Providing Interoperability Using the Open Geoservices REST Specification

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Agenda

• The Open Geospatial Consortium (OGC) and the Standards Process

• Understanding REST – Representational State Transfer

• Esri’s ArcGIS Server & the ArcGIS REST API

• The Open GeoServices REST Specification
  - What is it?
  - Some Examples of Support

• Ongoing work within OGC on the GeoServices REST Specification
ArcGIS 10 — A Complete System

Easier
More Powerful
and Everywhere

• Discover
• Create
• Manage
• Visualize
• Analyze
• Collaborate

Cloud
Enterprise
Local

Mobile
Desktop
ArcGIS Server is Open & Interoperable
Using Standards to Integrate with Any System

Open API's
- GDB
- Share Point
- Flex
- REST
- Silverlight
- Java

Standards
- OGC
- CAD
- WCS
- ISO
- INSPIRE
- KML
- WFS
- WMS
- WWW
- SQL

Open Data Access
Open GeoServices REST API
Any Application

Any Application
REST API
GIS

• Creating and Managing Geo Information Products
  - Proprietary
  - Open Specifications
  - Standards

• Dissemination of Geo Products
  - Proprietary
  - Open Specifications
  - Standards
Interoperability Enablers

Standards used in creation of Geo Information products

- Data:
  - Simple Features Model
  - GML, WKT, WKB, Spatial Types, netCDF
- Metadata:
  - ISO 19139, FGDC, ...

Standards used for Dissemination

- File Based
  - Simple Features Access
- On Demand Services
  - OGC Web Services - WMS, WFS, WCS, OGC GeoServices REST, ...
## REST – The Elevator Pitch

<table>
<thead>
<tr>
<th>4 Key Principles*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification Of Resources</td>
<td>Everything is a URL</td>
</tr>
<tr>
<td>Manipulation Of Resources</td>
<td>Exchange standard formats using standard verbs</td>
</tr>
<tr>
<td>Through Representations</td>
<td></td>
</tr>
<tr>
<td>Self-Descriptive Messages</td>
<td>Every request asks the full question, every response includes</td>
</tr>
<tr>
<td></td>
<td>the full answer</td>
</tr>
<tr>
<td>Hypermedia As The Engine Of</td>
<td>Hyperlinks</td>
</tr>
<tr>
<td>Application State</td>
<td>&lt;a href=&quot;url&quot;&gt;Yeah!&lt;/a&gt;</td>
</tr>
</tbody>
</table>

[http://www.intertwingly.net/blog/2198.html](http://www.intertwingly.net/blog/2198.html)
So if you are not a RESTafarian*

3 points to remember…

- Everything is a URL,
- Everything is a URL,
- Everything is a URL

Berners-Lee's pitch on Web architecture 101

1. Things are denoted by URIs.
2. Use them to denote things.
3. Serve useful information at them.
4. Dereference them.

* A person who believes in the Religion of REST
Everything is a URL

- Hierarchy of resources
  - Catalog, Services (Map, Geocode, etc.), Layers, Tasks, etc.

- *interoperable*

- Searchable

- Bookmark-able

- Browser is the new command line
HTTP Goodness

- HTTP as an *application* protocol
  - Cache-Control headers
  - ETags (Conditional GETs)
  - Compression (gzip)
  - Status codes
ArcGIS Server REST API

• The ArcGIS Server REST API, short for Representational State Transfer, provides a simple, open Web interface to services hosted by a Server. All resources exposed by the REST API are accessible through a hierarchy of endpoints or Uniform Resource Locators (URLs) for each GIS service published with the Server.

• Simple view of the Server

• The Server hosts a Services Directory
  - Used by developer while building application

• Discoverable, accessible, and useable
Types of Services

Map
- View or query a 2D map on the server

Geocode
- Perform address matching on the server

Geometry
- Provides basic geometric operations for use by web service clients (ex. simplify, buffer, difference, trim, ...)

