X3DOM:

Next-Generation Web3D Applications on Open Standards and Open Source

Web3D Consortium

www.web3d.org

Abstracting Rendering Layer with Scene Graphs

Extensible 3D (X3D)

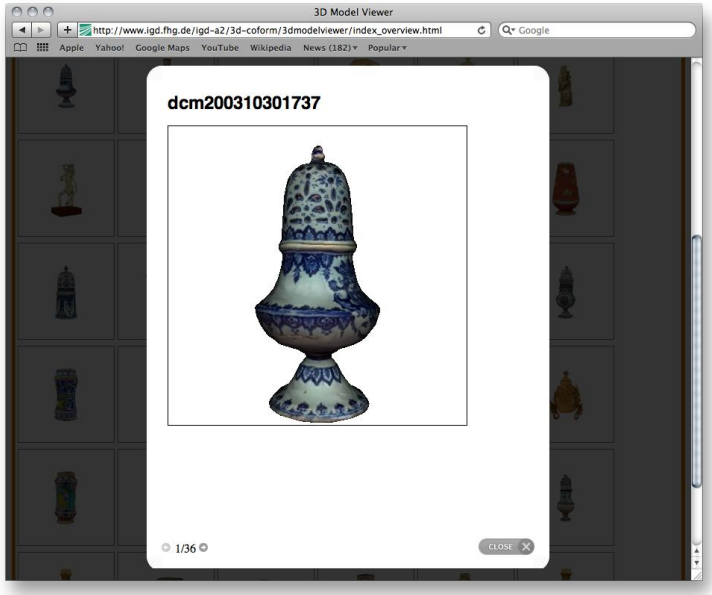
- Refactored VRML descendant - new features, multiple encodings (XML, binary, utf-8)
- Open ISO-Standard Scene graph

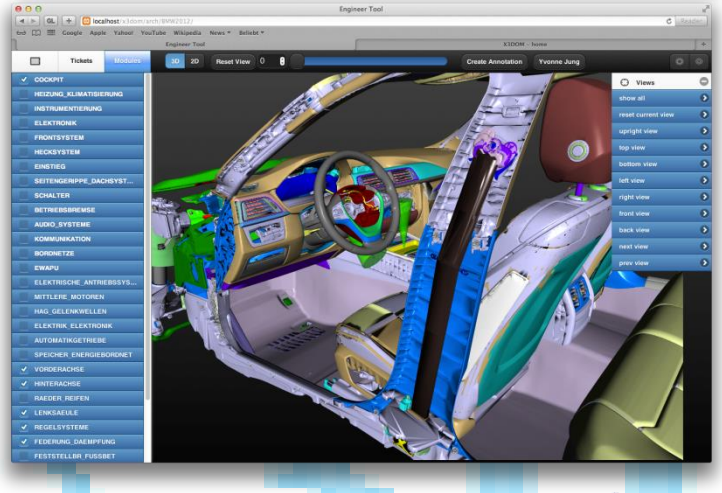
X3DOM

- Profile of X3D integrating with W3C infrastructure (HTML5, CSS, DOM)
- Liberal Open Source (Javascript / WebGL)

3D Information inside the Web

- Websites (have) become Web applications
- Increasing interest in 3D for
  - Product presentation
  - Visualization of abstract information
  - Experiencing Cultural Heritage data etc.
  - Supporting decision making, e.g. in Virtual Engineering
- Enhancing user experience with more sophisticated visualizations
  - Yesterday: Flash-based site with videos
  - Today: Immersive 3D inside Browsers





