

3D Graphics on the Internet

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Outline



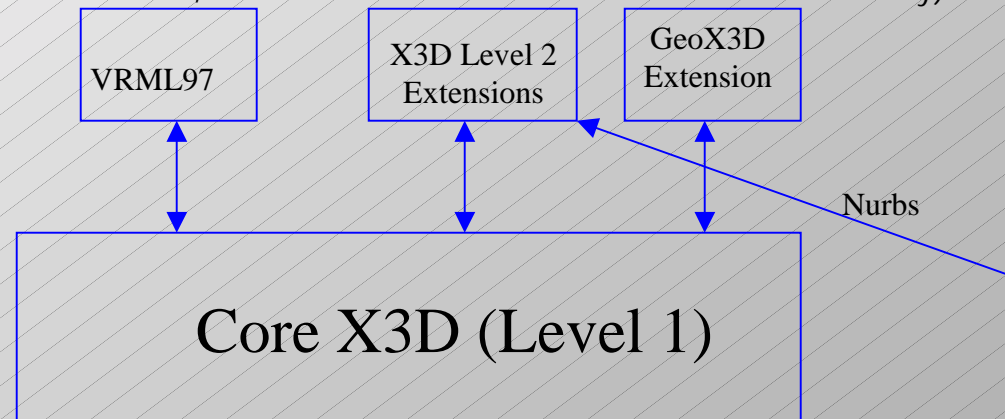
- VRML
- X3D with XML Primer
- Proprietary Approaches
- A look at streaming graphics
- Conclusion

VRML

- VRML has for years been the language of choice to bring objects to the web. It contains of 54 nodes and is purely polygon based.
- Advantages:
 - Content generation relatively easy: Every CAD program has faceted representation of NURBS based model. High quality VRML files are created by using the meshing code for example.
 - File structure relatively easy to parse.
 - Extensible: Blaxxun Interactive put VRML browser into open source: hence everybody can extend VRML to include custom nodes such as morphing nodes.
- Disadvantages:
 - files are large, no compression has been built in. No streaming technology.
 - Viewing requires download of browser. BAD!!
- VRML is often considered a failure. I disagree. What succeeded:
 - Necessary first step
 - Allowed for creation of apps on Web such as virtual worlds
 - Quite heavily used in niche areas for example GeoVRML for GIS apps.
 - It is a standard
- The deeper issue again is that we have technology in need of an obvious killer app. Network gaming is not there yet.

From VRML to X3D

- The main motivation for moving to X3D is to have a more lightweight representation and hence eliminate the need for downloading of heavy browser. The browser is downloadable with content.
- What is X3D:
 - XMLized VRML
 - Layered architecture: core consists of 18 nodes (no audio support)
 - Expanded set of full VRML nodes, level2 extensions with more advanced functionality)



XML Core Nodes

The nodes contained in the core are:

- Coordinate Nodes (*Coordinate*)
- Geometry Nodes (*IndexedFaceSet*, *IndexedLineSet*, *IndexedPointSet*)
- Grouping Nodes (*Anchor*, *Group*, *Inline*, *Transform*)
- Light Nodes (*DirectionalLight*)
- Material Nodes (*Material*)
- Shape Nodes (*Shape*)
- Texture Nodes (*Image Texture*)
- World Info Nodes (*WorldInfo*)

NOTE: My Example uses a dtd which supports the full VRML97 spec.

Brief XML Primer

XML is the extensible markup language and allows to specify custom tags.

One needs to specify three things:

- 1) DTD or Schema which specifies the syntax of the XML document.
- 2) The XML document itself which looks similar to an html document but enforces stricter syntax.
- 3) A style sheet (.xsl) which specifies how the page will be rendered on the browser.

The DTD is a BNF style document which specifies all the tags and which other tags and attributes can be occurring within the tag.

Every xml document has exactly one root element.

For vertical industries standard DTDs are developed which allow the exchange of information in a standardized way

X3D in a XML framework

- Each node is encoded as an XML tag. The DTD is currently being revised. Sony is actively involved and proposed a compromise DTD. I am using an older version for my example.

