Background, Concepts and Current Status of SEDRIS

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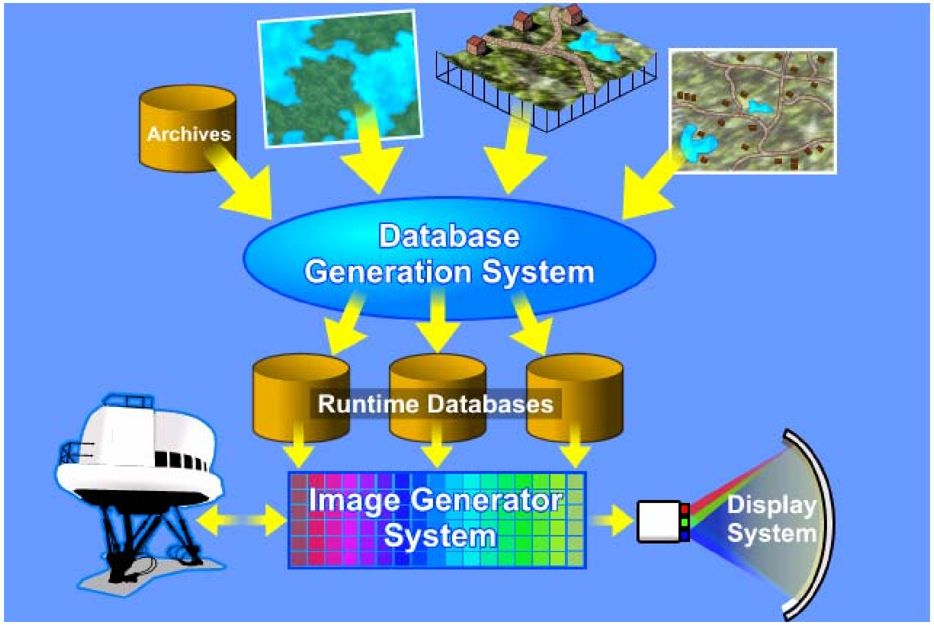


Topic to be Addressed

- Visual and other sensor databases provide a data representation of environmental data
- Multi-sensor databases cannot easily be interchanged between different types of applications
- This presentation examines the reasons why the specification and interchange of environmental data is difficult and how this has been addressed by SEDRIS

Agenda

- Multi-sensor databases that represent the physical environment
- Factors that limit database interchange
- Approaches to overcome interchange problems
- Decision to publish SEDRIS as ISO/IEC standards
- Concepts of the DRM
- Concepts of the EDCS
- Concepts of the SRM
- Current status of ISO/IEC standards
- Examples of SEDRIS applications
- Summary
- Further Information

Multi-Sensor Databases

- A Multi-sensor Database is a **Data Representation of the Environment**
- Environment consists of Terrain, Ocean, Atmosphere and/or Space
- The type of database most frequently produced is a Visual Out the Window (OTW) database
  - Typically terrain, coastline, sea surface and moving models, plus special features to depict weather effects and sea waves

- Other types of Multi-sensor Database;
  - Infra-Red (IR, FLIR)
  - Night Vision (NVG)
  - Radar (DRLMS)

Factors that limit Database Interchange (1 of 3)

- Environmental entities can be represented in many different ways, depending on the application. The representation of a building, for example, could be;
  - Visualisation: - physical dimensions, colour and appearance
  - Military training simulation: - material strength of the building and its proximity to a major communication line
  - Entertainment or urban training application: - interior details of the building

- For visualisation, there are multiple ways in which an environmental object may be represented;
  - Terrain features may be represented as vector data or as a set of polygons or as both
  - A cloud may be represented either as a 3D grid of moisture content or as a 3D polygonal model

SEDRIS solution: Allow multiple representations of the same environmental object

Factors that limit Database Interchange (2 of 3)

- Even when the application is the same, the data models that define an environmental object may combine different sets of characteristics.
- A tree, for example, could be represented by data models A and B;

Data Model A	Data Model B
Height	Location
Species	Material properties
Stem diameter	Stem radius
Location	Height

