

X3D and HTML5 Integration

W3C TPAC HTML5
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X3D: REAL TIME 3D SOLUTION FOR THE WEB



We will cover:

- Family of X3D Specifications
- X3D Strengths
- Web3D Consortium and Formal Liaisons
- Relationship between 3D scene graphs, APIs and render layers
- Similarities between MathML, SVG, and X3D
- X3D scene graph APIs
- Differences with underlying render layers
- Simple X3D and HTML5 examples
- Action items for X3D and HTML5

Family of X3D Specifications

- X3D Abstract Specification describes basic functionality of how X3D works
- Three file formats are available:
 - XML (.x3d) with XML Schema and also DTD
 - ClassicVRML (.x3dv)
 - Compressed Binary Encoding (.x3db) with geometric compression and Fast Infoset (FI)
- High-performance Application Programming Interfaces (APIs) are defined for EcmaScript-264 (Javascript) and Java

X3D Strengths

- Non-profit Web3D Consortium maintains and extends X3D via working groups <http://www.web3D.org>
- Set of international standards certified over 12 year period by multiple national bodies in ISO
- Multiple implementations are available (open and commercial source)
- Numerous resources available online, including specifications themselves
- Third-generation 3D graphics language that extends predecessor Virtual Reality Modeling Language (VRML97)
- Long-time W3C member and contributor

Web3D Consortium

- Formal liaisons and working partnerships with other key organizations
 - [International Organization for Standardization \(ISO\)](#)
 - [World Wide Web Consortium \(W3C\)](#)
 - [Open Geospatial Consortium \(OGC\)](#)
 - [The Khronos Group](#)
 - [Digital Imaging and Communications in Medicine \(DICOM\)](#)

Relationships between 3D scene graphs, APIs and render layers

1

- **Scene graphs** are high-level declarative models about how geometry is constructed, colored and animated; these can be expressed as an XML tree
- **Application Programming Interfaces (APIs)** provide mid-level libraries for programmers to create imperative source code about geometry and animation (various proprietary codebases, perhaps WebGL or O3D)
- **Rendering layers** are low-level software libraries that expose the functionality of graphics hardware (such as OpenGL and DirectX)

Relationships between 3D scene graphs, APIs and render layers

2

- Numerous other 3D technologies exist at each of these layers, often in the form of codebases
- The X3D Specifications include both declarative models and strongly typed APIs

Similarities between MathML, SVG and X3D

- MathML: describes mathematical expressions and renders a presentation of them
- SVG: describes and presents renderings of 2D shapes, with optional animation and interaction
- X3D: describes and presents renderings of 3D shapes, with optional animation and interaction
- All three of these languages are formally specified and have well-developed XML encodings
- Authors want to use these languages for multimedia content in HTML pages

X3D Scene Graph APIs

- X3D Scene Access Interface (SAI) provides functionally consistent standardized high-performance APIs
- X3D SAI: EcmaScript and Java bindings; other programming languages can be added
- X3D SAI: is functionally equivalent and has same expressive power as file formats (.x3d, .x3dv, .x3db)
- DOM: also legal (X3D is XML after all) but historically has been infrequently used because of low performance
 - ... but it looks like that is changing




Simple X3D and HTML5 examples

- X3D scene as external reference (Anchor link)
 - Here is my `HelloWorld example` in X3D.
- X3D embedded in object tag
 - Shown on next slide
- HTML5 + embedded mixed-namespace X3D document
 - Demonstration using “Freedom” rendering from www.x3dom.org
 - Script references Javascript library utilizing WebGL layer
 - Runs in Mozilla Minefield and WebKit nightly builds
 - No plugin required!

HTML object tag containing X3D

The following examples show how to place an X3D object within an HTML page.

- The left column shows what is displayed when an X3D plugin is installed (if one is installed).
- The center column shows what is displayed if no X3D plugin is installed.
- The right column shows the HTML source.

X3D plugin object (if installed)	No X3D plugin installed	HTML source
<p>Online example scene:</p> 	<p>Anchor-link text backup:</p> <p>Select an X3D plugin to see this example...</p>	<pre> <html> <body> <object data="http://www.web3d.org/x3d/content/examples/HelloWorld.x3d" type="model/x3d+xml" height="360" width="300"> <param name="src" value="http://www.web3d.org/x3d/content/examples/HelloWorld.x3d"/> <param name="DASHBOARD" value="FALSE"/> <param name="SPASHSCREEN" value="FALSE"/> <!-- the following anchor-link text is only displayed to user if no X3D plugin is already installed --> <div class="noX3dPluginInstalled"> Select an X3D plugin to see this example... </div> </object> </body> </html> </pre>
<p>Online example scene:</p> 	<p>Anchor-link image backup:</p> 	<pre> <html> <body> <object data="http://www.web3d.org/x3d/content/examples/HelloWorld.x3d" type="model/x3d+xml" height="360" width="300"> <param name="src" value="http://www.web3d.org/x3d/content/examples/HelloWorld.x3d"/> <param name="DASHBOARD" value="FALSE"/> <param name="SPASHSCREEN" value="FALSE"/> <!-- the following anchor-link image is only displayed to user if no X3D plugin is already installed --> <div class="noX3dPluginInstalled"> </div> </object> </body> </html> </pre>

x3dom Instant 3D the HTML way!

