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OGC WPS 2.0 Interface Standard

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Contents

1.	SCOPE	10
2.	CONFORMANCE	10
3.	REFERENCES.....	11
4.	TERMS AND DEFINITIONS.....	11
5.	CONVENTIONS	13
5.1	ABBREVIATED TERMS.....	13
5.2	USE OF THE TERM “PROCESS”	13
5.3	UML NOTATION	13
5.4	NAMESPACE CONVENTIONS	14
6.	WPS CONCEPTUAL MODEL.....	15
6.1	SERVICE DISCOVERY	16
6.2	SERVICE CAPABILITIES	16
6.3	ABSTRACT PROCESS MODEL.....	17
6.4	JOB CONTROL	20
6.5	PROCESS EXECUTION	21
6.6	DATA TRANSMISSION BY VALUE AND BY REFERENCE	24
6.7	JOB MONITORING	26
7.	WPS NATIVE PROCESS MODEL	29
7.1	COMMON DESCRIPTION TYPE.....	30
7.2	DATA DESCRIPTION STRUCTURE.....	32
7.3	DATA TYPES.....	33
7.3.1	<i>Complex Data</i>	34
7.3.2	<i>Literal Data</i>	36
7.3.3	<i>BoundingBox Data</i>	40
7.4	PROCESS DESCRIPTION.....	43
7.5	PROCESS PROFILES	46
7.5.1	<i>Process Concept</i>	47
7.5.2	<i>Generic Process Profile</i>	47
7.5.3	<i>Process Implementation Profile</i>	50
7.5.4	<i>Profile Inheritance</i>	51
8.	WPS NATIVE PROCESS MODEL ENCODING	54
8.1	XML SCHEMA IMPLEMENTATION.....	54
8.1.1	<i>Data Types</i>	54
8.1.2	<i>Process Description</i>	55
8.1.3	<i>Generic Process</i>	55
8.2	PLAIN TEXT ENCODING FOR LITERALDATA AND BOUNDINGBOXDATA VALUES.....	56
9.	COMMON WPS SERVICE MODEL	58
9.1	OVERVIEW OF WPS CORE OPERATIONS	59
9.2	DATA TRANSMISSION	60
9.3	WPS SERVICE HANDLING	63
9.4	PROCESS OFFERING	64
9.5	STATUSINFO DOCUMENT.....	65
9.6	RESULT DOCUMENT	66

9.7	GETCAPABILITIES OPERATION.....	68
9.7.1	<i>GetCapabilities Request</i>	68
9.7.2	<i>GetCapabilities Response</i>	69
9.7.3	<i>GetCapabilities Exceptions</i>	72
9.8	DESCRIBEPROCESS OPERATION.....	72
9.8.1	<i>DescribeProcess Request</i>	72
9.8.2	<i>DescribeProcess Response</i>	74
9.8.3	<i>DescribeProcess Exceptions</i>	75
9.9	EXECUTE OPERATION.....	76
9.9.1	<i>Execute Request</i>	77
9.9.2	<i>Execute Response</i>	80
9.9.3	<i>Execute Exceptions</i>	81
9.10	GETSTATUS OPERATION	83
9.10.1	<i>GetStatus Request</i>	84
9.10.2	<i>GetStatus Response</i>	85
9.10.3	<i>GetStatus Exceptions</i>	85
9.11	GETRESULT OPERATION	86
9.11.1	<i>GetResult Request</i>	87
9.11.2	<i>GetResult Response</i>	88
9.11.3	<i>GetResult Exceptions</i>	88
9.12	SYNCHRONOUS WPS.....	90
9.13	ASYNCHRONOUS WPS.....	90
10.	BINDING EXTENSIONS FOR WPS OPERATIONS.....	91
10.1	HTTP/POST + XML BINDING	91
10.1.1	<i>GetCapabilities</i>	92
10.1.2	<i>DescribeProcess</i>	92
10.1.3	<i>Execute</i>	93
10.1.4	<i>GetStatus</i>	93
10.1.5	<i>GetResult</i>	94
10.2	HTTP/GET + KVP BINDING	94
10.2.1	<i>GetCapabilities</i>	95
10.2.2	<i>DescribeProcess</i>	96
10.2.3	<i>GetStatus</i>	97
10.2.4	<i>GetResult</i>	98
11.	SERVICE PROFILES	100
11.1	BASIC WPS	100
12.	DISMISS EXTENSION.....	101
12.1	DISMISS OPERATION.....	101
12.1.1	<i>Dismiss Request</i>	102
12.1.2	<i>Dismiss Response</i>	103
12.1.3	<i>Dismiss Exceptions</i>	104
12.2	BINDING EXTENSIONS FOR THE DISMISS OPERATION	104
12.2.1	<i>HTTP/POST + XML Binding</i>	104
12.2.2	<i>HTTP/GET + KVP Binding</i>	105
ANNEX A: ABSTRACT TEST SUITE (NORMATIVE)	107	
A.1	BASIC WPS (CONFORMANCE CLASS)	107
A.2	SYNCHRONOUS WPS (CONFORMANCE CLASS)	107
A.3	ASYNCHRONOUS WPS (CONFORMANCE CLASS).....	108
A.4	WPS PROCESS MODEL ENCODING (CONFORMANCE CLASS).....	108

A.4.1	PROCESS XML ENCODING	108
A.4.2	GENERIC PROCESS XML ENCODING	109
A.4.3	PROCESS DATA TYPES XML ENCODING	109
A.5	BASIC TESTS	110
A.5.1	REQUEST SERVICE NAME	110
A.5.2	REQUEST VERSION NUMBER	110
A.5.3	INPUT DATA TRANSMISSION BY VALUE	110
A.5.4	INPUT DATA TRANSMISSION BY REFERENCE	111
A.5.5	OUTPUT DATA TRANSMISSION BY VALUE	111
A.5.6	OUTPUT DATA TRANSMISSION BY REFERENCE	111
A.5.7	UNIQUE PROCESS IDENTIFIER	112
A.5.8	UNIQUE JOB IDENTIFIER	112
A.5.9	GETCAPABILITIES POST/XML ENCODING REQUEST/RESPONSE	112
A.5.10	DESCRIBEPROCESS POST/XML ENCODING REQUEST/RESPONSE	112
A.5.11	SYNCHRONOUS EXECUTE POST/XML ENCODING REQUEST/RESPONSE	113
A.5.12	ASYNCHRONOUS EXECUTE POST/XML ENCODING REQUEST/RESPONSE	113
A.5.13	AUTO EXECUTE POST/XML ENCODING REQUEST/RESPONSE	113
A.5.14	GETSTATUS POST/XML ENCODING REQUEST/RESPONSE	114
A.5.15	GETRESULT POST/XML ENCODING REQUEST/RESPONSE	115
A.5.16	GETCAPABILITIES GET/KVP ENCODING REQUEST/RESPONSE	115
A.5.17	DESCRIBEPROCESS GET/KVP ENCODING REQUEST/RESPONSE	115
A.5.18	GETSTATUS GET/KVP ENCODING REQUEST/RESPONSE	116
A.5.19	GETRESULT GET/KVP ENCODING REQUEST/RESPONSE	116
A.6	DISMISS EXTENSION (CONFORMANCE CLASS)	117
A.6.1	DISMISS POST/XML ENCODING REQUEST/RESPONSE	117
A.6.2	DISMISS GET/KVP ENCODING REQUEST/RESPONSE	117
ANNEX B: XML EXAMPLES (INFORMATIVE).....		119
B.1	DATA TYPES	119
B.1.1	COMPLEX DATA DESCRIPTION.....	119
B.1.2	LITERAL DATA DESCRIPTION	119
B.1.4	BOUNDINGBOX DATA DESCRIPTION.....	120
B.1.5	BOUNDINGBOX DATA VALUES	120
B.2	PROCESS DESCRIPTION	120
B.3	GENERIC PROCESS	122
B.4	GETCAPABILITIES	123
B.4.1	GETCAPABILITIES REQUEST	123
B.4.2	GETCAPABILITIES RESPONSE	124
B.5	DESCRIBEPROCESS.....	126
B.5.1	DESCRIBEPROCESS REQUEST	126
B.5.2	DESCRIBEPROCESS RESPONSE	126
B.6	EXECUTE.....	129
B.6.1	EXECUTE REQUEST (ASYNCHRONOUS, RESULT DOCUMENT).....	129
B.6.2	EXECUTE RESPONSE (STATUSINFO)	129
B.6.3	EXECUTE RESPONSE (RESULT).....	129
B.7	GETSTATUS.....	130
B.7.1	GETSTATUS REQUEST	130
B.7.2	GETSTATUS RESPONSE	130
B.8	GETRESULT	130
B.8.1	GETRESULT REQUEST.....	130
B.8.2	GETRESULT RESPONSE	131
B.9	DISMISS	131
B.9.1	DISMISS REQUEST	131

B.9.2	DISMISS RESPONSE.....	131
B.10	PROFILE INHERITANCE EXAMPLE	131

List of Figures

FIGURE 1 - ARTIFACTS OF THE WPS SERVICE MODEL	15
FIGURE 2 – ABSTRACT PROCESS MODEL UML CLASS DIAGRAM.....	18
FIGURE 3 – SYNCHRONOUS PROCESS EXECUTION UML SEQUENCE DIAGRAM	21
FIGURE 4 – ASYNCHRONOUS PROCESS EXECUTION UML SEQUENCE DIAGRAM	22
FIGURE 5 – EXECUTE CALL AND RESPONSE "BY VALUE" AND "BY REFERENCE" UML SEQUENCE DIAGRAM.....	25
FIGURE 6 – DESCRIPTIONTYPE FOR PROCESSES, PROCESS INPUTS AND PROCESS OUTPUTS UML CLASS DIAGRAM	31
FIGURE 7 – DATADESCRIPTION AND SUPPORTED FORMATS UML CLASS DIAGRAM	32
FIGURE 8 – I/O DATA TYPES OVERVIEW	34
FIGURE 9 – LITERALDATA UML CLASS DIAGRAM	37
FIGURE 10 – LITERALVALUE UML CLASS DIAGRAM.....	40
FIGURE 11 – BOUNDINGBOXDATA UML CLASS DIAGRAM	41
FIGURE 12 – PROCESS UML CLASS DIAGRAM	44
FIGURE 13 – GENERICPROCESS UML CLASS DIAGRAM	49
FIGURE 14 – INHERITANCE HIERARCHY FOR PROCESS PROFILES UML CLASS DIAGRAM.....	52
FIGURE 15 – COMMON SEQUENCE OF WPS OPERATIONS UML SEQUENCE DIAGRAM	60
FIGURE 16 – INPUT AND OUTPUT DATA TRANSMISSION STRUCTURES UML CLASS DIAGRAM.....	61
FIGURE 17 – GETCAPABILITIES REQUEST UML CLASS DIAGRAM	68
FIGURE 18 – CAPABILITIES DOCUMENT UML CLASS DIAGRAM	70
FIGURE 19 – DESCRIBEPROCESS REQUEST UML CLASS DIAGRAM	73
FIGURE 20 – EXECUTE RESPONSE DOCUMENT AND RAW DATA UML SEQUENCE DIAGRAM.....	77
FIGURE 21 – EXECUTE REQUEST UML CLASS DIAGRAM	78
FIGURE 22 – GETSTATUS REQUEST UML CLASS DIAGRAM.....	85
FIGURE 23 – GETRESULT REQUEST UML CLASS DIAGRAM.....	87
FIGURE 24 – DISMISS OPERATION – UML SEQUENCE DIAGRAM	101
FIGURE 25 – DISMISS REQUEST UML CLASS DIAGRAM	103
FIGURE 26 – PROFILE INHERITANCE EXAMPLE FOR A MOSAIC PROCESS	132
FIGURE 27 – PROFILE INHERITANCE EXAMPLE FOR A MOSAIC PROCESS, EXTENSION BY AN IMPLEMENTATION	133

List of Tables

TABLE 1 – CONFORMANCE CLASSES RELATED TO WPS 2.0.....	10
TABLE 2 – DATA ENCODING PROPERTIES	20
TABLE 3 – BASIC STATUS SET FOR JOBS	27
TABLE 4 – PROPERTIES OF THE DESCRIPTIONTYPE STRUCTURE.....	31
TABLE 5 – PROPERTIES OF THE METADATA STRUCTURE.....	31
TABLE 6 – FORMAT PROPERTIES.....	33
TABLE 7 – COMPLEXDATA DESCRIPTION PROPERTIES.....	35
TABLE 8 – THE LITERALDATA STRUCTURE.....	38
TABLE 9 – PARTS OF THE LITERALDATA DOMAIN STRUCTURE.....	38
TABLE 10 – PARTS OF THE POSSIBLELITERALVALUESCHOICE STRUCTURE	38
TABLE 11 – RECOMMENDED DATA TYPE URIS FOR LITERAL DATA.....	39
TABLE 12 – PARTS OF THE LITERALVALUE STRUCTURE	40
TABLE 13 – THE BOUNDINGBOX STRUCTURE.....	42

TABLE 14 – THE SUPPORTEDCRS TYPE STRUCTURE	42
TABLE 15 – THE PROCESS STRUCTURE	44
TABLE 16 – PARTS OF THE INPUT STRUCTURE	45
TABLE 17 – PARTS OF THE OUTPUT STRUCTURE	45
TABLE 18 – THE GENERICPROCESS STRUCTURE	49
TABLE 19 – PARTS OF THE GENERICINPUT STRUCTURE	49
TABLE 20 – PARTS OF THE GENERICOUTPUT STRUCTURE	50
TABLE 21 – INHERITANCE AND OVERRIDE RULES FOR PROCESS PROFILES	52
TABLE 22 – ROLE IDENTIFIERS FOR PROCESS PROFILES	53
TABLE 23 – PARTS OF THE INLINE DATA STRUCTURE	61
TABLE 24 – PROPERTIES OF THE DATAENCODINGATTRIBUTES STRUCTURE	61
TABLE 25 – PARTS OF THE REFERENCE STRUCTURE	62
TABLE 26 – PARTS OF THE REQUESTBODY STRUCTURE	62
TABLE 27 – PARTS OF THE BODYREFERENCE STRUCTURE	63
TABLE 28 – PROPERTIES OF THE REQUESTBASETYPE	63
TABLE 29 – PARTS OF THE PROCESSOFFERINGPROPERTIESATTRIBUTES STRUCTURE	64
TABLE 30 – BASIC JOB CONTROL OPTIONS	65
TABLE 31 – DATA TRANSMISSION OPTIONS	65
TABLE 32 – STATUSINFO STRUCTURE	65
TABLE 33 – RESULT STRUCTURE	67
TABLE 34 – PARTS OF THE DATAOUTPUTTYPE STRUCTURE	67
TABLE 35 – ADDITIONAL PROPERTIES IN THE GETCAPABILITIES REQUEST	69
TABLE 36 – ADDITIONAL PROPERTIES IN THE CAPABILITIES DOCUMENT	71
TABLE 37 – PROPERTIES OF THE PROCESSSUMMARY	71
TABLE 38 – ADDITIONAL PROPERTIES IN THE DESCRIBEPROCESS REQUEST	73
TABLE 39 – PROPERTIES IN THE PROCESSOFFERINGS DOCUMENT	74
TABLE 40 – PROCESSOFFERING PROPERTIES	75
TABLE 41 – ADDITIONAL EXCEPTION CODES FOR THE DESCRIBEPROCESS OPERATION	76
TABLE 42 – ADDITIONAL PROPERTIES IN THE EXECUTE REQUEST	78
TABLE 43 – PROPERTIES OF THE DATAINPUTTYPE	79
TABLE 44 – PROPERTIES OF THE OUTPUTDEFINITIONTYPE	80
TABLE 45 – POSSIBLE RESPONSES TO AN EXECUTE REQUEST	81
TABLE 46 – ADDITIONAL EXCEPTION CODES FOR THE EXECUTE OPERATION	82
TABLE 47 – ADDITIONAL PROPERTIES IN THE GETSTATUS REQUEST	85
TABLE 48 – ADDITIONAL EXCEPTION CODES FOR THE GETSTATUS OPERATION	86
TABLE 49 – ADDITIONAL PROPERTIES IN THE GETRESULT REQUEST	87
TABLE 50 – ADDITIONAL EXCEPTION CODES FOR THE GETRESULT OPERATION	89
TABLE 51 – DESCRIBEPROCESS REQUEST KVP ENCODING	97
TABLE 52 – GETSTATUS REQUEST KVP ENCODING	98
TABLE 53 – GETRESULT REQUEST KVP ENCODING	99
TABLE 54 – ADDITIONAL PROPERTIES IN THE DISMISS REQUEST	103
TABLE 55 – DISMISS REQUEST KVP ENCODING	106

i. Abstract

In many cases geospatial or location data, including data from sensors, must be processed before the information can be used effectively. The OGC Web Processing Service (WPS) Interface Standard provides a standard interface that simplifies the task of making simple or complex computational processing services accessible via web services. Such services include well-known processes found in GIS software as well as specialized processes for spatio-temporal modeling and simulation. While the OGC WPS standard was designed with spatial processing in mind, it can also be used to readily insert non-spatial processing tasks into a web services environment.

The WPS standard provides a robust, interoperable, and versatile protocol for process execution on web services. It supports both immediate processing for computational tasks that take little time and asynchronous processing for more complex and time consuming tasks. Moreover, the WPS standard defines a general process model that is designed to provide an interoperable description of processing functions. It is intended to support process cataloging and discovery in a distributed environment.

ii. Keywords

The following are keywords to be used by search engines and document catalogues.

geoprocessing, ogcdoc, OGC document, processes, processing, WPS

iii. Preface

This standard is a continuation of WPS 1.0, a standard for web-based processing of geospatial data. It incorporates a range of change requests that have been submitted since the release of WPS 1.0 and further follows the OGC standard for modular specifications [OGC 08-131r3].

In contrast to the prior version, WPS 2.0 provides a core conceptual model that may be used to specify a WPS in different architectures such as REST or SOAP.

The WPS process model has been encapsulated into separate requirements and conformance classes, so it may be used independently from WPS servers in process catalogs and metadata records. The expressive power of process descriptions has been enhanced by permitting structured (or nested) inputs and outputs. The concept of process profiles has been clarified and extended to support process descriptions at different levels of abstraction.

Conversely, the process model itself has been largely decoupled from the WPS protocol, allowing the use of other domain-specific descriptions of processes, e.g. those defined in SensorML, and to execute them on a WPS server.

This specification also provides a Basic WPS conformance class that comprises the synchronous and asynchronous execution protocol, the WPS process model, and implements HTTP/POST+XML and HTTP/GET+KVP encodings.

Future work will target the definition of process interfaces for common processes based on the process model conformance class. Such profiles will encourage the development of well-defined, reliable, interoperable and exchangeable process implementations.

If OGC baseline and related specifications should further progress towards REST-oriented interfaces, the development of a REST-oriented WPS interface standard should be considered.

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iv. Submitting organizations

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v. Submitters

All questions regarding this submission should be directed to the editor or the submitters.

1. Scope

This document specifies the interface to a general purpose Web Processing Service (WPS). A WPS is a web service that enables the execution of computing processes and the retrieval of metadata describing their purpose and functionality. Typically, these processes combine raster, vector, and/or coverage data with well-defined algorithms to produce new raster, vector, and/or coverage information.

The WPS protocol supports both synchronous and asynchronous execution of processes. Synchronous execution may be used in simple and quick computation scenarios, where the data processing takes little to almost no time. Asynchronous processing is particularly well suited for complex computation scenarios which may take significant time.

The specification uses a core and extensions model to organize its features:

- 1) A core conceptual model, defining basic requirements for a web based processing service,
- 2) A process model to support the description and discovery of processes on the web,
- 3) A basic data model that supports arbitrary (standard or non-standard) data formats for inputs and outputs,
- 4) A WPS service model and encoding based on OGC baseline standards, and
- 5) A Dismiss extension to allow clients to terminate asynchronous processing jobs.

2. Conformance

Conformance with this standard shall be checked using all the relevant tests specified in Annex A (normative) of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the OGC Compliance Testing Policies and Procedures and the OGC Compliance Testing web site¹.

Table 1 – Conformance classes related to WPS 2.0

Conformance Class	Description	Clause
http://www.opengis.net/spec/WPS/2.0/conf/service/profile/basic-wps	Basic WPS service profile	A.1
http://www.opengis.net/spec/WPS/2.0/conf/service/synchronous-wps	Synchronous WPS	A.2
http://www.opengis.net/spec/WPS/2.0/conf/service/asynchronous-wps	Asynchronous WPS	A.3

¹ www.opengeospatial.org/cite

Conformance Class	Description	Clause
rvise/ asynchronous-wps		
http://www.opengis.net/spec/WPS/2.0/conf/pr rocess-model-encoding	WPS process model encoding	A.4
http://www.opengis.net/spec/WPS/2.0/conf/se rvise/ dismiss-extension	Dismiss extension	A.6

3. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of 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 06-121r9, OGC Web Service Common Specification, version 2.0

OGC 08-131r3 – The Specification Model – A Standard for Modular Specifications

IETF RFC 4646: Tags for Identifying Languages

IETF RFC 3986: Uniform Resource Identifier (URI): Generic Syntax

ISO 8601:2004, Data elements and interchange formats – Information interchange – Representation of dates and times

XML Schema Part 2: Datatypes Second Edition, W3C Recommendation 28 October 2004.

4. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r9], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this standard.

For the purposes of this document, the following additional terms and definitions apply.

4.1 Process

A **process** p is a function that for each input returns a corresponding output

$$p: X \rightarrow Y$$

where X denotes the domain of arguments x and Y denotes the co-domain of values y . Within this specification, process arguments are referred to as process inputs and result values are referred to as process outputs. Processes that have no process inputs represent value generators that deliver constant or random process outputs.

4.2 Process description

A process description is an information model that specifies the interface of a process. A process description is used for a machine-readable description of the process itself but also provides some basic information about the process inputs and outputs.

4.3 Process input

Process inputs are the arguments of a process and refer to data provided to a process. Each process input is an identifiable item.

4.4 Process output

Process outputs are the results of a process and refer to data returned by a process. Each process output is an identifiable item.

4.5 Process profile

A process profile is a description of a process on an interface level. Process profiles may have different levels of abstraction and cover several aspects. On a generic level, a process profile may only refer to the provided functionality of a process, i.e. by giving a verbal or formal definition how the outputs are derived from the inputs. On a concrete level a process profile may completely define inputs and outputs including data type definitions and formats.

4.6 WPS Server

A WPS Server is a web server that provides access to simple or complex computational processing services.

4.7 Process offering

A process offering is an identifiable process that may be executed on a particular service instance. A process offering contains a process description as well as service-specific information about the supported execution protocols (e.g. synchronous and asynchronous execution).

4.8 Process execution

The execution of a process is an action that calculates the outputs of a given process for a given set of data inputs.

4.9 Job

The (processing) job is a server-side object created by a processing service for a particular process execution. A job may be latent in the case of synchronous execution or explicit in the case of asynchronous execution. Since the client has only oblique access to a processing job, a Job ID is used to monitor and control a job.

4.10 Service profiles for WPS

A service profile for WPS is a conformance class that defines the general capabilities of a WPS server, by (1) specifying the supported service operations, (2) the process model, (3) the supported process execution modes, (4) the supported operation binding(s).

5. Conventions

This section provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

5.1 Abbreviated Terms

CRS	Coordinate Reference System
GML	Geography Markup Language
HTTP	Hypertext Transfer Protocol
ISO	International Organization for Standardization
KVP	Keyword Value Pair
MIME	Multipurpose Internet Mail Extensions
OGC	Open Geospatial Consortium
UML	Unified Modeling Language
URI	Universal Resource Identifier
URL	Uniform Resource Locator
WPS	Web Processing Service
XML	Extensible Markup Language

5.2 Use of the Term “Process”

The term process is one of the most used terms both in the information and geosciences domain. If not stated otherwise, this specification uses the term process as an umbrella term for any algorithm, calculation or model that either generates new data or transforms some input data into output data as defined in section 4.1.

