COLLADA Overview

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Topics - COLLADA and 3D Authoring

- Objectives of COLLADA and its vital role in the 3D ecosystem
- Adoption of COLLADA in the industry
- Feature overview of COLLADA 1.4 and new COLLADA 1.5

Common 3D Authoring Problems

- **Longevity and accessibility of authored 3D assets**
  - Often 3D assets and data are “trapped” – tied to a particular tool-chain
  - It can be hard to take your data to a different tool or production flow
  - If the tool dies – your data becomes inaccessible
- **3D assets are created for a single target device**
  - Production flow can be tied to a single delivery platform
  - Hard to re-purpose data for alternative platforms – e.g. go from console to mobile

The COLLADA Authoring Solution

- **COLLADA defines an "intermediate" format**
  - Doesn't try define the beginning (authoring) or end (run-time acceleration) of the pipeline
  - Designed for moving content along the content pipeline
- **Freedom to innovate!**
  - COLLADA provides stability and flexibility so authoring toolchains and run-time engines can evolve independently

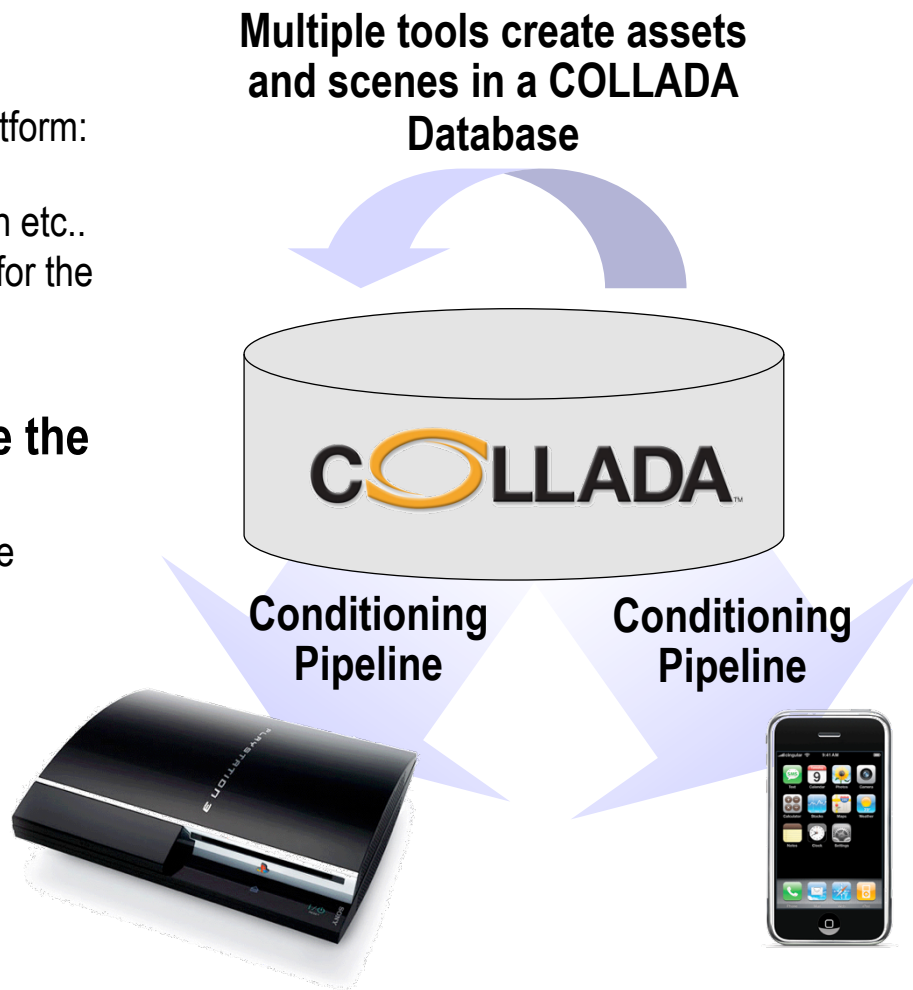
COLLADA = XML Interchange

- **COLLADA is a XML database schema for 3D assets**
  - Can hold everything to do with a scene: geometry with full skinning, advanced material and visual effects, animation, physical properties and collisions
- **COLLADA can be used to transport 3D assets between applications**
  - Enables binding of diverse DCC and 3D processing tools into a production pipeline
- **COLLADA can be lossless – never lose information**
  - Retains all information - even multiple versions of the same asset
- **COLLADA is an open, archive-grade format that retains meta information**
  - When your DCC tool upgrades, you keep your assets

