Week 7 - Module 4a - Interoperability Standards. WFS & WCS

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Overview

- OGC Web Feature Services (WFS)
  - Capabilities and purpose
  - Overview of the collection of WFS commands
  - Sample WFS requests
- OGC Web Coverage Services (WCS)
  - Capabilities and purpose
  - Overview of the collection of WCS commands
  - Sample WCS requests

OGC Web Feature Service (WFS)

Background

The documents related to the OGC WFS standard are available from: http://www.opengeospatial.org/standards/wfs and all operation parameter tables presented here are based upon the OpenGIS Web Feature Service 2.0 Interface Standard - Panagiotis (Peter) A. Vretanos, editor - 2010-11-02

From the Version 2.0.0 WFS Scope Section:

> This International Standard specifies the behaviour of a service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions.
>
> Discovery operations allow the service to be interrogated to determine its capabilities and to retrieve the application schema that defines the feature types that the service offers.
>
> Query operations allow features or values of feature properties to be retrieved from the underlying data store based upon constraints, defined by the client, on feature properties.
>
> Locking operations allow exclusive access to features for the purpose of modifying or deleting features.
>
> Transaction operations allow features to be created, changed, replaced and deleted from the underlying data store.
>
> Stored query operations allow clients to create, drop, list and described parameterized query expressions that are stored by the server and can be repeatedly invoked using different parameter values.

WFS Requests/Operations

These request types are submitted as part of the required `REQUEST` key in a KVP HTTP GET request.

`GetCapabilities` service metadata (XML) that documents the types of features supported by the service and the operations supported by each feature type

`DescribeFeatureType` metadata (XML) that describes the structure of supported feature types

`GetPropertyValue` a request for the value(s) of a specified property for a specified *featuretype*

`GetFeature (GetFeatureWithLock)` a request for actual features (XML, or other formats) from the service. The request may include both spatial and non-spatial query constraints

`LockFeature` Feature locking operation

`Transaction` a request to a WFS that may create, update, or delete features

`CreateStoredQuery` a request to create a named WFS query that is stored on the server for future reuse

`DropStoredQuery` a request to remove a named WFS query that has previously been stored on the server

`ListStoredQueries` a request to retrieve a list of named WFS queries that have been stored on the server

`DescribeStoredQueries` a request for more detailed information about specific named WFS queries that are stored on the server

WFS Conformance Levels

WFS 2.0.0 Requests and their corresponding WFS Compliance Levels

Operation (`REQUEST=`)	V 1.1.0	V 2.0.0	Simple	Basic	Transactional	Locking
`GetCapabilities`	✓	✓	✓	✓	✓	✓
`DescribeFeatureType`	✓	✓	✓	✓	✓	✓
`ListStoredQueries`		✓	✓	✓	✓	✓
`DescribeStoredQueries`		✓	✓	✓	✓	✓
`GetFeature`	✓	✓	✓	✓	✓	✓
`StoredQuery`		✓	✓	✓	✓	✓
`GetPropertyValue`		✓		✓	✓	✓
`Transaction`	✓	✓			✓	✓
`GetFeatureWithLock`	✓	✓				✓
`LockFeature`	✓	✓				✓
`GetGMLObject`	✓					

Request Composition

Requests submitted to a WFS may be submitted either via

HTTP GET a request that includes all request parameters within the URL submitted to the service. Request parameters are included in the URL as "key=value" pairs (KVPs)

HTTP POST a request where the URL consists of only the Host and path, with all other request parameters included in the body of the POST document submitted to the service. The request parameters supplied to the server are encoded as XML within the POST document.

SOAP a request submitted as an encapsulated message within a SOAP transaction.

Servers implementing WFS may support either the HTTP GET, POST, or SOAP request model

Conceptually *FeatureType* = *Layer*

Table 4 — KVP-encoding of the base request type

URLComponent	Operation	O/M[a]	Description
SERVICE	All operations.	M	See 7.6.2.4.
VERSION[b] (All operations)	All operations except GetCapabilities.	M	See 7.6.2.5.

[a] O = Optional, M = Mandatory

[b] VERSION is mandatory for all operations except the GetCapabilities operation.