5.3 UML Notation

Unified Modeling Language (UML) static structure diagrams appearing in this specification are used as described in section 5.2 of OGC06-121r9. Further, the following conventions hold:

- UML elements having a package name of “OWS Common” are those defined in the UML model of OWS Common [OGC 06-121r9].
- UML data type Any is used here as an equivalence to XML’s xsd:any.
- UML elements not qualified with a package name are those defined in this standard.

The UML model data dictionary is specified herein in a series of tables. The contents of the columns in these tables are described in section 5.5 of [OGC 06-121r9]. The contents of these data dictionary tables are normative, including any table footnotes.

5.4 Namespace Conventions

The following namespaces are used in this document. The prefix abbreviations used constitute conventions used here, but are not normative. The namespaces to which the prefixes refer are normative, however.

Prefix	Namespace URI	Description
ows	http://www.opengis.net/ows/2.0	OWS Common 2.0 XML Schema
xlink	http://www.w3.org/1999/xlink	Definitions for XLINK
xml	http://www.w3.org/XML/1998/namespace	XML (required for xml:lang)
xs	http://www.w3.org/2001/XMLSchema	XML Schema

6. WPS Conceptual Model

The WPS service model defines basic properties of any WPS server. A WPS server is a web service that provides access to pre-defined processes and provides job control operations to instantiate, control and monitor processing jobs (Figure 1).

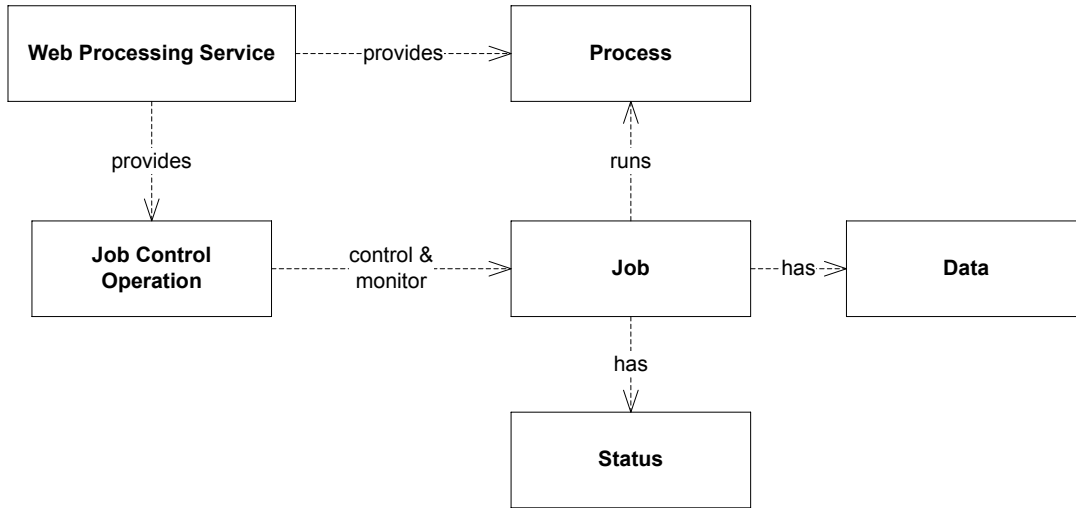


Figure 1 - Artifacts of the WPS service model

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model	
Target type	Derived information model, encoding, and software implementation
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/discovery <i>Requirements class for service discovery.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities <i>Requirements class for service capabilities.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-model <i>Requirements class for supported process models.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control <i>Requirements class for job control.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution <i>Requirements class for process execution.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission

	<i>Requirements class for data transmission between service and client.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring
	<i>Requirements class for job monitoring.</i>

6.1 Service Discovery

Any WPS server shall be self-contained, i.e. provide an initial endpoint that can be used by a WPS client to determine the server's capabilities.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/discovery	
Target type	Derived information model, encoding, and software implementation
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/discovery/endpoint
	<i>All WPS servers shall have an initial end-point (HTTP URI).</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/discovery/capabilities
	<i>The service shall provide a systematic discovery mechanism for all service capabilities.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/discovery/mechanism
	<i>The discovery mechanism for the service capabilities shall be predictable from the initial endpoint.</i>

6.2 Service Capabilities

The basic capabilities of any WPS server fall into two categories: The first category comprises capabilities for process discovery and retrieval of process descriptions. The second category comprises capabilities to manage and monitor processing jobs.

Since the processes provided by a WPS server may have different degrees of complexity, the server shall indicate the allowed job control capabilities mode per process offering.

Further service capabilities, i.e. for secure communication and user authentication may be provided with the service but are neither covered nor restricted by this specification as long as they do not alter or change the semantics of other job control capabilities.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities/process-offering

	<i>The service shall provide a process offering capabilities. This capability informs service clients about the available processes.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities/process-model-identification <i>All process offerings shall provide an identifier for their process model used.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities/job-control <i>The service shall provide job control and monitoring capabilities. These capabilities enable service clients to manage processing jobs via the service interface.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities/job-control-per-process-offering <i>The service shall indicate the allowed job control capabilities per process.</i>

6.3 Abstract Process Model

The abstract process model specifies generic requirements for process offerings that can be used in conjunction with WPS. Processes, as well as their inputs and outputs, are elements with identity. A process input may have arbitrarily defined value cardinality, i.e. for a given input, multiple datasets may be submitted for execution. A process output always has a value cardinality of one. Process inputs and outputs may also be nested. Identifiers for inputs and outputs shall be unique. For nested children it is sufficient to have a unique nesting path. Any input and output that does not have child elements shall have a defined data type so that a client is aware of the valid data formats for process execution.

The abstract process model provides many degrees of freedom for process descriptions. However, it does not enforce additional complexity for very simple processes.

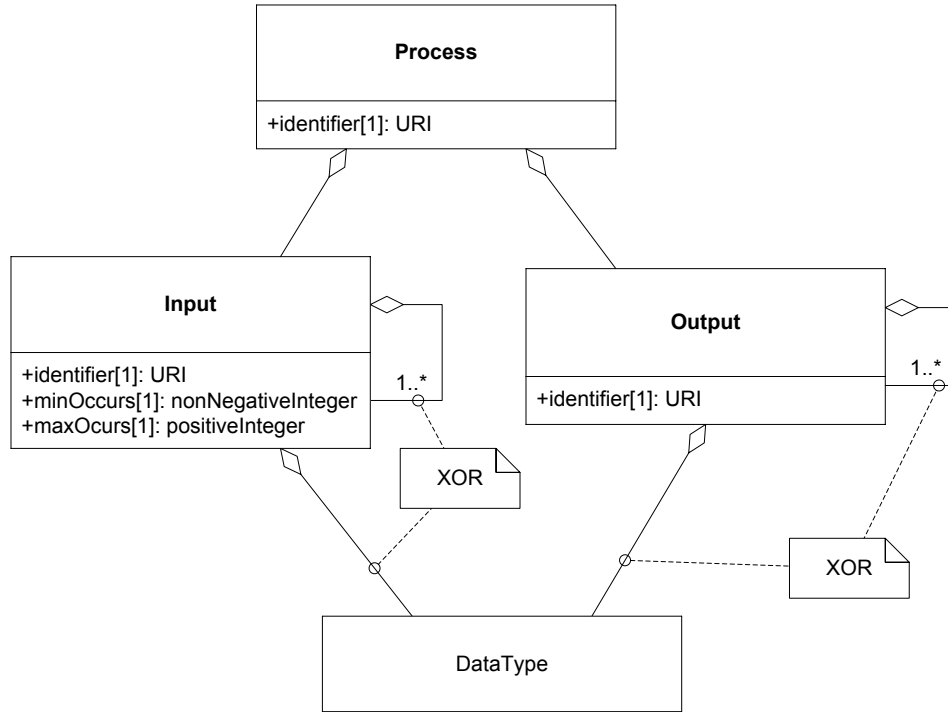


Figure 2 – Abstract process model UML class diagram

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process	
Target type	Derived information model, encoding, and software implementation
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/identifier <i>A process shall provide a unique identifier to distinguish the process from other processes.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/identifier-string <i>The unique identifier of a process shall be a character string or preferably a resolvable URI.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/input <i>A process may have an arbitrary number of inputs (zero or more).</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/input-identifier <i>Each input of a process shall have a unique identifier to distinguish the input from all other inputs.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/input-

	<p>identifier-string</p> <p><i>The unique identifier of an input shall be a character string.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/input-value-cardinality</p> <p><i>Each process input shall have a defined cardinality for values.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/nested-input</p> <p><i>Process inputs may be nested according to Figure 2.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/nested-input-identifier</p> <p><i>The identifier of a nested input shall be unique within its nesting node.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/output</p> <p><i>A process shall have one or more outputs.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/output-identifier</p> <p><i>Each output of a process shall have a unique identifier to distinguish the output from all other outputs of the process.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/output-identifier-string</p> <p><i>The unique identifier of an output shall be a character string.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/output-value-cardinality</p> <p><i>Each process output shall have a value cardinality of one.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/nested-output</p> <p><i>Process outputs may be nested according to Figure 2.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/nested-output-identifier</p> <p><i>The identifier of a nested output shall be unique within its nesting node.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/io-format</p> <p><i>All inputs and outputs that do not serve as nesting parents shall have a defined data format.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process/io-format-properties</p> <p><i>If inputs and outputs require encoding attributes, these shall be limited to</i></p>

	<i>the properties defined in Table 2.</i>
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Table 2 – Data encoding properties

Status	Definition
mimetype	Media type of the data.
encoding	Encoding procedure or character set used (e.g. raw, base64, or UTF-8).
schema	Identification of the data schema.

6.4 Job Control

The execution capability, that permits WPS clients to instantiate and run processing jobs, is the most prominent job control capability. Furthermore, the ability to dismiss or delete a job is useful for long-running processes in order to release server resources.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/capabilities
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job/identifier <i>The service shall assign a unique identifier to each job.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job/identifier-unavailable-exception <i>The Service shall return an exception, if the client has attempted to use an invalid job identifier.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control/execution <i>The service shall provide the ability to execute a process, i.e. to create a new job for a given process execution capability. This capability enables service clients to execute the process defined in capabilities.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control/dismiss <i>The service may provide the capability to dismiss a submitted job. This capability enables service clients to indicate that they are no longer interested in the job or its results and permit the server to free the associated resources as soon as possible.</i>

6.5 Process Execution

Process executions on a WPS server may be run either synchronously (Figure 3) or asynchronously (see Figure 4). Synchronous execution is a suitable approach for jobs that take a relatively short time² to complete. Asynchronous execution is preferable for jobs that may take a long time to complete.

In the synchronous case, a WPS client submits an execute request to the WPS server and keeps listening for a response until the processing job has completed and the processing result has been returned. This requires a persistent connection between client and server.

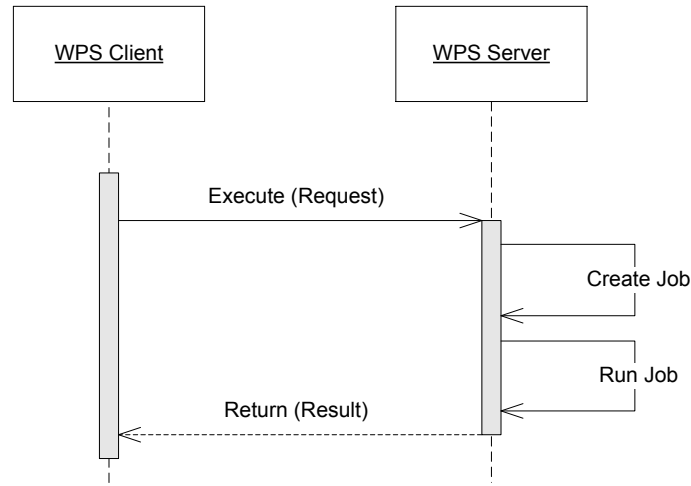


Figure 3 – Synchronous process execution UML sequence diagram

In the asynchronous case, the client sends an execute request to the WPS server and immediately receives a status information response. This information confirms that the request was received and accepted by the server and that a processing job has been created and will be run in the future. The status information response also contains a processing job identifier that is used by the client when checking to see if execution has completed. (The client may also manage the processing job using available steering capabilities.) In addition, the status information response contains the result location, i.e. the URL where the processing result can be found after the processing job has completed.

² Short and long are relative terms and requires considerations on both client and server side and the application context. This specification does not give any guidelines regarding what short or long means. There may also be an architectural consideration that suggests either synchronous or asynchronous communication.

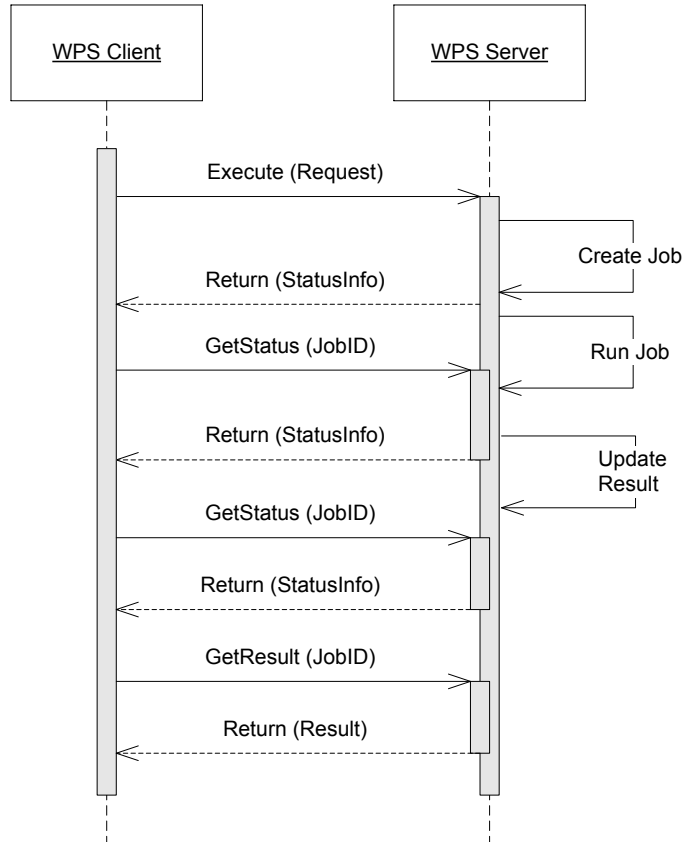


Figure 4 – Asynchronous process execution UML sequence diagram

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/select-process <i>The service shall permit a client to determine the process to be executed.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/process-unavailable-exception <i>The service shall return an exception if the client has attempted to execute an unavailable process.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/result <i>On successful execution, the service shall deliver a result to the client. This result will contain the output data or a reference to the data.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-

	<p>execution/result-expiry</p> <p><i>The execute result may have an expiration date. After that time the output data will be inaccessible for the client.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/failed-exception</p> <p><i>On failed execution, the service shall deliver an exception to the client.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/input-data</p> <p><i>The service shall permit a client to specify the input data to be used for a process execution.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/input-data-exception</p> <p><i>The service shall return an exception if the client has specified invalid input data for process execution.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/output-data-format</p> <p><i>The service shall permit a client to define the desired data exchange format for the results of the process execution, based on the advertised formats for the process offering.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/output-data-format-exception</p> <p><i>The service shall return an exception if the client has defined an unsupported data exchange format for the results.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/mode</p> <p><i>The service shall provide execution capabilities in synchronous, asynchronous or both modes.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/mode-per-process-offering</p> <p><i>The service shall indicate the allowed execution modes per process offering.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/mode-select</p> <p><i>In the case of multiple supported execution modes, the WPS server shall permit the client to specify the desired execution mode.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/mode-auto</p>

	<i>If the client does not specify the desired execution mode, the service shall automatically pick³ an appropriate⁴ mode out of the supported modes.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution/mode-unavailable-exception <i>The service shall return an exception if the client has specified an unsupported execution mode.</i>

6.6 Data Transmission by Value and by Reference

Data exchange between WPS clients and servers requires an agreement on the general data exchange patterns and suitable communication protocols. This specification defines two general data transmission modes for data exchange between WPS client and server.

Clients may send input data to or receive output data from a process in two distinct ways: (1) by reference, and (2) by value (see Figure 5). For brevity, this figure only shows the transmission patterns in the pure form, i.e. the same pattern is used for all inputs and outputs. However, mixed patterns are possible. Typically, small or atomic data such as integers, doubles or short strings are submitted by value. Large data inputs (outputs) are usually supplied by reference.

³ The duration of the execution may also depend on data size, network bandwidth, and available computing resources on the server side. In general, the client is not aware of these parameters, and may choose to defer the decision to the server.

⁴ Synchronous execution is generally preferred for very quick computations while asynchronous execution shall be chosen for long-running jobs. Foremost, the service shall respond quickly to the client to avoid connection timeouts.

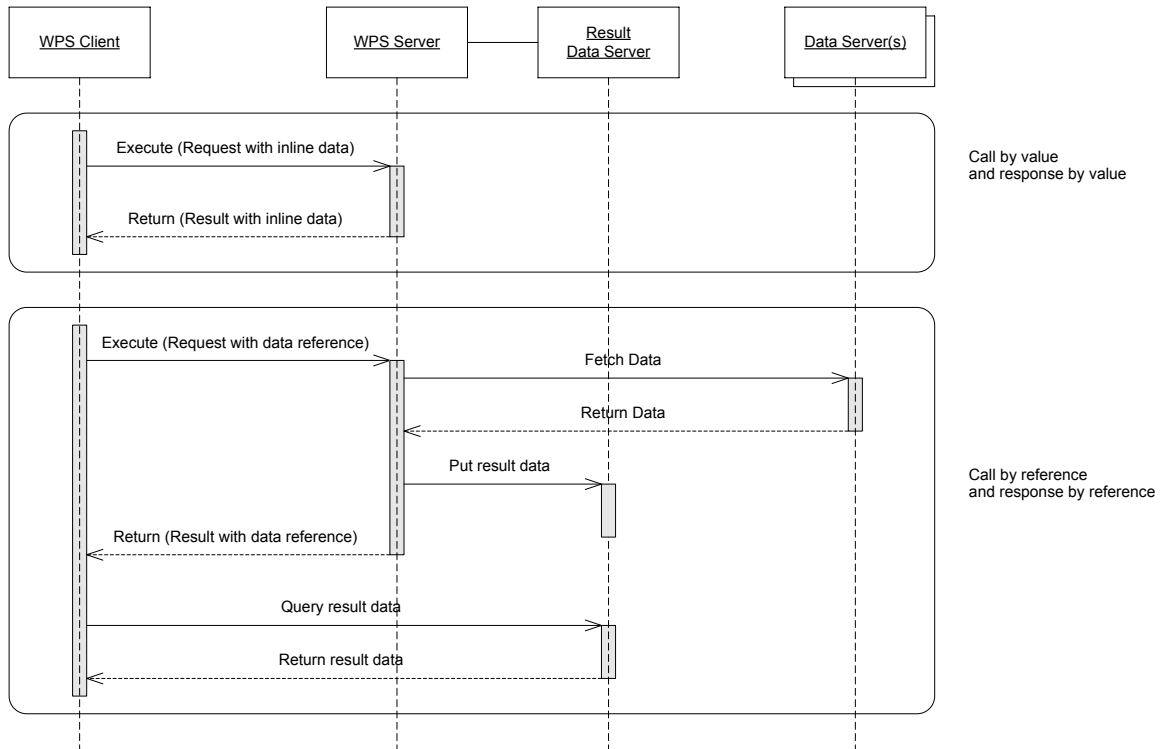


Figure 5 – Execute call and response "by value" and "by reference" UML sequence diagram

This specification makes no assumptions about the encoding of the transmitted data. Due to the variety of data formats and supplementary encoding procedures, the receiver may not be able to automatically detect the data format. The set of encoding attributes that may be used by the receiver to decode inline or directly referenced data is defined by the data format description (see Table 2).

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/input-by-value <i>The service shall accept input data by value.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/input-by-reference <i>The service shall accept input data by reference.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/input-by-reference-unavailable-exception <i>The service shall return an exception, if the given input data reference is</i>

	<i>inaccessible.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/output-mode <i>The service shall support output data delivery by value, and / or by reference.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/output-mode-per-process-offering <i>The supported output modes shall be specified per process offering.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/output-mode-select <i>In the case of multiple available data transmission modes (by value AND by reference), the Service shall allow a client to specify the desired data-transmission mode for each output.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/data-transmission/output-mode-unavailable-exception <i>The service shall return an exception if the client has specified an unsupported transmission mode.</i>

6.7 Job Monitoring

By definition, a processing job is a server-side object created by a processing service in response for a particular process execution. It is comprised of a process definition (i.e. one of the process offerings defined in the WPS server's capabilities), the input data provided or specified by the WPS client, and the outputs that are eventually delivered when the job has been completed.

Since the processing job is a server-side object, a WPS client has no means to inspect the status of a job on its own. Therefore, the server should provide a unique identifier for each job. For privacy, it is recommended to keep this identifier confidential between client and server.

For jobs running in asynchronous mode, the WPS server shall also provide monitoring information and it may also contain estimates on the completion time or additional elements related to status polling.

If a client finds a polling time in the status information, it shall respect it and behave accordingly. The service may rely on the client polling roughly around this time to obtain updated status information.

If a client finds an expiry date in the status information, it shall respect it and behave accordingly, i.e. ensure that the execution result is evaluated on time and the outputs are retrieved before the job is removed from the server. This requirement allows for robust WPS implementations and the timely re-allocation of server resources.

This section also defines a basic status set to communicate the status of a server-side job to the client. Extensions of this specification may introduce additional states for fine-grained monitoring or domain-specific purposes.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-control
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process-execution
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/status</p> <p><i>The Service shall provide access to machine-readable status information for asynchronously running jobs.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/status-set</p> <p><i>In general, the service shall use the terms of the basic status set (Table 3) describe the current status of a processing job.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/progress</p> <p><i>The Service may report the progress of a running job in percent.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/estimated-completion</p> <p><i>The Service may provide an estimate when the process results will be available.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/next-poll</p> <p><i>The Service may suggest a polling time for the next status check.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/job-monitoring/job-expiry</p> <p><i>The server may report an expiration time for a job. After this time, a job identifier will become invalid and existing results are removed from the server.</i></p>

Table 3 – Basic status set for jobs

Status	Definition
Succeeded	The job has finished with no errors.

Status	Definition
Failed	The job has finished with errors.
Accepted	The job is queued for execution. ^a
Running	The job is running. ^a
^a States are only defined for asynchronous execution.	

7. WPS Native Process Model

The WPS native process model is a realization of the abstract process model defined in section 6.3. The native process model breaks down into the following components:

1. A general structure for process interface descriptions (sections 7.1, 7.4) that support process discovery and cataloging
2. A set of data types to submit and receive data during process execution (sections 7.2, 7.3)
3. A framework for defining process profiles to improve interoperability between different process implementations (section 7.5).

The native process model is encapsulated in a separate conformance class (A.4) and can be used independently from the rest of the WPS specification. It is designed to provide an interoperable description of processing functions, regardless whether they are offered by a web service for remote invocation, or reside in a Desktop GIS for local use. By abstracting from a concrete implementation this process model may be used to create metadata records in process catalogs or help comparing and aligning the processing functions in different systems.

