OGC Testbed-14

WPS-T Engineering Report
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Chapter 1. Summary

This Engineering Report describes a proposed transactional extension for the OGC Web Processing Service (WPS) 2.0 standard including Key-Value Pair (KVP) and Extensible Markup Language (XML) bindings and recommendations for a process deployment profile for BPMN (Business Process Model and Notation).

1.1. Requirements & Research Motivation

The need to dynamically add custom processing functionality to servers is steadily growing. For example, in the Earth Observation community the custom is to move the processing functionality to the data, typically using containers. Also, the creation of workflows and the dynamic upload of them is an area of growing interest.

This ER builds on lessons from the previous testbed, Testbed-13, which were documented and presented by Pross and Stasch [1].

1.2. Prior-After Comparison

Currently, no transactional extension is available for WPS 2.0. An unofficial discussion paper is currently available that is the basis for this report. That discussion paper uses concepts from WPS 1.0. This Engineering Report defines a transactional extension for WPS 2.0. In abbreviated form, the transactional extension of WPS is referred to as WPS-T. The ER also provides the schemas and abstract test suite for the extension.

1.3. Recommendations for Future Work

This document should be the foundation for a transactional extension for the WPS 2.0 standard. The following aspects need further investigation:

- Security
- Discovery of deployment profiles
- WPS-T Representational State Transfer (REST) binding

1.4. Document contributor contact points

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

Contacts

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<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
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<td>Compusult</td>
</tr>
</tbody>
</table>
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Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.
Chapter 2. References

- OGC: OGC 14-064r2r9, OGC® WPS 2.0.2 Interface Standard, 2010 [http://docs.opengeospatial.org/is/14-065/14-065.html]

Chapter 3. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard OGC 06-121r9 [https://portal.opengeospatial.org/files/?artifact_id=38867&version=2] shall apply. In addition, the following terms and definitions apply.

- **Container**
  
  A standardized unit of software

- **Workflow**
  
  Automation of a process, in whole or part, during which electronic documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules (source ISO 12651-2:2014)

3.1. Abbreviated terms

- BPMN Business Process Model and Notation
- COM Component Object Model
- COTS Commercial Off The Shelf
- WPS Web Processing Service
- WPS-T Transactional Web Processing Service
Chapter 4. Overview

Section 5 introduces an update to the WPS 2.0 GetCapabilities operation.

Section 6 describes the DeployProcess operation.

Section 7 presents the UndeployProcess operation.

Section 8 provides an overview of the BPMN DeploymentProfile specified in Testbed-14.
Chapter 5. GetCapabilities Operation Update

This section describes the update to the GetCapabilities operation.

5.1. Introduction

The WPS mandatory GetCapabilities operation allows clients to retrieve service metadata from a server. The response to a GetCapabilities request shall be an XML document containing service metadata about the server, including specific information about the offered processes. The extension of the Web Processing Service 2.0 interface with two new operations requires the modification of the GetCapabilities Metadata accordingly:

- Operation Metadata element shall be updated with two new Operation names "DeployProcess" and "UndeployProcess".
- For the specific case of DeployProcess Operation Metadata, the Constraint element is used to specify a list of supported process deployment profiles and consequently shall become mandatory.

This clause specifies an additional part of the XML document that a WPS 2.0 server implementing WPS-T extension shall return to describe its transactional capabilities.

5.2. GetCapabilities Operation Response Update

5.2.1. Normal response update

In addition to sections specified in [OGC 14-065] - Web Processing Service 2.0 that specify common parts of an RPC-style implementation, the service metadata document shall contain revised sections specified in Table 1.

<table>
<thead>
<tr>
<th>Section name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>OperationsMetadata</td>
<td>Metadata about the operations specified by this service and implemented by this server, including the URLs for operation requests. The basic contents and organization of this section shall be the same as for all OWSs, as specified in Subclause 7.4.6 and owsOperationsMetadata.xsd of [OGC 06-121r9] OGC Web Service Common Implementation Specification 2.0 and comply with specificities of [OGC 14-065r2] Web Processing Service 2.0 Interface Standard.</td>
</tr>
</tbody>
</table>

5.2.2. OperationsMetadata section standard contents

For the WPS-T, the OperationsMetadata section shall be the same as for all OGC Web Services, as specified in Subclause 7.4.5 and owsOperationsMetadata.xsd of [OGC 05-008] plus WPS 2.0 specificities specified in [OGC 14-065] WPS 2.0 Interface Standard. The mandatory values of various (XML) attributes shall be as specified in Table 2. Similarly, the optional attribute values listed in Table 3 shall be included, or not, depending on whether that operation is implemented by that
server. In Table 2 and Table 3, the “Attribute name” column uses dot-separator notation to identify parts of a parent item. The “Attribute value” column references an operation parameter, in this case an operation name, and the meaning of including that value is listed in the right column.