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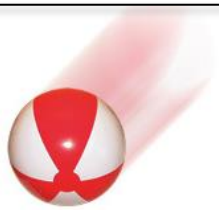
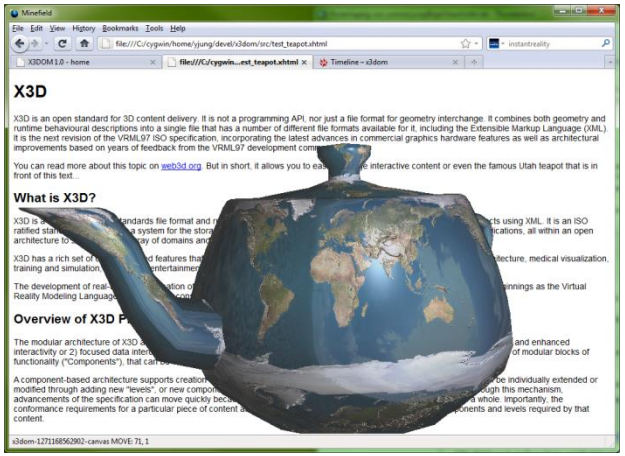
X3DOM – Declarative (X)3D in HTML5

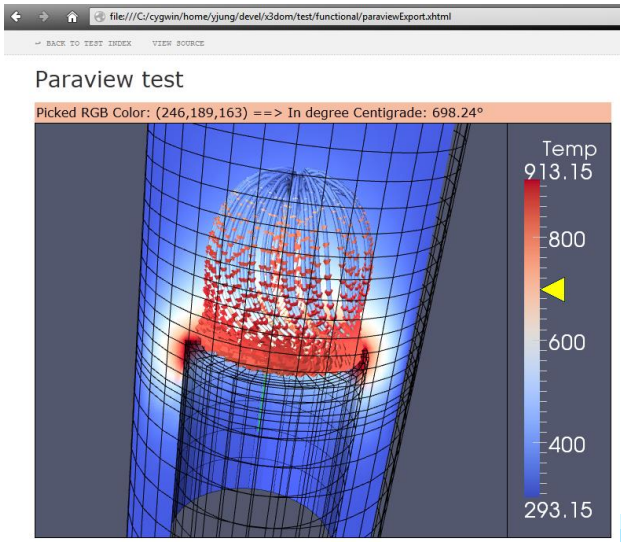
Completes todays graphics technologies

	2D (Final HTML5 spec)	3D (No W3C spec yet)
Declarative Scene-graph Part of HTML document DOM Integration CSS / Events	SVG	
Imperative Procedural API Drawing context Flexible	 <canvas>	

OpenGL + GLSL on the Web: WebGL

- JavaScript Binding for OpenGL ES 2.0 in Web Browser
  - → Firefox, Chrome, Safari, Opera
- Only GLSL shader based, no fixed function pipeline
  - No variables from GL state
  - No Matrix stack, etc.
- HTML5 *<canvas>* element provides 3D rendering context
  - *gl = canvas.getContext('webgl');*
- API calls via GL object
  - X3D via X3DOM framework
  - http://www.x3dom.org





