SEDRIS: Does it make sense as a model for HBR?

June 19, 2001
Topics

- What is SEDRIS - a quick overview
- How & when did we start (motivation and timing)
- Small team, big ideas
- Technical challenges, business challenges
- The tough problems
- Key milestones through the years
- SEDRIS today
- Issues in human behavior representation and modeling
- What lessons can be used
Primary Aspects of SEDRIS (technical)

• An infrastructure technology for expressing and sharing environmental data

• Unambiguous representation of environmental data
  - Semantics and relationships of data elements
  - All environmental domains
  - Expressed in a data representation model

• Efficient interchange of environmental data
  - Sharing and re-use
  - Ease of access and software development (API)
  - Tools and applications
Technical Objectives

• Articulate and capture the complete set of data elements and associated relationships needed to fully represent environmental data
  - Data Representation Model (DRM)
  - Environmental Data Coding Specification (EDCS)
  - Spatial Reference Model (SRM)

• Provide a standard interchange mechanism to pre-distribute environmental data and promote database reuse among heterogeneous applications
  - Software interface specification (API)
  - SEDRIS Transmittal Format (STF)

• Support the full range of applications across all environmental domains (terrain, ocean, atmosphere, and space) and 3-D models
Technology Components of SEDRIS

- **Data Representation Model (DRM):** Provides syntax and structural semantics for representing environmental data and databases (the “grammar” of the language)

- **Environmental Data Coding Specification (EDCS):** Provides “thing” level semantics (the dictionary of the language) (classify/attribute scheme)

- **Spatial Reference Model (SRM):** Unified and robust description of the spatial reference systems (coordinate systems), along with an accurate, efficient, and fast software implementation

- **Software Interface Specification:** (Read and Write Application Programmer Interfaces (APIs))
  - Allows ease of access
  - Lowers the barrier-to-entry in software development

- **SEDRIS Transmittal Format (STF):** Platform independent storage and transmission of data
Primary Aspects of SEDRIS (business)

- A technology base for reducing data access cost, saving development cost, and improving business efficiency
- A platform for leveraging existing products, value-adding and accessing current data sets, creating new products, or building on the core technologies
- A structured method for describing and communicating environmental data requirements/needs
- A community and an open forum for exchanging and sharing ideas and concepts
- Promoting innovation and business growth through open standards
Business Objectives

- Enable and promote interoperability
- Shift the business focus from “competing to dominate based on infrastructure” to “competing to provide the best value-added or most cost-effective content”
- Expand the commercial business base by providing innovative and practical solutions
- Support existing projects and applications through reuse
- Offer solutions only when there is a clear gain
How SEDRIS Technologies are Applied

Use:

- **the DRM** to model environmental data
- **the DRM, EDCS, and the SRM** to specify environmental database content
- **the EDCS** as a stand alone component
- **the SRM** as a stand alone component
- **all SEDRIS technology components** as an interchange mechanism
- **SEDRIS tools** to examine environmental data
- **SEDRIS Technologies** as a base to develop new tools
The Conditions - The Motivation

- Very high database development costs
- Database reuse costs in several hundred thousands
- No support for expressing semantics - highly visual system driven
- Database reuse non-existent in practice
- Interoperability of networked systems costly and nearly impossible to achieve - environmental database creation and interchange a large source of problems
- Industry not motivated to take action
- Past efforts to rectify the situation only partially successful
- Efforts to energize existing projects or industry to take on the task failed
Timing

- Early 90’s: based on 80’s experience, high potential and promise for use of heterogeneous networked systems
- Nearly two years of effort to expand existing projects to take on (“own”) and solve the problem
- The idea for “SEDRIS” initiated in May 1994, work began in September ‘94
- In response to interchange deficiencies faced by STRICOM and DARPA’s projects
- Started as an effort to “fix” data interchange problem so we can then focus on interoperability
- Initially envisioned as a few person-months of effort over a few calendar months!
Small team, big ideas

- A team of six experienced engineers
  - Database, visual, SAF, vehicle simulation, & systems engineers
- Based on a philosophy of practical solutions built on solid technologies and iterative design
- Established guiding principals for development
- Balance between practicality and elegance
- Focus on core design first, dress it up later
- Content before form (or process)
- Favor no domain or application over any other
- Emphasize important but neglected business areas
- Recognize the need for expertise from outside
Technical Challenges