- Software designed for Data Model A's data structure will not parse the values communicated by Data Model B

SEDRIS solution: Separate the semantics of what a component means from the syntax of the data structure

Factors that limit Database Interchange (3 of 3)

- Different methods may be used to describe an environmental entity and its attributes
  - E.g.; FID, FACC or proprietary feature catalogue

SEDRIS solution: Define an Environmental Data Coding Specification (EDCS) that references existing feature catalogues and covers the complete spectrum of the environment including urban, terrain, ocean, atmosphere and space

- Positions that are based on different co-ordinate systems may produce errors when converted

SEDRIS solution: Define a Spatial Reference Model (SRM) that ensures accurate and high precision transformation between alternative representations of location data

- For any of the above reasons, information may be lost when a database is interchanged

Approaches to overcome interchange limitations;

- Fixed data format, e.g. SIF/HDI, OpenFlight
  - Multiple representations of the same environmental entity are not supported
  - New types of data representation require extensions to the data format
  - Usually limited to visual-only applications
  - The various domains of environment are not supported or integrated
- Conventional data model
  - Directly tied to the entity or concept it models
  - Attributes specific to each entity's class are built in to the class definition
- Data representation model
  - Defines a mechanism that allows a variety of data to be modelled and represented through a common set of classes
- SEDRIS uses a Data Representation Model approach

Primary SEDRIS Objectives;

- The clear and unambiguous representation of environmental data
- The practical and efficient interchange of environmental data

Secondary SEDRIS Objectives;

- Include all types and domains of environmental data;
  - Physical (e.g. forest) and abstract (e.g. air space)
  - Natural (e.g. river) and constructed (e.g. computer generated model)
  - 3D models, including articulations
  - Terrain, ocean, atmosphere, space
- Allow environmental objects to be represented in different ways for different purposes
  - Polymorphic representation
- Support the creation of data models that allow an application to completely and accurately represent its environmental data, while ensuring that such data can be understood and used by another application

SEDRIS Technology Components;

- A Data Representation Model (DRM)
  - A model that defines how specific data models can be represented
- SEDRIS Transmittal Format (STF)
  - A practical means to interchange environmental data
- SEDRIS Application Program Interface (API)
  - Provides access to a data transmittal
- An Environmental Data Coding Specification (EDCS)
  - A set of dictionaries that define classification and attribution
- A Spatial Reference Model (SRM)
  - A framework that supports the unambiguous specification of positions, directions, distances and time associated with spatial information

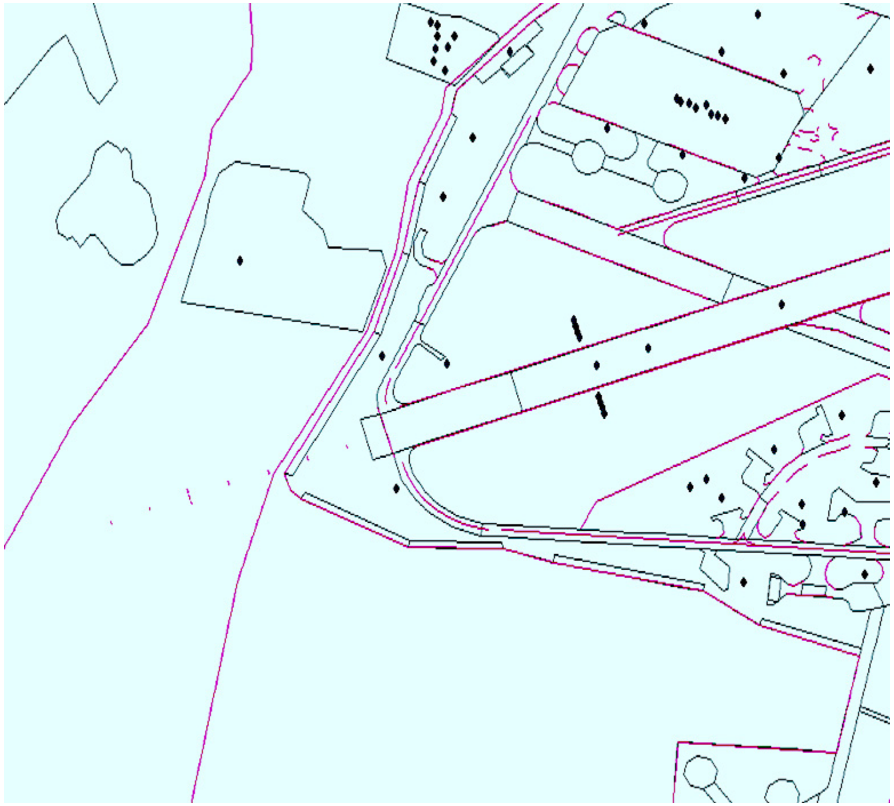
Decision to publish SEDRIS as ISO/IEC standards

