X3D Graphics Standard for GRID-related progress

Technology, Process, Deployment, Stability

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What is Extensible 3D (X3D)?

X3D is a royalty-free open-standard file format

- Communicate animated 3D scenes using XML
- Run-time architecture for consistent user interaction
- ISO-ratified standard for storage, retrieval and playback of real-time graphics content
- Enables real-time communication of 3D data across applications: archival publishing format for Web
- Rich set of componentized features for engineering and scientific visualization, CAD and architecture, medical visualization, training and simulation, multimedia, entertainment, education, and more

Web3D Consortium

Web3D Consortium founded in 1998 to protect, support and advance the VRML specification

- http://www.web3D.org

Continued efforts on new technology by multiple working groups led its successor, X3D

- http://www.web3D.org/x3d

Non-profit organization of many stakeholders ensures that X3D remains royalty free, relevant

- Partnership of industry, agency, academic and professional members

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Why does X3D work so well?

Scene graph technology is technically rich and well understood

- Multiple 3D technologies harmonized
- Insistence on implementation, evaluation
- Multiple implementations tested
- Authoring examples, translators, etc. etc.

First law of engineering:

- “If it ain't broke, don't fix it”
- We get it right first time, avoid deprecation

Interoperability - what's the difference?

Multiple paths, but often confused as equal

Standard: proven process for content interoperability, scalability, compatibility, licensing, growth, success

Specification: Algorithm descriptions, necessary detail

- But: might hide royalty problems, such as GIF imagery debacle in 1990s

Open source software: pile of (maybe repeatable) code

- But: usage licensing is not same as source-code licensing

Market share dominance: biggest competitor wins?

- Companies (or at least investors) hope to "own" 3D
- But: many defunct companies, dead-end technologies
- Everyone ends up with much smaller market than the Web

Intellectual property rights (IPR)

Web3D and W3C have similar policies

- Any known patented technology must be declared by members prior to consideration in safe haven of working groups
- Any patented technology contributions must be licensed on a royalty-free (RF) basis for inclusion in an openly used Web standard http://www.web3d.org/membership

Caveat: any legal problem can be solved, but only in advance!

Must innoculate against patent problems

Stability is important!

- Most 3D graphics authors create lots of wonderful content, but it tends to "time out" and break after 2-3 years, simply becoming no longer usable due to software changes, company acquisitions or shutdowns, etc.
- Creating quality 3D content is expensive, both in time and software costs
- Something just as expensive: recreating that same 3D content when the underlying commercial technology no longer works

X3D Mobile Progress

Integrating multiple different implementations

- BitManagement, Fraunhofer, ETRI, others

Korea Chapter announced ISO study group

- Consolidation workshop at ISO meeting August 2011

X3D Mobile Profile now proposed

- finds common ground for mobile devices, HTML5 deployment, possibly Augmented Reality (AR)
- Interchange profile geometry, user interaction model harmonized with HTML, optimized Javascript

Augmented Reality working group

Multiple efforts ongoing

- Christine Perry's AR workshop series
- Is AR a 2D-overlay or 3D problem?

Multiple X3D proposals for common technology

- ETRI, Fraunhofer, others
- Working to harmonize different capabilities

Potential sweet spot for deploying content:
Mobile + AR + HTML5

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

Also runs on Apple Safari and Google Chrome
current developmental browsers supporting WebGL

Grab File Edit Capture Window Help (67%) Thu 6:33 PM

x3dom_simpleManip.tx

Styles Spacing

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dt
<html xmlns="http://www.w3.org/1999/xhtml">
    <head>
        <meta http-equiv="Content-Type" content="te
        <title>Simple attribute update</title>
        <style>          p.case { clear: both; border-to
        </style>
    <link rel="stylesheet" type="text/css" href="x3dom.
    </head>

