85971
0.980642	i	p173970
0.980643	s	w86982
0.980644	i	p173972
0.980658	i	p171943
0.980696	i	p173873
0.980712	s	w86419
0.980729	i	p173090
0.980730	i	p173966
0.980767	s	w85972
0.980780	s	w86375
0.980783	i	p172751
0.980797	s	w86985
0.980818	s	w86983
0.980858	i	p173230
0.980870	s	w86376
0.980929	i	p173917
0.980945	i	p173045
0.980946	i	p173963
0.980998	s	w86399
0.981109	i	p173851
0.981152	s	w86465
0.981192	i	p172961
0.981263	s	w86531
0.981300	s	w86427
0.981369	s	w86981
0.981396	s	w86521
0.981419	i	p170707
0.981424	i	p173961
0.981467	i	p173825
0.981496	i	p172938
0.981535	i	p173365
0.981555	s	w86479
0.981580	i	p173669
0.981613	s	w86509
0.981619	s	w86713

Property	Value
Name	p173965
IntersectionTime	9.805865e-01
CurrentCell	c3743873
Point	(2.108377e+00)
Velocity	1.552275e+00-->

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JOGL on Embedded Devices

- Development Env:
  - Beagleboard / Pandaboard w/ ARM7l / PowerVR
    - Linux
    - Android
  - Platform based Unit tests
  - Continuous Integration with auto-builds.
  - Cross platform compilation/building
  - Utilizing HW accelerated GL if available (EGL/ES)

JOGL Android Binding

- Details:
  - Enhanced EGL binding
  - Exposing GLES1 and GLES2 native profiles
  - GL2ES1 and GL2ES2 profiles for Desktop/Mobile
  - Using Android SDK/NDK
    - Requires SDK Level 9, Android 2.3 Gingerbread for NIO Surface access
  - Tested with:
    - Pandaboard - PowerVR
    - Samsung Galaxy S2 – Arm/Mali
    - Samsung Galaxy S – PowerVR
    - Samsung Tablet / ASUS TF2 – Tegra2
    - ASUS TF3 - Tegra3

JOGL Android Binding

- Cross platform builds/tests with Linux host
- Scripts provided in source code repository
- NEWT Helper class (NewtActivity)
  - Android Surface / NEWT Window mapping
  - Android Input Event / NEWT translation

JogAmp's Ecosystem

- Middle and high level APIs
  - Scenegraphs: Ardor3D, Java3D, JMonkeyEngine, JReality, Aviatrix3D, 3DzzD, Avengina, Xith3D, MSG
  - UI frameworks: FengGUI, Nifty GUI
  - Visualization frameworks: LibGDX, Jzy3D, GLG2D, Gephi, …
  - Sound framework: Paul Lamb Sound Library
- Low level APIs & bindings
  - JOGL, JOCL, JOAL, JInput for JogAmp

Nifty GUI

- UI framework
- Layout in XML or Java
- Some build-in widgets, effects and styles
- Focused on easing controls creation rather than on providing tons of “standard” widgets

Java3D

- Object oriented and scenegraph based API
- Runs on top of JOGL
- Supports GLSL
- Spatial sound

Java3D

- Pros:
  - Quite easy to learn
  - Lots of tutorials and examples
  - Importers for some mainstream formats
  - Supports some “exotic” devices (multiple screen projectors, gloves, headsets, …)

Java3D

- Cons:
  - Very dependent on AWT (hard to port to NEWT)
  - Bad reputation (only minor maintenance loads for years, replaced by Prism in JavaFX)
  - Performance concerns (memory, speed)
  - Lacks lots of “common” features already implemented in other popular engines

Ardor3D

- Java based retained mode 3D engine
- Runs on top of JOGL, SWT OpenGL binding…
- Supports GLSL
- Skeletal animation
- Supports Android
- Hardware accelerated UI
- Terrain system (with geometry and texture clipmaps, level of details, ...)

Ardor3D

- Pros:
  - Actively maintained
  - Most reliable JOGL based renderers
  - Abstracts rendering details but does not prevent you from extending its features with or without renderer independence
  - Render delegates used for legacy OpenGL code
  - Supports shaders (but still supports OpenGL 1.3)
  - Both community and paid support

Ardor3D

- Cons:
  - Focused on rendering (no sound, no physics, no networking, no state machines)
  - Lacks tutorials and very elaborated examples
  - Lacks importers (only Collada, OBJ and MD2)
  - Not yet any fully shader-based architecture (planned in Ardor3D 2.0)
  - No integrated game development environment
  - No build-in spatial partitioning

T.U.E.R

- (Graphically rudimentary) first person shooter
- Project started in October 2006
- Has used 4 different 3D engines
  - D3Caster (software rendering, raycasting)
  - My own engine (JOGL, optimized for flat mazes)
  - JMonkeyEngine 2 (with “my” custom JOGL renderer)
  - Ardor3D (with “my” JOGL 2 renderer)
- Focused on performance

T.U.E.R

- Relying on several third party libraries
  - JOGL 2.0
  - JOAL 1.1.3
  - JOrbis
  - Ardor3D 0.8
  - Paul Lamb's Sound Library
  - Fettle API (state machine framework)

T.U.E.R

- Main aspects about performance
  - Careful threading
    - Tick, update, render
    - No interruption in rendering code
    - No OpenGL context switch (when possible)
  - Careful use of native resources
    - Slicing of direct NIO buffers
    - Destruction of useless direct NIO buffers

T.U.E.R

- Main aspects about performance
  - Mesh optimization: merge of coplanar adjacent right triangles whose all 2D texture coordinates are canonical
  - Spatial partitioning
    - BSP trees (wip)
    - cells and portals (wip, only working on “flat” mazes)

T.U.E.R

- JFPSM, WYSIWYG FPS editor
  - 3D visualizer and editor
  - Designed for rapid prototyping
  - Focused on the editing of the game design by combining existing models and the packaging rather than on the modeling (Blender is better for that)
  - Allows to create “simple” 3D meshes from 2D maps and 3D patches

Q&A

- Whats Next?
- Why is neither Swing nor AWT recommended?
- What are the supported IDEs?

Thank You

Rami Santina

Sven Gothel

Xerxes Ranby

Julien Gouesse

Wade Walker

Demoscene Passivist

Michael Bien

Mark Raynsford

… all the many contributors & users

COMPUTERS & COMMUNICATION technology

Jausoft Sven Gothel Softwaredevelopment

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