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OGC® OWS-9 Reference Architecture Profile (RAP) Advisor Engineering Report

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Abstract

The Reference Architecture Profiler (RAP) Advisor™ is a web based application that recommends OGC Standards and OGC Reference Model (ORM) Sections that are relevant to a system development; such that a community of interest could derive and build a profile of suitable OGC standards to meet their specific needs. This Engineering Report contains the requirements, conceptual design, development methodology, and implementation of the RAP Advisor.

Initial development of the RAP Advisor™ was concurrent with the OGC Web Services Testbed, Phase 9 (OWS-9) with NGA sponsorship. During OWS-9 timeframe, key concepts of the RAP Advisor were confirmed through prototyping. Future development is required to complete the functions and content of the Advisor.

Keywords

Ogcdoc, ogc document, rap, ows9, ows-9, orm

What is OGC Web Services 9 (OWS-9)?

OWS-9 builds on the outcomes of prior OGC interoperability initiatives and is organized around the following threads:

- **Aviation**: Develop and demonstrate the use of the Aeronautical Information Exchange Model (AIXM) and the Weather Exchange Model (WXXM) in an OGC Web Services environment, focusing on support for several Single European Sky ATM Research (SESAR) project requirements as well as FAA (US Federal Aviation Administration) Aeronautical Information Management (AIM) and Aircraft Access to SWIM (System Wide Information Management) (AAtS) requirements.

- **Cross-Community Interoperability (CCI)**: Build on the CCI work accomplished in OWS–8 by increasing interoperability within communities sharing geospatial data, focusing on semantic mediation, query results delivery, data provenance and quality and Single Point of Entry Global Gazetteer.

- **Security and Services Interoperability (SSI)**: Investigate 5 main activities: Security Management, OGC Geography Markup Language (GML) Encoding Standard Application Schema UGAS (UML to GML Application Schema) Updates, Web Services Façade, Reference Architecture Profiling, and Bulk Data Transfer.

- **OWS Innovations**: Explore topics that represent either new areas of work for the Consortium (such as GPS and Mobile Applications), a desire for new approaches to existing technologies to solve new challenges (such as the OGC Web Coverage Service (WCS) work), or some combination of the two.

- **Compliance & Interoperability Testing & Evaluation (CITE)**: Develop a suite of compliance test scripts for testing and validation of products with interfaces implementing the following OGC standards: Web Map Service (WMS) 1.3 Interface Standard, Web Feature Service (WFS) 2.0 Interface Standard, Geography Markup Language (GML) 3.2.1 Encoding Standard, OWS Context 1.0 (candidate encoding standard), Sensor Web Enablement (SWE) standards, Web Coverage Service for Earth Observation (WCS-EO) 1.0 Interface Standard, and TEAM (Test, Evaluation, And Measurement) Engine Capabilities.

The OWS-9 sponsors are: AGC (Army Geospatial Center, US Army Corps of Engineers), CREAF-GeoViQua-EC, EUROCONTROL, FAA (US Federal Aviation Administration), GeoConnections - Natural Resources Canada, Lockheed Martin Corporation, NASA (US National Aeronautics and Space Administration), NGA (US National Geospatial-Intelligence Agency), USGS (US Geological Survey), UK DSTL (UK MoD Defence Science and Technology Laboratory).

License Agreement

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1 Introduction

Initial development of the RAP Advisor™ was concurrent with the OGC Web Services Testbed, Phase 9 (OWS-9) with NGA sponsorship. During OWS-9 timeframe, key concepts of the RAP Advisor were confirmed through prototyping. Future development is required to complete the functions and content of the Advisor.

Usability Testing confirmed the conceptual design and operational functions. The Advisor was rated as "very good" in finding relevant OGC Standards. In general, users agreed the Advisor would be beneficial in their system development work.

The RAP Advisor is built on the OGC Knowledge Base – the collection of databases and digital artifacts OGC has created and collected throughout the last 17 years. Knowledge Management concepts considered in design of the RAP Advisor were:

- Use multiple Discovery methods then merge for a comprehensive answer.
- Evaluation of discovered standards aided by information beyond the standards.
- Employ methods that allow users to relate OGC knowledge to their context.
- Summary Report to contain benefits from using the identified standards.

Users interact with the RAP Advisor through a web interface to convey their understanding of the scope of the system development. Users have the option of selecting among three discovery methods:

1. Navigate OGC Reference Model (ORM) sections
2. Search on text in the ORM, and
3. Select one of the OGC Domain Working Groups.

Using these discovery methods, users select relevant OGC Standards based on their system application(s); selections are saved in a Profile Folder and used for the creation of the RAP Advisor Summary Report.

The RAP Advisor was tested using the Joint IC/DoD Content Discovery and Retrieval (CDR) system development. CDR concepts were tested on the RAP Advisor. CDR experts took part in the Usability Testing.

The version of RAP Advisor developed during OWS-9 is a prototype with further developments needed both in function and content. Ideas for further development are included in this Engineering Report.

1.1 Scope

This Engineering Report (ER) documents the development of the Reference Architecture Profile (RAP) Advisor as conducted during the OWS-9 Testbed.

The RAP Advisor is a web based application that recommends OGC Standards and ORM Sections that are relevant to a system development; such that a community of interest could derive and build a profile of suitable OGC standards to meet their specific needs. This ER contains the requirements, conceptual design, development methodology, and implementation of the RAP Advisor.

The ER also contains results of usability testing and application of the Advisor to the Joint IC/DoD Content Discovery and Retrieval (CDR) system development. The ER concludes with further development ideas for the RAP Advisor.

1.2 Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

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1.3 Revision history

Date	Release	Editor	Primary clauses modified	Description
20121226	0.1	G. Percivall	New	First version posted to OGC Pending

1.4 Future work

No further improvements to this document are envisioned at this time. Ideas for future work on the RAP Advisor are listed in Clause 11.

1.5 Forward

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

2 References

The following documents are referenced in this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

OGC 08-062r7, *OGC Reference Model*, 2011-12-19, Version 2.1, (http://www.opengis.net/doc/orm/2.1)

IC/DoD Content Discovery and Retrieval Reference Architecture, Intelligence Community and Department of Defense Content Discovery and Retrieval Integrated Project Team, v1.1, 25 February 2011

3 Terms and definitions

For the purposes of this report, the following terms and definitions apply. Several terms are from the OGC Glossary (http://www.opengeospatial.org/ogc/glossary/)

3.1
standard
document that specifies a technological area with a well-defined scope, usually by a formal standardization body and process. (OGC Glossary)

3.2
profile
collection of standards, with parameters, options, classes, or subsets, necessary for building a complete computer system, application, or function. An implementation case of a more general standard or set of standards.

3.3
architecture
abstract technical description of a system or collection of systems. (OGC Glossary)

NOTE Modern software architectures employ interoperability interfaces to enable enterprises and whole industries to establish coherent, flexible, integrated information flows that can be implemented with heterogeneous but intercommunicating software systems. The OpenGIS Specification defines the interoperability interfaces that make it possible to include geographic information in these information flows. Conceptually based, architecture does not contain the level of detail needed for construction.

3.4
knowledge management
a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences [Wikipedia].

4 Conventions

4.1 Abbreviated terms

CDR	Content Discovery and Retrieval
GUI	Graphical User Interface
HCI	Human Computer Interactions
IC/DoD	Intelligence Community/Department of Defense
KB	Knowledge Base
KM	Knowledge Management
NGA	National Geospatial-Intelligence Agency
ORM	OGC Reference Model
OWS-9	OGC Web Services Testbed, Phase 9
RAP	Reference Architecture Profile

5 RAP Advisor overview

The RAP Advisor was developed in the OGC Web Services Testbed, Phase 9 (OWS-9) with NGA sponsorship. During OWS-9, key concepts of the RAP Advisor were confirmed through prototyping. Future development is required to complete the functions and content of the Advisor. The overall objectives in developing the prototype are to:

- Update the OGC Reference Model (ORM)
  - Add/update based on new standards, and
  - Enable HTML-based web access to the document paragraph by paragraph
- Web-enable the ORM and build a GUI
  - Such that a community of interest could derive and build a profile of suitable OGC standards to meet their specific needs.
  - Provide a knowledge base that would identify when or what standards are required based on a users requirements
- Evaluate the ORM against the Intelligence Community (IC)/Department of Defense (DoD) Content Discovery and Retrieval (CDR) Reference Architecture.

The Advisor prototype is designed as an OGC Web interface and based on three different discovery methods, users can select relevant OGC standards that will support their system applications. After a profile of OGC standards are selected, users can create a summary report that lists and describes their selected standards.

6 Conceptual Design

6.1 Introduction

The Reference Architecture Profile (RAP) Advisor was developed to be a web based application that recommends OGC Standards and ORM Sections that are relevant to a system development; such that a community of interest could derive and build a profile of suitable OGC standards to meet their specific needs.

The RAP Advisor was developed to interact with users through a web interface to gain understanding of the scope of the system development. Based on the users input on scope, the RAP Advisor will produce a list of relevant OGC Standards and ORM Sections.

6.2 Requirements

The RAP Advisor shall:

- Provide users with a web HCI (human-computer interface)

- Using the web interface, allow a user to communicate the scope of their system development.
- Based on the system development scope, identify relevant OGC Standards and ORM Sections.
- Take into account any dependency between different standards.
- Output a report of the identified OGC Standards and ORM sections
- Format of Report, e.g., Excel, MS Word or PDF.

6.3 Design Overview

A conceptual design for the RAP Advisor (Figure 1) was developed at the OWS-9 Kickoff and slightly modified during the course of development. The figure shows the conceptual design in particular based on a functional separation of 1) the RAP Advisor Human Computer Interaction (HCI) functions and 2) the RAP Advisor Reporting function from 3) the existing OGC Knowledge Base (KB). The RAP Advisor interactions with the OGC KB are anticipated to be multifold and not all implemented in the initial prototype.

Elements of the conceptual design (Figure 1) not implemented in the initial prototype (OWS-9) include Semantic Mediation component and access to external resources, e.g., DISR.

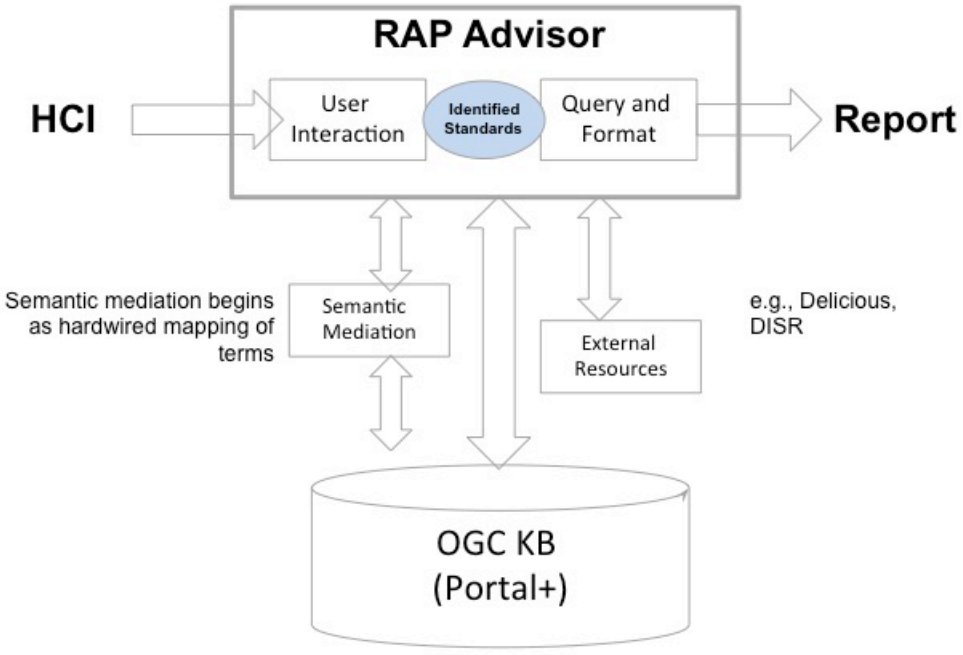


Figure 1 – RAP Advisor Conceptual Design

6.4 Knowledge Management considerations

Knowledge management (KM) comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences [Wikipedia]. KM concepts were considered in the design of the RAP Advisor.

The Watson/Jeopardy Project is an excellent recent example of the advances in KM that was reviewed for background on the RAP Advisor. "Towards the Open Advancement of Question Answering Systems" – an IBM research paper describing the Watson/Jeopardy Project – provides concepts and possible terminology for design of KM systems. The Watson Architecture [Wikipedia] shows the approach of using multiple evaluations merged for a single answer.

As part of the design process, the application of KM to RAP was discussed with an OGC Member expert on KM[1]. KM provides a broad set of concepts, e.g., Table 1 shows the progression of knowledge states.

- Knowledge can be either tacit or explicit. The ORM and OGC standards capture explicit knowledge.
- Conveyance of knowledge requires not only information transfer but also the receiver must trust the information. It is important for OGC KM to think beyond just the OGC standards to achieve conveyance of knowledge.
- The first step is Discovery of the relevant OGC KM artifacts, e.g., standards.
- After Discovery the receiver will be making a judgment about the artifacts. Its one thing to identify the standards, but the RAP Advisor must also convey trust. The Advisor must supply information beyond the standards for this Judgment step.
- Conveyance of knowledge can be aided by use of Patterns. Patterns allow for the receiver to see a familiar description to information that is new and foreign. Patterns show domain context to user.

During the development it was noted by one of the reviewers that the RAP Advisor functionality was similar to "Shepardizing a Case" the process conducted in law to check the relevance of a past court decision as precedent for a current case.

[1] Ken Galluppi, Arizona State University, personal communication on 19 July 2012.

Table 1 – Progression of Knowledge States

Sense-making Focus	Descriptive Knowledge	Procedural Knowledge	Reasoning Knowledge
Syntax (clarity)	Datum	Algorithm Syntax	Rule Syntax
Semantics (meaning)	Information	Algorithm Semantics	Rule Semantics
Interrelationships (dependencies, consistency)	Structured information	Connections and Patterns across algorithms	Relationships among rules and sets of rules *(workflows)*
Validity (correctness, confidences)	Evaluation	Algorithm Validity	Rule and rule set validity (policy)
Applicability (importance, relevance)	Judgment	Algorithm Applicability	Rule and rule set applicability (policy)
Choice (action)	Decision	Algorithm Choice	Rule Choice (policy)

Adapted from Clyde W. Holsapple, 2005. The inseparability of modern knowledge management and computer-based technology. Journal of Knowledge Management. 9:1 pp 42-52.

