Open Geospatial Consortium

Date: 2011-12-19

Reference number of this document: OGC 11-139r2
http://www.opengis.net/doc/ows8-summary-report

Category: Public Engineering Report

Editor: David Arctur

Summary of the
OGC Web Services, Phase 8 (OWS-8)
Interoperability Testbed

OGC Document **11-139r2**

Warning

This document is not an OGC Standard. This document is an OGC Public Engineering Report created as a deliverable in an OGC Interoperability Initiative and is not an official position of the OGC membership. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an OGC Standard. Further, any OGC Engineering Report should not be referenced as required or mandatory technology in procurements.

Document type:	**OGC® Engineering Report**
Document subtype:	**NA**
Document stage:	**Approved for public release**
Document language:	**English**

Preface

OGC Web Services (OWS) testbeds are part of OGC's Interoperability Program, a global, hands-on and collaborative prototyping program designed to rapidly develop, test and deliver proven candidate specifications into OGC's Specification Program, where they are formalized for public release. In OGC's Interoperability Initiatives, international teams of technology providers work together to solve specific geoprocessing interoperability problems posed by the Initiative's sponsoring organizations. OGC Interoperability Initiatives include test beds, pilot projects, interoperability experiments and interoperability support services - all designed to encourage rapid development, testing, validation and adoption of OGC standards.

This report summarizes the results of OGC Web Services Initiative, Phase 8 (OWS-8). The content of the OWS-8 initiative are organized around the following four threads:

- **Observation Fusion subthreads: OF-Coverages, OF-Tracking**
  - **OF-Coverages**: WCS 2.0 Earth Observation Application Profile, WCPS, Compliance Tests.
  - **OF-Tracking**: Detection, tracking, and bookmarking of moving objects in video, implemented using SWE and other OGC encodings and interfaces.
- **Geosynchronization and Geodata Bulk Transfer (Geosync)**
  - **Geosynchronization**: Web services and client components to support synchronization and updates of geospatial data across a hierarchical Spatial Data Infrastructure (SDI).
  - **Geodata Bulk Transfer**: The ability to distribute individual data sets and/or collections of data sets in a consistent manner offline and over networks.
- **Cross-Community Interoperability (CCI)**
  - **Semantic Mediation**: Advancement of semantic mediation approaches to query and use data based on different heterogeneous data models, which are available via OGC WFS.
  - **Portrayal**: Advancement of the use of style registries and styling services; and advancement of the use of KML.
  - **Schema**: Advancement of UML/OCL for Schema Automation on Domain Models.
- **Aviation**
  - **AIXM**: Maturing the delivery, filtering and update of AIXM 5.1 using WFS-T/FE 2.0; continuing the development of reusable tools, benchmarking of compression techniques for enhanced performance, advancing styling and portrayal support, and validating the emerging metadata and GML profiles.
  - **Aviation Architecture**: Advancing Event Notification Architecture, including Digital NOTAM Events; supporting AIXM Authoritative Data Source requirements; and leveraging DataLink concepts and requirements.
  - **WXXM and Weather Concepts**: reviewing/validating the WXXM schemas; encoding representative 4D/5D weather forecast and radar datasets; supporting on-demand Coordinate Reference System (CRS) specifications/transformations; and exploring distributed architectures for managing Units of Measure (UoM).

Suggested additions, changes, and comments on this report are welcome and encouraged. Such suggestions may be submitted by email message or by making suggested changes in an edited copy of this document (keep Revision Tracking enabled).

License Agreement

Permission is hereby granted by the Open Geospatial Consortium, Inc. ("Licensor"), free of charge and subject to the terms set forth below, to any person obtaining a copy of this Intellectual Property and any associated documentation, to deal in the Intellectual Property without restriction (except as set forth below), including without limitation the rights to implement, use, copy, modify, merge, publish, distribute, and/or sublicense copies of the Intellectual Property, and to permit persons to whom the Intellectual Property is furnished to do so, provided that all copyright notices on the intellectual property are retained intact and that each person to whom the Intellectual Property is furnished agrees to the terms of this Agreement.

If you modify the Intellectual Property, all copies of the modified Intellectual Property must include, in addition to the above copyright notice, a notice that the Intellectual Property includes modifications that have not been approved or adopted by LICENSOR.

THIS LICENSE IS A COPYRIGHT LICENSE ONLY, AND DOES NOT CONVEY ANY RIGHTS UNDER ANY PATENTS THAT MAY BE IN FORCE ANYWHERE IN THE WORLD.

THE INTELLECTUAL PROPERTY IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. THE COPYRIGHT HOLDER OR HOLDERS INCLUDED IN THIS NOTICE DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE INTELLECTUAL PROPERTY WILL MEET YOUR REQUIREMENTS OR THAT THE OPERATION OF THE INTELLECTUAL PROPERTY WILL BE UNINTERRUPTED OR ERROR FREE. ANY USE OF THE INTELLECTUAL PROPERTY SHALL BE MADE ENTIRELY AT THE USER’S OWN RISK. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR ANY CONTRIBUTOR OF INTELLECTUAL PROPERTY RIGHTS TO THE INTELLECTUAL PROPERTY BE LIABLE FOR ANY CLAIM, OR ANY DIRECT, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM ANY ALLEGED INFRINGEMENT OR ANY LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR UNDER ANY OTHER LEGAL THEORY, ARISING OUT OF OR IN CONNECTION WITH THE IMPLEMENTATION, USE, COMMERCIALIZATION OR PERFORMANCE OF THIS INTELLECTUAL PROPERTY.

This license is effective until terminated. You may terminate it at any time by destroying the Intellectual Property together with all copies in any form. The license will also terminate if you fail to comply with any term or condition of this Agreement. Except as provided in the following sentence, no such termination of this license shall require the termination of any third party end-user sublicense to the Intellectual Property which is in force as of the date of notice of such termination. In addition, should the Intellectual Property, or the operation of the Intellectual Property, infringe, or in LICENSOR’s sole opinion be likely to infringe, any patent, copyright, trademark or other right of a third party, you agree that LICENSOR, in its sole discretion, may terminate this license without any compensation or liability to you, your licensees or any other party. You agree upon termination of any kind to destroy or cause to be destroyed the Intellectual Property together with all copies in any form, whether held by you or by any third party.

Except as contained in this notice, the name of LICENSOR or of any other holder of a copyright in all or part of the Intellectual Property shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Intellectual Property without prior written authorization of LICENSOR or such copyright holder. LICENSOR is and shall at all times be the sole entity that may authorize you or any third party to use certification marks, trademarks or other special designations to indicate compliance with any LICENSOR standards or specifications.

This Agreement is governed by the laws of the Commonwealth of Massachusetts. The application to this Agreement of the United Nations Convention on Contracts for the International Sale of Goods is hereby expressly excluded. In the event any provision of this Agreement shall be deemed unenforceable, void or invalid, such provision shall be modified so as to make it valid and enforceable, and as so modified the entire Agreement shall remain in full force and effect. No decision, action or inaction by LICENSOR shall be construed to be a waiver of any rights or remedies available to it.