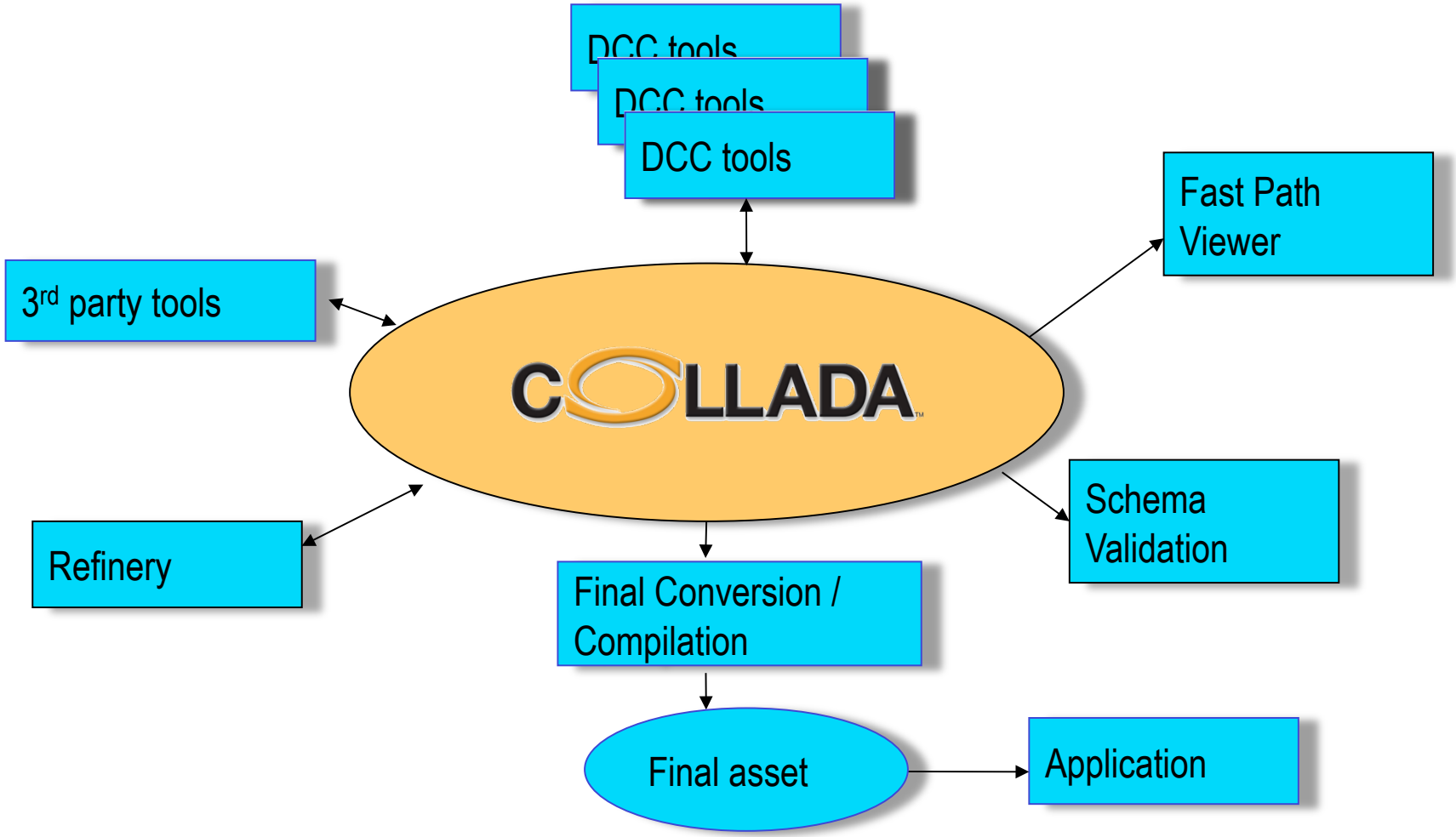
COLLADA is non-destructive and so supports round-tripping of tools to enable powerful authoring pipelines