<body>

  <h1>Simple attribute update</h1>

    <p class="case">
        <X3D xmlns="http://www.web3d.org/specificat
showStat="false" showLog="false" x="0px" y="0px" wid
height="400px" altImg="helloX3D-alt.png">
      <Scene>
        <Viewpoint position='0 0 10' />
        <Shape>
          <Appearance>
            <Material diffuseColor='1 0 0.5' />
          </Appearance>
          <Box DEF='box'/>
        </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("
        var i = 0, n = mat.length;

        var aMat = mat[0];
        aMat.setAttribute("diffuseColor", (!solid ? "0 0
```

X3DOM 1.0 – home

http://www.x3dom.org/

Most Visited Getting Started Latest Headlines

X3DOM 1.0 – home

Fraunhofer IGD

about

X3DOM (pronounced X-Freedom) is an experimental open source runt
support the ongoing discussion in the Web3D and W3C communiti
an integration of HTML5 and declarative 3D content could look like. It
fulfill the current HTML5 specification for declarative 3D content and
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
you to manipulate the 3D content by only adding/ removing or changin
elements. No specific plugin or plugin interface (like SAI) are needed.
supports some of the HTML events (like "onclick") on 3D objects. The
integration model is still evolving and open for discussions.

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

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

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

Alternatively you, as web-developer, can also just utilize the system to
build web-pages and applications, which include declarative (X)3D
that will be rendered hardware accelerated (thanks to WebGL) with
