

Geospatial Standards for Aviation Information Exchange

Open Geospatial Consortium
(OGC)

Presented to: ATIEC 2019

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CEO, OGC

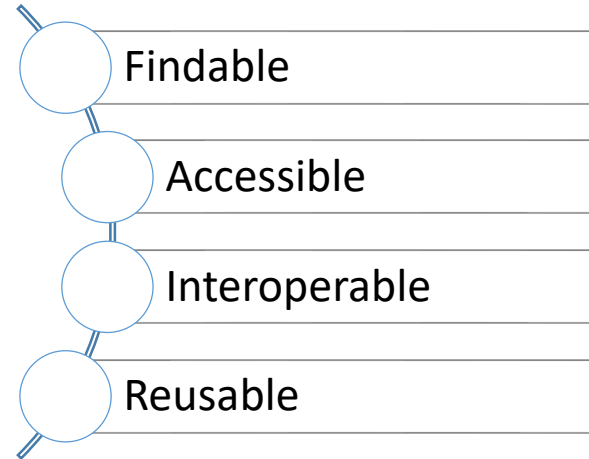
Date: September 24, 2019

Aviation Information World – Forecasting the Future

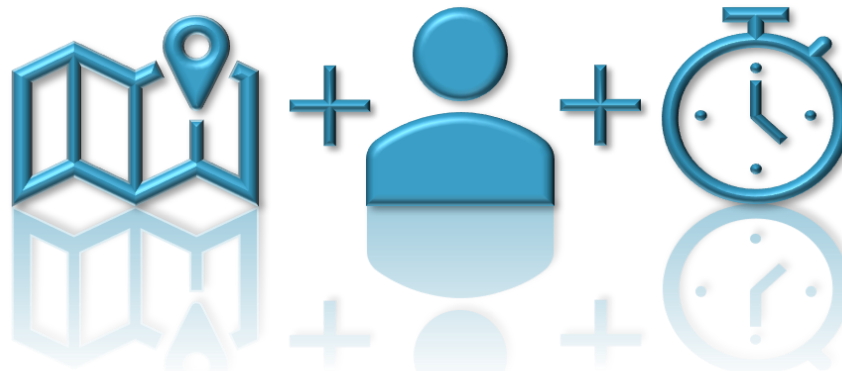


OGC and Aviation

Geospatial/
Location



Right Information to the **Right Person** at the **Right Time**





Why focus on Geo/Location?



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Comprehensive
global community-
driven forward-
looking expertise
in 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

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Comprehensive
global community-
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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*



Communities-
Tech & Domain



Partnerships &
Alliances



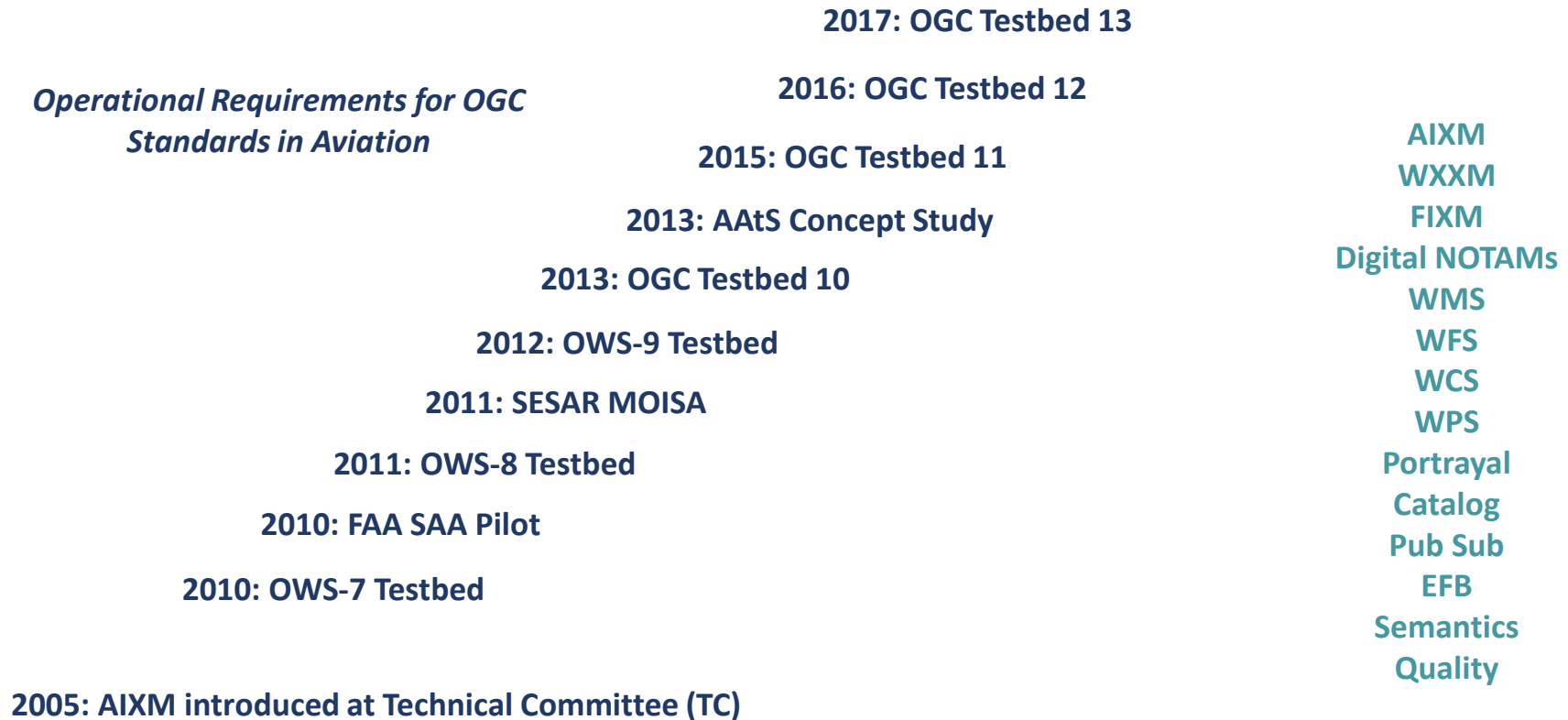
Process for Standards
& Innovation



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From Innovation to Operations