COLLADA Conditioning

- **COLLADA is an interchange format**
  - Not a delivery format or a scene graph
- **Conditioning pipelines**
  - 1. Strips out authoring-only information
  - 2. Data optimization to suit the target platform: geometry optimization, normal map computation, data streaming optimization etc..
  - 3. Compresses and formats binary data for the target platform run-time engine
- **Different target platforms can use the same asset database**
  - With the appropriate conditioning pipeline



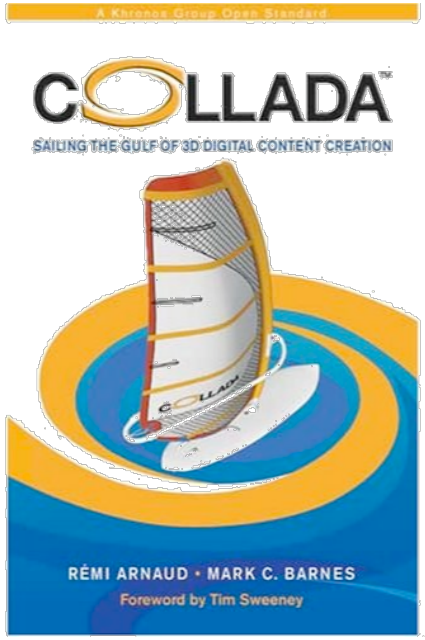
COLLADA Data-centric model



COLLADA Momentum

- **COLLADA 1.4 supported by all major tools and thousands of users**
  - 3ds Max, Photoshop CS3, Blender, DAZ|Studio, C4 Game Engine, Poser
  - NVIDIA FX Composer, Google Earth, Houdini, Maya, Sketchup, and XSI
- **COLLADA 1.5 Released in August 2008**
  - New functionality for CAD and Geographic industries
  - 20,000 specification downloads in first month

Autodesk
Houdini
NVIDIA
Adobe
www.omegame.com
OGRE
blender
XSI
feeling software
Maya
SketchUp from Google
Google Earth
AWAY3D
DAZ 3D Content & Software



COLLADA adoption

- **Game Developers**
  - Many using COLLADA now (Epic, Crytek, Square Enix, Rockstar)
- **DCC tools**
  - Adobe, Autodesk, Softimage, Luxology, Blender, Daz3D
- **Hardware vendors**
  - RenderMonkey [shader editor] (AMD)
  - FX Composer 2.0 [shader editor], NVSG [scene graph] (NVIDIA)
  - Inscriber G7 [Broadcast Graphics System] (Harris)
- **CAD & Automation**
  - AutomationML (Daimler, ABB, Siemens A&D…)
  - SolidWorks (Microsoft and Dassault Systemes)
  - Microsoft Robotics Developer Studio
- **GIS**
  - Google Earth, SketchUp & 3D Warehouse (Google, Adobe)
  - GeoCOLLADA (OSGeo, OGC)
  - X3D Earth (Web3D companies)
  - Virtual Earth (Microsoft, Dassault, Allegorithmic)
- **3D for the Web**
  - Flash (PaperVision3D, Unity2.0)
  - X3D (Yumetech, NPS, Media Machines, Bitmanagement)

