

**Game**Developers  
Conference

MARCH 20-24  
SAN JOSE, CALIFORNIA

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.....GDC:06

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# PSGL (PlayStation Graphics Library)

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# Tools for graphic programming

“An apprentice carpenter may want only a hammer and saw, but a master craftsman employs many precision tools. Computer programming likewise requires sophisticated tools to cope with the complexity of real applications, and only practice with these tools will build skill in their use.”

Robert L. Kruse, Data Structures and Program Design

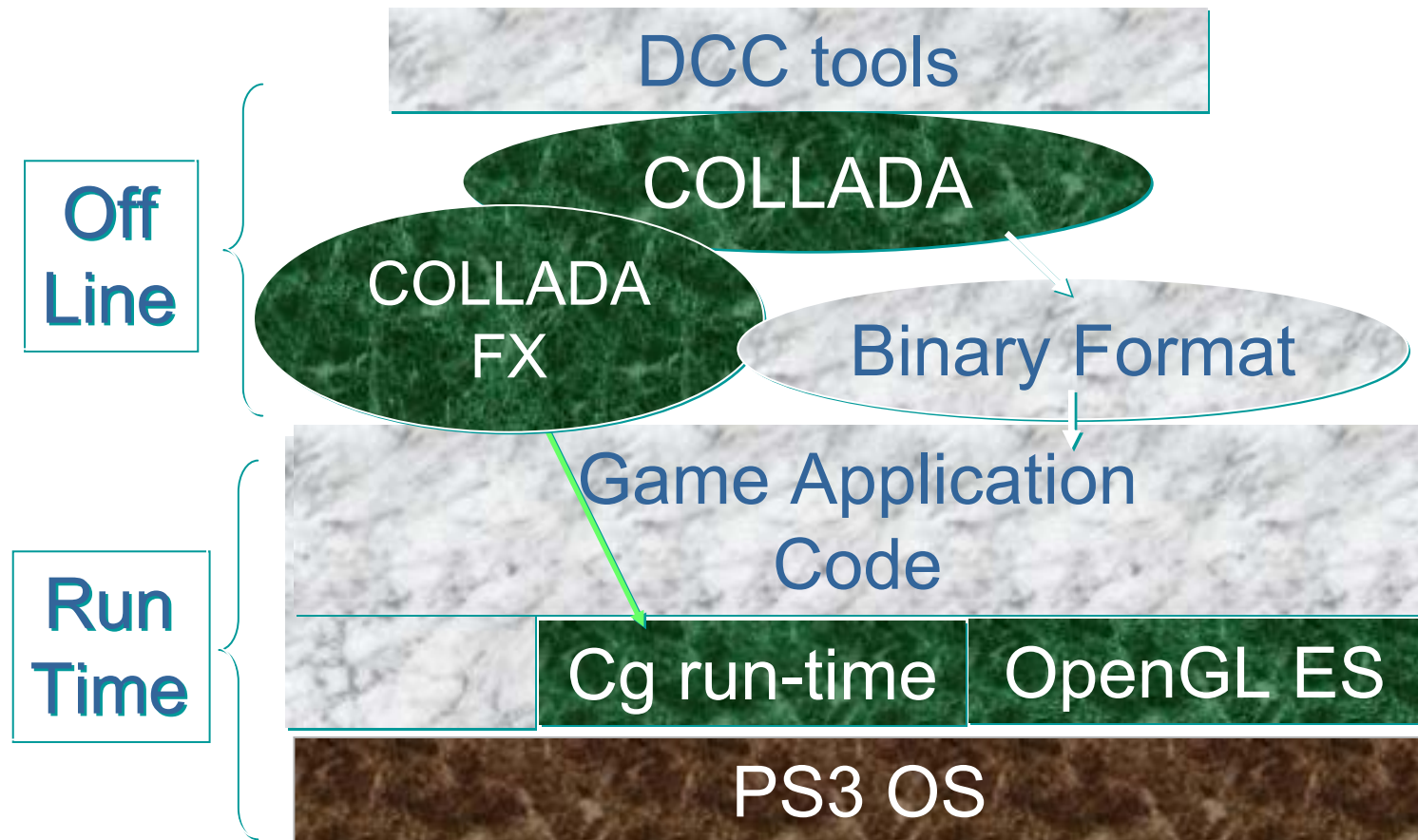
# Industry standards for PS3

- Well defined behavior
- It take years to create good libraries
- Companies collaboration
- Conformance test -> Guarantee of quality
  - “A collection of precision tools ...”
- Plenty of expertise available
- Leverage exiting development tools
  - “...for skilled craftsmen”

# Industry standards for PS3



# What is covered ?



# OpenGL ES

- Why OpenGL ES ?

This makes no sense !?!

OpenGL ES is a low-end phone API

PS3 has the most advanced graphics



# OpenGL ES 1.0

- PS3 gfx is all about shaders ! But ...
  - Need to manage non programmable state
  - Need vertex array, VBO, FBO...
- Could take a subset of OpenGL Desktop
  - Need Quality Assurance from conformance test
- Just need to add shaders to ES 1.x ☺
  - and shader effects !