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The screenshot shows a browser window with the following content:

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0
WebGL is not yet supported in your browser!
</html>
<head>
  <title>Simple WebGL example</title>
</head>
<body style="background-color:#E0E0E0;">
  <h1>x3dom</h1>
  <X3D xmlns="http://www.khronos.org/x3dom-1.1#">
    <Scene DEF="Scene">
      <Viewport DEF="vp">
        <Background DEF="bg">
          <Shape>
            <App
          </App
        </Shape>
      </Scene>
    </X3D>
    <script type="text/javascript">
  </body>
</html>
  
```

Below the code, the text "x3dom" is displayed in a large font, and a 3D cube is rendered with the text "X3D ANYWHERE" on its faces. The Fraunhofer IGD logo is visible at the bottom left of the screenshot.

about

X3DOM (pronounced X-Freedom) is an experimental open source runtime to support the [ongoing discussion](#) in the Web3D and W3C communities how an integration of HTML5 and declarative 3D content could look like. It tries to fulfill the current HTML5 specification for [declarative 3D content](#) and allows including [X3D](#) elements as part of any HTML5 DOM tree.

The goal here is to have a live X3D scene in your HTML DOM, which allows you to manipulate the 3D content by only adding/ removing or changing DOM elements. No specific plugin or plugin interface (like [SAI](#)) are needed. It also supports some of the HTML events (like "onclick") on 3D objects. The whole integration model is still evolving and open for discussions.

We hope to trigger a process similar to how the SVG in HTML5 integration evolved:

- Provide a vision and runtime today to experiment with and furthermore develop an integration model for declarative 3D in HTML5
- Get the discussion in the HTML5 and X3D communities going and evolve the system and integration model
- Finally it would be part of the HTML5 standard and supported by every major browser natively

More architectural and background information can be found in the [X3DOM-paper](#) (published at the Web3D symposium 2009).

Alternatively you, as web-developer, can also just utilize the system today to build web-pages and applications, which include declarative (X)3D content that will be rendered hardware accelerated (thanks to [WebGL](#)) without the need for using any plugin.