COLLADA – Adoption ’08 (partial list)

act-3D
Activision
Adobe - Photoshop
Adobe - Acrobat
AGEIA
Agency 9
Aika
AMD / ATI
Anark
Autodesk - 3dsMax
Autodesl – Maya
Autodesk – MotionBuilder
Away3D
Bentley Systems
Biodroid Entertainment Group
BigStage Bitmanagement
Blender
Bit Management
Bullet Physics
Caligari
Cannibal Game Studios
Chargeur_F
Crytek
Daimler
Dassault
DAZ Productions
Delphine 3D Tools
Double Fine
eFrontier
Electronic Arts
Ensemble
Epic Games
ESRI
Feeling Software
Frictional Games
FX Chumbalum Soft
Gamr7
Garage Games
German Archaeological Ins.
Geomerics
Google
IMSI/Design
Illusoft
Intel
Java Monkey Engine
Konani
Kynogon
Lightsprint s.r.o.
Luxology
MADLIX
Media Machines
Microsoft
Motion Node
Multiverse
Neoflash
Next Generation
NetAllied
NewTek
Newton Dynamics
N-Sided
Nvidia – FXComposer
Nvidia - NVSG
OGRE 3D
Okino
Omegame
Open Scene Graph
Papervision
PARTsolutions
Planet 9 Studios, Inc.
Physics Abstraction Layer
RadTools, Inc
RealViz, Inc
Remograph
Right Hemisphere
SG57
Side Effects Software, Inc.
Sony SCEA R&D
SoftImage
Square Enix
StoneTrip
Terathon Software
THQ
Ultimate UnWrap 3D
Unity Technologies VERTICE
Virtools, a Dassault Co.
WorldForge
Worley Works Productions
Worldweaver LtD.
xNormal
Yumetech, Inc.
3D Nature LLC

COLLADA Milestones @ SIGGRAPH

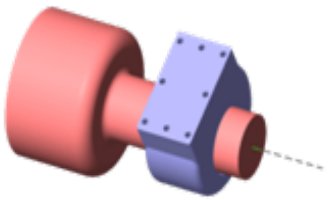
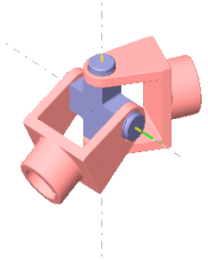
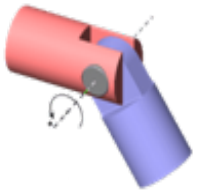
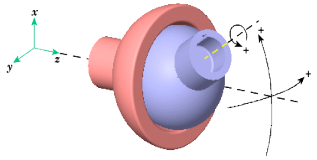
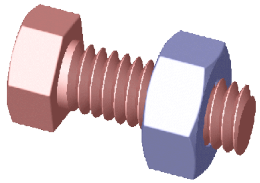
- **SIGGRAPH '03 – San Diego**
  - COLLADA project launched
- **SIGGRAPH '04 – Los Angeles**
  - COLLADA 1.0 announcement
- **SIGGRAPH '05 – Los Angeles**
  - COLLADA 1.3.1 released
  - Geometry / Material / Animation / Skinning
- **SIGGRAPH '06 – Boston**
  - COLLADA 1.4.1 released
  - Animation Clip / Morphing / Physics / FX
- **SIGGRAPH '07 – San Diego**
  - Stability – focus on adoption
  - 3D for the Web – X3D collaboration, PV3D
- **SIGGRAPH '08 – Los Angeles**
  - COLLADA 1.5 announcement – CAD and GIS features

COLLADA 1.4 = Game Technology

- Mesh Geometry
- Transform hierarchy (rotation, translation, shear, scale, matrix)
- Materials / Textures
- Shader programs (Cg, GLSL, GLES)
- Shader effects (FX)
- Lights / Cameras
- Skinning / Morphing
- Animation
- Physics (rigid bodies, constraints, rag dolls, collision volumes)
- Instancing
- Techniques / Multi-representations
- Assets / Libraries
- User data

