D7.3b, Contributions to Web3D Standards

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Abstract:

We report on activities of the COVEN project concerning standards in the area of 3D technologies on the Web. Following on from an earlier review, we summarise current activities in Web3D standards, and the direct contributions we have made through support of the Web3D Consortium's Technical Advisory Board and contributions to the H-Anim specification.

Keyword list:
Collaborative Virtual Environments, Collaborative VE platform, Virtual Reality Modelling Language

***Type: P-public, R-restricted, L-limited, I-internal**
****Nature: P-Prototype, R-Report, S-Specification, T-Tool, O-Other**

Executive summary

The aim of workpackage 7 is to contribute to the standardisation process related to the VE domain. Several international standards were likely to make a major impact on CVE technology: **Distributed Interactive Simulation (DIS)**, a set of communication protocols to allow the interoperability of heterogeneous, geographically dispersed simulators, and its successor the **High Level Architecture (HLA)** defining a standard architecture for large-scale distributed simulations; **Virtual Reality Modelling Language (VRML)**, which supports the integration of virtual reality with the World Wide Web with the goal of broadening access to VR environments via the WWW infrastructure; and **MPEG4 SNHC** for video compression. The strategic objective of workpackage 7 is to strengthen European involvement in these key international standards. The successful integration of recent developments in CVEs with these emerging standards would result in an extremely powerful basis for constructing a wide range of future CVE applications.

In this part of Deliverable 7.2 we report on the activities COVEN in the area of 3D graphics for the web (Web3D). These are mostly usually associated with the VRML97 standard, but there have been implications for future Web3D standard such as the X3D initiative, and also parallel efforts such as the 3D scene components of MPEG4. The two main activities have been in our contributions to the Web3D Consortium's Technical Advisory Board, and in major contributions to the H-Anim specification for descriptions of virtual humans.

This is the second part of Deliverable 7.3. The first part of Deliverable 7.3 describes activities in the area of HLA.

Contents

1. Introduction

The aim of work package 7 is to contribute to the various standardisation processes related to virtual environment technology. The **Virtual Reality Modelling Language (VRML)** is one such standard that is quite broad in its scope and application. The basic VRML specification provides a 3D metafile format that can be used to describe the appearance, geometry, behaviour and interactions of a 3D scene. Its major advantage over other 3D file formats is that it is tightly integrated with other World Wide Web technologies, and that VRML browsers have been developed for a broad range of machines.

In Deliverable 7.2, we reviewed the VRML97 standard that was, at the time of the report, just about to be published as an ISO/IEC standard. We also outlined the various efforts that were investigating extensions of VRML97 to other applications areas or to incorporate other technologies. Finally we critiqued the application of VRML97 in the area of collaborative virtual environments.

Since that report, the on-line 3D community has diversified in several directions. However VRML97 remains the only open standard for 3D graphics on the web, and although proprietary solutions such as MetaStream (www.metastream.com) have garnered some market share, VRML97 remains the preferred solution in the areas of 3D visualisation, data interchange and editing.

We refer to this deliverable as "Contributions to Web3D Standards" since the implications of the COVEN efforts are not just in VRML extensions, but in efforts in next-generation VRML technology such as X3D, and also parallel developmental efforts that have been influenced by VRML such as the Binary Format for Scenes (BIFS) component of MPEG4 [Koenen99].

2. Overview of 3D on the Web

2.1 Web3D Consortium

The Web3D Consortium (W3DC, see http://www.web3d.org) is a consortium of roughly 50 companies and scientific institutions interested in standards for 3D on the world-wide web. It was founded in 1996, and changed its name from the VRML Consortium in 1998 to reflect its growing role.

The W3DC's main role is in the promotion and maintenance of the ISO/IEC 14772:1 *Virtual Reality Modelling Language*, or *VRML97*, the only open standard for 3D graphics on the web. The W3DC is closest in composition and operation to the World-Wide Web Consortium (W3C), in that it favours intellectually unencumbered specifications. The W3DC's working process is largely open, and indeed VRML97 was largely created in an open community process. These characteristics distinguish the W3DC and the W3C from, say, the MPEG consortium which is closed in non-member institutions.