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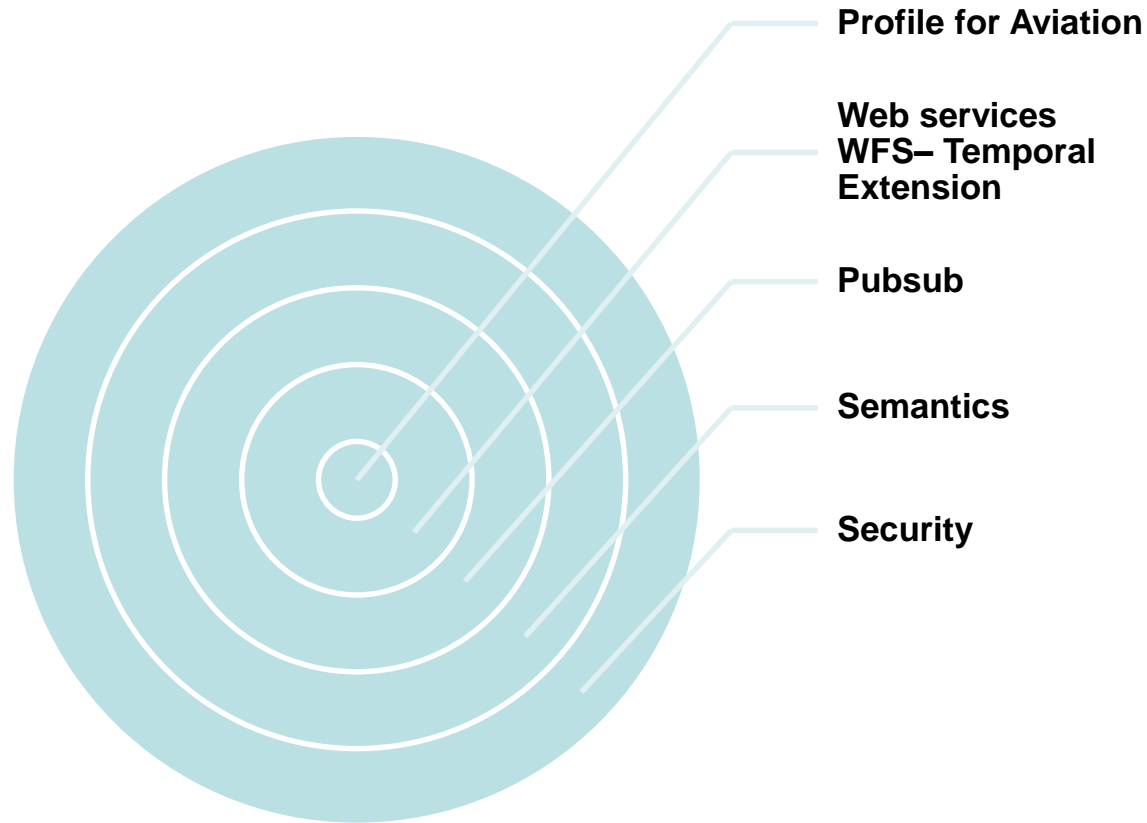
ICAO SWIM Concept

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

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

Where we are?

Where are we going?



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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)

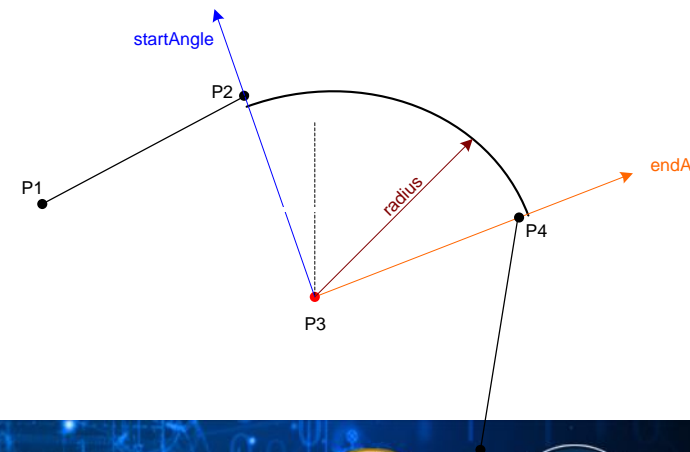
Discussion paper [OGC 12-028r1]

https://portal.opengeospatial.org/files/?artifact_id=62061

Next step – Best practice – Official position of the Consortium

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  <gml:pos>52.2889 -32.0350</gml:pos>  
</aixm:ElevatedPoint>
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•“(E) AIR DISPLAY WILL TAKE PLACE WI LATERAL
LIMITS: 443838N 0200818E (NDB OBR) - 444508N
0201455E (VILLAGE JAKOVO) - 443445N 0202447E -
443838N 0200818E (NDB OBR).