COLLADA 1.5 New Features

- **B-rep (boundary representation) descriptions of complex CAD objects**
  - Enables complex models to be rebuilt and modified exactly - with less data than meshes
- **Kinematics**
  - Joints and Compound joints with Definition of degree-of-freedom using MathML formulas
- **Accurate geo-referencing of assets – latitude, longitude and altitude**
  - GIS applications can blend real and virtual 3D assets
- **".ZAE" archive package specification (Zipped Asset Exchange)**
  - Enables distribution through the warehouses such as Google 3D Warehouse
  - Will be support in SketchUp version 7, due out later this summer
- **Games and Graphics**
  - Enhanced profiles for rendering systems - including OpenGL ES 2.0
  - Bridge profiles for tools frameworks such as CgFX
  - Improved texturing and multi-pass effects

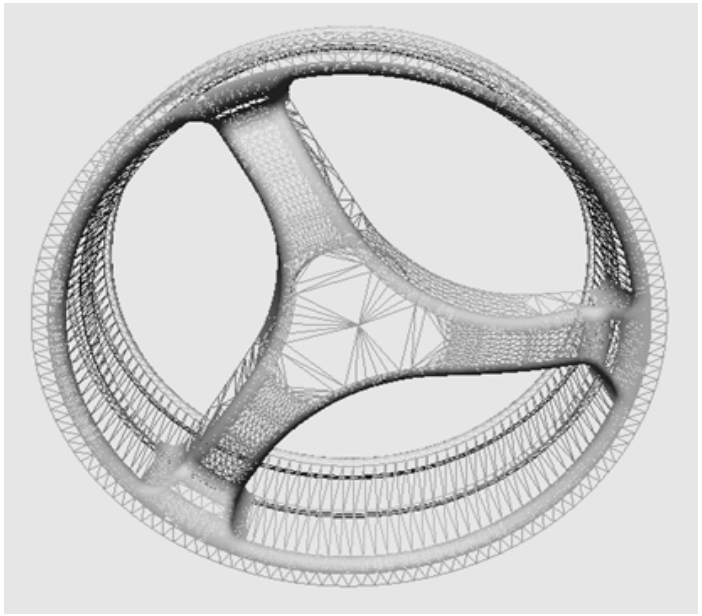






Continued Support for COLLADA 1.4

- **New 1.5.0 schema does not replace 1.4.1 schema**
  - Existing 1.4 documents and tools remain valid
- **XML Transform tools can migrate data between schema**
  - Developers can adopt new 1.5 features at their own pace
- **COLLADA 1.4.1 2nd Edition specification**
  - Corrections, clarifications, and minor additions
- **Conformance Test Suite for COLLADA 1.4**
  - Complete GUI and scripting framework that integrates testing methodology with authoring tools and rendering applications and contains up to 500 COLLADA-based content test cases

