Overview of OGC Services Architecture

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Overview of OGC Services Architecture

- Open Standards
- Information Standards
- Service Standards
- Putting it all together
OPEN STANDARDS
Why Open Standards?

• Rapidly mobilize new capabilities – plug and play

• Lower systems costs

• Encourage market competition
  – Choose based on functionality desired
  – Avoid “lock in” to a proprietary architecture

• Decisions to share information and services become policy decisions
What do we mean by “Open” Standard?

- Freely and publicly available
- Non discriminatory
- No license fees
- Vendor neutral
- Data neutral
- Agreed to by a formal consensus process
Types of OGC Specifications

• Implementation Specifications - Standards
  – Basis for working software; detail the interface structure between software components

• Abstract Specifications
  – Conceptual foundation / reference model for spec development

• Best Practices
  – Describe use of specifications

• Engineering Reports
  – Results from OGC Interoperability Program

• Discussion Papers
  – Forum for public review of concepts

http://www.opengeospatial.org/standards
OGC Geography Markup Language (GML)

- GML an application of eXtensible Markup Language (XML)
  - XML specified by World Wide Web Consortium (W3C)
  - GML specifies XML Schemas that specify XML encoding of geographic features, their geometry, and their attributes

- GML encodes digital feature data
  - Encodes features, attributes, geometries, collections, etc.
  - Applications require specifying more specific Application XML Schemas
  - GML v3, supports 2 1/2 and 3D geometry as well as complex geometry and topology

- GML 3 is also ISO 19136
## Types of Coordinate Reference Systems

<table>
<thead>
<tr>
<th>CRS</th>
<th>Coordinate System</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geocentric</td>
<td>Cartesian or spherical</td>
<td>Proper 3D spatial modeling; spatial applications</td>
</tr>
<tr>
<td>Geographic 3D</td>
<td>ellipsoidal</td>
<td>Locations described relative to ellipsoidal surface</td>
</tr>
<tr>
<td>Geographic 2D</td>
<td>ellipsoidal</td>
<td>Locations described on ellipsoidal surface; for large national/continental geodetic control networks</td>
</tr>
<tr>
<td>Projected</td>
<td>Cartesian</td>
<td>For national mapping; smaller area than Geographic 2D. Carefully controlled mapping distortions</td>
</tr>
<tr>
<td>Engineering</td>
<td>various</td>
<td>Earth curvature ignored; mostly flat-earth model</td>
</tr>
<tr>
<td>Image</td>
<td>Cartesian or oblique Cartesian</td>
<td>Distortions due to earth curvature determined by data acquisition characteristics</td>
</tr>
<tr>
<td>Vertical</td>
<td>gravity-related, depth, barometric</td>
<td>Gravity-related means relative to geoid (~MSL) Depth: complex reference surfaces (tidal)</td>
</tr>
</tbody>
</table>
GML Application Activities

Profiles
- GML Point Profile
- GML Simple Features Profile
- GML GeoShape for use in IETF
- GML in JPEG2000
- GeoRSS: GML Serialization

Application Schemas
- Climate Science Modelling Language (CSML)
- CityGML
- CleanSeaNet
- NcML/GML (NetCDF and GML)
- TDWG Biodiversity GML
- GeoSciML - Geological Sciences ML
- MarineXML
- Ground Water Modeling Language
- **WaterML**

GML Schemas for NSDI Framework
- Base Transportation
- Roads
- Governmental Units
- Linear Reference Systems
- Dictionaries
- Hydrology

Further information on OGC Network
http://www.ogcnetwork.net/node/210
Observations and Measurements (O&M)

- An **observation** is an event that estimates an **observed property** of a **feature of interest**, using a **procedure**, and generating a **result**
  - Sometimes ‘observed property’ and ‘feature of interest’ are conflated in describing geophysical parameters, e.g. *sea surface temperature*
- Often sampling is used to measure properties of a feature
  - In this case the feature of interest is a ‘**sampling feature**’

Observations are modeled within General Feature Model [ISO 19109]
WaterML

 OMG®
Weather Information Exchange Model (WXXM)
“A coverage is a feature that associates positions within a bounded space to feature attribute values”

• That is to say -- a collection of features that share a common regular geometry

• Examples
  – Raster image
  – Polygon overlay
  – Digital elevation matrix
Coverage Encodings