The Web3D Consortium's focus has shifted over the past few years: with an increasing emphasis on lightweight virtual environments for use in web browsers, and multi-media integration. For example, the Living Worlds activity briefly described in Deliverable 7.2 has failed to complete. COVEN has previously commented on the un-suitability of VRML97 for large-scale CVEs (D1.4a), but where COVEN has expertise we have been able to apply it in assisting the technical progress of the Web3DC. Note that the Web3DC consortium does not have a formal submission procedure for technical contributions, as does the MPEG Consortium. Indeed most technical contributions are made at face to face meetings, which are held monthly, usually in California, USA.

2.2 Current Consortium Activities

The W3DC sponsors currently several activities:

- Technical review of VRML97 (Clarifications)
- Extensions to VRML97 (EAI, H-Anim)
- Next generation technology (X3D technology)

The External Authoring Interface (EAI) activity was described in Deliverable 7.2 (see also Steed97). The EAI standardises an interface between the VRML browser and the external environment, be it a web browser, or an interface such as COM or Java. Although a necessary component for many of the small-scale CVE systems that have been built upon VRML97, the specification has not yet been submitted to ISO for consideration, though this should happen in the next few months.

The second major activity is an amendment to the VRML97 specification based upon clarification and minor extensions. These include a scripting language amendment (making both Java and ECMAScript compulsory) and SQL Database Access in VRML [DB].

The third major activity is a low-level next-generation technology initiative called X3D. This is a recent activity initiated in late 1998 that aims to better integrate VRML like nodes and field structures with current web-browser technology though the use of eXtensible Markup Language (XML) and Document Object Model (DOM) technologies developed by the W3C [XML, DOM]. Though this is a next-generation technology, it does not address the same aims as COVEN. Indeed it revisits low-level issues of format, representation, interchange and programming interface, whereas COVEN has focused upon high-level user-oriented services.

2.3 Background to COVEN Activities

The research and development aims of the COVEN project and the standardisation activities of the W3DC have diverged over the life-time of the project. Although CVE technology does exist upon VRML97, it is mostly using proprietary server technology, a technology that COVEN experience has shown to be limiting in practice. However wherever Web3D interest has overlapped COVEN's experience, we have provided input.

2.3.1 Previous Activities

The main activity that took place previously in workpackage 7 was a review of ISO/IEC 14771:1; more commonly known as VRML97. Contributions were made through UCL's activities with the British Standard's Institute. Details of the activities can be found in Deliverable 7.2. In Section 3 we report on the more recent activities that fall under the current activity.

2.3.2 Relationship with MPEG4 Activities

Activity 7.3 details contributions to the standardisation of MPEG4. These two standards effort have been drawn together over the past two year with the MPEG4 consortium adopting VRML97 as the basis of its scene description language. There are now opportunities for each

consortium to draw on each other's strengths, especially as MPEG4 is now moving in to interactive systems, and has even recently proposed to look at collaborative systems.

3. Overview of Contributions

3.1 Main Achievements

Two main activities have taken place under Activity7.3. Firstly UCL has contributed directly to the Web3D Consortium through joining that consortium and having a member stand for and be elected to the Technical Advisory Board. Secondly EPFL have continued to contribute considerably to the Web3D Consortium's Working Group on Humanoid Animation (H-Anim).

UCL has contributed throughout the activity on the Technical Advisory Board (TAB) of the Web3DC. We have applied expertise in VE technologies gained during the COVEN Project to the review and standardisation of VRML97 extensions. Current Web3DC activities that we have been able to advise on are: impending submission of External Authoring Interface (EAI) to ISO /IEC SC24 as a committee draft that would form VRML97 Part 2; comments and support of the continuing VRML97 clarification, and potential submission of VRML97 Amendment 1; review of MPEG4 technologies for inclusion in VRML97 Amendment 1; and review of the Web3D next-generation technology initiative X3D. We have also represented COVEN at two larger consortium meetings, both in the USA.

The second major contribution has been EPFL and University of Geneva's contributions to the HANIM 1.1 specification that permits to define, in a standard way, a virtual human in VRML. EPFL has implemented part of specification, implementations (displacement nodes, JAVA/VRML MPEG4 player for HANIM, JAVA Humanoid library) which were a part of the submission to the web3D technical advisory board. HANIM 1.1 was accepted on the 24th September 1999.

3.2 Summary of Achievements

- Election of Anthony Steed to Web3D TAB by consortium member election.
- Participation in TAB activities. (Internal Web3D process review, public comment on standards, decision making).
- Election of Anthony Steed as Chair of TAB, part responsible for directing technical work with Technical Executive.
- Technical comments to ongoing development work.