- For SEDRIS technology to be most effective, it had to be published as a formal standard
- Although SEDRIS technology is a US-initiated development, it was strongly felt that the standard should be international and non-military
- Decision was taken to publish SEDRIS as ISO/IEC standards
- Generation of ISO/IEC standards for SEDRIS technology began in 2000
- It has been a co-operative task between the SEDRIS Organization and the associated ISO/IEC Sub-Committee

Concepts of the SEDRIS DRM

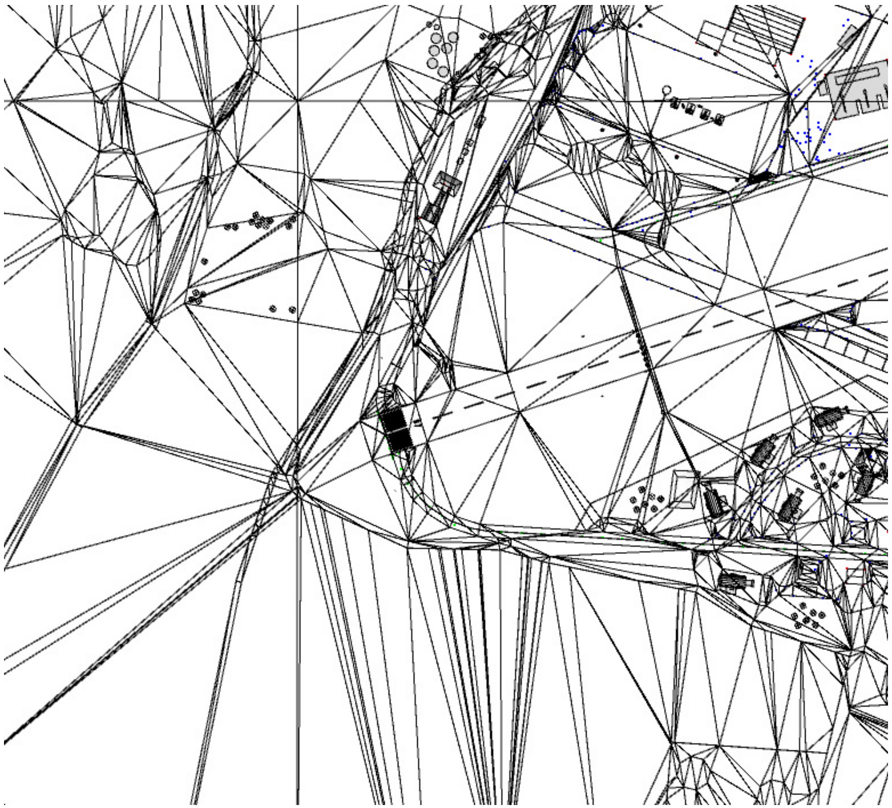
- In order to define a set of classes that may represent any environmental object, information has to be factored out so that syntax is separated from the semantics. Classes may then be used like building blocks and hence be combined to represent a variety of environmental objects
- The DRM contains 303 classes that are defined using UML notation.
- DRM classes fall into the following broad categories;
  - Geometry classes that define physical shape or form
  - Feature classes that describe a more abstract representation of a physical object or non-physical concept
  - Topology
  - Attributes of objects or concepts
  - Data organization schemes
  - Explicit relationships between classes