- Can there be one model that accommodates many
- Generalize the result to tackle similar problems, but stay specific enough so users can find their solutions
- Must stay practical - size, speed, efficiency
- Full blown semantics cannot be mandatory, but highly encouraged (through business incentives)
- Design solutions beyond state of the art, 5-10 years
- Cover all the domains of environment
- Support all classes of applications
- Establish a foundation that can be grown without requiring to be rebuilt
- Provide software tools to reduce effort
Business Challenges

• Is it ready for a test drive?!
• Have we thought about (but not done) all the issues - is there a home for different business areas?
• Who knows the requirements? Everybody is in charge!
• Industry vs. government
• How to get buy-in from (a CPFF) industry!
• Market size and volunteer participation (incentives)
• Where do we get the money?!
• Seeding the community
• Changing an established mind set
• Maximum return on minimal investment
• Who cares about infrastructure technologies
Tackling the Requirements

Problem

Very large number of users with both common & unique requirements

The Key: Small number of environmental database builders

(in contrast to environmental data users)
The Tough Problems

• **Get a total set of requirements**
• **Keep commercial processes and proprietary products involved but maintain an open exchange mechanism**

• **Different views of the environment**
  - Air, land, sea, space
  - Spatial location and orientation (coordinate system and datum)

• **Lack of underlying environmental framework**
  - No integrated reference model available
    • Representation
    • Naming/semantics
  - Existing Data Models are conceptual, future models which are non-integrated and don’t address current data repositories and data interchange requirements
Commercial Process Issues

- Proprietary products (are not bad)
- Open exchange (same place) required for interoperability
- Value-added tools and utilities for small product volume
The Development Timeline

- **FY95**
- **FY96**
- **FY97**
- **FY98**
- **FY99**
- **FY00**
- **FY01**
- **FY02**
- **FY03**

**R&D Funding**

**DARPA/STRICOM --- DMSO**

**DMSO/SEDRIS**

**SAMs**

18, 19, 20, 21

**Dev Releases**

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

**SEDRIS Public Releases**

2.0, 2.5.2, 3.0.2, 3.X and on

**Data Model**

**Interface Specification**

**Transmittal Format**

**Organization**

**ISO Standardization**

**NPs**

**WDs**

**FCDs**

**TRAINING**

**Technology Conferences**

2002

1, 2, 2000, 2001

**Experimentation**

INT Exps, CCTT, STOW-A, UKCATT, Pegasus, DiMuNDS, 2000, AvCATT, JMASS, EF2000

**Other Funding**

slide
Within the first nine months...

- Developed the core technology (data representation model) using a small, focused team of experts
- Addressing terrain, atmosphere, and ocean domains
- Unified and articulated the basics of environmental data requirements
- Refined it based on feedback
- Involved the community and key M&S vendors and data providers
  - Seeded the community by targeting industry partners
  - Briefed the community at industry conferences
- Started the project move to DMSO
- Began expanding the core team
Within 18 months ...

- Solicited and selected industry participation through a STRICOM BAA Process
- Established an integrated management team
- Migrated to an object oriented DRM
- Implemented, iterated, & evolved software prototypes
- Web site and internal e-mail lists established
- Outreach (DIS/SIW, I/ITSEC, program briefs, ...)
- Began verification of the DRM through small interchange experiments, conversions, and tools
  - Terrain features (VPF data)
  - 3D models/icons
- Initial assessment of possible formats
Within 36 months …

- Engaged in development through many SEDRIS Associates (and associate meetings (SAMs))
- Refined the DRM and the API
- Completed the design of the format
- Verification through more interchange experiments
- New tools and conversion applications generated
- Outreach (I/ITSEC, DMSO Industry Days, SIW, OGC, …)
- Technology insertion to other programs (WARSIM, JSIMS)
- Began spinning off EDCS & SRM as independent pieces
- Began looking into standardization efforts
- Tools … and more tools …
SEDRIS Today: Mature Technologies

- Focus on standardization and market development
- Develop and conduct more training (Education)
- Establish certification & compliance testing processes
- Expand the marketplace through focused experiments and exercise involvement (Outreach)
- Maintain and configuration manage the interchange mechanism (Infrastructure Support & Sustainment)
- Monitor customer satisfaction
- Implement approved changes based on operational use
Standards Development