The main implications on the RAP Advisor design based on considering KM were:

1. Discovery step to use multiple evaluations methods, merged for a single answer.
2. Judgment or evaluation of the discovered standards needs to be aided by information beyond the standards.
3. Methods such as Patterns should be considered that allow for the user to relate the OGC knowledge to the User's context.
4. The Advisor Report should contain a benefits section about the value of using the identified standards.

6.5 Discovery methods

Three approaches for identifying the standards were identified:

1. Navigate ORM structure. Provide a telescopic menu structure using the outline of the ORM. Once the user selects a leaf in the ORM outline, the clause is displayed along with the standards listed in the clauses. (prototyped in Sprint #2)
2. Search the ORM text. Response to the search is the relevant ORM clauses and the Standards contained in those clauses (prototyped in Sprint #1)
3. Keyword Checkboxes. Provide the user with a list of keywords that are in the OGC KB. User selects the keywords of interest and submits request. Response is the list of ORM clauses or relevant standards to those keywords. (During development this became the Domain Working Groups approach to discovery)

These methods can be used separately or in combination to identify standards.

6.6 Report Structure

Based on the KM considerations, the RAP Advisor Summary Report was identified to have two main sections:

- Summary Table
- ORM Sections
- Report per Standard (1 or more reports)

The content of Summary Table will be:

- Lists of identified Standards (What if any is the grouping in this listing?
- Standard Dependency

The content of the Report per Standard

- ORM Paragraph
- Titles of Standard with link to each version
- Implementation Scorecard:
  - Self-declared implementations registered - yes/no - if yes, provide link
  - Compliance test exists - yes/no - if yes, provide link
  - Compliant implementations - yes/no - if yes, provide link.
- Titles of other OGC Document with links
- Titles and links to other resources.

The report will need to be available in several formats, e.g.,

- On a Web page of the Advisor
- Export as MS Word .doc

6.7 Relationships between Standards

One pattern for users to understand the OGC standards was identified as a conveying the "relationships" between standards. Several types of relationships were discussed in the design process but not all have been implemented in OWS-9.

- Normative Reference relationship
  - As extracted from Section 3, Normative References, from the standard.
  - Not a history of the standards but rather dependency.
  - Consistency of normative reference citations in the OGC KB is addressed in Section 6.8.
  - Option on graphic display to show the depth of references
    - One level: CityGML -> GML
    - Two levels: CityGML -> GML -> XML

- Provenance or Roadmap relationships
  - Beyond normative references, other relationships can be depicted between the OGC standards.

- A graphic display could be constructed of standards that share common concepts or that were an influence or were developed in a coordinated fashion.
- These relationships are much more subjective and are not documented in the standard itself so creation of the links and maintenance is not part of the OGC standards development workflow.

Graphic display of the relationships between standards is a quick and effective way for understanding. Figures below depict different types of relationships. Future work on the Advisor could develop a semantic ontology for the standards, e.g., Figure 3.

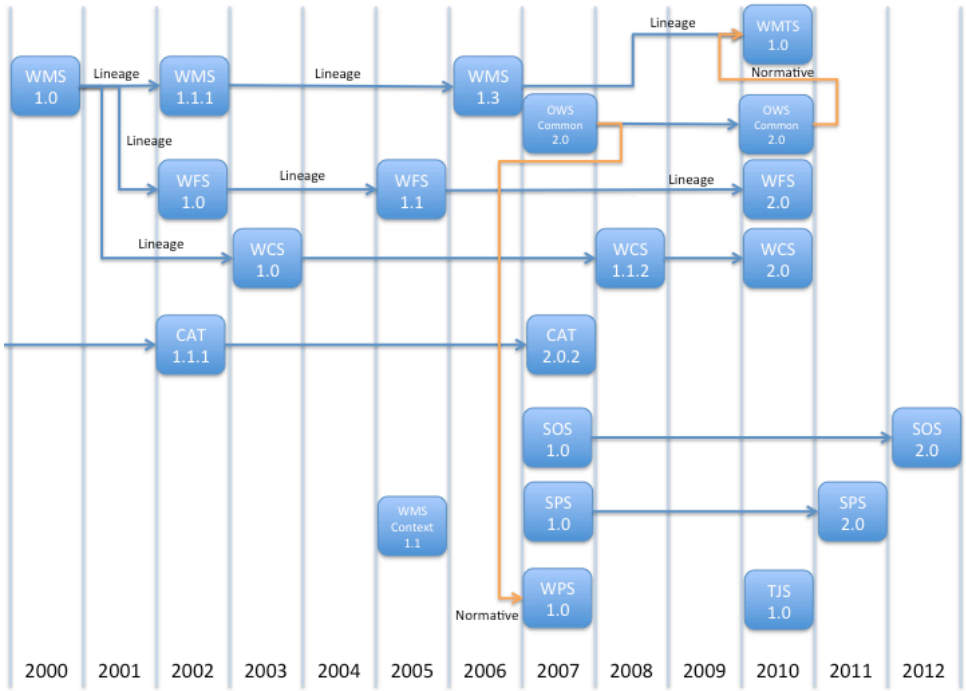


Figure 2 – OGC Standards Relationships: a historical view

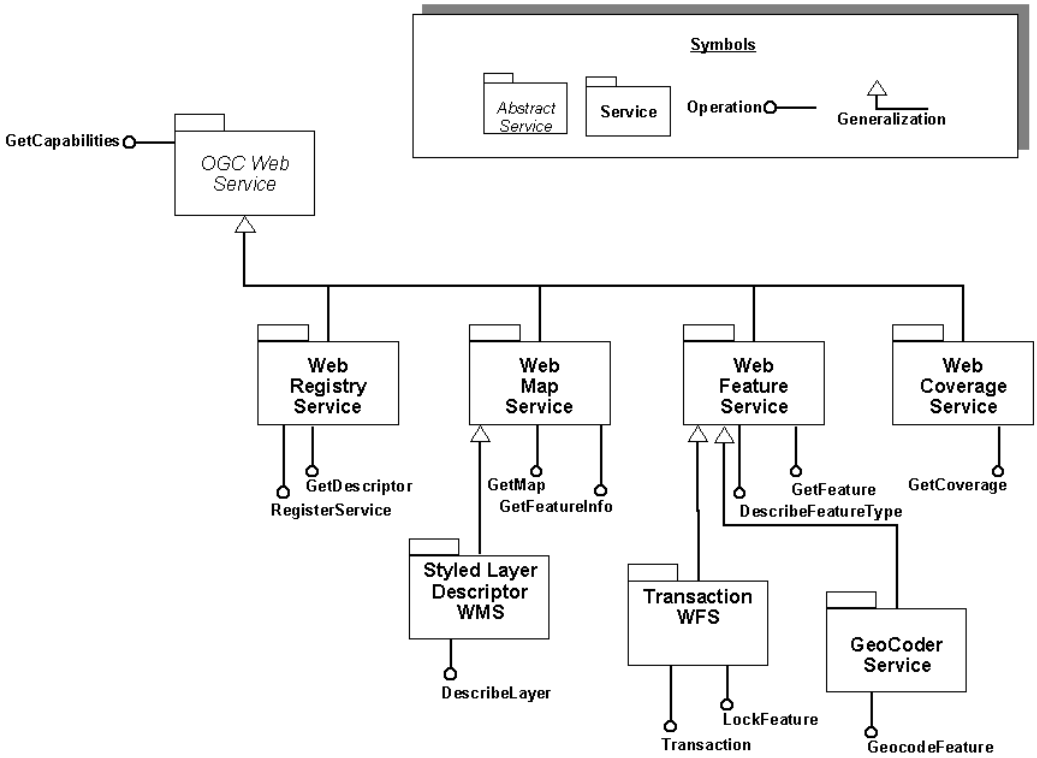


Figure 3 – Standard Relationships – Type Hierarchy

source

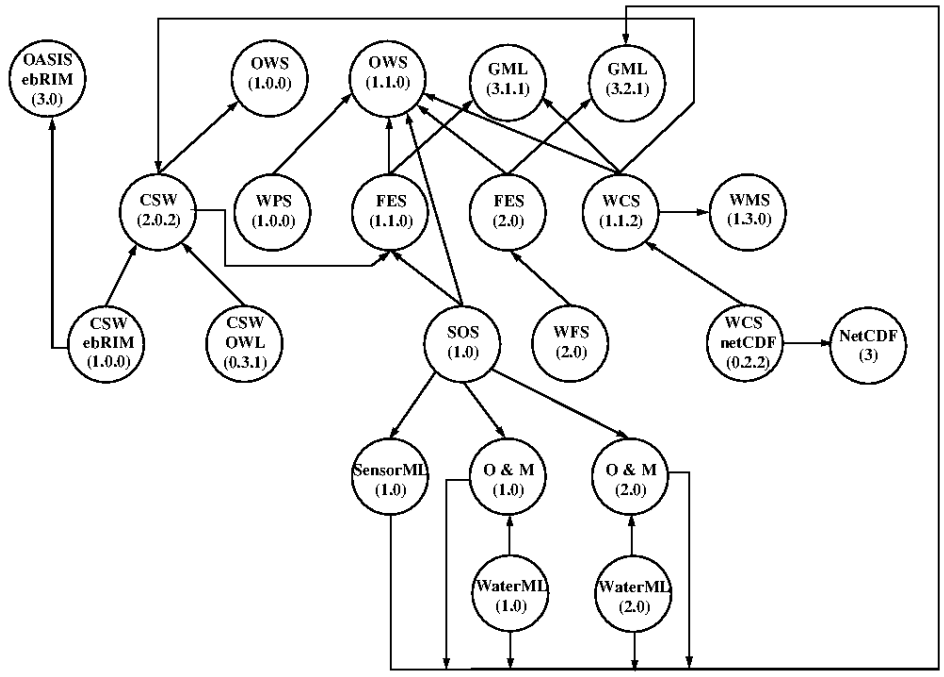


Figure 4 – Standard Relationships: spaghetti view

6.8 Normative Reference Schema

6.8.1 Introduction

To improve the OGC Knowledge Base a consistent schema should be used in all OGC Standards for normative references. This section developed and recommends a schema for normative references.

The following standards were considered in the development of a schema

- ISO 15836 - Dublin Core
- ISO 690-2, Information and documentation — Bibliographic references — Part 2: Electronic documents or parts thereof
- W3C
- ISO 19115

Table 2 provides a comparison of the standards that were considered. Dublin Core was used as the primary list of terms to which terms from the other standards were arranged. The table shows that many of the terms are similar in the standards.

The recommended schema for normative references in OGC Standards is listed in Table 3.

Table 2 – Comparison of Schemas

Dublin Core	W3C	ISO 690-2	ISO 19115
5.1 Title	Title	Title	Title
			alternate Title
5.2 Creator	authors (or editors)	Primary responsibility	citedResponsibleParty
		Subordinate responsibility (Optional)	
5.3 Subject			
5.4 Description			
5.5 Publisher	Publisher	Publisher	citedResponsibleParty
		Place of publication	
5.6 Contributor			
5.7 Date	Date	Date of publication	CI_Date
		Edition	edition
			edition Date
		Date of update/revision	
		Date of citation	
5.8 Type			
5.9 Format			
		Type of medium	
			presentation Form
5.10 Identifier	URI of this version		MD_Identifier
	persistent URI		
		Availability and access	
			ISBN
			ISSN
5.11 Source			
		series	series
			Other Citation Details
			Collective Title
5.12 Language			
5.13 Relation			
		Standard number	
		Notes	

Table 3 – Recommended Schema

Element	Mult.	Date Type	Notes
Title	1	Text	Same as Title in Dublin Core, W3C, ISO 690-2 and ISO 19115
Creator	1	Text	Same as DC Creator, W3C Authors/Editors, 690-2 Primary responsibility
Publisher	1	Text	Same as Publisher in DC, 690-2 and W3C.
Date	1	ISO date YYYY-MM-DD	Same as DC Date, W3C Date, 690-2 date of publication
Version	1	Text	Same as 960-2 Edition
Format	1	Code list	Subset of IANA Media Types. Currently 57 types. See also DC Format, 690-2 Type of medium
URI	1	Text	URI
ISBN	1	Text	ISBN
Standard Number	1	Text	Same as 690-2
Notes	1	Text	Same as 690-2, include other items from others

Multi = multiplicity

6.8.2 Application of the Recommended Schema

The following citations are the normative references in the PUCK 1.4 standard. All of the references here are listed using the recommended schema (Table 3) where as the citations in PUCK 1.4 are variable format.

- Title: Dynamic Configuration of IPv4 Link-Local Addresses
- Creator: S. Cheshire, B. Aboba, E. Guttman
- Publisher: IETF
- Date: 2005-05-01
- Format: txt
- Identifier: http://www.ietf.org/rfc/rfc3927.txt
- Standard Number: IETF RFC 3927

- Title: Multicast DNS
- Creator: Stuart Cheshire, Marc Krochmal
- Publisher: IETF
- Date: 2006-08-10
- Format: txt
- Identifier: http://files.multicastdns.org/draft-cheshirednsext-multicastdns.txt

- Notes: Document no longer accessible at listed URI.

- Title: DNS-based Service Discovery
- Creator: Stuart Cheshire
- Publisher: IETF
- Format: txt
- Identifier: http://files.dns-sd.org/draftcheshire-dnsext-dns-sd.txt
- Notes: Document no longer accessible at listed URI.

- Title: A Universally Unique Identifier (UUID) URN Namespace
- Creator: P. Leach, M. Mealling, R. Salz
- Publisher: IETF
- Date: 2005-07-01
- Format: txt
- Identifier: http://www.ietf.org/rfc/rfc4122.txt
- Standard Number: IETF RFC 4122

- Title: Transmission Control Protocol
- Creator: Jon Postel
- Publisher: IETF
- Date: 1981-09-01
- Format: txt
- Identifier: http://www.ietf.org/rfc/rfc793.txt
- Standard Number: IETF RFC 793

- Title: EIA Standard RS-232-C Interface Between Data
Terminal Equipment and Data Communication Equipment Employing Serial Data Interchange
- Creator: Electronic Industries Association
- Publisher: Telebyte Technology Data Communication Library, Greenlawn NY
- Date: 1969-08-01
- Format: book
- Notes: No ISBN

6.8.3 Handling empty fields

Where any unused labels are omitted, the easiest thing to parse would be to have each of the labels as a Bulleted List Item in word (or unordered list <ul> in HTML).
- Title:
- Creator:
- Publisher:
- Date: <YYYY-MM-DD>
- Version:

- Format: <media type extension if applicable, i.e. for application/msword use doc, HTML use htm, Text use txt etc. >
- Identifier: <uri>
- Series:
- Standard Number: <OGC xx-xxxx, ISBN, IETF RFC, etc>
- Notes:

6.8.4 Implementation in the OGC KM

The following figure shows the normative schema recommendation (Table 3) implemented in the user interface of the OGC KB.