Geoprocessing
- Run a geo processing tool or model on the server and get the results back

Image
- Provide access to raster data though a Web service

Feature
- Provide access to feature querying and editing
REST API

- All GIS Services are exposed as resources
  - Service level metadata

- Some resources have operations
  - Map Service (export, find, identify)
  - Map Service Layers (query)
  - Image Services (export)
  - Geocode Service (findAddressCandidates, Reverse Geocode)
  - Geoprocessing (execute, submit job)
  - Geometry Service (project, buffer, and others)

- ...So While some resources are in and by themselves (catalog, map, layer, etc.), other resources are produced as a result of an operation ...i.e. “Controller resources”
Service Oriented Architecture

- ArcGIS Supports Interoperability for:
  - Spatial Data Infrastructures
  - Enterprise Architectures
  - Neogeography, Mashup and WEB 2.0 environments
ArcGIS Server – Web protocols

- **Support industry standards**
- Its GIS services can be accessed via
  - Open Geospatial Consortium (OGC)
  - Simple Object Access Protocol (SOAP)
  - Representational State Transfer (REST)
ArcGIS Server - Building open and interoperable Systems

OGC Services

ArcGIS Server

ArcGIS Desktop

ArcGIS Online

Google Earth

ArcExplorer

Google Earth

HV

QGIS

gvSig

OpenLayers

uDig

Gaia

ENVI

AutoCAD

Imagine

GeoMedia

Ionic

MapInfo
ArcGIS Server can work with many different clients

- Microsoft Virtual Earth
- Flex/Flash
- Google Earth
- ArcMap
- SAP
- Yahoo! Maps
- Silverlight
- Yahoo Pipes
- ArcGIS Explorer
- .Net Java
- iPhone
- OpenLayers
- Python
- PHP
- Ruby
- ArcGIS Mobile
### ArcGIS Server – OGC versus REST Services

<table>
<thead>
<tr>
<th>Difference</th>
<th>ArcGIS Server OGC Services</th>
<th>ArcGIS Server REST Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interfaces</strong></td>
<td>OGC (ISO) Standards</td>
<td>Esri Geoservices specification</td>
</tr>
<tr>
<td><strong>Encoding style</strong></td>
<td>KVP, XML-POST,SOAP</td>
<td>REST</td>
</tr>
<tr>
<td><strong>Metadata encoding</strong></td>
<td>OWS XML</td>
<td>Esri JSON</td>
</tr>
<tr>
<td><strong>Feature encoding</strong></td>
<td>GML, KML</td>
<td>Esri JSON</td>
</tr>
<tr>
<td><strong>Feature editing</strong></td>
<td>Pessimistic locking</td>
<td>No lock, last win</td>
</tr>
<tr>
<td><strong>Symbology encoding</strong></td>
<td>SLD</td>
<td>Esri JSON</td>
</tr>
<tr>
<td><strong>Filter encoding</strong></td>
<td>OGC Filter spec</td>
<td>Esri JSON</td>
</tr>
<tr>
<td><strong>Client applications</strong></td>
<td>OGC compliant clients (ArcGIS Desktop, uDig, gvSig, OpenLayers, OpenScales etc.)</td>
<td>Esri products (ArcGIS Desktop, ArcGIS JS/Flex/Silverlight API)</td>
</tr>
</tbody>
</table>
Open Layers - Supporting ArcGIS REST Services

ArcGIS Server

REST

http://openlayers.org/dev/examples/arcgis93rest.html
Can I support Esri’s REST Specification on my non ArcGIS Server Platform?
REST API powers Web (client) APIs

- **Client-side programming**
  - Allow developers to easily build custom Web applications
    - ArcGIS API for JavaScript
    - ArcGIS API for Flex
    - ArcGIS API for Silverlight
  - Built on a simple architecture
    - Use REST services endpoint
    - Web services based

- Enables creation of RIAs for Mapping, Querying, Editing, Analysis, …
- Choice depends on developer experience and style preference
- **Examples** - [http://www.csc.noaa.gov/slr/viewer/#1](http://www.csc.noaa.gov/slr/viewer/#1)
GeoServices REST Specification

The GeoServices REST Specification provides a way for Web clients to communicate with geographic information system (GIS) servers through Representational State Transfer (REST) technology.