```

x3dom_simpleManip.tx
Styles Spacing
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd"
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>Simple attribute update</title>
  <style>
    p.case { clear: both; border-top: 1px solid black; padding-top: 5px; }
  </style>
  <link rel="stylesheet" type="text/css" href="x3dom.css" />
</head>
<body>
  <h1>Simple attribute update</h1>
  <p class="case">
    <X3D xmlns="http://www.web3d.org/specifications/X3DOM"
    showStat="false" showLog="false" x="0px" y="0px" width="400px"
    height="400px" altimg="helloX3D-alt.png">
      <Scene>
        <Viewpoint position="0 0 10" />
        <Shape>
          <Appearance>
            <Material diffuseColor="1 0 0.5" />
          </Appearance>
          <Appearance>
            <Box DEF="box" />
          </Appearance>
        </Shape>
      </Scene>
    </X3D>
  </p>
  <script type="text/javascript"><![CDATA[
var solid = true;
function toggleRendering()
{
  var button = document.getElementById("color");
  solid = !solid;
  if (solid)
    button.value = "Blue";
  else
    button.value = "Red";
}
var mat = document.getElementsByTagName("X3D");
var i = 0, n = mat.length;
var aMat = mat[0];
aMat.setAttribute("diffuseColor", (!solid ? "0 0 0" : "1 0 0.5"));
]]>
</script>


```

X3DOM 1.0 - home

http://www.x3dom.org/

Most Visited Getting Started Latest Headlines

X3DOM 1.0 - home



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Done

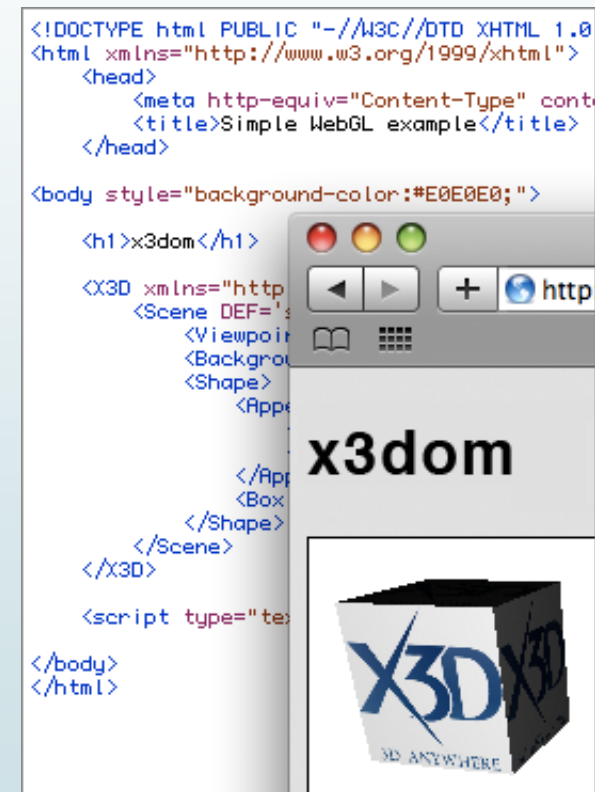
X3DOM.org implementation

- Open Source
- Javascript / WebGL based
- Needs Firefox/WebKit nightly builds
- Runs without any plugin
- Can be easily modified while evolving
- Needs XHTML encoded data
- One line script per XHTML



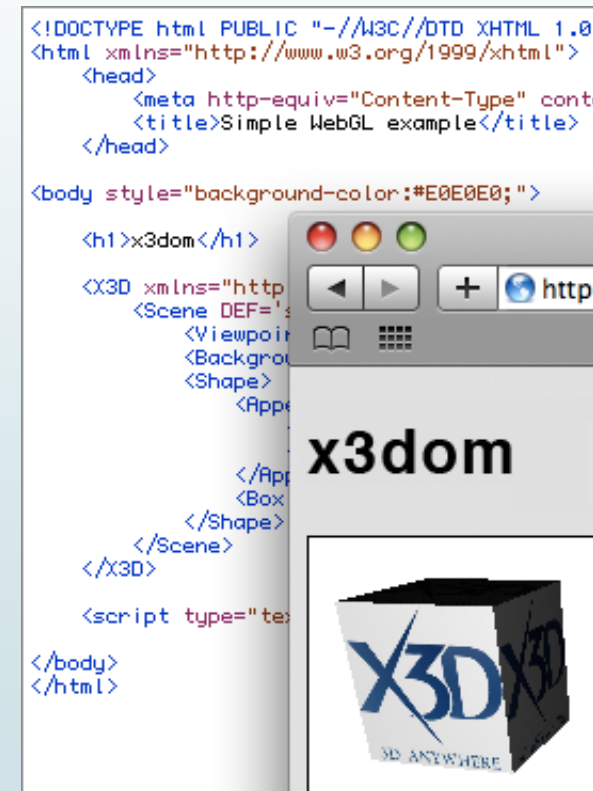
X3DOM.org functionality

- Searches for existing `<X3D xmlns= >` & creates scenegraph from DOM Tree
- Creates canvas with WebGL-Context for rendering
- Monitors changes with DOM Level 2 events (DOMNodeRemoved, DOMNodeInserted, DOMAttrModified)
 - **DOMAttrModified buggy in WebKit !!!**
- Supports simple interaction (HTML events on 3D Object) and navigation



X3DOM.org Status

- 3 work-months of development
- Manageable Code Size
 - ~ 5000 Lines JavaScript Code
 - ~ 1000 Lines GLSL Shader Code
- Support well defined Subset of X3D
 - Interchange + Inline, Scripting, Text
 - No Scripting or Prototype on the X3D side
- Dynamic X3D content
 - Support for n:m FieldToField ROUTEs
 - TimeSensor + Interpolator + Follower



X3DOM.org Solution Considerations

- Provides an experimental open-source runtime – not the ultimate solution
 - Feature Limitations: e.g. no access to spatial audio or video texture layer
 - Performance Limitation: Javascript/WebGL can only handle models up to ~200.000 Triangle right now
- Standardization and native implementations are needed
 - Support for SAI/X3D-Plugin in addition to the WebGL-Render backend will be next iteration
 - Final deployment solution best as part of browser
 - X3D community has open-source C/C++ codebases





Lessons learned from years developing FreeWrl X3D player

- FreeWRL was originally interpreted Perl with "C" functions. Hoped that hardware would improve faster than size of models; that was not the case.
- Interpreted was not good, rewritten in C for performance
- Write once, run anytime; even older NASA VRML1 models run efficiently on new hardware
- X3D models are not tied to specific hardware
- OpenGL requires significant programming skills... don't know why average web author would code in OpenGL ☹

Action Items for X3D and HTML5

1

- Ensure proper X3D references in HTML5 specifications - what happened, what happens next?
- How to allow X3D scene to either reserve screen space or float over the page? Presumably CSS, X3D elements include the class attribute
- X3D version 3.3 draft is considering SVG and HTML as source for image textures; how to pass events?
- X3D compression will likely evolve to use Efficient XML Interchange (EXI)

Action Items for X3D and HTML5

2

- Web Accessibility is a future interest
- Continue to document correct integration and best practices for X3D and HTML5
- Others?

Conclusions

- X3D Graphics is a natural fit for HTML5
- We want to maximize capabilities and deployment
- HTML5 feedback, guidance and collaboration welcome

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- Web3D Consortium
 - http://www.web3d.org/x3d/wiki/index.php/X3D_and_HTML5
 - <http://www.web3d.org>, x3d-public@web3d.org