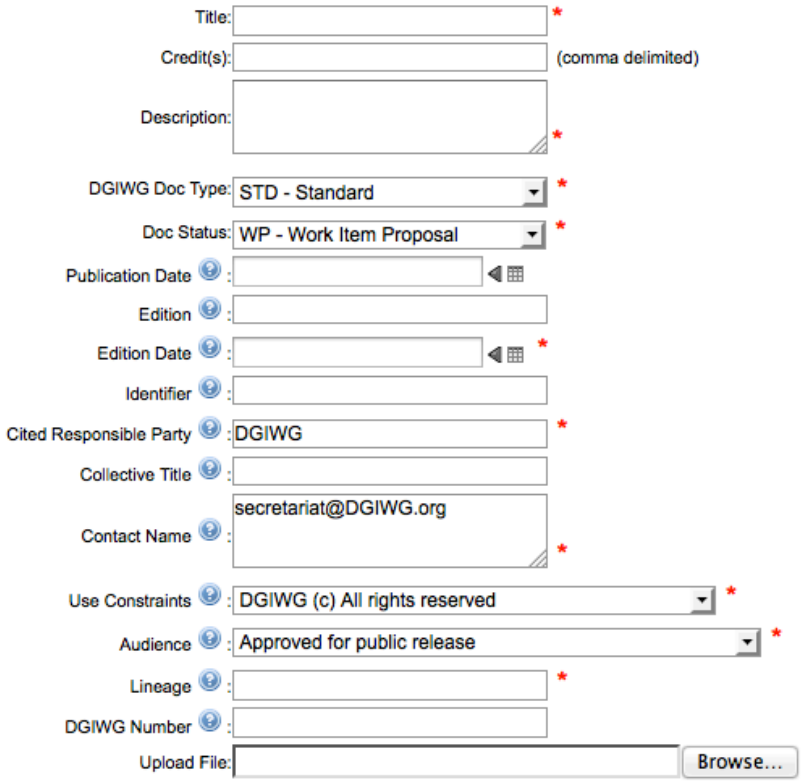


Figure 5 – Normative Reference implementation in OGC KB

7 Software Development Process

7.1 Agile development process

Agile software development is iterative and incremental development, where requirements and solutions evolve [Wikipedia]. The Agile Manifesto [1] introduced the term in 2001.

Scrum is one form of agile development based on Sprints. A Sprint is restricted to a specific duration normally between one week and one month. A Certified Scrum Master recommended the Scrum approach to agile development for use in the RAP Advisor.[2]

Listed below are the Sprints conducted to develop the RAP Advisor during OWS-9.

7.2 Content of development Sprints

7.2.1 Sprint #1 - July/August 2012

Sprint 1 focused on the "Query and Format" as shown in Figure 1 where the design was separated in to "HCI" and "Query and Format." Query and Format" functions developed in Sprint 1 were:

- Accept a list of standards from "User Interaction" (for sprint 1, only 1 standard need be used as input)
- Query the OGC KB (portal plus other OGC databases) as well as Delicious index of OGC articles.
- Create a Summary Report with the contents as defined in Section 6.6.

7.2.2 Sprint #2 - August 2012

The content of Sprint #2 was:

- Add menu structure using ORM
  - Consider the menu of https://nsgreg.nga.mil/overview.jsp
  - Selecting leaf in outline returns ORM page and list of cited standards.
  - Check boxes for each cited standard.
  - From ORM page to Standard Report page for selected standards using check boxes.
- Add "feedback" to Standard Report page form
- "Implementation Scoreboard" on Standard Report page
  - Self-declared implementations registered - yes/no - if yes, provide link
  - Compliance test exists - yes/no - if yes, provide link
  - Compliant implementations - yes/no - if yes, provide link.
- Bug fixes

[2] Personal communications with Joseph Percivall, Certified Scrum Master, July 2012.

During Sprint #2, the main web pages and workflow were initially developed. A diagram summarizing the pages and workflow was developed in Sprint #2 and updated during each subsequent sprint with its current form shown in Figure 6.

7.2.3 Sprint #3 conducted in September 2012

Sprint #3 was the first attempt to complete the major functionality to be developed in OWS-9 for the RAP Advisor. The content of Sprint #3 was

- Implement the "Cart" of identified standards that can be refined before creating final report (Eventually the “Cart” became the “Folder”)
- Check boxes throughout (no radio buttons) for selecting standards to be added to the Cart
- Add List of Standards to top of Report.
- Executive summary in Export report that describes criteria for standards in Cart, e.g.,
  - List of terms that were used in searches.
  - List of ORM paragraphs that were identified.
- Phrases or questions that suggest terms for query (stub/hardwire for semantic mediation and DWG inputs in the future)
- Usability clean up ongoing, e.g., styles in Word report

7.2.4 Sprint #4 conducted in October 2012

Sprint #4 completed all of the major functionality developed in OWS-9 for the RAP Advisor. The Content of Sprint 4 was:

- All of the main pages of RAP were prototyped: 1) Discovery, 2) Results, 3) Refinement, 4) Identified standards
- Refined "Cart/Folder" of identified standards that can be refined before creating final report
- Dependencies of standards on other documents. A schema for reference documents citations was created (see Section 6.8).
- During the sprint, the visual display of Relationships between Standards was discussed. Several concepts were developed but not implemented for OWS-9 development of the Advisor.
- Change button on Results page from "Submit Query" to "Add to Report" or similar term
- Fixed query based on phrases or terms listed on Discovery Page.
- Use of Domain WG names as search links
- Usability clean up ongoing, e.g., styles in Word report

7.2.5 Sprint #5 conducted in November 2012

The objective of Sprint #5 was to prepare for Usability Testing. During this sprint the guided exercise listed in Annex B was initially developed. Many small items were fixed, e.g., spelling and consistent labeling.

8 User interface Implementation

8.1 User Workflow – RAP Advisor Web pages.

Users interact with the RAP Advisor through a web interface to convey their understanding of the scope of the system development. The web pages of the RAP Advisor User Interface are shown in Figure 6. The figure also shows the transitions between the pages.

Starting at the RAP Advisor Home Page, users have the option of selecting among three discovery methods:

1. Navigate through ORM menu,
2. Search on free text, and
3. Select one of the Domain Working Groups.

During each discovery process, users select relevant OGC Standards based on their system application(s); these selections are saved in a profile Folder and used for the creation of the RAP Advisor Summary Report. Users can return to the Discovery screen as often as necessary to check, expand and/or revise their standard selections. After iteratively discovering standards of interest and adding them to the Folder, the user can chose to create a Summary Report.

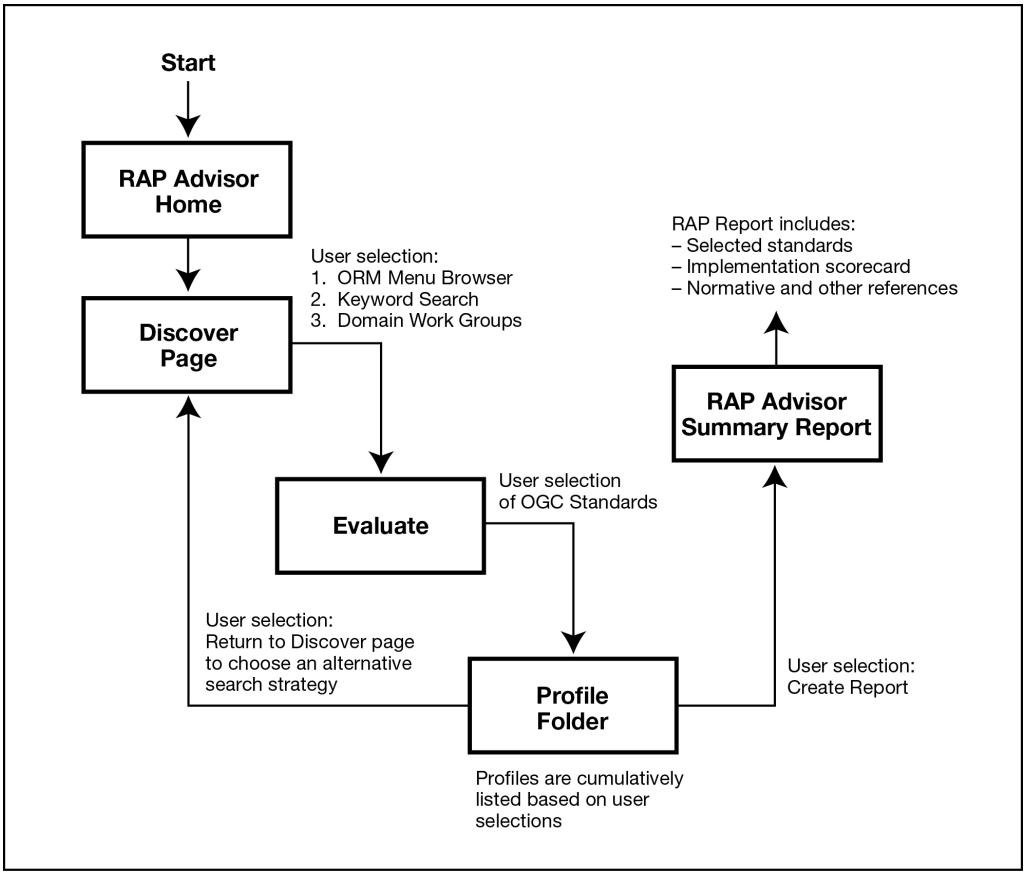


Figure 6 – RAP Advisor Webpages and Workflow

8.2 Advisor Webpage Screenshots

An interested user will enter the RAP Advisor web application on the Home page. The Home page consists of a short introduction and instructions for the RAP Advisor as well as a form for collection of minimal program information. The collection of this information serves two purposes. Program details collection:

- Helps the user think through program goals and objectives so that they can better ask questions to the Advisor,
- Stores associates program details and the outcomes of the Advisor into a database that will eventually be a resource for data-mining future RAP Advisor users.

The user of the RAP Advisor will then be directed to the Discover page (Figure 7) and iterate the three methods of discovery through Evaluate page (Figure 8) to add OGC documents to the Profile Folder (Figure 9). Once the user is satisfied with the collection of the Profile Folder then can generate a Summary Report.

