Open Geospatial Consortium, Inc.

OGC® OWS-7 Web Processing Service Profiling Engineering Report

Warning

Preface

Within the scope of OGC Web Services, Phase 7 (OWS-7) Testbed the Open Geospatial Consortium (OGC®) several Web Processing Services (WPS) provide access to Feature and Statistical Analysis (FSA) functionality. In order to provide interoperability beyond the rather coarse grained WPS interface, a detailed description of a 'WPS profile for FSA' should be provided. The use of the term WPS profile is not well defined. The current Engineering Report gives advice on the architecture of a WPS profile and provides some working examples of a FSA profile.

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OGC® OWS-7 WPS Profiling Engineering Report

1   Introduction

This OGC Engineering Report (ER) provides discussions and recommendations for defining, registering and using Web Processing Service (WPS) profiles. It will especially focus on the usage of a Feature and Statistical Analysis (FSA) profile for WPS as this has been targeted within OWS-7 WPS-FSA cross-thread effort. However, this ER will make recommendations on defining WPS profiles in general and give advise on how to register a profile to make it available for third-party users.

1.1   Scope

The overall scope of this ER is to clarify how to write and register a WPS profile. WPS profiles enable clients to search and identify equivalent WPS-based processes distributed on the web. Therefore, this ER provides guidelines for designing WPS Profiles based on WPS interface specification 1.0.0.
It is important to note that Web Coverage Processing Service specification is out of scope of this ER, as OWS-7 is focusing on vector-based operations and excludes Map Algebra operations, which are the basis for WCPS.

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
23.2.2010		CK,TF	ALL	Initial draft
30.3.2010		CK, TF	ALL	Document structure
26.5.2010		CK, TF	ALL	Draft submitted to Pending Documents
30.6.2010		CK, TF	ALL	Final version prepared

1.4   Future work

Improvements in this document are desirable to support workflow chaining of WPS-based processes and enhance interoperability between WPS profiles.

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 Inc. 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 06-121r3, *OpenGIS® Web Services Common Standard*
NOTE This OWS Common Specification contains a list of normative references that are also applicable to this Implementation Specification.

OGC 05-007r7, *OpenGIS® Web Processing Service*
OGC 08-062r4. *OGC Reference Model*
OGC 09-046r2, *OGC Naming Authority - Procedures*
OGC 09-047r2, *Name type specification - documents*
OGC 09-048r3, *Name type specification – definitions – part 1 – basic name*
OGC 09-049r1, *OGC urn policies. Name type specification – specification elements*
OGC 10-074, *OGC OWS-7 Feature and Statistical Analysis Engineering Report*
IETF RFC 5165, *A Uniform Resource Name (URN) Namespace for the Open Geospatial Consortium (OGC)*
ISO 19109:2005(E), *Geographic information -- Rules for application schema*

3   Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Specification [OGC 06-121r3] shall apply. In addition, the following terms and definitions apply.

1. **Application profile**

An Application Profile (AP) is considered to be a subtype of an OpenGIS Implementation Standard (OGC 08-062r4). It serves more detailed information about a specific domain than the standard itself. An AP specifies required interfaces, bindings and encodings to publish and access data.

2. **Application Schema**

In contrast to an application profile, an application schema derives from the ISO standard 19109 about rules for GI application schema: "An application schema provides the formal description of the data structure and content required by one or more applications. An application schema contains the descriptions of both geographic data and other related data." (ISO 19109:2005)

3. **Process classification**

Classifications allow users and systems to handle complexity. They support decision making and selecting the appropriate approach regarding a specific problem.

4. **Uniform Resource Name (URN)**

A URN identifies resources on the web following a specific urn scheme specified by OGC.

5. **WPS**

The term Web Processing Service (WPS) describes a service instance of a WPS server. A WPS is a container for one or many processes. The capabilities of a WPS contain the list of services which are hosted by the WPS. Each process is further described by a Process Description.