X3DOM Example 1: Interactive Car Configurator

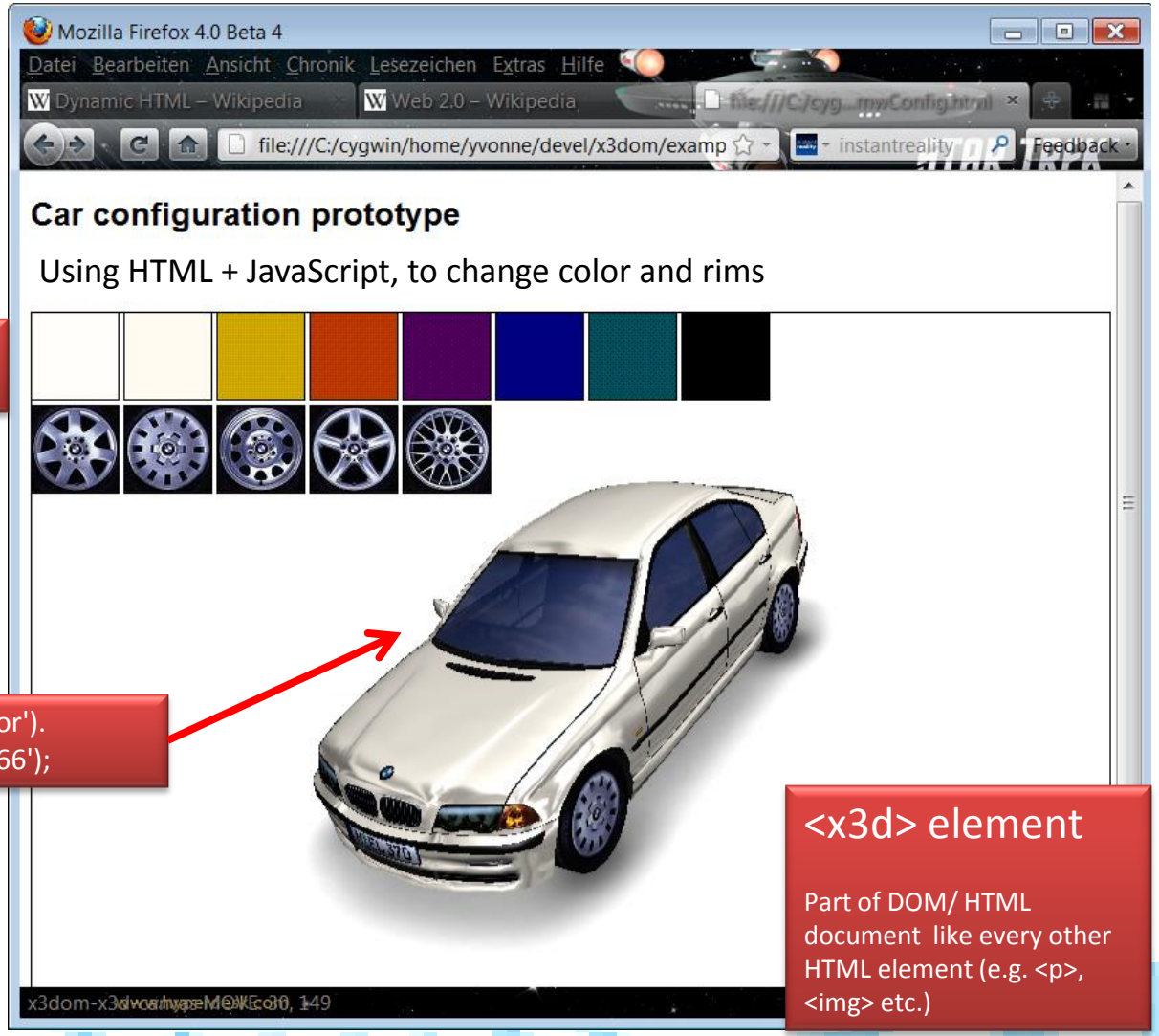
Interaction via standard Web technologies (e.g. JavaScript Events etc.)

```
<img src="felge1_64.jpg“
   onclick="..." style="…">
```

Click on <img> element…

```
document.getElementById('body_color').
   setAttribute("diffuseColor", '#000066');
```

…causes attribute change of <texture> url (i.e., other wheel rims appear)



<x3d> element

Part of DOM/ HTML document like every other HTML element (e.g. <p>, <img> etc.)