# OpenGL ES 1.0

- ES has ~110 entry points
  - pipeline state management
  - Vertex arrays
  - Texture management
  - Bonus: Fixed pipeline
    - Only ~20 entry points only for fixed pipeline
    - Fog, light, material, texenv
  - Inconvenience from conformance test
    - Fixed point functions (1 line C entry points)
    - DXT compression replaces palletized texture

# OpenGL ES 1.1 Extension Pack

- PSGL officially passed ES 1.0 conformance test
- Some good stuff in ES 1.1+, that PSGL supports:
  - VBO
  - FBO
  - PBO
  - Cube Map, texgen
- Other additions are superseded by shaders
  - Shader programs replace Matrix blending, crossbar texenv
- PSGL could be made ES 1.1+ compliant
  - Let us know if it is important to you

# PSGL Extensions

- Primitives:
  - Quads, Quads\_strips
  - primitive restart
  - Instancing
- Queries and Conditional Rendering
- More data types, eg half\_float
- Textures:
  - Floating point textures
  - DXT
  - 3D
  - non power of 2
  - Anisotropic filtering, Min/Max LOD, LOD Bias
  - Depth textures
  - Gamma correction
  - Vertex Texture

# More PSGL Extensions

- Polygon mode (free)
- Dual sided stencil – accelerate shadow volume
- Synchronizations: Fence and Events (wait/set)
- Memory usage hints
  - For texture, VBO, PBO, render-targets
- Attribute set
  - Accelerate state change

# Adding shaders ... requirements

- Providing off-line compiler
  - Shader compiler should be optional
  - Going against the current
    - Current technology does not include linkers
- Providing shader effects
  - Managing states, vp and fp
  - Managing multipass effects
- Need good compiler
- Need skilled craftsmen
- Need content

# Adding shaders ... choice

- There was no shaders in ES when we had to decide
- Cg was the best choice because:
  - Already used by game developers
  - Cg and HLSL are very close
    - Very good for leveraging content and tools
  - Good relationship with nVidia
    - No need to deal with the ARB or Microsoft
  - Can be extended (with profiles)
  - No virtualization layers
    - More predictable performance
  - Tools (performance tools, FXComposer)
  - Advance features such as interface and multiple entry points
  - Access to good compiler
  - Complete cross-platform Cg API
    - API and compiler can be easily modified to support Binary shaders
  - CgFX shader FX API, file format and DCC support

# OpenGL ES 2.x ?

- Came too late, PSGL already delivered
- OpenGL ES 2.x makes total sense
  - SCE contributing member for ES 2.0
  - Binary shaders load
    - Shader language choice
  - No fix pipeline
    - Still need to implement ES 1.x for that
  - No shader effect API
    - Still need Cg API
- PSGL 2.0 could be ES 2.x compatible
  - Would that be interesting to you ?



# Cg run-time

- Cg run-time (cg 1.5)
  - Collaborative work with nVidia
    - Cg 1.5 already in PSGL, soon on PC !
  - Modified to allow for pre-compiled shaders
    - in addition to embedded compiler
  - Modified to allow creation of FX at run-time
    - Load file should not be in a graphics API
    - More and more flexibility demanded by developers

# CgGL API

- `cgGLSetStateMatrixParameter()`
  - Let Cg use the OpenGL ES matrix stack
- `cgGLAttribPointer()`
  - Allows for decoupling shader and geometry
  - Defines an attribute interface

# Cg API (effects)

- `cgCreateEffect()`
- `cgCreateTechnique()`
- `cgCreatePass()`
- `cgCreateStateAssignment()`
- `cgCreateEffectAnnotation()`
- `cgCreateEffectParameter( )`
- `cgCreateTechniqueAnnotation()`
- .....
- `cgSetFloatStateAssignment()`
- ...

# Teleportation

From the low level ...

... to the content tools

In between is game developer territory !

# Getting Content

- PSGL need good content
- Exporters are hard and complex to do right
- Exporters quality is fundamental to content quality

We would like the DCC vendors to provide the data in a good standard format

# Market force

- That's more work for DCC tools
- Business wise, DCC vendors prefer locking developers to their products
- New concept for developers

Main issue: there were no standards !

# COLLADA

- First meetings SigGraph'03
  - Got enough momentum from all DCC vendors to create working group
- First release SigGraph'04
  - Minimum set of feature to test concept and collaboration
- Adding features 1.1, 1.2, 1.3
  - Game developers really interested
  - Adding necessary features
  - 1.3.1 SigGraph'05, 1<sup>st</sup> anniversary presentation
- COLLADA 1.4 accepted by Khronos as a standard
  - January 2006

An industry standard in 30 months !