6. **Process Description**

The term process description relates to the response of a describe process request (OGC 05-007r7). A process description contains all data to issue a execute request for a specific process. A process description is based on the XML Schema document located at http://schemas.opengis.net/wps/1.0.0/wpsDescribeProcess_response.xsd

7. **WPS profile**

According to the WPS specification (OGC 05-007r7), a WPS Application Profile should be defined as a standalone document containing:

- An Universal Resource Name (URN) that uniquely identifies the process
- A reference response to a DescribeProcess request for that process (reference process schema),
- A human-readable description of the process and its implementation (optional, but recommended).
- A Web Service Description Language (WSDL) document for that process (optional).

4   Conventions

4.1   Abbreviated terms

- AP Application Profile
- ER Engineering Report
- FDF Feature and Decision Fusion
- FSA Feature and Statistical Analysis
- GI Geographic Information

- GML Geography Markup Language
- IETF Internet Engineering Task Force
- ISO International Organization for Standardization
- OGC Open Geospatial Consortium
- ONA Open Geospatial Consortium Naming Authority
- OWS Open Geospatial Consortium Web Services
- RFC Request for Comments
- RM ODP Reference Model for Open Distributed Processing
- UML Unified Modeling Language
- URN Universal Resource Name
- WCPS Web Coverage Processing Service
- WPS Web Processing Service
- WSDL Web Service Description Language
- XML Extensible Markup Language

4.2   UML notation

Most diagrams that appear in this standard are presented using the Unified Modeling Language (UML) static structure diagram, as described in Subclause 5.2 of [OGC 06-121r3].

5   ER Topic overview

This Engineering Report addresses the development of a common pattern for defining and describing WPS profiles, guiding the WPS Profile developments across all threads of OWS-7. This ER is coordinated with SFE Change Detection ER, FDF FSA ER, and prior OGC work with WPS.

6   Profiling design guidelines

This section presents design guidelines based on the RM ODP model.

6.1   Example Vector Topology Profile

Within OWS-7 participants agreed on a list of example processes for a topology profile. The processes are derived from the ISO 19125 specification "Geographic Information – Simple Feature Access". The operators are:
- equals
- disjoint
- intersects
- touches
- crosses
- within
- contains
- overlaps

These operators are provided as processes through a Web Processing Service interface. Each process is described by a process description according to the WPS interface

specification. The description for the all the operators is listed in the Annex of the Feature and Statistical Analysis Engineering Report.

The processes of the topology profile accept as input parameters KML, subversions of GML 3 and GML 2, respectively. The output is a boolean literal. Other processes could produce geometric output like GML as well.

Based on ISO 19125 the operations mentioned above comprise a useful set of operations to compute vector- and topology relations. Other potential candidates for profiles are Map Algebra, Generalizations Algorithms and Geostatistics.

6.2   Design WPS Profiles using RM ODP

This section provides a guideline for designing WPS Profiles. Designing WPS Profiles is a challenge not only regarding choosing the appropriate input and output type definitions, but also regarding choosing appropriate classifications. For this reason, a holistic approach is required to reflect the complexity of appropriate process design.

One approach to model processes is the Reference Model of Open Distributed Processing (RM ODP). It is comprehensive as it tackles the design aspect from various viewpoints:

- Enterprise viewpoint

- Information viewpoint

- Computational viewpoint

- Engineering viewpoint

- Technology viewpoint.

As RM ODP focuses on modeling distributed systems, describing some viewpoints for WPS Profiles is trivial, such as the engineering viewpoint. The questions to be issues regarding the other viewpoints are described in Table 1.

Viewpoint	Enterprise	Information	Computation	Technology
Areas of concern	Objectives of processes	Information models and information manipulation	Logical decomposition of processes	Technical artifacts and solutions
Main concepts	Artifacts, roles	Data schemas	Computational interfaces	

Table 1: Aspects of the RM ODP model for WPS Profiles.

6.2.1 Enterprise Viewpoint

In the *enterprise viewpoint*, the objectives of the set of processes are identified. Additionally, it is interesting to know, which artifacts are processed by which roles. This helps to identify the level of granularity of the specific processes. Granularity describes the level of complexity of the modeled process as well as of the modeled information.

6.2.2 Information Viewpoint

In the *information viewpoint*, the information models are described and the manipulation of this information regarding the set of processes is specified. These information models are mostly described in data schemas.