need for using any plugin.

Done

GIS Interoperability

- Correlating approaches with Open Geospatial Consortium (OGC) formats and tools
  - 3D Portrayal Interoperability Experiment (3DPIE) group participation
- X3D Earth: "mash up" globe data on-the-fly from OpenStreetMap and OpenAerialMap
  - OpenAerialMap reconstitution in progress
- NPS built high-fidelity DTED globe using a supercomputer-class cluster
  - Need more experimentation for broad optimization

CAD Interoperability

Numerous different CAD formats exist

- No single dominant format
- Formats typically obscure, engineering oriented
- Companies carefully "protect" their customers

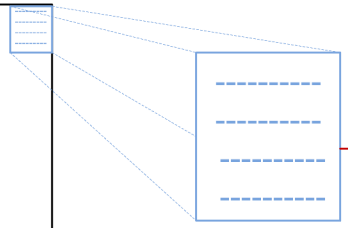
Common denominators nevertheless exist

- History file of author steps thus consistently applies fifty-term vocabulary consisting of B-Reps and constructive solid geometry (CSG) operations
- History log can be converted into common syntax, then reconstruct original geometry
- Current KAIST work targeted to produce X3D

X3D conversion of CAD models

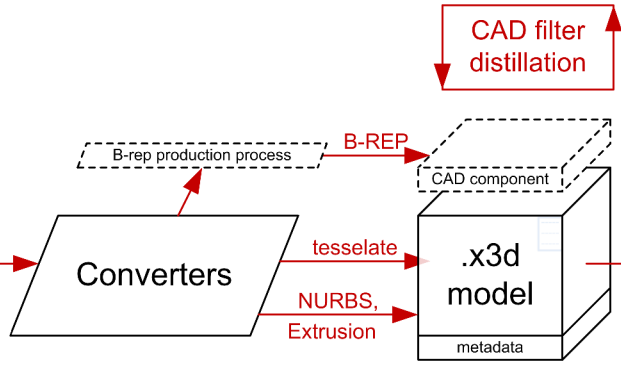
CAD model

- Large file size
- Proprietary format
- “Locked in” tool chain, expensive
- Licensing renewal needed long-term?
- Engineering detail, specialized metadata
- Specialized viewers, plugins
- Hard to convert
- Hard to reuse, compose, integrate



Parametric History

- List of author actions, similar to Do/Undo list
- Controlled vocabulary matching ISO STEP
- About 50 operators
- Constructive solid geometry (CSG)
- Can then build via CAD geometry engine
- Potential interoperability path despite differences between tools



Convert history log, not engineering details

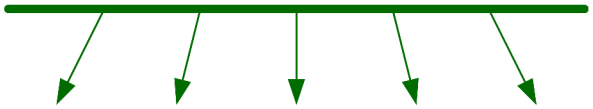