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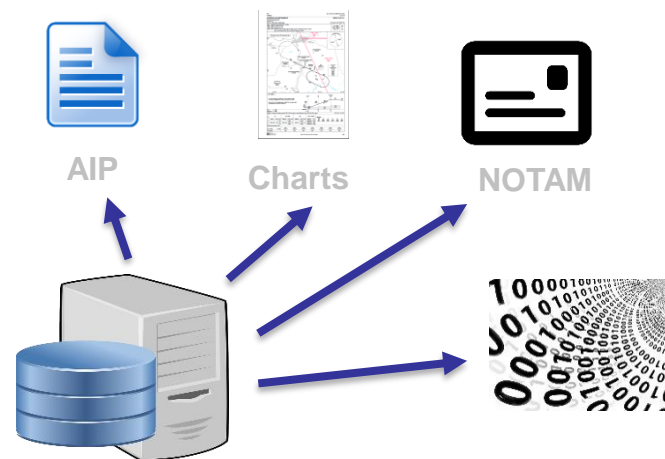


Web Feature Service – Temporarily Extension

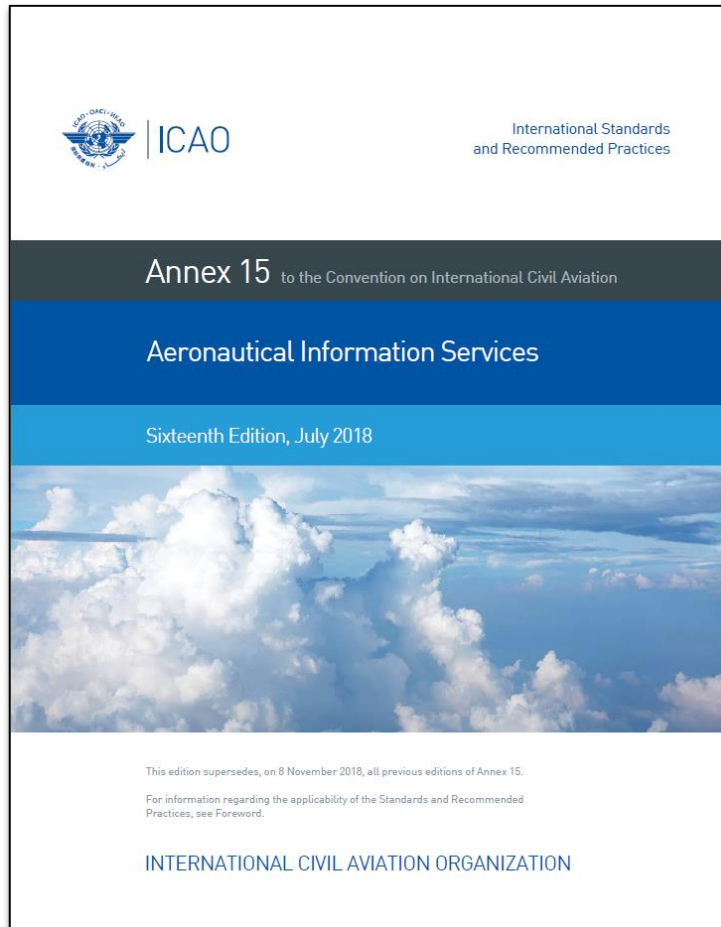
- AIXM Temporality Model for dynamic features
 - Not covered by WFS 2.0 standard
- WFS query for an AIXM feature returns complete history, inconvenient for clients, waste of network traffic
- WFS-TE

Discussion paper [OGC 12-027r3]

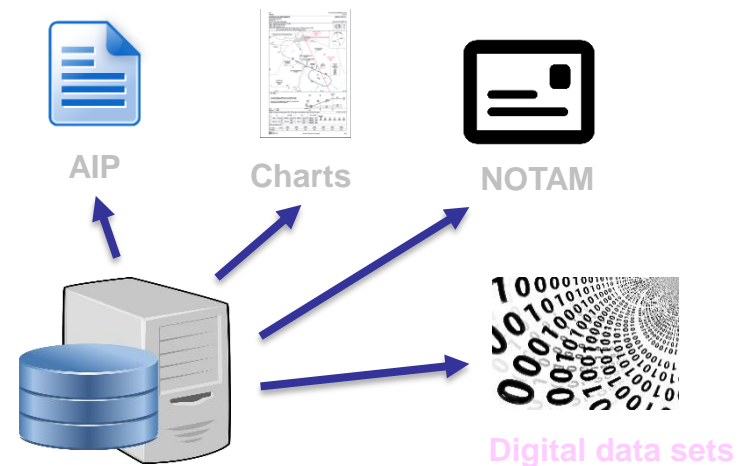
https://portal.opengeospatial.org/files/?artifact_id=58922



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.***"





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Coverages for Weather



Meteorological data structures – a challenge

3D



4D



- 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



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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 ?

→ *Need new way of thinking about MetOcean coverages!*

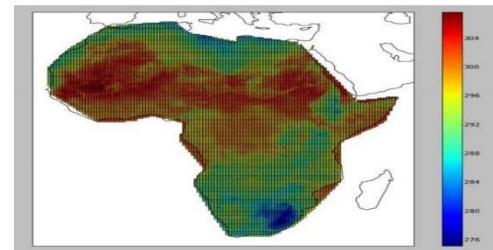
- **MultiDimensionality**

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

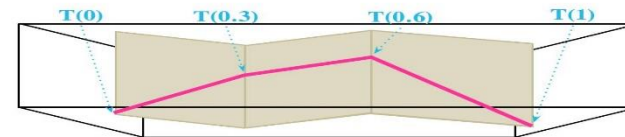
Getting the Data: New Operations to Query MetOcean Coverages