Table 2. Required values of OperationsMetadata section attributes

<table>
<thead>
<tr>
<th>Attribute name</th>
<th>Attribute value</th>
<th>Meaning of attribute value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation.name</td>
<td>GetCapabilities</td>
<td>The GetCapabilities operation is implemented by this server.</td>
</tr>
<tr>
<td></td>
<td>DescribeProcess</td>
<td>The DescribeProcess operation is implemented by this server.</td>
</tr>
<tr>
<td></td>
<td>Execute</td>
<td>The Execute operation is implemented by this server.</td>
</tr>
<tr>
<td></td>
<td>GetStatus</td>
<td>The GetStatus operation is implemented by this server.</td>
</tr>
<tr>
<td></td>
<td>GetResult</td>
<td>The GetResult operation is implemented by this server.</td>
</tr>
</tbody>
</table>

Table 3. Optional values of OperationsMetadata section attributes

<table>
<thead>
<tr>
<th>Attribute name</th>
<th>Attribute value</th>
<th>Meaning of attribute value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation.name</td>
<td>DeployProcess</td>
<td>The DeployProcess operation is implemented by this server.</td>
</tr>
<tr>
<td></td>
<td>UndeployProcess</td>
<td>The UndeployProcess operation is implemented by this server.</td>
</tr>
</tbody>
</table>

5.2.3. Constraint element for DeployProcess operation

Operation element for the operation DeployProcess uses the included Constraint element to specify the list of supported process deployment profiles. This Constraint element includes the element listed in Table 4.

Table 4. Parameters included in Constraint section

<table>
<thead>
<tr>
<th>Names</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>SupportedDeploymentProfiles</td>
<td>List of supported process deployment profiles - see Table 5</td>
<td>Ows:DomainType</td>
<td>Zero on One (conditional [1: Mandatory for Operation &quot;DeployProcess&quot;)</td>
</tr>
</tbody>
</table>

The SupportedDeploymentProfiles elements include elements listed in Table 5

Table 5. Parts of SupportedDeploymentProfiles data structure
### Default DeploymentSchema

Default deployment profile schema [2: Default deployment schema shall exist in the list of SupportedDeploymentSchema.] - see Table 6

<table>
<thead>
<tr>
<th>Names</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default DeploymentSchema</td>
<td>Default deployment profile schema [2: Default deployment schema shall exist in the list of SupportedDeploymentSchema.] - see Table 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DeploymentSchema</td>
<td>One (Mandatory)</td>
</tr>
</tbody>
</table>

The DeploymentSchema elements includes element listed in Table 6

### Supported DeploymentSchema

List of deployment profile schema - see Table 6

<table>
<thead>
<tr>
<th>Names</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported DeploymentSchema</td>
<td>List of deployment profile schema - see Table 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DeploymentSchema</td>
<td>One or more (mandatory)</td>
</tr>
</tbody>
</table>

**Table 6. Parts of DeploymentSchema data structure**

<table>
<thead>
<tr>
<th>Names</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>SchemaName</td>
<td>Name of the deployment schema</td>
<td>string</td>
<td>One (Mandatory)</td>
</tr>
<tr>
<td>SchemaReference</td>
<td>xlink to the deployment profile schema</td>
<td>xlink:href</td>
<td>Zero to One (Optional)</td>
</tr>
</tbody>
</table>

### 5.2.4. Capabilities document example

In response to a GetCapabilities operation request, a WPS 2.0 server which implement the WPS-T extension might generate a document for the section OperationMetadata that looks like:
<ows:Operation name="DeployProcess">
  <ows:DCP>
    <ows:HTTP>
    </ows:HTTP>
  </ows:DCP>
  <ows:Constraint>
    <wps:SupportedDeploymentProfiles>
      <wps:Default>
        <wps:DeploymentSchema
          name="BPMN"
      </wps:Default>
      <wps:Supported>
        <wps:DeploymentSchema
          name="BPMN"
        <wps:DeploymentSchema
          name="JavaVM"/>
      </wps:Supported>
    </wps:SupportedDeploymentProfiles>
  </ows:Constraint>
</ows:Operation>

<ows:Operation name="UndeployProcess">
  <ows:DCP>
    <ows:HTTP>
    </ows:HTTP>
  </ows:DCP>
</ows:Operation>
Chapter 6. DeployProcess Operation (Mandatory)

In the following sections, the DeployProcess operation is specified.

6.1. Introduction

The DeployProcess operation allows WPS 2.0 clients to dynamically deploy a process into a WPS 2.0 server which implements the WPS 2.0 Transactional Extension. On successful deployment, this process is now part of the WPS 2.0 server processing offering. Consequently, a WPS 2.0 client will be able to query its detailed description and request an execution as specified in [OGC 14-065r2] WPS 2.0 Standard Interface.

6.2. Transactional and atomic behavior of DeployProcess operation

The DeployProcess operation impacts the result and/or behavior of:

- GetCapabilities operation
- DescribeProcess operation
- Execute operation

DeployProcess shall have an atomic behavior:

- On successful deployment, the process shall be part of the process offerings.
- On failed deployment, the process shall not be part of the process offerings in its full meaning.

From transactional point of view, process offering shall be impacted after the successful completion of the DeployProcess operation only.

6.3. DeployProcess operation request

In the following sections, the DeployProcess operation request is specified.

