Geospatial Standards for Aviation Information Exchange

Open Geospatial Consortium (OGC)

Presented to: ATIEC 2019
By: Nadine Alameh, Ph.D.
    CEO, OGC
Date: September 24, 2019
OGC and Aviation

Geospatial/Location

- Findable
- Accessible
- Interoperable
- Reusable

Right Information to the Right Person at the Right Time

OGC - Open Geospatial Consortium
Why focus on Geo/Location?
Using location, we connect people, communities, technology and decision making to create a sustainable future for us, our children and future generations

- By specializing in making location more Findable, Accessible, Interoperable and Reusable
- Via a proven collaborative and agile process combining standards, innovation and partnerships

Communities-Tech & Domain
Partnerships & Alliances
Process for Standards & Innovation
What is OGC?

- Open location standards organization
- Global consortium of members (industry, government and academia)
- Forum for communities to tackle interoperability issues within and across communities
- Hub for thought leadership and innovation

Comprehensive global community-driven forward-looking expertise in location

Communities-Tech & Domain
Partnerships & Alliances
Process for Standards & Innovation
From Innovation to Operations

2005: AIXM introduced at Technical Committee (TC)

2010: OWS-7 Testbed

2011: SESAR MOISA

2011: OWS-8 Testbed

2012: OWS-9 Testbed

2013: AAtS Concept Study

2013: OGC Testbed 10

2013: OGC Testbed 11

2015: OGC Testbed 11

2016: OGC Testbed 12

2017: OGC Testbed 13

Operational Requirements for OGC Standards in Aviation

Digital NOTAMs
- AIXM
- WXXM
- FIXM

EFB
- Semantics
- Quality

WMS
- WCS
- WPS

Portrayal
- Catalog
- Pub Sub

Aviation Information World - Forecasting the Future
### ICAO SWIM Concept

#### Table 1. Global Interoperability Framework - Overview of Functions and Standards

<table>
<thead>
<tr>
<th>SWIM-enabled Applications</th>
<th>Functions or Sub layers</th>
<th>Candidate Standards, models, implementations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Service Interoperability</td>
<td>ATS, ATFM, Airline Ops</td>
</tr>
<tr>
<td></td>
<td>Interface Definition</td>
<td>OGC CS-W, WSDL, WADL, WFS, WMS, WCS</td>
</tr>
<tr>
<td>Information Exchange Models and Schemas</td>
<td>For aeronautical, MET, and flight information</td>
<td>AIXM, WXXM, IWXMM, FIXM, FIXS, AIXS, WXXS</td>
</tr>
<tr>
<td></td>
<td>Semantic Interoperability</td>
<td>Domain Specific: AIIVM, General: RDF/RDFS, OWL, SKOS</td>
</tr>
<tr>
<td>SWIM Infrastructure</td>
<td>Enterprise Service Management</td>
<td>DDS, JMX, SNMP</td>
</tr>
<tr>
<td></td>
<td>Policy</td>
<td>WS-Policy standards</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>WS-RM &amp; WS-RM Policy</td>
</tr>
<tr>
<td></td>
<td>Security</td>
<td>WS-Security &amp; SSL</td>
</tr>
<tr>
<td></td>
<td>Interface Management (Service Registration</td>
<td>OASIS/ebXML</td>
</tr>
<tr>
<td></td>
<td>Data Representation</td>
<td>XML, XSD, GML</td>
</tr>
<tr>
<td></td>
<td>Messaging</td>
<td>SOAP, JMS, DDS</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td>HTTP, JMS, MQ</td>
</tr>
<tr>
<td></td>
<td>Boundary Protection</td>
<td>No global standards as yet</td>
</tr>
<tr>
<td></td>
<td>Service Registry</td>
<td>UDDI, work on-going</td>
</tr>
<tr>
<td>Network Connectivity</td>
<td>Secure Network Connectivity</td>
<td>IPv4, IPv6</td>
</tr>
<tr>
<td></td>
<td>Naming and Addressing</td>
<td>DNS</td>
</tr>
<tr>
<td></td>
<td>Identity Management</td>
<td>No global standards as yet</td>
</tr>
<tr>
<td></td>
<td>Incident Detection and Response</td>
<td>No global standards as yet</td>
</tr>
</tbody>
</table>
Where we are?
Where are we going?