- Responsible for first draft of "Web3D Roadmap" that was used as basis for Web3D marketing and technical planning for 1999.
- Liaison between Web3D Working Groups and COVEN.
- Several contributions to H-Anim specification

4. Technical Advisory Board Activities

4.1 Face to Face Meetings

Attendance at the Web3D members meeting March 1999 (Sony Corporation, Mountain View, California) and separate TAB meeting. A confidential report was circulated to COVEN Project members. Attendance at Web3D members meeting and Web3D Board of Directors meetings that took place in August 1999 (SIGGRAPH 99, Los Angeles, California). Also participation in several subsidiary public meetings during the SIGGRAPH conference [Steed99].

4.2 Teleconferences

We have taken part in approximately 28 teleconferences in the last year in pursuance of our role on the TAB. These include Web3D Technical Advisory Board, Board of Directors, Executive Board and ad hoc meetings.

4.3 Publicity

We have noted, where appropriate that our contributions to Web3D have been sponsored by COVEN. In addition some of our dissemination activities have been based upon these Web3D activities. See for example Appendix B, an overview of Web3D activities presented to recent UK special interest group meeting.

5. H-Anim Activities

One of the main activities of the COVEN project was in the simulation and animation of realistic human avatars for use on CVE systems. COVEN has concentrated on two main aspects: simulation of single humans for use as one's personal avatar in the virtual world, and simulation of autonomous crowds of avatars for illustration and simulation roles for large-scale environments [D44].

The lead in these activities was provided by the University of Geneva and EPFL. Given these institutes broader interests, it was natural for them to become involved in the H-Anim working group of the Web3D Consortium. Personnel at these institutions were instrumental in providing the background experience in these areas, text for the specification and examples for testing purposes. Much of this work was done in parallel with MPEG4 activities [D74] since there is common material between the two standards. The newly released H-Anim1.1 standard will become a Recommended Practice of the Web3D Consortium in the near future, whilst the equivalent elements of MPEG4 will be standardised in Version 2.

The main participation of EPFL and University of Geneva was in discussion on the H-anim working group mailing list and implementation of some proposals to validate proposals. Then, some additional work was performed in order to test and demonstrate capabilities included in the H-anim proposal.

The classical context for this work is a VRML plugin included in a HTML page. The link between the VRML world and main program is based on the use of the External Authoring Interface (EAI). All the following work is based on a JAVA library, which allows to manipulate a H-anim 1.1 compliant body from a JAVA program. It retrieves the entire body hierarchy and permits to take control of it by updating joint values. This library is grouped in a JAVA package named EAIHuman.jar.

Main realizations were in real-time body deformation, facial animation, MPEG4 player and motion capture interface.

5.1 Real-time body deformation

Based on the H-anim 1.1 specification, this proposal is based on two new VRML prototypes in charge of body surfaces to be deformed. These two prototypes are integrated in a normal H-anim hierarchy. The method is based on a specific organization of body surfaces in a set of contours composed of a given number of points. The deformation is performed through the

orientation of these contours in relation with the body movement. Details on the method can be found in [Babski99]. This was the first real-time deformed body realized in VRML using H-anim 1.1 specification.

Figure 1: The real-time deformed body demo: the rodeo.

5.2 Facial animation

The basic method is based on H-anim 1.1 specification introducing the *Displacer* VRML prototype. The *Displacer* associates a given movement to a given set of points. Involved 3D points are specified by using their indexes in the main point set. The default specification of *Displacer* does not permit to several *Displacers* to act on a common set of points. EPFL and University of Geneva proposal extends the basic prototype and defines a new one in order to be able to modify a point through several *Displacers*. The extended prototype also introduced a set of new parameters in order to obtain a better control and a better usability of the *Displacer* prototype. The entire proposal and two VRML examples can be found at http://ligwww.epfl.ch/~babski/StandardBody/FacialAnimation/index2.html.

Figure 2: An example of facial animation obtained through the use of a set of Displacers.