This section describes the information model of requirements. The corresponding XML and plain text encodings are specified in section 8.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/descriptiontype <i>Requirements class for the common description type.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format <i>Requirements class for IO format.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes <i>Requirements class for data types.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description <i>Requirements class for process description.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile <i>Requirements class for process profile.</i>

7.1 Common Description Type

Descriptive elements of processes, inputs and outputs are derived from the `BasicIdentificationType` provided by OWS Common (Figure 6). Other descriptive information shall be recorded in the Metadata element in the form of simple links with an appropriate role identifier.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	OWS Common 2.0 – BasicDescriptionType
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type/basic-identification</p> <p><i>Process descriptions as well as the associated process inputs and outputs shall be derived from the OWS Common BasicIdentificationType.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type/structure</p> <p><i>The DescriptionType shall comply with the structure defined in Figure 6 and Table 4.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type/metadata</p> <p><i>For linking documentation material or other metadata with the process itself, its inputs and its outputs, the metadata element from the BasicIdentificationType shall be used.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type/metadata-simple-xlink</p> <p><i>The metadata elements within process descriptions shall be simple links with a human-readable title (Table 5).</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type/metadata-documentation-role</p> <p><i>The metadata elements for documentation shall use the role identifier “http://www.opengis.net/spec/wps/2.0/def/process/description/documentation”.</i></p>

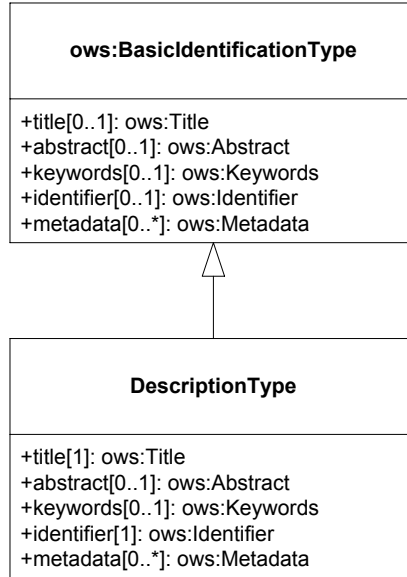


Figure 6 – DescriptionType for processes, process inputs and process outputs UML class diagram

Table 4 – Properties of the DescriptionType structure

Names	Definition	Data type and values	Multiplicity and use
Title	Title of the process, input, and output. Normally available for display to a human.	ows:Title	One (mandatory)
Abstract	Brief narrative description of a process, input, and output. Normally available for display to a human.	ows:Abstract	Zero or one (optional) Include when available and useful.
Keywords	Keywords that characterize a process, its inputs, and outputs.	ows:Keywords	Zero or more (optional) Include when available and useful.
Identifier	Unambiguous identifier of a process, input, and output.	ows:Identifier Value is a URI or HTTP-URI ^a	One (mandatory)
Metadata	Reference to additional metadata about this item.	ows:Metadata Allowed values are specified in Table 5.	Zero or more (optional)

^a Additional content such as separate code space and version attributes in the Identifier element are not allowed.

Table 5 – Properties of the Metadata structure

Names	Definition	Data type and values	Multiplicity and use
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Names	Definition	Data type and values	Multiplicity and use
Title	Title of the documentation. Normally available for display to a human.	Character String	One (mandatory)
Link type	Type of the xlink, fixed to simple.	Character String, fixed to “simple”.	One (mandatory)
Role	Role identifier, indicating the role of the linked document.	HTTP-URI	One (mandatory)
href	Reference to a documentation site for a process, input, or output.	HTTP-URI	One (mandatory)

7.2 Data Description Structure

The DataDescription structure contains basic properties for defining data inputs and outputs, including mimetype, encoding and schema. These properties specify supported formats for input and output data of computing processes. Any input or output item may support multiple formats, one of which is the default format. Processes may require that an input or output data set does not exceed a certain data volume.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format	
Target type	Derived information model, encoding, and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format/structure <i>Format descriptions of process inputs and outputs shall comply with the DataDescription structure defined in Figure 7 and Table 6.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format/default <i>One of the formats defined in the DataDescription structure shall be the default format, i.e. have the attribute “default” set to “true”.</i>

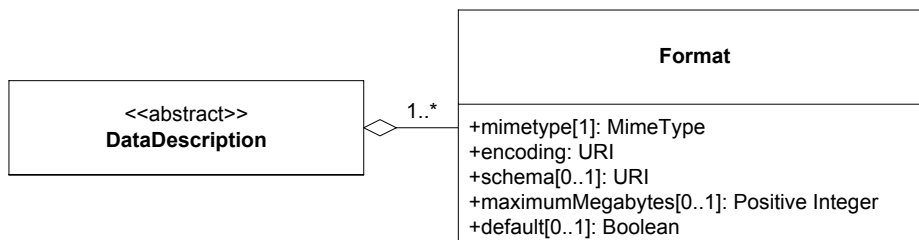


Figure 7 – DataDescription and supported formats UML class diagram

Table 6 – Format properties

Names	Definition	Data type and values	Multiplicity and use
mimetype	Media type of the data.	Character String	One (mandatory)
encoding	Encoding procedure or character set of the data (e.g. raw or base64)	Character String, fixed to “simple”.	One (mandatory)
schema	Identification of the data schema.	HTTP-URI	One (mandatory)
maximumMegabytes	The maximum size of the input data, in megabytes.	Integer	Zero or one (optional)
default	Indicates that this format is the default format. ^a	Boolean	Zero or one (conditional) ^{a,b}
^a Defaults to FALSE if omitted. ^b One of the formats included in the DataDescription structure shall have the attribute “default” set to “true”.			

7.3 Data Types

This specification defines three common data types for process input and output data (Figure 8):

- a) **ComplexData**, such as GML or geo-referenced imagery. This type is kept generic regarding the content and may be extended to provide more detailed domain-specific information.
- b) **LiteralData**, defined as a value with an optional unit.
- c) **BoundingBoxData**, defined as a minimum bounding rectangle in geographic coordinates.

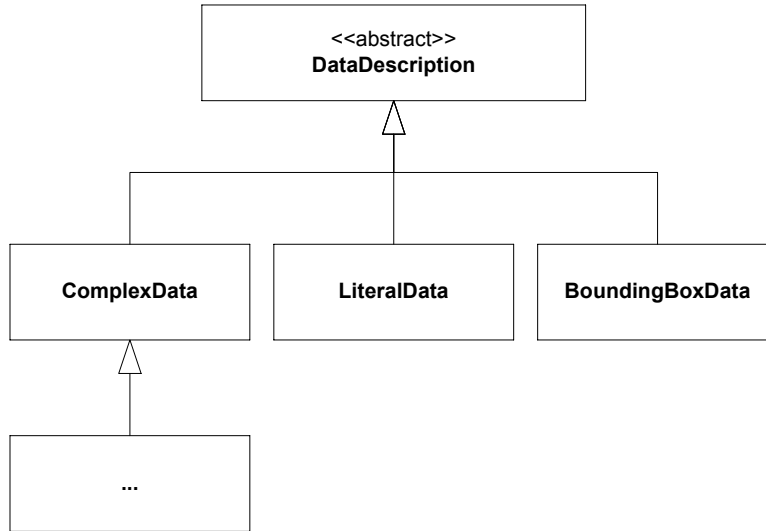


Figure 8 – I/O data types overview

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data <i>Requirements class for the complex data.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data <i>Requirements class for the literal data.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data <i>Requirements class for the bounding box data.</i>

7.3.1 Complex Data

The ComplexData type does not describe the particular structure for value encoding. Instead, the passed values must comply with the given format and the extended information, if provided.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data	

Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/description</p> <p><i>Requirements class for the complex data description.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/values</p> <p><i>Requirements class for the complex data values.</i></p>

7.3.1.1 ComplexData Description

The ComplexData structure is a direct realization of the abstract DataDescription element (Figure 7). It relies on the encoding attributes defined in Table 6 for a basic description of input and output data. In cases where these attributes do not sufficiently capture the structure and content of the required or produced data, the ComplexData element provides the ability to include any other descriptive elements next to the format specification. This hook may be used by process providers and consumers to communicate essential information and further constraints for input and output data items.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/description	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/description/structure</p> <p><i>The description of valid complex data input and output shall comply with the structure defined in Table 7.</i></p>

Table 7 – ComplexData description properties

Names	Definition	Data type and values	Multiplicity and use
Format	Identifies a valid format for an input or output.	Format properties, see Table 6.	One or more (mandatory)
Any	Placeholder for schema extensions to WPS complex data.	Any type.	Zero or more (optional)

7.3.1.2 ComplexData Values

A Complex data value is directly passed to (or returned by) a process. The generic nature of Complex data does not permit a particular structure for value encoding. Instead, this structure is defined by the ComplexData description and the passed values must comply with the given format and the extended information, if provided.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/value	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/description
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data/value/encoding <i>Complex data values must comply with the encoding specified in the complex data description.</i>

7.3.2 Literal Data

The LiteralData type encodes atomic data such as scalars, linear units, or well-known names. Domains for LiteralData are a combination of data types (e.g. Double, Integer, String), a given value range, and an associated unit (e.g. meters, degrees Celsius).

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/description <i>Requirements class for the literal data description.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/values <i>Requirements class for the literal data values.</i>

7.3.2.1 LiteralData Description

The LiteralData description structure inherits essential elements from ows:DomainType allowing it to specify value domains including Units of Measure and Default Values. It restricts ows:DomainType by forbidding:

1. “NoValues” for a particular domain

2. the ability to specify further metadata on the values (since this information is already present at the level of input and output definitions in the DescriptionType element).

LiteralData data types should use the well-known types from XML Schema by their URI definition⁵. Table 11 lists the recommended URIs for the most common literal data types.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/description	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/description/structure</p> <p><i>The description of valid literal data input and output shall comply with the structure defined in Figure 9, Table 8, Table 9, Table 10, and Table 11.</i></p>

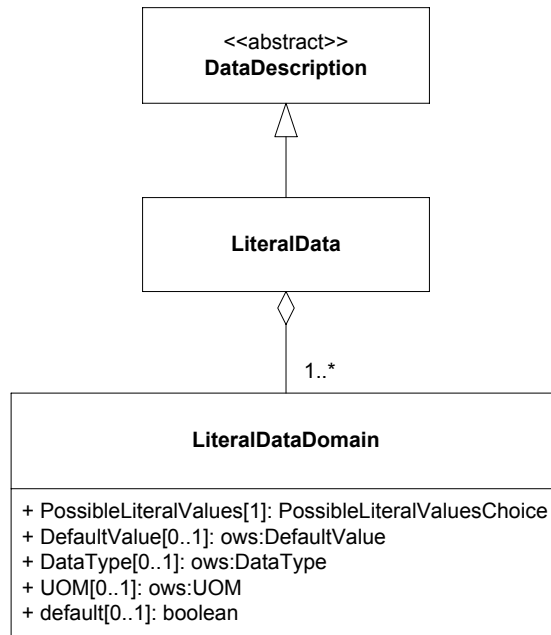


Figure 9 – LiteralData UML class diagram

⁵ see <http://www.w3.org/TR/xmlschema-2/#built-in-datatypes>

Table 8 – The LiteralData structure

Names	Definition	Data type and values	Multiplicity and use
Format	Identifies a valid format for an input or output.	Format properties, see Table 6.	One or more (mandatory)
LiteralDataDomain	The valid domain for literal data	LiteralDataDomain type	One or more (mandatory)

Table 9 – Parts of the LiteralDataDomain structure

Names	Definition	Data type and values	Multiplicity and use
PossibleLiteralValues	Identifies a valid format for an input or output.	PossibleLiteralValues Choice, see Table 10.	One (mandatory)
Data Type	Reference to the data type of this set of values	ows:DataType. The use of well-known data type URNs is highly recommended; see Table 11.	One (mandatory)
UOM	Indicates that this quantity has units and provides the unit of measurement.	ows:ValuesUnit	Zero or one (optional) Include when values have units or reference system.
DefaultValue	Default value for this quantity.	ows:DefaultValue	Zero or one (optional) Include if there is a default. ^a
default	Indicates that this is the default/native domain.	Boolean, defaults to false.	Zero or one (conditional) ^{b,c}
^a For outputs, the DefaultValue has no meaning and shall thus be omitted. ^b Defaults to FALSE if omitted. ^c One of the formats included in the LiteralData structure shall have the attribute “default” set to “true”.			

Table 10 – Parts of the PossibleLiteralValuesChoice structure

Names	Definition	Data type and values	Multiplicity and use
AllowedValues	List of all valid values and/or ranges of values for this quantity.	ows:AllowedValues	Zero or one (conditional) ^a
AnyValue	Specifies that any value is allowed for this quantity.	ows:AnyValue	Zero or one (conditional) ^a
ValuesReference	Reference to list of all valid values and/or ranges of values for this quantity.	ows:ValuesReference	Zero or one (conditional) ^a
^a One and only one of these three items shall be included.			

Table 11 – Recommended data type URIs for literal data

Data Type	URI
String	http://www.w3.org/2001/XMLSchema#string
Integer	http://www.w3.org/2001/XMLSchema#integer
Decimal	http://www.w3.org/2001/XMLSchema#decimal
Boolean	http://www.w3.org/2001/XMLSchema#boolean
Double	http://www.w3.org/2001/XMLSchema#double
Float	http://www.w3.org/2001/XMLSchema#float

7.3.2.2 LiteralData Values

LiteralData values represent values that correspond to a particular domain defined in the LiteralData structure. Figure 10 shows the mapping from the LiteralValue structure to the corresponding elements in the LiteralDataDescriptionType.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/value	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/description
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data/value/structure <i>The description of valid literal data values shall comply with the structure defined in Figure 10 and Table 12.</i>

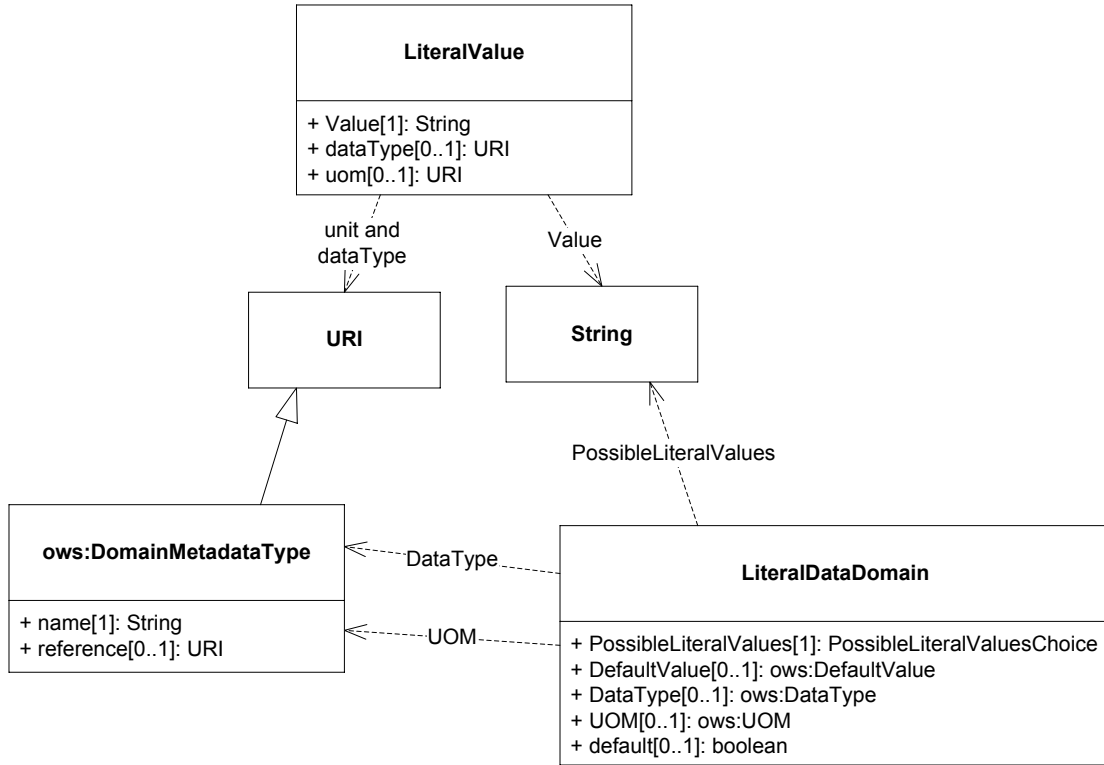


Figure 10 – LiteralValue UML class diagram

Table 12 – Parts of the LiteralValue structure

Names	Definition	Data type and values	Multiplicity and use
Value	String representation of the actual value.	Character String	One (mandatory)
dataType	The data type of the Value.	URI	Zero or one (optional) ^a
uom	The unit of measurement of the value.	URI	Zero or one (optional) ^a

^a If not specified, the relevant defaults from the LiteralData description (see section 7.3.2.1) will be used.

7.3.3 BoundingBox Data

Bounding box data serves a variety of purposes in spatial data processing. Some simple applications are the definition of extents for a clipping operation or the definition of an analysis region. This specification inherits the bounding box specification from OWS Common.

Requirements Class
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data

Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/description</p> <p><i>Requirements class for the bounding box data description.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/values</p> <p><i>Requirements class for the bounding box data values.</i></p>

7.3.3.1 BoundingBox Description

The domain for bounding box data is described by a listing of supported CRSs.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/description	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/io-format
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/description/structure</p> <p><i>The description of valid bounding box data input and output shall comply with the structure defined in Figure 11, Table 13, and Table 14.</i></p>

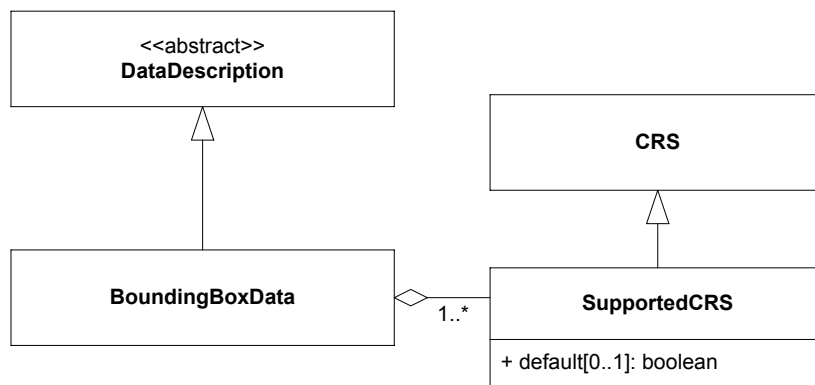


Figure 11 – BoundingBoxData UML class diagram

Table 13 – The BoundingBox structure

Names	Definition	Data type and values	Multiplicity and use
Format	Identifies a valid format for an input or output.	Format properties, see Table 6.	One or more (mandatory)
SupportedCRS	The supported CRS for BoundingBox data.	SupportedCRS type, see Table 14.	One or more (mandatory)

Table 14 – The SupportedCRS type structure

Names	Definition	Data type and values	Multiplicity and use
CRS	Reference to a CRS definition.	URI	One or more (mandatory)
default	Indicates that this CRS is the default CRS.	Boolean, defaults to false.	Zero or one (conditional) ^{a,b}
^a Defaults to FALSE if omitted. ^b One of the formats included in the BoundingBox structure shall have the attribute “default” set to “true”.			

7.3.3.2 BoundingBox Values

Values for bounding boxes are specified in the BoundingBox data type from OWS Common [OGC 06-121r9]. For consistency with the BoundingBoxData description, the specification of a CRS is mandatory.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/values	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/description
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/values/structure <i>The description of bounding box data values shall comply with the structure defined in OWS Common [OGC 06-121r9].</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data/values/crs <i>The CRS component of the Bounding box values structure shall not be empty.</i>

7.4 Process Description

This section defines information structures that describe a process. It includes elements that link to documentation resources on the behavior and mechanics of a process as well as descriptive elements about its inputs and outputs. The process description model realizes and extends the requirements defined in the abstract process model in section 6.3.

A process description is an extension of the DescriptionType (Figure 12). It shall be used to express identifier, title, and abstract and to link to associated metadata elements that provide additional or more detailed information about the process. An additional language attribute shall be used to indicate the language of human readable elements in the description of the process and its inputs and outputs.

The description structures for process inputs and outputs inherit common elements from the DescriptionType (section 7.1). These elements shall be used to express identifier, title, and abstract and to link to associated metadata elements that provide additional or more detailed information about the process inputs and outputs. The content of human readable elements in the description of inputs and outputs shall adhere to the language indicated in the process description.

Process inputs are arguments to a process. Process inputs have a cardinality in order to (1) pass multiple values with the same identifier to a process, or (2) declare process inputs as optional (cardinality "0"). Input elements may be simple (i.e. the input has no sub-inputs attached) or aggregate (i.e. the input has one or more sub-input elements attached). A simple input includes a realization of the DataDescription element. An aggregate input contains one or more sub-inputs.

Outputs are the return values of a process. Outputs have a cardinality of one. Output elements may be simple (i.e. the output has no sub-outputs attached) or aggregate (i.e. the output has one or more sub-output elements attached). A simple output includes a realization of the DataDescription element. An aggregate output contains one or more sub-outputs.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type
Dependency	<i>IETF RFC 4646</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description/model-compliance</p> <p><i>The process description shall be in compliance with the WPS process model requirements.</i></p>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description/structure

	<i>A process description shall comply with the structure defined in Figure 12 and Table 15.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description/language <i>The language of the human-readable elements within the process description shall be identified by a language identifier as specified in IETF RFC 4646.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description/io-description-type <i>The description of process inputs and outputs shall comply with the structure defined in Figure 12, Table 16, and Table 17.</i>

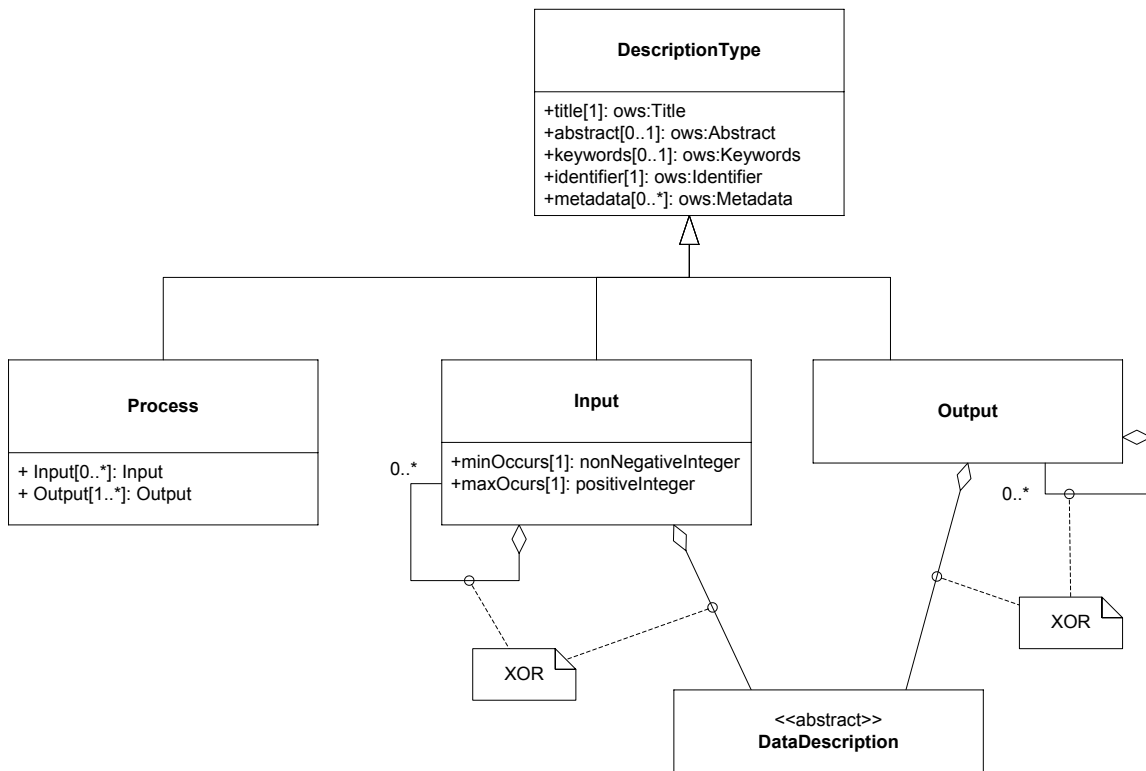


Figure 12 – Process UML class diagram

Table 15 – The Process structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			

Names	Definition	Data type and values	Multiplicity and use
Identifier			
Metadata			
Language	Language identifier for the human readable process description elements.	Character String. This language identifier shall be as specified in IETF RFC 4646.	One (mandatory)
Input	Input items (arguments) of a process.	Input structure, see Table 16.	Zero or more (optional)
Output	Output items (results) of a process	Output structure, see Table 17.	One or more (mandatory)

Table 16 – Parts of the Input structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			
Keywords			
Identifier			
Metadata			
minOccurs ^a	Minimum number of times that values for this parameter are required	Non-negative integer; defaults to “1”, ‘0’ means the input is optional.	Zero or one (optional)
maxOccurs ^a	Maximum number of times that this parameter may be present	Non-negative integer, defaults to “1”.	Zero or one (optional)
DataDescription	Data type and domain of this input.	A realization of DataDescription, i.e. ComplexData, LiteralData, BoundingBoxData.	Zero or one (conditional) ^b
Input	Nested Input. ^c	Input structure, Table 16 (this table).	Zero or more (conditional) ^b
^a The minOccurs and maxOccurs parameters have identical semantics to the like-named XML Schema occurrence constraints. ^b The input shall either include one realization of DataDescription or an arbitrary number of sub-Inputs. ^c It is recommended to keep the nesting level as low as possible.			