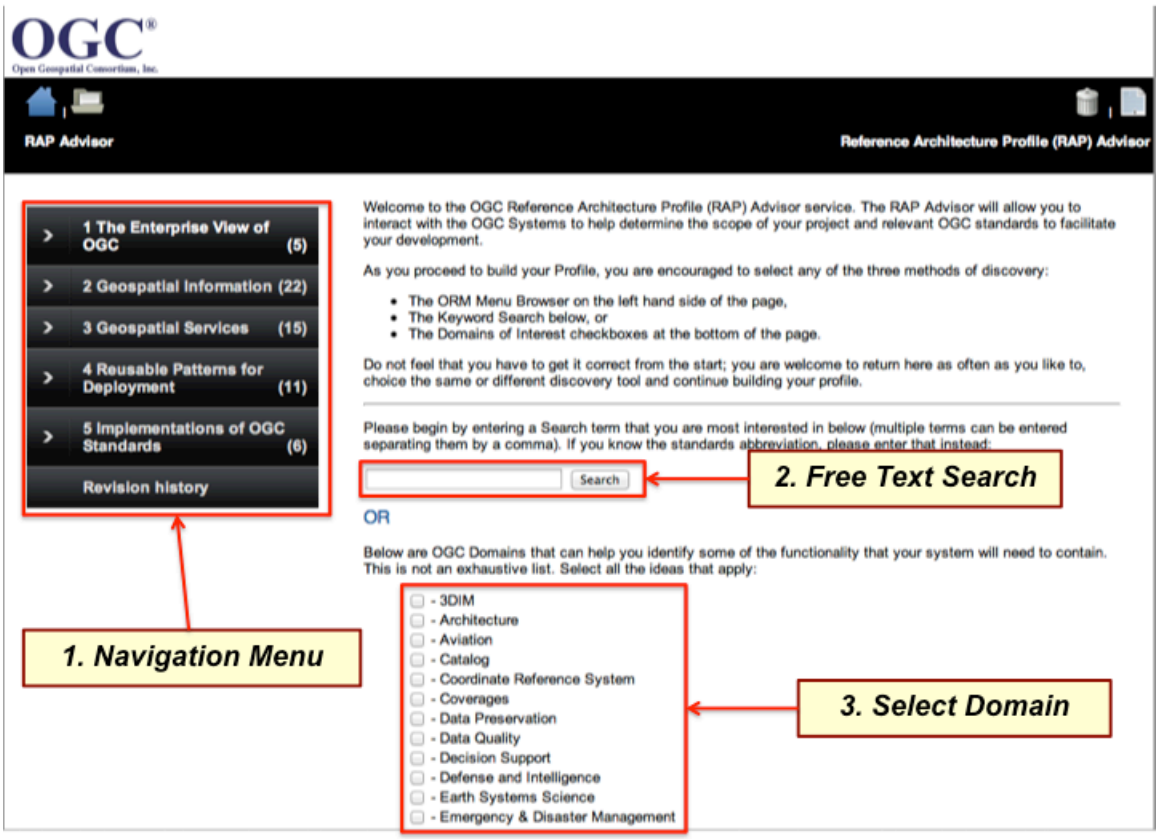


Figure 7 – RAP Advisor Webpage: Discover

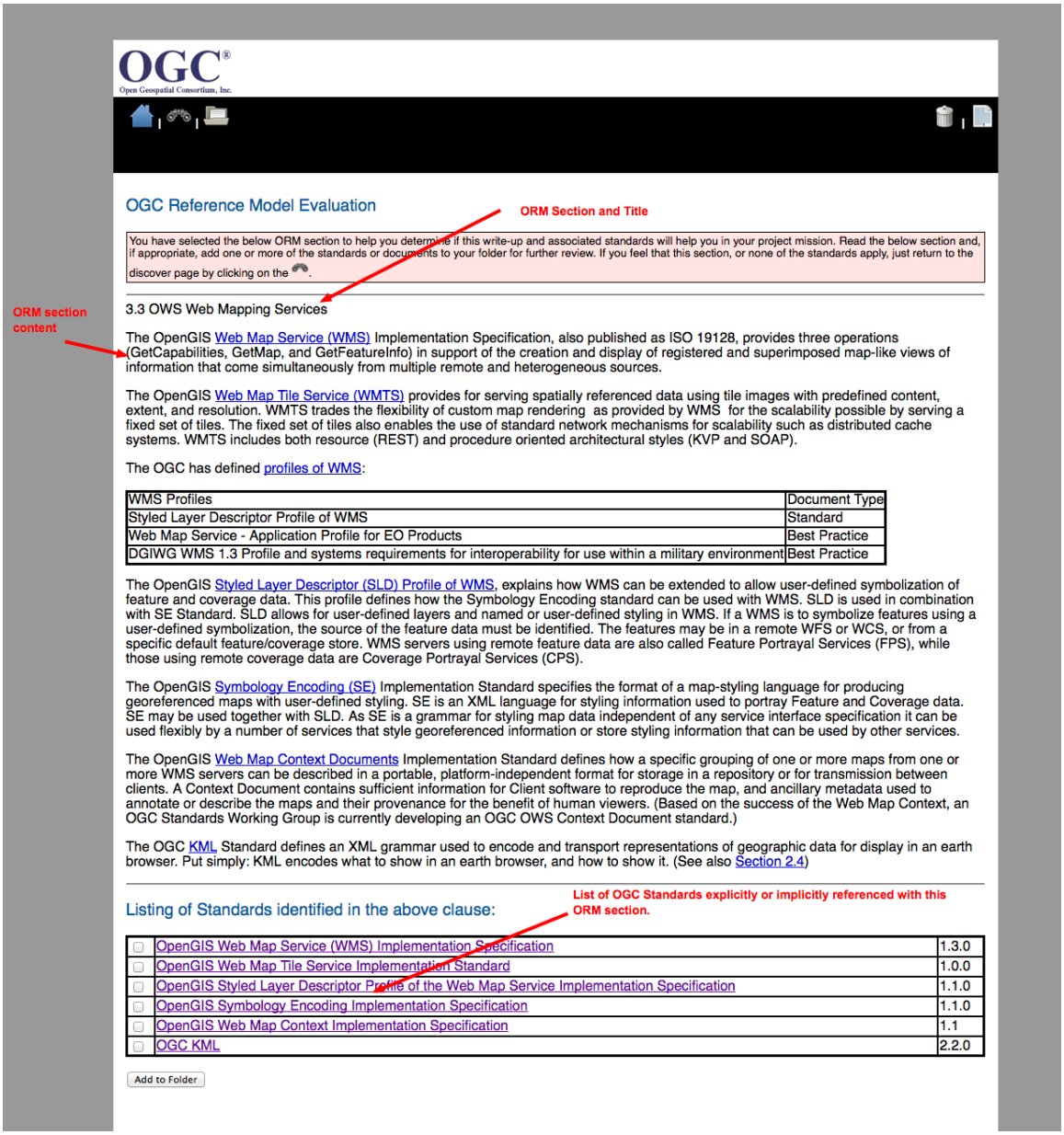


Figure 8 – RAP Advisor Webpage: Evaluate

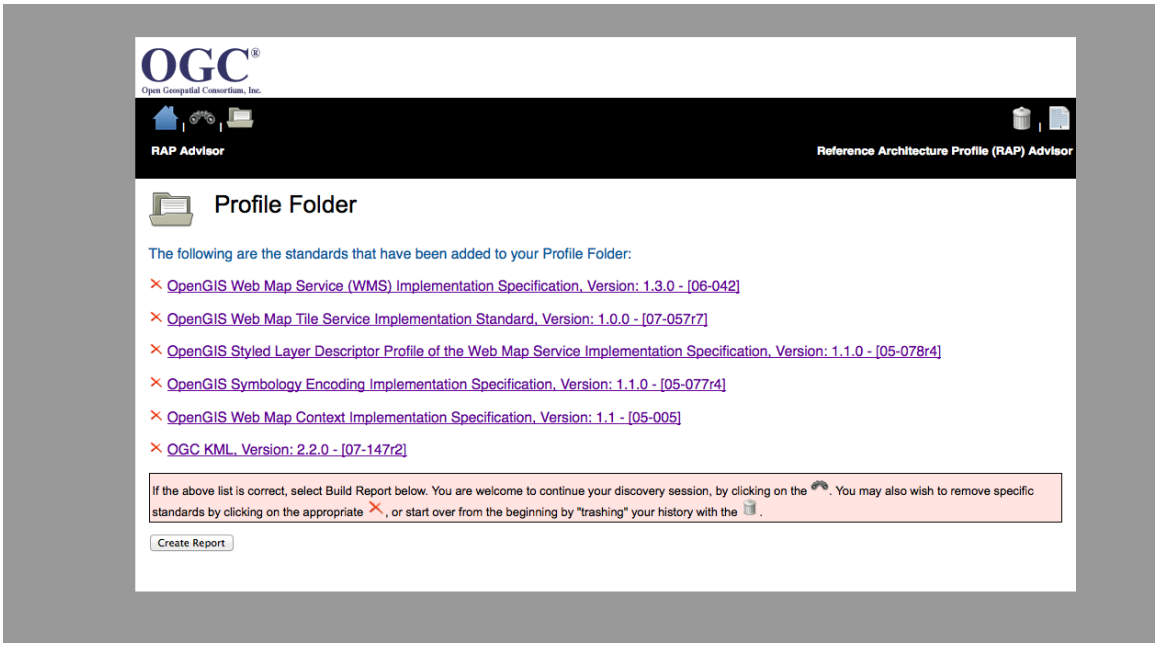


Figure 9 – RAP Advisor Webpage: Profile Folder

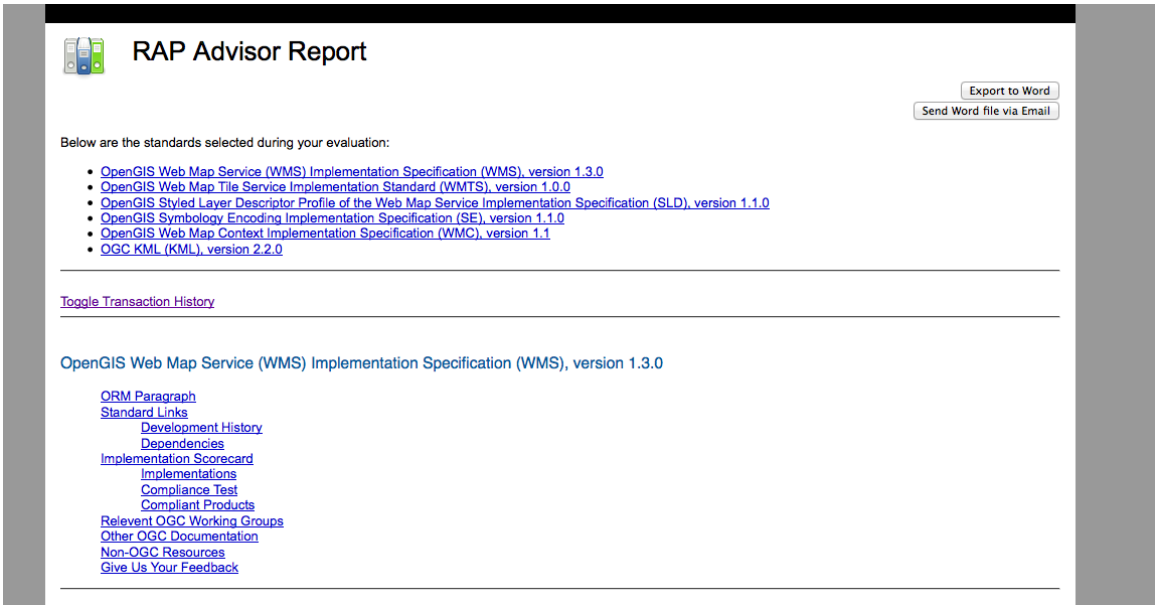


Figure 10 – RAP Advisor Webpage: Summary Report

8.3 Implementation Summary

8.3.1 Implementation of Discovery Methods

The RAP Advisor cannot assume that all users will approach discovery in the same manner. Therefore, three distinct discovery methods were constructed that for users to find relevant OGC baseline standards and best practice documents to their proposed program or project. These are each identified on the Discover page in Figure 7 – RAP Advisor Webpage.

8.3.1.1 Navigation Menu

The OGC Reference Model is outlined to be a foundational reference for the design of geospatially interoperable systems. The table of contents, or menu, of the ORM then becomes an outline for topics and services related to geospatial systems. The RAP Advisor takes advantage of the ORM Menu to allow a user to browse the ORM without reading the entire document. The "Browse ORM Menu" is the method that shortcuts this process and allows the user to view the ORM in a dynamically expanding tree that will display the branches and nodes of the ORM menu and produce the appropriate ORM section in HTML when a nodes is selected.

8.3.1.2 Free Text Search

A text search looks for the exact words from the "Free Text Search" input box on the discover page from anywhere within the OGC Reference Model. A Keyword search is a good substitute for a subject search when you do not know where in the ORM that you may find what you are looking for.

8.3.1.3 Select Domain

This is a dynamic listing of OGC's Domain Working Groups (DWG). The OGC membership has established these Domain Working Groups as either aligning with industry vertical markets (such as Defense & Intelligence) or horizontal technologies (such as Catalogues). The standards and best practices that an individual DWG will focus on can be identified and mapped. In doing so, we can let you know that if you identify your program with a specific Domain from the Discovery page, the RAP Advisor can propose the appropriate standards for your evaluation.

8.3.2 ORM formatting

The OGC Reference Model (ORM) version 2.1 was written and published in Microsoft Word. In order to be useful in this project, we needed to get the ORM into a format that would allow for simple web searching, display of individual fragments (or sections) and the potential for more complex natural language processing. The ORM was converted

into HTML using Pandoc[3] and stripped of any vendor specific tags, leaving basic HTML 4. Using Pandoc, section bookmarks were added (anchor tags in HTML) and the Table of Contents was constructed with hyperlinks to the anchor tags. At that point the ORM was a single document and could be searched via modern web search technologies, but not broken into individual pieces for display or future editing by section.

The ORM web page was broken into html fragments per section. Each fragment was placed into a database record with the corresponding metadata (i.e. ORM version, paragraph number scheme, etc.). This would allow for independent updates to a specific ORM section without rebuilding the system or modifying the code. After each of the sections were databased, the ORM Table of Contents was dynamically constructed. This would then allow for additional ORM sections to be inserted without the need for additional modifications.

8.3.3 Development Environment

The RAP Advisor is a web application developed in PHP. It is currently serving webpages via using the LAMP stack (Linux, Apache, MySQL, and PHP). This is the environment of choice for the development and hosting of web applications for the OGC Technology Office.

Table 4 – Development Environment at OGC Technology Office

Function	Name	Version	Notes
Operating System	Debian GNU/Linux	6.0.6 "Squeeze"	
Web Server	Apache 2	API Version: 20051115	Suhosin Extension 0.9.32.1
Database	MySQL	5.1.66	
Scripting	PHP	**5.3.3-7+squeeze14**	

PHPWord[4], an opensource PHP class library for generation of simple docx documents, generates the export to Microsoft Word. Any input forms used in the RAP Advisor are filtered through a cleaner script to prevent MySQL injection.

[3] Pandoc: http://johnmacfarlane.net/pandoc/

[4] PHPWord: http://phpword.codeplex.com/

8.3.4 OGC Knowledge Base

The OGC Knowledge Base is the collection of databases and digital artifacts that the OGC has collected throughout the last 17 years. It consists of public and private data (some data or documents are restricted to the OGC Membership or specific project members based upon sensitive or restrictive data, or Intellectual Property Rights) and includes but is not limited to:

- Public OGC Documents (Standards, Best Practices, Engineering Reports) and their associated schema documents and document metadata
- OGC Standards and Domain Working Group Projects within the OGC Web Portal (such things as calendar events, participation lists, tasks or actions)
- OGC Change Requests
- Issue Trackers
- Compliance Tests and Results
- Compliant Products
- Product Implementations
- Press Releases, White Papers, Request for Comment documents

Not all of the above items should or will be brought into the RAP Advisor. However, the more linkages we can make between each of these data stores, the better we can propose solutions for the RAP Advisor users: ORM, Search, DWGs.

8.3.5 Continuing Developments

In using the development process with multiple sprints and a scripting environment such as PHP, continual and real-time edits, bug-fixes, or enhancements can be deployed as simply as saving a file (or checking out a new version of a file via Subversion) and refreshing a web browser – no builds, server reload or package deployment is required. This was quite useful during the face-to-face usability testing discussed below. If an individual found an issue that we deemed to need correction (whether it was a bug, a spelling mistake, or some increased functionality), we were able to make changes immediately and allow the next tester to complete their testing with the new changes enabled. Therefore, some of the comments were addressed in real-time and future comments would not include any reference to them, as the later tester would not have found the RAP Advisor exactly the same.

9 Usability testing

9.1 Test Materials and the Testing Process

To evaluate the Advisor prototype, OGC conducted a nearly month-long, usability test cycle. OGC contracted with The Scientific Consulting Group (SCG) to support the usability test process. This section including the usability testing results was written mostly by SCG.

As background for the usability testing, four reference materials were developed:

- RAP Advisor Flyer (Annex A);
- RAP Advisor Guided Exercise (Annex B);
- RAP Advisor Questionnaire (Annex C);
- RAP Advisor Summary Report (Annex D).

The flyer offers users an overview of the tool including a screen shot of the Discovery Page, a description of the iterative process for OGC Standards selection, and a workflow diagram that illustrates how a customized summary report can be generated.

Using "Web Mapping" as a potential system application, the RAP Advisor Guided Exercise describes how users can employ three discovery methods – "ORM Menu Browser," "ORM Keyword Search," and "OGC Domain Work Groups (DWG)" – to find and select relevant OGC Standards for this application. A list of the relevant OGC standards selected through each discovery method can be saved (in a profile folder) or revised as needed.

After a satisfactory Profile Folder is developed, users can create a Summary Report that reviews their transaction history, lists the selected OGC Standards, provides a standards implementation scorecard, and normative and other references. The RAP Advisor HTML Summary Report can be discarded or saved electronically and a Microsoft Word file can be exported.

The questionnaire is available to record users' comments about the RAP Advisor. The questionnaire contains 25 questions that are both subjective (e.g., how did it work?) and objective (e.g., how would you rate it?) divided across four categories – user information, testing summary, operational topics, and overall performance.

The RAP Advisor usability test takes about 30 minutes to complete:

- 5 minutes to watch a video or receive an introduction to the tool;
- 15 minutes to conduct individual discovery and evaluations; and
- 10 minutes to complete the questionnaire.