- Profile for Aviation
- Web services
  - WFS– Temporal Extension
- Pubsub
- Semantics
- Security
GML Profile for Aviation

- Guidance for the use of GML for encoding specific AIXM data (such as WGS-84, arcs of circle, references to State borders, water courses, shapes of obstacles, etc)
- The ISO 19107 spatial schema, which is implemented in GML, is very complex and contains an extensive list of geometries, geometric properties and operations – many of which are not necessary for aeronautical information applications.
- Profile to restrict GML 3.2.1 (point/line/polygon geometries)

Discussion paper [OGC 12-028r1]
https://portal.opengeospatial.org/files/?artifact_id=62061

Next step – Best practice – Official position of the Consortium

```
<aixm:ElevatedPoint srsName="urn:ogc:def:crs:EPSG::4326" gml:id="ID55">
  <gml:pos>52.2889 -32.0350</gml:pos>
</aixm:ElevatedPoint>
```

**E) AIR DISPLAY WILL TAKE PLACE WITH LATERAL LIMITS: 443838N 0200818E (NDB OBR) - 444508N 0201455E (VILLAGE JAKOVO) - 443445N 0202447E - 443838N 0200818E (NDB OBR).**
Web Feature Service – Temporarily Extension

- AIXM Temporality Model for dynamic features
  - Not covered by WFS 2.0 standard
- WFS query for an AIXM feature returns complete history, inconvenient for clients, waste of network traffic
- WFS-TE

Discussion paper [OGC 12-027r3]
https://portal.opengeospatial.org/files/?artifact_id=58922
ICAO Requirements for AIS

- Applicable since NOV 2018
- "5.1.1 Aeronautical information shall be provided in the form of aeronautical information products and associated services."

Annex 15 to the Convention on International Civil Aviation
Aeronautical Information Services
Sixteenth Edition, July 2018

INTERNATIONAL CIVIL AVIATION ORGANIZATION
Coverages for Weather

Meteorological data structures – a challenge

- Large data volumes
- Multi-dimensional
- Lots of metadata
- Heterogeneous (forecast, analysis, etc)
- GRIB data format

MetOcean Application Profile for WCS 2.0
(Pete Trevelyan)

- Definition of “4D coverage” that share horizontal/temporal domains
- Principle of coverage collections
So What’s the Issue with “Coverages”? 

• **Data Size, Volume, Resolution**
  ➢ *Insufficient* storage, computer resources, bandwidth
  ➢ **Transfer** of MetOcean data sets harder to push thru web services

• **Subsetting**
  ➢ Returns only data *necessary* to consumer
  ➢ WCS Core Functionality: Trimming, Slicing, but *lacking*...
  ➢ *Not* **tailored** to specific MetOcean community’s needs.

• **Interoperability**
  ➢ *Improvement* between disparate web services. Needed for global cooperation ➢ SESAR & NEXTGEN.
  ➢ Can we **describe** MetOcean WCS data in a **community-based controlled vocabulary**?

• **MultiDimensionality**
  ➢ MetOcean data inherently **4D** (x/y/z/t)
  ➢ WCS Coverages often **2D** (x/y)
  ➢ Size & # WCS Requests & Responses w/ 2D Coverages **unwieldy**

→ **Need new way of thinking about MetOcean coverages!**
Getting the Data: New Operations to Query MetOcean Coverages

- Complex Data Extraction
  - Derived/Developed from Multi Dimensionality and 4D Coverages
  - Improved Efficiency: User retrieves only the data of interest.
- Tailored to common MetOcean Data Shapes
  - More Explicit than the WCS GetCoverage operation

- GetPolygon
  - Extract Data over an Area or Volume

- GetCorridor
  - Extract Data for a Path or Trajectory with Volume
OGC APIs

- Modernization of web services
- Open API-based next generation of standards aligned early in their development and sufficiently modular to maximize flexibility
- Implementer friendly
- Starting with WFS (WFS3)
  - In parallel Coverages, Map Tiles, Processing, Common
- OGC API – Features: Part 1 – Core is now officially an OGC standard

*Implementation Standard [OGC 17-069r1]*
Where we are?
Where are we going?