Table 17 – Parts of the Output structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			
Keywords			
Identifier			

Names	Definition	Data type and values	Multiplicity and use
Metadata			
DataDescription	Data type and domain of this input.	A realization of DataDescription, i.e. ComplexData, LiteralData, BoundingBoxData.	Zero or one (conditional) ^a
Output	Nested Output. ^b	Output structure, Table 17 (this table).	Zero or more (conditional) ^a
^a The output shall either include either one realization of DataDescription or an arbitrary number of sub-Outputs.			
^b It is recommended to keep the nesting level as low as possible.			

7.5 Process Profiles

Process profiles are blueprints for process implementations and are meant to harmonize process implementations to a certain degree. They serve as a reference for process implementations by providing a description of what the process actually does. While this specification does not attempt to enforce or suggest any particular process profiles, it provides a mechanism to define common processing functionality within the scope of WPS, thus supporting basic process cataloguing and retrieval tasks for distributed processing infrastructures. Depending on the degree of harmonization, the definitions of process profiles may be used to foster a common understanding of widely used processing functions. However, they may also be used to harmonize the technical details of process interfaces and thus document particular interoperability arrangements between process providers and consumers.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/concept <i>Requirements class for process concepts.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic <i>Requirements class for generic process profiles.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/implementation <i>Requirements class for process implementation profiles.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance <i>Requirements class for process profile inheritance.</i>

7.5.1 Process Concept

A process concept is an object that provides high-level documentation about a general group of processes. It describes the purpose, methodology and properties of a process but not the specific input and output parameters. It is rather a documentation resource that may be referenced by refined process definitions to document their relation to a common principle.

Example: The concept “Buffer” may be used to describe all Buffer operations. More specific Buffer processes may be defined on raster or vector data models, be performed on a geoid or in CRS units, have further inputs, such as distance or tolerance and may even perform additional computations such as dissolve or line cap styling.

Due to the heterogeneity of process definitions and the variety of documentation requirements, there is no general information model for process concepts. Most of the time, concepts will be documented in HTML or similar multimedia formats. Formally, a concept consists of a unique identifier and a descriptive document.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/concept	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/concept/identifier</p> <p><i>Process concepts are documentation resources with identity. They shall have an identifier that may be referenced by more detailed process definitions.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/concept/content</p> <p><i>The content of a process concept resource shall eventually lead to the definition of computing processes.</i></p>

7.5.2 Generic Process Profile

A generic profile is the abstract interface of a process. It provides a detailed description of the process mechanics and declares a signature for process inputs and outputs. The generic profile consists of a unique identifier and a generalized process description. This is similar to a process description as defined in clause 7.4 but does not provide a definition of supported data exchange formats.

Example: A generic profile for a Buffer operation may be derived from the Buffer definition in the ISO standard for simple feature access [ISO 19125-1:2006]. The buffer method on simple features “Returns a geometric object that represents all points whose distance from this geometric object is less than or equal to distance. Calculations are in the spatial reference system of this geometric object” (ISO 19125-1:2006, subclause 6.1.2.4). This definition is specific about the conceptual data model details the behavior

of the buffer method and the treatment of CRS units. In addition, it defines the name and data type of the distance parameter.

This generic definition of a Simple features buffer process may be inherited by multiple implementations that use arbitrary encodings for input and output data. The important part here is the well-defined behavior of the process at a generic level and the standardization of parameter names.⁶

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model/process
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description-type
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description
Dependency	<i>IETF RFC 4646</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic/structure</p> <p><i>A process description shall comply with the structure defined in Figure 13 and Table 18.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic/description-language</p> <p><i>The language of the human-readable elements within the process description shall be identified by a language identifier as specified in IETF RFC 4646.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic/io-description-type</p> <p><i>The description of process inputs and outputs shall comply with the structure defined in Figure 13, Table 19, and Table 20.</i></p>

⁶ NOTE: In terms of names, the Buffer definition in [ISO 19125-1:2006] only covers the distance parameter since it assumes a Geometry object providing that method. A complete generic profile would also have to define names for input and output geometries.

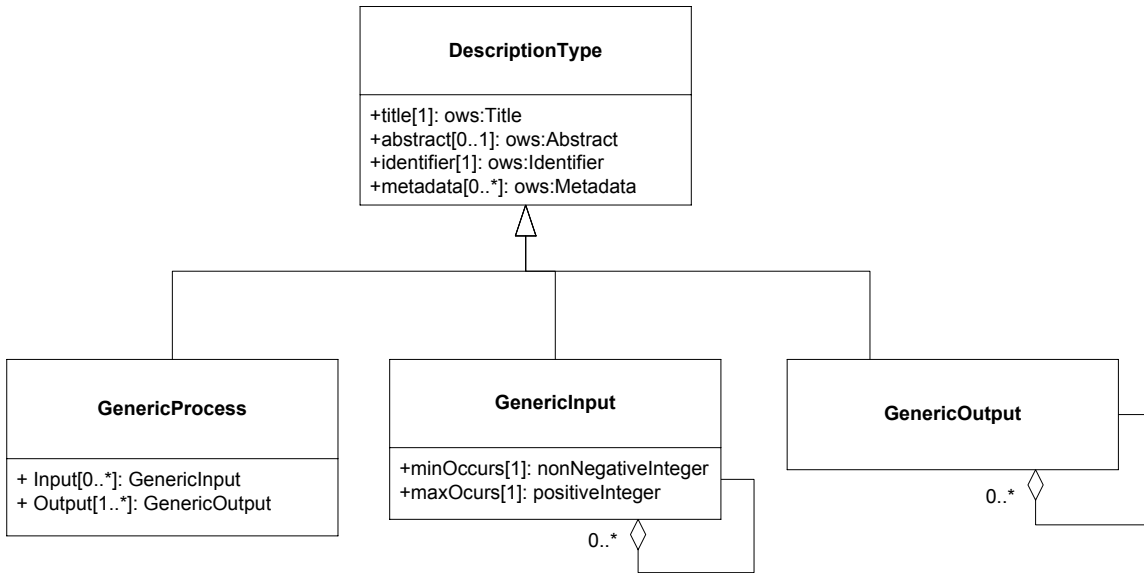


Figure 13 – GenericProcess UML class diagram

Table 18 – The GenericProcess structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			
Keywords			
Identifier			
Metadata			
Language	Language identifier for the human readable process description elements.	Character String. This language identifier shall be as specified in IETF RFC 4646.	One (mandatory)
Input	Input items (arguments) of a process.	GenericInput structure, see Table 167.	Zero or more (optional)
Output	Output items (results) of a process	GenericOutput structure, see Table 178.	One or more (mandatory)

Table 19 – Parts of the GenericInput structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			
Keywords			

Names	Definition	Data type and values	Multiplicity and use
Identifier			
Metadata			
minOccurs ^a	Minimum number of times that values for this parameter are required	Non-negative integer; defaults to “1”, ‘0’ means the input is optional.	Zero or one (optional)
maxOccurs ^a	Maximum number of times that this parameter may be present	Non-negative integer, defaults to “1”.	Zero or one (optional)
Input	Nested Input. ^b	GenericInput structure, Table 19(this table).	Zero or more (optional)
^a The minOccurs and maxOccurs parameters have identical semantics to the like-named XML Schema occurrence constraints. ^b It is recommended to keep the nesting level as low as possible.			

Table 20 – Parts of the GenericOutput structure

Names	Definition	Data type and values	Multiplicity and use
Title	Inherited from Table 4		
Abstract			
Keywords			
Identifier			
Metadata			
Output	Nested Output. ^a	GenericOutput structure, Table 20(this table).	Zero or more (conditional) ^a
^a It is recommended to keep the nesting level as low as possible.			

7.5.3 Process Implementation Profile

Implementation profiles cover all descriptive elements of a process down to the supported data exchange formats. Technically they are process descriptions, but with the scope of a process profile, i.e., a harmonized and well-defined computing process that may be implemented by multiple service providers.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/implementation	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/process-description
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/implementation/structure <i>A process implementation profile description shall comply with the process description structure defined in</i>

	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/process-description .
--	---

7.5.4 Profile Inheritance

The hierarchical structure allows for inheritance between different types of profiles (see Figure 14). The definition and use of generic profiles for commonly used processing functions is generally recommended. However, there might be use cases for a product-specific harmonization of process interfaces. In this case, an implementation profile may be directly derived from a concept or defined in isolation.

If a profile in the hierarchy is derived from another profile at an equal or higher level, it must respect the inheritance rules given in Table 21. These rules ensure consistency in the use of identifiers, the specification of inputs and outputs as well as compliance to the behavior of the declared parent profiles.

Processes and process profiles may use metadata links to indicate compliance to a particular process profile. Links to particular profiles shall be embedded in the process' metadata elements. The reserved role identifiers for the different profile levels are listed in Table 22.

An example which illustrates the inheritance rules for process profiles is given in annex B.10.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/concept
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance/hierarchy</p> <p><i>Process profiles may inherit properties from profiles specified at a higher or equal level. The hierarchy is defined in Figure 14.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance/rules</p> <p><i>Inheriting process profiles and processes shall obey to the inheritance rules defined in Table 21.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance/link</p>

	<i>Links to particular profiles are expressed in the DescriptionType's metadata element as specified in Table 5.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance/link-target
	<i>The links target for profile metadata is the URL of the process profile.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/inheritance/link-role-identifier
	<i>The link roles defined in Table 22 shall be used to express the hierarchical level of the linked profile.</i>

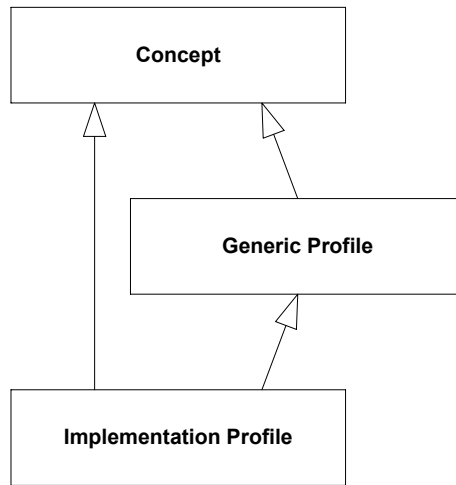


Figure 14 – Inheritance hierarchy for process profiles UML class diagram

Table 21 – Inheritance and override rules for process profiles

Property	Generic Profile	Implementation Profile	Implementation (instance level)
Process			
Identifier	D	O	O
Title	D	O	O
Keywords	D	E	E
Abstract	D	O	O
Metadata	D	E/O ^a	E/O ^a
Input			E ^b
Identifier	D	I	I
Title	D	I	I
Keywords	D	E	E

Property	Generic Profile	Implementation Profile	Implementation (instance level)
Abstract	D	I	I
Metadata	D	E/O ^a	E/O ^a
Multiplicity	D	R ^c	E ^d
Data format		D	E ^d
Output			E ^b
Identifier	D	I	I
Title	D	I	I
Keywords	D	E	E
Abstract	D	I	I
Metadata	D	O	O
Data format		D	E ^d

D – Declare (Introduction of a new property)
 I – Inherit (A property is inherited from a superior level AND its value remains unchanged.)
 O –Override (A property is inherited from a superior level AND its value is overridden.)
 E –Extend (A property is inherited from a superior level AND its value is extended.)
 R –Restrict (A property is inherited from a superior level AND its value is restricted.)
^a – The list of metadata references to superior process profiles shall be extended. Documentation metadata may be overridden, i.e. replaced by other documentation resources.
^b – Additional optional inputs or supplementary outputs may be added here.
^c – Implementation profiles may restrict the maximum cardinality of a superior generic profile (e.g. for theoretically infinite inputs). They shall not modify the minimum cardinality.
^d – Implementations may allow more or larger input datasets than the implementation profile, or support additional data exchange formats.

Table 22 – Role identifiers for process profiles

Profile level	URI
Process concept	http://www.opengis.net/spec/wps/2.0/def/process-profile/concept
Generic process profile	http://www.opengis.net/spec/wps/2.0/def/process-profile/generic
Process Implementation profile	http://www.opengis.net/spec/wps/2.0/def/process-profile/implementation

8. WPS Native Process Model Encoding

8.1 XML Schema Implementation

This section specifies the XML encoding of the elements of the WPS native process model. The referred XML schema elements are provided by the associated schema package delivered with this standard and located at <http://schemas.opengis.net/wps/2.0.0/>.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/datatypes <i>Requirements class for data type XML encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/process <i>Requirements class for process description XML encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/generic-process <i>Requirements class for generic profile XML encoding.</i>

8.1.1 Data Types

The XML encoding of data types defines encoding rules for ComplexData, LiteralData, BoundingBoxData as well as their values.

Examples for data type encodings are listed in Annex B.1.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/datatypes	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/datatypes/schema <i>The XML encoding of ComplexData, LiteralData, BoundingBoxData and</i>

	<i>their values shall comply with the XML schema provided by dataTypes.xsd.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/datatypes/mimetype <i>The mime type for XML encoded literal and bounding box data values shall be “text/xml”.</i>

8.1.2 Process Description

This clause specifies the XML encoding for the Process description.

A Process example is listed in Annex B.2.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/process	
Target type	Derived software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/process/schema <i>An XML encoded Process description shall be a valid XML document of the type wps:Process.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/process/content <i>The content of the XML encoded Process description shall comply with the content of the information elements defined by the requirements class http://www.opengis.net/spec/WPS/2.0/req/native-process/model/description.</i>

8.1.3 Generic Process

This clause specifies the XML encoding for the GenericProcess.

A GenericProcess example is listed in Annex B.3.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/profile/generic-process	
Target type	Derived software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/profile/generic
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/profile/generic/schema

	<i>An XML encoded description of a Generic Process shall be a valid XML document of the type <code>wps:GenericProcess</code>.</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/xml-encoding/profile/generic/content</p> <p><i>The content of the XML encoded description of a Generic Process shall comply with the content of the information elements defined by the requirements class http://www.opengis.net/spec/WPS/2.0/req/native-process/model/profile/generic.</i></p>

8.2 Plain Text Encoding for LiteralData and BoundingBoxData Values

This clause specifies the plain text encoding of data types for literal and bounding box data values.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/native-process/plain-text-encoding/datatypes	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/complex-data
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/literal-data
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model/datatypes/bounding-box-data
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/plain-text-encoding/datatypes/schema</p> <p><i>The plain text encoding of literal and bounding box values comply with the BNF schema below.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/native-process/plain-text-encoding/datatypes/mimetype</p> <p><i>The mime type for plain text encoded literal and bounding box values shall be "text/plain".</i></p>

Literal values – BNF schema:

```
literalvalue = value *1("@datatype=" datatype) *1("@uom=" uom)
value       = 1*VCHAR
datatype    = URI
uom         = URI
```

Literal values – Example:

```
70@datatype=http://www.w3.org/2001/XMLSchema#integer@uom=meter
```


BoundingBox values – BNF schema⁷:

```
bbox          = lc_coords "," uc_coords ["," crs] ["," dimensions]
lc_coords     = number ["," number]
uc_coords     = number ["," number]
number        = 1*DIGIT["." 1*DIGIT]
crs           = 1*VCHAR
dimensions    = 1*DIGIT
```

BoundingBoxData values – Examples:

51.9,7.0,53.0,8.0,EPSG:4326

51.9,7.0,53.0,8.0,<http://www.opengis.net/def/crs/EPSSG/0/4258>

⁷ The dimensions attribute is included for compliance with the BoundingBox structure defined in OWS Common [OGC 06-121r9]. However, its use should be generally avoided since the number of dimensions is already part of the CRS definition and usually superfluous.

9. Common WPS Service Model

A Web Processing Service consists of processes and service operations. By definition, processes represent the computational functionality of a WPS, while service operations are used to interact with the WPS and in particular to use the service's process offerings.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/data-transmission <i>Requirements class for data transmission.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling <i>Requirements class for WPS service handling.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/process-offering-properties <i>Requirements class for common process offering properties.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info <i>Requirements class for the status information document.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/result <i>Requirements class for the processing result document.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities <i>Requirements class for the GetCapabilities operation.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process <i>Requirements class for the DescribeProcess operation.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute <i>Requirements class for the Execute operation.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status <i>Requirements class for the GetStatus operation.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result <i>Requirements class for the GetResult operation.</i>

9.1 Overview of WPS Core Operations

The WPS interface specified in this section supports retrieval and execution of processes for geospatial computation. For that purpose, the WPS service model specifies the following operations that may be invoked by a WPS client and performed by a WPS server⁸:

GetCapabilities – This operation allows a client to request information about the server’s capabilities and processes offered (see subclause 9.7).

DescribeProcess – This operation allows a client to request detailed metadata on selected processes offered by a server (see subclause 9.8).

Execute – This operation allows a client to execute a process comprised of a process identifier, the desired data inputs and the desired output formats (see subclause 9.9).

GetStatus – This operation allows a client to query status information of a processing job (conditional, see subclause 9.10).

GetResult – This operation allows a client to query the results of a processing job (conditional, see subclause 9.11).

During a sequence of WPS requests, a client should first issue a GetCapabilities request to the server to obtain an up-to date listing of available processes. Then, it may issue a DescribeProcess request to find out more details about particular processes offered, including the supported data formats. To run a process with the desired input data, a client will issue an Execute request⁹ (Figure 15).

The operations GetStatus and GetResult are used in conjunction with asynchronous execution. If a WPS server offers synchronous process execution only, these operations may not be implemented. Detailed guidance is provided by the corresponding profiles (sections 9.12 and 9.13) and conformance classes.

⁸ NOTE: Future extensions of this specification may introduce additional operations.

⁹ NOTE: A WPS server can change its offering at any time, in particular between a GetCapabilities, a subsequent DescribeProcess, and a subsequent Execute request. Any quality of service (QoS) guarantees are within the responsibilities of the service provider and not covered by this standard.

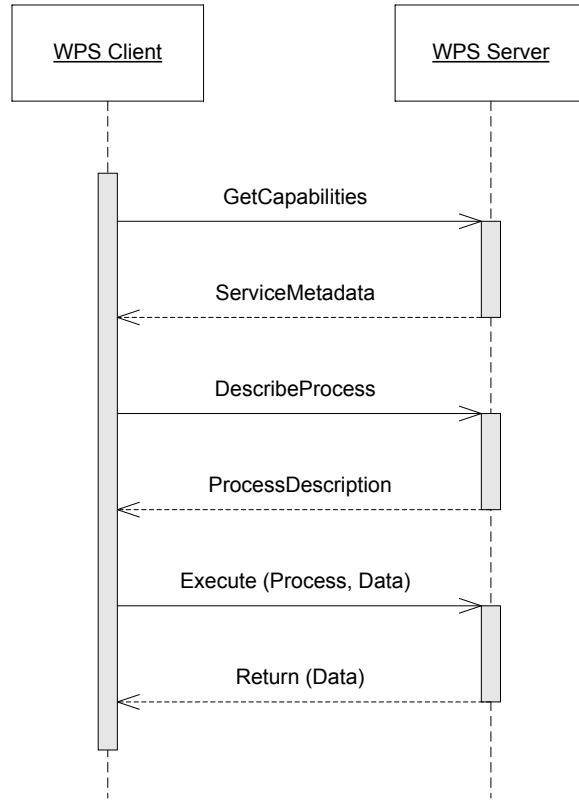


Figure 15 – Common sequence of WPS operations UML sequence diagram

9.2 Data Transmission

Data exchange between WPS clients and servers requires an agreement on the general data exchange patterns and suitable communication protocols. Data may be sent to (received from) a WPS in two distinct ways: (1) by reference (using HTTP/GET or HTTP/POST), and (2) by value. Clients may send input data in either fashion. Output data may be requested in any fashion declared by the data transmission options defined for the process offering. Typically, large data inputs and outputs are delivered by reference.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/data-transmission	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/data-transmission/data</p> <p><i>The data transmission structures for process inputs and outputs shall comply with the structures defined in Figure 16, Table 23, Table 24, Table 25, Table 26, and Table 27.</i></p>

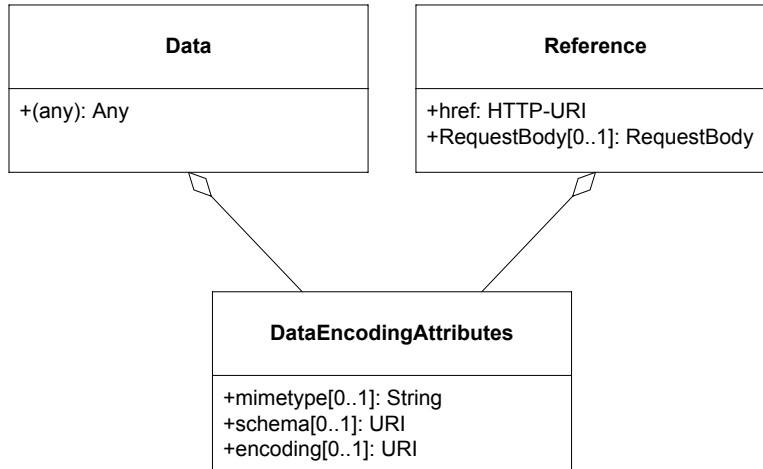


Figure 16 – Input and output data transmission structures UML class diagram

Table 23 – Parts of the inline Data structure

Names	Definition	Data type and values	Multiplicity and use
mimetype	See Table 24 – Properties of the DataEncodingAttributes structure.		
encoding			
schema			
(any) ^a	The actual input or output data.	Any type and value	One (mandatory)
^a The data is embedded here as part of the Data element, in the mimeType, encoding, and schema indicated by the first three parameters if they exist, or by the relevant defaults.			

Table 24 – Properties of the DataEncodingAttributes structure

Names	Definition	Data type and values	Multiplicity and use
mimetype	MimeType of the data.	Character String	One (mandatory)
encoding	Well-known encoding or character set of the data.	URI “raw” shall be used for plain binary data “base64” shall be used for base64 encoded data Character set identifiers (e.g. “UTF-8”) shall be used for text or CSV data.	Zero or one (conditional) ^a
schema	Identification of the data schema.	URI	Zero or one (conditional) ^a

Names	Definition	Data type and values	Multiplicity and use
^a This shall be provided if: <ol style="list-style-type: none"> 1) the process data item supports multiple encodings / schemas, and 2) the data is not of the default encoding / schema, and 3a) the schema / encoding cannot be retrieved from the data itself, or 3b) the encoding / schema information is deeply buried inside the data (i.e. not part of some header) and requires significant parsing effort. 			

Table 25 – Parts of the Reference structure

Names	Definition	Data type and values	Multiplicity and use
mimetype	See Table 24 – Properties of the DataEncodingAttributes structure.		
encoding			
schema			
href	HTTP URI that points to the remote resource where the data may be retrieved.	HTTP URI	One (mandatory)
RequestBody	Request body element that is used for HTTP/POST requests to the above URL. If no request body is present, an HTTP/GET Request should be used to retrieve the data.	RequestBody structure, see Table 26.	Zero or one (optional)

Table 26 – Parts of the RequestBody structure

Names	Definition	Data type and values	Multiplicity and use
Body	The contents of this element to be used as the body of the HTTP request message to be sent to the service identified in ../Reference/@href. For example, it could be an XML encoded WFS request using HTTP/POST.	Any type	Zero or one (conditional) ^a
BodyReference	Reference to a remote document to be used as the body of the an HTTP/POST request message to the service identified in the href element in the Reference structure (Table 25).	BodyReference, see Table 27.	Zero or one (conditional) ^a
^a One and only one of these items shall be included.			

