CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

TRIP REPORT

SUBJECT: Geospatial Interoperability Class for the Interagency Working Group on Software and Infrastructure (06366.01.001)

DATE/PLACE: August 5–7, 2003, Denver, Colorado

AUTHOR: D. Marius Necsoiu

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BACKGROUND AND PURPOSE OF TRIP:

To further NRC and CNWRA participation in the activities of the interagency working group on software and infrastructure (established by the interagency steering committee on multimedia environmental modeling), I attended a workshop on Geospatial Interoperability organized by the United States Geological Survey. The activities were conducted by Dr. George Percivall and Dr. John Evans, recognized leaders in the development of geospatial ISO TC211 and OpenGIS standards and spatial information systems.

The purpose of the seminar was to inform working group members on available software development standards to enable geospatial interoperability between organizations. An expectation of the working group is that use of common software development standards among agencies will facilitate collaboration and sharing of data and software tools. Understanding the framework of geospatial interoperability and familiarization with various available standards that support interoperability were the main components of the workshop. In addition, examples were provided to demonstrate the interoperability concept. One example suggested several ways of applying the Open GIS Consortium standard to the planned working group effort to develop a Geospatial Object Library for Environmental Modeling (called GeoLEM) (see http://www.iscmem.org/WG01_Geolem.htm). In short, GeoLEM is a software library tool designed to enhance and automate the translation of data from geographic information system databases to models or modeling frameworks. While geographic information system data used by NRC is currently limited to specific projects, maintaining awareness of current development standards and various federal development efforts is useful for exploring future options for NRC.

SUMMARY OF PERTINENT POINTS:

A recent survey of geospatial data showed that tens of billions of dollars worth of archived spatial data exist. It is judged to be prohibitively expensive to move, store and centrally manage these large data sets. Alternatively, a mechanism is needed that can provide access to the data sets in a rapid and simplified way at their current locations.

A set of standardized interfaces among interoperating clients and servers would allow data to remain in its current location (there is no need to maintain the data by the user), while the internet networks could be used as a mechanism for distributing geo-processed data. Thus, the

existing in-house tools and applications remain viable and only the interface will need to be defined among clients and servers. This mechanism will allow digital systems to work together in managing geospatial information (geospatial interoperability).

The workshop started by emphasizing the importance of designing and implementing systems to standards. It then discussed relevant geospatial standards, coordinate reference systems, metadata and catalogs, and maps and visualization. Standards were defined as a "deliberate acceptance by organizations with common interest of a quantifiable metric for comparison, that directly or indirectly, influences the behavior and activities of a group by permitting and (possibly) encouraging some sort of interchange". The main geospatial standards bodies are the Open GIS Consortium (www.opengis.org), ISO TC211 – Geographic Information (www.isotc211.org), and the Federal Geographic Data Committee (www.fgdc.gov). In addition, there are several general standards bodies with geospatial content (e.g., W3C, IETF, or OASIS). The following standards were briefly discussed:

ISO 19103 – Geographic Information – Conceptual Language Schema
ISO 19112 – Spatial Referencing by Geographic Identifiers
ISO 19111 – Spatial Reference by Coordinates
ISO 3166 – Country Codes
ISO 19117 – Rules for Portraying Geospatial Features
ISO 19100 – XML
ISO 19108 – Geographic Information – Temporal Schema
ISO 19125 – Simple Features Common Architecture
ISO 19107 – Spatial Schema – Feature Encoding
ISO 19110 – Feature Cataloguing Methodology
ISO 19109 – Geographic Information – Rules for Applying the Schema
ISO 19123 – Coverages as Spatial Functions
ISO 19127 – Geodetic codes and parameters
ISO 8601 – GML
TC211 – Geographic Information - GML3
ANSI NCIS 320 – 1998 – ANSI for SDTS
ISO 10746 – Boarder STD than Geospatial
ISO 19115 – GIS Metadata
FGDC CSDGM – Content Standard for Digital Geospatial Metadata
ISO 19118 – Geographic Information – Encoding
ISO 23950 – ANSI Z39.50

The ISO 19115 was one of the most referenced standards during the three-day workshop. This standard will slowly replace the 10-year old FGDC CSDGM standard.

The workshop also covered Open GIS Consortium specifications as well as the behavior and interface of various Open GIS Consortium web services, such as the Sensor Collection Service (SCS), Web Coverage Service (WCS), Web Feature Service (WFS), the Web Registry Service (WRS), and Web Mapping Service (WMS). (See Fig 1)

Open GIS Consortium specifications could offer a variety of devices to the GeoLEM development effort, such as:

- standardized specifications for map-making
- transmission of features and coverages
- encoding information and manipulation of services
- publication and discovery of geographic services