- ❑ 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

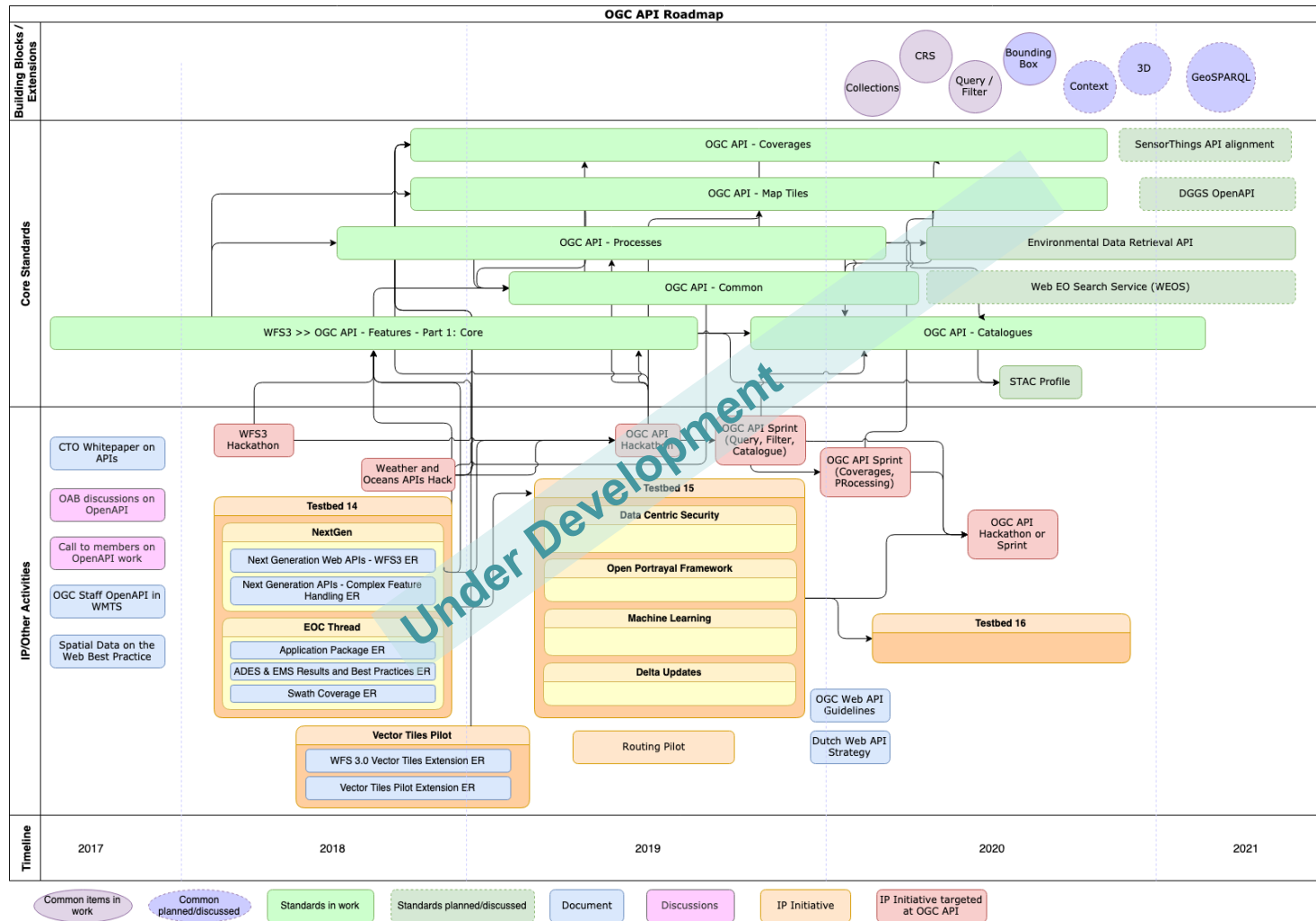
- Modernization of web services
- Open API-based next generation of standards aligned early in their development and sufficiently modular to maximize flexibility
- Implementer friendly
- Starting with WFS (WFS3)
 - In parallel Coverages, Map Tiles, Processing, Common
- OGC API – Features: Part 1 – Core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

Implementation Standard [OGC 17-069r1]

https://portal.opengeospatial.org/files/?artifact_id=84541&version=1



OGC APIs

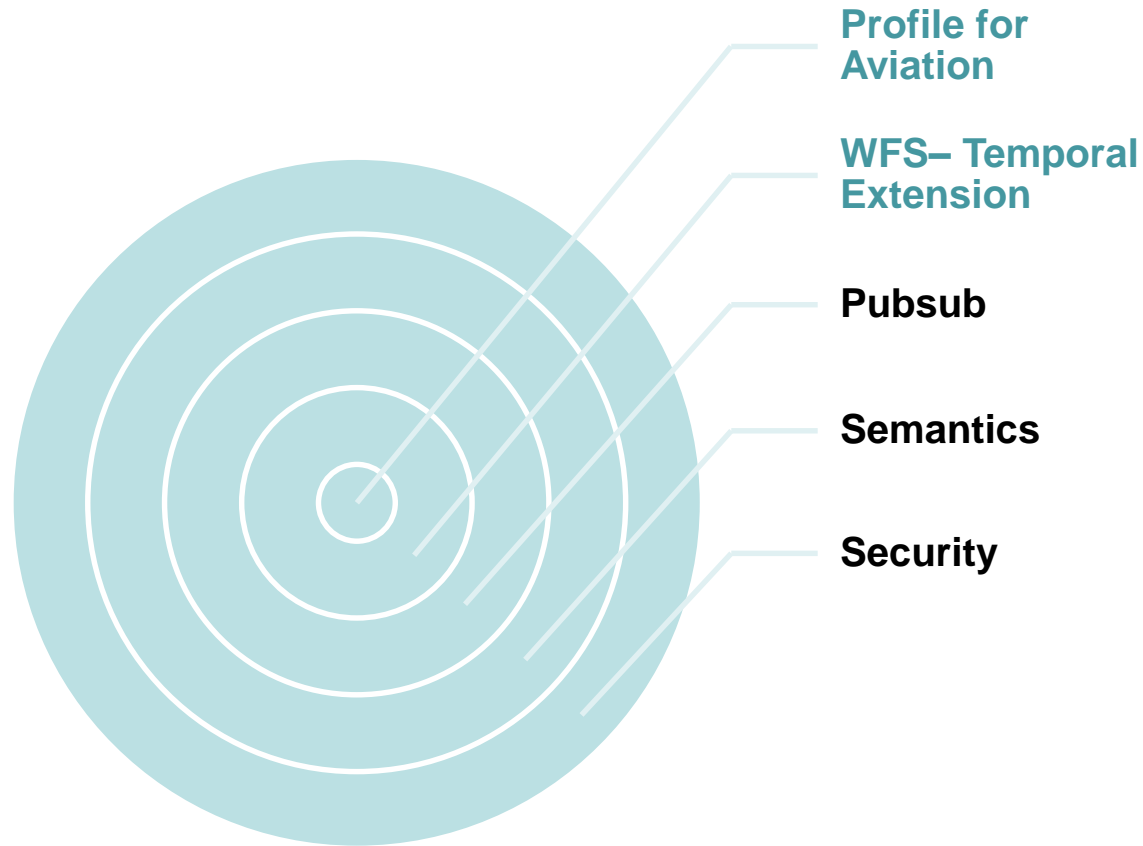


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Where we are?