None of the Intellectual Property or underlying information or technology may be downloaded or otherwise exported or reexported in violation of U.S. export laws and regulations. In addition, you are responsible for complying with any local laws in your jurisdiction which may impact your right to import, export or use the Intellectual Property, and you represent that you have complied with any regulations or registration procedures required by applicable law to make this license enforceable.

TABLE OF CONTENTS

Summary of OGC Web Services Initiative, Phase 8 (OWS-8)

1 Overview

The OGC Web Services, Phase 8 (OWS-8) Testbed was an initiative of OGC's Interoperability Program to collaboratively extend and demonstrate OGC's baseline for geospatial interoperability. The majority of work for OWS-8 was conducted from March to September 2011, with the following outcomes:

- **43** Software Components (servers, clients and other applications) were implemented and participated in interoperability testing.

- **35** Engineering Reports (ERs) and Change Requests (CRs) to existing OGC standards were written. The OWS-8 ERs were either technical specifications or reports regarding testing and analysis. The OWS-8 CRs were recommendations for changes to existing standards, and have been entered into OGC's public process for reporting such requests here: http://www.opengeospatial.org/standards/cr

  The OWS-8 ERs have also been posted to the OGC Standards Program Pending Documents list for consideration in the consensus process. The Engineering reports have been approved for public release, accessible on the web here: http://www.opengeospatial.org/standards/per

- **24** Demonstrations of OWS-8 components, many of which were shown during the OWS-8 Technical Review meeting held in Boulder Colorado, USA on 22 September 2011. The demonstrations with a voice-over explaining the content are being released as multi-media products via the web here: http://www.opengeospatial.org/pub/www/ows8/

- **40** organizations participated in some aspect of OWS-8. Roles for organizations in OWS-8 included sponsors, participants and architects. Additionally there were many organizations that were observers of OWS-8.

- **9** sponsoring organizations defined requirements for OWS-8. The sponsors' requirements were captured in a set of RFQ/CFP documents that were released by OGC seeking organizations that wished to participate in OWS-8.

2 Organizations in OWS-8

2.1 Sponsoring Organizations

OWS-8 was sponsored by the following organizations:

- US National Geospatial-Intelligence Agency (NGA)
- US Geological Survey (USGS)
- US Army Geospatial Center
- US Federal Aviation Administration (FAA)
- EUROCONTROL
- US National Aeronautics and Space Administration (NASA)
- European Space Agency (ESA)
- UK Defence Science and Technology Laboratory (DSTL)
- Lockheed Martin – Information Systems and Global Services

2.2 OWS-8 IP Team

The IP Team is an engineering and management team to oversee and coordinate an OGC Interoperability Initiatives. The IP Team facilitates architectural discussions, synopsizes technology threads, and supports the specification editorial process. The IP Team is comprised of OGC staff and representatives from member organizations. The OWS-8 IP Team was as follows:

- Interoperability Program Executive Director: George Percivall, OGC
- Initiative Director: Dr. David Arctur, OGC
- Thread Architects
    - Aviation: Dr. Nadine Alameh, OGC
    - Cross-Community Interoperability: Dr. Luis Bermudez, OGC
    - Observation Fusion: Dr. Raj Singh, OGC
    - Geosynchronization and Geodata Bulk Transfer: Michael Maynard and Jennifer Harne, Lockheed Martin Corporation
- IT and Demonstration Support: Greg Buehler, OGC; Mark Buehler, OGC

2.3 Complete List of Organizations

The following organizations played one or more roles in OWS-8 as sponsors, participants and/or architects. Additionally there were many organizations that were observers of OWS-8.

- 52North
- AGC
- Atmosphere, Systèmes et Services
- ATOS
- Australia DSTO
- Carbon Project
- Carmenta
- Compusult
- Comsoft
- CubeWerx
- Envitia
- ESA
- Esri
- EURO-CONTROL
- FAA
- Feng Chia University GIS Research Center
- Frequentis
- Galdos
- GMU CSISS
- IDS
- iGSI
- Interactive Instruments
- Jacobs Univ-EOX-rasdaman
- La Trobe Univ.
- LISAsoft
- Lockheed Martin
- Luciad
- NASA
- NGA
- NGIS
- OpenGeo
- PYXIS Innovation
- Snowflake
- Technical Univ. Munchen
- UAB-CREAF
- UK DSTL
- Univ. Muenster IfGI
- USGS
- University of the Bundeswehr

3 Schedule

The OWS-8 Testbed Execution Phase was preceded by a Concept Development Phase.

OWS-8 Concept Development Phase:

Sponsor Meetings	July – October 2010
RFQ development	September – November 2010
RFQ/CFP release	19 November 2010
Bidders Conference	6 December 2010
RFQ responses due	14 January 2011
Participant Selection	28 January 2011

OWS-8 Execution Phase:

Kickoff Meeting	9-11 March 2011, GMU, Fairfax VA

- Key early services due 13 May 2011
- Interim Milestone 24 June 2011
- Implementation Milestone 26 August 2011
- OWS-8 Demonstrations 22 September 2011, TC Meeting, Boulder CO, USA
- Final Delivery 30 September 2011
- OWS-8 Demo web release 30 October 2011
- Specification Program review of ERs September 2011, TC Meeting, Boulder CO, USA

After the Kickoff Meeting, design, development and testing of OWS-8 components was conducted in a distributed fashion supported by the collaborative development resources of telecoms, a web portal, twiki, web collaboration tools, and e-mail.

The SOW milestones had various deliverables particular to the participant. A limited number of ERs were extended beyond this schedule as the inputs needed for the work were not available as anticipated. See ER table for more information.

4 Development Threads

The development of the OWS-8 initiative was organized around the following 4 threads:

1) Aviation
2) Cross-Community Interoperability (CCI)
3) Geosynchronization and Geodata Bulk Transfer (Geosync)
4) Observation Fusion, with two major subthread themes: Coverages and Tracking

An introduction to each of these threads and subthreads is presented below, followed by a listing of the components and ERs developed in each thread.