Table 27 – Parts of the BodyReference structure

Names	Definition	Data type and values	Multiplicity and use
href	HTTP URI that points to the remote resource where the request body may be retrieved.	HTTP URI	One (mandatory)

9.3 WPS Service Handling

The WPS service model seeks compliance with OWS Common and implements the baseline communication protocol for OWS services and the related information elements defined in [OGC 06-121r9], clause 9.2.1.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/handling	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling/request-base <i>All request types of a WPS, except GetCapabilities, shall use the minimum request parameters, defined in [OGC 06-121r9].</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling/service <i>For all WPS request types, the service parameter shall have a fixed value of "WPS".</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling/version <i>For all WPS request types, the request version parameter shall have a fixed value of "2.0.0".</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling/request-base-type <i>All request types of a WPS, except GetCapabilities, shall comply with the request type structure defined in Table 28.</i>

Table 28 – Properties of the RequestBaseType

Names	Definition	Data type and values	Multiplicity and use
service	Service type identifier	Character String, fixed to "WPS"	One (mandatory)
version	Specification version for operation	Character String, fixed to "2.0.0"	One or more (mandatory)

Names	Definition	Data type and values	Multiplicity and use
Extension	Any ancillary information to be sent from client to server. Placeholder for further request parameters defined by WPS extension standards.	Any type	Zero or more (optional)

9.4 Process Offering

A process offering structure contains information about the processes that may be run on a WPS server. Furthermore, the process offerings structure contains properties that describe the available execution modes of a process, the allowed data transmission modes, its version, and the process type (if it deviates from the native process model).

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/process-offering-properties	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/process-offering-properties/attributes <i>For all process offerings, the attributes defined in Table 29 shall be specified.</i>

Table 29 – Parts of the ProcessOfferingPropertiesAttributes structure

Names	Definition	Data type and values	Multiplicity and use
jobControlOptions	Job control options supported for this process	List of supported options for process control (see Table 30)	One or more (mandatory)
outputTransmission	Supported transmission modes for output data (by value / by reference)	List of supported data transmission options (see Table 31).	One or more (mandatory)
processVersion	Release version of process (not of WPS specification). May be specified to reflect updates or changes in the process offering.	ows:VersionType	Zero or one (optional) Include when needed to identify process version. ^a
processModel	Type of the process description	HTTP-URI. Value is defined by the process description specification. Defaults to “native”.	Zero or one (conditional) Include when using a different process model than the native process model. ^b

^a The processVersion is informative only. Version negotiation for processVersion is not available. Requests to Execute a process do not include a processVersion identifier.

^b This is an extension hook to support processes that have been specified in other OGC Standards, such as SensorML. For

Names	Definition	Data type and values	Multiplicity and use
those process models, compliance with the WPS abstract process model (section 6.3) has to be ensured.			

Table 30 – Basic job control options

Option	Definition
sync-execute	The process offering can/shall be executed synchronously.
async-execute	The process offering can/shall be executed asynchronously.

Table 31 – Data transmission options

Option	Definition
value	The data is delivered by value.
reference	The data is delivered by reference.

9.5 StatusInfo Document

The StatusInfo document is used to provide identification and status information about jobs on a WPS server.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info/document <i>The StatusInfo document shall comply with the structure defined in Table 32.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info/document-status <i>The Status element shall contain a well-known identifier for the JobStatus. A basic set has been defined in the WPS conceptual model. WPS operations and WPS extensions may define additional states.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info/document-status-case-insensitive <i>The content of the Status element shall be treated case insensitive.</i>

Table 32 – StatusInfo structure

Names	Definition	Data type and values	Multiplicity and use
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Names	Definition	Data type and values	Multiplicity and use
JobID	Unambiguously identifier of a job within a WPS instance.	Character String ^a	One (mandatory)
Status	Well-known identifier describing the status of the job.	Character String ^b	One (mandatory)
ExpirationDate	Date and time by which the job and its results will be no longer accessible. ^c	ISO-8601 date/time string in the form YYYY-MM-DDTHH:MM:SS.SS SZ with T separator character and Z suffix for coordinated universal time (UTC)	Zero or one (optional) Include if required.
EstimatedCompletion	Date and time by which the processing job will be finished.	ISO-8601 date/time string in the form YYYY-MM-DDTHH:MM:SS.SS SZ with T separator character and Z suffix for coordinated universal time (UTC)	Zero or one (optional) Include if available.
NextPoll	Date and time for the next suggested status polling.	ISO-8601 date/time string in the form YYYY-MM-DDTHH:MM:SS.SS SZ with T separator character and Z suffix for coordinated universal time (UTC)	Zero or one (optional) Include if required.
PercentCompleted	Percentage of process that has been completed.	Integer {0..100} ^d	Zero or one (optional) Include if available.
<p>^a Particularly suitable JobIDs are UUIDs or monotonic identifiers such as unique timestamps. If the privacy of a Processing Job is imperative, the JobID should be non-guessable.</p> <p>^b The basic status set is defined in Table 3. Additional states may be defined by certain operations or extensions of this standard.</p> <p>^c This element will usually become available when the execution has finished (Status = “finished”).</p> <p>^d Zero (0) means the execution has just started, and 100 means the job is complete. This value is informative only without any accuracy guarantees.</p>			

9.6 Result Document

A Result document is a structure that contains the results of a process execution. It is a shared element between the Execute and GetResult operations.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/result	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/data-transmission
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/result/document <i>The Result document shall comply with the structure defined in Table 33.</i>

Table 33 – Result structure

Names	Definition	Data type and values	Multiplicity and use
JobID	Unambiguously identifier of a job within a WPS instance.	Character String ^a	Zero or one (conditional) ^b
ExpirationDate	Date and time by which the results will be no longer accessible. ^c	ISO-8601 date/time string in the form YYYY-MM-DDTHH:MM:SS.SS SZ with T separator character and Z suffix for coordinated universal time (UTC)	Zero or one (conditional) Include if required, i.e. if the server will delete stored results at some point in time.
Output	Output item returned by a process execution.	DataOutputType structure, see Table 34.	One or more (mandatory)

^a Particularly suitable JobIDs are UUIDs or monotonic identifiers such as unique timestamps. If the privacy of a Processing Job is imperative, the JobID should be non-guessable. In asynchronous execution, the JobID would be shared among related StatusInfo and Result documents.

^b Include if required, e.g. in a response to an asynchronous execution.

^c For results delivered “by reference” this element may indicate when the Data Outputs will be deleted by the server.

Table 34 – Parts of the DataOutputType structure

Names	Definition	Data type and values	Multiplicity and use
id	Unambiguous identifier or name of an output item.	URI	One (mandatory)
Data	The data provided by this output item.		Zero or one (conditional) ^a
Output	Nested output, child element.	DataOutputType structure, see Table 34 (this table)	Zero or one (conditional) ^a

^a One and only one of these items shall be included.

9.7 GetCapabilities Operation

Per OGC 06-121r9, a GetCapabilities operation is required for any OGC Web service. For WPS, this operation allows a client to retrieve service metadata, basic process offerings, and the available processes present on a WPS server.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/request <i>Requirements class for the GetCapabilities request.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response <i>Requirements class for the GetCapabilities response.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/exception <i>Requirements class for GetCapabilities operation exceptions.</i>

9.7.1 GetCapabilities Request

The GetCapabilities request is mandatory for any OGC service. Figure 17 shows how the GetCapabilities request for a WPS relates to the generic GetCapabilitiesType defined by OWS Common. An Extension element provides a hook for further request parameters that may be defined by WPS extension specifications.

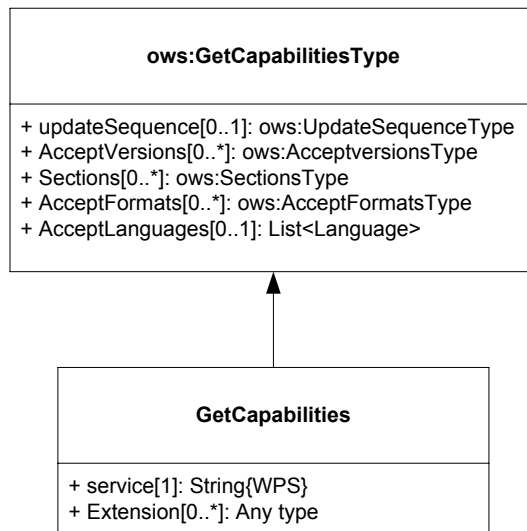


Figure 17 – GetCapabilities request UML class diagram

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/request	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/request/ows</p> <p><i>The GetCapabilities operation request shall be implemented as specified in Clause 7 of OWS Common [OGC 06-121r9].</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/request/accept-versions</p> <p><i>If the AcceptVersions parameter is contained in the request, it shall contain the character string “2.0.0”.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/request/properties</p> <p><i>In addition to the properties inherited from OWS Common GetCapabilities, the WPS GetCapabilities request shall include the properties according to Table 35.</i></p>

Table 35 – Additional properties in the GetCapabilities request

Names	Definition	Data type and values	Multiplicity and use
Service	Service type identifier	Character string, fixed to “WPS”	One (mandatory)
Extension	Container for elements defined by extension specifications	Any type. Value is defined by the extension specification.	Zero or more (optional)

9.7.2 GetCapabilities Response

The response to a GetCapabilities operation is a document describing the service’s capabilities. Figure 18 shows how the WPS Capabilities are derived from the CapabilitiesBaseType defined in [OGC 06-121r9]. The OperationsMetadata element lists the request types supported by a WPS server. The contents section delivers information about the process offerings of the server. An Extension element provides a hook for additional service capabilities that cannot be covered by other available elements.

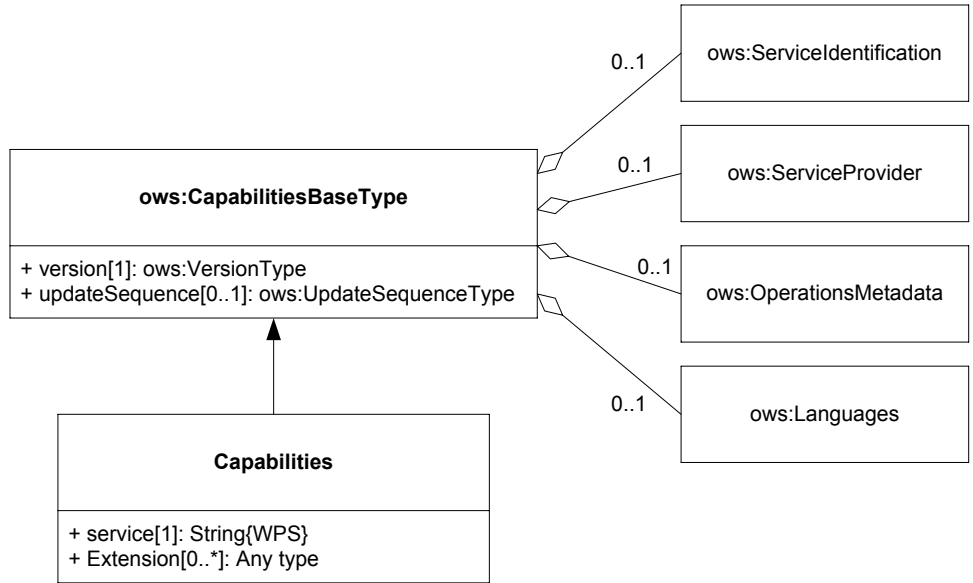


Figure 18 – Capabilities document UML class diagram

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response/ows</p> <p><i>The capabilities response shall provide service metadata according to [OGC 06-121r9], clause 7.4.2.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response/version</p> <p><i>The default version of the Capabilities document returned by a service implementing this standard shall be “2.0.0”.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response/properties</p> <p><i>In addition to the properties inherited from OWS Common OWSServiceMetadata, the WPS Capabilities shall include the properties according to Table 36.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response/process-summary</p> <p><i>The contents section of the Capabilities document shall contain a process summary for each of the process offerings.</i></p>

Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/response/process-summary-properties</p> <p><i>The properties of a process summary shall provide the properties defined in Table 37.</i></p>
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Table 36 – Additional properties in the Capabilities document

Names	Definition	Data type and values	Multiplicity and use
service	Service type identifier	Character string, fixed to “WPS”	One (mandatory)
Contents	List of brief descriptions of the processes offered by this WPS server.	ProcessSummary, see Table 37	One (mandatory)
Extension	container for elements defined by extension specifications	Any type. Value is defined by the extension specification.	Zero or more (optional)

Table 37 – Properties of the ProcessSummary

Names	Definition	Data type and values	Multiplicity and use
Title	Title of a process, normally available for display to a human.	ows:Title	One (mandatory)
Abstract	Brief narrative description of a process, normally available for display to a human.	ows:Abstract	Zero or more (optional)
Keywords	Keywords that characterize a process,	ows:Keyword	Zero or more (optional)
Identifier	Unambiguous identifier or name of a process.	ows:Identifier ^a	One (mandatory)
Metadata	Reference to more metadata about this item.	ows:Metadata	Zero or more (optional) Include when available and useful
processModel	Inherited from Table 29.		
jobControlOptions			
outputTransmission			
^a Additional content such as separate code space and version attributes in the Identifier element are not allowed.			

9.7.3 GetCapabilities Exceptions

If a WPS server encounters an error while performing a GetCapabilities operation, it shall return an exception report as specified in Clause 7.4 of [OGC 06-121r9].

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/exception	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities/exception/common</p> <p><i>If a WPS server encounters an error while performing a GetCapabilities operation, it shall return an exception report message as specified in subclause 7.4 of [OGC 06-121r9].</i></p>

9.8 DescribeProcess Operation

The DescribeProcess operation allows WPS clients to query detailed process descriptions for the process offerings.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/request</p> <p><i>Requirements class for the DescribeProcess request.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/response</p> <p><i>Requirements class for the DescribeProcess response.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/exception</p> <p><i>Requirements class for DescribeProcess operation exceptions.</i></p>

9.8.1 DescribeProcess Request

The DescribeProcess request inherits basic properties from the RequestBaseType. An Identifier element shall contain a list of the process identifiers for which the process descriptions shall be obtained. If the service supports multilingual process descriptions, the desired language of the free-text elements in the process description may be queried with a language parameter.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/request	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Dependency	IETF RFC 4646
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/request/structure</p> <p><i>The DescribeProcess request shall comply with the structure defined in Figure 19 and Table 38.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/request/all-identifiers</p> <p><i>The reserved character string “ALL” shall be used to obtain a response that contains descriptions of all process offerings provided by the server.</i></p>

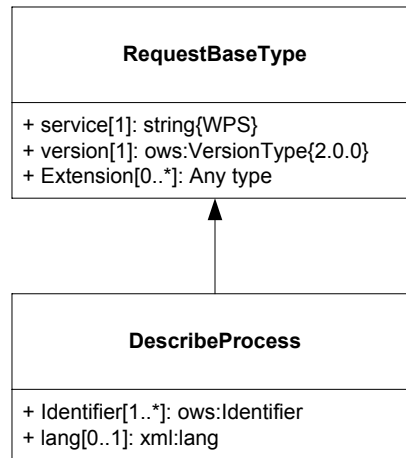


Figure 19 – DescribeProcess request UML class diagram

Table 38 – Additional properties in the DescribeProcess request

Names	Definition	Data type and values	Multiplicity and use
Identifier	One or more process identifiers for which the detailed description shall be obtained.	ows:Identifier Value shall be one of the process identifiers listed in the ProcessSummary elements in the Capabilities document. The fixed value	One or more (mandatory)

Names	Definition	Data type and values	Multiplicity and use
		“ALL” indicates that the description of all process offerings shall be returned.	
lang	Desired language of the process description.	xml:lang IETF RFC 4646 language code of the human-readable text elements in the process description (e.g. "en"). This shall be one of the languages defined in the Capabilities document.	Zero or one (optional)

9.8.2 DescribeProcess Response

The response to a DescribeProcess operation is a ProcessOfferings document. This document contains a ProcessOfferings section for each available process on the server. In contrast to the ProcessSummary in the server’s capabilities, the processes are described in their declared description format.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/response	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	IETF RFC 4646
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/response/structure</p> <p><i>The DescribeProcess response shall comply with the structure defined in Table 39 and Table 40.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/response/offerings-language</p> <p><i>If the client has requested a particular response language, the process descriptions shall be delivered in that language.</i></p>

Table 39 – Properties in the ProcessOfferings document

Names	Definition	Data type and values	Multiplicity and use
lang	Language in which the process offerings are described.	xml:lang IETF RFC 4646 language code of the human-readable text	Zero or one (optional)

Names	Definition	Data type and values	Multiplicity and use
		elements in the process description (e.g. "en"). This shall be the language identified in the DescribeProcess request.	
ProcessOfferings	List of ProcessOfferings.	ProcessOffering, defined in Table 40.	One or more (optional)

Table 40 – ProcessOffering properties

Names	Definition	Data type and values	Multiplicity and use
processModel	Inherited from Table 29		
jobControlOptions			
outputTransmission			
Process	Native Process description.	Process type, as defined in the native process model.	Zero or one (conditional) ^a
Any	Any other well-defined process description, identified by the processType.	Any type. Must conform to requirements associated with the declared processType.	Zero or one (conditional) ^a
^a One and only one of these items shall be included.			

9.8.3 DescribeProcess Exceptions

If a WPS server encounters an error while performing a DescribeProcess operation, it shall return an exception report as specified in Clause 8 of [OGC 06-121r9]. If the error was encountered due to an invalid process identifier, the server shall respond with the exception code defined in Table 41.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/exception	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/exception/common</p> <p><i>If a WPS server encounters an error while performing a DescribeProcess operation, it shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i></p>

Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process/exception/specific</p> <p><i>If the error was encountered due to an invalid process identifier, the server shall respond with the exception code defined in Table 41.</i></p>
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Table 41 – Additional exception codes for the DescribeProcess operation

exceptionCode value	ExceptionText	locator	HTTP status code
NoSuchProcess	One of the identifiers passed does not match with any of the processes offered by this server.	List of violating process identifiers.	400 (Bad request)

9.9 Execute Operation

The Execute operation allows WPS clients to run a specified process implemented by a server, using the input parameter values provided and returning the output values produced. Inputs may be included directly in the Execute request (by value), or reference web accessible resources (by reference). The outputs may be returned in the form of an XML response document, either embedded within the response document or stored as web accessible resources. Alternatively, for a single output, the server may be directed to return that output in its raw form without being wrapped in an XML response document. This is illustrated in Figure 20.

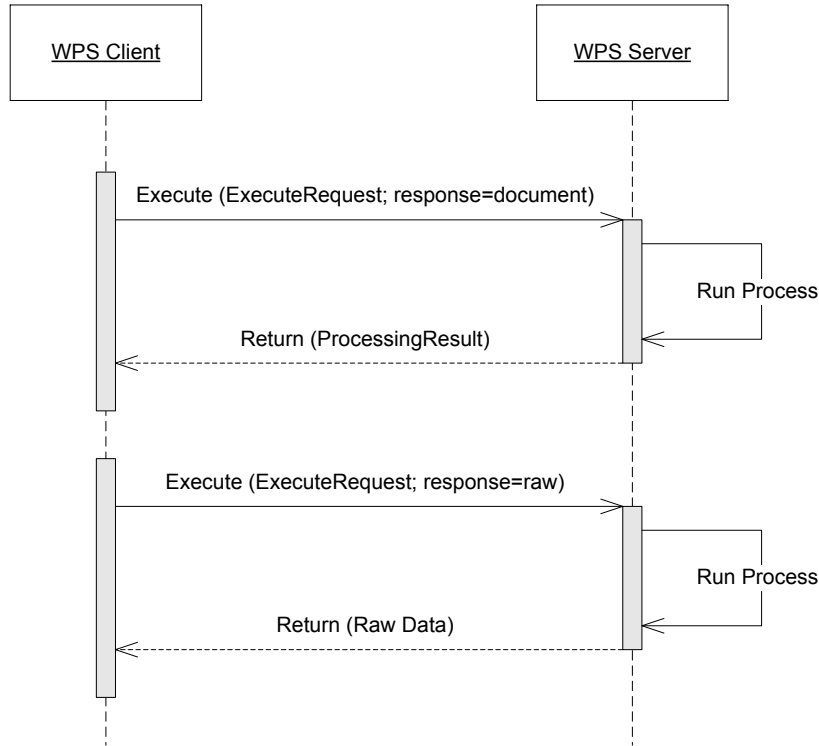


Figure 20 – Execute response document and raw data UML sequence diagram

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/execute	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/request <i>Requirements class for the Execute request.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response <i>Requirements class for the Execute response.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/exception <i>Requirements class for Execute operation exceptions.</i>

9.9.1 Execute Request

The Execute request is a common structure for synchronous and asynchronous execution. It inherits basic properties from the RequestBaseType and contains additional elements that identify the process that shall be executed, the data inputs and outputs, and the response type of the service.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/request	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/request/structure</p> <p><i>The Execute request shall comply with the structure defined in Figure 21, Table 42, Table 43, and Table 44.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/request/raw-for-single-output</p> <p><i>Raw data output shall only be requested if the processes execution will deliver one single output value. (For a process that provides more than one output, the desired output has to be specified in the request for raw data delivery.)</i></p>

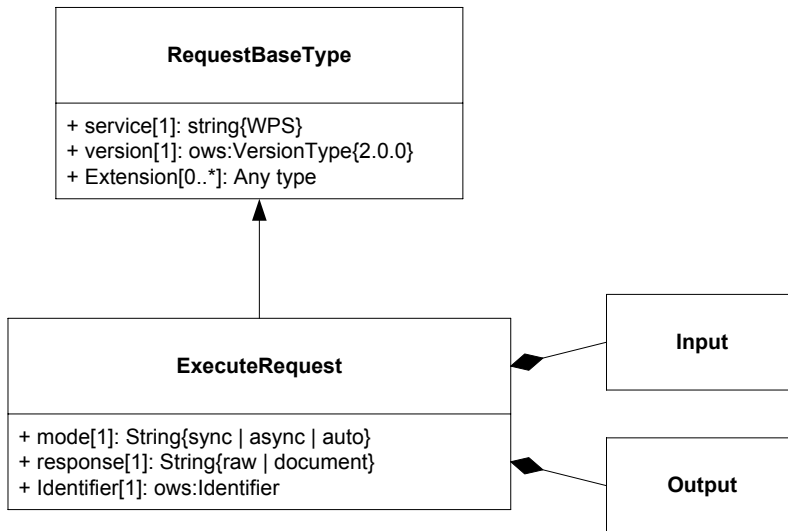


Figure 21 – Execute request UML class diagram

Table 42 – Additional properties in the Execute request

Names	Definition	Data type and values	Multiplicity and use
response	Desired response format, i.e. a response document or raw data.	String {raw ^a document}	One (mandatory)
mode	Desired execution mode.	String{sync async auto}	One (mandatory)

Names	Definition	Data type and values	Multiplicity and use
		Valid values are to be derived from the jobControlOptions property of each ProcessOffering. “auto” delegates the choice of execution mode to the server.	
Identifier	Unambiguous identifier of the process that shall be executed.	ows:Identifier Value shall be one of the process identifiers listed in the ProcessSummary elements in the Capabilities document.	One (mandatory)
Input	Data inputs provided to this process execution.	DataInputType structure, see Table 43.	Zero or one (optional) ^c
Output	Specification of outputs expected from the process execution, including the desired format and transmission mode for each output.	OutputDefinitionType structure, see Table 44.	Zero or one (optional) ^d
<p>^a Raw output shall only be requested if the execution would return a single output.</p> <p>^b In the case of auto, the server shall respond quickly to avoid connection timeouts.</p> <p>^c If a process does not have any inputs, or if, for all required inputs the process description contains default values, this element may be omitted.</p> <p>^d If a process shall return all outputs in their default format, this element may be omitted.</p>			

Table 43 – Properties of the DataInputType

Names	Definition	Data type and values	Multiplicity and use
id	Identifier of a particular input, as defined in the process description.	URI	One (mandatory)
Data	The data provided for this input item.	Data structure, Table 23	Zero or one (conditional) ^a
Reference		Reference structure, Table 25	Zero or one (conditional) ^a
Input	Nested input, child element.	DataInputType structure, Table 43 (this table)	Zero or one (conditional) ^a
<p>^a One and only one of these items shall be included.</p>			

Table 44 – Properties of the OutputDefinitionType

Names	Definition	Data type and values	Multiplicity and use
mimetype	See Table 24 – Properties of the DataEncodingAttributes structure.		
encoding			
schema			
transmission	Code that indicates the desired data transmission mode for this output.	Character string. Valid values are listed in the outputTransmission property of each ProcessOffering.	Zero or one (conditional) ^a
id	Identifier of a particular output, as defined in the process description.	URI	One (mandatory)
Output	Nested output, child element.	DataDefinitionType structure, Table 44 (this table).	Zero or one (optional) ^c
<p>^a This element may be omitted for (1) raw data output, (2) output elements that serve as nesting parents.</p> <p>^b Depending on the process model, a client may provide a basic specification of the desired output format. This information shall ensure a successful decoding of the process outputs. Use and interpretation of this element shall be specified within a WPS service profile.</p> <p>^c Include only for nested outputs.</p>			

9.9.2 Execute Response

Depending on the desired execution mode and the response type declared in the execute request, the execute response may take one of three different forms: A response document, a StatusInfo document, or raw data.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/result
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response/type</p> <p><i>The execute response type shall comply with the properties specified in the execute request according to Table 45.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response/raw-data</p> <p><i>A raw data response shall comply with the output format specified in the execute request.</i></p>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response/d

	<p>ocument</p> <p><i>The response document shall comply with Requirements Class http://www.opengis.net/spec/WPS/2.0/req/service/model/result.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response/status-info</p> <p><i>A StatusInfo response shall comply with Requirements Class http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/response/status-info-status</p> <p><i>The StatusInfo response to a valid execute response shall have the status element set to “Accepted”.</i></p>

Table 45 – Possible responses to an execute request

		Execution mode		
		sync	async	auto
Response format	Raw	Raw data	StatusInfo document	Raw data or StatusInfo document (choice is made by server) ^a
	document	Response document	StatusInfo document	Response document or StatusInfo document (choice is made by server) ^a
	n/a	Response document (default)	StatusInfo document	Response document or StatusInfo document (choice is made by server) ^a
<p>^a The client identifies the server’s choice by inspection of the response type (Table 45).</p>				

9.9.3 Execute Exceptions

When a WPS server encounters an error while performing an Execute operation, it shall return an exception report as specified in clause 8 of [OGC 06-121r9]. If appropriate, the server shall use additional exception codes as defined in this section.