5.3 MPEG4 player

The MPEG4 player was realized on the top of H-anim 1.1 specification. The goal was to animate a H-anim 1.1 compliant body with a MPEG4 BAP (Body Animation Parameters) ASCII file in order to demonstrate the compatibility between the two standards. The entire needed library is made in JAVA. Basically, the player can get a MPEG4 animation file from the local disk or from any location on the WEB. The MPEG4 animation is then converted in real-time (as it is formatted to be applied on a MPEG4 body, which is different from H-anim 1.1 specification). Then the resulting animation can be applied on any H-anim 1.1 compliant bodies. This work was based on the ASCII version of the BAP file, but by adding a new layer in charge of decompressing a MPEG4 stream, the ASCII file can be replaced by a MPEG4 stream. Details and a demo can be found on the WEB at http://ligwww.epfl.ch/~babski/StandardBody/mpeg4

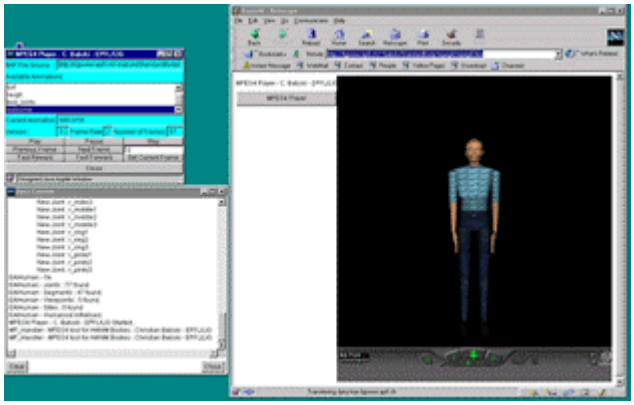

Figure 3: The MPEG4 player graphical interface.

5.4 Real-time animation using a motion capture system

Still within a WEB context, this makes a link between a H-anim 1.1 body and a motion capture system. The system used is the *MotionStar* from Ascension technology. It is based on a set of magnetic sensors, which are moving in a magnetic field. A connection is established between the real animator (who is wearing the magnetics sensors) and the associated H-anim 1.1 body. A complete description of the method can be found in [babski00].

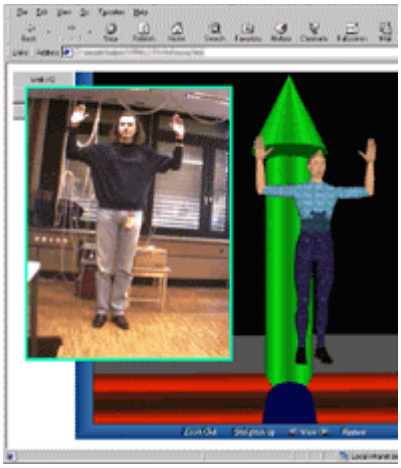

Figure 4: Example of real-time animation captured from the MotionStar system and applied to a H-anim 1.1 body.

References

[Babski99] C.Babski, D.Thalmann, A Seamless Shape for HANIM Compliant Bodies, Proc. VRML 99, ACM Press, 1999, pp.21-28.

[Babski00] C. Babski, D. Thalmann, Real-Time Animation and Motion Capture in Web Human Director, Proc. Web3D & VRML 2000 Symposium (to appear).

[D44] Deliverable 4.4, Integration of the interaction techniques into the Applications, ACTS Project N. AC040 (COVEN)

[D72] Deliverable 7.2, Review of VRML and WWW Techniques, ACTS Project N. AC040 (COVEN)

[D74] Deliverable 7.4, Contribution to the MPEG4 SNHC Forum, ACTS Project N. AC040 (COVEN)

[DB] SQL Database Access in VRML, Recommended Practice of the Web3D Consortium, http://www.web3d.org/Recommended/vrml-sql/vrml-sql-ex.html

[DOM] Document Object Model (DOM) Level 1 Specification, W3C Recommendation, http://www.w3.org/TR/REC-DOM-Level-1/

[EAI] External Authoring Interface 1.0, Draft Specification of the Web3D Consortium, http://www.web3d.org/WorkingGroups/vrml-eai/Specification/

[H-Anim] Humanoid Animation 1.1, Draft Specification of the Web3D Consortium, http://ece.uwaterloo.ca/~h-anim/spec1.1/

[Koenen99] Rob Koenen (editor), MPEG-4 Overview, October 1999, http://drogo.cselt.stet.it/mpeg/standards/mpeg-4/mpeg-4.htm

[Steed97] The External Authoring Interface, Talk at Visualisation and Virtual Environments Community Club Meeting, Rutherford Appleton Laboratory, 21st May 1997, http://www.cs.ucl.ac.uk/staff/A.Steed/eai

[Steed99] Anthony Steed, SIGGRAPH99 Web3D/VRML Activities - Report to COVEN Project, Internal COVEN Project report, September 1999.