6.2.3 Computational Viewpoint

In the *computational viewpoint* the decomposition of the processes is described, which basically also involves to select the granularity of the processes. The granularity of a specific process also depends on the design of its interface (syntax). The syntax of the processes applies the information models described in the information viewpoint.

6.2.4 Technology Viewpoint

Finally, these information models are specified in the *technology viewpoint* by describing the particular encoding of the inputs and outputs of the process. For the OWS-7 testbed GML 2, GML 3, KML have been identified as appropriate candidate input/output types.

After the WPS Profile is designed, it should be registered at the OGC to retrieve a URN. This URN should be identified within the published process descriptions and sharable with others. However, before designing and registering new profiles, a developer should identify existing profiles and evaluate their reuse.

6.3 WPS Profile Entry Points

This section describes the entry points of GetCapabilities and DescribeProcess response documents to reference specific profiles. This requires that the service provider has identified in a previous step the appropriate WPS Profile to be referenced.

The GetCapabilities response document contains two different profile elements:

- The first profile element (Capabilities/ServiceIdentification/Profile) is inherited from OWS Common and is an unnecessary duplication of the second. The only justification to preserve this element here is, that OWS Common clients expect to find profile information within this element.

- The second profile element (Capabilities/ProcessOfferings/Process/Profile) applies to a specific process and is thus useful to support service discovery and appropriately positioned in the schema.

The DescribeProcess response document contains one profile element (ProcessDescriptions/ProcessDescription/Profile). This is intended to be a duplicate of

the second GetCapabilitiesResponse profile element. It is duplicated here deliberately in order to allow a client to confirm that a specific behavior should be able to be applied in order to generate a User Interface or workflow.

7   URN management

This section describes, how URNs can be created in the OGC realm. The technical baseline for URNs is detailed within the following set of documents:
- OGC 09-046r2, *OGC Naming Authority - Procedures*
- OGC 09-047r2, *Name type specification - documents*
- OGC 09-048r3, *Name type specification – definitions – part 1 – basic name*
- OGC 09-049r1, *OGC urn policies. Name type specification – specification elements*
- IETF RFC 5165, A Uniform Resource Name (URN) Namespace for the Open Geospatial Consortium (OGC)

The Open Geospatial Consortium Naming Authority (ONA) manages the assignment and management of resources withing the Naming Authority. To register a URN within ONA an OGC member has to complete a URN proposal and send this proposal to the names@opengeospatial.org. According to IETF RFC 5165 the generic syntax for OGC URNs is:
URN = "urn:ogc:" OGCResource ":" ResourceSpecificString

ONA will review the proposal. After acceptance, the requested URN will be publicly available within the OGC Naming Authority registry. The OGC Naming Authority hosts an URN resolver which resolves an URN to a specific resource, e.g. a document describing a WPS profile.

The resolver tool is available online: http://urn.opengis.net/

Attention is drawn to the fact that each process of a profile should be registered within the OGC Naming Authority as well as the profile document itself. Section "profile deployment" describes the necessary steps.

8   Profile deployment

Profile deployment is the last necessary step to share a WPS profile and allow other parties to implement software components based on the definitions made within the profile. Profile deployment requires:
- Document containing a description of the profile (processes, scope, use-cases, etc.)
- Universal Resource Name (URN) that uniquely identifies the profile document.
- A reference response to a DescribeProcess request for each process,
- if applicable, a Web Service Description Language (WSDL) document each process.

It is not necessary to provide a working reference implementation, although this is considered as good style to ensure interoperability and ease the development of interoperable software components.

The Feature and Statistical Analysis profile would be referenced as urn:ogc:doc:SAP:WPS:FSAProfile