**OGC Specifications**
- GeoJPG
- GML
- GML in JPEG2000 (GMLJP2)
- SWE Common
- Network Common Data Format (NetCDF)

**Other Specifications**
- GeoTIFF
- National Imagery Transfer Format / BIIF
- HDF and HDF-EOS
Metadata

• Metadata is data about data

• Dataset metadata
  – characterize geographic data; enables in most efficient manner; facilitates data discovery, retrieval and reuse; fitness for of use
  – datasets, aggregations of datasets, individual geographic features,
  – core metadata - subset of the full set of elements
  – OGC adopted ISO 19115

• Service Metadata
  – "Get Capabilities" operation common to all OWS1 services, returns a "capabilities document" describing the service.
  – OGC AS Topic 12 (identical with ISO 19119)

• Registry Information Model (RIM)
  – all metadata and data types are registry objects.
  – ebRIM applied for registries in OGC
GeoSPARQL Vocabulary: Basic Classes and Relations

ogc:SpatialObject

Same as ISO GM_Object

ogc:Feature

0 .. *

ogc:hasGeometry

ogc:Geometry

0 .. 1

ogc:hasDefaultGeometry

ogc:isEmpty

ogc:isSimple

ogc:dimension : xsd:int
ogc:coordinateDimension : xsd:int
ogc:spatialDimension : xsd:int
ogc:isSimple : xsd:boolean
ogc:isSimple : xsd:boolean

ogc:asWKT : sf:wktLiteral
ogc:asGML : gml:gmlLiteral
...

Geometry encoded as a Literal

OGC®
SERVICE STANDARDS
Publish, Discover, Access, Fuse

Web Map Service
Web Coverage Service
Web Feature Service

Crowds
Calls for help

Sensors
Seismic Readings

Geo-fusion

Catalog

OGC®
OGC Web Services ("W*S") Pattern

What can you do?

GetCapabilities

Capabilities Document

Great! Give me data

Get Map, Feature, or Coverage

Data

Here you are....

Here… read this.

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OGC Web Map Service

- **Spatial Context**
  - Spatial Reference System (EPSG)
  - Corners of map (geographic extent)
  - Image width & height

- **List of “layers”**
  - Layer name
  - Symbolization style

- **Return Format**
  - GIF | JPEG | WebCGM | SVG, etc.
  - Background info (color, transparency)
  - Exception Type = InImage | Encoded/Parseable
OGC WMS – GetMap Operation

REQUEST1:
- [http://amapco.com/mapserver.cgi](http://amapco.com/mapserver.cgi)?
  VERSION=1.1.0&REQUEST=GetMap&
  SRS=EPSG:4326&
  BBOX=-97.105,24.913,78.794,36.358&
  WIDTH=560&HEIGHT=350&
  LAYERS=AVHRR-09-27&STYLES=&
  FORMAT=image/png&
  EXCEPTIONS=application/vnd.ogc.se_inimage

REQUEST2:
- [http://b-maps.com/map.cgi](http://b-maps.com/map.cgi)?
  VERSION=1.1.0&REQUEST=GetMap&
  SRS=EPSG:4326&
  BBOX=-97.105,24.913,78.794,36.358&
  WIDTH=560&HEIGHT=350&
  LAYERS=BUILTUPA_1M,COASTL_1M,POLBNDL_1M&
  FORMAT=image/png&STYLES=style1,style2,style3&
  TRANSPARENT=TRUE&
  EXCEPTIONS=application/vnd.ogc.se_inimage

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WMS-Tiling (WMTS) builds on WMS

- WMTS designed for high performance: anticipates high volume of identical requests
  - Pre-render data as tiles
  - Supports caching
- WMS request by bbox & h/w vs. WMTS request by Tiles
  - TileMatrixSet (CRS)
  - TileCol
  - TileRow
- Bindings:
  - KVP, SOAP/WSDL, RESTful
Web Feature Service (WFS)

- Access Vector Data using Web standards: HTTP, SOAP
- request components
  - service binding URL
  - geographic bounding box
  - coordinate reference system (CRS)
  - complex “filter” (much like a SQL query)
OGC Web Coverage Service (WCS)

• Service for Coverage offerings
  – Domain: grids; polygons, points, etc.
  – Range components: vector- or scalar-valued

• Operations similar to WFS - tuned to Coverages
  – GetCapabilities: Inquire about a WCS server
  – DescribeCoverage: Fetch details about a coverage
  – GetCoverage: Fetch data from a coverage