[XML] eXtensible Markup Language (XML) 1.0, W3C Recommendation, http://www.w3.org/TR/1998/REC-xml-19980210

Appendix A: Contributions to International Standards

Stds Body/ Committee/ Subcommittee	Date	Title of contribution	Impact on world standard *	Impact on European standard *	Impact* on standard in normal use
Web3D Consortium	Jul 1999	Contributions to H-Anim 1.1 Specification	3		
Web3D Consortium	Jul 1999	Technical Advisory Board, Report to August 1999 Members Meeting (Progress in ISO standards, study groups and Recommened Practices)	2		
Web3D Consortium / Technical Advisory Board	Oct 1999	Report on MPEG4 Technical Review (On study of incorporating MPEG4 technology in ISO/IEC VRML97)	3		
Web3D Consortium / Technical Advisory Board	Mar-Dec 1999	Minutes of TAB meetings (Internal Web3D communications)	1		

* Use scale: 0 = No impact; 1 = Low impact; 2 = Moderate impact; 3 = High impact

Appendix B: The State of Web3D

This appendix contains the slides of a talk given to the UK Visualisation and Virtual Environment Community Club meeting, *Web Graphics - the Way Forward*, 11th November 1999, Rutherford Appleton Laboratory.

See also http://www-ais.itd.clrc.ac.uk/VVECC/proceed/webgraphics/index.html

The State of Web 3D

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VVECC 11th November 1999

The State of Web3D

- **Status Quo**
  - **VRML97 Part 2, Amendment 1**
  - **RoadMap**
- **Evolution**
  - **X3D**
- **Revolution**
  - **VRML/Web3D Futures**

Status Quo

Context

- **VRML97 well established, still only open standard for 3D content**
  - **Way ahead of its time**
- **MPEG4 adopted VRML97-like structures for scene graph**
- **Increasing number of competitors**
- **Today's desktop ships with a 3D accelerator card**

Perceived VRML Deficiencies

- **Integration with web page is poor**
- **No streaming audio/video**
- **No binary compression**
- **Graphics**
  - **Multi-texture**
  - **NURBS**
- **YourFavouriteNode**

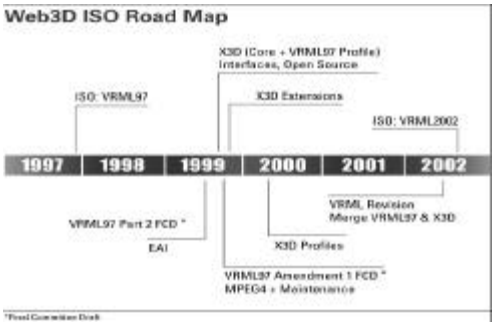
Web3D Consortium

- **Oversee technical development of Web3D technologies**
- **Modelled along the lines of W3C**
  - **But submits specifications to ISO**
- **Has strict IPR disclosure policy**
  - **Unlike MPEG4 consortium**
- **Not a single IPR restriction within VRML97**

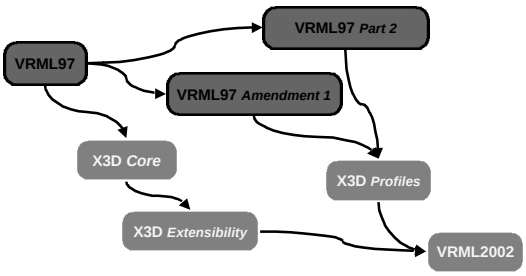
Web3D Working Groups

- **Specification Extensions**
  - *EAI*, **CBF, streaming, user input, living-worlds,** *MPEG4*
- **Best Practise/Examples**
  - **Content, vrml-dis-java, VRTP, HAnim, conformance**
- **Mixed/Miscellaneous**
  - **Enterprise, GeoVRML, OpenSource**

Web3D Road Map



Web3D Road Map



External Authoring Interface

- **Standardises interface between VRML browser and external world (usually web browser)**
- **Also interaction between page content and VRML scene**
- **Now in 2nd version, with two implementation**
- **Will become *ISO/IEC 14772 Part 2***

VRML Amendment 1

- **Scheduled components**
  - **MPEG4 enhancements**
  - **Scripting Language amendment**
  - **SQL Database Access in VRML**
  - **Clarifications**
- **Status**
  - **MPEG4 under review**
  - **Scripting language and SQL database enhancement are completed**