6.3.1. DeployProcess request parameters

A request to perform the DeployProcess operation shall include the use of the data structure specified in Table 7. This table also specifies the Unified Modeling Language (UML) model data type, source of values, and multiplicity of each listed parameter, plus the meaning to servers when each optional parameter is not included in the operation request. Although some values listed in the “Names” column appear to contain spaces, they shall not contain spaces.
To reduce the need for readers to refer to other documents, the first three parameters listed below are largely copied from Table 29 in Subclause 9.2.1 of [OGC 06-121r9].

Table 7. Parameters in DeployProcess operation request

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>Service type identifier</td>
<td>Character String type, not empty Value is OWS type abbreviation, fixed to “WPS”</td>
<td>One (Mandatory)</td>
</tr>
<tr>
<td>Request</td>
<td>Operation name</td>
<td>Character String type, not empty Value is operation name, fixed to “DeployProcess”</td>
<td>One (mandatory)</td>
</tr>
<tr>
<td>Version</td>
<td>Specification version for operation</td>
<td>Character String type, not empty Value is specified by each Implementation Specification and Schemas version</td>
<td>One (mandatory)</td>
</tr>
<tr>
<td>ProcessDescription</td>
<td>Full description of process, including all input and output parameters</td>
<td>ProcessDescriptionChoice data structure - see Table 8</td>
<td>Zero or One (optional) [4: This may be generated from the ExecutionUnit.]</td>
</tr>
<tr>
<td>ExecutionUnit</td>
<td>Concrete executable unit of the process</td>
<td>ExecutionUnit data structure - see Table 9</td>
<td>One or more (mandatory)</td>
</tr>
<tr>
<td>DeploymentProfileName</td>
<td>Name of the process profile deployment</td>
<td>Character String type, not empty</td>
<td>Zero or One (optional) [5: If not specified, default deployment profile would be used.]</td>
</tr>
<tr>
<td>immediateDeployment</td>
<td>Deploy the ExecutionUnit on the first execution</td>
<td>Boolean, default value is true.</td>
<td>Zero to One (optional)</td>
</tr>
</tbody>
</table>

Table 8. Parts of ProcessDescriptionChoice data structure

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Identifies process description as a web accessible resource, and references that resource</td>
<td>Reference data structure, see [OGC 14-065r2], Table 25</td>
<td>Zero or one (conditional) [6: One and only one of these two items shall be included.]</td>
</tr>
<tr>
<td>Name</td>
<td>Definition</td>
<td>Data type and values</td>
<td>Multiplicity and use</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>ProcessOffering</td>
<td>Identifies process description as being encapsulated in the DeployProcess request</td>
<td>ProcessOffering data structure - see [OGC 14-065r2], Table 40</td>
<td>Zero or one (conditional) [6: One and only one of these two items shall be included.]</td>
</tr>
</tbody>
</table>

Note: It may be useful to include additional metadata in the ProcessOffering.

### Table 9. Parts of ExecutionUnit data structure

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>Identifies the ExecutionUnit as a web accessible resource, and references that resource</td>
<td>Reference data structure, see [OGC 14-065r2], Table 25</td>
<td>Zero or one (conditional) [7: One and only one of these two items shall be included.]</td>
</tr>
<tr>
<td>Unit</td>
<td>Identifies the ExecutionUnit being encapsulated in the DeployProcess request</td>
<td>Any</td>
<td>Zero or one (conditional) [7: One and only one of these two items shall be included.]</td>
</tr>
</tbody>
</table>

**NOTE**

The data type of many parameters is specified as “Character String type, not empty”. In the XML Schema Documents specified herein, these parameters are encoded with the xsd:string type, which does NOT require that these strings not be empty.

The “Multiplicity and use” columns in Table 7 through Table 9 specify the optionality of each listed parameter and data structure in the DeployProcess operation request. All the “mandatory” parameters and data structures shall be implemented by all WPS 2.0 clients, using a specified value(s). Similarly, all the “mandatory” parameters and data structures shall be implemented by all WPS 2.0 servers, checking that each request parameter or data structure is received with any specified value(s). All the “optional” parameters and data structures, in the DeployProcess operation request, should be implemented by all WPS 2.0 clients using specified values. Similarly, all the “optional” parameters and data structures shall be implemented by all WPS 2.0 servers.

### 6.3.2. DeployProcess request KVP encoding

Servers may implement HTTP GET transfer of the DeployProcess operation request, using KVP encoding. The KVP encoding of the DeployProcess operation request shall use the parameters specified in Table 10. The parameters listed in Table 10 shall be as specified in Table 7 above.