• Subsetting
The Big Picture of WCS 2.0

- Uses Core and Extension approach
- Extensions for KVP, POST, SOAP; NetCDF

Legend:
- abstract extension (not advertised)
- concrete extension (advertised)

WCS extensions
- grouping
- nil values
- n-D Domain
- uncertainty
- data model
- service model
- CRS/ general
  - CRS/ EPSG
  - scaling
  - async
  - polygon
  - WCS-T
  - WCPS
- uncertainty
- GET/KVP
- POST/XML
- JPEG2000
- NetCDF
- GeoTIFF
- manifest
- formats
- protocols
- GET/KVP
- POST/XML
- SOAP
- manifest
- formats
- protocols
- abstract extension (not advertised)
- concrete extension (advertised)

WCS core
- data model
- service model
- formats
- protocols
- uses model
- service model
- formats
- protocols
- uncertainty

WCS foundation
- Abstract Topic 6 / ISO 19123
- GML 3.2.1 Application Schema for WCS
OWS-9 Testbed Innovations Thread
- OWS-9 Kickoff Workshop occurring this week -

- WMTS Harmonization
  - Align diverse web map tiling APIs
  - Scalable interoperability architectures
  - Map Tiling Methods Harmonization Engineering Report
  - WMTS change requests
  - WMTS service

- Coverage Access and Data Quality
  - NITF, LIDAR, and DAP/OPeNDAP with WCS 2.0
  - Data quality in WMS, WMTS and KML
  - GMLJP2-wrapped LIDAR HRE Data
  - WCS and GMLJP2 change requests
  - WCS 2.0 for coverage access
  - Coverage Access Engineering Report
  - OWS Context Document

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Geo-Processing

- Hundreds of types of algorithms for geodata
- How can we scale to interoperable geo-processing?

- OGC Web Processing Service (WPS)
  - Interface that facilitates the publishing of geospatial processes, and the discovery of and binding to those processes by clients
  - Processes include any algorithm, calculation or model that operates on spatially referenced data.
  - WPS may offer calculations as simple as subtracting one set of spatially referenced numbers from another) or as complicated as a global climate change model.
OGC Web Processing Service (WPS)

Communication over the web using HTTP

GetCapabilities
DescribeProcess
Execute

Web Processing Service

Algorithm 1

Data Handler A
OGC Sensor Web Enablement

Enables discovery and tasking of sensor assets, and application of sensor observations for enhanced situational awareness, much like HTML, and HTTP enabled the WWW.
SWE Information Models and Schema

- **Observations and Measurements (O&M)** – Core models and schema for observations
- **Sensor Model Language (SensorML) for In-situ and Remote Sensors** - Core models and schema for observation processes: support for sensor components, georegistration, response models, post measurement processing
- **SWE Common** - Low level data models for exchanging sensor related data. Structure, encode and transmit sensor datasets in a self describing and semantically enabled way.
SWE Web Services

• **Sensor Observation Service** - Access Observations for a sensor or sensor constellation, and optionally, the associated sensor and platform data

• **Sensor Alert Service**  – Subscribe to alerts based upon sensor observations

• **Sensor Planning Service**  – Request collection feasibility and task sensor system for desired observations

• **Web Notification Service**  – Manage message dialogue between client and Web service(s) for long duration (asynchronous) processes

• **Sensor Registries**  – Discover sensors and sensor observations
Search/Discovery of Geospatial Data

- OGC Catalog Service
  - Catalog Service for the Web (CSW)
  - ISO 19119 Metadata Profile
  - OASIS ebRIM Profile
  - OpenSearch

- Request components
  - service binding URL
  - geographic bounding box
  - coordinate reference system (CRS)
  - complex “filter” (much like a SQL query)
Publisher reads features from a WFS managed by the GSS and proposes changes to those features. This may include proposing creation of new features.

GSS notifies Publisher whether proposed changes were Approved or Rejected.

GSS notifies Followers of changes to features (i.e. Transactions).

GSS notifies Reviewer of pending Change proposals.

Reviewer approves or rejects the proposed changes.

Approved changes are applied to features via OGC WFS-T.