The specification is:

- A proven and easy to understand method for a broad range of clients and applications to request map, feature, attribute, and image information from a GIS server.
- A JSON-based, RESTful specification that will make the GIS server instantly usable by thousands of developers working in popular client-side development environments with the ArcGIS Web mapping APIs for JavaScript, Flex, Silverlight®, iOS®, and Android®.

Use of the GeoServices REST Specification is subject to the current Open Web Foundation Agreement. The Open Web Foundation (OWF) is an independent non-profit dedicated to the development and protection of open, non-proprietary specifications for web technologies. Terms and conditions of the OWF Agreement are subject to change without notice.

For questions about the GeoServices REST Specification, contact opengeoservices@esri.com

ESRI Shapefile Technical Description


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Can I support Esri’s REST Specification on my non ArcGIS Server Platform?
What’s Inside

• Resources
  - Catalog, Map, Geocode, Geoprocessing, Geometry, Image, Feature

• Objects
  - Geometry, Feature, Symbol, Domain, Label, Renderer

All REST URLs support an `f` (format) Parameter - Default is html

• Response Formats
  Html, Json, Amf, Image, Ve, Gmaps, Kml
Arc2Earth and the Geoservices REST Specification

Arc2Earth - Open GeoServices REST Implementation

Folder: /

Current Version: 10.0

View Footprints In: Google Earth

Folders:

- Census
- EditingDemos
- NYC
- SomersetCounty

Services:

- Geometry (GeometryServer)

Supported Interfaces: REST

©2010 Arc2Earth

http://beta.arc2cloud.com/

http://www.arcgis.com/home/item.html?id=889ec82bc8304d61955e8c11fd316470
Geometry Service

Sample Geometry service from 52 North

http://dl.dropbox.com/u/35158796/REST%20Demo1.wmv
Esri – Open Specifications


Our intent

- Take the Geoservices REST Specification from an OPEN specification to an OGC standard.
RESTful Encoding / Style

Richardson Maturity Model

Level 0: The Swamp of POX
Level 1: Resources
Level 2: HTTP Verbs
Level 3: Hypermedia Controls

http://martinfowler.com/articles/richardsonMaturityModel.html
Extending the Geoservices REST Specification

• An example implementation of the Open Geoservices REST specification extended to support Sensor Observation Service

Demonstration Video
Sharing Environmental Data in a Homogeneous Way Across Europe

EEA’s 32 member states

[Map of Europe showing member countries and cooperating countries]


Courtesy: 52 North. Org
European Environment Agency

- **Data themes:**
  - Air quality, biodiversity, climate change, land use
Problem

Data Providers

Heterogeneous Interfaces:
- Proprietary formats
- FTP / HTTP

Data Consumers

Application-specific Interfaces

EEA

ArcGIS Server Based Infrastructure

Courtesy: 52 North. Org
Solution

Data Consumers

SOS 2.0
SOS 2.0
+ GeoServices SOS

EEA

ArcGIS Server Based Infrastructure

Data Providers

Courtesy: 52 North. Org
Example Deployment

- ~ 1,500 air quality stations (measuring O3, CO, ...)
- > 1,000,000 observations for 30 days


Courtesy: 52 North. Org
Data Model - Observations and Measurements

- **Observed Property:** "Windspeed"
- **Feature of Interest:** "Weatherstation X"
- **Result:** 23 m/s
- **Sampling Time:** 16.9.2010 13:45
- **Unit of Measure:**
- **Sensor:** "DAVIS Anemometer" (Procedure)

Courtesy: 52 North. Org
SOS Geoservices REST API

Catalog
http://<host>/<root>/<services>
or
http://<host>/<root>/<services>/<folderName>