### Table 10. DeployProcess operation request URL parameters
<table>
<thead>
<tr>
<th>Name and example [8: All parameter names are here listed using mostly lower case letters. However, any parameter name capitalization shall be allowed in KVP encoding, see Subclause 11.5.2 of [OGC 06-121r9]]</th>
<th>Optionality and use</th>
<th>Definition and format</th>
</tr>
</thead>
<tbody>
<tr>
<td>service=WPS</td>
<td>Mandatory</td>
<td>Service type identifier</td>
</tr>
<tr>
<td>request=DeployProcess</td>
<td>Mandatory</td>
<td>Operation name</td>
</tr>
<tr>
<td>version=2.0.0</td>
<td>Mandatory</td>
<td>Standard and schema version for this operation</td>
</tr>
<tr>
<td>processdescription=<a href="http://foo.bar/BufferProcessDescription.xml">http://foo.bar/BufferProcessDescription.xml</a></td>
<td>Optional</td>
<td>Reference to a full process description</td>
</tr>
<tr>
<td>executionunit=<a href="http://foo.bar/BufferProcessExecutable.war">http://foo.bar/BufferProcessExecutable.war</a></td>
<td>Mandatory</td>
<td>Reference to a concrete executable unit of the process</td>
</tr>
<tr>
<td>deploymentprofilename=&quot;ApplicationServer&quot;</td>
<td>Optional</td>
<td>Name of the process profile deployment</td>
</tr>
<tr>
<td>immediatedeployment=true</td>
<td>Optional</td>
<td>Boolean</td>
</tr>
</tbody>
</table>

**EXAMPLE**

An example DeployProcess operation request KVP encoded for HTTP GET is:

```
```

### 6.3.3. DeployProcess request XML encoding

All WPS 2.0 servers which support the WPS-T extension should implement HTTP POST transfer of the DeployProcess operation request, using XML encoding.

**EXAMPLE**

An example DeployProcess operation request, encoded in XML for HTTP POST, is:
6.4. DeployProcess operation response

In the following sections, the DeployProcess operation response is specified.

6.4.1. Normal response parameters

The normal response to a valid DeployProcess operation request shall be a DeploymentResult
document. WPS 2.0 server may have updated the process identifier in case of collision with an
existing process. WPS 2.0 client shall check the returned process identifier. More precisely, a
response from the DeployProcess operation shall include the parts listed in Table 11. This table also
specifies the UML model data type plus the multiplicity and use of each listed part.

Table 11. Parts of DeployProcess operation response

<table>
<thead>
<tr>
<th>Names</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProcessSummary</td>
<td>Brief information about the process</td>
<td>ProcessSummary data structure - see [OGC 14-065r2], Table 37</td>
<td>One(mandatory)</td>
</tr>
</tbody>
</table>

6.4.2. DeployProcess response example

A DeployProcess operation response can look like this, encoded in XML:
6.4.3. DeployProcess exceptions

When a WPS 2.0 server implementing WPS-T encounters an error while performing a DeployProcess operation, it shall return an exception report message as specified in Subclause 8 of [OGC 06-121r9]. The allowed standard exception codes shall include those listed in Table 12. For each listed exceptionCode, the contents of the “locator” parameter value shall be as specified in the right column of Table 12.

NOTE To reduce the need for readers to refer to other documents, the first five values listed below are copied from Table 28 in Subclause 8.6 of [OGC 06-121r9].

<table>
<thead>
<tr>
<th>exceptionCode</th>
<th>value</th>
<th>Meaning of code &quot;locator&quot; value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OperationNotSupported</td>
<td>Request is for an operation that is not supported by this server</td>
<td>Name of operation not supported</td>
</tr>
<tr>
<td>MissingParameterValue</td>
<td>Operation request does not include a parameter value, and this server did not declare a default value for that parameter</td>
<td>Name of missing parameter</td>
</tr>
<tr>
<td>InvalidParameterValue</td>
<td>Operation request contains an invalid parameter value</td>
<td>Name of parameter with invalid value</td>
</tr>
<tr>
<td>OptionNotSupported</td>
<td>Request is for an option that is not supported by this server</td>
<td>Identifier of option not supported</td>
</tr>
<tr>
<td>NoApplicableCode</td>
<td>No other exceptionCode specified by this service and server applies to this exception</td>
<td>None, omit “locator” parameter</td>
</tr>
<tr>
<td>DeploymentProfileNotSupported</td>
<td>Deployment of the process required a deployment profile which is not supported by the server</td>
<td>Process identifier not deployed.</td>
</tr>
</tbody>
</table>
Chapter 7. UndeployProcess Operation (mandatory)

In the following sections, the UndeployProcess operation is specified.

7.1. Introduction

The UndeployProcess operation allows WPS 2.0 clients to dynamically undeploy a process from a WPS 2.0 server which implements the WPS 2.0 Transactional Extension. The UndeployProcess operation is applicable to processes that have been previously deployed dynamically. On successful undeployment, the undeployed process is no more part of the process offering of the WPS 2.0 server with all the consequence. Especially a request for execution shall not be accepted. A successful UndeployProcess operation shall result in the permanent removal of the associated execution unit unless parameters of the UndeployProcess operation explicitly request the server to keep the execution unit. In any case, all associated data shall be permanently deleted.

7.2. Transactional and atomic behavior of DeployProcess operation

The UndeployProcess operation impacts the result and/or behavior of the following WPS 2.0 operations:

- GetCapabilities operation
- DescribeProcess operation
- Execute operation

The UndeployProcess shall have an atomic behavior:

- On successful undeployment, the process is no more part of the process offerings.
- On failed undeployment, the process shall remain part of the process offerings in its full meaning.