Evolution

(Acronym Preparation)

- **A VRML browser is a *plugin* so it is not part of the page description**
- **HTML has a Document Object Model**
  - **allows scripts to access items in page and manipulate them (DHTML)**
- **HTML being replaced by XML**
  - **eXtensible Markup Language**

X3D Rationale

- **Remove barriers to entry**
  - **Small enough that a browser need not be required (no plugin!)**
- **Streamline**
  - **Remove unnecessary nodes**
  - **Simplify APIs**
- **Increase integration with browser**
- **Built-in extensibility mechanism**

X3D Process

- **Open process (was originally closed)**
- **Several "core" proposals, Blaxxun, Draw, Shout3D**
  - **e.g. Blaxxun is a strict VRML97 subset**
  - **e.g. Shout3D**
- **Two "extensibility" efforts**
  - **Blendo (Chris Marrin, Sony)**
  - **Jamal (Mark Rudolph)**

X3D Core Node Set

- **Anchor**
- **Appearance**
- **Background**
- **Color**
- **CoordinateInterpolator**
- **DirectionalLight**
- **Group**
- **ImageTexture**
- **Inline**
- **IndexedFaceSet**
- **IndexedLineSet**
- **Material**
- **Material**
- **NavigationInfo**
- **OrientationInterpolator**
- **PointSet**
- **PositionInterpolator**
- **ScalarInterpolator**
- **Shape**
- **TimeSensor**
- **TouchSensor**
- **Transform**
- **Viewpoint**
- **WorldInfo**

A few X3D Modifications

- **Timebases**
  - **Still being argued, VRML97 approach was/is "novel"**
- **Field changes**
  - **line width on IndexedLineSet**
- **Unified field model**

X3D Encodings

- **XML encoding**
- **VRML97-style encoding**
- **Binary encoding**

X3D APIs

- **One true Scene Authoring Interface (SAI)**
- **Based upon EAI2.0**
  - **Event model based, not route based**
- **Internal and external access are the *same***

X3D Extensibility

- **Will componentise the specification**
- **Core will be extensible**
  - **Similar to the internal Browser API proposed for VRML97 (Marrin)**
- **Still under development**

X3D Profiles

- **Core Profile: 23 of 54 nodes**
- **VRML97 Profile**
- **VRML97 Amendment 1 Profile**
  - ***(EAI expressible through DOM?)***
- **Profiles including hardware only extensions**
  - **Multi-texture, NURBS, etc…**
- **Profiles for set-top box, (PS2?)**

Implications

- **VRML97 browser will NOT read X3D files**
  - **X3D Core in the VRML97-like encoding will not be strictly VRML97 compliant (?)**
- **X3D Browser that supports VRML97 profile will read VRML97**
- **Conversion of files to and fro will be trivial**
  - **Converters already exist / are being built**

X3D Milestones

- **December 1999: first draft deliverables**
  - **Consortium meeting first week December**
- **February 2000: publicly review, discuss at Web3D-VRML 2000 Symposium**
  - **February 21-24, Monterey**
- **March 2000: Web3D-W3C spec relationships**
  - **XML/XHTML, modularise, language family etc.**
- **SIGGRAPH 2000: push feature-frozen specification to ISO (probably)**
- **Roadmap shows master plan**

X3D Relationships

- **SVG (W3C)**
  - **Competes with MPEG4 2D nodes**
- **SMIL (W3C SYMM Working Group)**
- **DOM/DOM2**
- ***XML***
  - **where (* = Schema, Link, etc…)**

VRML2002?

- **5 years is the average review cycle**
- **It will be a synthesis of ongoing VRML97 work**
  - **Reflects many needs**
- **Dick Puk is signed up to edit the specification …**

Revolution

Pushing the State of the Art

- **X3D prepares the ground for extension**
- **Many areas for extension**
  - **NURBS**
  - **Streaming …**
- **Could be added to VRML97 first**
  - **Volunteers required to implement and write specifications!**

Implementing It

- **Browser Sources**
  - **Community Source Blaxxun Contact**
    - **Web3D will "ship" browser**
  - **Open Source Java3D/VRML Browser**
    - **Available for CVS**
- **NOT reference implementations**

Futures

- **VRML97 is not going away**
- **X3D simplifies and extends**
  - **Supports VRML97 as a profile**
- **Exciting times for 3D on the web**

www.web3d.org