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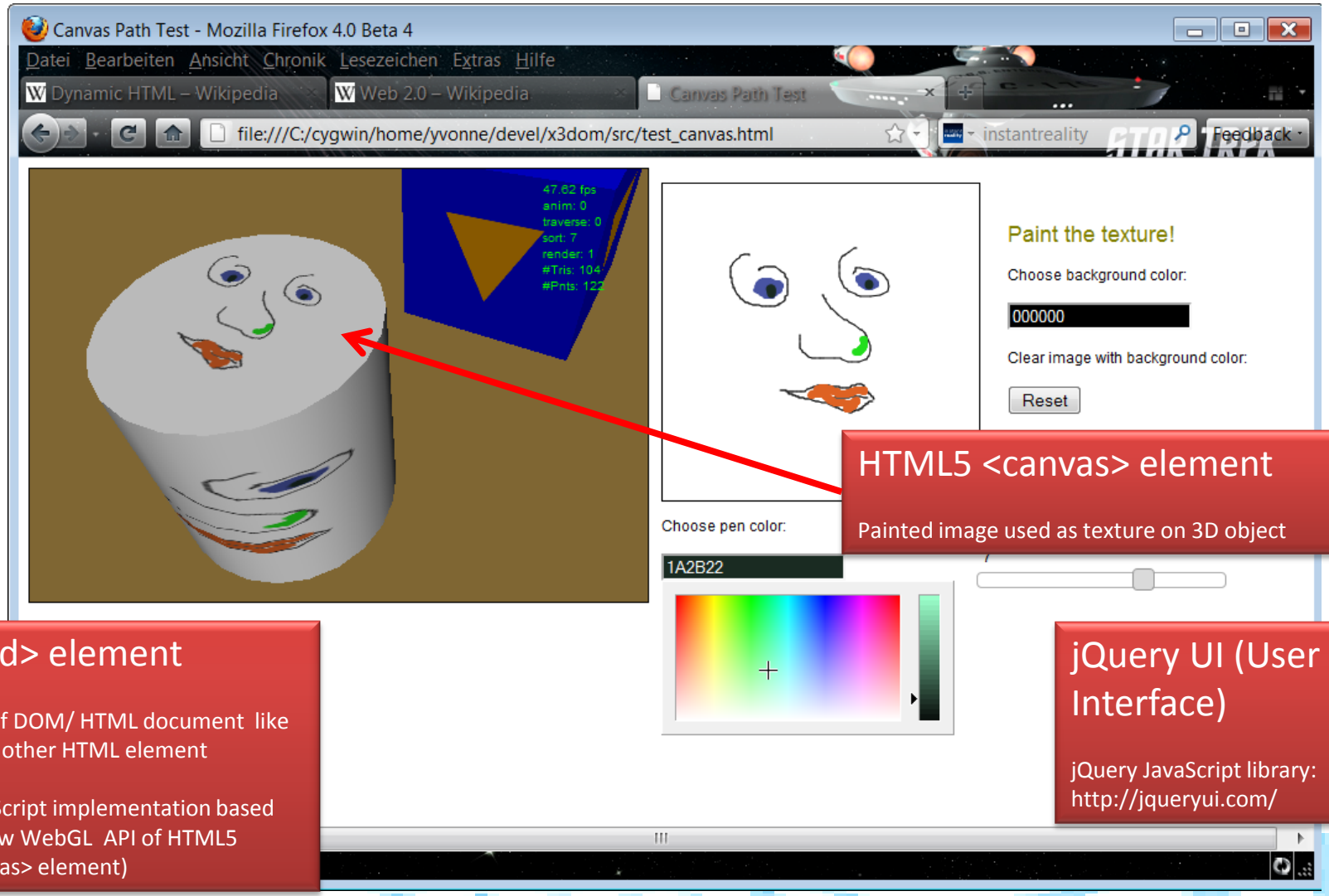
X3DOM Example 2: Painting Textures of 3D Objects



HTML5 <canvas> element

Painted image used as texture on 3D object

<x3d> element

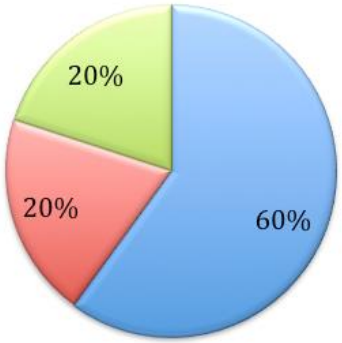
Part of DOM/ HTML document like every other HTML element

(JavaScript implementation based on new WebGL API of HTML5 <canvas> element)

jQuery UI (User Interface)