Figure 1: Table 4 from OpenGIS Web Feature Service 2.0 Interface Standard - Panagiotis (Peter) A. Vretanos, editor - 2010-11-02

KVP for Base WFS Requests

Base request parameters for all HTTP GET KVP requests

`VERSION` is required for all operations *except* the `GetCapabilities` request

Sample GetCapabilities Requests

Sample request to USGS Framework Layer (Governmental Units) WFS Service advertised by the USGS *TNM Access API page* service list - Live Link

```
http://services.nationalmap.gov/arcgis/services/WFS/govunits/MapServer/WFSServer?
    request=GetCapabilities&
    service=WFS
```

Sample request to NM RGIS (NM 2010 Census Block Groups) - Live Link

```
http://gstore.unm.edu/apps/rgis/datasets/715663ba-c1c3-414c-84a7-c671526f8316/services/ogc/wfs?
    SERVICE=wfs&
    REQUEST=GetCapabilities&
    VERSION=1.0.0
```

KVP for DescribeFeatureType Request

`DescribeFeatureType` HTTP GET KVP request

Sample DescribeFeatureType Requests

USGS Framework Layer (Governmental Units) WFS Service linked from the USGS *TNM Access API page* service list - Live Link

```
http://services.nationalmap.gov/arcgis/services/WFS/govunits/MapServer/WFSServer?
    version=1.1.0&
    request=DescribeFeatureType&
    service=WFS&
    typeName=WFS_govunits:State_or_Territory_High-res
```

Sample request to NM RGIS (NM 2010 Census Block Groups) - Live Link

Table 15 — DescribeFeatureType KVP encoding

URL Component	O/M[a]	Description
Common Keywords (REQUEST=DescribeFeatureType)		See Table 7. (Only keywords for all operations or the DescribeFeatureType operation.)
TYPENAME	O	A comma separated list of feature types to describe. If no value is specified, the complete application schema offered by the server shall be described.
OUTPUTFORMAT	O	Shall support the value "application/gml+xml; version=3.2" indicating that a GML (see ISO19136:2007) application schema shall be generated. A server may support other values to which this International Standard does not assign any meaning.
[a] O = Optional, M = Mandatory		

Figure 2: Table 15 from OpenGIS Web Feature Service 2.0 Interface Standard - Panagiotis (Peter) A. Vretanos, editor - 2010-11-02

```
http://gstore.unm.edu/apps/rgis/datasets/715663ba-c1c3-414c-84a7-c671526f8316/services/ogc/wfs?
    VERSION=1.0.0&
    SERVICE=wfs&
    REQUEST=DescribeFeatureType&
    TYPENAME=tl_2010_35_bg10
```

KVP for GetFeature Request

`GetFeature` HTTP GET KVP request

Table 17 — Keywords for GetFeature KVP-encoding

URL Component	Description
Common Keywords (REQUEST=GetFeature)	See Table 7 for additional parameters that may be used in a KVP-encoded GetFeature request.
Standard Presentation Parameters	See Table 5.
Standard Resolve Parameters	See Table 6.
Adhoc Query Keywords (Mutually exclusive with Stored Query Keywords)	See Table 8.
Stored Query Keywords (Mutually exclusive with Adhoc Query Keywords)	See Table 10.

KVP for GetFeature Request - Presentation Parameters

Table 5 — KVP-encoding of standard presentation parameters

URLComponent	Operation	O/M[a]	Default	Description
STARTINDEX	GetPropertyValue, GetFeature, GetFeatureWithLock	O	1	See 7.6.3.4.
COUNT	GetPropertyValue, GetFeature, GetFeatureWithLock	O	1	See 7.6.3.5.
OUTPUTFORMAT	DescribeFeatureType, GetPropertyValue, GetFeature, GetFeatureWithLock	O	application/gml+xml; version=3.2	See 7.6.3.7.
RESULTTYPE	GetPropertyValue, GetFeature, GetFeatureWithLock	O	results	See 7.6.3.6.
[a] O = Optional, M = Mandatory				

KVP for GetFeature Request - Resolve Parameters

Table 6 — KVP encoding of standard resolve parameters

URLComponent	Operation	O/M[a]	Default	Description
RESOLVE	GetPropertyValue, GetFeature, GetFeatureWithLock	O	None	See 7.6.4.4.
RESOLVEDEPTH	GetPropertyValue, GetFeature, GetFeatureWithLock	O	*	See 7.6.4.5. RESOLVE parameter shall have a value other than "none".
RESOLVETIMEOUT	GetPropertyValue, GetFeature, GetFeatureWithLock	O	Server Specific (see ResolveTimeoutDefault, Table 14)	See 7.6.4.6. RESOLVE parameter shall have a value other than "none".
[a] O = Optional, M = Mandatory				

KVP for GetFeature Request - Ad-hoc Query Parameters (Figure)