During the period from November 28 – December 18, 2012, a total of 11 users tested the RAP Advisor prototype. The overall test period consisted of three phases:

(1) Face-to-face testing conducted November 28, 2012, U.S. Geological Survey (USGS) Facility, Reston, VA;
(2) By-request, WebEx testing, (1 session conducted on November 30, 2012); and
(3) Self-testing conducted December 5th – December 18th.

The Face-to-face testing was conducted by appointment during a 2-3 hour test period at the USGS Facility. Ten users from various DoD agencies and organizations scheduled and conducted 30-minute tests with OGC staff assistance during this period. An OGC support contractor interviewed most participants about their RAP Advisor test and evaluation, and assisted them in completing their questionnaires.

After testing the RAP Advisor, users were provided copies of the background materials and the URL (http://rap.opengeospatial.org) to encourage them to revisit the tool and further evaluate its capabilities. Following their face-to-face sessions, testers also were asked to follow up (by phone or e-mail) with OGC staff directly with any questions or suggestions for improvement.

Like the face-to-face testing, the WebEx testing provided participants an opportunity to conduct the usability testing with direct support from OGC staff. In addition, any WebEx tester had the opportunity to view an online version of the RAP Advisor Guided Exercise and complete an online version of the questionnaire.

Similar to the WebEx testing, all of the Advisor reference materials were available online for the self-testing phase of the RAP Advisor usability testing.

Table 1 lists the organizational affiliations of the users who participated in the usability testing.

Table 5 – RAP Advisor Usability Testing

Organization	Face-to-Face	Web Ex	Self-Testing[5]
NGA	4		
NGA Support Contractors	2	1	
Other Geospatial Support Contractors	1		
USGS	3		
TOTAL	10	1	

Given the overall homogeneous nature of the Advisor testers, the profiles of individual users were very similar. About 90 percent of the testers selected the Defense and Intelligence (D&I) Domain as their primary interest, had extensive experience with OGC Standards, and had previously developed a reference profile. Most testers were engineers/developers (60%), and were evenly split (about 50%) between experienced and casual users based on their geospatial data and systems experience.

Likewise, there was a lot of similarity among the search interests of the testers across the ORM browser menu, ORM keyword search, and DWGs. Testers were most interested in: CDR, National Mapping, Web Mapping Service, Web Security Services, and Service Architecture and Implementation. Nearly all users created and saved their RAP Advisor Summary Reports.

9.2 Test Results and Recommendations

9.2.1 Overview of results

In general, the conceptual design and operational approach in developing the RAP Advisor prototype was validated in the usability testing. Users described the prototype as a "glorious tool," "highly beneficial for systems development use," and "user friendly." During the face-to-face testing sessions, users had an opportunity to interact directly with OGC staff, and offer immediate suggestions for improvement. Some of the real-time

[5] As of December 26, 2012, no self-testing was conducted on the RAP Advisor, so it was decided that the self-test period would be extended until the OGC TC Meeting, January 14-18, 2013. As additional self-test data is collected, the overall usability test results will be revised accordingly.

updates made as a result of the suggestions provided during the face-to-face session included:

- Revised the RAP Advisor Summary HTML Report to display only selected OGC Standards regardless of the number of times each Standard was selected during individual discovery and evaluation sessions;
- Corrected typographical errors in the RAP Advisor screens; and
- Enhanced the appearance of the "binoculars" discover icon to highlight for users the technique for returning to the discovery screen to initiate an alternative search method.
- Modified the display/appearance of the input text areas and text boxes for better visibility.
- Fixed session cache bug that was requiring many browsers to have to reload after the user would hit the back button.
- Changed the behavior of the "Try Again" button, after a free text search with no results from returning to home to going to the Discover page.

Users offered both subjective comments and objective ratings about the prototype and these results and recommendations are organized across three areas: Design Concepts, Functional Errors, and General Improvements.

9.2.2 Design Concepts

Generally, testers gave the RAP Advisor high marks in its conceptual design and operational approach. Testers were asked to rate the Advisor on a scale from 1 = poor; 2 = fair; 3 = good; 4 = very good; and 5 = excellent. Table 2 summarizes their ratings for the portal tool and the HTML Report generated as a result of the OGC standard selections.

Table 6 – RAP Advisor Ratings

Question	Cumulative Score	Question	Cumulative Score
Find Relevant OGC Standards	**4.1**	Summary Report Reflect Discovery	**4**
ORM Menu Browser	**3.5**	Summary Report Organization	**4.1**
ORM Text Search	**3.3**	Summary Report Provide Information for Determining the Applicability of the OGC Standards	**3.7**
DWG selection	**3.1**		

In general, RAP Advisor testers rated the ability of the Advisor to "find relevant OGC Standards" high (e.g., 4.1). This score reflected the importance and high value testers had for the prototype capability, even though their scores for the individual Advisor discovery methods were lower.

The highest scored Advisor discovery method was the ORM Menu Browser (e.g., 3.5). Users liked the browser because "selection options were clear" and the "the OGC Standards were understandable." There were some questions, however, about how useful the ORM Menu Browser may be to non-OGC users, and if there is sufficient information about the capabilities available if relevant OGC Standards are used in a specific system application.

Other questions raised by the testers about the Advisor included:

- Will external policy directives (e.g., GWG or CDR requirements) be included if an agency wants to use an OGC Standard in a development project?
- Will procurement language be included that reflects requirements for OGC standards?
- Will users have the option to conduct discovery sessions with multiple objectives?
- Will users have the option to post discovery results for others to view?
- Will users have the opportunity to conduct interrupted sessions, store a profile folder and return later for future exploration?
- Will users have the opportunity to develop a "preferences" profile to allow them to customize their discovery options?

- Will approved and under development (e.g., REST, Provenance) OGC Standards be included?
- Will information about the OGC Network implementation be included?
- DISR vs. RAP Advisor. The DoD IT Standards Registry (DISR) is a single, unifying DoD registry for approved information technology (IT) and national security systems (NSS) standards and standards profiles. A user suggested that the questionnaire used in the DISR for creating a standards "TV-1" profile would be a good thing to compare with the RAP Advisor.

9.2.3 Functional Errors

ORM Text Search

Users assigned comparable ratings to the ORM Keyword and OGC DWG search methods. Testers rated the Keyword Search method as "good" because of the RAP Advisor's limitation to only ORM terms. Many testers found no results or "false positive" results and recommended that the keyword lexicon be greatly expanded. Some of the erroneous keyword search results included:

- "Service Architecture" – several ORM clauses appear unrelated to the search term and there were more results with this term than when using "ORM Service Architecture;
- "Results for ORM Clause Selections" – four OGC Standards were displayed yet only two OGC Standards should have appeared;
- "Human Geography" – no results were obtained;

It was suggested that installing a semantic search engine to support the keyword search method, as originally proposed in the RAP Advisor conceptual design, may offer a solution to the free text search limitations. Rather than relying exclusively on preset ORM keywords, a semantic engine would be able to match the search queries to a user's context and return results within that context. In other words, a semantic engine can learn and expand the keyword vocabulary based on user queries and through association build a more responsive system.

Another tester suggested that the RAP Advisor Keyword Search function could be improved by developing an "Advanced Search" capability. Using an advanced search engine with the Boolean operators AND, OR, and NOT, could broaden or narrow a search by combining words or phrases. Alternatively, automatically populating the Keyword Search entries with the initial project description and other data that a user identified as their topic(s) of interest also could assist in text searching.

Testers also questioned how acronyms and OGC standards under development are handled in Advisor text searches. For example, OGC recently sought public comment on the candidate OGC GeoServices "REST" applications programming interface (API) standard. The REST API provides a standard way for Web clients to communicate with geospatial technologies based on Representational State Transfer (REST) principles, yet

there is no connection between these terms (e.g., REST and Representational) in the Advisor.

A fuller description of why OGC standards under development are not included in the RAP Advisor is provided below.

OGC Domain Work Groups

One of the most controversial issues about the RAP Advisor design was the use of DWGs in identifying and applying OGC standards. Some users said that "Domain" is a presumptive term because it is not relevant to non-OGC members, and it might be useful to substitute an alternative term such as OGC "functions." Others suggested that the initial list of 31 Domains provided in the Advisor was not sufficiently descriptive and DWG definitions were needed. Still others recommended that "keywords" associated with each DWG are needed to better acquaint users with the Domains and potentially expand their membership to new users.

If Domains continue to be one of the RAP Advisor discovery methods, a more complete list of DWGs is needed, but testers suggested a more understandable organization of Domains is needed to better classify them for review. For example, one tester asked about the number of Domains for the Web Mapping Server (WMS). He suggested that users may want to "drill down" on the Domains but the existing terms are not sufficiently descriptive.

Concerning the list of Domains in the RAP Advisor, another user suggested that a "list all" and "de-select" option is needed to allow users to customize their discovery strategies.

9.2.4 General Improvements

As described earlier, testers generally agreed with (and saw the value in) the overall Advisor conceptual design, which is to develop a Web-enabled ORM with a graphical user interface to build useful OGC standard profiles to meet various system application needs. To indicate their support for Advisor development, users offered a variety of suggestions about how to improve the prototype.

Standards under development

One tester suggested that the OGC Web Service Common (OWS) Implementation standard should be included in the Advisor. It is currently not in the ORM as the OWS Common was approved after the most recent version of the ORM was developed. The ORM describes only those documents approved by the OGC members to be in the OGC standards baseline, e.g., standards and best practices.

The ORM and therefore the current version of the RAP Advisor do not contain Engineering Reports, Discussion Papers or any developments currently in work by an OGC Standards Working Group. Another example was a tester looking for OGC work on REST that is in process but has not yet been approved. This exclusive focus on approved standards was confusing and somewhat misleading to the testers and should be reconsidered in future versions of the Advisor.

External Standards

Several testers suggested that external standards and specifications such as CDR should be available in the Advisor. One tester suggested that the CDR Integrated Product Team (IPT) specifications should be available for comparison to OGC standards. It was argued, however, that the Advisor was designed for use by DoD users to determine which OGC standards will apply to their system applications. If external standards such as CDR are not available on the Advisor, and may only be linked as normative references within OGC standards, a statement regarding this issue should be provided in the Advisor.

Advisor Home Page and Screens

There were numerous typographical and grammatical errors on the RAP Advisor Home Page and the following screens, and it was suggested that a spell check be conducted and possibly professional editing of the Advisor pages be employed. It also was suggested that font colors and styles be properly selected to ensure that users can distinguish "hyper-type" links from other emphasized text in the screens. Further, it was suggested that the amount of text within each box be reviewed to minimize the number of words; also more bullets should be used to call attention to the steps that users must take to execute an action.

Furthermore, it was suggested that a text change on the Home page be made from "Program Details" to "Program Scope."

Binoculars Icon

There was no "Back ←" or "Forward →" icons on the Advisor screens, and testers were unfamiliar with the need to use the binoculars icon to revise their discover strategies. Because of the common use of back and forward arrows in Web searching, several testers suggested that arrows not binoculars be used to return or advance to relevant pages. Alternatively, one tester suggested using the "house" icon as a means of returning to the home page or initial discovery screen.

Trash Icon

Numerous testers unknowingly deleted their folder profiles because there was no warning on the trash icon that these entries would be deleted if this icon was selected. A two-step confirmation process is needed in the trash icon to warn users about this function before it is executed.

Discovery Method Labels

Several testers suggested that each of the RAP Advisor discovery methods needs to be clearly labeled and defined to ensure that all users understand the differences among the various search methods. It was suggested that the methods be labeled and defined as "ORM Browser Menu," "ORM Keyword Search," and "OGC Domain Work Group(s)."

Web Browser Selection

It may be necessary to offer specific Web Browser recommendations (e.g., *Internet Explorer, Chrome, Firefox, Safari*, etc.) for satisfactory RAP Advisor use. One user found that the Guided Exercise video box initially appeared on the Advisor Discovery page but disappeared when he moved to the Discovery page. This problem occurred when using *Internet Explorer* but was corrected when the tester reopened the Advisor with the *Chrome* browser.

A similar problem occurred when a tester added GeoXACML standards to his folder, but in the profile folder the links to GeoXACML standards were not functional. By clicking on the title of the standard the tester was unable to connect to the standard using either the *Internet Explorer* or *Chrome* browsers.

HTML Summary Report

Nearly all testers created and found useful results in the RAP Advisor Summary Report. Everyone who created a report wanted both the Web and Word versions. Several users suggested ways to improve the Report. One formatting recommendation was to add a "Return to Top" icon after each standard to allow users to continually review their selections without continually scrolling the text.

Another tester thought it would be helpful if the initial project description required to activate the Advisor could appear on the front page of the Summary Report as part of the transaction record of the Advisor discovery process.

9.3 Conclusions

Usability testers endorsed the RAP Advisor conceptual design and operational functions, and rated it "very good" in finding relevant OGC Standards. In general, they agreed that the Advisor would be beneficial to them in their system development work. Specifically, testers endorsed the three discovery methods for querying, the use of a Profile Folder to review OGC Standards' selections, and the creation of the RAP Advisor Summary Report to fully review their search results.

As a prototype, the RAP Advisor does need some improvements and better descriptions about what is available in the data model. Testers raised a number of issues such as: the application of the RAP Advisor to CDR specifications, the availability of under development vs. accepted OGC standards, the incorporation of a semantic search engine in the ORM Keyword Search method, and the adaption of some more commonly used icons in RAP Advisor.

Some of the findings and recommendations from the RAP Advisor usability testing are addressed in other sections of this Engineering Report.

10 Application to Joint IC/DoD CDR

10.1 Overview of CDR

To test the RAP Advisor it was applied to the Joint IC/DoD Content Discovery and Retrieval (CDR). CDR was established to enable content discovery and retrieval from all IC and DoD data collections.

The CDR Reference Architecture (RA) is the keystone artifact for the overall set of guidance artifacts. The CDR RA defines two primary capabilities -- content discovery and content retrieval. Six core CDR components: Search, Brokered Search, Retrieve, Describe, Deliver, and Query Management provide these capabilities (Figure 11). The core components depend on externally defined Messaging and Security components, which are described in more detail in the CDR Specification Framework and CDR Specification documents. The CDR RA will iteratively evolve and mature in increments to maintain a clear scope and facilitate timely and actionable guidance.

The Scope of CDR is defined in the CDR RA as:

> Achieving a ubiquitous content discovery and retrieval solution presents a substantial challenge in the IC/DoD Enterprise where content exists in a large variety of structures, are represented in diverse semantics, and are exposed through many types of technical implementations. To meet this challenge, the CDR RA describes an architecturally driven approach for guiding the IC/DoD Enterprise towards enabling content discovery and retrieval.
>
> Content, in the scope of this architecture, refers to the information made available for discovery and retrieval. A Content Resource refers to a particular instance of Content that can be discovered or retrieved as a unit. A Content Collection is a component that makes a set of Content Resources available under an instance of the component. By addressing Content, the CDR RA thus addresses both Content Resources and Content Collections.