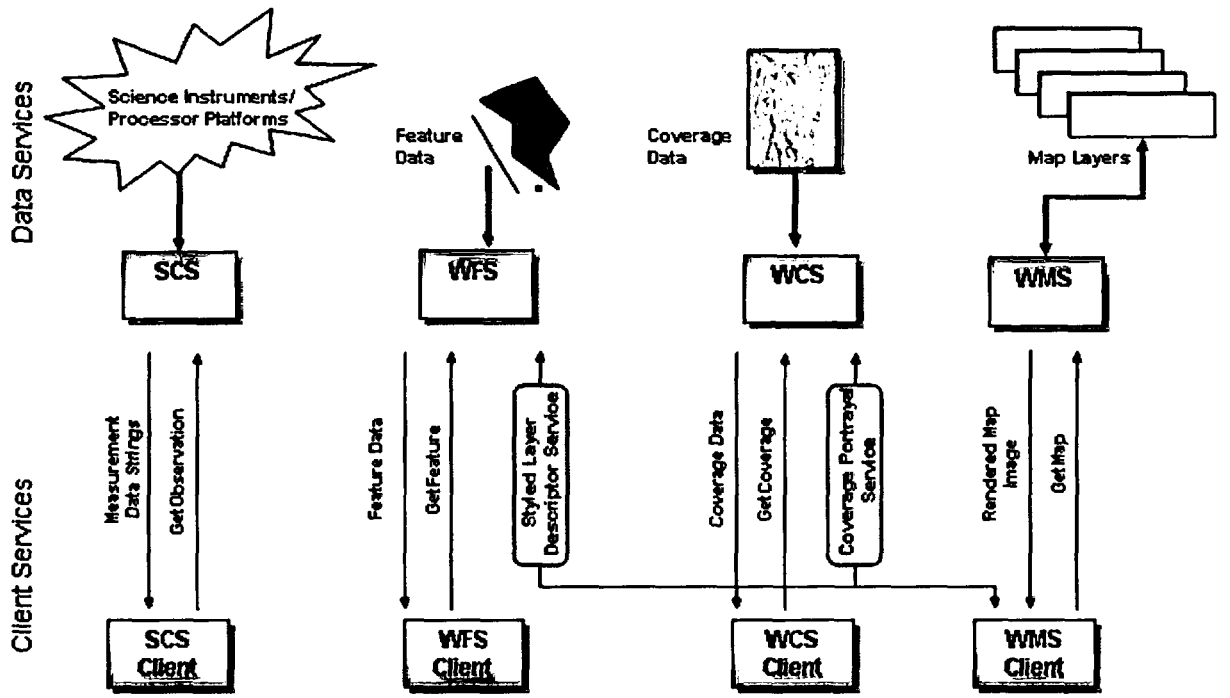

Figure 1. Open GIS Consortium Data Retrieval Operations

Unfortunately, the Open GIS Consortium specifications do not cover all the aspects of the proposed GeoLEM work. In particular, a lack of standardization for the derivation of new geographic information, or geoprocessing application programming interface (API) was noticed.

Of potential interest for NRC, CNWRA, or licensee research applications was a section dealing with SensorML and SensorWeb technologies. These technologies are applied to data collection activities from in-situ or remote sensors. SensorML is an XML schema for defining the geometric, dynamic, and observational characteristics of in-situ and remote sensing sensors. These sensors could be stationary/in-situ (light meter, thermometers, gravity meters, humidity device), stationary/remote (atmospheric profiler/radar Doppler), dynamic/in-situ (differential GPS, magnetometer, resistivity meter), and dynamic/remote (airborne/satellite camera/radiometer/spectrometer).

A sensor description could be based on SensorML. Thus, general sensor information could be provided in support of data discovery. A SensorML schema could allow processing and analysis of measurements as well as performance characteristics (i.e., accuracy, gain, offset, threshold, etc.). A Sensor Web represents a system composed of multiple science instrument/processor platforms that are interconnected for the purpose of collecting and monitoring environmental data. For more information on SensorMl and Sensor Web technologies please consult the following web documents:

http://ip.opengis.org/swe/ - Sensor Web Enablement Reference Site

http://vast.uah.edu/SensorML/ - Sensor Modeling Language

http://sensorwebs.jpl.nasa.gov/resources/documents.shtml - Sci/Tech Resources on Sensor Web

CONCLUSIONS:

Solving complex challenges of today's research and modeling activities are dependent on our ability to discover, access, integrate, and share information from multiple sources. One way to have efficient access to data is via a network of distributed and interoperable services.

This course provided the basic knowledge of Open GIS Consortium standards that could be used by NRC and other federal agencies for developing compatible geographic information systems. As more geospatial data and tools become generally available for use by the modeling community, there is likely to be an increasing need at NRC and other agencies for data systems and modeling interface tools that can facilitate efficient storage, retrieval, and use of site specific data and modeling results.

Linkage of modeling tools to geospatial databases using a standardized approach is a potentially useful yet complicated and perhaps costly undertaking. The interagency working group is testing the concept cautiously by starting with a small pilot project (GeoLEM). Understanding the various available programming standards that could be applied to the pilot project will help facilitate continued NRC and CNWRA involvement in the software and infrastructure interagency working group. This involvement will help keep the NRC staff and management informed on the direction and pace of this technology development and its potential applicability to NRC programs.

The insights gained from the course work also benefits CNWRA support for the High Level Waste program at NRC. In that program, CNWRA staff developed the Olympus Data and Information Sharing System™ (Olympus DISS™) to assist the storage, retrieval, and analysis of geospatial data related to the Yucca Mountain Project (Necsoiu, 2003). The workshop revealed that some additional DISS™ work may be needed (e.g., work on interface access) in order to fully comply with ISO and Open GIS Consortium specifications. The Olympus project is an example of a cost-effective practical software tool developed to meet specific staff needs for data storage, retrieval, and visualization.

REFERENCE:

Necsoiu M., "Managing Metadata - Olympus DISS™ software helps organize geospatial data", Technology Today, Spring 2003.

RECOMMENDATIONS:

1. In order to maximize access and sharing of spatial information resources and tools, federal agencies involved in development and use of geospatial data can benefit from designing databases and tools that comply with Open GIS Consortium geospatial interoperability standards.

2. For future NRC and CNWRA participation in the interagency working group activities, I suggest exploring areas of geoprocessing API and sensor web services to identify how these technologies could benefit NRC programs.

PENDING ACTIONS:

There are no pending actions.

SIGNATURES:

D. Marius Necsoiu
Research Scientist

08/28/03
Date

CONCURRENCE:

H. Lawrence McKague, Manager
Geology and Geophysics

08/29/03
Date

Budhi Sagar
Technical Director

9/2/2003
Date

/slo