4.1 Aviation

Sponsors: FAA, EUROCONTROL, NASA

Participants: 20 participant companies and universities

Tasks:

Advancement of AIXM

- Maturation of delivery, filtering and update of AIXM via WFS
- Continued development of reusable tools (Validation + refactoring)
- Benchmarking of compression and binary XML techniques
- Interoperable styling and portrayal
- Validation of AIXM metadata and GML profiles

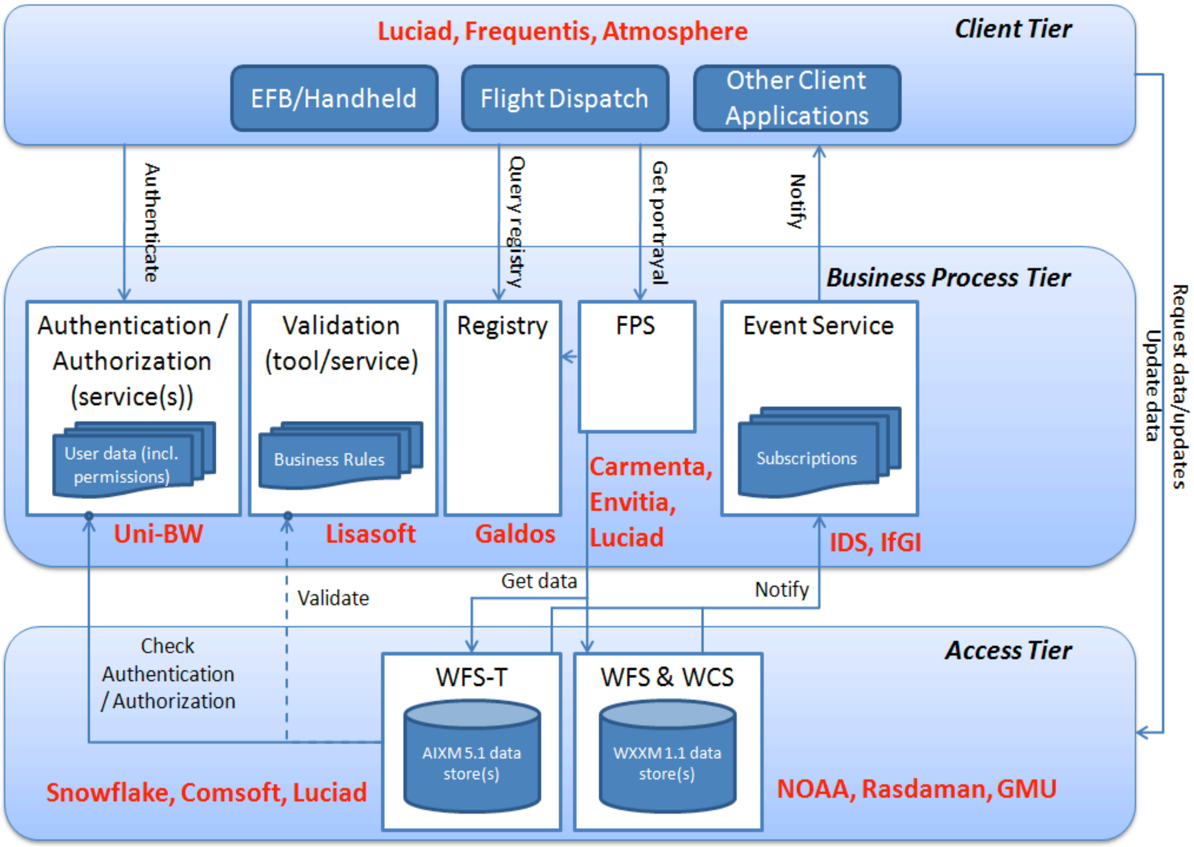
Advancement of Aviation Architecture

- Advancement of Event Architecture, including validation of Digital NOTAM Event Specification
- Support for AIXM Authoritative Data Source requirements
- Leveraging of DataLink concepts and requirements

Advancement of WXXM and Weather Concepts

- Review and validation of WXXM schemas
- Encoding rep 4D/5D weather forecast and radar datasets
- On-demand CRS definitions and transformations
- Distributed approach for managing UoM

OWS-8 Aviation Architecture Diagram:



Aviation Significant Results:

- WFS 2.0 successfully demonstrated capability to support complex requirements for aeronautical safety of navigation however additional enhancements identified
  - support to “Dynamic Features“ (version navigation, propertied with a schedule)
  - enhanced query support to retrieve specific timeslices of a feature
  - support for SNAPSHOT timeslices
  - support for advanced filter parameters
- Initial guidance for configuring and using a WFS 2.0 for managing and serving AIXM data have been drafted.
- Practical guidelines to domain modeling following a series of best practices were documented and applied towards improving the efficiency and reusability of the AIXM model
- OGC standards can be used to portray most ICAO styles (portrayal of AIXM5 is complex)
  - Proposed XLINK support in WFS for sysmbology required
  - Update to Symbol Encoding standard (SE Symbolizer and Rule for styling of nested child objects) Change Request submitted
  - Use of a Common repository of SVG symbols proposed
- OGC GeoXACML standard successfully implemented to demonstrate support for “data integrity and confidentiality“ in security based Access Control
- Bindings proxy demonstrated interoperability between SOAP and POST service requests
- A number of compression algorithms for AIXM were investigated to allow the usage of AIXM over data link connections

- ✧ The Event Architecture developed in previous OGC initiatives was further advanced to support the accurate delivery of the digital NOTAMs. Three new features were developed and tested“ event enrichment, dynamic filtering and pull support.
- ✧ A deatiled review of the new Ditial NOTAM Event Specification was performed, covering a conceptual review as well as the implementation of a suite of executable schematron tests
- ✧ Work on providing WXXM using the OGC WCS was performed and demonstrated
- ✧ An audit oft he WXXM XML schema was performed, revealing a number of issues regarding compliancy with encoding rules defined in ISO 19136.

Aviation Deliverable Engineering Reports:

11-061 OWS-8 AIXM 5.1 Metadata ER

11-072 OWS-8 WXXM and Weather ER

11-073 OWS-8 WFS Guidance for AIXM

11-086 OWS-8 Authoritative Data Source in Aviation ER

11-089 OWS-8 Aviation SLD Guidance for ICAO ER

11-091 OWS-8 WXXM Audit Results ER

11-092 OWS-8 Report on Digital NOTAM Event Specification

11-093 OWS-8 Aviation Architecture ER

11-097 OWS-8 AIXM Compression Performance Benchmarking ER

11-106 OWS-8 Digital NOTAM Refactoring ER

11-107 OWS-8 Domain Modeling Cookbook ER

4.2 Cross-Community Interoperability (CCI)

Sponsors: NGA, USGS, UK DSTL

Participants: 8 participant companies

Tasks:

Advancement of semantic mediation approaches to deal with differences in heterogeneous data models.

- ✧ Use of Semantic Web technologies (e.g. ontologies, RDF, SKOS).
- ✧ Enable machines to share specifications of concepts and thus be able to interpret, harmonize and convert information consistently.

Advancement of the use of portrayal: style registries and services focusing on the DGWIG portrayal registry.

- ✧ Use of a Feature Portrayal Service to render Features from styles available in the DGWIS portrayal registry.
- ✧ Creation of enhanced custom SLDs based on catalog discovery of features and Web feature Services.
- ✧ Use of Semantic Mediation to convert Features from one schema (e.g. USGS TNM) to another (e.g. NGA TDS) to portray data from one model (e.g. USGS TNM) using a set of symbols based on a user-preferred model (e.g. NGA TDS).

Advancement on the generation of KML to include interaction with portrayal registries.