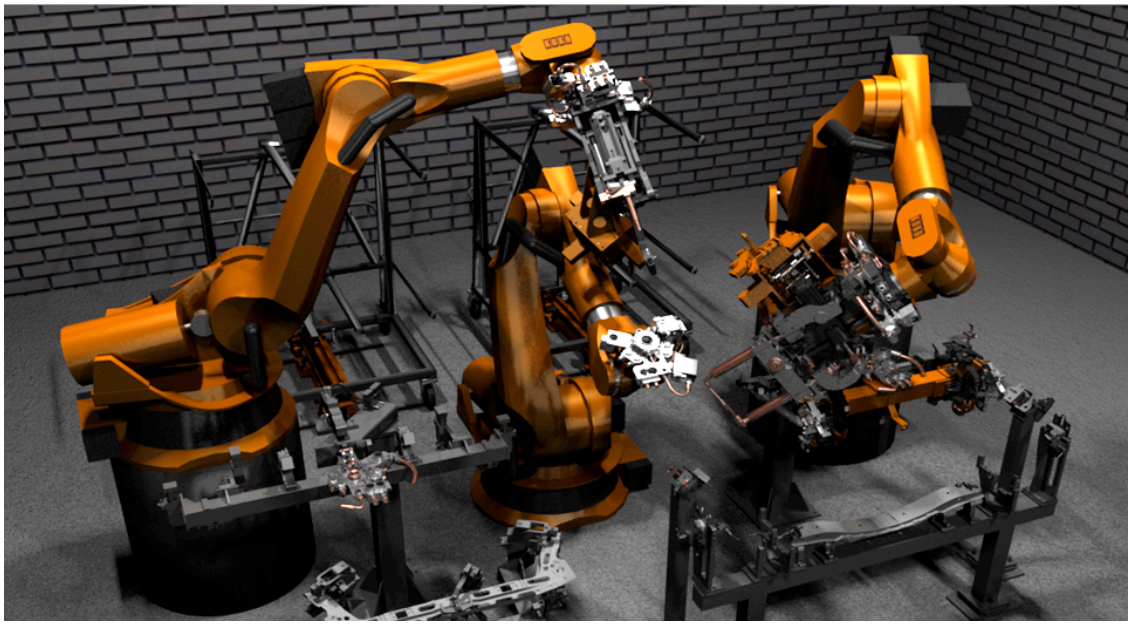
COLLADA 1.5 - B-reps

- **CAD systems work on B-rep models**
  - More flexible description of complex objects
- **B-rep describes the original model**
  - Exact model can be rebuilt and modified
- **Complex models need less data then meshes**



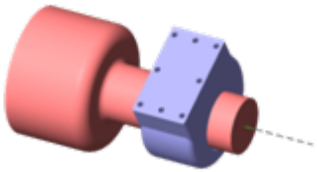
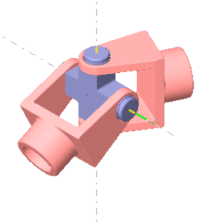
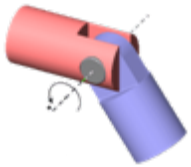
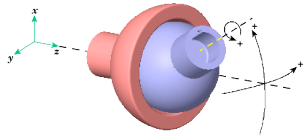
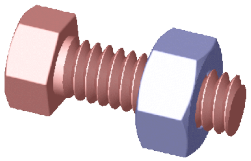
COLLADA 1.5 - CAD Industry Support

- **B-rep and kinematics is unprecedented in a royalty-free standard**
  - COLLADA becomes an intermediate language for CAD automation work flows
- **COLLADA has been adopted by the AutomationML group**
  - A consortium of automotive industry leaders that includes Daimler and ABB,



COLLADA 1.5 - Kinematics

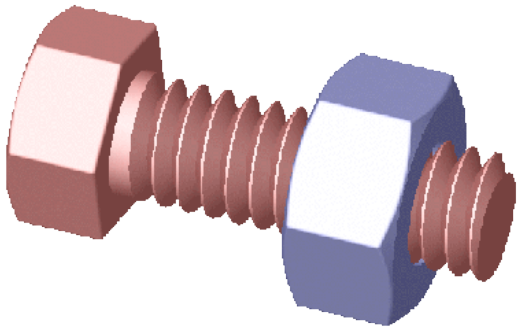
- **Structure is analogous to COLLADA physics**
- **Kinematics hierarchies**
  - Handling of closed loops
  - Specification of dependencies by formula - MathML
- **Joints**
  - Compound joints
  - Definition of degree-of-freedom (DoF)

Mathematical Formula : MathML

- **Example: Screw Formula**

```
<!-- Define formula for the translation-rotation dependency -->
<!-- <value url="#trans">#rot / 360 * pitch </value>  -->
<formula target="#screw/trans">
      <math:math
            xmlns:math="http://www.w3.org/1998/Math/MathML">
            <math:apply>
                  <math:times />
                  <math:apply>
                        <math:divide />
                        <math:csymbol encoding="COLLADA"
                              definitionUrl="#screw/rot">rot
                        </math:csymbol>
                        <math:ci>360</math:ci>
                  </math:apply>
                  <math:csymbol encoding="COLLADA"
                        definitionUrl="#screw/pitch">pitch
                  </math:csymbol>
            </math:apply>
      </math:math>
</formula>
```



