

## **X3D Augmentations for General Spatial Referencing**

### **Abstract**

X3D is already capable of presenting geo-spatially referenced data. However, these capabilities are somewhat rudimentary and can be significantly improved. This white paper describes how the spatial referencing of X3D can be generalized through adoption of recently approved SEDRIS standard technologies.

### **Introduction**

X3D Earth is a project that is intended to make spatial data residing in publicly available databases easily accessible. One goal of this project is to use International Standards that support the project and that also do not have significant intellectual property rights restrictions. X3D is the name given to one such set of standards. Another set of standards are those that specify SEDRIS technologies. This paper will describe how the SEDRIS technologies may be used to augment X3D with general spatial referencing capabilities as well as providing the means whereby metadata information can be integrated into X3D worlds in a standard manner.

### **Relevant Standards**

#### ***X3D Standards***

The moniker, X3D, stands for Extensible 3D. The set of X3D standards specifies a representation and run-time environment for presenting dynamic 3D data. ISO/IEC 19775 is a two-part standard that specifies an abstract representation mechanism for describing 3D worlds and for accessing those worlds from external programs. Part 1 is a specification of the abstract description of the X3D architecture and description mechanism. Part 2 is a specification of the Scene Access Interface that defines a set of services which can be accessed either from within an X3D world or from external programs. These services can be used to modify the world as it runs.

The X3D Architecture divides X3D functionality into a set of components. Each component specifies the capabilities for a particular type of functionality. For example, the Geometry3D Component describes 3D geometry nodes and the Navigation Component specifies the viewing and navigating functionality with X3D worlds. There are currently 40 components that are either standardized or in the process of being standardized. Historically, X3D is a 2<sup>nd</sup> generation standard that improves upon the Virtual Reality Modeling Language (VRML) which was standardized as ISO/IEC 14772. Both VRML and X3D are widely used throughout the world.



The set of abstract nodes and fields described in Part 1 of the X3D standard can be represented in files by encoding the abstract descriptions using various encoding techniques. ISO/IEC 19776 is a three-part standard that describes three different interchangeable encoding techniques: XML, Classic VRML, and Compressed Binary. Any X3D file can be encoded in one and converted to another without loss of information. In addition, X3D browsers that implement more than one encoding technique can intermix the X3D content that use differing encoding techniques. Additional techniques can be added by standardizing additional parts of ISO/IEC 19776.

The services specified abstractly in Part 2 of X3D can be utilized from different scripting languages. ISO/IEC 19777 is a two-part standard that specifies language bindings for the abstract services. Part 1 specifies a binding to ECMAScript while Part 2 specifies a binding to Java. Other languages can be supported by standardizing additional parts of ISO/IEC 19777.

There are no IPR restrictions imposed by the X3D standards.

### ***SEDRIS Standards***

SEDRIS is a set of standards for representing accurate descriptions of real or virtual spatial environments. SEDRIS does not specify a run-time environment. Instead, it supports the precise and standard description of spatial environments for use in simulations. The goal of SEDRIS is to allow the reuse of these spatial environments on differing simulation systems. The SEDRIS technologies consist of a Data Representation Model (DRM), an Environmental Data Coding Standard (EDCS), and a Spatial Reference Model (SRM). The latter two standards are defined generally so that they can be used either by the DRM or by other non-SEDRIS applications.

EDCS is standardized in ISO/IEC 18025 and specifies a standard set of codes for representing various concepts. For example, there is a standard code for representing a school building. This allows anyone who reads the code to understand that the associated data represents a school building. There are codes for such concepts: as *classifications* (what does the data describe), *attributes* (what are the properties of the object and what are the values for those properties), and *units* and *unit scale factors* (in what units is the object specified). Other codes are specified for working with these fundamental codes. Each concept is assigned a standard name, a standard code, and other information including descriptions, source references, and related information.

