XML Hierarchical Database for Missions and Technologies

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Topics

- Introduction
- Functional Block Diagram
- Requirements and Desirements
- Relational Database Limitations
- XML Database Advantages
- Architecture and Organization
- User Interface
- Sample Database Schema
- Status and Plans
Introduction

- NMP charter
- TCA identification and prioritization
- Quantitative, traceable, defensible ROI
- Two tasks
  - ROI evaluation
  - Database
- Hierarchical, XML-based database
Requirements and Desirements

- Hierarchically organized data
- Machine-readable entries
  - explicit definition of data types
  - conceptual meanings and relationships (ontology)
- User interface
  - Web-based
  - intuitive and obvious
- Security model
  - access control (authentication)
  - multiple concurrent users (authorization)
  - undo feature
- User not required to populate entire structure
- Efficient and fast
- Historical record of requirements, technology changes
**Relational Database Limitations**

<table>
<thead>
<tr>
<th>Technology Requirements Data Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date Last Modified</strong>: 2/13/2002</td>
</tr>
<tr>
<td><strong>Acronym</strong>: MMS</td>
</tr>
<tr>
<td><strong>Science Theme</strong>: SEC</td>
</tr>
<tr>
<td><strong>Cognizant Center</strong>: GSFC</td>
</tr>
<tr>
<td><strong>Product Breakdown Structure (PBS)</strong></td>
</tr>
<tr>
<td><strong>TSG PBS1</strong>: 3.0 Guidance, Navigation, and Control</td>
</tr>
<tr>
<td><strong>TSG PBS2</strong>: 3.5 Precision Control and Distributed Spacecraft</td>
</tr>
<tr>
<td><strong>TSG PBS3</strong>: 3.5.3 Formation/Constellation Control</td>
</tr>
</tbody>
</table>

**Mission Attributes Affecting This Technology**: Multi-scale examination of the magnetosphere

**Technology Item (Record Name)**: MMS/ Constellation Control

**Performance Metrics**:
- 5 s/c in loose tetrahedral configuration
- Position knowledge 1% separation (as low as 100m): orientation to 15°

**Potential Solution Technologies (funded)**:
- Ground tracking
- GPS at high altitude
- Inter spacecraft ranging (IRAS)

**Funding start year**: 2000

**Additional Cost to Complete Total Cost**: 2340

**Estimated Funding Required**: $K: 240 600 500 1000 0 0 0

**Status of Funding Estimate**: Grass-roots

**Theme Technologist Priority**: Highly Enhancing

**Mission Priority For Technology**: Highly Enhancing

**Need date**

**Need Date Tied to**

**Begin phase C/D for NMS**

**Comments**

- Hierarchical structure isn’t intuitively displayed or navigable.
- Important data is buried in a text field. This does NOT encourage consistency, completeness or easy access to the data.
- Technology links are buried in a text field.
- Difficult to determine a complete set of common data fields and to modify this set for all entries. No customization for entries.
XML Database Advantages

- Inherently hierarchical
- Flexible
  - sparsely populated data structures
  - easier to add performance metrics
- Quantitative matches between requirements and technology capabilities
- Taxonomy can grow and evolve more easily
Architecture and Organization

Web GUI

JSP

Tomcat Application Server

Web Service

Java API

Tamino Database Server

Excel Analysis Tool
User Interface

**Name**: Acquire Relative Range 1

**Description**: Determine the relative range to another spacecraft.

**Type**: Acquire Relative Range

**DataSource**: http://origins.ipl.nasa.gov/library/techreports/TPF_response.pdf

**Metrics**:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Operator</th>
<th>Value</th>
<th>Units</th>
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<tbody>
<tr>
<td>Maximum Operational Range</td>
<td>Maximum Operational Range</td>
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<td>0.1</td>
<td>km</td>
</tr>
<tr>
<td>Minimum Operational Range</td>
<td>Minimum Operational Range</td>
<td>eq</td>
<td>15</td>
<td>m</td>
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<tr>
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<td>Range Accuracy</td>
<td>eq</td>
<td>0.01</td>
<td>cm</td>
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</tbody>
</table>
Sample Database Schema

**CapabilityNode**
- **type**
  - This is a data type that stores mission capability requirements data. It also stores instances of the NASA management hierarchy and high-level science and technology requirements.

**description**
- **type** *xs:string*
  - *description*

**nodeType**
- **type**
  - *nodeType*
  - reference: points to a TaxonomyElement in the mission structural or functional taxonomy.

**dataSource**
- **type**
  - *dataSource*
  - reference to a DataSource document.

**requirements**
- **type**
  - *requirements*

**budgets**
- **type**
  - *budgets*
  - 0..∞ reference to a Budget document

**schedules**
- **type**
  - *schedules*
  - 0..∞ reference to a Milestone document

**metrics**
- **type**
  - *metrics*
  - 0..∞ reference to a Metric document

**metric**
- **type**
  - *metric*
Status and Plans

- Alpha testing
- Ongoing taxonomy development
- Standard software interface to analysis tools
- Common data repository for several tools
- Two tools in development to assess impact of technologies
  - ROI Analysis: science goals
  - CoMET: system mass, power, cost