Where are we going?



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PubSub



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PubSub

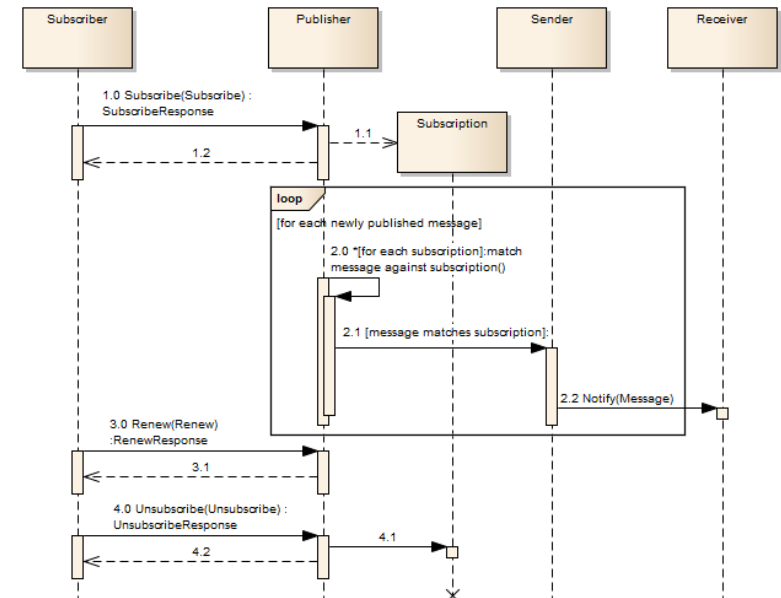
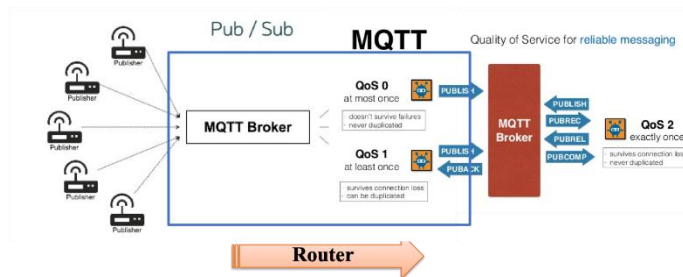
- Need for asynchronous messaging for aviation
- Subscribing for specific subsets of data (e.g. FIXM flights intersecting a given Airspace)
- Different delivery methods such as (Advanced Message Queuing Protocol (AMQP), JMS, WS-N)
- Next is looking at OASIS Message Queue Telemetry Transport (MQTT) Extension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

Implementation Standard [OGC 16-017]

<http://docs.openeospatial.org/per/16-017.html>

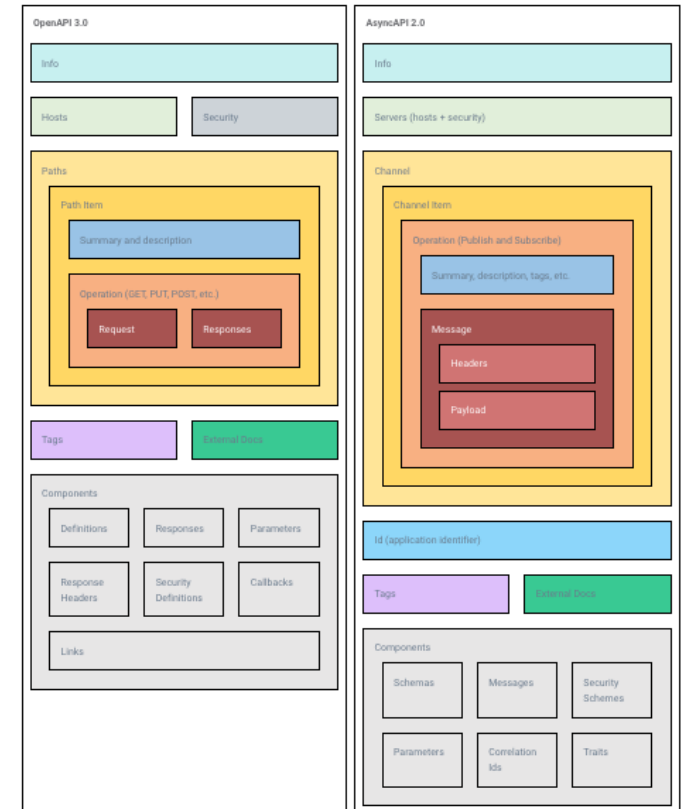
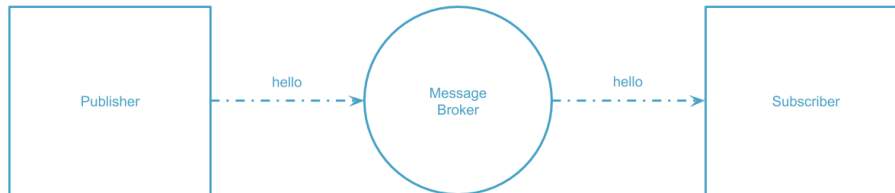
Engineering Report [OGC 13-131r1]