Profile for Aviation
WFS – Temporal Extension
Pubsub
Semantics
Security
PubSub

- Need for asynchronous messaging for aviation
- Subscribing for specific subsets of data (e.g. FIXM flights intersecting a given Airspace)
- Different delivery methods such as (Advanced Message Queuing Protocol (AMQP), JMS, WS-N)
- Next is looking at OASIS Message Queue Telemetry Transport (MQTT) Extension (used by OGC Sensor Things API)

Implementation Standard [OGC 16-017]
http://docs.opengeospatial.org/per/16-017.html

Engineering Report [OGC 13-131r1]
http://docs.opengeospatial.org/is/13-131r1/13-131r1.html
PubSub

- Evaluating AsyncAPI for defining asynchronous / event-driven interfaces
- Open source initiative that seeks to improve the current state of Event-Driven Architectures (EDA).
  - Goal is to make working with EDA’s as easy as it is to work with REST APIs. That goes from documentation to code generation, from discovery to event management. Most of the processes we apply to our REST APIs nowadays would be applicable to our event-driven/asynchronous APIs too.
Where we are?
Where are we going?

Profile for Aviation
WFS– Temporal Extension
Pubsub
Semantics
Security
Semantics
Linked Data

Table of Contents
1. Semantics 4
2. Linked Data 4

Engineering Report [OGC 18-035]
http://docs.opengeospatial.org/per/18-035.html

Aviation Information World - Forecasting the Future
Where we are?
Where are we going?

- Profile for Aviation
- WFS– Temporal Extension
- Pubsub
- Semantics
- Security
Security

• **OGC Web Service Security**
  – For hosting an OGC Web Service (W*S) on HTTPS
  – How to present security requirements on the W*S standards in the capabilities
  – Does not recommend particular security setups
    
    *Implementation Standard [OGC 17-007r1]*
    
    [http://docs.opengeospatial.org/is/17-007r1/17-007r1.html](http://docs.opengeospatial.org/is/17-007r1/17-007r1.html)

• **Testbed work**
  – Best practices for the integration of OAuth2.0/OpenID Connect services
  – Mediation services for different security environments
  – Federated identity management
  – Securitization of workflows

  *Implementation Standard [OGC 17-007r1]*
  
  [http://docs.opengeospatial.org/is/17-007r1/17-007r1.html](http://docs.opengeospatial.org/is/17-007r1/17-007r1.html)
Security

- Testbed 15 goes beyond the typical point-to-point data protection by HTTPS
  - NATO STANAG 4774 / 4778 and WFS Feature Collection co-play
  - Encryption is put to data assets to achieve end-to-end protection (so i.e. from an Amazon S3 bucket to the hard drive of the user)

- NATO STANAG 4778 is like a Feature Collection but enriched by XML Encryption & Digital Signature
  - Data (and metadata) can stay encrypted from the producer to the end user to ensure confidentiality
  - Digital Signature allows the end user to determine the producer and that the data is authentic (has not been tampered with).

- Expected outcomes: Recommendation that OGC supports a Digital Signature on OGC Encoding Standards (e.g. Feature Collection)
Where we are?
Where are we going?

- Profile for Aviation
- WFS– Temporal Extension
- Pubsub
- Semantics
- Security
OGC and Aviation

Geospatial/Location

Findable
Accessible
Interoperable
Reusable

Communities-Tech & Domain
Partnerships & Alliances

Process for Standards & Innovation

STANDARDIZATION ROADMAP
For Unmanned Aircraft Systems, Version 3.0

Prepared by the ANSI Unmanned Aircraft Systems Standardization Collaborative (UASC)
December 2019

ISO TC 211

STANDARDS BY ISO/TC 20/SC 16
Unmanned aircraft systems

ASTM International
International Organization for Standardization
ISO
RTCA, Inc.
RTCA

SAE International
IEEE
Consumer Technology Association
CES

Open Geospatial Consortium
OGC
Underwriters Laboratories Inc.
National Fire Protection Association
NFPA

American Society of Safety Professionals
American Society of Mechanical Engineers
Telecommunications Industry Association
TIA

Aviation Information World - Forecasting the Future

FAA
OGC and Aviation

Geospatial/Location

Findable
Accessible
Interoperable
Reusable

Communities-Tech & Domain
Partnerships & Alliances
Process for Standards & Innovation

OGC SensorThings API Scope

LuS Working Group
(chaired by NASA, Harris, Boeing)

OGC Architecture

AT-IEC
Aviation Information World - Forecasting the Future
OGC and Aviation

How to follow up?
- nalameh@ogc.org
- Get involved in our Aviation Domain Working Group
  - https://www.opengeospatial.org/projects/groups/aviationdwg
- Engage in upcoming pilots and testbed related to Aviation
  - Possible WFS-TE Pilot (2020)
  - Aviation Thread in Testbed 16 (2020)
  - https://www.opengeospatial.org/projects/initiatives/active