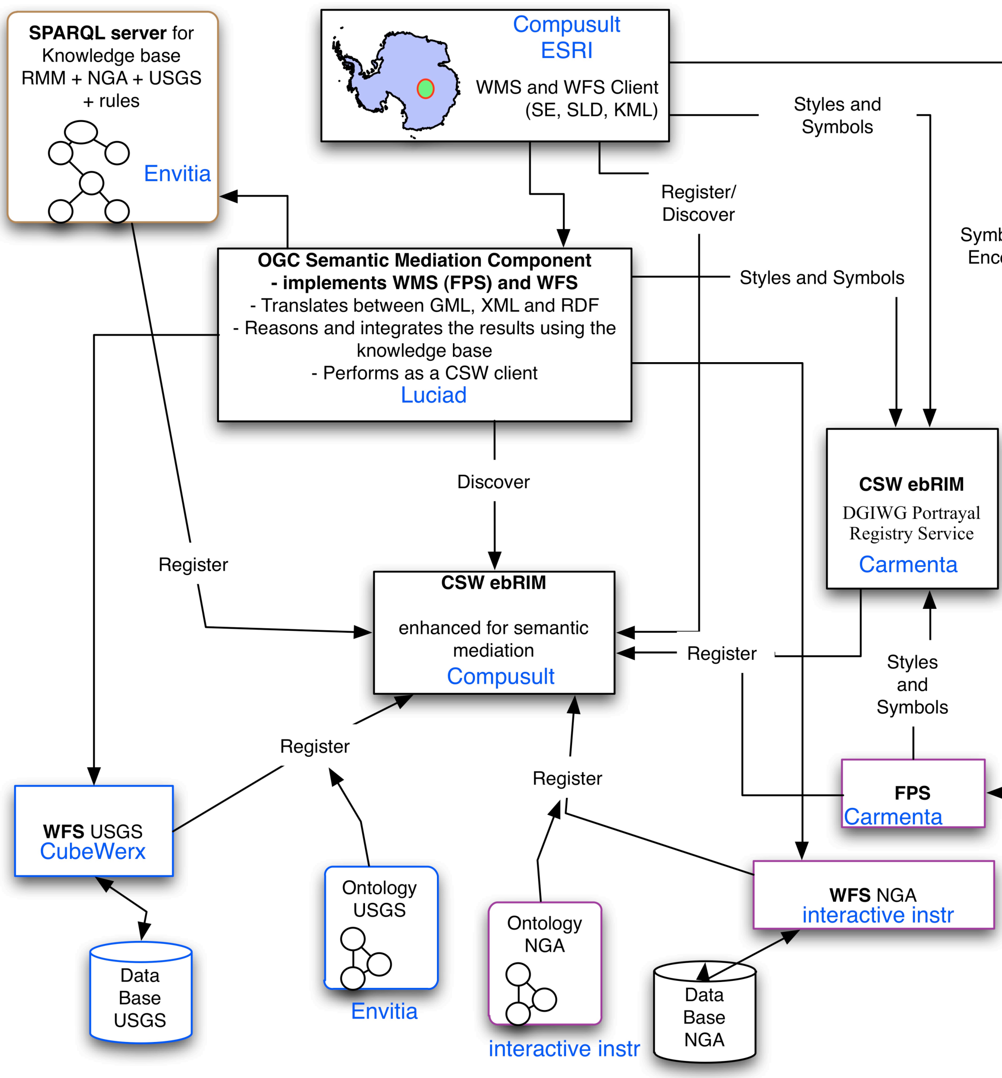
- ✧ KML encoding rule support for different styles per feature type

- Evaluate the use the same portrayal rules used before by the Feature Portrayal Services for KML portrayal
- Evaluate the use of portrayal registries in this context
- Cache KML data to improve the performance of accessing the KML data from Google Earth

Advancement of Schema Automation transforming domain models from UML to GML.

- Support for ISO 19115 metadata profiles - Additional tagged value to suppress XML Schema components for types that are only used as an anchor for constraints in a profile
- OCL-to-Schematron encoding rule extensions to support the ISO/TS 19139 and the proposed GML 3.3 encoding
- Support for OCL let expressions
- Specific focus on code list value and unit constraints - Additional tagged values specified to allow for automated validation of the code list value and unit references

OWS-8 CCI Mediation / Portrayal Architecture Diagram:



Cross-Community Interoperability Significant Results:

- ✧ Harmonization of heterogeneous geospatial datasets in order to present consistent views of the data is possible through the use of Semantic Web technologies.
- ✧ Implemented a prototype “Semantic Mediation Service” that wraps a WFS into a user preferred Feature Model.
- ✧ Implemented a knowledge base SPARQL service.
- ✧ Developed Rossetta Mediation Models for mapping between USGS and NGA data models.
- ✧ Identified the need to stand up several new OGC standards working groups to support SPARQL, Semantic Mediator Service and Mapping Table generation.
- ✧ An ebRIM Profile of CSW was implemented with interface to a central repository for structured portrayal information.
- ✧ A Feature Portrayal Service was successfully implemented as a means to access vector data via a Web Feature Service, portray that data based on predefined and stored rules and symbols and visualize as through a Web Map Service.
- ✧ A study was conducted on KML ability to support complex rule sets and symbols with the following results:
  - ✧ Simple portrayal rule sets the approach worked well.
  - ✧ Caching of KML regions worked well.
  - ✧ Scale information in all portrayal rules is strongly recommended and helps to reduce the data load for both server and client.
- ✧ Enhanced the open source ShapeChange UML conversion tool to support automated creation of RDF /OWL , Codelists (SKOS), KML (XSLT), GML (XML Schemas), Codelists (GML), Constraints (Schematron)
- ✧ It was concluded that Complex Schematron assertions can be derived automatically from application schemas in UML to support; XML based on different encoding rules (GML, ISO/TS 19139), OCL constraints and from other information in the UML model.

Cross-Community Interoperability Deliverable Engineering Reports:

11-042 Improve control over KML BalloonStyle layout with Change Request 146

11-062 OWS-8 CCI Portrayal ER

11-063 OWS-8 CCI Semantic Mediation ER

11-064 OWS-8 CCI Schema Automation ER

4.3 Geosynchronization and Geodata Bulk Transfer (Geosync)

Sponsors: NGA, AGC, Lockheed Martin

Participants: 5 participant companies

Tasks:

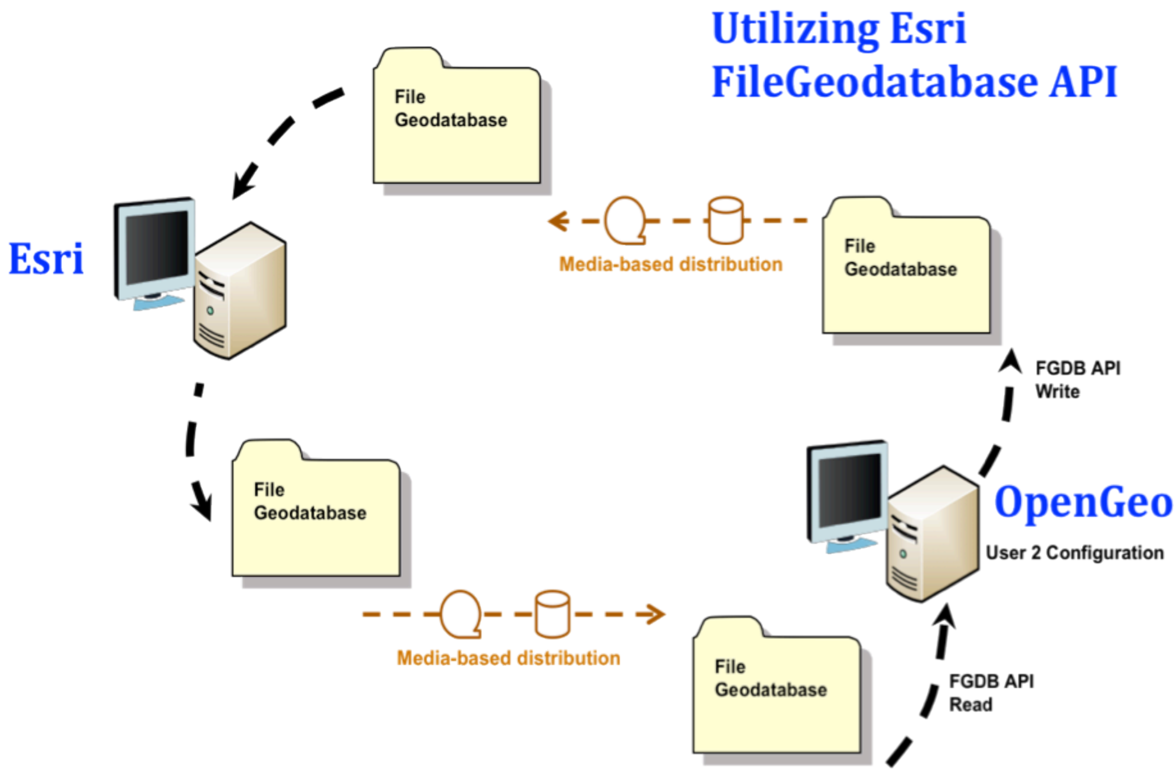
Geodata Bulk Transfer (2 approaches)

- ✧ Investigated 2 approaches for data access supporting users with limited or disconnected network access (*API* and an *Encoding* approach)
- ✧ Provide the ability to distribute individual data sets and/or collections of data sets in a consistent and accurate manner

FileGeodatabase API Sub-thread - The API Approach (Esri, OpenGeo)

- ✧ Develop method to transfer data to field operations. Provide capability for field edits and updates to be returned.
- ✧ Accurate and consistent round-trip transfer of “bulk data” FileGeodatabase, utilizing the ESRI FileGeodatabase API

OWS-8 FileGeodatabase API Diagram:



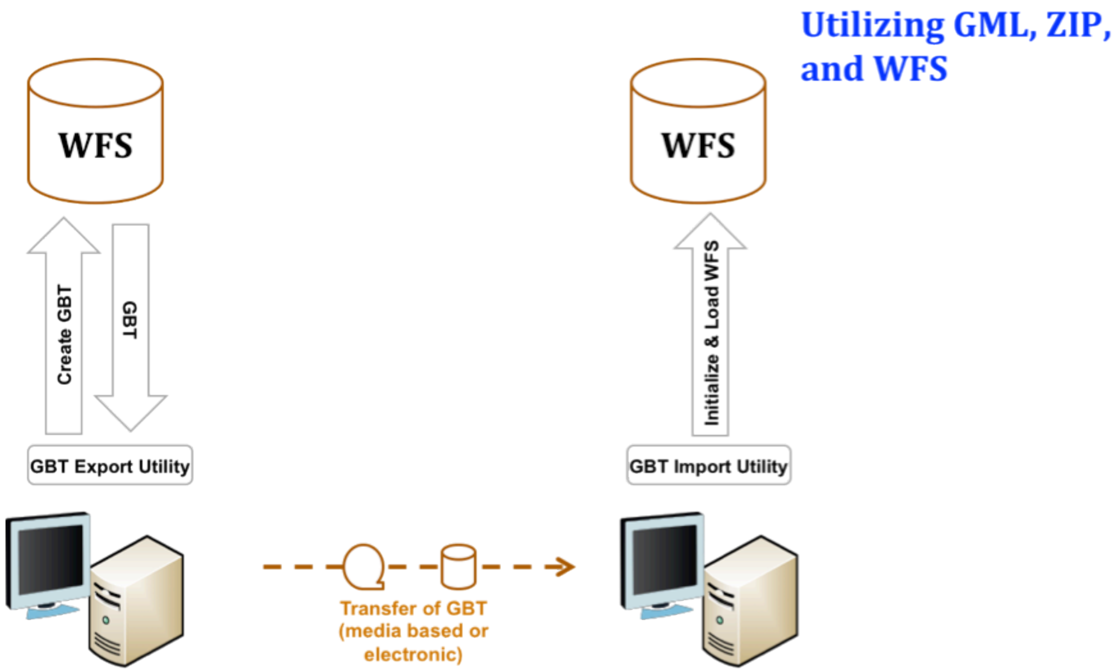
FileGeodatabase API Sub-thread Significant Results:

- FGDB/API is implementable outside proprietary environment to support very large databases
  - support individual datasets containing well over 300 million features and can scale beyond 500 GB per file with very fast performance
  - If FGDB is going to be a workable interchange format between multiple systems it needs to be able to turn off the precision enforcement
  - Full content metadata at database, dataset and feature class level provide understanding of data
  - Feature class level topology rules allow users to check logical consistency of dataset
  - Further investigation required on the use of ISO and NMF metadata, checksum, and topology rules in FGDB
- Significant compression with ZIP and more with 7zip which also provides checksum capabilities
  - The API doesn't currently allow accessing files that use FGDB's own compression schemes
- Need to improve the OGR connectors, there is not a direct FGDB reader in GeoServer/GeoTools.
  - Some features in the OGR model that are not implemented in the driver (DeleteField, DeleteFeature, ReorderFields, SetFeature, for example)

GSS/GML/WFS Sub-thread- The Encoding Approach (The CarbonProject, CubeWerx, OpenGeo, GIS.FCU)

✧ Demonstrate bulk transfer of base data using the WFS and GML approach. Provide for Data & Schema initialization on WFS, provide capability for field edits and updates to be returned.

OWS-8 WFS/GML/GSS Workflow Diagram:



GSS/GML/WFS Sub-thread Significant Results:

✧ Performance scalability is achieved by operating the Import/Export utility on the local machine unless an efficient network is used.

✧ For maximum interoperability, the WFS schemas should conform to GML Simple Features.