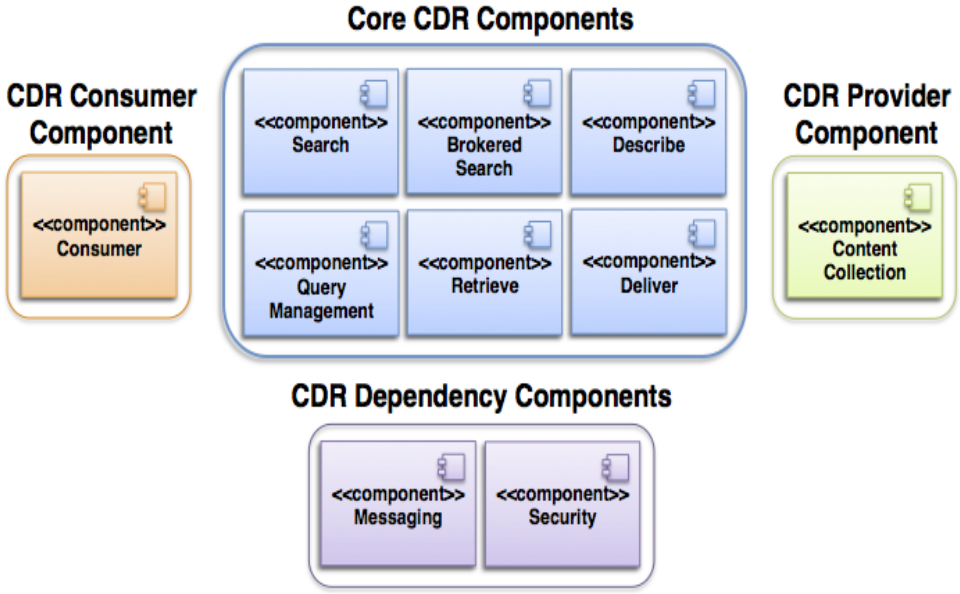


Figure 11 – IC/DoD Content Discovery and Retrieval (CDR)

10.2 CDR concepts for RAP

To run the advisor on CDR concepts a list of terms were selected from the CDR RA introduction and scope (listed in 10.1). These terms (along with slight variations as listed in parentheses) were used as the basis for discovery in the RAP Advisor:

- Discovery
- Retrieval
- Search
- Brokered Search (Broker)
- Retrieve (retrieval)
- Describe
- Deliver (Delivery)
- Query
- Messaging (Message)
- Security
- Semantics
- Information Content
- Content Collections

Below is the transaction history of the RAP Advisor Report Build for the CDR terms listed above.

At 2012-12-26T11:40:20-05:00, you navigated the ORM menu for clause # 3.5 Catalogue Service for the Web.
At 2012-12-26T11:40:20-05:00, you added the following documents to your :
- OpenGIS Catalogue Service Implementation Specification [Catalogue Service for the Web]
- CSW-ebRIM Registry Service - Part 1: ebRIM profile of CSW
At 2012-12-26T11:40:50-05:00, you navigated the ORM menu for clause # 2.2 Information Specifications.
At 2012-12-26T11:40:50-05:00, you added the following documents to your :
- OpenGIS Geography Markup Language (GML) Encoding Standard
At 2012-12-26T11:41:35-05:00, you navigated the ORM menu for clause # 2.11 Geographic Metadata.
At 2012-12-26T11:41:35-05:00, you added the following documents to your :
- Topic 11 - Metadata
- Topic 12 - The OpenGIS Service Architecture
At 2012-12-26T11:51:14-05:00, you navigated the ORM menu for clause # 3.1 Services Architecture.
At 2012-12-26T11:51:14-05:00, you added the following documents to your :
- Topic 12 - The OpenGIS Service Architecture
At 2012-12-26T11:51:45-05:00, you navigated the ORM menu for clause # 3.4.1 Web Feature Service.
At 2012-12-26T11:51:45-05:00, you added the following documents to your :
- OpenGIS Web Feature Service 2.0 Interface Standard (also ISO 19142)
At 2012-12-26T11:52:01-05:00, you navigated the ORM menu for clause # 3.4.2 Web Coverage Service.
At 2012-12-26T11:52:01-05:00, you added the following documents to your :
- OGC® WCS 2.0 Interface Standard- Core: Corrigendum
At 2012-12-26T11:53:58-05:00, you navigated the ORM menu for clause # 4.3 Multi-Tier Architectures.
At 2012-12-26T11:53:58-05:00, you added the following documents to your :
- GIGAS Methodology for comparative analysis of information and data management systems
At 2012-12-26T11:55:40-05:00, you navigated the ORM menu for clause # 4.11 Securing OGC Web Services.
At 2012-12-26T11:55:40-05:00, you added the following documents to your :
- OWS-6 Security Engineering Report
- Authentication IE Engineering Report
At 2012-12-26T11:56:11-05:00, you searched the ORM for the term "discovery".
At 2012-12-26T11:56:51-05:00, you selected the ORM clause # 4.1 Publish, Find and Bind Pattern and # 4.2 Geospatial Portal and Clients and # 4.4 Spatial Data Infrastructures
At 2012-12-26T11:57:16-05:00, you added the following documents to your :
- Geospatial Portal Reference Architecture
- OWS Integrated Client (GeoDSS Client)
- OpenGIS Catalogue Service Implementation Specification [Catalogue Service for the Web]
- OGC Web Services Architectural Profile for the NSG
- OpenGIS Geography Markup Language (GML) Encoding Standard
- OpenGIS Web Feature Service 2.0 Interface Standard (also ISO 19142)
At 2012-12-26T11:57:28-05:00, you searched the ORM for the term "retrieval".
At 2012-12-26T11:57:50-05:00, you selected the ORM clause # 3.4.2 Web Coverage Service and # 3.9 Fine-Grained Services and # 4.5 Sensor Webs
At 2012-12-26T11:58:20-05:00, you added the following documents to your :
- Geospatial Portal Reference Architecture
- OWS Integrated Client (GeoDSS Client)
- OpenGIS Catalogue Service Implementation Specification [Catalogue Service for the Web]
- OGC Web Services Architectural Profile for the NSG
- Sensor Web Enablement Architecture
- OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option
- OGC® WCS 2.0 Interface Standard- Core: Corrigendum
At 2012-12-26T11:58:38-05:00, you searched the ORM for the term "search".
At 2012-12-26T11:58:56-05:00, you searched the ORM for the term "brokered".
At 2012-12-26T11:59:01-05:00, you searched the ORM for the term "broker".
At 2012-12-26T11:59:11-05:00, you selected the ORM clause # 4.1 Publish, Find and Bind Pattern
At 2012-12-26T11:59:43-05:00, you searched the ORM for the term "broker".
At 2012-12-26T11:59:51-05:00, you selected the ORM clause # 4.1 Publish, Find and Bind Pattern
At 2012-12-26T12:01:17-05:00, you searched the ORM for the term "broker".
At 2012-12-26T12:01:49-05:00, you selected the ORM clause # 4.1 Publish, Find and Bind Pattern
At 2012-12-26T12:03:42-05:00, you searched the ORM for the term "retrieval".

At 2012-12-26T12:03:58-05:00, you searched the ORM for the term "describe".
At 2012-12-26T12:05:41-05:00, you searched the ORM for the term "deliver".
At 2012-12-26T12:05:56-05:00, you searched the ORM for the term "delivery".
At 2012-12-26T12:06:02-05:00, you searched the ORM for the term "query".
At 2012-12-26T12:06:53-05:00, you selected the ORM clause # 2.6 Geometry and Topology and # 3.4.4 Filter Encoding
At 2012-12-26T12:07:20-05:00, you added the following documents to your :
- Topic 1 - Feature Geometry
- OpenGIS Filter Encoding 2.0 Encoding Standard
At 2012-12-26T12:07:30-05:00, you searched the ORM for the term "messaging".
At 2012-12-26T12:07:34-05:00, you searched the ORM for the term "message".
At 2012-12-26T12:08:29-05:00, you searched the ORM for the term "security".
At 2012-12-26T12:08:49-05:00, you searched the ORM for the term "semantics".
At 2012-12-26T12:09:09-05:00, you selected the ORM clause # 2.2 Information Specifications and # 2.7.4 CityGML and # 3.1 Services Architecture
At 2012-12-26T12:09:33-05:00, you added the following documents to your :
- OGC City Geography Markup Language (CityGML) Encoding Standard
At 2012-12-26T12:09:43-05:00, you searched the ORM for the term "information content".
At 2012-12-26T12:09:56-05:00, you searched the ORM for the term "collection".
At 2012-12-26T12:10:15-05:00, you selected the ORM clause # 2.5 Geographic Features and # 4.4 Spatial Data Infrastructures

10.3 RAP Results for CDR

This report is a dynamic summary of OGC resources identified by the Reference Architecture Profile (RAP) Advisor from publicly available content mostly available on OGC Websites or resources maintained by OGC Staff or members. The Profiler has helped you browser, search and question the OGC Reference Architecture document to help you narrow down the standards and supporting documents required (and or recommended) to implement your proposed system.

During your research you selected the following standards:

- OpenGIS Catalogue Service Implementation Specification [Catalogue Service for the Web] (CAT CSW)
- CSW-ebRIM Registry Service - Part 1: ebRIM profile of CSW (CAT2 ebRIM part1)
- OpenGIS Geography Markup Language (GML) Encoding Standard (GML)
- Topic 11 - Metadata (Topic 11)
- Topic 12 - The OpenGIS Service Architecture (Topic 12)
- OpenGIS Web Feature Service 2.0 Interface Standard (also ISO 19142) (WFS)
- OGC WCS 2.0 Interface Standard- Core: Corrigendum (WCS 2.0 Corrigendum)
- GIGAS Methodology for comparative analysis of information and data management systems (GIGAS)
- OWS-6 Security Engineering Report (OWS6SecurityER)
- Authentication IE Engineering Report (AuthIE)
- Geospatial Portal Reference Architecture (Portal Architecture)
- OWS Integrated Client (GeoDSS Client) (GeoDSS Client)
- OGC Web Services Architectural Profile for the NSG (OWS Arch for NSG)

- Sensor Web Enablement Architecture (SWE Arch)
- OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option (SFS)
- Topic 1 - Feature Geometry (Topic 1)
- OpenGIS Filter Encoding 2.0 Encoding Standard (Filter)
- OGC City Geography Markup Language (CityGML) Encoding Standard (CityGML2)

Further research into OGC and related standards should help provide you with a possible framework for developing and constructing your system.

10.4 Discussion

The testing listed earlier in this section was performed by OGC staff. It is interesting to contrast this with the testing of CDR experts. Members of the CDR Integrated Project Team (IPT) participated in the Usability Testing.

Comments by several CDR experts during Usability Testing:

- Looking for more crosswalks of OGC and CDR reference architectures. One way is to include CDR specs into a version of this tool.
- Include external policy directives? EX: GWG requirements, an agency requires OGC Standards for development projects.
- Show examples of procurement language that include requirements for OGC Standards?
- Reference other Standards Developing Organizations standards?
- Can multiple objectives/sessions be included? Can interrupted sessions be conducted? Can folders be stored and returned to in the future?
- GWG DISR has questionnaire tool for creating TV-1 profile. DISR vs. RAP Advisor
- Did not find OpenSearch and OGC contributions to geospatial extensions to OpenSearch
- Note that standards are not "connected" to implementation.
- Likes implementation scorecards.
- Discovered WFS, WMS, WMTS, WCS, GEOXCML
- Content of several domains was empty.
- Should consider an evaluation method beyond ORM text. Make use of graphic display of web.

Some general conclusions are clear from these comments, e.g., continual refinement of the RAP Advisor is needed (and some has been done since the Usability Testing):

- To increase the content that is discovered
- Continue to improve the reporting so that discovered standards are seen as relevant to users that come from outside of OGC

11 Future work

The version of the RAP Advisor developed concurrent with OWS-9 Testbed successfully demonstrated key conceptual design and operational functions with an overall usability test rating of "very good" in finding relevant OGC Standards. In general, users agreed that the Advisor would be beneficial to them in their system development work.

Nevertheless, the version of OWS-9 is a prototype with further developments needed both in functions and content. Ideas for further development include:

- Include OGC SWGs as well as adopted OGC standards
- Greater inclusion of OGC Engineering Reports and other non-baseline documents
- Show examples of procurement language that include requirements for OGC Standards
- Consider including external policy directives that an agency requires for development projects, e.g., GWG requirements.
- Consider adding external documents beyond normative references perhaps through ORM Section 5, "Implementations of OGC Standards"
- Users recommendations for external documents to be included beyond the current user comment sections, e.g., add a button to automate.
- Consider referencing standards from other Standards Developing Organizations beyond just as normative references to OGC standards.
- Make greater use of graphic display of web, e.g., Graphic display of relationships between standards.
- Incorporation of a semantic mediation in the ORM text search method
- Continued development and refinement of the DWG Discovery method including increased content for each DWG.
- Dynamically generating figures of Document Relationships
- Consider displaying crosswalk of OGC and external standards, e.g., CDR reference architectures. One way is to include external specs into a version of the Advisor.
- Testing through further application of the RAP Advisor to specific developments, e.g., CDR
-

Annex A

RAP Advisor Flyer

Reference Architecture Profile

RAP Advisor™

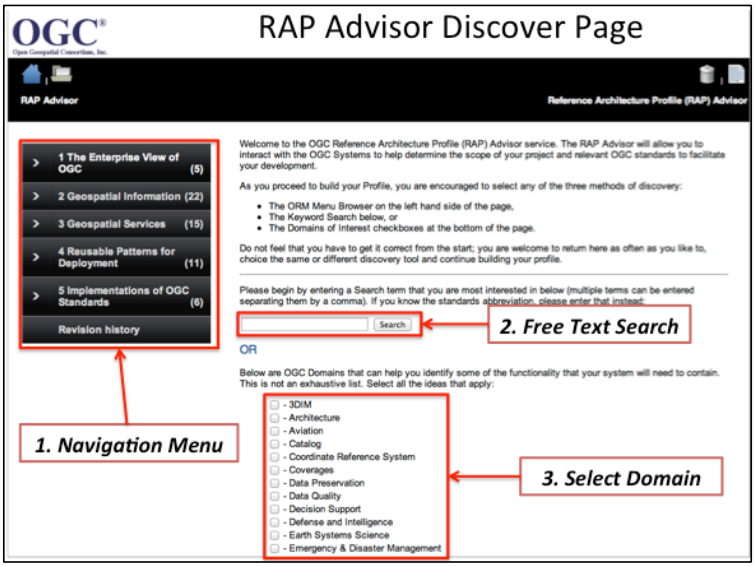
OGC®
Making location count.
www.opengeospatial.org

- The RAP Advisor recommends OGC Standards and OGC Knowledge Management resources relevant to a system development;
- The Advisor is useful in defining a profile of OGC standards suited to a user's community needs.