For synchronous execution, an exception is returned instead of a result. For asynchronous execution, it is recommended to return the exception at the earliest possible time. In the case of a syntactically wrong request (e.g. due to the use of wrong identifiers and data formats), the exception report message may be returned instead of a StatusInfo document. If the exception occurs later during execution, the StatusInfo shall be set to “Failed” and the GetResult operation shall be used to deliver the exception report.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/exception	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/exception/common</p> <p><i>If a WPS server encounters an error while performing an Execute operation, it shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/exception/specific</p> <p><i>If the encountered error is related to the properties and elements in the execute request or has occurred during the result computation, the server shall respond with the specific exception codes defined in Table 46.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/execute/exception/accepted-job</p> <p><i>If the server encounters an error for an asynchronously executed job, that had already been accepted, the server shall behave as follows:</i></p> <ol style="list-style-type: none"> 1. <i>The next StatusInfo responses shall have the status element set to “Failed”, and</i> 2. <i>The GetResult operation report shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i>

Table 46 – Additional exception codes for the Execute operation

exceptionCode value	ExceptionText	locator	HTTP status code
NoSuchProcess	One of the identifiers passed does not match with any of the processes offered by this server.	List of violating process identifiers.	400 (Bad request)
NoSuchMode	The process does not permit the desired execution mode.	Violating mode value.	400 (Bad request)
NoSuchInput	One or more of the input identifiers passed does not match with any of the input identifiers of this process.	List of violating input identifiers	400 (Bad request)
NoSuchOutput	One or more of the output identifiers	List of violating input	400 (Bad request)

exceptionCode value	ExceptionText	locator	HTTP status code
	passed does not match with any of the input identifiers of this process.	identifiers	
DataNotAccessible	One of the referenced input data sets was inaccessible.	List of violating input identifiers	400 (Bad request)
SizeExceeded	The size of one of the input parameters was too large for this process to handle.	List of violating input identifiers	400 (Bad request)
TooManyInputs	Too many input items have been specified.	List of violating input identifiers	400 (Bad request)
TooManyOutputs	Too many output items have been specified. ^a	List of violating input identifiers	400 (Bad request)
ServerBusy	The server is too busy to accept and queue the request at this time.	None (omit locator parameter)	503 (Service Unavailable)
StorageNotSupported	Execute operation request included transmission="reference" for one of the outputs, but storage is not offered by this server.	None (omit locator parameter)	400 (Bad request)
NoSuchFormat	One or more of the input or output formats specified in the request did not match with any of the formats defined for that particular input or output.	List of violating input and / or output identifiers	400 (Bad request)
WrongInputData	One or more of inputs for which the service was able to retrieve the data but could not read it.	List of violating input identifiers	400 (Bad request)
InternalServerError	None (omit exception text)	None (omit locator parameter)	500 (Internal Server Error) ^b
^a This shall be used in conjunction with raw data, where the execute request must specify only one output. ^b If the cause could not be determined or is not covered by the above exception codes, this exception shall be used.			

9.10 GetStatus Operation

The GetStatus operation allows WPS clients to query the status of an asynchronously executed job.

Requirements Class

<http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status>

Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/request <i>Requirements class for the GetStatus request.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/response <i>Requirements class for the GetStatus response.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/exception <i>Requirements class for GetStatus operation exceptions.</i>

9.10.1 GetStatus Request

The GetStatus request inherits basic properties from the RequestBaseType. It contains an additional element that identifies the JobID of the processing job, of which the status shall be returned.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/request	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/request/structure <i>The GetStatus request shall comply with the structure defined in Figure 22 and Table 47.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/request/job-id <i>The JobID used in the request shall be a valid identifier which the client has received with the execute response.</i>

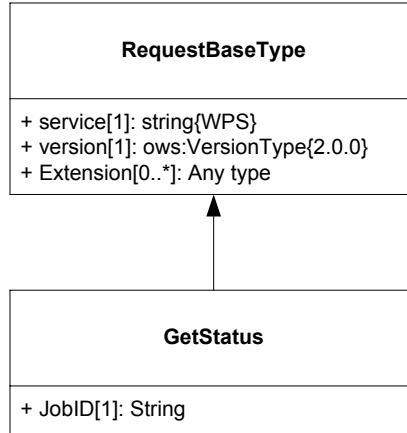


Figure 22 – GetStatus request UML class diagram

Table 47 – Additional properties in the GetStatus request

Names	Definition	Data type and values	Multiplicity and use
JobID	Job identifier.	Character String. This shall be a JobID the client has received during process execution.	One (mandatory)

9.10.2 GetStatus Response

The response to a GetStatus request is a StatusInfo document as defined in section 9.5.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/response	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/response/status-info</p> <p><i>The response to a GetStatus request shall be a StatusInfo document as defined in http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info.</i></p>

9.10.3 GetStatus Exceptions

If a WPS server encounters an error while performing a GetStatus operation, it shall return an exception report as specified in Clause 8 of [OGC 06-121r9]. If the error was

encountered due to an invalid process identifier, the server shall respond with the exception code defined in Table 48.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/exception	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/exception/common</p> <p><i>If a WPS server encounters an error while performing a GetStatus operation, it shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status/exception/job-id</p> <p><i>If the error was encountered due to an invalid JobID, the server shall respond with the exception code defined in Table 48.</i></p>

Table 48 – Additional exception codes for the GetStatus operation

exceptionCode value	ExceptionText	locator	HTTP status code
NoSuchJob	The JobID from the request does not match any of the Jobs running on this server	Violating JobID	400 (Bad request)

9.11 GetResult Operation

The GetResult operation allows WPS clients to query the result of a finished processing job. It is used in conjunction with asynchronous execution.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/request</p> <p><i>Requirements class for the GetResult request.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/response</p> <p><i>Requirements class for the GetResult response.</i></p>

Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception <i>Requirements class for GetResult operation exceptions.</i>
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9.11.1 GetResult Request

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/request	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/request/structure <i>The GetResult request shall comply with the structure defined in Figure 23 and Table 49.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/request/job-id <i>The JobID used in the request shall be a valid identifier which the client has received with the execute response.</i>

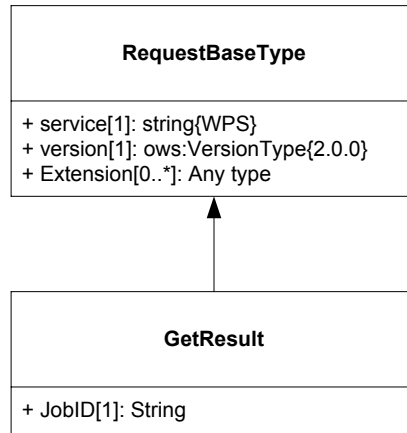


Figure 23 – GetResult request UML class diagram

Table 49 – Additional properties in the GetResult request

Names	Definition	Data type and values	Multiplicity and use
JobID	Job identifier.	Character String. This shall be a JobID the client has received during	One (mandatory)

Names	Definition	Data type and values	Multiplicity and use
		process execution.	

9.11.2 GetResult Response

The response to a GetResult request is a Processing Result document as defined in section 9.6.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/response	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/result
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/response/result</p> <p><i>The response to a GetResult request shall be a Result document as defined in http://www.opengis.net/spec/WPS/2.0/req/service/model/result.</i></p>

9.11.3 GetResult Exceptions

When a WPS server encounters an error while performing a GetResult operation, it shall return an exception report as specified in Clause 8 of [OGC 06-121r9]. If the error was encountered due to an invalid JobID, the server shall respond with the exception code defined in Table 48 (NoSuchJob). If, for some reason, GetResult was invoked too early and the results have not been computed yet, the server shall respond with the exception defined in Table 50 (ResultNotReady).

If a job finishes with status “failed”, GetResult will provide the corresponding exception report. In this case, the appropriate exception codes defined for the execute operation shall be used.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception/common</p> <p><i>If a WPS server encounters an error while performing a GetResult operation, it shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i></p>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception/job-id

	<i>If the error was encountered due to an invalid process identifier, the server shall respond with the exception code defined in Table 48 (NoSuchJob).</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception/execution-exception</p> <p><i>If the encountered error has occurred during the result computation, the server shall respond with the appropriate exception codes defined in Table 46.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result/exception/result-not-ready</p> <p><i>If the results have not yet been computed and the job is still in the “running” state, the server shall respond with the exception code defined in Table 50.</i></p>

Table 50 – Additional exception codes for the GetResult operation

exceptionCode value	ExceptionText	locator	HTTP status code
ResultNotReady ^a	The result for the requested JobID has not yet been generated.	Violating JobID	400 (Bad request)
^a Typically, this exception is thrown if a client violates the asynchronous protocol (Figure 4) and calls GetResult before the job execution has completed.			

9.12 Synchronous WPS

The synchronous WPS is a requirements class profile that indicates the general availability of synchronous execution capabilities on a WPS server.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/synchronous-wps	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/synchronous-wps/sync-execute</p> <p><i>The Synchronous WPS server shall provide synchronous execution capabilities for one or more process offerings.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/synchronous-wps/operations</p> <p><i>A Synchronous WPS server shall provide the following operations:</i></p> <ul style="list-style-type: none"> • <i>GetCapabilities</i> • <i>DescribeProcess</i> • <i>Execute (with mode “sync”)</i>

9.13 Asynchronous WPS

The asynchronous WPS is a requirements class that indicates the general availability of asynchronous execution capabilities on a WPS server.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/asynchronous-wps	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/synchronous-wps/sync-execute</p> <p><i>The Aynchronous WPS server shall provide asynchronous execution capabilities for one or more process offerings.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/asynchronous-wps/operations</p>

	<p><i>An Asynchronous WPS server shall provide the following operations:</i></p> <ul style="list-style-type: none"> • <i>GetCapabilities</i> • <i>DescribeProcess</i> • <i>Execute (with mode “async”)</i> • <i>GetStatus</i> • <i>GetResult</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/asynchronous-wps/result-jobid</p> <p><i>Result documents delivered by asynchronous execution shall contain a JobID.</i></p>

10. Binding Extensions for WPS Operations

10.1 HTTP/POST + XML Binding

This section specifies the encoding of WPS requests using HTTP/POST and XML. The referred XML schema elements are provided by the associated schema package delivered with this standard and located at <http://schemas.opengis.net/wps/2.0.0/>.

Requirements Class	
	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-capabilities</p> <p><i>Requirements class for the GetCapabilities operation POST/XML encoding.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/describe-process</p> <p><i>Requirements class for the DescribeProcess operation POST/XML encoding.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/execute</p> <p><i>Requirements class for the Execute operation POST/XML encoding.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-status</p> <p><i>Requirements class for the GetStatus operation POST/XML encoding.</i></p>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-

	<p>result</p> <p><i>Requirements class for the GetResult operation POST/XML encoding.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-result</p> <p><i>Requirements class for the GetResult operation POST/XML encoding.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/extension-binding</p> <p><i>An operation extension for WPS servers that seeks compliance with this requirements class shall define an HTTP/POST+XML binding in compliance with [OGC 06-121r9].</i></p>

10.1.1 GetCapabilities

This clause specifies the XML encoding for the GetCapabilities operation.

A GetCapabilities example is listed in Annex B.4.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-capabilities	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-capabilities/request</p> <p><i>A GetCapabilities request using POST/XML shall be a valid XML document of the type wps:Capabilities.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-capabilities/response</p> <p><i>The response to a successful GetCapabilities request shall be a valid XML document of the type wps:Capabilities.</i></p>

10.1.2 DescribeProcess

This clause specifies the XML encoding for the DescribeProcess operation.

A DescribeProcess example is listed in Annex B.5.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/describe-process	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process
Dependency	OWS Common 2.0

Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/describe-process/request <i>A DescribeProcess request using POST/XML shall be a valid XML document of the type wps:DescribeProcess.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/describe-process/response <i>The response to a successful DescribeProcess request shall be a valid XML document of the type wps:ProcessOfferings.</i>

10.1.3 Execute

This clause specifies the XML encoding for the Execute operation.

An Execute example is listed in Annex B.6.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/execute	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/execute
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/execute/request <i>An Execute request using POST/XML shall be a valid XML document of the type wps:Execute.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/execute/response <i>The response to a successful Execute request shall is one of the following types:</i> <ul style="list-style-type: none"> a) <i>A valid XML document of the type wps:Result</i> b) <i>A valid XML document of the type wps:StatusInfo</i> c) <i>A raw data response</i>

10.1.4 GetStatus

This clause specifies the XML encoding for the GetStatus operation.

A GetStatus example is listed in Annex B.7.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-status	
Target type	Software implementation

Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-status/request</p> <p><i>A GetStatus request using POST/XML shall be a valid XML document of the type wps:GetStatus.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-status/response</p> <p><i>The response to a successful GetStatus request shall be a valid XML document of the type wps:StatusInfo.</i></p>

10.1.5 GetResult

This clause specifies the XML encoding for the GetResult operation.

A GetResult example is listed in Annex B.8.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-result	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-result/request</p> <p><i>A GetResult request using POST/XML shall be a valid XML document of the type wps:GetResult.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/get-result/response</p> <p><i>The response to a successful GetResult request shall be a valid XML document of the type wps:Result.</i></p>

10.2 HTTP/GET + KVP Binding

This section specifies the encoding of WPS requests using HTTP/GET and KVP. Since different HTTP client and server libraries may restrict the size of the URL this binding should only be used if the resulting HTTP/GET URL is reasonably short. The HTTP/GET + KVP binding is only defined for the operations GetCapabilities, DescribeProcess, GetStatus, and GetResult.¹⁰

¹⁰ There is no HTTP/GET + KVP binding for execute requests due to the complex and nested structure of the request.

Any WPS request in the HTTP/GET + KVP binding consists of a URL with KVP parameters. The response is always an XML document defined for the HTTP/POST + XML binding.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-capabilities <i>Requirements class for the GetCapabilities operation GET/KVP encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/describe-process <i>Requirements class for the DescribeProcess operation GET/KVP encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-status <i>Requirements class for the GetStatus operation GET/KVP encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-result <i>Requirements class for the GetResult operation GET/KVP encoding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/case-sensitivity <i>Keys shall be case insensitive; values shall be case sensitive unless stated otherwise.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/extension-binding <i>An operation extension for WPS servers that seeks compliance with this requirements class shall define an HTTP/GET+KVP binding in compliance with [OGC 06-121r9].</i>

10.2.1 GetCapabilities

This clause specifies the KVP encoding for the GetCapabilities operation. A minimalist GetCapabilities request might look like this:

```
http://hostname:port/path?service=WPS&request=GetCapabilities
```

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-capabilities	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-capabilities
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-capabilities/request</p> <p><i>The KVP encoding of the GetCapabilities operation request shall be as specified in Table 5 in Subclause 7.2.3 of [OGC 06-121r9]. The fixed value of the service parameter shall be “WPS”.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-capabilities/response-xml</p> <p><i>The response to a successful GetCapabilities request shall be a valid XML document of the type wps:Capabilities.</i></p>

10.2.2 DescribeProcess

This clause specifies the KVP encoding for the DescribeProcess operation. Possible DescribeProcess requests might look like these:

```
http://hostname:port/path?service=WPS&version=2.0.0&request=DescribeProcess&identifier=buffer,viewshed
```

```
http://hostname:port/path?service=WPS&version=2.0.0&request=DescribeProcess&identifier=ALL
```

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/describe-process	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/describe-process
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/describe-process/request</p> <p><i>The KVP encoding of DescribeProcess shall be as defined in Table 51.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/describe-process/response-xml</p> <p><i>The response to a successful GetCapabilities request shall be a valid XML document of the type wps:ProcessOfferings.</i></p>

Table 51 – DescribeProcess request KVP encoding

Names	Definition	Data type and values	Multiplicity and use
service	Identifier of the OGC service.	String, fixed to “WPS”	One (mandatory)
version	Request protocol version.	String, 2.0.0	One (mandatory)
request	Request name.	String, fixed to “DescribeProcess”, case insensitive.	One (mandatory)
lang	Desired language of the process description.	IETF RFC 4646 language code of the human-readable text elements in the process description (e.g. "en"). This shall be one of the languages defined in the Capabilities document. If the client specifies more than one language, the server may create a response in any of these languages.	Zero or one (optional)
identifier	List of one or more process identifiers.	Comma-separated list of URI escaped character strings. ^a These shall be one or more of the process identifiers listed in the ProcessSummary elements in the Capabilities document. The fixed case insensitive value “ALL” indicates that the description of all processes shall be returned.	One (mandatory)
^a The general syntax for URIs and URI escaping are defined in IETF RFC 3986.			

10.2.3 GetStatus

This clause specifies the KVP encoding for the GetStatus operation. A possible GetStatus request might look like this:

```
http://hostname:port/path?service=WPS&version=2.0.0&request=GetSt
atus&jobid=FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66
```

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-status	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-status
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-status/request</p> <p><i>The KVP encoding of GetStatus shall be as defined in Table 52.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-status/response-xml</p> <p><i>The response to a successful GetStatus request shall be a valid XML document of the type wps:StatusInfo.</i></p>

Table 52 – GetStatus request KVP encoding

Names	Definition	Data type and values	Multiplicity and use
service	Identifier of the OGC service.	String, fixed to “WPS”	One (mandatory)
version	Request protocol version.	String, 2.0.0	One (mandatory)
request	Request name.	String, fixed to “GetStatus”, case insensitive.	One (mandatory)
jobid	Job identifier.	Character String. This shall be a JobID the client has received during process execution.	One (mandatory)

10.2.4 GetResult

This clause specifies the KVP encoding for the GetResult operation. A possible GetResult request might look like this:

```
http://hostname:port/path?service=WPS&version=2.0.0&request=GetResult&jobid=FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66
```

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-result	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/get-result

Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-result/request</p> <p><i>The KVP encoding of GetResult shall be as defined in Table 53.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-result/response-xml</p> <p><i>The response to a successful GetResult request shall be a valid XML document of the type wps:Result.</i></p>

Table 53 – GetResult request KVP encoding

Names	Definition	Data type and values	Multiplicity and use
service	Identifier of the OGC service.	String, fixed to “WPS”	One (mandatory)
version	Request protocol version.	String, 2.0.0	One (mandatory)
request	Request name.	String, fixed to “GetResult”, case insensitive.	One (mandatory)
jobid	Job identifier.	Character String. This shall be a JobID the client has received during process execution.	One (mandatory)

11. Service Profiles

11.1 Basic WPS

The basic WPS is an aggregate requirements class that implements the WPS conceptual model based on the following requirements classes:

1. The WPS Service Model,
2. The binding extensions defined in section 9.12, and
3. The native WPS process model

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/profile/basic-wps	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/native-process/model
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/profile/basic-wps/common-service-model</p> <p><i>The Basic WPS server shall implement the common WPS service model as defined in Requirements class http://www.opengis.net/spec/WPS/2.0/req/service/model.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/profile/basic-wps/binding</p> <p><i>The Basic WPS server shall support one or more of the following bindings for each operation:</i></p> <ol style="list-style-type: none"> 1. <i>http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml</i> 2. <i>http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp</i>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/profile/basic-wps/process-model</p> <p><i>The Basic WPS server shall use the native process model defined in http://www.opengis.net/spec/WPS/2.0/req/native-process/model for all of its process offerings.</i></p>

12. Dismiss Extension

The dismiss extension for WPS allows a client to communicate to the server that he is no longer interested in the results of a job. In this case, the server *may* free all associated resources and “forget” the JobID (Figure 24). For jobs that are still running, the server may cancel the execution at any time. For jobs that were already finished, the associated status information and the stored results may be deleted without further notice, regardless of the expiration time given in the last status report.