  ✧ NGA data is very schema intensive, thought required on mobile GML versions

✧ GBT is based on open standards: ZIP, GML, XML-Schema, ISO-19112, OWS Common manifest.

✧ GBT mechanism can be easily enhanced to support other encodings and schemas (i.e. GeoJSON and JSON Schema).

✧ There is a limitation imposed on GBT by the maxFeatures parameter in the WFS GetFeature operation.

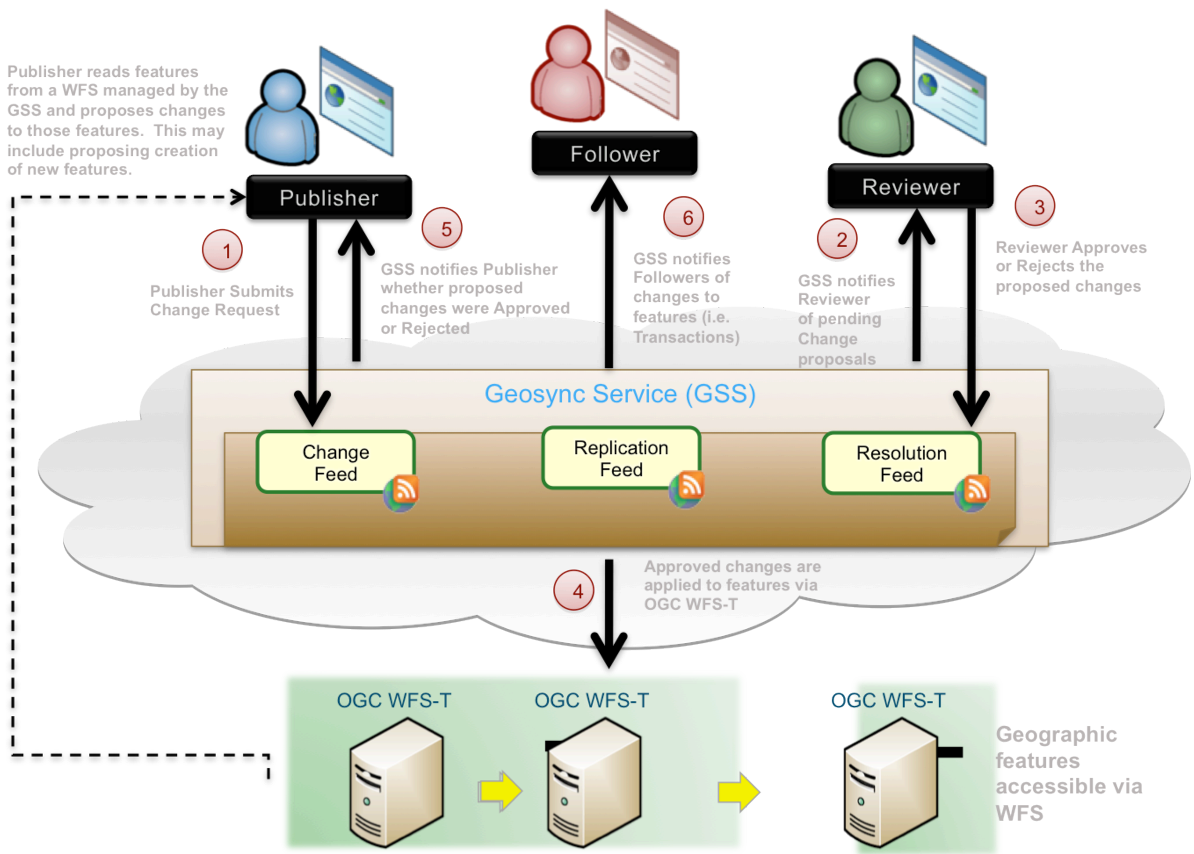
✧ The GBT format is easily extensible in an interoperable manner without breaking existing client applications.

✧ Two significant Change Requests drafted against Web Feature Service 2.0 to integrate GeoSynchronization Service GBT (Create Schema and Drop Feature Type) allows for database initialization and field update information

GeoSynchronization:

- GeoSynchronization Service (GSS) Enhancements;
  - Advance the state of geographic synchronization, improving on previous support for temporal queries.
  - Provide web services and client applications to support synchronization and updates of geospatial data across a hierarchical Spatial Data Infrastructure (SDI)
  - Streamline the validation scenarios, bootstrap database creation and population, and define query based subscription mechanisms
  - Include support for Mobile and disadvantaged users.

OWS-8 GeoSynchronization Service Diagram:



GeoSynchronization Service Significant Results:

- Client side enhancements to include Android based app developed for GSS (Mobile device interface)
- GSS enhancements implemented and tested
- New capability provided to initialize a remote server as a WFS and load with synchronized database content using a WFS API

VIDEO: http://www.cubewerx.com/OWS8_GBT_Demo/

Bulk Data Transfer with GeoSynchronization Service Deliverable Engineering Reports:

11-085 OWS-8 Geodata Bulk Transfer with GML/WFS ER

11-087 OWS-8 GSS Change Requests for WFS

11-114 OWS-8 Geodata Bulk Transfer with FileGDB ER

11-125 OWS-8 Best Practices for Use of Geosynchronization ER

4.4 Observation Fusion - Coverages

Sponsors: NASA, European Space Agency (ESA)

Participants: 7 participant companies and universities

Tasks:

WCS 2.0 Earth Observation Application Profile (EO-AP) Definition and Implementation.
- ✧ Develop WCS 2.0 Extensions for band subsetting, scaling & interpolation, EPSG CRS
- ✧ Design WCS 2.0 EO-AP to scale to large number of coverages

WCS 2.0 EO-AP to include data models for:
- ✧ 2-D Coverage with latitude and longitude axes, which can represent, for example, a hyperspectral satellite scene.
- ✧ the subset of a 2-D satellite scene (either radar or multispectral)
- ✧ a time series of co-registered 2-D satellite scenes
- ✧ Stitched Mosaic as a 2-D horizontal coverage which can refer to several co-referenced non-overlapping Datasets;
- ✧ Dataset Series as a collection of coverages; A Dataset Series can refer to any number of co-referenced Datasets and Stitched Mosaics.