- Feature classes describe vector data, such as in DFAD and VMap
- Geometry classes describe more explicit physical forms, such as polygons in a facetised database



Vector Data

Features Classes



Equivalent Polygonal Data

Geometry Classes

Common Syntax and Structural Semantics

- A **Common Syntax** is provided by geometry and feature primitive classes, enabling them to be used to represent different types of real world objects
  - A point feature, for example, can be used to represent a lamp post, or a tree or a building

- **Structural Semantics** are provided by data organization classes
  - The organization of data, such as by time or by spatial partition, has a meaning that is independent of the meaning of the data it relates to

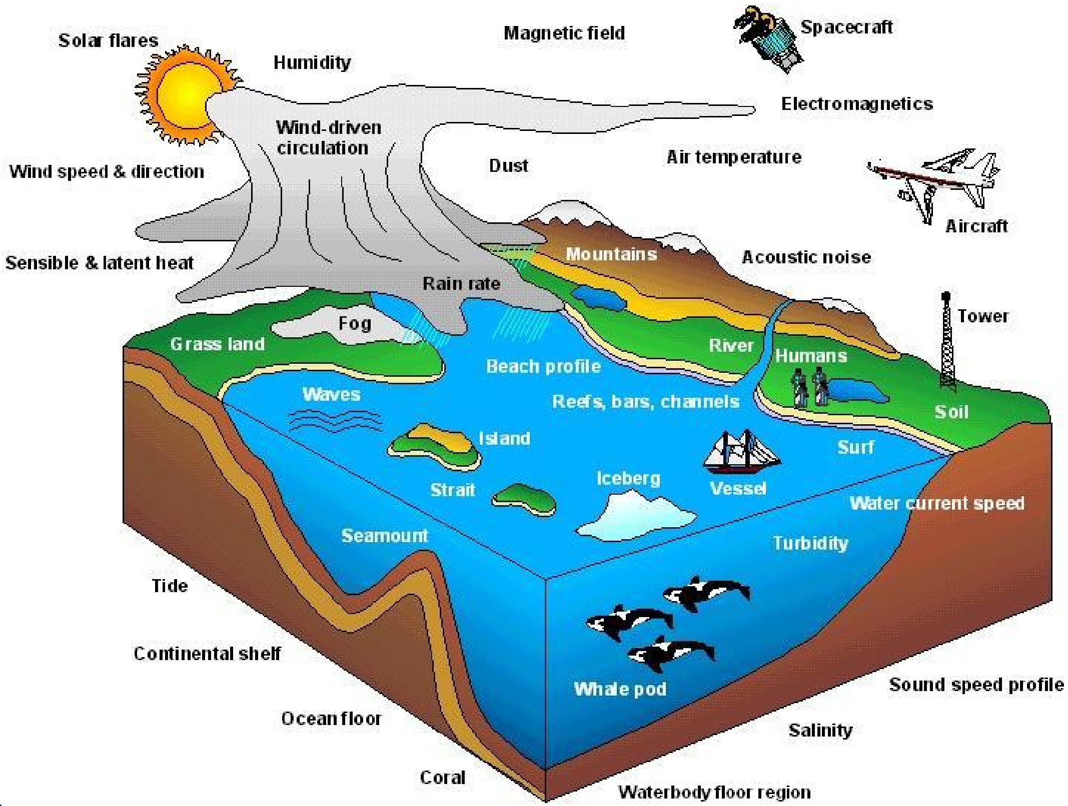
Summary of the DRM Concepts

- DRM classes separate the primitives that define the representation of something from the semantics that describe what it is.
- Common syntax and structural semantics are independent of the data they relate to, hence are factored out
- The result is a set of “Building Blocks” that can be combined in different ways to represent many different types of environmental objects
  - Primitives
  - Common syntax
  - Structural semantics
  - Object semantics (EDCS)
  - Location semantics (SRM)
- These concepts allow a single schema to represent a large variety of possible data models