From a transactional point of view, as soon as an UndeployProcess request is received and accepted by a WPS 2.0 server, the associated process shall no more be part of the process offering. More specifically, the process offering is updated before running into the undeployment of the process. Consequently, later requests shall have a result or a behavior that reflects the process is no more part of the process offering. It is left up to the implementer to decide which behavior the WPS 2.0 server should have with Jobs (and its associated output results) of the involved Process currently managed by the WPS 2.0 server when UndeployProcess operation is received.

7.3. UndeployProcess operation request

In the following sections, the UndeployProcess operation request is specified.
7.3.1. UndeployProcess request parameters

A request to perform the UndeployProcess operation shall include the use of the data structure specified in Table 13. This table also specifies the UML model data type, source of values, and multiplicity of each listed parameter, plus the meaning to servers when each optional parameter is not included in the operation request. Although some values listed in the “Names” column appear to contain spaces, they shall not contain spaces.

Table 13. Parameters in UndeployProcess operation request

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>service</td>
<td>Service type identifier</td>
<td>Character String type, not empty Value is OWS type abbreviation, fixed to ”WPS”</td>
<td>One (Mandatory)</td>
</tr>
<tr>
<td>version</td>
<td>Specification version for operation</td>
<td>Character String type, not empty Value is specified by each Implementation Specification and Schemas version</td>
<td>One (mandatory)</td>
</tr>
<tr>
<td>Identifier</td>
<td>Unambiguous identifier or name of a process</td>
<td>Process Identifier - see [OGG 14-065r2], Table 4</td>
<td>One (mandatory)</td>
</tr>
<tr>
<td>keepExecutionUnit</td>
<td>Do not remove process execution unit to speed up future deployment</td>
<td>Boolean, default value is false.</td>
<td>Zero to One (optional)</td>
</tr>
</tbody>
</table>

7.3.2. UndeployProcess request KVP encoding

Servers may implement HTTP GET transfer of the UndeployProcess operation request, using KVP encoding. The KVP encoding of the UndeployProcess operation request should use the parameters specified in Table 14. The parameters listed in Table 14 shall be as specified in Table 13 above.

Table 14. UndeployProcess operation request URL parameters
<table>
<thead>
<tr>
<th>Name and example [10:</th>
<th>Optionality and use</th>
<th>Definition and format</th>
</tr>
</thead>
<tbody>
<tr>
<td>All parameter names</td>
<td>Mostly lower case</td>
<td>Service type identifier</td>
</tr>
<tr>
<td>are here listed using</td>
<td>letters. However, any</td>
<td>Operation name</td>
</tr>
<tr>
<td>mostly lower case</td>
<td>parameter name</td>
<td>Standard and schema version for</td>
</tr>
<tr>
<td>letters. However, any</td>
<td>capitalization shall be</td>
<td>this operation</td>
</tr>
<tr>
<td>parameter name</td>
<td>allowed in KVP</td>
<td>Process identifier</td>
</tr>
<tr>
<td>capitalization shall</td>
<td>encoding, see Subclause</td>
<td></td>
</tr>
<tr>
<td>be allowed in KVP</td>
<td>11.5.2 of [OGC 06-121r9]]</td>
<td></td>
</tr>
</tbody>
</table>

| service=WPS | Mandatory | Service type identifier |
| request=UndeployProcess | Mandatory | Operation name |
| version=2.0.0 | Mandatory | Standard and schema version for |
| Identifier=Buffer | Mandatory | this operation |
| keepExecutionUnit=false | Optional | Boolean |

**EXAMPLE**

An example UndeployProcess operation request, encoded as KVP for HTTP GET, is:

```
http://foo.bar/foo?service=WPS&request=UndeployProcess&version=2.0.0&identifier=Buffer&keepExecutionUnit=false
```

### 7.3.3. UndeployProcess request XML encoding

All WPS 2.0 servers which support the WPS-T extension should implement HTTP POST transfer of the UndeployProcess operation request, using XML encoding.

**EXAMPLE**

An example UndeployProcess operation request, encoded in XML for HTTP POST, is:

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <ows:Identifier>Buffer</ows:Identifier>
</wps:UndeployProcess>
```

### 7.4. UndeployProcess operation response

In the following sections, the UndeployProcess operation response is specified.
7.4.1. Normal response parameters

The normal response to a valid UndeployProcess operation request shall be an UndeploymentResult document. More precisely, a response from the UndeployProcess operation shall include the parts listed in Table 15. This table also specifies the UML model data type plus the multiplicity and use of each listed part.

Table 15. Parts of UndeployProcess operation response

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition</th>
<th>Data type and values</th>
<th>Multiplicity and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifier</td>
<td>Unambiguous identifier or name of a process</td>
<td>Process Identifier - see [OGG 14-065r2], Table 4</td>
<td>One (mandatory)</td>
</tr>
</tbody>
</table>

7.4.2. UndeployProcess response example

An UndeployProcess operation response can look like this encoded in XML:

```xml
<?xml version="1.0" encoding="UTF-8"?>
  <ows:Identifier>Buffer</ows:Identifier>
</wps:UndeploymentResult/>
```

7.4.3. UndeployProcess exceptions

When a WPS 2.0 server implementing WPS-T encounters an error while performing a UndeployProcess operation, it shall return an exception report message as specified in Subclause 8 of [OGC 06-121r9]. The allowed standard exception codes shall include those listed in Table 16. For each listed exceptionCode, the contents of the “locator” parameter value shall be as specified in the right column of Table 16.

Table 16. Parts of UndeployProcess operation response

<table>
<thead>
<tr>
<th>exceptionCode</th>
<th>value</th>
<th>Meaning of code &quot;locator&quot; value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OperationNotSupported</td>
<td>Request is for an operation that is not supported by this server</td>
<td>Name of operation not supported</td>
</tr>
<tr>
<td>MissingParameterValue</td>
<td>Operation request does not include a parameter value, and this server did not declare a default value for that parameter</td>
<td>Name of missing parameter</td>
</tr>
<tr>
<td>InvalidParameterValue</td>
<td>Operation request contains an invalid parameter value</td>
<td>Name of parameter with invalid value</td>
</tr>
<tr>
<td>OptionNotSupported</td>
<td>Request is for an option that is not supported by this server</td>
<td>Identifier of option not supported</td>
</tr>
<tr>
<td>exceptionCode</td>
<td>value</td>
<td>Meaning of code &quot;locator&quot; value</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>NoApplicableCode</td>
<td>No other exceptionCode specified by this service and server applies to this exception</td>
<td>None, omit “locator” parameter</td>
</tr>
<tr>
<td>UndeploymentDenied</td>
<td>Process not dynamically deployed</td>
<td>Process identifier.</td>
</tr>
</tbody>
</table>
Chapter 8. BPMN Deployment Profile

In the following sections, a BPMN Deployment Profile is specified.

8.1. Introduction

Processes can be deployed in many ways, e.g. by specifying the URL of a docker container or uploading jar-files or scripts to the WPS. It is therefore necessary to specify profiles that describe the mechanisms and data formats of the deployment.

In Testbed-14, the WPS-T works together with a BPMN-Engine. The mechanisms are described in detail in the OGC Testbed-14: BPMN Workflow Engineering Report [OGC 18-085].

For sending the BPMN document to the WPS-T, the ProcessOffering-element is used. The element allows, as subelements, either a Process-element or any other element from a different namespace. So using BPMN is conformant. An example is shown in the following (BPMN largely omitted for better readability):
The DeploymentProfileName corresponds to a SupportedDeploymentProfile advertized in the capabilities document of the WPS-T.
## Appendix A: Abstract Test Suite

### Table 17. A.1.1 Capabilities

<table>
<thead>
<tr>
<th>Test identifier</th>
<th>getcapabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test purpose:</strong></td>
<td>Confirm that the WPS-T advertises the transactional functionality.</td>
</tr>
<tr>
<td><strong>Test method:</strong></td>
<td>Request the capabilities. Verify that a SupportedDeploymentProfiles is present and that the DeployProcess and UndeployProcess operations are listed in the OperationsMetadata section.</td>
</tr>
<tr>
<td><strong>Requirement:</strong></td>
<td>Section GetCapabilities Operation Update</td>
</tr>
<tr>
<td><strong>Test type:</strong></td>
<td>Capability</td>
</tr>
</tbody>
</table>

### Table 18. A.1.2 Test case for DeployProcess

<table>
<thead>
<tr>
<th>Test identifier</th>
<th>deployprocess</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test purpose:</strong></td>
<td>The DeployProcess operation works as expected.</td>
</tr>
<tr>
<td><strong>Test method:</strong></td>
<td>Send a valid DeployProcess request to the WPS-T server. Verify that a valid DeploymentResult document is returned.</td>
</tr>
<tr>
<td><strong>Requirement:</strong></td>
<td>Section DeployProcess Operation (Mandatory)</td>
</tr>
<tr>
<td><strong>Test type:</strong></td>
<td>Capability</td>
</tr>
</tbody>
</table>

### Table 19. A.1.3 Test case for UndeployProcess

<table>
<thead>
<tr>
<th>Test identifier</th>
<th>undeployprocess</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test purpose:</strong></td>
<td>The UndeployProcess operation works as expected.</td>
</tr>
<tr>
<td><strong>Test method:</strong></td>
<td>Send a valid UndeployProcess request to the WPS-T server. Verify that a valid UndeploymentResult document is returned.</td>
</tr>
<tr>
<td><strong>Requirement:</strong></td>
<td>Section UndeployProcess Operation (mandatory)</td>
</tr>
<tr>
<td><strong>Test type:</strong></td>
<td>Capability</td>
</tr>
</tbody>
</table>
Appendix B: XML Schema Documents

The term “XML schema” means all the XML schema parts having the same XML namespace, usually separated into multiple XML Schema Document files (with the file type “.xsd”. The XML schema parts in one XML namespace are usually separated into multiple XML Schema Documents to ease human understanding.

In addition to this document, this report includes several XML Schema Documents. These XML Schema Documents can be found in the following GitHub repository: https://github.com/spacebel/common-xml/tree/spacebel/tb14/wps-t/52n-ogc-schema/src/main/resources/META-INF/xml/wps/t

They will be moved to the official OGC schema repository after the WPS-T extension described in this document will be published.

The capabilities response schema was modified to allow the specification of the supported deployment profiles.

`wpsGetCapabilities.xsd`