jQuery JavaScript library: http://jqueryui.com/

X3DOM Application (Large Data and Picking): 3D-Internet Design Review

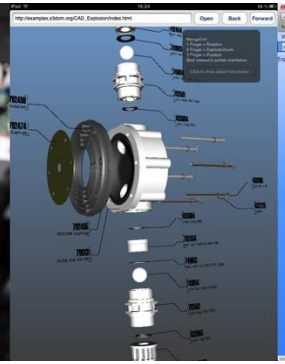


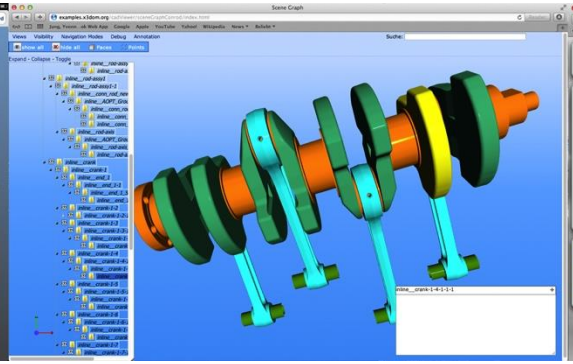
Maximum Visualization

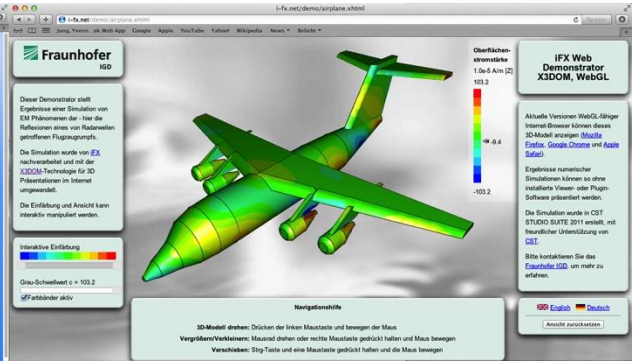
- Whole car incl. modules and parts
- Whole car incl. modules
- Modules with parts
- Only parts

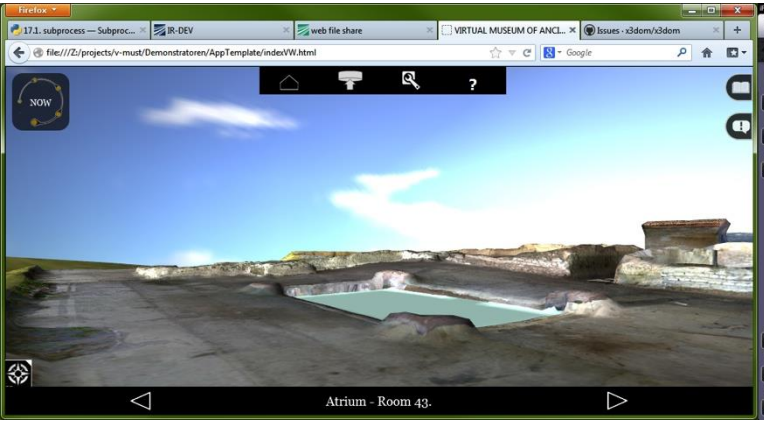
X3DOM Application Integration:

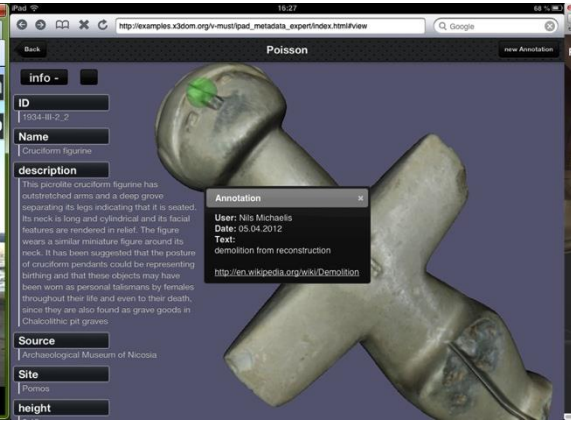
Virtual Engineering and Cultural Heritage on the Web