Example Demo:

- using Xeena (XML Editor) I created a simple X3D scene. Xeena is a nice tool. One starts it with a given DTD and hence one has an immediate semantics check. (Java based)
- Using the X3DToVRML97 style sheet I output a wrl file and display it with blaxxun's browser (hopefully)

Other Standards

- MPEG-4 can deal with full-blown VRML. MPEG pushes BIFS as a compression and streaming tool for VRML scenes. France Telecom has some impressive demos there. (9kbits/sec was max requirement for a complex animated sequence)
- SNHC working group within MPEG deals with integrating synthetic content into MPEG-4.
- H-Anim is a spin-off of VRML. It specifies a standard representation for animatable humans.
- Wildcard: Java3D: One starts to see content being rendered by Java3D. Java3D has capabilities similar to VRML in particular support for sensors and headmounted display devices. It is polygon-based and supports compression. Java3D has a built -in capability to import wrl files and convert them.
- Sony's Blendo proposal: Attempt to merge graphics and audio in an easy to use API. This is preliminary. It seems not too much different from Java3D or VRML.

Proprietary efforts

- There is not much agreement on what constitutes the ideal representation for web based graphics. Most content on the web is created by proprietary means and hence authoring solutions are not widely available.
- Example Lattice Technologies: Convert CAD files into a very lightweight representation based on curve networks:
 - Information loss but this is probably ok
 - Requires some effort to generate the scene, might be fatal for complex scenes.
 - Lattice Designer: Simple authoring environment for creating scenes
 - <http://www.lattice.co.jp/en/index.html>
- Cybelius: Interactive exploration of CAD models on web site.
 - In part use Kodak technology to scan real-life objects.
 - Shout3D browser technology is used as well.
 - <http://www.cybelius.com>
- Shout3D:
 - Proprietary technology which is Java-based.
 - Downloads with content. Scene gets parsed initially and then displayed. Allows for hardware-accelerated rendering. Probably the most impressive content on the web.
 - Technology: <http://www.shout3d.com/technology.html>

Semi-proprietary: Blaxxun

- Blaxxun interactive is providing technologies for virtual worlds and e-commerce. Here are some examples: http://www.blaxxun.de/c/s?cat=7&sub=3&url=/products/blaxxun_3d/index.html
- Blaxxun has incorporated NURBS (trimmed and untrimmed) as well as most recently and implementation of subdivision surfaces into its VRML browser.
- A description of the NURBS implementation can be found in *Grahn, Volk, Wolters: NURBS in VRML, Web 3D Proc, 2000*

Some notes on streaming

- MetaCreations presented MetaStream streaming technology two years ago. Recently, MetaCreations sold most of their graphics software assets to focus on streaming.
- Here is a demo: [Metastream demo](#)
- Features:
 - MS uses XML as Media Description Language and includes geometry and texture as binary external files
 - Texture Compression via wavelets; claimed to be much higher quality than JPEG at compatible compression ratios
- Virtue has created a SDK for streaming graphics ([Example](#)) In addition there is compression technology for compressing VRML files.
- Of course MPEG4 BIFS is another option.
- All approaches focus on polygons as streaming primitives. It is not clear that this is the right primitive. NURBS, meshes or other lightweight representations are candidates as well as integration with video based technologies

Conclusion

- 3D content on the web is driven by two applications: virtual worlds and gaming.
- Virtual worlds are favored by advertisers since their stickyness is high. The average duration of a visit is 47 minutes and the click through rate is around 8%. This is very good.
- E-commerce applications are starting to emerge but face obstacles: the average consumer does not want to download and install plug-ins. This means that currently most content is generated by proprietary means.
- X3D is reacting to the need for lightweight components. It is a subset of VRML specified via XML.
- I did not address the issue of Image-based models and 3D photography techniques.
- The question of what representation is most appropriate for Internet graphics is disputed. Tradeoff between bandwidth and client thickness.
- NURBS might be the best compromise after all (see blaxxun's browser)