*International Civil Aviation Organization*

**The Seventh Meeting of System Wide Information Management Task Force (SWIM TF/7)**

*Bangkok, Thailand, 09 – 12 May 2023*

Agenda Item 3: Updates on the assigned tasks by task leads/contributors including progress report and issues

**d) Governance**
- Task 5: Registry and Other Related Governance Policies

# Enabling SWIM Service Composition with REST-based API

(Presented by USA/Federal Aviation Administration)

**SUMMARY**

In this paper, we discuss our experiences using Representational State Transfer (REST) APIs in System Wide Information Management (SWIM) to deliver context-driven information, improve developer productivity, and streamline service deployment, including data fusion, service composability, and filtering mechanisms. We also share key lessons learned from these experiences, including the importance of REST APIs for interoperability, scalability, security, and developer-friendliness.

## 1. INTRODUCTION

1.1 Service Oriented Architecture (SOA) is a design principle that has been widely adopted in the development of SWIM infrastructures.

1.1.1 SOA defines a set of principles for building distributed systems based on the concept of services. By following the SOA principal, SWIM services can be used across different systems, independent of the underlying technologies, programming languages, or platforms.

1.2 Representational State Transfer (REST) is an architectural style for building web services that is consistent with the design principles of the World Wide Web.

1.2.1 RESTful web services use HTTP protocol, URIs, and standard Create, Read, Update and Delete (CRUD) operations to provide a scalable, reliable, and predictable way to access and manipulate resources over the web.

1.2.2 By using standardized protocols and operations, RESTful web services can achieve interoperability across different systems and platforms, further reducing the barriers of communication and collaboration across different regions, languages, and platforms.

1.3 In this paper, we focus on our experiences exploring REST APIs as we evolve the FAA SWIM platform, to achieve the following objectives:

- Delivering context-driven information to consumers: RESTful web services provide a scalable and flexible way to integrate, fuse, and filter data from existing SWIM services.
- Improving developer productivity and service deployment: RESTful web services leverage open standards and tools, making it easier for developers to build, test, and deploy services on the FAA SWIM platform.
- Achieving global interoperability: RESTful web services provide a standardized and interoperable way to exchange aviation data globally.

## 2. DISCUSSIONS

2.1 SWIM Discovery Service (SDS) [1], a joint effort to facilitate the exchange of service metadata among independently developed and autonomously managed SWIM programs, leverages standard-based REST API extensively, as shown in Figure 1.

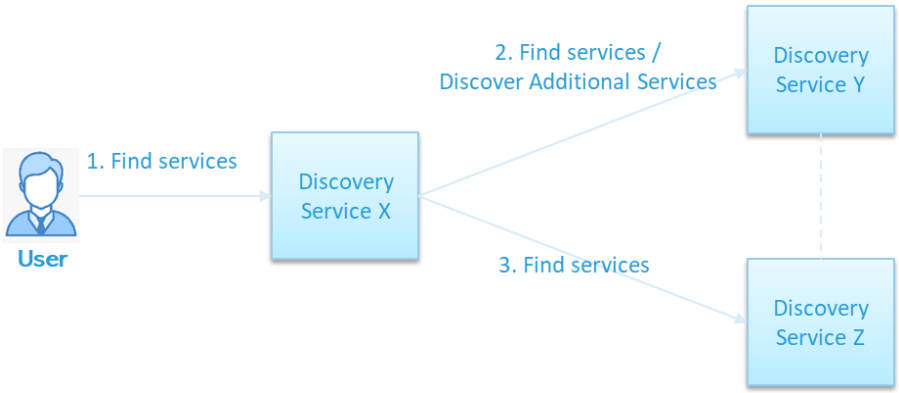


*Figure 1 SDS*

2.1.1 From an architectural perspective, individual discovery services are composed together via REST APIs. From the user's perspective, it allows querying a network of interconnected discovery services to discover information needed for its mission.

2.1.2 Consistent with the REST principle, resources are defined for concepts associated with SWIM services, such as Service Descriptions. This allows a Service Description to be uniquely identified using URI and uniformly accessed by an SDS client, especially important for SDS since a service description may be provided by any of the SDS instances with a region.

2.1.3 SDS uses Open API to describe services. This allows a new SDS implementer to jump start the development effort quickly.

2.2 Through Open Geospatial Consortium (OGC) testbed initiatives, FAA has explored how standard-based API can enhance SWIM data distribution, as shown in Figure 2. Deliverables from these initiatives included Engineering Reports (ER) that detailed the solution architecture and technical recommendations, as well as live demonstrations using SWIM services and data.