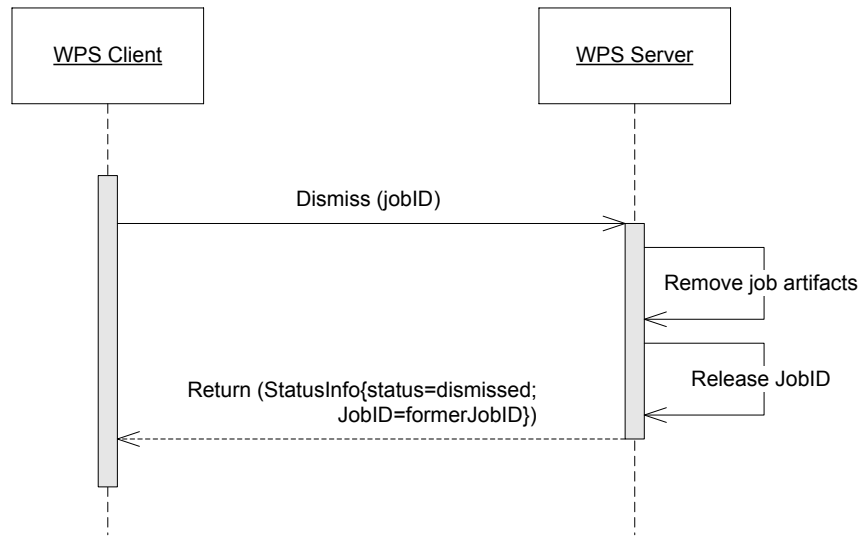


Figure 24 – Dismiss operation – UML sequence diagram

12.1 Dismiss Operation

The dismiss operation is a job control operation. Its availability is indicated per process using the jobControlOptions in the ProcessSummary and the ProcessOffering structures.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/request <i>Requirements class for the Dismiss request.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/response <i>Requirements class for the Dismiss response.</i>

Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/exception <i>Requirements class for Dismiss operation exceptions.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/job-control-attribute <i>All process offerings that support the dismiss operation shall have the String “dismiss” listed in their jobControlOptions.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/execute-response-jobid <i>All results that can be dismissed after a process has finished shall have the JobID included.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/status-dismissed <i>The case insensitive status code for a dismissed job is “Dismissed”.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/status-transient <i>The status “Dismissed” is transient. It shall only be used during a dismiss transaction.</i>

12.1.1 Dismiss Request

The Dismiss request inherits basic properties from the RequestBaseType. It contains an additional element that identifies the JobID of the processing job to be dismissed.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/request	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/handling
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/request/structure <i>The Dismiss request shall comply with the structure defined in Figure 25 and Table 54.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/request/job-id <i>The JobID used in the request shall be a valid identifier which the client has received with the execute response.</i>

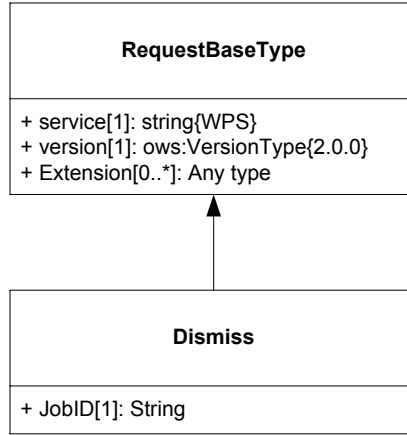


Figure 25 – Dismiss request UML class diagram

Table 54 – Additional properties in the Dismiss request

Names	Definition	Data type and values	Multiplicity and use
JobID	Job identifier.	Character String. This shall be a JobID the client has received during process execution.	One (mandatory)

12.1.2 Dismiss Response

The response to a Dismiss request is a StatusInfo document as defined in section 9.5. The status of the job shall be set to “Dismissed”. Subsequent requests to the service using the dismissed jobID shall result in a NoSuchJob exception.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/response	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/response/structure</p> <p><i>The response to a Dimiss request shall be a StatusInfo document as defined in http://www.opengis.net/spec/WPS/2.0/req/service/model/status-info.</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/response/status-dismissed</p> <p><i>The value of the Status element in the returned StatusInfo document shall be “dismissed”.</i></p>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/response/re

	<p>lease-job-id</p> <p><i>With the delivery of a dismiss response, the associated JobID shall be released.</i></p>
--	---

12.1.3 Dismiss Exceptions

If a WPS server encounters an error while performing a Dismiss operation, it shall return an exception report as specified in Clause 8 of [OGC 06-121r9]. If the error was encountered due to an invalid JobID, the server shall respond with the exception code defined in Table 48 (NoSuchJob).

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/exception	
Target type	Derived encoding and software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/conceptual-model
Dependency	OWS Common 2.0
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/exception/common</p> <p><i>If a WPS server encounters an error while performing a GetStatus operation, it shall return an exception report message as specified in Clause 8 of [OGC 06-121r9].</i></p>
Requirement	<p>http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss/exception/job-id</p> <p><i>If the error was encountered due to an invalid process identifier, the server shall respond with the exception code defined in Table 48 (NoSuchJob).</i></p>

12.2 Binding Extensions for the Dismiss Operation

12.2.1 HTTP/POST + XML Binding

This clause specifies the XML encoding for the Dismiss operation.

A Dismiss example is listed in Annex B.9.

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/dismiss	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/dismiss/compliance

	<i>The POST/XML encoding of Dismiss shall be in compliance with http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/extension-binding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/dismiss/request <i>A Dismiss request using POST/XML shall be a valid XML document of the type <code>wps:Dismiss</code>.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/post-xml/dismiss/response <i>The response to a successful Dismiss request shall be a valid XML document of the type <code>wps:StatusInfo</code>.</i>

12.2.2 HTTP/GET + KVP Binding

This clause specifies the KVP encoding for the Dismiss operation. A possible Dismiss request might look like this:

```
http://hostname:port/path?service=WPS&version=2.0.0&request=dismiss&jobid=FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66
```

Requirements Class	
http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/dismiss	
Target type	Software implementation
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/model/dismiss
Dependency	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/dismiss/compliance <i>The KVP encoding of Dismiss shall be in compliance with http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/extension-binding.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/dismiss/request <i>The KVP encoding of Dismiss shall be as defined in Table 55.</i>
Requirement	http://www.opengis.net/spec/WPS/2.0/req/service/binding/get-kvp/get-status/response-xml <i>The response to a successful Dismiss request shall be a valid XML document of the type <code>wps:StatusInfo</code>.</i>

Table 55 – Dismiss request KVP encoding

Names	Definition	Data type and values	Multiplicity and use
service	Identifier of the OGC service.	String, fixed to “WPS”	One (mandatory)
version	Request protocol version.	String, 2.0.0	One (mandatory)
request	Request name.	String, fixed to “Dismiss”, case insensitive.	One (mandatory)
jobid	Job identifier.	Character String. This shall be a JobID the client has received during process execution.	One (mandatory)

Annex A: Abstract Test Suite (Normative)

Tests and requirement identifiers below are relative to
<http://www.opengis.net/spec/WPS/2.0>

A.1 Basic WPS (Conformance Class)

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/WPS/2.0/conf/service/profile/basic-wps>

- a) Test purpose: Verify that the server implements the Basic WPS conformance class.
- b) Test method: Verify that the server implements the Synchronous WPS and/or the Asynchronous WPS conformance class. Verify that the requests and responses to a supported operation are syntactically correct. Verify that the service supports the Synchronous WPS Conformance class, the Asynchronous WPS Conformance class or both. Verify that all process offerings implement the native process model. Verify the following list of conformance tests:
 - A.4.1, A.4.3
 - A.2 and/or A.3

A.2 Synchronous WPS (Conformance Class)

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/WPS/2.0/conf/service/synchronous-wps>

Test id: **conf/service/synchronous-wps**

Requirement: **req/service/model/synchronous-wps/sync-execute**

Test purpose: Verify that the server correctly advertises synchronous execution capabilities. Verify that the server correctly implements all operations that are mandatory for synchronous execution.

Test method: Verify that the `GetCapabilities`, `DescribeProcess` and `Execute` operations appear in the *ows:OperationsMetadata* element.

Verify that the server offers at least one *wps:ProcessSummary* element whose “`jobControlOptions`” attribute contains “`sync-execute`”.

Verify that the service supports at least one binding (e.g. HTTP GET/POST) for each supported operation. Verify the following list of conformance tests:

- A.5.1, A.5.2, A.5.3, A.5.4, A.5.5, A.5.6, A.5.7, A.5.8

- A.5.9 and/or A.5.16
- A.5.10 and/or A.5.17
- A.5.11, A.5.13.

A.3 Asynchronous WPS (Conformance Class)

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/WPS/2.0/conf/service/asynchronous-wps>

Test id: **conf/service/asynchronous-wps**

Requirement: **req/service/model/asynchronous-wps**

Test purpose: Verify that the server correctly advertises asynchronous execution capabilities. Verify that the server correctly implements all operations that are mandatory for asynchronous execution.

Test method: Verify that the GetCapabilities, DescribeProcess, Execute, GetStatus and GetResult operations appear in the *ows:OperationsMetadata* element.

Verify that the server offers at least one *wps:ProcessSummary* element whose “jobControlOptions” attribute contains “async-execute”.

Verify that the service supports at least one binding (e.g. HTTP GET/POST) for each supported operation. Verify the following list of conformance tests:

- A.5.1, A.5.2, A.5.3, A.5.4, A.5.5, A.5.6, A.5.7, A.5.8
- A.5.9 and/or A.5.16
- A.5.10 and/or A.5.17
- A.5.12, A.5.13
- A.5.14 and/or A.5.18
- A.5.15 and / or A.5.19

A.4 WPS Process Model Encoding (Conformance Class)

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/WPS/2.0/conf/process-model-encoding>

A.4.1 Process XML Encoding

Test id: **conf/process-model-encoding/xml-encoding/process**

Requirement: **req/native-process/xml-encoding/process**

Test purpose: Verify that a given process description is in compliance with the Process XML encoding.

Test method: Verify that the tested document fulfils all requirements listed in req/native-process/xml-encoding/process.

A.4.2 Generic Process XML Encoding

Test id: **conf/process-model-encoding/xml-encoding/generic-process**

Requirement: **req/native-process/xml-encoding/generic-process**

Test purpose: Verify that a given generic process description is in compliance with the generic process XML encoding.

Test method: Verify that the tested document fulfils all requirements listed in req/native-process/xml-encoding/generic-process.

A.4.3 Process data types XML Encoding

Test id: **conf/process-model-encoding/xml-encoding/datatypes**

Requirement: **req/native-process/xml-encoding/datatypes**

Test purpose: Verify that any XML data type description and values that are used in conjunction with the native process model are encoded in compliance with the process model XML encoding.

Test method: For ComplexData descriptions: Test passes if the tested XML fragment validates against *wps:ComplexData*.

For LiteralData descriptions: Test passes if the tested XML fragment validates against *wps:LiteralData*.

For BoundingBoxData descriptions: Test passes if the tested XML fragment validates against *wps:BoundingBoxData*.

For ComplexData values: No general test available; the correctness of complex data values must be tested against a particular data type specification given by mime type, encoding and schema.

For LiteralData values: Test passes if the tested XML fragment validates against *wps:LiteralValue*.

For BoundingBoxData values: Test passes if the tested XML fragment validates against *ows:BoundingBox*.

A.5 Basic tests

A.5.1 Request service name

Test id: **conf/common-wps/handling/service**

Requirement: **req/service/model/handling/service**

Test purpose: Verify that the correctly handles the service name parameter.

Test method: For each request type, send valid requests to server under test. Modulate service parameter:

- Parameter value equal to what is required. Verify that request succeeds.
- Parameter value not equal to what is required. Verify that request fails.

Overall test passes if all individual tests pass.

A.5.2 Request version number

Test id: **conf/common-wps/handling/version**

Requirement: **req/service/model/handling/version**

Test purpose: Verify that the correctly handles the service version parameter.

Test method: For each request type, send valid requests to server under test. Modulate the version parameter:

- Parameter value equal to what is required. Verify that request succeeds.
- Parameter value not equal to what is required. Verify that request fails.

Overall test passes if all individual tests pass.

A.5.3 Input data transmission by value

Test id: **conf/common-wps/data-transmission/input-by-value**

Requirement: **req/conceptual-model/data-transmission/input-by-value**

Test purpose: Verify that the server correctly handles input data transmission by

value.

Test method: Send Execute requests to the server under test with valid inputs passed by value. Test passed if the execution finishes successfully.

A.5.4 Input data transmission by reference

Test id: **conf/common-wps/input-by-reference**

Requirement: **req/conceptual-model/data-transmission/input-by-reference**

Test purpose: Verify that the server correctly handles input data transmission by reference.

Test method: Send Execute requests to the server under test with valid inputs passed by reference. Test passed if the execution finishes successfully.

A.5.5 Output data transmission by value

Test id: **conf/common-wps/data-transmission/output-by-value**

Requirement: **req/conceptual-model/data-transmission/output-by-value**

Test purpose: Verify that the server correctly handles output data transmission by value.

Test method: Check the available process offerings for outputs that can be retrieved by value. If there is an output that can be retrieved by value, send an Execute request to the server requesting the output by value. Test passes if a valid Execute response is returned containing the requested output.

Skip this test if no output can be retrieved by value.

A.5.6 Output data transmission by reference

Test id: **conf/common-wps/data-transmission/output-by-reference**

Requirement: **req/conceptual-model/data-transmission/output-by-reference**

Test purpose: Verify that the server correctly handles output data transmission by reference.

Test method: Check the available process offerings for outputs that can be retrieved by reference. If there is an output that can be retrieved by reference, send an Execute request to the server requesting the output by reference. Test passes if a valid Execute response is returned containing a reference to the requested output.

Skip this test if no output can be retrieved by reference.

A.5.7 Unique process identifier

Test id: **conf/common-wps/identifier**

Requirement: **req/conceptual-model/process/identifier**

Test purpose: Verify that each process the server offers has a unique identifier.

Test method: Get all available processes from the server under test. Test passes if all processes have a unique identifier.

A.5.8 Unique job identifier

Test id: **conf/common-wps/job/identifier**

Requirement: **req/conceptual-model/job/identifier**

Test purpose: Verify that the server creates a unique jobID for each job.

Test method: Send more than one asynchronous Execute requests to the server under test. Test passes if the retrieved JobIDs differ from each other.

A.5.9 GetCapabilities POST/XML encoding request/response

Test id: **conf/service/binding/post-xml/get-capabilities/request-response**

Requirement: **req/service/binding/post-xml/get-capabilities/request**
req/service/binding/post-xml/get-capabilities/response

Test purpose: Verify that the server can handle GetCapabilities requests via POST/XML.

Test method: Send a valid GetCapabilities request to the server under test. Test passes if a valid document of the type *wps:Capabilities* is returned.

A.5.10 DescribeProcess POST/XML encoding request/response

Test id: **conf/service/binding/post-xml/describe-process/request-response**

Requirement: **req/service/binding/post-xml/describe-process/request**
req/service/binding/post-xml/describe-process/response

Test purpose: Verify that the server can handle DescribeProcess requests via POST/XML.

Test method: Send a valid DescribeProcess request to the server under test. Test

passes if a valid document of the type *wps:ProcessOfferings* is returned.

A.5.11 Synchronous Execute POST/XML encoding request/response

- Test id: **conf/service/binding/post-xml/execute-sync/request-response**
- Requirement: **req/service/binding/post-xml/execute/request**
req/service/binding/post-xml/execute/response
- Test purpose: Verify that the server can handle synchronous Execute requests via POST/XML.
- Test method: Send a valid XML Execute request to the server under test, setting the “mode” attribute to “sync”. Modulate the “response” parameter:
- Parameter value equal “document”. Verify that a valid Execute *wps:Result* is returned.
 - Parameter equal to “raw”. Verify that is returned.

Overall test passes if all individual tests pass.

A.5.12 Asynchronous Execute POST/XML encoding request/response

- Test id: **conf/service/binding/post-xml/execute-async/request-response**
- Requirement: **req/service/binding/post-xml/execute/request**
req/service/binding/post-xml/execute/response
- Test purpose: Verify that the server can handle asynchronous Execute requests via POST/XML.
- Test method: Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Test passes if a valid Execute *wps:StatusInfo* document is returned.

A.5.13 Auto Execute POST/XML encoding request/response

- Test id: **conf/service/binding/post-xml/execute-auto/request-response**
- Requirement: **req/service/binding/post-xml/execute/request**
req/service/binding/post-xml/execute/response
- Test purpose: Verify that the server can handle the execution mode “auto” requested via POST/XML.
- Test method: Send a valid XML Execute request to the server under test, setting the

“mode” attribute to “auto”. Modulate the “response” parameter.

- **Case 1)** If the process offering supports document output set “response” parameter value equal “document”. Check the execute response according to the following cases:
 - Case 1a) If the process offering supports “sync-execute” and not “async-execute”: Verify that a valid Execute *wps:Result* document is returned.
 - Case 1b) If the process offering supports “async-execute” and not “sync-execute”: Verify that a valid Execute *wps:StatusInfo* document is returned.
 - Case 1c) If the process offering supports “sync-execute” and “async-execute”: Verify that a valid Execute *wps:Result* document or a valid *wps:StatusInfo* document is returned.
- **Case 2)** If the process offering supports raw output set “response” parameter equal to “raw”. Check the execute response according to the following cases:
 - Case 2a) If the process offering supports “sync-execute” and not “async-execute”: Verify that valid that raw data is returned.
 - Case 2b) If the process offering supports “async-execute” and not “sync-execute”: Verify that a valid Execute *wps:StatusInfo* document is returned.
 - Case 2c) If the process offering supports “sync-execute” and “async-execute”: Verify that raw data or a valid *wps:StatusInfo* document is returned.

Overall test passes if all individual tests pass.

A.5.14 GetStatus POST/XML encoding request/response

Test id:	conf/service/binding/post-xml/get-status/request-response
Requirement:	req/service/binding/post-xml/get-status/request req/service/binding/post-xml/get-status/response
Test purpose:	Verify that the server can handle GetStatus requests via POST/XML.
Test method:	Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Verify that a valid <i>wps:StatusInfo</i> document is returned. Extract the <i>wps:JobID</i> .

Send a valid XML GetStatus request to the server under test using the extracted JobID. Test passes if a valid *wps:StatusInfo* document is returned.

A.5.15 GetResult POST/XML encoding request/response

- Test id: **conf/service/binding/post-xml/get-result/request-response**
- Requirement: **req/service/binding/post-xml/get-result/request**
req/service/binding/post-xml/get-result/response
- Test purpose: Verify that the server can handle GetResult requests via POST/XML.
- Test method: Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Modulate the “response” parameter. Verify that a valid *wps:StatusInfo* document is returned. Extract the *wps:JobID*. Check the status of the job. If the job succeeded, send a valid XML GetResult request to the server under test using the extracted JobID. Depending on the value of the “response” parameter of the above Execute request:
- Parameter value equal “document”. Verify that a valid Execute *wps:Result* document is returned.
 - Parameter equal to “raw”. Verify that raw is returned.
- Overall test passes if all individual tests pass.

A.5.16 GetCapabilities GET/KVP encoding request/response

- Test id: **conf/service/binding/get-kvp/get-capabilities/request-response**
- Requirement: **req/service/binding/get-kvp/get-capabilities/request**
req/service/binding/get-kvp/get-capabilities/response
- Test purpose: Verify that the server can handle GetCapabilities requests via GET/KVP.
- Test method: Send a valid KVP GetCapabilities request to the server under test, modulating upper and lower case of the parameter names. Test passes if a valid document of the type *wps:Capabilities* is returned.

A.5.17 DescribeProcess GET/KVP encoding request/response

- Test id: **conf/service/binding/get-kvp/describe-process/request-response**
- Requirement: **req/service/binding/get-kvp/describe-process/request**
req/service/binding/get-kvp/describe-process/response
- Test purpose: Verify that the server can handle DescribeProcess requests via GET/KVP.

Test method: Send a valid KVP DescribeProcess request to the server under test, modulating upper and lower case of the parameter names. Test passes if a valid document of the type *wps:ProcessOfferings* is returned.

A.5.18 GetStatus GET/KVP encoding request/response

Test id: **conf/service/binding/get-kvp/get-status/request-response**

Requirement: **req/service/binding/get-kvp/get-status/request**
req/service/binding/get-kvp/get-status/response

Test purpose: Verify that the server can handle GetStatus requests via GET/KVP.

Test method: Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Verify that a valid *wps:StatusInfo* document is returned. Extract the *wps:JobID*.

Send a valid KVP GetStatus request to the server under test, using the extracted JobID and modulating upper and lower case of the parameter names. Test passes if a valid document of the type *wps:StatusInfo* is returned.

A.5.19 GetResult GET/KVP encoding request/response

Test id: **conf/service/binding/get-kvp/get-result/request-response**

Requirement: **req/service/binding/get-kvp/get-result/request**
req/service/binding/get-kvp/get-result/response

Test purpose: Verify that the server can handle GetResult requests via GET/KVP.

Test method: Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Modulate the “response” parameter. Verify that a valid *wps:StatusInfo* document is returned. Extract the *wps:JobID*. Check the status of the job. If the job succeeded, send a valid KVP GetResult request to the server under test using the extracted JobID and modulating upper and lower case of the parameter names. Depending on the value of the “response” parameter of the above Execute request:

- Parameter value equal “document”. Verify that a valid Execute *wps:Result* document is returned.
- Parameter equal to “raw”. Verify that raw is returned.

Overall test passes if all individual tests pass.

A.6 Dismiss Extension (Conformance Class)

The OGC URI identifier of this conformance class is:

<http://www.opengis.net/spec/WPS/2.0/conf/service/dismiss-extension>

Test id: **conf/service/dismiss-extension**

Requirement: **req/service/model/dismiss/operation**

Test purpose: Verify that the server correctly advertises dismiss capabilities. Verify that the server correctly implements the Dismiss operation.

Test method: Verify that the Dismiss operation appears in the `ows:OperationsMetadata` element.

Verify that the server offers at least one *wps:ProcessSummary* element whose “jobControlOptions” attribute contains “dismiss”.

Verify that the service supports at least one binding (e.g. HTTP GET/POST) for the dismiss operation by verifying A.6.1 and/or A.6.2.

A.6.1 Dismiss POST/XML encoding request/response

Test id: **conf/service/binding/post-xml/dismiss/request-response**

Requirement: **req/service/binding/post-xml/dismiss/request**
req/service/binding/post-xml/dismiss/response

Test purpose: Verify that the server can handle Dismiss requests via POST/XML.

Test method: Precondition: The process offering used for testing must have “dismiss” listed among its job control options.

Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Verify that a valid *wps:StatusInfo* document is returned. Extract the *wps:JobID*.

Send a valid XML Dismiss request to the server under test using the extracted JobID. Test passes if a valid *wps:StatusInfo* document is returned containing a *wps:Status* element with value “Dismissed” (case insensitive).

A.6.2 Dismiss GET/KVP encoding request/response

Test id: **conf/service/binding/get-kvp/dismiss/request-response**

Requirement: **req/service/binding/get-kvp/dismiss/request**
req/service/binding/get-kvp/dismiss/response

Test purpose: Verify that the server can handle Dismiss requests via GET/KVP.

Test method: Precondition: The process offering used for testing must have “dismiss” listed among its job control options.

Send a valid XML Execute request to the server under test, setting the “mode” attribute to “async”. Verify that a valid *wps:StatusInfo* document is returned. Extract the *wps:JobID*.

Send a valid KVP Dismiss request to the server under test using the extracted JobID and modulating upper and lower case of the parameter names. Test passes if a valid document of the type *wps:StatusInfo* document is returned containing a *wps:Status* element with value “Dismissed” (case insensitive).