SRM is standardized in ISO/IEC 18026 and specifies a standard reference model for specifying spatial data. The SRM not only specifies the means for specifying such data but also the algorithms for implementing those specifications. In addition, names and codes are assigned for representing well-known and accepted celestial objects such as the planets, moons, and the sun. The SRM is especially valuable in that it collects in a single document information that has heretofore only been available in source material



that is often hard to find or, once found, hard to obtain. The concepts supported by the SRM include the specification of Spatial Reference Frames and Object Reference Models. The current X3D Geospatial Component uses a very small and limited subset of the information specified by the SRM.

The SEDRIS DRM is standardized in ISO/IEC 18023 and specifies a standard mechanism for representing spatial environments. The DRM is actually a mechanism for specifying the characteristics of data models and populating those data models. An instance of a populated data model is termed a transmittal in this standard. Part 1 of the SEDRIS standard specifies an abstract description of the capabilities of the DRM. Also specified is an abstract specification of functions for creating and accessing transmittals and the constituent DRM elements of that transmittal. Parts 2 and 3 specify an abstract transmittal file format and a particular binary encoding for transmittals. It is intended by this standard that transmittals be an interchange mechanism for environmental data which, to be utilized, needs to be imported into a simulation system for processing.

Each of the abstract standards described above have an associated standard binding to the C programming language.

The SEDRIS Organization is comprised of SEDRIS Associates representing a variety of organizations whose goal is to support the SEDRIS standards either as users or as product developers. One SEDRIS associate is ObjectRaku of Vancouver, BC. ObjectRaku is a company that supports SEDRIS and VRML for a variety of mostly military projects. Since they already support both SEDRIS and the X3D predecessor, it might be worthwhile inviting them to join the X3D Earth project.

There are no IPR restrictions imposed by the SEDRIS standards.

## **Integration of SEDRIS technologies within X3D**

### ***SRM Integration***

X3D already supports a very limited subset of the SRM. While this does allow geopositioning objects within an X3D world, it falls far short of supporting standardly available environmental data. For example, only one form of geodetic and one form of geocentric spatial reference frames are supported. Moreover, it is not generally possible to integrate environmental data specified in more than one SRF. The proposal is for the X3D Geospatial Component to be either enhanced to support all of the capabilities of the SRM or to specify a new X3D Spatial Component that supports the entirety of the SRM. Further research is needed to determine the best course. It should be noted that the entirety of the SRM has been implemented in an open source implementation available at <http://www.sedris.org>. In addition, there are many commercial implementations of the functionality. Thus, the time-consuming and



expensive job of implementing the algorithms is not needed. However, the means of specifying the requisite parameters within X3D remains.

### ***EDCS Integration***

The information provided by EDCS can be considered metadata for most applications. X3D already has a powerful and flexible metadata capability that allows metadata to be specified at any level and according to any metadata standard. Anyone wishing to use EDCS code in X3D worlds need only include the codes in the appropriate X3D metadata nodes. This should be encouraged as it does provide for a standard meaning to the metadata. The only area in which EDCS might influence the design of X3D is that EDCS allows values to be specified in any of a variety of compatible units. Should X3D desire to support units other than meters and radians, additional fields could be added as appropriate to allow unit and unit scale factor specification. However, this is not currently being proposed for X3D Earth. It should be noted that EDCS units are the units specified by ISO 41 which specifies international standard units.

### ***DRM Integration***

There are currently no plans to integrate DRM functionality into X3D. However, it might be worthwhile to evaluate some of the capabilities of specific DRM classes as a means of augmenting X3D capabilities. An example is that the DRM supports a range of level of detail capabilities in addition to distance LOD.

One SEDRIS-based project that might be worthwhile would be to develop a translator from SEDRIS transmittals to X3D nodes. This would allow for convenient presentation of SEDRIS environments in a wider context.

## **Proposal**

As part of the X3D Earth project, a general enhancement to the X3D Geospatial Component (or an additional Spatial Component) will be necessary to handle the data that exists throughout the world in a variety of SRFs thus avoiding unnecessary SRF conversions and database duplications. In addition, integrating the entirety of the SRM in X3D would also provide support for non-Earth presentations as well as the SRM supports the ability to represent most of the celestial objects in our solar system.

Additionally, the X3D Earth project should impose a requirement to use the EDCS to classify features being represented by X3D Earth data. In this manner, worldwide understanding of the meaning of environmental data will be ensured.