Table 8 — Keywords for Ad hoc query KVP-encoding

URL Component	O/M[a]	Description
TYPENAMES	M[b]	See 7.9.2.4.1.
ALIASES	O	See 7.9.2.4.3.
SRSNAME	O	See 7.9.2.4.4.
Projection clause	O	See Table 9.
FILTER	O	See ISO 19143:2010, 6.3.3.
FILTER_LANGUAGE	O	See ISO 19143:2010, 6.3.3.
RESOURCEID	O	See ISO 19143:2010, 6.3.3.
BBOX	O	See OGC 06-121r3.
SORTBY	O	See ISO 19143:2010, Clause 8 The SORTBY parameter is used to specify a list of property names whose values should be used to order (upon presentation) the set of feature instances that satisfy the query. The value of the SORTBY parameter shall have the form *"PropertyName [ASC|DESC][,PropertyName [AASC|DESC],]"* where the letters ASC are used to indicate an ascending sort and the letters DESC are used to indicate a descending sort. If neither ASC nor DESC are specified, the default sort order shall be ascending. An example value might be: *"SORTBY=Field1 DESC,Field2 DESC,Field3"*. In this case the results are sorted by Field 1 descending, Field2 descending and Field3 ascending

a. O = Optional , M = Mandatory

b. The TYPENAMES parameter is mandatory in all cases except when the RESOURCEID parameter is specified (see 7.9.2.4.1).

KVP for GetFeature Request - Stored Query Parameters (Figure)

Table 10 — Keywords for Stored query KVP-encoding

URL Component	O/M[a]	Description
STOREDQUERY_ID	M	The identifier of the stored query to invoke.
storedquery_parameter=value	O	Each parameter of a stored query shall be encoded in KVP as a keyword-value pair. Stored query parameters shall not have names that conflict with any WFS parameter name.

[a] O = Optional, M = Mandatory

Sample GetFeature Requests

USGS Framework Layer (Governmental Units) WFS Service linked from the USGS *TNM Access API page* service list - Live Link

Note: `TYPENAME` for `VERSION=1.1.0` instead of `TYPENAMES` for `VERSION=2.0.0`

```
http://services.nationalmap.gov/arcgis/services/WFS/govunits/MapServer/WFSServer?
    VERSION=1.1.0&
    REQUEST=GetFeature&
    SERVICE=WFS&
    TYPENAME=WFS_govunits:State_or_Territory_High-res
```

Alternative request (Live Link) that includes an `OUTPUTFORMAT` parameter

```
http://services.nationalmap.gov/arcgis/services/WFS/govunits/MapServer/WFSServer?
    VERSION=1.1.0&
    REQUEST=GetFeature&
    SERVICE=WFS&
    TYPENAME=WFS_govunits:State_or_Territory_High-res&
    OUTPUTFORMAT=text/xml;%20subType=gml/3.1.1/profiles/gmlsf/1.0.0/0
```

OGC Web Coverage Services

Background

The documents related to the OGC WCS standard are available from: [http://www.opengeospatial.org/standards/wcs][wcs] with the sample parameters in the following slides based upon the *OGC Web Coverage Service 2.0 Interface Standard - KVP Protocol Binding Extension* - Peter Baumann, editor - 2010-10-27

From the OGC WCS 2.0 *Introduction*

> The OGC Web Coverage Service (WCS) supports electronic retrieval of geospatial data as "coverages" – that is, digital geospatial information representing space/time-varying phenomena.
>
> This document specifies the WCS core; every implementation of a WCS shall adhere to this standard. This standard thus defines only basic requirements. Extensions to the core will define extensions to meet additional requirements, such as the response encoding. Indeed, additional extensions are required in order to completely specify a WCS for implementation.
>
> A WCS provides access to coverage data in forms that are useful for client-side rendering, as input into scientific models, and for other clients. The WCS may be compared to the OGC Web Feature Service (WFS) and the Web Map Service (WMS). As WMS and WFS service instances, a WCS allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria.

WCS Requests/Operations

`GetCapabilities` service metadata (XML) that documents the service, including brief information about the data coverages available from the service

`DescribeCoverage` a request for more detailed metadata (XML) for one or more coverages listed in the output of the GetCapabilities request

`GetCoverage` a request for an actual data product representing a specified coverage. The specific data formats available for delivery will vary from service to service.

Request Composition

Requests submitted to a WCS may be submitted either via the following protocols, as defined in the three extensions developed thus far for the *core* WCS standard.

HTTP GET a request that includes all request parameters within the URL submitted to the service. Request parameters are included in the URL as "name=value" pairs. Extension Link

HTTP POST a request where the URL consists of only the Host and path, with all other request parameters included in the body of the POST document submitted to the service. The request parameters supplied to the server are encoded as XML within the POST document. Extension Link

XML/SOAP a request-response model between the client that conforms with the W3C SOAP web services protocol Extension Link

Table 1 — DescribeCoverage request URL encoding

Name	Definition	Data type	Multiplicity
`service`	Identifier of the OGC service	`String`, fixed to "WCS"	One (mandatory)
`version`	Request protocol version	`String`	One (mandatory)
`request`	Request type name	`String`, fixed to "DescribeCoverage"	One (mandatory)
`coverageId`	List of coverage identifiers to be described	Comma-separated `NCName` list	One (mandatory)