<http://docs.openeospatial.org/is/13-131r1/13-131r1.html>



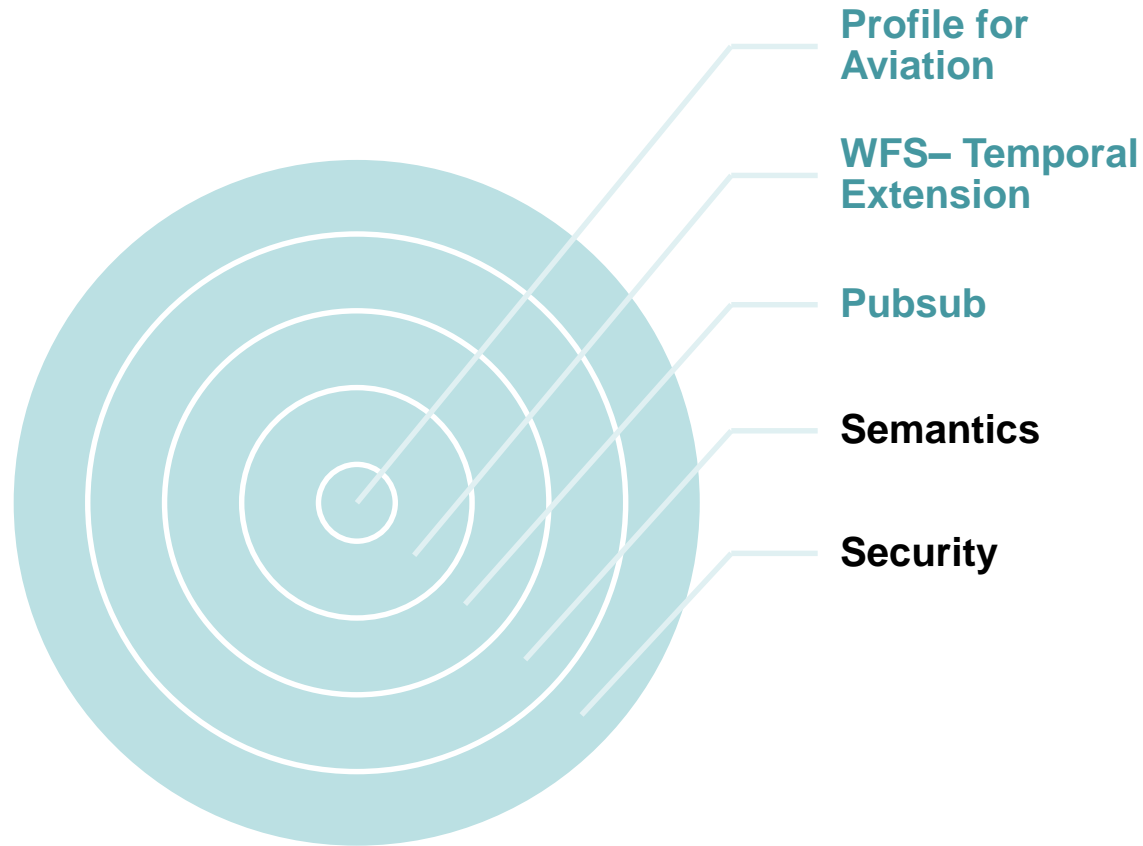
PubSub

- 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.



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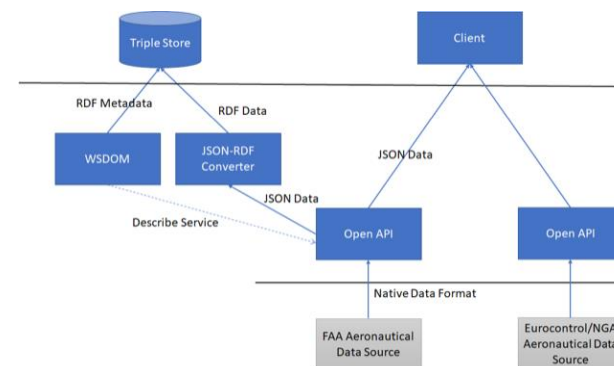
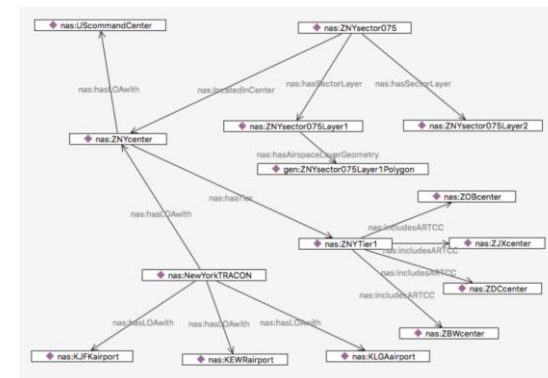
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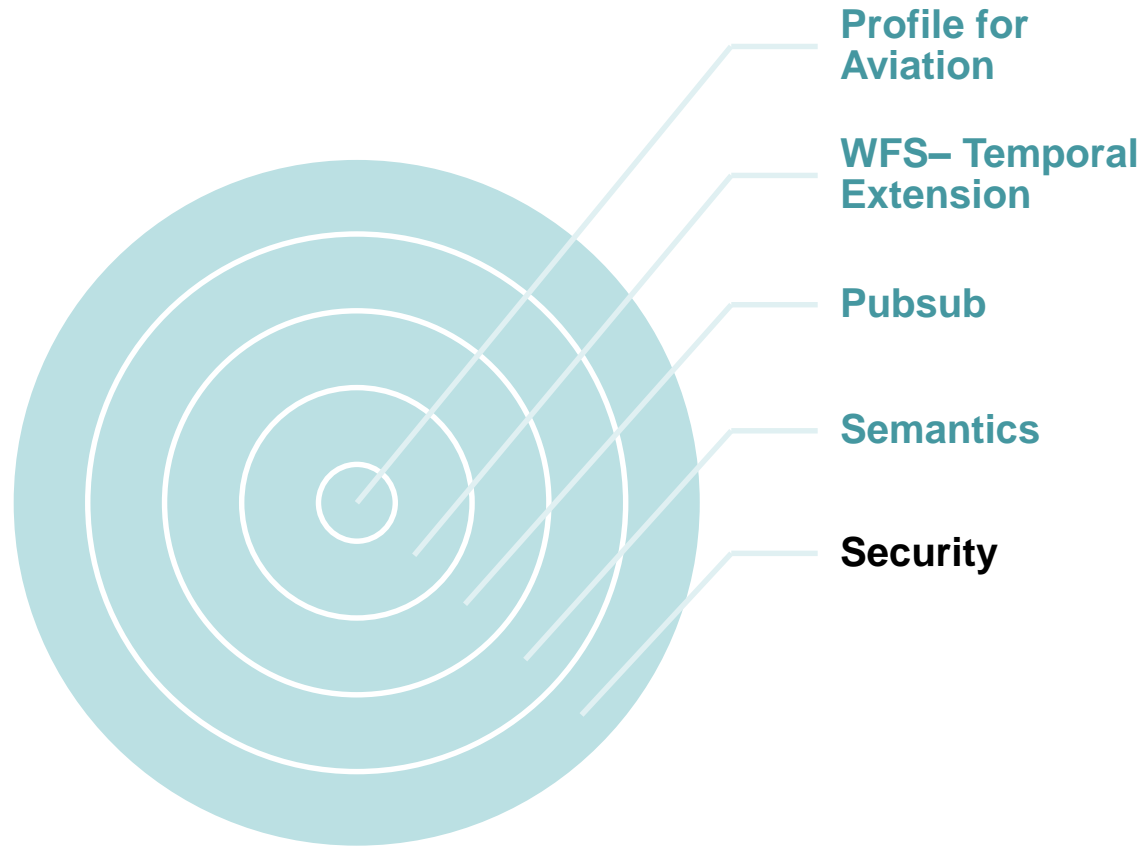
graph LR
    SP([ServiceProfile]) --- SPV([ServiceProvider])
    SP --- SC([ServiceConsumer])
    SP --- SF([ServiceFunction])
    SP --- CF("<<Categorization Facets>>")
    SP --- QoS([QoS])
    SP --- Sec([Security])
    