Annex B: XML Examples (informative)

B.1 Data Types

B.1.1 Complex Data Description

```
<wps:ComplexData>
  <wps:Format mimeType="application/geotiff" encoding="raw"
    default="true"/>
  <wps:Format mimeType="application/geotiff" encoding="base64"/>
</wps:ComplexData>
```

B.1.2 Literal Data Description

```
<wps:LiteralData>
  <wps:Format mimeType="text/plain" default="true"/>
  <wps:Format mimeType="text/xml"/>
  <LiteralDataDomain default="true">
    <ows:AllowedValues>
      <ows:Range>
        <ows:MinimumValue>1</ows:MinimumValue>
        <ows:MaximumValue>1000</ows:MaximumValue>
      </ows:Range>
    </ows:AllowedValues>
    <ows:DataType
      ows:reference="http://www.w3.org/2001/XMLSchema#float">float
    </ows:DataType>

    <ows:UOM>meters</ows:UOM>
    <ows:DefaultValue>100</ows:DefaultValue>
  </LiteralDataDomain>
  <LiteralDataDomain>
    <ows:AllowedValues>
      <ows:Range>
        <ows:MinimumValue>1</ows:MinimumValue>
        <ows:MaximumValue>3000</ows:MaximumValue>
      </ows:Range>
    </ows:AllowedValues>
    <ows:DataType
      ows:reference="http://www.w3.org/2001/XMLSchema#float">float
    </ows:DataType>

    <ows:UOM>feet</ows:UOM>
  </LiteralDataDomain>
</wps:LiteralData>
```

B.1.3 Literal data values

```
<LiteralValue
  dataType=http://www.w3.org/2001/XMLSchema#double
  uom="meter">
```

```

    42.1
  </LiteralValue>

  <LiteralValue
    dataType="http://www.w3.org/2001/XMLSchema#string">
    ArableLand
  </LiteralValue>

```

B.1.4 BoundingBox Data Description

```

<wps:BoundingBoxData>
  <wps:Format mimeType="text/plain" default="true"/>
  <wps:Format mimeType="text/xml"/>
  <wps:SupportedCRS default="true">EPSG:4326</wps:SupportedCRS>
  <wps:SupportedCRS>
    http://www.opengis.net/def/crs/EPSSG/0/4258
  </wps:SupportedCRS>
</wps:BoundingBoxData>

```

B.1.5 BoundingBox Data Values

```

<ows:BoundingBox crs="EPSG:4326">
  <ows:LowerCorner>51.9 7.0</ows:LowerCorner>
  <ows:UpperCorner>53.0 8.0</ows:UpperCorner>
</ows:BoundingBox>

<ows:BoundingBox
  crs="http://www.opengis.net/def/crs/EPSSG/0/4258">
  <ows:LowerCorner>51.9 7.0</ows:LowerCorner>
  <ows:UpperCorner>53.0 8.0</ows:UpperCorner>
</ows:BoundingBox>

```

B.2 Process Description

This example describes a buffer command that accepts polygon coordinates in GML, and used a buffer distance in meters to produce a buffered polygon feature, which is output in GML.

```

<wps:Process xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation=
    "http://www.opengis.net/wps/2.0.0 ../wps.xsd">

  <ows:Title>Planar Buffer operation for GML features</ows:Title>
  <ows:Abstract>

```



```

Create a buffer around a GML feature. Accepts any valid GML
feature and computes the joint buffer.</ows:Abstract>
<ows:Identifier>
  http://some.host/profileregistry/implementation/Planar-GML-
                                          Buffer
</ows:Identifier>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process-profile/concept"
  xlink:href="http://some.host/profileregistry/concept/
              buffer"/>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process-profile/concept"
  xlink:href="http://some.host/profileregistry/concept/
              planarbuffer"/>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process-profile/generic"
  xlink:href="http://some.host/profileregistry/generic/
              SF-Buffer"/>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process/description/documentation"
  xlink:href="http://some.host/profileregistry/implementation/
              Planar-GML-Buffer.html"/>
<wps:Input>
  <ows:Title>Geometry to be buffered</ows:Title>
  <ows:Abstract>Geometry input in GML</ows:Abstract>
  <ows:Identifier>INPUT_GEOMETRY</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                implementation/Planar-GML-Buffer.html#input_geometry"/>
  <wps:ComplexData>
    <wps:Format mimeType="text/xml" encoding="UTF-8"
      schema="http://schemas.opengis.net/gml/3.2.1/feature.xsd"
      default="true"/>
  </wps:ComplexData>
</wps:Input>
<wps:Input minOccurs="0">
  <ows:Title>Distance</ows:Title>
  <ows:Abstract>
    Distance to be used to calculate buffer.
  </ows:Abstract>
  <ows:Identifier>DISTANCE</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                implementation/Planar-GML-Buffer.html#distance"/>

```

```

<wps:LiteralData>
  <wps:Format mimeType="text/plain" default="true"/>
  <wps:Format mimeType="text/xml"/>
  <LiteralDataDomain default="true">
    <ows:AllowedValues>
      <ows:Range>
        <ows:MinimumValue>1</ows:MinimumValue>
        <ows:MaximumValue>unbounded</ows:MaximumValue>
      </ows:Range>
    </ows:AllowedValues>
    <ows:DataType
      ows:reference="http://www.w3.org/2001/
                    XMLSchema#double">Double</ows:DataType>
  </LiteralDataDomain>
</wps:LiteralData>
</wps:Input>
<wps:Output>
  <ows:Title>Buffered Geometry</ows:Title>
  <ows:Abstract>
    GML stream describing the buffered Geometry.</ows:Abstract>
  <ows:Identifier>BUFFERED_GEOMETRY</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                implementation/Planar-GML-Buffer.html#buffered_geometry"/>
  <wps:ComplexData>
    <wps:Format mimeType="text/xml" encoding="UTF-8"
      schema="http://schemas.opengis.net/gml/3.2.1/feature.xsd"
      default="true"/>
  </wps:ComplexData>
</wps:Output>
</wps:Process>

```

B.3 Generic Process

This example describes a generic profile for a simple features buffer. It returns a geometry that represents all points whose distance from this Geometry is less than or equal to distance. Calculations are in the Spatial Reference System of this Geometry.

```

<wps:GenericProcess
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xml="http://www.w3.org/XML/1998/namespace"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
    ../..../processProfile.xsd">
  <ows:Title>Simple Features Buffer</ows:Title>
  <ows:Identifier>http://some.host/profileregistry/generic/
    SF-Buffer</ows:Identifier>

```

```

<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process-profile/concept"
  xlink:href="http://some.host/profileregistry/
              concept/buffer"/>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process-profile/concept"
  xlink:href="http://some.host/profileregistry/
              concept/planarbuffer"/>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/def/
              process/description/documentation"
  xlink:href="http://some.host/profileregistry/
              generic/SF-Buffer.html"/>
<wps:Input>
  <ows:Title>Input Geometry</ows:Title>
  <ows:Identifier>INPUT_GEOMETRY</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                generic/SF-Buffer.html#input_geometry"/>
</wps:Input>
<wps:Input>
  <ows:Title>Distance</ows:Title>
  <ows:Identifier>DISTANCE</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                generic/SF-Buffer.html#distance"/>
</wps:Input>
<wps:Output>
  <ows:Title>Buffered Geometry</ows:Title>
  <ows:Identifier>BUFFERED_GEOMETRY</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/def/
                process/description/documentation"
    xlink:href="http://some.host/profileregistry/
                generic/SF-Buffer.html#buffered_geometry"/>
</wps:Output>
</wps:GenericProcess>

```

B.4 GetCapabilities

B.4.1 GetCapabilities Request

```

<wps:GetCapabilities service="WPS"
  xmlns:ows="http://www.opengis.net/ows/2.0"

```

```

xmlns:wps="http://www.opengis.net/wps/2.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
  ../wpsGetCapabilities.xsd">
</wps:GetCapabilities>

```

B.4.2 GetCapabilities Response

```

<wps:Capabilities service="WPS" version="2.0.0"
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xml="http://www.w3.org/XML/1998/namespace"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
    ../wpsGetCapabilities.xsd ">
  <ows:ServiceIdentification>
    <ows:Title>MyWebProcessingService</ows:Title>
    <ows:Abstract>
      A Web Processing Service offering typical GIS distance
      transform processes.
    </ows:Abstract>
    <ows:Keywords>
      <ows:Keyword>Geoprocessing</ows:Keyword>
      <ows:Keyword>Toolbox</ows:Keyword>
      <ows:Keyword>Distance transform</ows:Keyword>
    </ows:Keywords>
    <ows:ServiceType>WPS</ows:ServiceType>
    <ows:ServiceTypeVersion>2.0.0</ows:ServiceTypeVersion>
    <ows:Fees>NONE</ows:Fees>
    <ows:AccessConstraints>NONE</ows:AccessConstraints>
  </ows:ServiceIdentification>
  <ows:ServiceProvider>
    <ows:ProviderName>TU Dresden</ows:ProviderName>
    <ows:ProviderSite
      xlink:href="http://tu-dresden.de/geo/gis" />
  <ows:ServiceContact>
    <ows:IndividualName>Matthias Mueller</ows:IndividualName>
    <ows:ContactInfo>
      <ows:Address>
        <ows:ElectronicMailAddress>
          matthias_mueller@tu-dresden.de
        </ows:ElectronicMailAddress>
      </ows:Address>
    </ows:ContactInfo>
  </ows:ServiceContact>
</ows:ServiceProvider>
<ows:OperationsMetadata>
  <ows:Operation name="GetCapabilities">

```

```

    <ows:DCP>
      <ows:HTTP>
        <ows:Get
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  <ows:Operation name="DescribeProcess">
    <ows:DCP>
      <ows:HTTP>
        <ows:Get
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        <ows:Post
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  <ows:Operation name="Execute">
    <ows:DCP>
      <ows:HTTP>
        <ows:Post
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  <ows:Operation name="GetStatus">
    <ows:DCP>
      <ows:HTTP>
        <ows:Get
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        <ows:Post
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  <ows:Operation name="GetResult">
    <ows:DCP>
      <ows:HTTP>
        <ows:Get
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        <ows:Post
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        </ows:HTTP>
      </ows:DCP>
    </ows:Operation>
  <ows:Operation name="Dismiss">
    <ows:DCP>
      <ows:HTTP>
        <ows:Get
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>
        <ows:Post
          xlink:href="http://wps1.gis.geo.tu-dresden.de/wps"/>

```

```

        </ows:HTTP>
    </ows:DCP>
</ows:Operation>
</ows:OperationsMetadata>
<wps:Contents>
    <wps:ProcessSummary
        jobControlOptions="sync-execute async-execute dismiss">
        <ows:Title>Euclidean Distance</ows:Title>
        <ows:Identifier>
            http://my.site/distance-transform/euclidean-distance
        </ows:Identifier>
    </wps:ProcessSummary>
    <wps:ProcessSummary
        jobControlOptions="async-execute dismiss">
        processVersion="1.4.0">
        <ows:Title>Cost Distance</ows:Title>
        <ows:Identifier>
            http://my.site/distance-transform/cost-distance
        </ows:Identifier>
    </wps:ProcessSummary>
</wps:Contents>
</wps:Capabilities>

```

B.5 DescribeProcess

B.5.1 DescribeProcess Request

```

<wps:DescribeProcess service="WPS" version="2.0.0"
    xmlns:ows="http://www.opengis.net/ows/2.0"
    xmlns:wps="http://www.opengis.net/wps/2.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
        ../wpsDescribeProcess.xsd">
    <ows:Identifier>Buffer</ows:Identifier>
    <ows:Identifier>Viewshed</ows:Identifier>
</wps:DescribeProcess>

```

B.5.2 DescribeProcess Response

```

<wps:ProcessOfferings
    xmlns:wps="http://www.opengis.net/wps/2.0.0"
    xmlns:ows="http://www.opengis.net/ows/2.0"
    xmlns:xlink="http://www.w3.org/1999/xlink"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
        ../wpsDescribeProcess.xsd">
    <wps:ProcessOffering
        jobControlOptions="sync-execute async-execute dismiss"
        outputTransmission="value reference">

```

```

<wps:Process>
  <ows:Title>
    Planar Buffer operation for Simple Features
  </ows:Title>
  <ows:Abstract>
    Create a buffer around Simple Feature geometries. Accepts
    any valid simple features input in GML or GeoJson and
    computes their joint buffer geometry.
  </ows:Abstract>
  <ows:Identifier>
    http://my.wps.server/processes/proximity/Planar-Buffer
  </ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/
                def/process-profile/concept"
    xlink:href="http://some.host/profileregistry/
                concept/buffer"/>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/
                def/process-profile/concept"
    xlink:href="http://some.host/profileregistry/
                concept/planarbuffer"/>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/
                def/process-profile/generic"
    xlink:href="http://some.host/profileregistry/
                generic/SF-Buffer"/>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/
                def/process/description/documentation"
    xlink:href="http://my.wps.server/processes/
                proximity/Planar-Buffer.html"/>
  <wps:Input>
    <ows:Title>Geometry to be buffered</ows:Title>
    <ows:Abstract>
      Simple Features geometry input in GML or GeoJson
    </ows:Abstract>
    <ows:Identifier>INPUT_GEOMETRY</ows:Identifier>
    <ows:Metadata
      xlink:role="http://www.opengis.net/spec/wps/2.0/
                  def/process/description/documentation"
      xlink:href="http://my.wps.server/processes/
                  proximity/Planar-Buffer.html#input_geometry"/>
    <wps:ComplexData>
      <wps:Format mimeType="text/xml" encoding="UTF-8"
        schema="http://schemas.opengis.net/gml/
                3.2.1/feature.xsd" default="true"/>
      <wps:Format mimeType="application/json"
        encoding="UTF-8"/>
    </wps:ComplexData>
  </wps:Input>
  <wps:Input minOccurs="0">

```

```

<ows:Title>Distance</ows:Title>
<ows:Abstract>
  Distance to be used to calculate buffer.
</ows:Abstract>
<ows:Identifier>DISTANCE</ows:Identifier>
<ows:Metadata
  xlink:role="http://www.opengis.net/spec/wps/2.0/
    def/process/description/documentation"
  xlink:href="http://my.wps.server/processes/
    proximity/Planar-Buffer.html#distance"/>
<wps:LiteralData>
  <wps:Format mimeType="text/plain" default="true"/>
  <wps:Format mimeType="text/xml"/>
  <LiteralDataDomain default="true">
    <ows:AllowedValues>
      <ows:Range>
        <ows:MinimumValue>1</ows:MinimumValue>
        <ows:MaximumValue>unbounded</ows:MaximumValue>
      </ows:Range>
    </ows:AllowedValues>
    <ows:DataType
      ows:reference="http://www.w3.org/2001/
        XMLSchema#double">
      Double
    </ows:DataType>
  </LiteralDataDomain>
</wps:LiteralData>
</wps:Input>
<wps:Output>
  <ows:Title>Buffered Geometry</ows:Title>
  <ows:Abstract>
    Output Geometry in GML or GeoJson
  </ows:Abstract>
  <ows:Identifier>BUFFERED_GEOMETRY</ows:Identifier>
  <ows:Metadata
    xlink:role="http://www.opengis.net/spec/wps/2.0/
      def/process/description/documentation"
    xlink:href="http://my.wps.server/processes/
      proximity/Planar-Buffer.html#buffered_geometry"/>
  <wps:ComplexData>
    <wps:Format mimeType="text/xml" encoding="UTF-8"
      schema="http://schemas.opengis.net/gml/
        3.2.1/feature.xsd" default="true"/>
    <wps:Format mimeType="application/json"
      encoding="UTF-8"/>
  </wps:ComplexData>
</wps:Output>
</wps:Process>
</wps:ProcessOffering>
</wps:ProcessOfferings>

```


B.6 Execute**B.6.1 Execute Request (asynchronous, result document)**

```

<wps:Execute
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
                      ../wpsExecute.xsd"
  service="WPS" version="2.0.0" response="document"
                                     mode="async">
  <ows:Identifier>
    http://my.wps.server/processes/proximity/Planar-Buffer
  </ows:Identifier>
  <wps:Input id="INPUT_GEOMETRY">
    <wps:Reference xlink:href="http://some.data.server/
                      mygmldata.xml"/>
  </wps:Input>
  <wps:Input id="DISTANCE">
    <wps:Data>10</wps:Data>
  </wps:Input>
  <!-- Uses default output format -->
  <wps:Output id="BUFFERED_GEOMETRY"
              wps:dataTransmissionMode="reference">
  </wps:Output>
</wps:Execute>

```

B.6.2 Execute Response (StatusInfo)

```

<wps:StatusInfo xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
                      ../wpsStatusInfo.xsd">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
  <wps:Status>Accepted</wps:Status>
  <wps:NextPoll>2014-12-24T16:00:00Z</wps:NextPoll>
</wps:StatusInfo>

```

B.6.3 Execute Response (Result)

```

<wps:Result
  xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0

```

```

                ../wpsGetResult.xsd ">
    <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
    <wps:ExpirationDate>2014-12-24T24:00:00Z</wps:ExpirationDate>
    <wps:Output id="BUFFERED_GEOMETRY">
      <wps:Reference
        xlink:href="http://result.data.server/
                    FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66/
                    BUFFERED_GEOMETRY.xml"/>
    </wps:Output>
  </wps:Result>

```

B.7 GetStatus

B.7.1 GetStatus Request

```

<wps:GetStatus service="WPS" version="2.0.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
    ../wpsStatusInfo.xsd ">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
</wps:GetStatus>

```

B.7.2 GetStatus Response

```

<wps:StatusInfo xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
    ../wpsStatusInfo.xsd">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
  <wps:Status>Running</wps:Status>
  <wps:NextPoll>2014-12-24T16:00:00Z</wps:NextPoll>
</wps:StatusInfo>

```

B.8 GetResult

B.8.1 GetResult Request

```

<wps:GetResult service="WPS" version="2.0.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
    ../wpsGetResult.xsd ">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
</wps:GetResult>

```

B.8.2 GetResult Response

See Annex B.6.3.

B.9 Dismiss

B.9.1 Dismiss Request

```

<wps:Dismiss service="WPS" version="2.0.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
                      ../wpsDismiss.xsd ">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
</wps:Dismiss>

```

B.9.2 Dismiss Response

```

<wps:StatusInfo xmlns:ows="http://www.opengis.net/ows/2.0"
  xmlns:wps="http://www.opengis.net/wps/2.0.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.opengis.net/wps/2.0.0
                      ../wpsStatusInfo.xsd">
  <wps:JobID>FB6DD4B0-A2BB-11E3-A5E2-0800200C9A66</wps:JobID>
  <wps:Status>Dismissed</wps:Status>
</wps:StatusInfo>

```

B.10 Profile inheritance example

Taking the example of a simple Mosaic process, Figure 26 and Figure 27 illustrate the inheritance rules for process profiles provided in section 7.5.4. In its most simple form, a mosaic process transforms a set of tiles (Coverages or georeferenced imagery) into a single output dataset. Starting from the conceptual level, the process definition is incrementally refined until the specificity of an implementation profile is reached. At the level of a profile implementation, e.g. on a particular WPS instance, the implementer may still extend the contract of the implementation profile (e.g. by allowing more or larger input data).

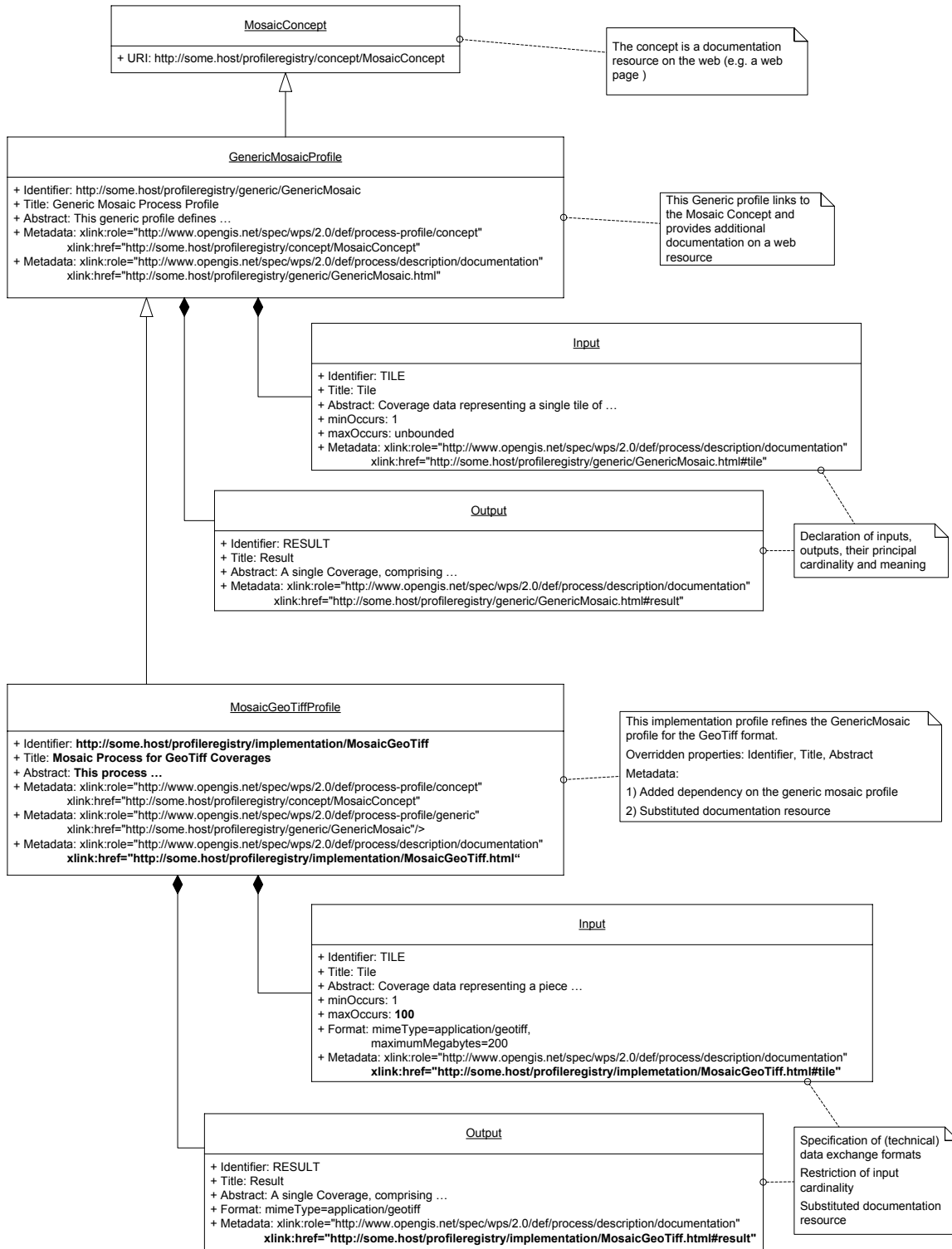


Figure 26 – Profile inheritance example for a mosaic process

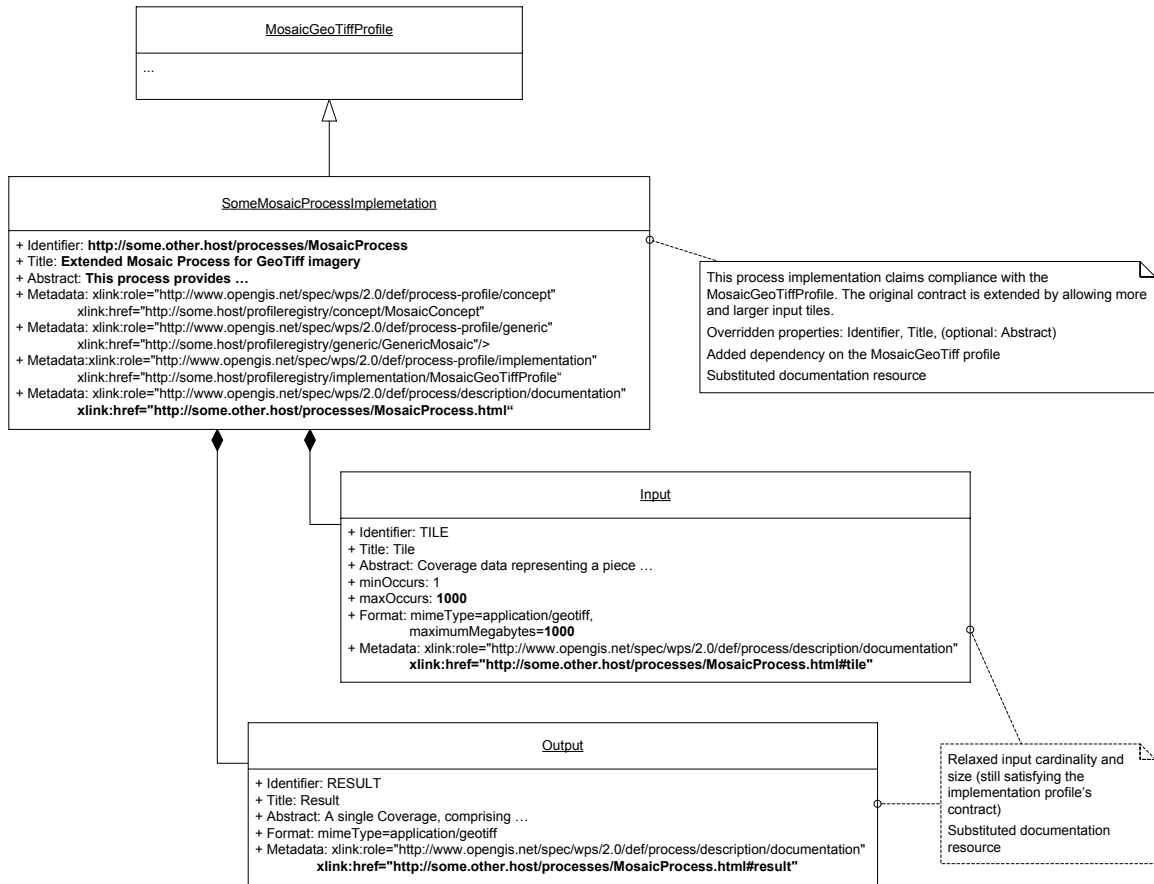


Figure 27 – Profile inheritance example for a mosaic process, extension by an implementation