Users interact with the RAP Advisor through a web interface to convey their understanding of the scope of the system development. To create a profile of the OGC Knowledge Base, the user iteratively discovers OGC resources using several methods : 1. Navigate, 2. Search, 3. Select.

OGC has over 60 standards and many more resources in its Knowledge Base on geospatial interoperability

How can a system developer identify and choose the standards they need?
The RAP Advisor!



The RAP Advisor was developed in the OGC Web Services Testbed, Phase 9 (OWS-9) with sponsorship from the NGA.

In addition to meeting the sponsor's needs, the RAP Advisor is part of the OGC Knowledge Management Strategy

The OGC Knowledge Management Strategy broadens global adoption of OGC content through education, training and KM.

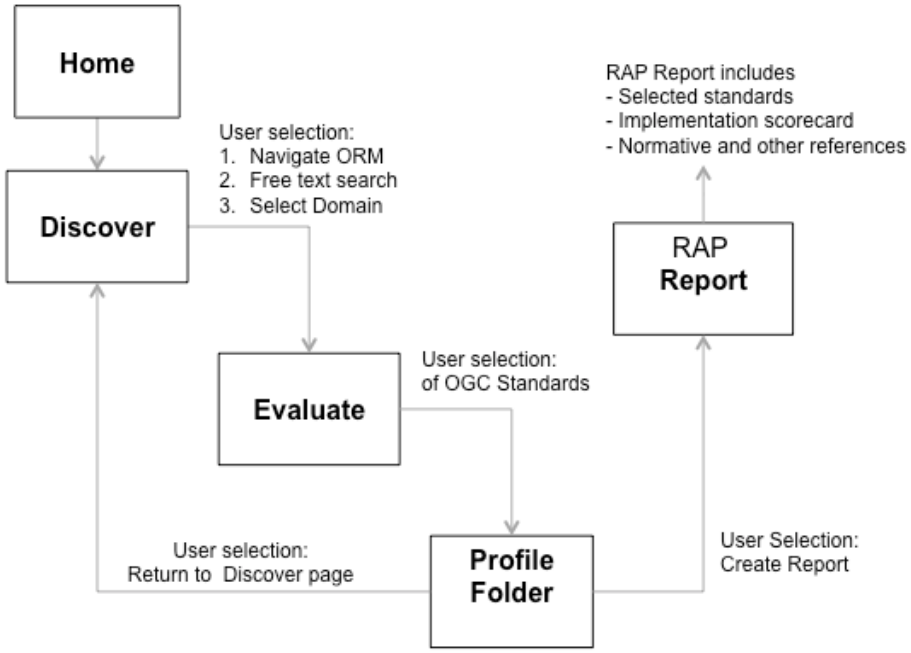
OGC Knowledge Management including, the RAP Advisor, will grow over time based on user feedback.

RAP Advisor™

The RAP Advisor engages users in an iterative process for selection of OGC Standards.

- Discover resources from the OGC KM by one of three methods:
  1. Navigate the OGC Reference Model (ORM)
  2. Search on text provide by the user
  3. Select an OGC Domain
- Evaluate resources and select standards for the Profile Folder.
- When the user is satisfied with the contents of the folder, a Report is created.
- The RAP Report contains information for the user to evaluate the standards

RAP Advisor iterative workflow creates a custom report



Example Discovery inputs:
1. Navigate to the ORM section on "Web Mapping Services"
2. Searching on "Web Mapping"
3. Selecting "Defense and Intel" Domain

Evaluation of the standards from each input results in a Profile of Standards

RAP Advisor Report provides not just the Standards of interest, but other information for the user to evaluate the profile of standards.

RAP Advisor Report includes:
- Selected Standards
- Implementation scorecard
- Normative and other References

For further information contact George Percivall, gpercivall@opengeospatial.org

Annex B

Usability Testing Guided Exercise

Thank you for testing the newly developed RAP Advisor. We appreciate your input and interest in this new OGC tool.

The testing consists of three phases:

1) Guided introduction to the RAP Advisor, ~5 min

2) Your unscripted exploration of the Advisor, ~15 minute

3) Collecting your feedback through discussion with OGC staff, ~10 min

A script for the Guided introduction is attached and can be used to test the Advisor using this public website: http://rap.opengeospatial.org

Usability Testing Guided Exercise

Discovery Method		User Action	RAP Advisor Response
Menu Browser	1	On Home page: Enter info about your system development and select "*Submit*"	Info is captured on Home page. "Continue" button appears
	2.	*Select* "Continue"	Discover page appears
	3.	On Discover page – ORM Menu: - *Click* "3. Geospatial services" - *Click* "3.3 Web Mapping"	ORM Evaluation page appears
	4.	On Evaluation page: - *Scroll* to bottom of page - *Select* WMS 1.3 *Click* "Add to Folder"	Profile Folder appears WMS is in the folder
	5	On Profile Folder: - *Select* binocular's icon	Discover page appears
Text Search	6.	On Discover page: - *Enter* "web mapping" into free text search box - *Click* "Search"	Evaluation page appears - Three ORM sections listed: 1.2, 3.3, 4.4
	7.	On Evaluation page: - *Select* check boxes for 1.2, 3.3 - *Click* "View Standards"	Results page appears - 7 OGC documents listed.
	8.	On Search Results page: - *Select* WMS 1.3 and WMTS - *Click* "Add to Folder"	Profile Folder appears - WMS and WMTS are in the folder
	9.	On Profile Folder: - *Select* binocular's icon	Discover page appears
Domain Selection	10	On Discover page: - *Select* "Defense and Intel" - *Click* "Select"	Domain Selection page appears with list of 5 standards
	11	On Domain Selection page: - *Select* WMS and WFS - *Click* "Add to Profile Folder"	Profile Folder appears WMS, WMTS, WFS are in the folder
Create and Review Report	12	From Profile folder - *Click* "Create Report"	Report page appears *Toggle* transaction history
	13	Review sections of Report page.	Jump to WMS 1.3 outline
	14	*Scroll* back to top of page - *Click* "Export to Word"	Open document in Word
	15	Review Word Document	Save Word doc.
	16	*Select* home icon	Home page appears

Annex C

Usability Testing Questionnaire

The RAP Advisor questionnaire contains four sections:

1. User Information
2. Brief Summary of Testing
3. Operational Topics
4. Overall Performance

Completing this questionnaire should take no longer than 10 minutes, and we can assist you in completing the questionnaire. Our goal in using this questionnaire is to better understand your reaction to the RAP Advisor and improve it based on your input.

USER INFORMATION

1. Identify the domain(s) of your system development.
   - ❑ Aviation
   - ❑ Built Environment – Civil
   - ❑ Business Intelligence
   - ❑ Defense and Intelligence
   - ❑ Emergency Response and Disaster Management
   - ❑ Law Enforcement
   - ❑ Geosciences and Environment
   - ❑ Spatial Data Infrastructure and National Mapping
   - ❑ Mobile Internet and Location Services
   - ❑ Sensor Webs
   - ❑ University and Research
   - ❑ Other – Please explain _____

2. How would you classify yourself professionally?
   - ❑ Operations/Analyst
   - ❑ Data development/collection
   - ❑ Scientist/Researcher
   - ❑ Engineer/Developer
   - ❑ Executive/Management
   - ❑ Other – Please explain _____

3. What best describes your experience with geospatial data and systems?
   - ❑ Experienced user
   - ❑ Casual/inexperienced user
   - ❑ Software development and/or data integration user
   - ❑ Data development
   - ❑ Other – Please explain _____

4. What experience do you have with reference architecture and standards profiles?
   - ❑ Previously developed a reference profile
   - ❑ Previously used a reference profile developed by others
   - ❑ Familiar with the concept of a reference profile but no direct use
   - ❑ No familiarity with reference profiles
   - ❑ Other – Please explain _____

5. What experience do you have with OGC Standards
   - ❑ Extensive - have participated in OGC activities
   - ❑ Awareness but no direct participation in OGC
   - ❑ Some familiarity
   - ❑ None

BRIEF SUMMARY OF TESTING

6. What information did you look for?

_____

7. Which OGC Reference Model (ORM) Sections did you explore?

_____

8. What Text searching did you do?

_____

9. What Domains did you select?

_____

10. Did you generate and save a report?

_____

11. Did you find the information that would be valuable for your system development?
    ❑ YES ❑ NO ❑ Uncertain

If "NO" or "Uncertain", please explain_____

OPERATIONAL TOPICS

For the following questions, please rate the overall capability of the RAP Advisor according to the following scale: 1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent.

Discovery and Evaluation

12. Rate the success of identifying OGC Standards relevant to your needs.
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

13. Rate the effectiveness of browsing ORM Sections in identifying relevant Standards
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

14. Rate the effectiveness of Text search in identifying relevant Standards
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

15. Rate the effectiveness of Domain selection in identifying relevant Standards
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

16. How could the Discovery and Evaluation phase be improved?

_____

Reporting

Rate the RAP Advisor Report in the following questions

17. Did the report reflect your discovery and evaluation activity?
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

18. Does the organization of the report make it easy to reference and/or share?
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

19. Does the report provide information for determining the applicability of the standards?
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

20. Which of the report formats is most useful for you?
    - ❑ Web page
    - ❑ Word document
    - ❑ Both
    - ❑ Other – Please explain _____

21. How could the report be improved?

_____

OVERALL PERFORMANCE

For the following questions, please rate the overall capability of the RAP Advisor according to the following scale: 1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent.

22. Rate the overall usefulness of the RAP Advisor.
    ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

23. Would you use the RAP Advisor when it is operational?
    ❑ YES ❑ NO ❑ Uncertain
    If "NO" or "Uncertain", please explain_____

24. Would you recommend the RAP Advisor to another person?
    ❑ YES ❑ NO ❑ Uncertain
    If "NO" or "Uncertain", please explain_____

25. Do you have any other comments?

_____

Thank you for participating. Your input is very helpful.

Annex D

Sample Report RAP Advisor

This annex contains the Summary Report that results from executing the "Web Mapping" guided exercise in the prior Annex.

Summary Report

This report is a dynamic summary of OGC resources identified by the Reference Architecture Profile (RAP) Advisor from publicly available content mostly available on OGC Websites or resources maintained by OGC Staff or members. The Profiler has helped you browser, search and question the OGC Reference Architecture document to help you narrow down the standards and supporting documents required (and or recommended) to implement your proposed system.

During your research you selected the following standards:

- OpenGIS Web Map Service (WMS) Implementation Specification (WMS)
- OpenGIS Web Map Tile Service Implementation Standard (WMTS)
- OpenGIS Web Feature Service (WFS) Implementation Specification (WFS)

Further research into OGC and related standards should help provide you with a possible framework for developing and constructing your system.

Selected ORM Clauses

1.2 An Example: Web Map Service

OGC's Web Map Service standard is an example of interoperability achieved through open standards. It is of particular importance since the "map" is a potent user interface tool for conveying spatial information in a compact, useful and meaningful form. The Web Map Service standard began as discussion in the OGC Standard Program that became the first OGC Interoperability Program initiative, the Web Mapping Testbed, in 1998. The WMS candidate interface standard that was developed in the WMS Testbed was adopted as an OpenGIS Implementation Specification in 2000 (WMS version 1.0). Since then, WMS has progressed in maturity with implementations numbering in the thousands. WMS is now also published as ISO 19128.

WMS provides a simple example of how topics are discussed in this reference model:

- Section 2.3 Spatial Referencing describes coordinate reference systems (CRSs) used in WMS. CRSs are vital to geospatial interoperability;
- Section 3.2 OGC Web Services describes several OGC geospatial web services, including WMS, as a coordinated service architecture implemented with common elements across services;
- Section 4.4 Spatial Data Infrastructures describes the use of WMS and other OGC Web Services in a reusable pattern for deployment for worldwide SDIs.
- Section 5.1 OGC Compliance Test Program describes the automated testing resources available for all approved OGC services; these resources allow implementers to determine compliance with the OGC standards.

WMS has dramatically increased the use of on-line mapping. One issue of OGC User describes the use of the WMS standard in helping with disaster response to hurricane Katrina, soils data distribution in Europe, a statewide data center, and access via mobile phones. In another OGC User article, the number of WMS servers on the Internet is seen to rise each week as more organizations realize the power of using open standards. At the same time, the number of WMS clients – designed for use in a browser, or on the desktop or on a mobile device – is growing.

3.3 OWS Web Mapping Services

The OpenGIS Web Map Service (WMS) Implementation Specification, also published as ISO 19128, provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple remote and heterogeneous sources.

The OpenGIS Web Map Tile Service (WMTS) provides for serving spatially referenced data using tile images with predefined content, extent, and resolution. WMTS trades the flexibility of custom map rendering – as provided by WMS – for the scalability possible by serving a fixed set of tiles. The fixed set of tiles also enables the use of standard network mechanisms for scalability such as distributed cache systems. WMTS includes both resource (REST) and procedure oriented architectural styles (KVP and SOAP).

The OGC has defined profiles of WMS:

WMS Profiles	Document Type
Styled Layer Descriptor Profile of WMS	Standard
Web Map Service - Application Profile for EO Products	Best Practice
DGIWG WMS 1.3 Profile	Best Practice

The OpenGIS Styled Layer Descriptor (SLD) Profile of WMS, explains how WMS can be extended to allow user-defined symbolization of feature and coverage data. This profile defines how the Symbology Encoding standard can be used with WMS. SLD is used in combination with SE Standard. SLD allows for user-defined layers and named or user-defined styling in WMS. If a WMS is to symbolize features using a user-defined symbolization, the source of the feature data must be identified. The features may be in a remote WFS or WCS, or from a specific default feature/coverage store. WMS servers using remote feature data are also called Feature Portrayal Services (FPS), while those using remote coverage data are Coverage Portrayal Services (CPS).

The OpenGIS Symbology Encoding (SE) Implementation Standard specifies the format of a map-styling language for producing georeferenced maps with user-defined styling. SE is an XML language for styling information used to portray Feature and Coverage data. SE may be used together with SLD. As SE is a grammar for styling map data independent of any service interface standard it can be used flexibly by a number of services that style georeferenced information or store styling information that can be used by other services.