```xml
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:ows="http://www.opengis.net/ows/2.0" xmlns:wps="http://www.opengis.net/wps/2.0" targetNamespace="http://www.opengis.net/wps/2.0" elementFormDefault="qualified" version="2.0.0" xml:lang="en">
  <annotation>
    <documentation>
      WPS is an OGC Standard.
      Copyright (c) 2015 Open Geospatial Consortium.
      To obtain additional rights of use, visit http://www.opengeospatial.org/legal/.
    </documentation>
  </annotation>
  <!-- all-components document include (OGC 06-135r11 s#14) -->
  <include schemaLocation="wps.xsd"/>
  <!-- === IMPORTS === -->
  <import namespace="http://www.opengis.net/ows/2.0" schemalocation="http://schemas.opengis.net/ows/2.0/owsAll.xsd"/>
  <!-- === INCLUDES === -->
  <include schemalocation="supportedDeploymentProfiles.xsd"/>
  <!-- GetCapabilities request elements and types -->
  <element name="GetCapabilities" type="wps:GetCapabilitiesType">
    <annotation>
      <documentation>Request to a WPS server to perform the GetCapabilities operation. This operation allows a client to retrieve a Capabilities XML document providing metadata for the specific WPS server. </documentation>
    </annotation>
  </element>
  <complexType name="GetCapabilitiesType">
    <complexContent>
      <annotation>
        <documentation>
          Description of the GetCapabilitiesType complex type.
        </documentation>
      </annotation>
      <restriction base="anyType">
        <attribute name="title" type="xsd:string"/>
        <attribute name="abstract" type="xsd:string"/>
        <attribute name="contact" type="xsd:string"/>
        <attribute name="serviceType" type="xsd:string"/>
        <attribute name="supportedDeploymentProfiles" type="xsd:string"/>
        <attribute name="footnotes" type="xsd:string"/>
        <attribute name="contactInfo" type="xsd:string"/>
        <attribute name="serviceTypeCode" type="xsd:string"/>
      </restriction>
    </complexContent>
  </complexType>
</schema>
```
GetCapabilities response elements and types

Capabilities

WPS GetCapabilities operation response. This document provides clients with service metadata about a specific service instance, including metadata about the processes that can be executed. Since the server does not implement the updateSequence and Sections parameters, the server shall always return the complete Capabilities document, without the updateSequence parameter.

Capabilities

List of brief descriptions of the processes offered by this
The schema for the supported deployment profiles is presented in the following listing:

```
supportedDeploymentProfiles.xsd
```

```xml
  <!-- ============================================================== -->
  <!-- includes and imports -->
  <!-- ============================================================== -->
  <!-- elements and types -->
  <!-- ============================================================== -->
  <element name="SupportedDeploymentProfiles">
    <annotation>
      <documentation>List of default and other schemas profiles supported for deployement and execution, i.e. ApacheOdeBPEL, GridProfile, ...</documentation>
    </annotation>
  </element>
</schema>
```
The following listing shows the schema for the DeployProcess operation:

wpsDeployProcess.xsd
WPS is an OGC Standard.
Copyright (c) 2015 Open Geospatial Consortium.
To obtain additional rights of use, visit http://www.opengeospatial.org/legal.

<!-- all-components document include (OGC 06-135r11 s#14) -->
<include schemaLocation="wps.xsd"/>
<!-- === IMPORTS === -->
<import namespace="http://www.opengis.net/ows/2.0" schemaLocation="http://schemas.opengis.net/ows/2.0/owsAll.xsd"/>
<!-- === INCLUDES === -->
<!-- DeployProcess request elements and types -->
<complexType name="ExecutionUnitType">
  <choice>
    <element ref="wps:Reference"/>
    <element name="Unit" type="anyType">
      <annotation>
        <documentation>Identifies the ExecutionUnit being encapsulated in the DeployProcess request. If the provided document is a binary file, it is assumed that it uses base64 encoding.</documentation>
      </annotation>
    </element>
  </choice>
</complexType>
<complexType name="DeploymentProfileType">
</complexType>
<element name="DeployProcess">
  <annotation>
    <documentation>WPS DescribeProcess operation request.</documentation>
  </annotation>
  <complexType>
    <complexContent>
      <extension base="wps:RequestBaseType">
        <sequence>
          <element name="ProcessDescription" type="wps:ProcessDescriptionChoiceType" minOccurs="0">
            <annotation>
              <documentation>Full description of process, including all input and output parameters. This may be generated from the ExecutionUnit. The document provides the informaiton intended to the WPS client.</documentation>
            </annotation>
          </element>
        </sequence>
      </extension>
    </complexContent>
  </complexType>
</element>
<element name="ExecutionUnit" maxOccurs="unbounded">
  <annotation>
    <documentation>Concrete executable unit of the process also called 'Application Package'. It may contains libraries, configuration files, binaries, etc.</documentation>
  </annotation>
  <complexType>
    <complexContent>
      <extension base="wps:ExecutionUnitType"/>
    </complexContent>
  </complexType>
</element>

<element name="DeploymentProfileName" type="normalizedString" minOccurs="0">
  <annotation>
    <documentation>Name of the process profile deployment. By default, the default WPS implementation process profile is expected.</documentation>
  </annotation>
</element>

<attribute ref="xml:lang" use="optional">
  <annotation>
    <documentation>RFC 4646 language code of the human-readable text (e.g. "en-CA") in the process description.</documentation>
  </annotation>
</attribute>

<attribute name="immediateDeployment" type="boolean" default="true">
  <annotation>
    <documentation>Deploy the ExecutionUnit on the backend only on the first execution of the process.</documentation>
  </annotation>
</attribute>

<!-- DeployProcess response elements and types -->
<element name="DeploymentResult">
  <annotation>
    <documentation>DeployProcess result.</documentation>
  </annotation>
  <complexType>
    <complexContent>
      <extension base="wps:DeploymentResultType"/>
    </complexContent>
  </complexType>
</element>

<!-- ============================================================== -->
<!-- DeployProcess response elements and types -->
<!-- ============================================================== -->
The following listing shows the schema for the UndeployProcess operation:

**supportedDeploymentProfiles.xsd**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2016 rel. 2 sp1 (x64) (http://www.altova.com) by Joel Lim (spacebel SA) -->
<!--
OGC LICENSE HEADER
The official OGC XML schemas can be accessed under http://schemas.opengis.net.
Please consider the schema copyright notices:
http://www.opengeospatial.org/ogc/document
and the OGC Copyright Notice and Disclaimers:
http://www.opengeospatial.org/ogc/legal
If there are any questions left there is also a copyright FAQ:
http://www.opengeospatial.org/ogc/legalfaq
-->
<schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:ows="http://www.opengis.net/ows/2.0" xmlns:wps="http://www.opengis.net/wps/2.0" targetNamespace="http://www.opengis.net/wps/2.0" elementFormDefault="qualified" version="2.0.0" xml:lang="en">
  <annotation>
    <documentation>
```

```
WPS is an OGC Standard.

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To obtain additional rights of use, visit
http://www.opengeospatial.org/legal./

</documentation>
</annotation>
<!-- all-components document include (OGC 06-135r11 s#14) -->
<include schemaLocation="wps.xsd"/>
<!-- === IMPORTS === -->
<import namespace="http://www.opengis.net/ows/2.0" schemaLocation="http://schemas.opengis.net/ows/2.0/owsAll.xsd"/>
<!-- === INCLUDES === -->
<!-- UndeployProcess request elements and types -->
<element name="UndeployProcess">
  <annotation>
    <documentation>
      WPS UndeployProcess operation request.
    </documentation>
  </annotation>
  <complexType>
    <complexContent>
      <extension base="wps:RequestBaseType">
        <sequence>
          <element ref="ows:Identifier">
            <annotation>
              <documentation>
                Identifier of the process to be undeployed.
              </documentation>
            </annotation>
          </element>
        </sequence>
        <attribute name="keepExecutionUnit" type="boolean" default="false"/>
      </extension>
    </complexContent>
  </complexType>
</element>

<!-- UndeployProcess response elements and types -->
<element name="UndeploymentResult" type="wps:UndeploymentResultType">
  <annotation>
    <documentation>
      UndeployProcess result.
    </documentation>
  </annotation>
</element>
<complexType name="UndeploymentResultType">
  <sequence>
    <element ref="ows:Identifier">
      <annotation>
        <documentation>
          Identifier of the undeployed
process.</documentation>
  </annotation>
  </element>
  </sequence>
  </complexType>
</schema>
### Appendix C: Revision History

*Table 20. Revision History*

<table>
<thead>
<tr>
<th>Date</th>
<th>Editor</th>
<th>Release</th>
<th>Primary clauses modified</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 30, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>all</td>
<td>initial version</td>
</tr>
<tr>
<td>Jun 5, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>5,6,7,8</td>
<td>Add section 5,6,7,8</td>
</tr>
<tr>
<td>Jun 10, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>8</td>
<td>Add first version of BPMN DeploymentProfile</td>
</tr>
<tr>
<td>Jul 25, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>all</td>
<td>Adjustments with respect to OWS Common 2.0 and WPS 2.0</td>
</tr>
<tr>
<td>Aug 28, 2018</td>
<td>B. Pross, C. Noel</td>
<td>.1</td>
<td>6</td>
<td>Incorporated comments from Spacebel</td>
</tr>
<tr>
<td>Sep 26, 2018</td>
<td>B. Pross, C. Noel</td>
<td>.1</td>
<td>Annex b</td>
<td>Incorporated comments from Spacebel</td>
</tr>
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<td>Sep 26, 2018</td>
<td>B. Pross, C. Noel</td>
<td>.1</td>
<td>Annex a</td>
<td>Added Abstract Test Suite</td>
</tr>
<tr>
<td>Nov 15, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>2, 3, Annex c</td>
<td>Incorporated comments from Scott Serich</td>
</tr>
<tr>
<td>Dec 18, 2018</td>
<td>B. Pross</td>
<td>.1</td>
<td>1, 5</td>
<td>Incorporated comments from Carl Reed</td>
</tr>
</tbody>
</table>
Appendix D: Bibliography