    SPV --- SO([stakeholder: Organization])
    SC --- G([geosparql:Geometry])
    SF --- RWE([RealWorldEffect])
    CF --- CFList["• Flight Cancelled  
• Airspace Closed  
• Flightplan Submitted  
• ..."]
    QoS --- QoSList["• Response Time  
• Capacity  
• Availability  
• ..."]
    Sec --- SecList["• ..."]
  
```

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Where we are?

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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>

- **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>



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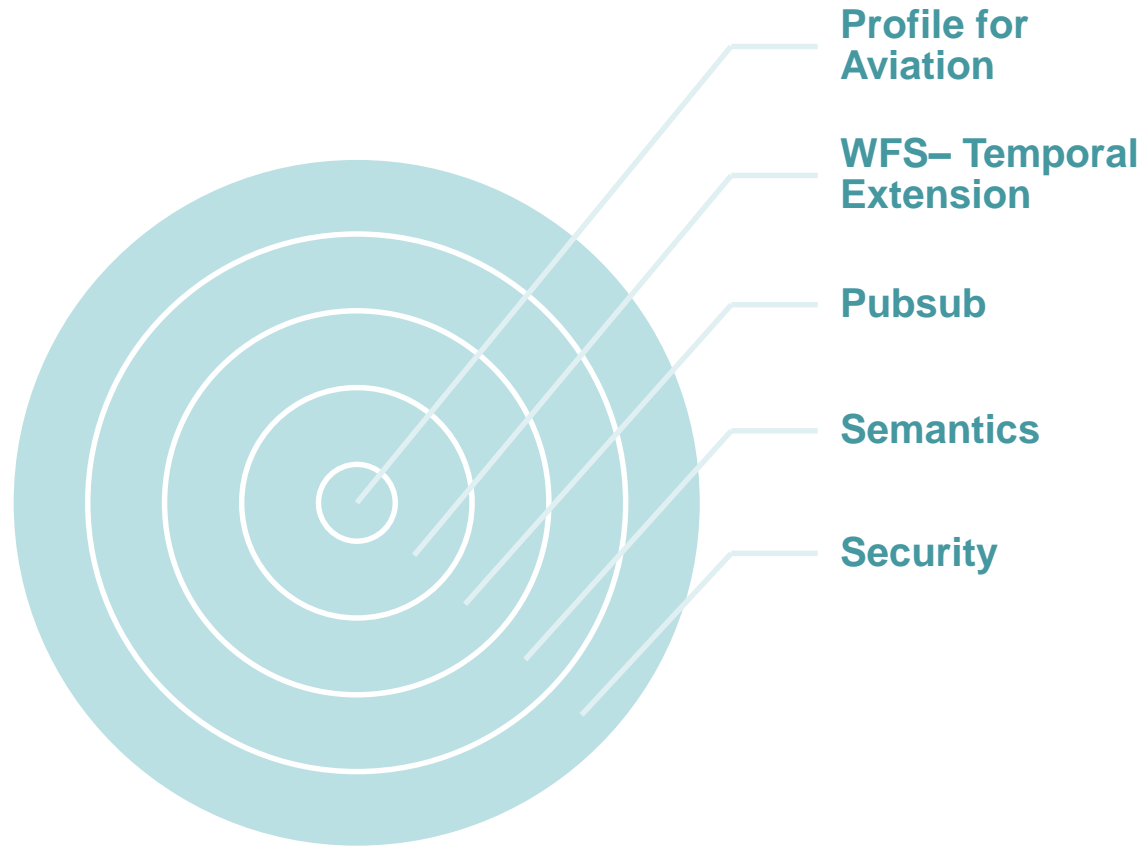


Security

- 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)

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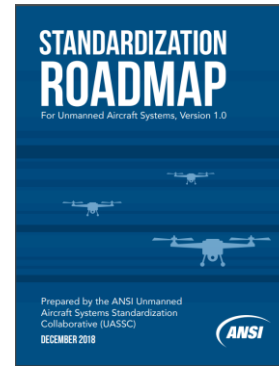
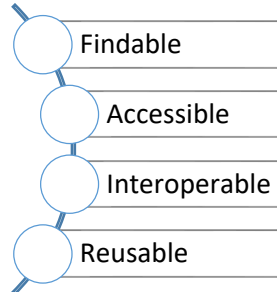
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Location



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

ASTM International 	International Organization for Standardization 	RTCA, Inc.
SAE International 	Institute of Electrical and Electronics Engineers 	Consumer Technology Association
Open Geospatial Consortium 	Underwriters Laboratories Inc. 	National Fire Protection Association
American Society of Mechanical Engineers 	American Society of Safety Professionals 	Telecommunications Industry Assn.

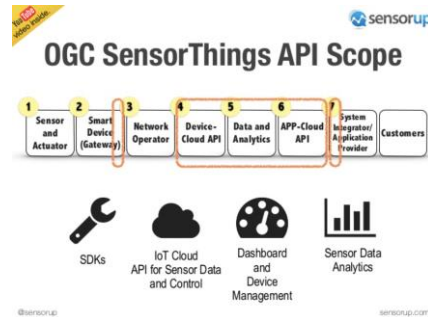
