Agenda

Esri’s participation in Standards Bodies

Interoperability Challenges
- Tackling Interoperability challenges using standards

Service Standards
- The Open GeoServices REST Specification
- The W*S Open Geospatial Consortium Standards

Sharing Environmental Data in a Homogeneous Way Across Europe
- A real world example leveraging interoperability principles and hybrid platforms.

ArcGIS Online – Leveraging Interoperability
ESRI Participates in Many Standards Organizations

- ISO
- OGC
- ANSI/INCITS
- OASIS
- IHO
- CEN
- OMA
- FGDC
- WSI
- CSGDI
- ACSM
- DGIWG
- ASPRS
- EPSG
ISO Participation

- ESRI provides leadership role in ISO TC 211 Standards Development:
  - ISO 19115: Metadata (Project Leader)
  - ISO 19115-2: Metadata – Imagery extension (Editor)
  - ISO 19125: Simple Feature Access (Editor)
    - Part 1 – Common Architecture
    - Part 2 – SQL Option
  - ISO 19139: Metadata – Implementation Specification (Project Leader – supported Editor/committee process)
  - ISO 19142 : Web Feature Service ( Editing committee member representing USA)
  - ISO 19143 : Filter Encoding ( Editing committee member representing USA)

- Provide technical experts on many WI project teams

  - SQL Multimedia and Application Packages – Part 3: Spatial
OGC Participation

- ESRI
  - Principal member
  
  - Actively participates:
    - Technical Committee
    - Planning Committee
    - Board of Directors
    - All three OGC programs
      - Interoperability program
      - Standards program
      - Community Outreach and Adoption program

- Current chair
  - Metadata Working Group
  - Web Map Service Working Group

- Has an elected member in the OGC Architecture Board
Interoperability

- Challenges

- Multiple Platforms (Operating Systems, Databases, …)

- Multiple Architecture (Local, Enterprise, Web, Cloud, …)

- Multiple Clients (Desktop, Web, Mobile, …)

- Multiple Developer Environments (.NET, Java, …)

- Multiple Protocols (SOAP, REST, OGC, …)

- Multiple Encodings (XML, Raster Formats, GML, JSON, …)
ArcGIS — A Complete System

Easier
More Powerful
and Everywhere

- Discover
- Create
- Manage
- Visualize
- Analyze
- Collaborate

Cloud
Enterprise
Local

Desktop
Mobile
Web
ArcGIS - is Open & Interoperable

Open API's / Open Specifications
- File GDB
- Shapefile
- Geoservices REST

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

Open Data Access

Vendor Specific Files

ETL
Interoperability Enablers

- **Data Standards**
  - Simple Features Model, …
  - WKT, WKB, Spatial Types, GML, netCDF, …

- **Metadata Standards**
  - ISO 19115, 119, 139, FGDC, ….

- **Service Standards**
  - GeoServices REST Specification
  - OGC Web Services - WMS, WFS, WCS, CS-W, WMTS, WPS
Simple Features

- Simple Feature specification
  - Common Architecture
    - Geometry Model
    - Well Known Text Representation for Geometry
    - Well Known Binary Representation for Geometry
    - Well Known Text Representation for Spatial reference Systems
    - ...
  - Part 2 – SQL Option
    - Database schema to support feature tables, Geometry, and Spatial Reference
    - SQL Geometry Type
    - SQL routines for constructing / obtaining a geometry object given its WKT, WKB representations
    - SQL Operations on Type Geometry
    - ...

GML

GML or Geography Markup Language is an XML based encoding Standard for geographic information developed by the Open Geospatial Consortium (OGC).