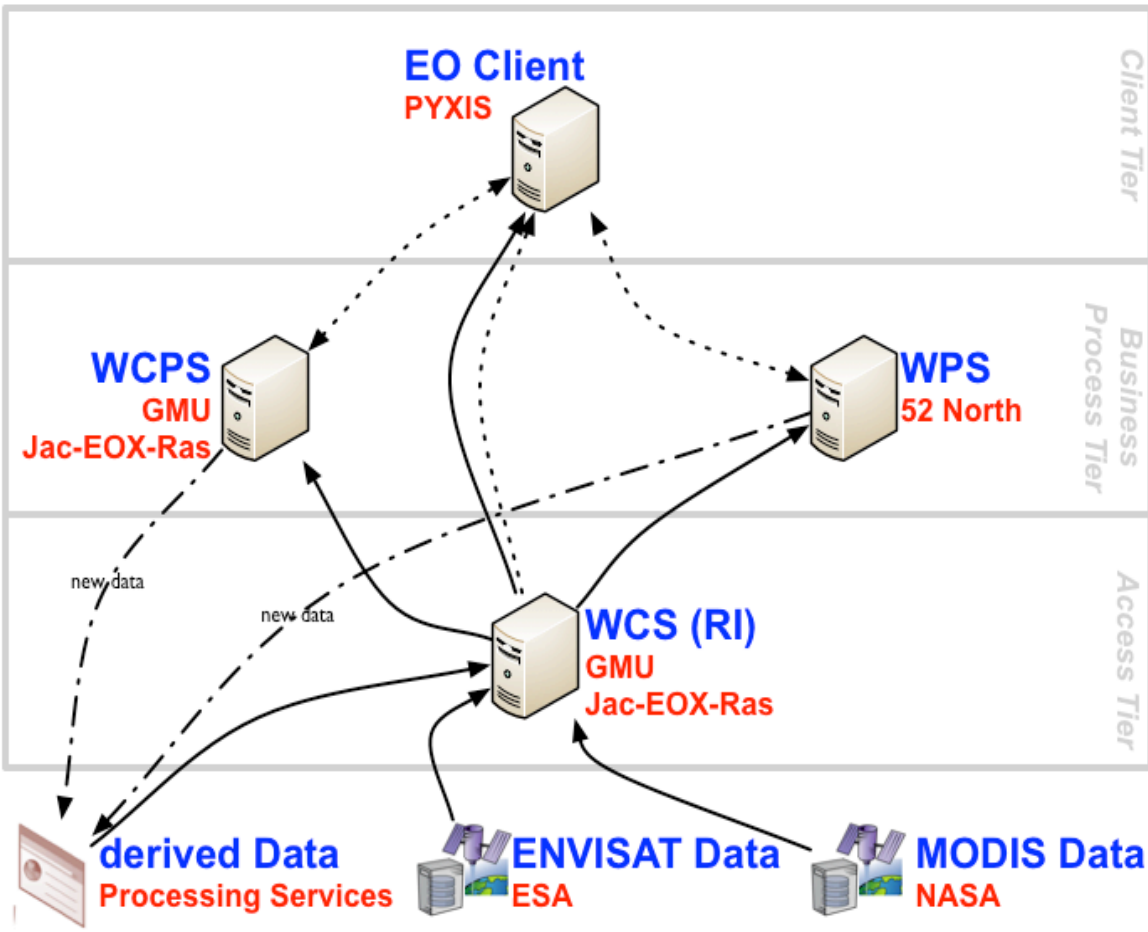
Support for these data products:
- ✧ MODIS (specific products to be identified.)
- ✧ ENVISAT MERIS L3 demonstration products (http://earth.eo.esa.int/level3/)
- ✧ ENVISAT ASAR Wide Swath
- ✧ Limb-scanning instruments (e.g. Microwave Limb Sounder) typically produce vertical profiles,
- ✧ Narrow-swath instruments (e.g., CALIPSO) produce vertical cross-sections.

Support for these encodings:
- ✧ GeoTIFF, netCDF / CF-netCDF, JPEG2000, HDF-EOS

WCPS / WPS processing support for WCS 2.0
- ✧ Develop WCPS for advanced access to Earth Observation Coverages.
- ✧ Deploy a WCPS that provides multi-coverage fusion capabilities
- ✧ Develop complex WCPS queries
- ✧ Develop WPS for Earth Observation data analysis of multiple coverages and other data.

Develop Compliance Test Suite for the WCS 2.0 AP

Observation Fusion - Coverages Architecture Diagram:



Observation Fusion (Coverages) Significant Results:

- Compliance test development – WCS 2.0 core / extension model standard conformance testing framework for core/extension model developed
    - Executable tests developed for GML Coverages, WCS Core, GET, POST, EO-WCS
    - Reference Implementations from rasdaman, MapServer, GMU
- EO Profile for WCS 2.0 successfully demonstrated
- Chaining of Web Coverage Processing Service and Web Processing Service successfully demonstrate the ability to combine mutiple image sources to produce change detection models, time series processing and homogeneous access to 2D, 3D, 4D, 5D data sets

Observation Fusion (Coverages) Deliverable Engineering Reports:

11-090 OWS-8 Engineering Report Metadata Mapping between NASA ECS/HDF-EOS and WSC2.0

11-095 OWS-8 WCS 2.0 Earth Observation Application Profile Compliance Tests and Reference Implementation ER