Geographic features accessible via WFS.
OGC Open GeoSMS

- **Innovation:** Location encoding for SMS
- **Activities:** Sahana, Ushahidi, Frontline SMS and the UN ITU
- **Applications:** Disaster monitoring (debris flow and earthquakes), emergency response, transportation planning, taxi services and many more.
OGC and Security

• The OGC does not develop authentication, authorization and security standards

• We define best practices and extensions to existing standards from other standards organizations, such as OASIS
  – XACML (OASIS): access control policy language in XML and a processing model to interpret the policies
  – GeoXACML (OGC): geographic access control rules for distributed geographic content.
Security in OWS-9 Testbed

- XML Appliance
- User Creation
- Includes Logging
- PEP
- OR
- PDP
- Will attempt trying all 3 PDP on 3 separate passes

- Visualization Application
- Geospatial Filtered Response
- WFS Request
- OR
- STS
- WFS SAML 2.0 (SOAP)
- Geospatial Filtered Response

- Data
- Policy Filtered WFS
- WFS Response
- OR
- Access Manager
- User Creation
- Includes Logging
- PEP
- OR
- PDP
- Includes Logging

- PAP
- XACML Policy SAML
- GeoXACML

- Policy Creation GUI

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PUTTING SERVICES TOGETHER
Interoperability “Stack” - Service Viewpoint

- **Clients**: User Applications
- **Middleware**: Geoprocessing Services
- ** Servers**: Content Repositories, Features, Coverages, Other data
- ** Catalogs**: Metadata search and retrieval
- **Access to transformed data**
- **Service Chaining**: Direct data access

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Aviation Information in OWS-9 Testbed

Client Tier
- ATM-TGS, Luciad
  - EFB/Handheld
  - Flight Dispatch
  - Other Client Applications

Business Process Tier
- WPS
- Registry
- FPS
- DMS
- Event Service
- Other OGC Services
- 52 North, Galdos
- Envitiae, Luciad
- ATM-TGS, Harris
- IDS, IfGI

Access Tier
- WFS-T
  - AIXM 5.1 / WXXM 1.1.3 data store(s)
- Other OGC Services
- COMSOFT, Snowflake

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Engineering Components:
Host data; Interact thru Services

GEOSS Common Infrastructure
- Geo Web Portal
- GEOSS Clearinghouse
- Discovery Brokers
- Test Facility

Registered Community Resources
- Community Portals
- Client Applications

Client Tier
- CSW
- WMS

Mediation Tier
- Community Catalogues
- Workflow Management
- Portrayal Servers
- Processing Servers
- User Management
- Access Brokers

Access Tier
- GEONETCast
- Data Servers
- Sensor Web Servers
- Model Web Servers

GEOSS Portal Components
- Standards and Interoperability
- Best Practices Wiki
- User Requirements
- EO Vocabulary

Registries
- Components & Services
OGC Compliance Testing

Determines whether a product implementation of a particular specification fulfills all mandatory elements of the spec.
Compliance Program – Great Success

- More than 650 implementing products in the market

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<thead>
<tr>
<th>ESRI</th>
<th>Product Name</th>
<th>OGC Spec</th>
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<tbody>
<tr>
<td>ArcGIS 8.1</td>
<td>IntraMap/Web v5.6</td>
<td>GML 3.0, WCS 1.1</td>
</tr>
<tr>
<td></td>
<td>IntraMap/Web 6.0</td>
<td>WMS 1.3.0 (compliant)</td>
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<tbody>
<tr>
<td></td>
<td>degree Sensor</td>
<td>SOS 1.0.0 (compliant)</td>
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<tr>
<td></td>
<td>Observation Service 3.0</td>
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<td>Rolta OnPoint 6.4</td>
<td>WMS 1.3.0 (server compliant), CAT 2.0.2, WFS 1.0.0 (server compliant)</td>
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<tr>
<td></td>
<td>Oracle Application Server MapViewer,</td>
<td>WMS 1.1.1 (server compliant)</td>
</tr>
<tr>
<td></td>
<td>10g Release 2</td>
<td>(10.1.2)</td>
</tr>
<tr>
<td></td>
<td>Oracle Locator 11g, SFS(TE) 1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(compliant)</td>
</tr>
</tbody>
</table>

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For Details on OGC Standards…

• OGC Standards
  – Freely available
  – www.opengeospatial.org/standards

• OGC Reference Model (ORM)
  – Overview of OGC Standards Baseline
  – Resource for defining architectures for specific applications
  – www.opengeospatial.org/standards/orm

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