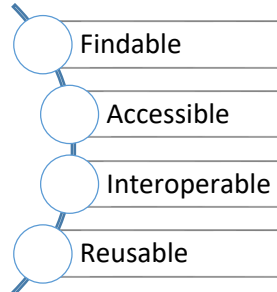
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UxS Working Group

Chaired by NASA, Harris, Nobilis

Category	Requirements	OGC Deliverables
Data management	high volume data of variable accuracy	Big Data, Data Quality, WCS-T, SWI/SensorThings
Data discovery	no metadata	Metadata, Data Quality, CSW
Data quality	mixed sources of mixed accuracy	Data Quality, link to ASPRS & ISPRS
Data dissemination	Streaming of oblique imagery and point clouds	Merge inactive Oblique Imagery DWG, Point Clouds, JPIP (more than just WCS-JPIP)
Mission planning	exchange of flight planning data	GML, KML, Aviation DWG
Oblique sensors	quality, indexing, georepositioning	Merge inactive Oblique Imagery DWG, Data Quality, SWI/SensorThings



Linked-data
API for
Networked
DRones



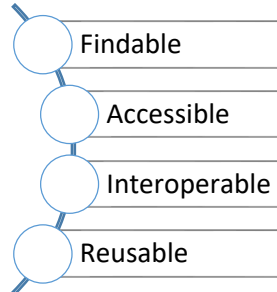
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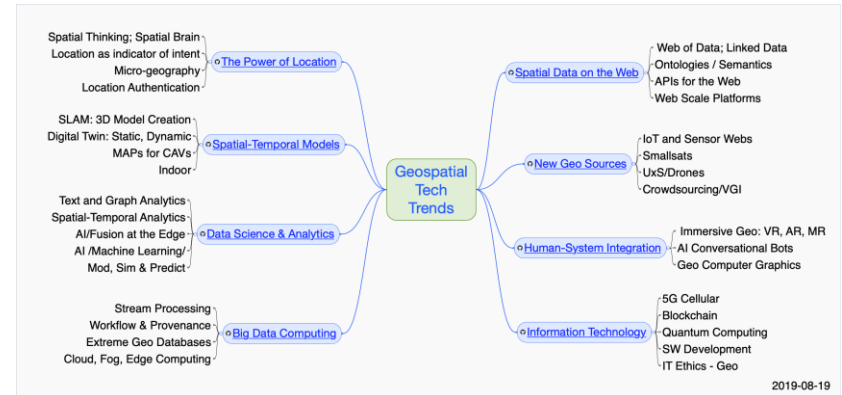
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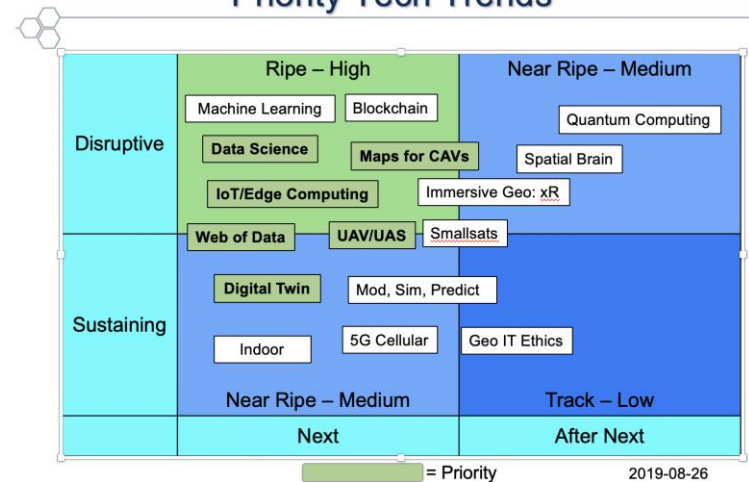
Communities-
Tech & Domain



Partnerships &
Alliances



Priority Tech Trends



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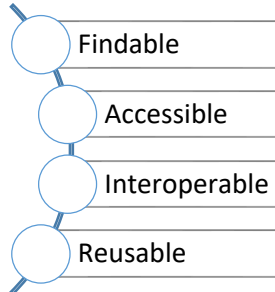
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Partnerships &
Alliances



Process for Standards
& Innovation

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>



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