- GML Profiles – Point profile, Simple Features Profile
  - Simple Feature profile
    - Initially motivated to help WFS use of GML 3
    - Constrains the many optional elements of GML schema
    - Provides 3 levels of compliance: Level 0, 1 and 2

- GML Application Schemas – OSMasterMap, CityGML, WaterML, O&M, Top10NL,....
ArcGIS - Data Interoperability Extension

ESRI & SAFE Co-Development based on FME

- **Format Support**
  - Adds support for 110+ data formats
  - Custom Formats
  - Direct use in ArcGIS Desktop

- **Quick Data Translation**
  - Data Interoperability Tools Toolbox
  - Convert between data formats

- **Spatial ETL (Extract, Transform, Load)**
  - Semantic Data Translation
  - Data Restructuring
Interoperability Enablers

- **Data Standards**
  - Simple Features Model, …
  - WKT, WKB, Spatial Types, GML, netCDF, …

- **Metadata Standards**
  - ISO 19115, 119, 139, FGDC, …

- **Service Standards**
  - GeoServices REST Specification
  - OGC Web Services - WMS, WFS, WCS, CS-W, WMTS, WPS
ArcGIS 10.1 Metadata support

- Make metadata easier
- Complete support for FGDC and many ISO metadata standards
  - Content Standard for Digital Geospatial Metadata
  - 19115 – Metadata
  - 19119 – Services
  - 19139 – Implementation Specification for 19115 and 19119
  - 19110 – Feature Cataloguing Methodology
- Support profiles of ISO metadata standards
  - North American Profile
  - INSPIRE
- Auto update of metadata per the data’s intrinsic properties
- Validation - standards based metadata
- Extensible to support emerging profiles
- Templates supporting auto fill common metadata elements
- Provide methods for updating multiple metadata records (change address/phone number for example)
Interoperability Enablers

- **Data Standards**
  - Simple Features Model, …
  - WKT, WKB, Spatial Types, GML, netCDF, …

- **Metadata Standards**
  - ISO 19115, 119, 139, FGDC, …

- **Service Standards**
  - GeoServices REST Specification
  - OGC Web Services - WMS, WFS, WCS, CS-W, WMTS, WPS
Digital Government Strategy

- Make Open Data, Content, and Web APIs the New Default.
- Make Existing High-Value Data and Content Available through Web APIs

*…from Digital Government - Building a 21st Century Platform to Better Serve the American People*
Interoperability

• Challenges

  - Multiple Platforms (Operating Systems, Databases, …)
  - Multiple Architecture (Local, Enterprise, Web, Cloud,…)
  - Multiple Clients (Desktop, Web, Mobile, …)
  - Multiple Developer Environments (.NET, Java,…)
  - Multiple Protocols (SOAP, REST, OGC,…)
  - Multiple Encodings (XML, Raster Formats, GML, JSON, …)

• Solution

  - Build interoperable Web services across platforms, applications, and programming languages.
Powerful GIS capabilities
Delivered as Web services
To help solve real problems
ArcGIS for Server

- Web, Mobile and Desktop Clients
- Web Server
- Web Adaptor
- GIS Server(s)
- Data Server
- Administrator
- Publisher
ArcGIS Server - Building open and interoperable Systems

- Popular Mass market Mapping Environments:
  - Google Maps
  - Microsoft VE
  - Yahoo Maps

- Esri Client Solutions:
  - ArcGIS for Desktop
  - ArcGIS for Mobile
  - ArcGIS Online

- GIS Software:
  - Intergraph
  - Autodesk
  - PitneyBowes

- Solution Developer Frameworks:
  - php
  - Ruby
  - Python

- Business Applications:
  - SAP
  - Sharepoint
  - IBM WebSphere Portal
ArcGIS Server - Building open and interoperable Systems

**Supporting Multiple Protocols**

- Representational State Transfer (REST)
- Simple Object Access Protocol (SOAP)
- Open Geospatial Consortium (OGC)

**Catering to Multiple Communities:**

Spatial Data Infrastructures (SDI)
Enterprise Architectures (EA)
Neogeography/Mashup (WEB 2.0)
ArcGIS Server - Building open and interoperable Systems

Representational State Transfer (REST)
## REST – The Elevator Pitch

### 4 Key Principles*

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

*http://www.intertwingly.net/blog/2198.html*
ArcGIS Server - Building open and interoperable Systems

- Javascript
- Flex
- Silverlight
- Google Maps
- Microsoft VE
- Yahoo Maps
- REST Services
- SAP
- Sharepoint
- IBM WebSphere Portal
- iOS
- Android
- Windows Mobile
- php
- Ruby
- Python
- ArcGIS Server
The ArcGIS Server REST API provides a simple, open Web interface to services hosted by a Server.