Objectives

• "Document technologies as recognized standards"

• "Obtain review, and feedback, from the broader international community"

• "Establish international standards"

• "Promote software implementations:"
  - Software library for the Spatial Reference Model (SRM)
  - Data dictionary database and mapping software for the Environmental Data Coding Specification (EDCS)
ISO / IEC Standards

• **18023: SEDRIS** – multi-part -
  - **Part 1:** SEDRIS Functional Specification (includes the Data Representation Model and the Interface Specification)
  - **Part 2:** SEDRIS Transmittal Format
  - **Part 3:** SEDRIS Transmittal Format Binary Encoding

• **18024: SEDRIS Language Bindings** – multi-part, initially -
  - **Part 4:** SEDRIS Language Binding to ISO C

• **18025: Environmental Data Coding Specification (EDCS)**

• **18026: Spatial Reference Model (SRM)**

• **18041: EDCS Language Bindings** – multi-part, initially -
  - **Part 4:** EDCS Language Binding to ISO C

• **18042: SRM Language Bindings** – multi-part, initially -
  - **Part 4:** SRM Language Binding to ISO C
Participating in ISO / IEC Standards

- SEDRIS standards work assigned to Joint Technical Committee 1 (JTC1) Sub-Committee 24 (SC 24) (Computer Graphics and Image Processing)
- SC 24 established Working Group 8 (WG 8) (Environmental Representation): SEDRIS work started October 1999
- National standards development organizations represent member countries in the ISO / IEC standards development, review, and voting process
- One vote per member country
- For more information see the following web sites:
  - http://www.iso.ch
  - http://www.jtc1.org
  - http://www.bsi.org.uk/sc24
  - http://www.sedris.org/wg8home
Other Standards Activities

- **Simulation Interoperability Standards Organization (SISO)** has established product development groups (PDG) to review, promote, and establish SEDRIS-developed technologies as SISO guidance and/or reference products.

- PDGs working on EDCS and SRM to:
  - Review and input to ISO / IEC standards for EDCS and SRM
  - Adopt existing, and develop new, technical implementations of EDCS and SRM as SISO products

- For more information on SISO PDG activities visit the SISO web site at: [http://www.sisostds.org](http://www.sisostds.org)
How the Pieces fit Together

ISO/IEC Standards
1. 18023: SEDRIS Functional Specification
2. 18024: SEDRIS Language Bindings: C
3. 18025: Environmental Data Coding Specification (EDCS)
4. 18026: Spatial Reference Model (SRM)
5. 18041: EDCS Language Bindings: C
6. 18042: SRM Language Bindings: C

SISO Products
Implementation Specific
1. SRM Software
2. EDCS Database and Software
3. EDCS Mapping Documents
4. Reports and Guidance Documents

Tools & Utilities
1. Browser
2. Checker
3. Depth
4. Feature Viewer
5. Model Viewer
6. Netscape Plug-In
7. Ocean Profile
8. SEE-IT
9. Side-By-Side Viewer
10. Wind Map
11. API Implementations & Format conversions
12. Others

Frequent Updates
Non changing or infrequently changing
Commercial & Government Products
Associates and Core Team Roles

- **SEDGIS Associates** (key environmental database developers/users)
  - Review and feedback
    - Data Representation Model
    - Interface Specification (API)
  - Native-model mapping
  - Interchange experiments
  - Value-added tools/utilities

- **Core Team**
  - Manage evolution
    - Data Representation Model
    - Interface Specification (API)
  - Reference implementation(s)
  - Transmittal Format
  - Common tools & applications
Industry Associate Developers ...