Figure 3: Table 1 from *OGC Web Coverage Service 2.0 Interface Standard - KVP Protocol Binding Extension* - Peter Baumann, editor - 2010-10-27

KVP for Base WCS Requests

Name	Mandatory/Optional	Definition	Data Type
service	M	Identifier of the OGC service	`String`, fixed to "WCS"
request	M	Request type name	`String`, set to operation name
version	M (except for GetCapabilities)	Request protocol version	`String`

Sample WCS `GetCapabilities` requests

NOAA Global Forecast System THREDDS catalog. Live Link

```
http://nomads.ncdc.noaa.gov/thredds/wcs/gfs-004/201602/20160228/
    gfs_4_20160228_0000_384.grb2?
    service=WCS&
    version=1.0.0&
    request=GetCapabilities
```

New Mexico Resource Geographic Information System PRISM Precipitation Normals WCS Service. Live Link

```
http://gstore.unm.edu/apps/rgis/datasets/2ce10b57-3925-4971-b876-b6fc66d3cca2/services/ogc/wcs?
    SERVICE=wcs&
    REQUEST=GetCapabilities&
    VERSION=1.1.2
```

KVP for DescribeCoverage Request

`DescribeCoverage` HTTP GET KVP request (Figure {@fig:wcsTable01})

Sample DescribeCoverage Request

NOAA Global Forecast System THREDDS catalog. Live Link

```
http://nomads.ncdc.noaa.gov/thredds/wcs/gfs-004/201602/20160228/
gfs_4_20160228_0000_384.grb2?
    service=WCS&
    version=1.0.0&
    request=DescribeCoverage&
    COVERAGE=Categorical_Rain
```

Table 2 — *GetCoverage* request KVP encoding

Name	Definition	Data type	Multiplicity
service	Identifier of the OGC service	String, fixed to "WCS"	one (mandatory)
version	Request protocol version	String	one (mandatory)
request	Request type name	String, fixed to "GetCoverage"	one (mandatory)
coverageId	Identifier of coverage to be inspected	NCName	one (mandatory)
subset	boundaries of coverage subset	SubsetSpec as defined in Requirement 7	zero or more (optional)

Figure 4: Table 2 from *OGC Web Coverage Service 2.0 Interface Standard - KVP Protocol Binding Extension* - Peter Baumann, editor - 2010-10-27

Requirement 7 /req/get-kvp/getCoverage-request-subsetspec:
Each SubsetSpec **shall** adhere to this EBNF syntax:

```
SubsetSpec:       dimension [ , crs ] ( intervalOrPoint )
dimension:        NCName
crs               anyURI
intervalOrPoint:  interval | point
interval:         low , high
low:              point | *
high:             point | *
point:            number| "token "  // " = ASCII 0x42
```

Figure 5: Requirement 7 from *OGC Web Coverage Service 2.0 Interface Standard - KVP Protocol Binding Extension* - Peter Baumann, editor - 2010-10-27

New Mexico Resource Geographic Information System PRISM Precipitation Normals WCS Service. Live Link

```
http://gstore.unm.edu/apps/rgis/datasets/2ce10b57-3925-4971-b876-b6fc66d3cca2/services/ogc/wcs?
    SERVICE=wcs&
    REQUEST=DescribeCoverage&
    VERSION=1.1.2&
    COVERAGE=us_ppt_1971_2000_11
```

KVP for GetCoverage Request

`GetCoverage` HTTP GET KVP request (Figure {@fig:wcsTable01})

Subset Definition for GetCoverage Request

Subset definition for the `GetCoverage` HTTP GET KVP request

Example from the 2.0 specification:

```
http://www.myserver.org:port/path?
    service=WCS
    &version=2.0
    &request=GetCoverage
    &coverageId=C0002
    &subset=lon,http://www.opengis.net/def/crs/EPSG/0/4326(-71,47)
```

```
    &subset=lat,http://www.opengis.net/def/crs/EPSG/0/4326(-66,51)
    &subset=t,http://www.opengis.net/def/trs/ISO- 8601/0/Gregorian+UTC("2009-11-06T23:20:52Z")
```

Sample GetCoverage Request

New Mexico Resource Geographic Information System PRISM Precipitation Normals WCS Service. Live Link

```
http://gstore.unm.edu/apps/rgis/datasets/2ce10b57-3925-4971-b876-b6fc66d3cca2/services/ogc/wcs?
    SERVICE=wcs&
    REQUEST=GetCoverage&
    VERSION=1.1.2&
    COVERAGE=us_ppt_1971_2000_11&
    CRS=urn:ogc:def:crs:EPSG::4326&
    BBOX=24.0625,-125.02083333333,49.93749998965,-66.47916669008&
    FORMAT=image/tiff&
    WIDTH=2048&
    HEIGHT=905
```