The OpenGIS Web Map Context Documents Implementation Standard defines how a specific grouping of one or more maps from one or more WMS servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. A Context Document contains sufficient information for Client software to reproduce the map, and ancillary metadata used to annotate or describe the maps and their provenance for the benefit of human viewers. (Based on the success of the Web Map Context, an OGC Standards Working Group is currently developing an OGC OWS Context Document standard.)

The OGC KML Standard defines an XML grammar used to encode and transport representations of geographic data for display in an earth browser. Put simply: KML encodes what to show in an earth browser, and how to show it. (See also Section 2.4)

OpenGIS Web Map Service (WMS) Implementation Specification (WMS), version 1.3.0

- Standard Links
  - Development History
  - Dependencies
- Implementation Scorecard
  - Implementations
  - Compliance Test
  - Compliant Products
- Relevant OGC Working Groups
- Other OGC Documentation
- Non-OGC Resources
- Give Us Your Feedback

Standard Links

Version	Document Title	Document #	Type
1.3.0	OpenGIS Web Map Service (WMS) Implementation Standard	06-042	IS

Development History

There is no additional history included for this standard.

Dependencies

This section helps to identify documentation dependencies within a standard. Typically these are normative references within the document itself.

- ISO 8601:2004 Data elements and interchange formats - Information interchange - Representation of dates and times
- ISO 19115:2003 Geographic information Â‚Ã„Ã® Metadata
- IETF RFC 2616 Hypertext Transfer Protocol -- HTTP/1.1 Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and Berners-Lee, T., eds. 1999-06-00
- ISO 19111 Geographic information Â— Spatial referencing by coordinates
- IETF RFC 2045 Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies Freed, N. and Borenstein N., eds 1996-11-00
- IETF RFC 2396 Uniform Resource Identifiers (URI): Generic Syntax Berners-Lee, T., Fielding, N., and Masinter, L., eds. August 1998

- IETF RFC 2616 Hypertext Transfer Protocol - HTTP/1.1 Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and Berners-Lee, T., eds June 1999
- W3C XML 1.0 (October 2000) eXtensible Markup Language (XML) 1.0 (2nd edition), World Wide Web Consortium Recommendation Bray, T., Paoli, J., Sperberg-McQueen, C.M., and Maler, E., eds. 2000-10-06
- W3C Recommendation 2 May 2001: XML Schema Part 1: Structures Thompson, H.S., Beech, D., Maloney, M., and Mendelsohn, N., eds. 2001-05-02
- UCUM Unified Code for Units of Measure Schadow, G. and McDonald, C.J. (eds.)

Implementation Scorecard

- ***Implementations***

This standard does have implementing products. A listing is available at: (http://www.opengeospatial.org/resource/products/byspec?specid=107)

Note: Unless noted by the label of Compliant, all products are self-declared implementations and are not reviewed by OGC.

- ***Compliance Test***

This standard has a Compliance Test Suite (http://cite.opengeospatial.org/test_engine/wms/1.3.0/)

- ***Compliant Products***

There are Compliant Products for this standard.(http://www.opengeospatial.org/resource/products/compliant)

Relevant OGC Working Groups

Need to add links to working groups

Other OGC Documentation

Version	Document Title (click to download)	Document #	Type
1.3.0	OpenGIS Web Map Service (WMS) Implementation Standard	06-042	**IS**
	Web Map Services - Application Profile for EO Products (0.3.3)	07-063r1	BP
	~~Web Map Services - Application Profile for EO Products~~ (0.2.0)	07-063	D-BP
	~~OpenGIS Web Map Services - Application Profile for EO Products~~ (0.1.0)	06-093	D-DP
	DGIWG WMS 1.3 Profile and systems requirements for interoperability for use within a military environment (0.9.0)	09-102	BP
	~~OpenGIS Tiled WMS Discussion Paper~~ (0.3.0)	07-057r2	D-DP
1.1.1	~~Web Map Service~~	01-068r3	D-IS
1.1	~~Web Map Service~~	01-047r2	D-IS
1.0	~~Web Map Service~~	00-028	D-IS

NOTE: Documents with a ~~Strike~~ of the title and/or a 'D-' in the Type have been Deprecated.

Non-OGC Resources

Delicious Feed

Delicious API servers are down. Please check back soon.

OpenGIS Web Map Tile Service Implementation Standard (WMTS), version 1.0.0

- Standard Links
  - Development History
  - Dependencies
- Implementation Scorecard
  - Implementations
  - Compliance Test
  - Compliant Products
- Relevant OGC Working Groups
- Other OGC Documentation
- Non-OGC Resources
- Give Us Your Feedback

Standard Links

Version	Document Title	Document #	Type
1.0.0	OpenGIS Web Map Tile Service Implementation Standard	07-057r7	IS

Development History

There is no additional history included for this standard.

Dependencies

This section helps to identify documentation dependencies within a standard. Typically these are normative references within the document itself.

- ISO 19105:2000 Geographic information - Conformance and Testing 2000-00-00
- OGC 06-121r3 OpenGIS Web Services Common Specification, version 1.1.0 with Corrigendum 1 Arliss Whiteside, ed. 2009-02-09
- CGI, The Common Gateway Interface
- IETF RFC 2045 Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies Freed, N. and Borenstein N., eds 1996-11-00
- IETF RFC 2141 URN Syntax, R. Moats, http://www.ietf.org/rfc/rfc2141.txt R. Moats 1997-05-00
- IETF RFC 2396 Uniform Resource Identifiers (URI): Generic Syntax Berners-Lee, T., Fielding, N., and Masinter, L., eds. August 1998
- IETF RFC 2616 Hypertext Transfer Protocol - HTTP/1.1 Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and Berners-Lee, T., eds June 1999

- IETF RFC 4646 Tags for Identifying Languages Phillips, A. and Davies, M., eds September 2006
- IANA Internet Assigned Numbers Authority, MIME Media Types
- ISO/IEC Directives, Part 2. Rules for the structure and drafting of International Standards
- ISO 4217:2001 Codes for the representation of currencies and funds
- ISO 8601:2000(E) Data elements and interchange formats - Information interchange - Representation of dates and times
- ISO 19115:2003 Geographic information Â‚Ã„Ã® Metadata
- ISO 19119:2005 Geographic information Â‚Ã„Ã® Services
- ISO 19123:2005 Geographic information - Schema for coverage geometry and functions
- OGC 02-112 OpenGIS Abstract Specification Topic 12: OpenGIS Service Architecture Percivall, G. (ed.) 2001-09-14
- OGC 03-105r1 OpenGIS Geography Markup Language (GML) Implementation Specification, Version 3.1 Simon Cox, Paul Daisey, Ron Lake, Clemens Portele, Arliss Whiteside 2004-04-19
- OGC 04-046r3 The OpenGIS Abstract Specification, Topic 2: Spatial Referencing by Coordinates August 2004
- OGC 04-092r4 OpenGIS Geography Markup Language (GML) Implementation Specification Schemas, Version 3.1.1
- OGC 06-023r1 Definition identifier URNs in OGC namespace
- W3C Recommendation January 1999, Namespaces In XML Bray, Hollander, Layman, eds. 1999-01-14
- W3C Recommendation 4 February 2004, Extensible Markup Language (XML) 1.0 (Third Edition)
- W3C Recommendation 2 May 2001: XML Schema Part 0: Primer
- W3C Recommendation 2 May 2001: XML Schema Part 1: Structures Thompson, H.S., Beech, D., Maloney, M., and Mendelsohn, N., eds. 2001-05-02
- W3C Recommendation 2 May 2001: XML Schema Part 2: Datatypes 2001-05-02
- W3C SOAP Version 1.2 Part 1: Messaging Framework, W3C Recommendation 24 June 2003
- W3C SOAP 1.2 Attachment Feature, W3C Working Group Note 8 June 2004
- W3C Web Services Description Language (WSDL) 1.1, W3C Note 2001-03-15

Implementation Scorecard

- ***Implementations***

This standard does have implementing products. A listing is available at: (http://www.opengeospatial.org/resource/products/byspec?specid=405)

Note: Unless noted by the label of Compliant, all products are self-declared implementations and are not reviewed by OGC.

Compliance Test

This standard does not have a Compliance Test Suite.

Compliant Products

There are no Compliant Products for this standard.

Relevant OGC Working Groups

Need to add links to working groups

Other OGC Documentation

Version	Document Title (click to download)	Document #	Type
1.0.0	OpenGIS Web Map Tile Service Implementation Standard	07-057r7	IS

NOTE: Documents with a ~~Strike~~ of the title and/or a 'D-' in the Type have been Deprecated.

Non-OGC Resources

Delicious Feed

Delicious API servers are down. Please check back soon.

OpenGIS Web Feature Service (WFS) Implementation Specification (WFS), version 1.1.0

- Standard Links
  - Development History
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- Implementation Scorecard
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Standard Links

Version	Document Title	Document #	Type
2.0	OpenGIS Web Feature Service 2.0 Interface Standard (also ISO 19142)	09-025r1	IS
1.1.0	OpenGIS Web Feature Service (WFS) Implementation Specification	04-094	IS

Development History

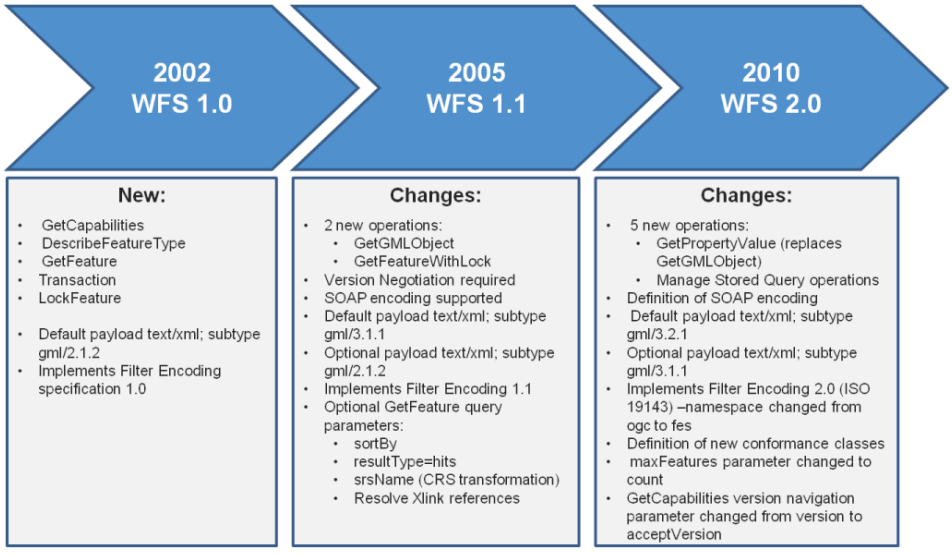

Figure 1: Changes between versions of Web Feature Service Standards.

Dependencies

This section helps to identify documentation dependencies within a standard. Typically these are normative references within the document itself.

- OGC 04-095 Filter Encoding Implementation Specification Peter Vretanos 2005-05-03
- IETF RFC 2119 (March 1997) Key words for use in RFCs to Indicate Requirement Levels Bradner, S., ed. 1997-03-00
- OGC 02-112 OpenGIS Abstract Specification Topic 12: OpenGIS Service Architecture Percivall, G. (ed.) 2001-09-14
- W3C XML 1.0 (October 2000) eXtensible Markup Language (XML) 1.0 (2nd edition), World Wide Web Consortium Recommendation Bray, T., Paoli, J., Sperberg-McQueen, C.M., and Maler, E., eds. 2000-10-06
- W3C Recommendation 2 May 2001: XML Schema Part 1: Structures Thompson, H.S., Beech, D., Maloney, M., and Mendelsohn, N., eds. 2001-05-02
- W3C Recommendation January 1999, Namespaces In XML Bray, Hollander, Layman, eds. 1999-01-14
- W3C Recommendation (16 November 1999): XML Path Language (XPath) Version 1.0 Clark, James, DeRose, Steve 1999-11-00
- IETF RFC 2616 Hypertext Transfer Protocol -- HTTP/1.1 Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and Berners-Lee, T., eds. 1999-06-00
- IETF RFC 2396 Uniform Resource Identifiers (URI): Generic Syntax Berners-Lee, T., Fielding, N., and Masinter, L., eds. August 1998
- CGI, The Common Gateway Interface
- IETF RFC 2045 Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies Freed, N. and Borenstein N., eds 1996-11-00
- IANA Internet Assigned Numbers Authority, MIME Media Types
- W3C XLink, XML Linking Language (XLink) Version 1.0, W3C Recommendation Steve DeRose, Eve Maler, David Orchard 2001-06-27
- OGC 02-023r4 OpenGIS? Geography Markup Language (GML) Implementation Specification, version 3.1.1 Cox S., Daisey P., Lake, R., Portele C., Whiteside A. (eds.) 2005-01-00
- OGC 04-016r3 OWS Common Implementation Specification Whiteside, Arliss (ed.) 2004-06-17
- IETF RFC 2660 The Secure Hypertext Transfer Protocol Rescorla et. al 1999-08-00
- XPointer xmlns() Scheme DeRose et al. 2003-03-00

Implementation Scorecard

- *Implementations*

This standard does have implementing products. A listing is available at: (http://www.opengeospatial.org/resource/products/byspec?specid=143)

Note: Unless noted by the label of Compliant, all products are self-declared implementations and are not reviewed by OGC.

- *Compliance Test*

This standard has a Compliance Test Suite (http://cite.opengeospatial.org/test_engine/wfs/1.1.0/)

- *Compliant Products*

There are Compliant Products for this standard.(http://www.opengeospatial.org/resource/products/compliant)

Relevant OGC Working Groups

Need to add links to working groups

Other OGC Documentation

Version	Document Title (click to download)	Document #	Type
2.0	OpenGIS Web Feature Service 2.0 Interface Standard (also ISO 19142)	09-025r1	**IS**
1.1.0	OpenGIS Web Feature Service (WFS) Implementation Specification	04-094	**IS**
	Gazetteer Service - Application Profile of the Web Feature Service Best Practice (1.0)	11-122r1	BP
	~~Gazetteer Service - Application Profile of the Web Feature Service Candidate Implementation Standard~~ (1.0)	11-122r1	D-RFC
	OpenGIS Web Feature Service (WFS) Implementation Specification (Corrigendum) (1.0.0)	06-027r1	**ISC**
1.0.0	~~Web Feature Service~~	02-058	D-IS
	~~Web Feature Service (Transactional)~~ (1.0.0)	02-058	D-SAP

NOTE: Documents with a ~~Strike~~ of the title and/or a 'D-' in the Type have been Deprecated.