All GIS Services are exposed as resources

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.

Some resources have operations
- Ex. Map Resource (export, find, identify)

Example:  http://sampleserver3.arcgisonline.com/arcgis/rest/services
Types of GIS Services

**Map**

View or query a 2D map on the server

**Geocode**

Perform address matching on the server

**Geometry**

Provides geometric calculations such as buffer, simplify, and project.

**Geoprocessing**

Provides spatial analysis and data processing services.

**Image**

Provide access to raster data though a Web service

**Feature**

Provide access to feature querying and editing

---

[http://resources.arcgis.com/content/web/gis-services](http://resources.arcgis.com/content/web/gis-services)
Client Libraries – Consuming the REST Services

• Client Libraries

• ArcGIS Developer Tools support for REST API
  - Web API
    - ArcGIS API for JavaScript
    - ArcGIS API for Flex
    - ArcGIS API for Silverlight
  - Mobile Runtime SDK’s
    - ArcGIS Runtime SDK for iOS
    - ArcGIS Runtime SDK for Windows Phone
    - ArcGIS Runtime SDK for Android
Open Layers - Supporting ArcGIS REST Services

http://openlayers.org/dev/examples/arcgis93rest.html
GDAL - Supporting ArcGIS REST Services
The Geoservices REST Specification

ArcGIS Server’s REST API is an “Open” Specification

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, REST-ful 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

Download PDF

The Geoservices REST Specification has been submitted to the OGC for Consideration.
Can I support Esri’s REST Specification on my non ArcGIS Server Platform?
Arc2Earth and the Geoservices REST Specification

https://www.arcgis.com/home/webmap/viewer.html?webmap=e1cdc4855ea54edf8ff9451e32fff5cb
Geometry Service

http://dl.dropbox.com/u/35958796/REST%20Demo1.wmv
ArcGIS Server - Building open and interoperable Systems

- Google Maps
- Microsoft VE
- Yahoo Maps

- Flex
- Silverlight
- Javascript

- Windows Mobile
- iOS
- Android

- SAP
- Sharepoint
- IBM WebSphere Portal

- Python
- php
- Ruby
ArcGIS Server - Building open and interoperable Systems
ArcGIS Server - Building open and interoperable Systems

Open GeoSpatial Consortium (OGC)
OGC Standards

OGC Services

- Web Map Service
- Web Map Tiling Specification
- Web Coverage Service
- Web Feature Service
- Web processing service
- OGC Keyhole Markup Language

- WMS
- WMTS
- WCS
- WFS
- WPS
- KML
OGC Support in ArcGIS Server

- Inherits from ArcGIS Server
  - Cartography
  - Security Framework
  - Performance & Scalability
  - Authoring, Publishing & Sharing

WMTS and WPS Support – New in 10.1
OGC Support in ArcGIS Server

- Differences with ArcGIS Server Services
  - Interfaces
  - Transfer protocols
  - Encoding
  - Clients

WMTS and WPS Support – New in 10.1
## 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>Geoservices REST specification</td>
</tr>
<tr>
<td><strong>Encoding style</strong></td>
<td>KVP, RESTful, 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>
Feature Editing – WFST

Non-Esri Clients
- Gaia
- Quantum GIS
- OpenLayers

GetFeature

Features in GML

Transactions

Transaction Confirmation

ArcGIS Server

OGC Services

WFST
Map Service
GeoData Service

Filter
Web Geoprocessing - WPS

Non-Esri Clients
- uDig
- Quantum GIS
- OpenLayers

GetCapabilities, DescribeProcess
Details of each process
Execute (Sync or Async)
Direct results
Results published as WMS