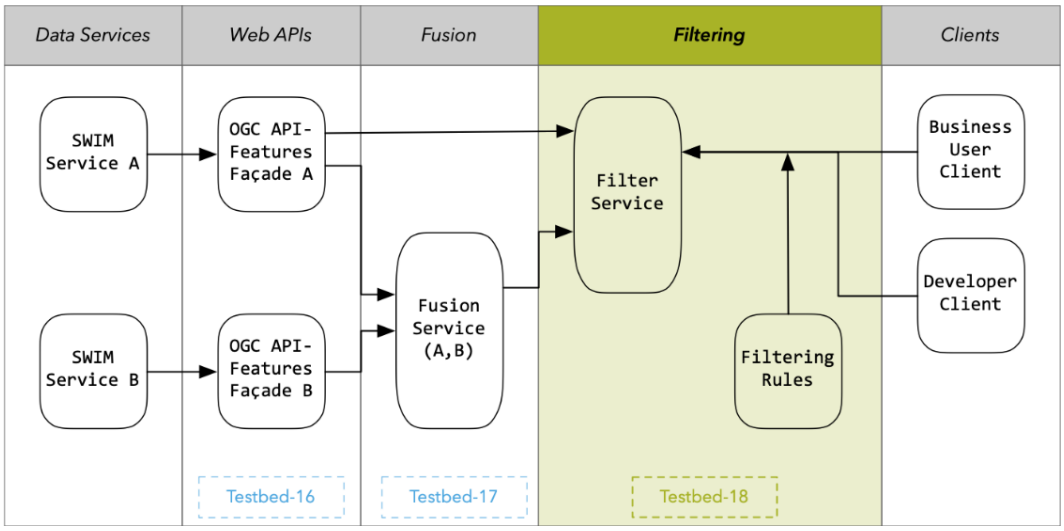


*Figure 2 API Exploration in OGC Testbeds*

2.2.1 Another key aspect of the OGC initiative is to explore the ability to establish services deployed on different SWIM platforms to create a new service with more comprehensive information using REST APIs. For example, flight data from US FAA and Eurocontrol can be fused together to provide more comprehensive and accurate information.

2.2.2 Such composability is important, since airspace users often need to correlate data from different categories, for example, flight, aeronautical and weather information, to better plan for their missions.

2.3 In Testbed 16, FAA and OGC laid the foundation for REST API exploration.

2.3.1 To adopt existing published/subscribed based SWIM services for REST, façades to existing SWIM services were implemented to deliver information via REST-based OGC API-Features [2] web services.

2.3.2 The web service interface was described using OpenAPI [3], enabling consumers to easily consume SWIM data with REST-compliant tools, resulting in less code (compared to previous OGC API) and better documentation.

2.3.3 Use of OpenAPI greatly improved developer productivity as five different organizations successfully developed, tested, and integrated six different software components using both SWIM data and service metadata in a matter of a few months.

2.3.4 Our experience in Testbed 16 highlighted the need for defining “features” and handling large data volume in SWIM.

2.4 Building on the REST APIs introduced in Testbed 16, Testbed 17 focused on service composability by creating new services through the fusing of SWIM data.

2.4.1 Testbed 17 demonstrated how standard-based REST API can enable SWIM service providers to build tailored products in a cost-efficient manner. Two fusion scenarios were prototyped during Testbed 17, namely:

- The Flight Restrictions Data Fusion Service uses aeronautical information from multiple FAA SWIM services to identify flight restrictions for past or future flights.

- The International Flight Data Fusion Service fused flight plans from the same flight spanning across the US and European airspaces. FAA SWIM Flight Data Publication Service (SFDPS) and EUROCONTROL Network Manager business-to-business web services (NM B2B) were used.

2.4.2 Testbed 17 demonstration illustrates SWIM data fusion from the perspectives of both fusion developers and business users:

- The Aviation Domain Expert Client was built to display aviation data to domain experts in a 3D map environment.
- The Aviation Developer Client was built to help developers access API information.

2.4.3 The ER recommended different architectural approaches to combine data elements from multiple sources and resolve discrepancies.

2.5 Testbed 18 further explored filtering mechanisms for feature data served by OGC API-Features instances. The experiments included filtering of native and fused SWIM data.

2.5.1 By leveraging REST API, these filtering services provide filtering capabilities that were not supported by the data services. In our scenario, the client is only interested in a subset of the data provided by a SWIM service. A filtering service was developed to connect existing services to access the necessary data, filter out everything that is not requested by the client, and deliver the result to the client.

2.5.2 The filtering service produced new data using filtering rules defined independent of the existing SWIM service. Decoupling filtering from data provisioning has advantages both for the data provider and the data consumer.

## 3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.

**REFERENCES**

[1] FAA and KAC, “SWIM Discovery Service (SDS)”, WP/08, ICAO SWIM Task Force/4, November 2020, https://www.icao.int/APAC/Meetings/2020%20SWIM%20TF4/WP08_USA%20and%20ROK%20AI.%205d_Task%201-5%20-SDS%20Introduction.pdf

[2] https://ogcapi.ogc.org/features/

[3] https://swagger.io/specification/

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