



ICAO

International Civil Aviation Organization
**The Third Meeting of System Wide Information
 Management Task Force (SWIM TF/3)**

Bangkok, Thailand, 07 – 10 May 2019

Agenda Item 3: Task 1-5: Regional SWIM Registry and Architecture

APAC SWIM REGISTRY APPROACH

(Presented by Task 1-5)

SUMMARY

The implementation of System Wide Information Management (SWIM) is in the initial phase where its concept and guidance are being developed. The APAC SWIM TF is discussing how to implement a regional SWIM, and SWIM registry is the topic being discussed as one of the tasks (i.e., Task 1-5) of the APAC SWIM TF.

Based on research findings of Task 1.5 works and best practices of SWIM registry implementations, this paper proposes the appropriate implementation approach for an APAC SWIM registry including the deployment model, minimum information set, and basic functionalities.

1. INTRODUCTION

1.1 The ICAO Information Management Panel (IMP) is revising the SWIM Concept (draft.) (Doc.10039) into the SWIM Concept Vol I: SWIM Concept and Vol II: SWIM Implementation. And basic functionalities of a SWIM registry, the Service Overview, which is a set of information service metadata, and the SWIM registry implementation guidance will be covered in the SWIM Concept document.

1.2 The Federal Aviation Administration (FAA) of the United States and the Single European Sky ATM Research Joint Undertaking (SESAR JU) of the European Union have their registries as the part of their SWIM programs. And two organizations have been conducting a joint-research for information exchange between two registries.

1.3 The APAC SWIM TF focuses on several of topics to implement a regional SWIM in the APAC region, and Task 1-5 puts together a paper to define a regional APAC SWIM registry. Task 1-5 reviewed some related materials on the sub-tasks of Task 1.5 as follows:

- A. Study on the NAS Service Registry and Repository (NSRR) and the European SWIM registry to analyze their functionalities and what elements do their service descriptions contain;
- B. Review on two draft SWIM documents from IMP;

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- C. Study on the Service Description Conceptual Model (SDCM) and the Registry Integration Module (RIM) designed for information exchange between SWIM registries;
- D. Study on the pros and cons of each SWIM registry deployment model; and
- E. Study on a common service description of a web service in the Republic of Korea;

1.4 Based on sub-tasks mentioned above, Task 1-5 proposes as follows;

- A. Minimum information set that includes the type of information provided (i.e., service profile) and the subscription method;
- B. Basic functionalities what all SWIM registries in the APAC region have to provide; and
- C. The appropriate SWIM registry deployment model for the APAC region;

2. DISCUSSION

2.1 The IMP is defining the SWIM concept and implementation guidelines, and in the SWIM Concept, SWIM service registry, which is needed to provide information regarding a SWIM service, is included. Therefore, the APAC region needs to define a suitable regional SWIM registry for global SWIM interoperability in compliance with the IMP works.

2.2 The Service Overview has 17 fields (i.e., 12 mandatory and 5 optional fields) to search service information and make an initial evaluation of the applicability of a service. The SDCM, which was developed to exchange information between the NSRR and the European SWIM registry, is already in use. The SDCM can provide enough information to practically-consume information from a SWIM service because it also has supplementary information needed to connect and access a service compared to the Service Overview. In the case of the APAC region, by using the Service Overview, a service consumer would search for information regarding a SWIM service and could know if it is applicable. And then, when applicability of a certain service is identified, a consumer could acquire more information from the service description document ((e.g., Web Service Description Document of FAA (WSDD)) that would be provided by a service provider. The service description document would include not only information defined in the Service Overview, but also additional information required (e.g., a service functionality, operation and access mechanism) to consume a service. The APAC service description to be defined by the APAC SWIM TF should include five additional fields such as network interface, protocol, message, service operation. (see Appendix C)