# COLLADA 1.4.0

- Now used in production
  - Ready after less than 3 years !
  - See, we are listening to your feedback ☺ ([collada.org](http://collada.org))
- Full feature
  - Geometry, material, scene, libraries, ....
  - Animation, skin, morph
- Advanced features – some frictions on the edge !
  - COLLADA PhX
  - COLLADA FX
- Content pipeline friendly
  - <asset>
  - Asset management recognized as the next challenge
- Missing ?
  - Sound
  - What else would you want ?

# COLLADA FX

- See next presentation
- Effect format for PSGL
  - Providing FX loader, using cg1.5 API
  - Cross platform effect file
  - Also for 1.x mobile phones
    - Multipass effects without shaders
- Effect format for OpenGL ES
- Effect format for OpenGL Desktop ?

# COLLADA parts

- COLLADA Schema
- COLLADA spec
- Export/Import
- COLLADA DOM **New!**

Public Domain

[www.collada.org](http://www.collada.org)

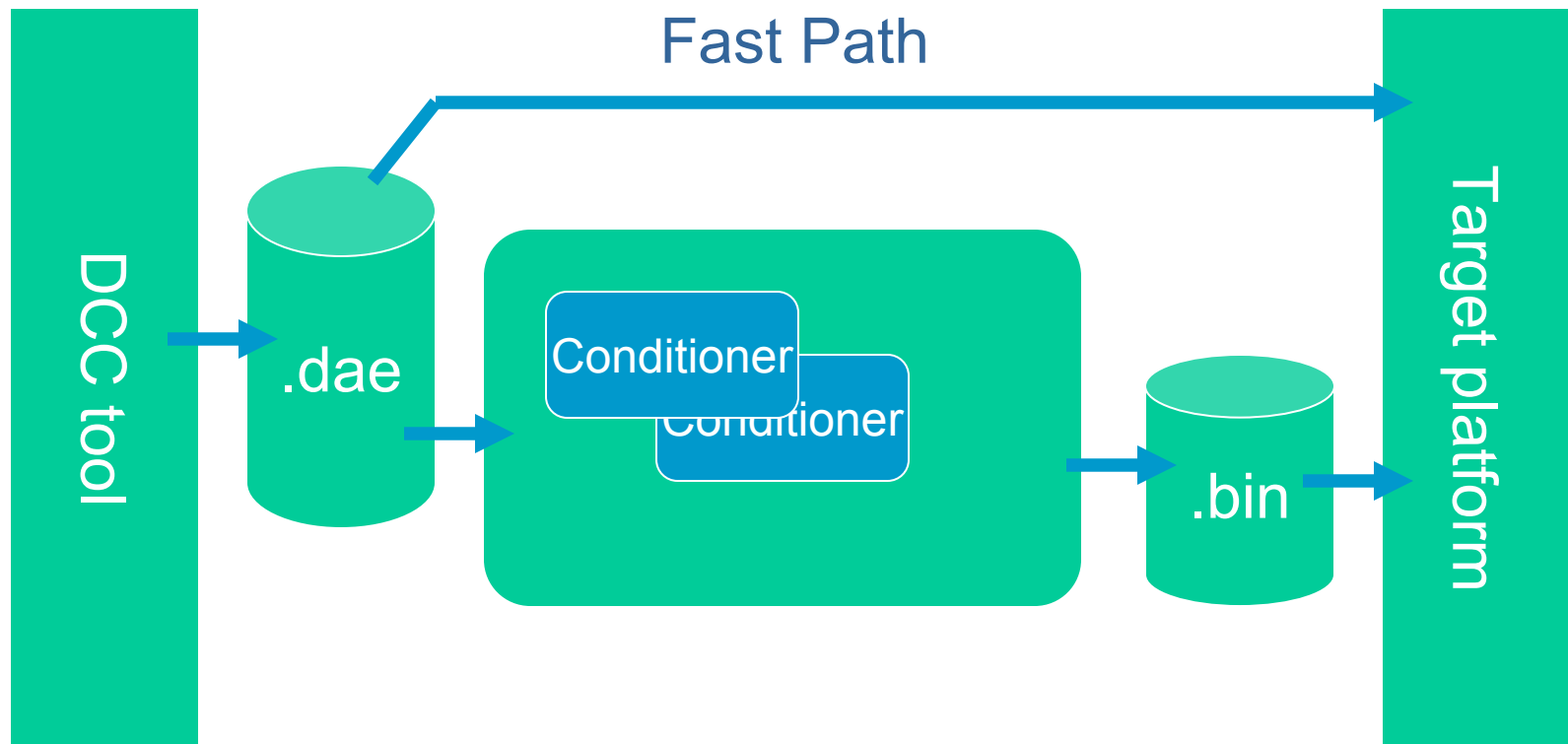
[www.khronos.org/collada](http://www.khronos.org/collada)

<http://sourceforge.net/projects/collada-dom/>

- COLLADA RT
- FX Loader (Cg 1.5)
- FXComposer 2.0 **New!**

PSGL developers

# COLLADA conditioning pipeline





# Questions?

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