- Use CAD engine or API (e.g. ACIS) to produce conversion
- Compute geometry by converting CSG operators into BREP Boundary Representatons
- Polygonal mesh tessellation also possible

Deployable, reusable model

- Can include metadata of interest
- Signable and encryptable via XML Security

Compressed binary encoding

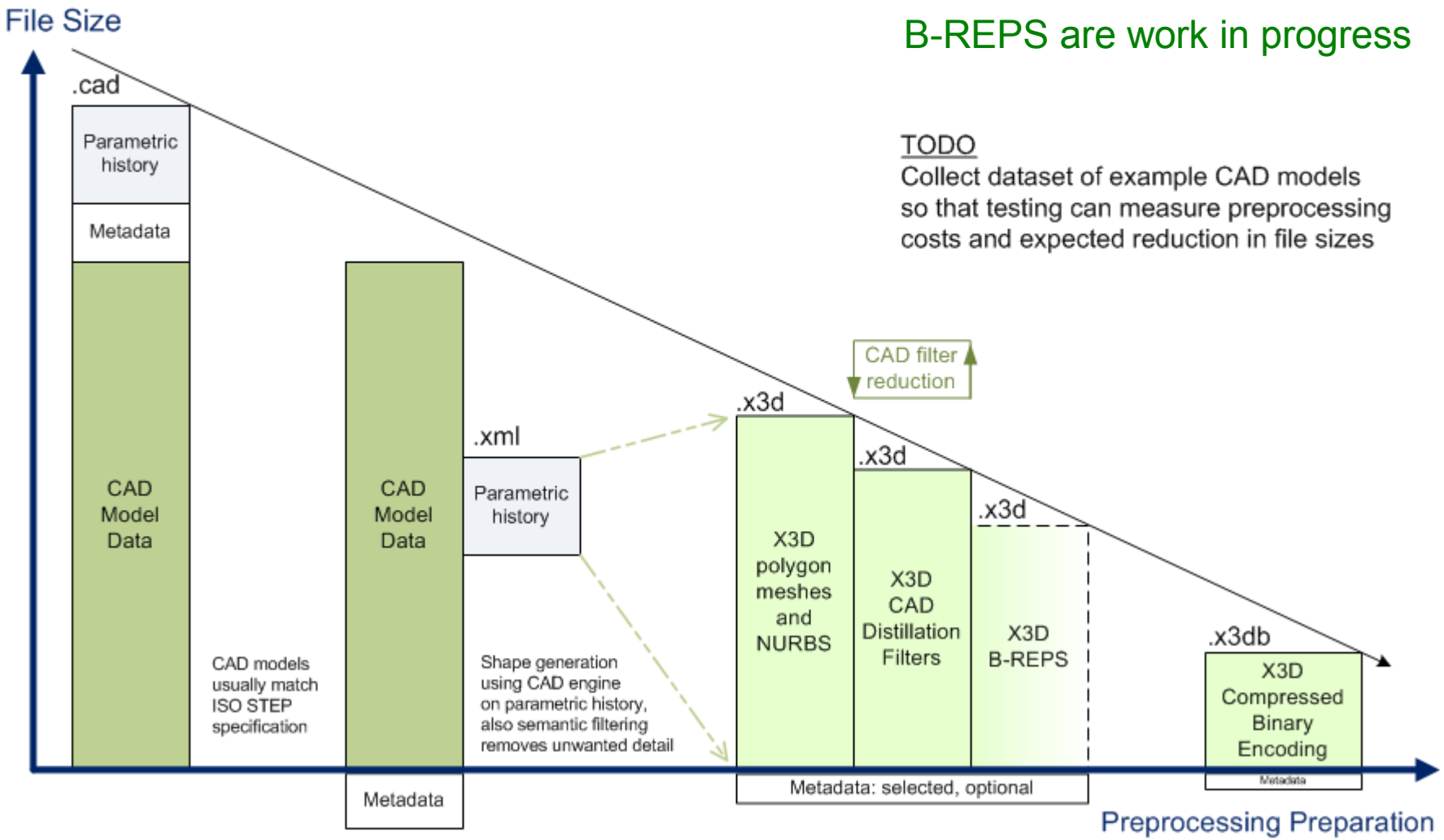
- Geometric reduction
- Fast Infoset XML reduction



Widely deployable for many purposes

Note: might even embed the Parametric History file as metadata in .x3d model, in order to enable reasonably accurate round-trip regeneration of the original CAD model despite data lossiness.

CAD Model Data Reduction



Conclusions and Recommendations

Web-based X3D interoperability reconciles diverse functionality in complementary ways

- X in X3D = extensibility, supporting stable growth
- Royalty-free standardization protects investments

Meaningful production, distribution, re-use of high-end X3D graphics can be commonplace

- Enabling important work on the bigger challenges

X3D architecture + extensibility mechanisms provide baseline framework for broad work

Proposal: show your cool tech in X3D

Lots of great work shown in GRID workshops

- … everything looked compatible with X3D

X3D extensibility includes authoring support

- Embedded script, Javascript or Java
- Prototype templates to create instances

Offer: collaborate to show compatibility

- Sketch out mapping, perhaps implement
- “Negative results have value” so identifying mismatches is also helpful

Contact

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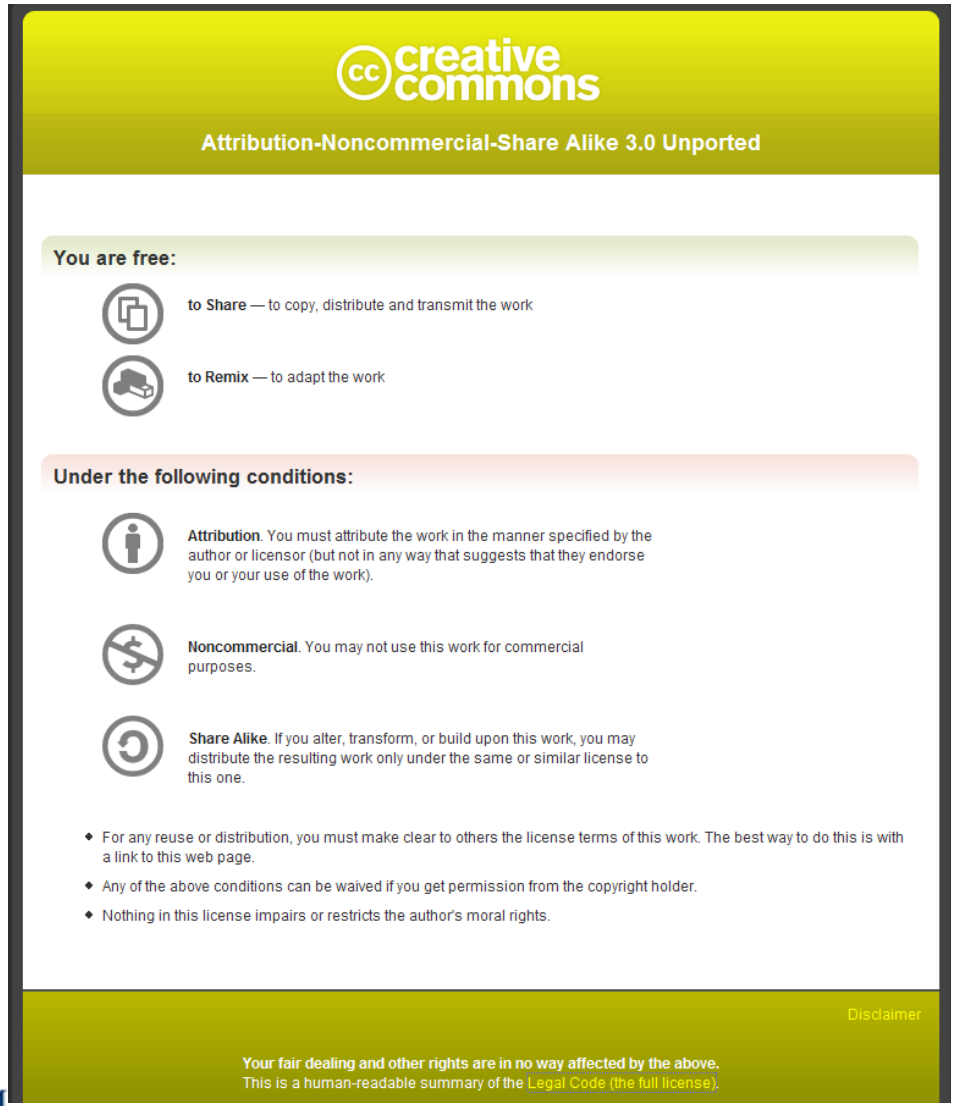

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X3D