ArcGIS Server
OGC Services
- WPS
- GP Service
- WMS
- Map Service
### OGC / ISO standards support (ArcGIS 10.1)

<table>
<thead>
<tr>
<th>Standard</th>
<th>Supported Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMS</td>
<td>+ SLD</td>
</tr>
<tr>
<td></td>
<td>+ Filter Encoding Support</td>
</tr>
<tr>
<td></td>
<td>+ Time Support</td>
</tr>
<tr>
<td>WFS</td>
<td>+ Transactions</td>
</tr>
<tr>
<td></td>
<td>+ Filter Encoding Support</td>
</tr>
<tr>
<td>WCS</td>
<td>+ GeoTiff, NITF, HDF, JPEG, JPEG2000, PNG</td>
</tr>
<tr>
<td>WMTS</td>
<td>+ REST &amp; KVP Encoding</td>
</tr>
<tr>
<td>WPS</td>
<td>+ Synchronous</td>
</tr>
<tr>
<td></td>
<td>+ Asynchronous</td>
</tr>
<tr>
<td></td>
<td>+ Data and Services as inputs</td>
</tr>
<tr>
<td>CSW</td>
<td>+ OGC Core</td>
</tr>
<tr>
<td></td>
<td>+ ISO 19139</td>
</tr>
<tr>
<td></td>
<td>+ ebRIM</td>
</tr>
</tbody>
</table>

ArcGIS Support for OGC Web services

• Server
  - ArcGIS Server
  - Esri Geoportal Server
  - ……

• Client
  - Desktop Applications
  - API’s
  - Viewers
  - ……

• More Information

• ESRI Web Site : White papers, Product Support Matrix, OGC compliancy
  - http://www.esri.com/standards
ArcGIS 10.1 – OGC Compliancy

Compliancy Certificates available for

WMS
WFS
WCS
CS-W
Simple Features

http://www.opengeospatial.org/resource/products/compliant#ESRI
Sharing Environmental Data in a Homogeneous Way Across Europe

- A real-world use case from European Environmental Agency (EEA)
Sharing Environmental Data in a Homogeneous Way Across Europe

EEA’s 32 member states


Courtesy: 52 North. Org
Problem

Data Providers

Heterogeneous Interfaces:
- Proprietary formats
- FTP / HTTP

Application-specific Interfaces

EEA

ArcGIS Server Based Infrastructure

Data Consumers

Courtesy: 52 North. Org
Solution

Step 1: Define a Standards based Data model for Observations and Measurements (OGC O&M)
Solution

Step 2: Leverage a Standards based Service Protocol (OGC SOS).

Data Providers

SOS 2.0

EEA

Data Consumers

SOS 2.0

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
Product Solution

ArcGIS Server SOS Extension – An Open Source Solution from 52 degrees North

….. Leverages the GeoServices REST principles and the OGC SOS protocol.

http://52north.org/communities/sensorweb/sosSOE/index.html
ArcGIS Online

A complete, cloud-based, collaborative content management system for working with geographic information.

Supporting Interoperability thru GeoServices REST Specification, OGC WMS, CSV, OGC KML, ….
ArcGIS Online

Create and Collaborate on Maps and Apps

ArcGIS Online is a cloud-based, collaborative content management system for maps, apps, data, and other geographic information.

Learn More »

http://www.arcgis.com
GIS

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

• Dissemination of Geo Products
  - Proprietary
  - Open Specifications
  - Standards
  
  Geoservices REST Specification
Steps to evaluate UC sessions

- My UC Homepage > “Evaluate Sessions”
- Choose session from planner
  OR
- Search for session

www.esri.com/ucsurveysessions
• Thank you for attending
• Have fun at UC2012
• Open for Questions

• Please fill out the evaluation:
  
  www.esri.com/ucsessionssurveys

  First Offering ID: XXXX