Environmental Data Coding Specification (EDCS)

Concepts of the EDCS

- References existing feature catalogues, where possible
- Adds value by;
  - Reducing ambiguity by factoring out information into separate dictionaries
  - Providing a 'seamless' cover of the complete environment, including urban, terrain, ocean, atmosphere and space



Concepts of the EDCS (continued)

- The EDCS is designed as a stand-alone component of SEDRIS and is populated with over 12 000 entries.
- It consists of 9 dictionaries;
  - Classification EC
  - Attribute EA
    - Attribute Value Characteristic EV
    - Attribute Enumerant EE
    - Unit EU
      - Unit Scale ES
      - Unit Equivalence Class EQ
  - Organizational Schema EO
    - Group EG
- Each dictionary entry has, as a minimum;
  - Definition
  - Label
  - Code
  - Reference Type and Reference
- An EDCS API assists access to the EDCS dictionaries
- An EDCS Registry allows new dictionary entries to be submitted

Spatial Reference Model (SRM)

Concepts of the SRM;

- Designed as a stand-alone component of SEDRIS
- Utilises existing spatial references, where appropriate
- Adds value by;
  - Providing a single framework for diverse communities of users
    - CAD/CAM
    - Modelling and Simulation
    - Geodesy
    - Space science
  - Providing an integrated framework that;
    - Supports the unambiguous spatial referencing of locations and directions
    - Provides a well-defined terminology
    - Uses formal mathematical definition of computational concepts
    - Is extensible through a registration process
- An application program interface (API) that supports more than 20 forms of position representation

Current Status of the ISO/IEC Standards for SEDRIS

ISO/IEC Ref.	Standard	Submit for Publication	Post for Ballot *	IS *
18023-1	SEDRIS DRM and API	May 05	Jul 05	Nov 05
18023-2	SEDRIS Abstract Transmittal	May 05	Jul 05	Nov 05
18023-3	STF Binary Encoding	Jun 05	Aug 05	Dec 05
18024-4	SEDRIS Language Binding to C	Aug 05	Oct 05	Jan 06
18025	EDCS	Completed	Completed	Apr 05
18041-4	EDCS Language Binding to C	Completed	Completed	Apr 05
18026	SRM	Apr 05	Jun 05	Nov 05
18042-4	SRM Language Binding to C	Jul 05	Aug 05	Dec 05

* These dates are not under the control of the Sub-Committee for SEDRIS standards