- AcuSoft, Inc.
- STN ATLAS Elektronik GmbH
- Boeing
- Charles River Analytics, Inc. (CRA)
- Curl Corporation
- Cybernet Systems Corporation
- ERDAS
- Evans and Sutherland (E&S)
- JRM Enterprises, Inc.
- Indra
- L3 Communications - Link Simulation & Training
- Lockheed Martin Information Systems (LMIS)
- Lockheed Martin Tactical Defense Systems (LMTDS)
- Logicon-TASC
- MultiGen - Paradigm Inc. (MPI)
- Northrup Grumman
- Oktal
- Netherlands Organization for Applied Scientific Research (TNO)
- ProLogic
- Raytheon Systems Company
- Raytheon Training Systems
- Reality By Design Government Systems, LLC (RBD)
- Science Applications International Corporation (SAIC)
- SGI
- Soft Reality, Inc.
- SOGITEC
- TerraSim
- TerrEx
- Thales Training & Simulation (TT&S)
- VCOM3D, Inc.
More Associate Implementers

**Government**

- U.S. Army Training and Doctrine Command (TRADOC) Mounted Maneuver Battlespace Battle Lab (MMBL) - Ft. Knox
- U.S. Army Communications Electronics Command (CECOM) Night Vision & Electronic Sensors Directorate (NVESD) - Ft. Belvoir
- U.S. Naval Surface Warfare Center - Dahlgren Division
- U.S. Joint Warfare System (JWARS) Joint Program Office / CACI

**Academic**

- University of Central Florida - Institute for Simulation and Training (UCF - IST)
Other Participating Organizations

- Arteon, Inc.
- BVR Systems Ltd. (Israel)
- Defense Threat Reduction Agency (DTRA)
- Institute for Defense Analyses (IDA)
- The MITRE Corporation
- Logicon Sterling Software, Inc.
- National Aeronautics and Space Administration (NASA)
- National Imagery and Mapping Agency (NIMA)
- Naval Air Warfare Center Training Systems Division (NAWC / TSD)
- Naval Oceanographic Office (NAVOCEANO)
- Naval Research Laboratory (NRL)
- SRI International
- U.S. Air Force Combat Climatology Center (AFCCC)
- U.S. Army Engineer Research and Development Command (ERDC) Topographic Engineering Center (TEC)
- U.S. Army Simulation Training and Instrumentation Command (STRICOM)
Supporting Organizations & Programs

- AEGis Technologies Group, Inc.
- Armed Forces Training Systems, Inc. (AFTS)
- Combined Arms Tactical Trainers (CATT)
- Defense Advanced Research Projects Agency (DARPA)
- Defense Modeling and Simulation Office (DMSO)
- Distributed Simulation Technology, Inc. (DiSTI)
- Joint Modeling & Simulation System, Joint Program Office (JMASS / JPO)
- Joint Simulation System, Joint Program Office (JSIMS/JPO)
- Joint Strike Fighter, Joint Program Office (JSF / JPO)
- Quantum Research International
- U.K. Combined Arms Tactical Trainer (UKCATT)
- U.S. Air Force Weather Agency (AFWA)
- U.S. Army Model and Simulation Office (AMSO)
- Virtual Emergency Response Training System (VERTS)
... other Participants / Contributors

• **Government Organizations:**
  - *Defence Science and Technical Laboratory (DSTL) (United Kingdom)*
  - *Defence Science and Technology Organisation (DSTO) (Australia)*
  - *Netherlands Organization for Applied Scientific Research (TNO) (Netherlands)*
  - *Defence Research Establishment (Sweden)*
  - *Ministry of Defence (MoD) (Singapore)*
  - *NATO Command, Control, and Consultative Agency (NC3A)*

• **International Membership Organizations:**
  - *ISO and ISO / IEC Technical Committees and Sub-Committees*
  - *Open Geographic Information Systems (GIS) Consortium (OGC)*
  - *Digital Geographic Information Working Group (DGIWG)*
  - *Simulation Interoperability Standards Organization (SISO)*
  - *NATO (M&S Coordination Office, M&S Group, and Armaments Groups)*
Associate Responsibilities

- Learn to "speak" SEDRIS (the data representation model)
- Monitor and participate in SEDRIS e-mail discussions
- Participate in SEDRIS Associate Meetings (as needed)
- Contribute to the state of the art in SEDRIS
- Provide feedback on SEDRIS technologies
- Educate other SEDRIS team members on their domain-specific issues and topics
- Develop "mapping documents" between their native format (if any) and SEDRIS
- Develop conversion software between their native format (if any) and SEDRIS
- Validate their conversion software (if any) by conducting comparison experiments
- Develop tools, utilities, or applications (as applicable)
- Cooperate and collaborate with other associates on projects of mutual benefit
- Promote SEDRIS and its use
Benefits of being an Associate