9 Example walk through

This section describes, how WPS profiles are used, whenever they are referenced by a WPS. The course of action is depicted in Figure 1.
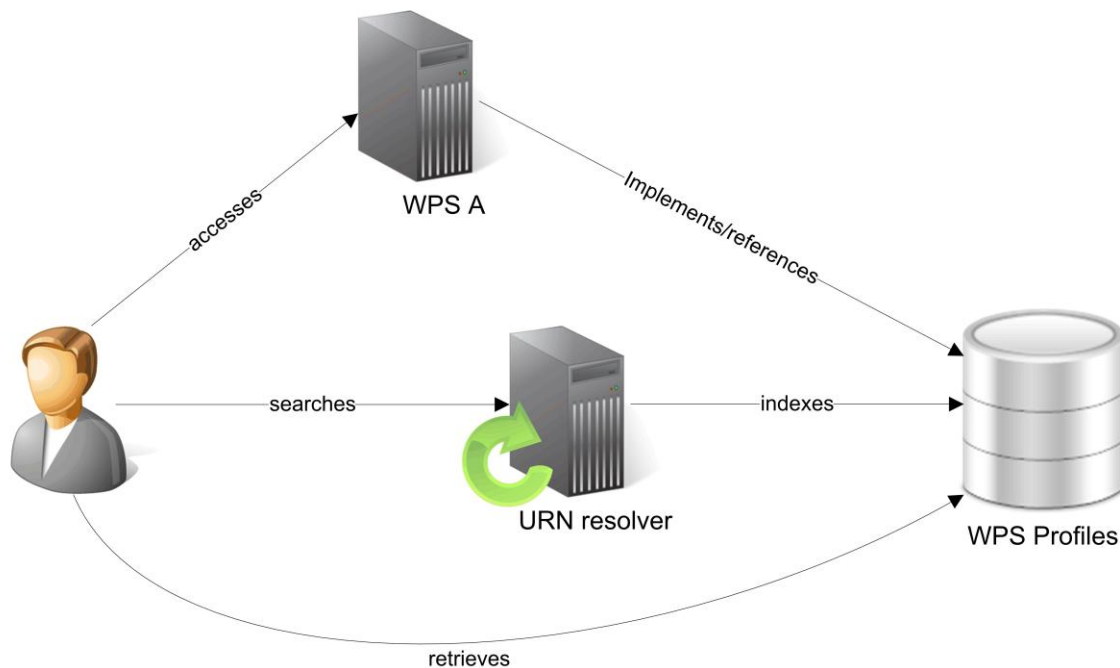

Figure 1: Basic interaction with WPS Profiles.

A user accesses a given WPS and queries its available processes. Some of the processes implement a WPS Profile, which is indicated by a referenced URN. The client retrieves the description of the specific process, by accessing the profile using the URN. In particular, the user retrieves the specific process description, by searching the URN resolver. The URN resolver returns a URL of the process description (i.e. the WPS Profile) to the user, which he/she can use to access the process description.

10 Lessons learned and open issues

Profiling of Web Processing Services is a crucial task to achieve syntactic interoperability between services, processes and input/output data. It is therefore important to provide the basis for service chaining, service orchestration and the development and deployment of WPS-based workflows. Within OWS-7 there was a lively discussion between providers of data services (mainly Web Feature Services and Sensor Observation Services) and especially processing services. During the still ongoing discussion some unresolved issues were unfolded:

- Which document should be used to provide the information needed to describe a profile?
- Which would be the workflow to publish a profile so that other vendors/users could implement / use this profile?
- Who would be responsible to review a submitted profile?
- Is it necessary to provide a proof-of-concept implementation along with the profile?
- What is the distinction between a Process Description, a WPS Profile, a WPS Application Profile, a Profile of the WPS Specification and how do these terms relate to the core-and-extension model?
- How could processes and services be described semantically to achieve interoperability (i.e. ensure the concept of a spatial buffer is a commonly agreed concept)
- Should data formats for process input / process outputs be mandatory? Which data formats should be mandatory?

Due to the fact that the implementation of the WPS instances began during the late project stage of OWS-7, it was not possible to review the experiences made by WPS developers. It would have been important to integrate those findings into the current report. Furthermore, none of the participants developed a WPS profile in its strict sense (i.e. provide a human readable document, register an URN and provide example Describe Process Responses). The experiences gained here would be an interesting source of information to be included in an Engineering Report and should be the basis for deriving a best practice approach.

It is obvious that WPS profiling needs more attention and should be considered by different domain experts. Discussion on WPS profiling will need a significant effort and amount of time, so it is advisable to facilitate a Technology Integration Experiment (TIE) to further explore issues and possible solutions for interoperable processes.