Examples of SEDRIS Applications

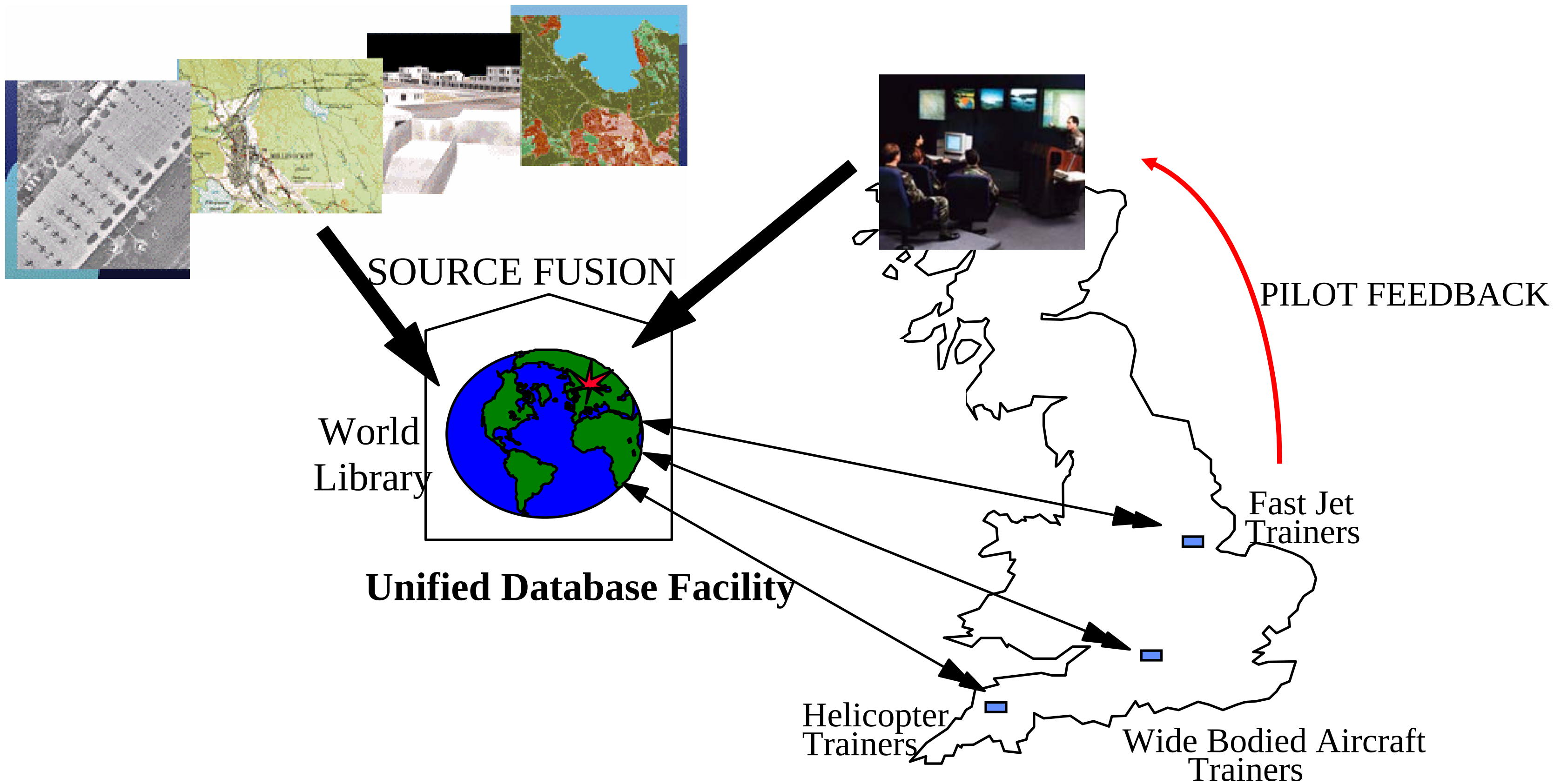
- SEDRIS is being used extensively in the US on DoD programmes
- It is now being used increasingly in Europe, as illustrated by the following examples;
  - Specified on military simulation trainers, such as Tornado GR4, Eurofighter Typhoon ASTA and TACTIS battle tank trainer. For these programmes, SEDRIS has been specified to enable the multi-sensor databases to be re-used on other training devices
  - Thales is using SEDRIS to interchange between visual and non-visual databases
  - Presentations at this conference
    - Urban Combat Simulation – Oktal
    - Natural Environment Server – Euclid development programme

Summary

- It has been shown that the principal problem with database interchange is the ambiguity of the data
- The aim of SEDRIS is to remove ambiguity such that;
  - An application may completely and accurately represent environmental data
  - Such data can be understood by another application
- Environmental data is specified completely using a Data Representation Model (DRM)
- To support the specifications in the DRM, precise definitions are required for feature classification and attribution and for location
- This has resulted in the generation of an Environmental Data Coding Specification (EDCS) and a Spatial Reference Model (SRM)
- It has taken 5 years of joint effort between the SEDRIS Organization and ISO/IEC to produce standards for SEDRIS, EDCS and SRM
- The detail of the SEDRIS technology and standards is extensive
- This presentation has addressed only the concepts. Further information is readily available

Why use SEDRIS ?

- So that Multi-Sensor Databases may be interchanged and re-used
- To facilitate the concept of a Unified Database Facility



Further Information

- SEDRIS web site http://www.sedris.org
  - Data Representation Model
  - EDCS
  - Spatial Reference Model
  - Tutorials
  - Papers etc..

  All this information may be downloaded free of charge

- Speak to representatives of the SEDRIS Organization at this conference