- Direct access to advance information on upcoming SEDRIS version additions, changes, or modifications.
- Benefit from interim releases of core technologies that can be used in early prototyping, advance product integration, or inclusion in project-specific milestones prior to the next formal release.
- Access to other associates' software that is releasable and of mutual value.
- Access to prototypes, tools, utilities, converters, and other applications.
- Interaction with others actively working on SEDRIS, including core team members.
- Opportunity to influence and shape the core SEDRIS technologies.
How to become an Associate

- Associate status is granted by the SEDRIS Management Team based on evaluation of the responses to the following questions.
  - What is the interest in becoming an associate?
  - What value is SEDRIS expected to provide the associate?
  - What benefit(s) will the associate offer SEDRIS?
  - What funding resources are expected to cover the associate's work?
  - Who are the primary points of contact and expected performers?
  - How long after start is the associate expecting to remain an active participant?

- The answer to these questions, in the form of a short white paper or proposal, along with any other pertinent information should be sent to: se-mgmt@sedris.org.
Recap

• An unambiguous representation of environmental data
  - Semantics and relationships of data elements
    • Expressed in a data representation model, with an
    • Associated data coding specification
  - All environmental domains

• An efficient interchange of environmental data
  - Promotes sharing and re-use
  - Ease of access and software development (API)
    - Tools and applications

• Undergoing international standardization
  (Your participation is Welcome!)

• Currently in use, rigorously tested

• Powerful representational and interchange technology

• Enabling businesses to succeed and grow
Performance Measures

- Greater number of accessible databases
- More rapid, cost effective access to databases
- Lower development costs through greater reuse
- Increased capability to facilitate rapid response requirements
- Lower life cycle management costs
- Incorporation of the SEDRIS concepts and technology in commercial products
- Agency letters stating adoption of SEDRIS as a way of doing business
- Government stated SEDRIS requirement
- Increase in number of contractors using SEDRIS as a data exchange format
- Monitor customer satisfaction
- MSRR, MEL, etc. requests for SEDRIS as a format for data exchange
- Positive customer feedback through web page and/or surveys
Issues to Consider in Human Behavior Representation / Modeling

• What is the size of the market for human behavior modeling?
• Who are the dominant players?
• What problems are currently faced by the community dealing with human behavior modeling (what is the exact motivation)?
• Separating human behavior representation, human behavior modeling, and human behavior
• Is the separation between models that create or use behavior and “behavior data sets” (e.g. initial conditions, behaviors over a certain time, behavior “animation” (predefined series/sequences of actions)) practiced or at least clear in industry?
Issues to Consider in Human Behavior Representation / Modeling (cont’)

- What does it mean to have “human behavior data” (vs. algorithm)? Is this data “after the fact”?
- What “human behavior data sets” would one share?
- Are there tools or established processes for creating “human behavior data”? Should there be? What should be their requirements for input and output?
- How can/will such new technology be applied to other broader (non-military M&S) business areas? How does aggregate behavior (group, herd) differ from organization behavior, vs. organized behavior?
- Will the development of these technology be limited to military domain? Will technology development be separated from business niche?
- Don’t decision making models (optimized or not) go hand in hand with behavior modeling (2nd and 3rd initiatives for FYxx)?
- ...
What lessons can be used...

- Don’t worry about money!
- Focus on business AND technical needs
- Treat it as product development (life cycle, marketing, engineering, testing, sales, training, evolution, ...)
- Start with a small team of ...
- Establish some guiding axioms
- Worry more about content than process at this stage
- Produce fundamental and strong solutions first
- Keep it practical, but tend to systems engineering too
- Pick a name around then (but be careful, names do last)
- Open it for broader review based on initial strong product
- Document your products
- Involve industry, provide incentives
- Add more (people and technology) to the mix
- Manage the growth (stir carefully), and market appropriately
- Plan for handing it off to industry
Back up / Extra charts
Definitions

- OED: Behavior - way of behaving
- OED: Behave - act or react in a specified way
- “Human Behavior” -
  - Actions, in a given context or situation, that result from processing emotions and reasoning based on reactions to (human) sensory inputs, and are combined with past experiences