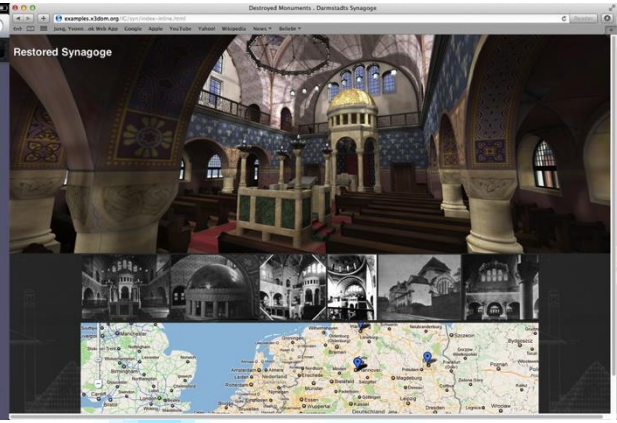






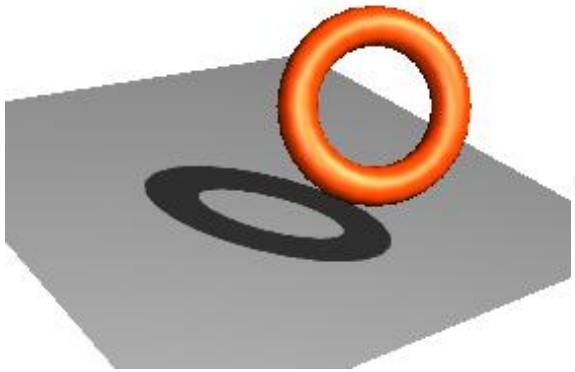






Other X3DOM rendering effects

shadows



fog

textures

- <directionalLight direction='0 0 -1' intensity='1' shadowIntensity='0.7'></directionalLight>
- <fog visibilityRange='1000'></fog>
- **<imageTexture** url="myTextureMap.jpg"**></ imageTexture>**
    - Note: like <material> only as child node of <appearance> possible!

X3DOM.org Online Examples

- Basic Examples
  - http://www.x3dom.org/?page_id=5
- Showcase Applications
  - Dynamic Shadows on large oilrig model http://examples.x3dom.org/binaryGeo/oilrig_demo/index.html
  - OcculusRift, more http://www.x3dom.org/?page_id=2429
- Geometry Compression
  - binaryGeometry : http://examples.x3dom.org/binaryGeo/index.html
  - POP buffers : http://examples.x3dom.org/pop-pg13/

Entry points for getting started

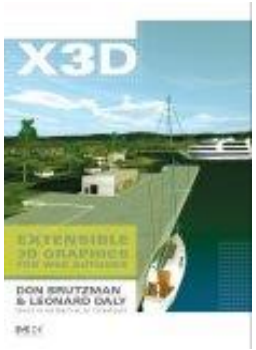
1.5 Release with advanced 3D graphics features

http://www.x3dom.org/?p=3423

X3DOM online documentation and code examples

- http://x3dom.org/docs/dev/ (tutorials and docs)
- http://www.x3dom.org/school/ (12 simple examples)
- http://www.x3dom.org/iX/ (7 examples with animation)
- http://www.x3dom.org/x3dom/test/functional/ (lots of feature tests)

X3D Background & Tools



Some books:

- "X3D: Extensible 3D Graphics for Web Authors"
- "The Annotated VRML 97 Reference" (explains concepts)

More docs and tools:

- http://www.instantreality.org/downloads/ (InstantPlayer and aopt converter)
- http://doc.instantreality.org/documentation/getting-started/ (links to X3D)

X3DOM Benefits

- **Development costs:** Web developer vs. graphics expert
- **Adaptability:** Declarative material abstraction allows shading adoption per client hardware (e.g. GLSL, ray-tracing…)
- **Efficiency:** UI events, culling, rendering can be implemented in native code, thus utilizes battery resources efficiently
- **Accessibility:** High level navigation and interaction styles allow very late adaptations for specific use cases
- **Metadata:** Allow indexing and searching content
- **Mash-ups:** Asset reuse in new context
- **Security:** No plugins or even direct GPU calls necessary

- → ***Powerful Abstraction for Web Applications !!!***

Join the Web3D Evolution!

The Web3D Consortium

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Slides courtesy of Johannes Behr and Yvonne Jung and the Fraunhofer IGD / VCST Team

Fraunhofer IGD

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