11-096 OWS-8 WCS 2.0 Earth Observation Application Profile ER

11-116 OWS-8 Geoprocessing of Earth Observations ER

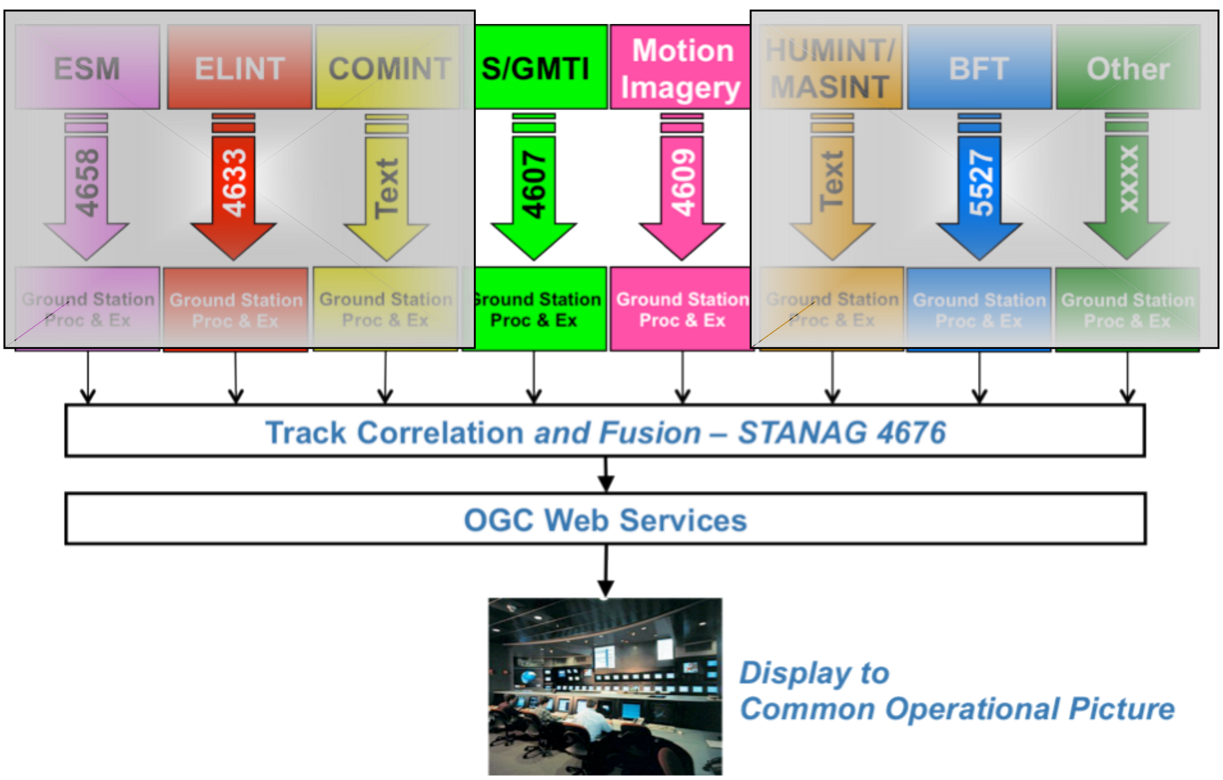
4.5 Observation Fusion - Tracking

Sponsors: NGA

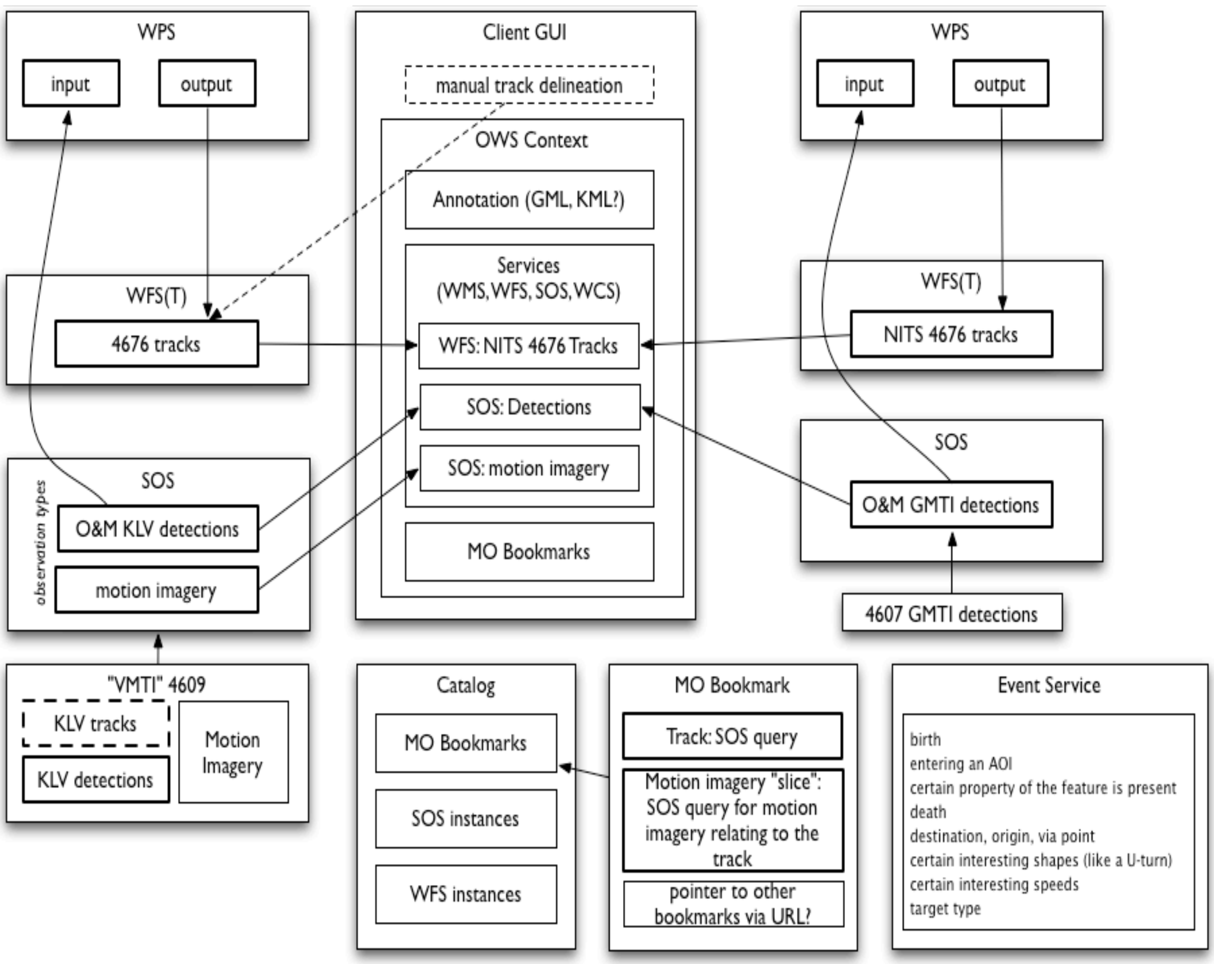
Participants: 4 participant companies and universities

Tasks:

- Provide an archtectual viewpoint / information model for the usage of video moving target indicator data (VMTI), ground moving target indicator (GMTI) and tracking information (STANAGs 4607, 4609, 4676, MISB EG0903.03) in the context of standardized spatial data infrastructures compliant to OGC and ISO standards.
- Provide traceability from a moving object back to the original base data through the use of a "bookmark" concept.
- Implement OGC services and encodings, extended by the XML-Schema-based implementations; allow access to target information data and tracking data based on VMTI, GMTI, and STANAG 4676 information.
- Identify any recommendations for enhancements to OGC, MISB, NATO standards supporting tracking architecture.



OWS-8 Observation Fusion - Tracking Architecture Diagram:



Observation Fusion (Tracking) Significant Results:

- ✧ Information Models developed for GMTI, VMTI, 4676 Tracks
- ✧ Information Model developed for new conceptual Bookmarking tag (ability to link back a track to the original spot in the source data)
- ✧ XML Schemas developed supporting GMTI, VMTI, 4676 Tracks and Bookmarks
- ✧ Defined and developed an integrated concept for supporting VMTI, GMTI and 4676 data within OGC web services and using OGC data models for exchange
  - ✧ Service-enabled motion imagery using MISB 903 standard via Sensor Observation Service
  - ✧ Service-enabled access to detections in the motion imagery metadata (via SOS)
  - ✧ Service-enabled moving object tracks via STANAG 4676 (via WFS)
- ✧ Demonstrated notification of tracking data using WS-Notification to a hand held android device through the use of the OGC GeoSMS standard

- ✧ Demonstrated the ability for OGC Web Processing Service implementing tracking algorithms to create track data from original source detection data (WPS accessing SOS)

Observation Fusion (Tracking) Deliverable Engineering Reports:

11-108 OWS-8 Tracking: Analysis of OGC Standards for Supporting Mobile Object Processing Implementation ER

11-113 OWS-8 Information Model for Moving Target Indicators and Moving Object Bookmarks ER

11-134 OWS-8 Tracking: Moving Target Indicator Process, Workflows and Implementation Results