COLLADA 1.5 Visual FX features

- **COLLADA FX enables effective creation of shader and effects**
  - OpenGL Shading Language, Cg and CgFX, DirectX FX
- **New BRIDGE profiles for external hardware effect frameworks**
  - Enables wide range of content authoring tools such as Microsoft XNA with DirectX
- **New OpenGL ES 2.0 profile**
  - For advanced rendering on mobile devices
- **Enhanced multi-pass rendering**
  - Camera lens passes, Full screen and post-processing passes, Layered rendering
- **Enhanced image and texture handling**
  - 2D, 3D, and Cube maps, easy initialization from external images like .DDS
  - Flexible and powerful format definition: Define MIP levels, Define cube map images per-face
  - Improved render-to-texture for all profiles

COLLADA 1.5 - External Effect Systems

- **New BRIDGE profile**
  - Reference external effects systems for Extended compatibility and future proofing
- **Frameworks supported**
  - Microsoft DirectX FX
  - NVIDIA CgFX
  - AMD SushiFX effects systems
  - Enhanced Cg profile
- **Profile level parameter binding, e.g.:**

```
<profile_BRIDGE platform="DIRECT3D9"
  url="http://www.YourDomain.com/myEffect.fx" />
```

COLLADA 1.5 - FX for OpenGL ES 2.0

- **New OpenGL ES 2.0 (GLES2) profile**
  - Advanced rendering on mobile devices
- **Binding flexibility**
  - Vertex attribute binding
  - Uniform parameter binding
- **Program management for deployment flexibility**
  - Source and pre-compiled binary shaders
  - Shareable source include and code
  - Linking together of Vertex and Fragment shaders

COLLADA 1.5 - Geographic Location

- **Coverage**
  - Provides information about the location of a `<visual_scene>` in physical space.
  - Dublin Core-style asset coverage meta data
- **Geographic Location**
  - Latitude and Longitude
    - Both following the WGS84 world geodetic system
  - Altitude
    - Following the Google KML conventions: meters above ground or sea level
    - Because WGS84 elevation is very complex
- **Example:**

```
<coverage>
  <geographic_location>
    <longitude>-105.2830</longitude
    <latitude>40.0170</latitude>
    <altitude mode="relativeToGround">0</altitude>
  </geographic_location>
</coverage>
```

COLLADA 1.5 - Node Proxies

- **Added an alternative URL for a <instance_node>**
  - Policy free attribute
- **Can be used to describe hierarchical scenes:**
  - Level of Detail (LoD)
  - Bounding boxes
    - Progressive or deferred loading
    - Streaming
- **Example:**

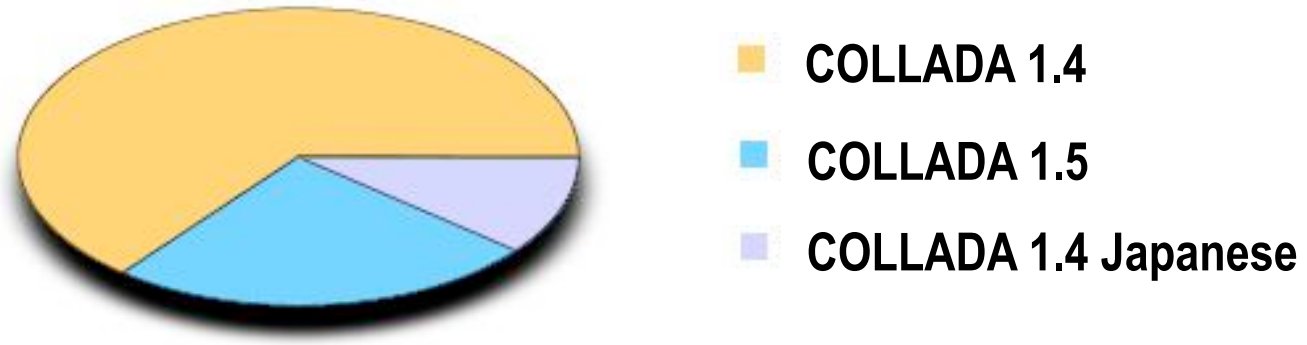
```
<visual_scene>
  <node>
    <instance_node url="#NODE0" proxy="#LOD1">
  </node>
</visual_scene>
```