Map Service
/serviceName>/MapServer

SOS
/exts/sos

Observations
/observations - query

Procedures
/procedures - query

Features
/features - query

Courtesy : 52 North. Org
## Observation Resource - Query

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>offering</td>
<td>List of identifiers</td>
</tr>
<tr>
<td>observedProperty</td>
<td>List of identifiers</td>
</tr>
<tr>
<td>procedure</td>
<td>List of identifiers</td>
</tr>
<tr>
<td>featureOfInterest</td>
<td>List of identifiers</td>
</tr>
<tr>
<td>spatialFilter</td>
<td>Example: ( \text{spatialFilter} = {x:7.0,y:52.0,\text{spatialReference}{\text{wkid:4326}}} )</td>
</tr>
<tr>
<td>temporalFilter</td>
<td>Example: ( \text{temporalFilter=} \text{equals}:2011-10-19T15:00:00+02:00 )</td>
</tr>
<tr>
<td>where</td>
<td>Example: ( \text{where=} \text{numeric_value}=35 )</td>
</tr>
<tr>
<td>f</td>
<td>html</td>
</tr>
</tbody>
</table>
Example Requests

- Observations query:
  
  `<sos URL> /observations/query
  ?offering=CO-Offering
  &featureOfInterest=BETR701,DERP023,CH0049A
  &temporalFilter=equals:2011-10-18T10:00:00+00:00`
"observationData": [
{
  "id": "738",
  "type": "OM_Measurement",
  "phenomenonTime": "2011-10-19T23:00:00+02:00",
  "resultTime": "2011-10-19T23:00:00+02:00",
  "observedProperty": "CO",
  "procedure": "CO-SensorNetwork",
  "featureOfInterest": "BETR701",
  "result": {
    "type": "numerical",
    "uom": "ug/m3",
    "value": 18
  }
}]

Courtesy : 52 North. Org
Getting to know the REST Api - Samples

**API Web help** -


**Sample Geoservices** -

http://sampleserver1.arcgisonline.com/ArcGIS/rest/services

http://sampleserver2.arcgisonline.com/ArcGIS/rest/services

http://sampleserver3.arcgisonline.com/ArcGIS/rest/services

http://sampleserver4.arcgisonline.com/ArcGIS/rest/services

http://sampleserver5.arcgisonline.com/ArcGIS/rest/services

**Javascript api examples** -

Using Layer definitions with feature layers to limit the information that gets displayed on the map. Tooltips for each feature are also displayed as you mouse over the map.
Using a RelationshipQuery to display information from a related table for the selected features.
FeatureServer – Advertise Templates for editing, apply edits operation
Feature Server - Create, view and delete attachments
MapServer Support for Time

TimeSlider to filter petroleum well data by date

Visualize a time-aware FeatureLayer in snapshot mode with the TimeSlider
Geometry Service Operations

This example shows how you can use an ArcGIS Server geometry service to measure polygon areas and perimeter lengths in your Web application.

Area: 52.4851137531284 acres
Length: 6351.56553327258 feet
Apply a rendering rule to dynamically modify the display of a raster dataset.
Network Analyst

Service Area

Closest Facility
March 8 - MeetUp at Esri (Vienna, VA)
April 12 - MeetUp in DC area (location TBD)
Mar 24-27 – Esri Partner Conference (Palm Springs, CA)
Mar 26-29 – Esri Developer Summit (Palm Springs, CA)
July 21-24 – Esri Homeland Security Summit (San Diego, CA)
July 23-27 – Esri International User Conference (San Diego, CA)

Upcoming Events  (www.esri.com/events)
Thursday Evening Reception

- **6:30 – 9:30 pm**
- **Smithsonian Air and Space Museum**

**Logistics:**
- **6:15 – 10:00 pm** Buses transport between convention center and reception
- Conference Badge needed for reception
- Coat check – available at entrance
- Serving hot hors d’oeuvres and beverages
Friday Closing Session and Hosted Lunch

• Join conference attendees for lunch and closing session
• 11:30 am – 1:30 pm
• Ballrooms A-C, Third Level
• Closing Speaker – Chris Smith, United States Department of Agriculture
• Wrap-up and request for feedback with Jack Dangermond
Questions
Thank You

Please complete session evaluation form