COLLADA 1.5 - Archive Package

- **New ".ZAE" Zipped Archive Exchange**
- **Standard archive structure**
  - Well known starting point – manifest.xml
- **Standard navigation rules**
  - Root document - <dae_root>
  - <dae_root> contains a relative URI
  - Follow URI resolution rules:
    - Choose URI "#" fragment
    - OR document's <scene> element
- **Can contain embedded archives (.zip, .rar, .kmz, .zae)**

COLLADA Developer Momentum

- Total spec downloads reaching 45000 worldwide!
- COLLADA 1.4 represents 75% of total
  - Including about 4000 Japanese translations
- COLLADA 1.5 users growing since SIGGRAPH'08 release

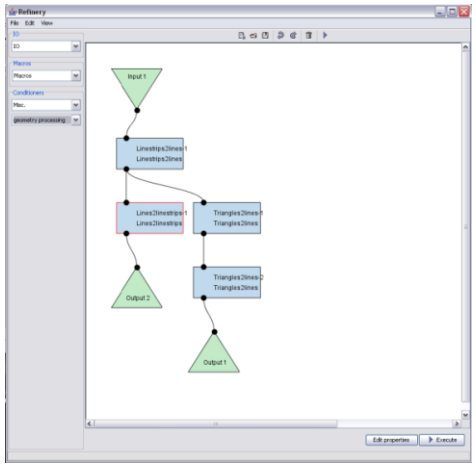


Open Source COLLADA DOM

- **COLLADA DOM – read, write, access data**
  - Open source, source-forge distribution
  - In place data access – avoid costly data duplication
  - Front-end generated automatically from Schema (C++)
  - Back-end as plug-in – libxml backend, database backend
  - Code generator (php script) source code -> add your own extensions to DOM
- **NEW: COLLADA 1.4.1. DOM NextGen released**

COLLADA – Tools and Sample Code

- **Autodesk plug-ins available**
  - ColladaMaya open source project on sourceforeg.net for Maya, 3ds Max, and MotionBuilder
- **NEW: Softimage|XSI Mod Tool freely available**
- **Coherency test**
  - XML validation + content coherency checker
  - An open source Refinery conditioner
- **COLLADA RT**
  - Open source, source-forge distribution
  - COLLADA RT – example Run Time / viewer (PC (OpenGL), PS3 (PSGL)…
  - COLLADA CFX – FX loader for Cg shader (companion to RT)
- **COLLADA Refinery – processing content framework**
  - Open source, source-forge distribution
  - User interface to create the conditioning pipeline
  - C++ conditioners can be combined
  - Batch mode for execution in the build process
- **NEW: Khronos is funding full COLLADA Conformance Test Suite**



COLLADA Benefits and Futures

- **COLLADA frees your data**
  - Use the tools you want
  - Keep your data in a vendor neutral format
  - Condition you data to a diverse range of target platforms
- **COLLADA is probably already in your 3D application**
  - Most applications already support COLLADA
  - Look for available plug-ins from you favorite tools
- **COLLADA**
  - Is fully documented and specified
  - Is royalty free
  - Is highly extensible
  - Has open source tools
- **COLLADA is inspiring forward-looking research and collaboration on content encoding and data structures**
  - Collaborative development, rich content databases, virtual worlds exchange, data compression, physics, geometry and topology stand-alone tools…

Help Khronos Help You!

- **Please consider joining Khronos to help develop COLLADA**
  - Have a voice and a vote in the evolution of this important standard
  - Special low cost membership fee for universities
- **Please review our specifications and provide feedback**
  - Public forums and developer resources at www.khronos.org/collada