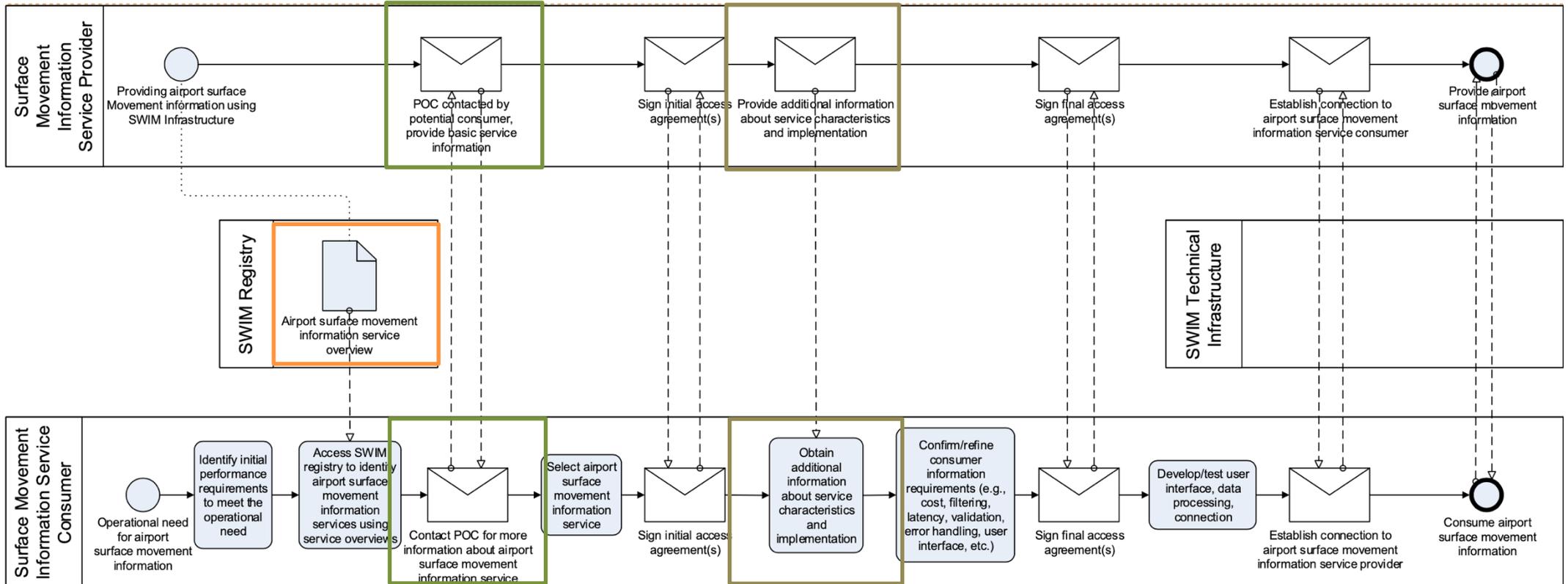


Figure 1 Information Service Consumer/Provider Interaction

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	Mandatory /Optional	Information Field
Service Overview	Mandatory	Service Name, Brief Description, Service Version
		Provider Organization, Access Restrictions
		Lifecycle Information, Quality of Service
		Message Exchange Pattern, Exchange Models
	Optional	Service Validation, Geographical Extent of Information
		Service Functions, Additional Service Information
		Sources of Information, Provider Point of Contact
Additional Information	Mandatory	Filtering Available, Support Availability
	Optional	Operation, Message, Network Interface, Protocol
	Optional	Message Header

2.3 The service description document could be provided directly from a service provider, or a service consumer could find a link or an attachment at a SWIM registry. Information defined in the Service Overview is sufficient for information exchange between registries because it has enough information to advertise a service and a customer could briefly understand a service from it.

2.4 Regarding the topic mentioned above, Task 1-4: Governance and Task 2-1-2: SWIM Registry Implementation gave comments regarding creating new service description model only for the APAC region and incompatibility issue triggered by a new model, and Task 1-4 suggested a special opinion as below;

- A. Use existing – mature and well-tested – implementations of SWIM registries as a blueprint;
- B. Adopt SDCM as a model for APAC registry content, and to work with the SDCM group on creating a new version to satisfy APAC specific requirement; and
- C. Consider an approach for APAC registries that would allow a user to access the whole service description in “one step” instead of the approach currently shown in the WP;

2.5 The SWIM Concept explains that any enterprise providing a SWIM service could implement their own SWIM registry, and more than one SWIM registry could co-exist in the state or regional level [1]. However, it should be noticed that the state, which operates the SWIM, has to guarantee the governance of a SWIM registry, and information provided from a SWIM registry also has to be ensured.

2.6 Task 1.5 choose three candidate deployment models (i.e., the local registry model, the inter-operable registry model, and the one centralized registry model) for an APAC SWIM registry and analyzed the pros and cons of each model as below; (See Appendix B)

- A. Local registry model consists of independent registries, and A registry can be implemented on the intention of implementor (e.g., state).
- B. Inter-operable registry model also consists of independent registries but each registry exchanges data with other registries

- C. One centralized registry model consists of the central registry and multiple, but independent registries. The central registry provides the single access point for a service consumer to search all service information registered in the APAC region.

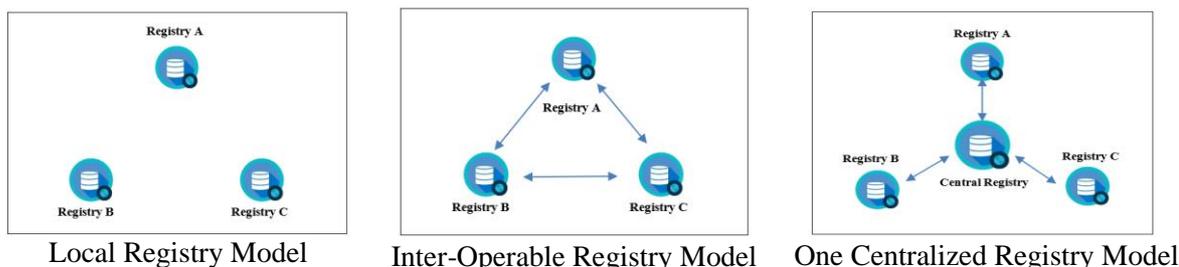


Figure 2. Registry Deployment Model

2.7 An APAC SWIM registry needs to provide the basic functionalities, which are defined by the IMP, such as A) service registration, B) search, C) filtering, D) notification. In addition, an APAC SWIM registry also needs to support other functionalities like E) access control that allows a user to find information with an approved manner and F) information exchange (i.e., interoperability) that enables to share information between registries. (See Appendix D)

2.8 An APAC SWIM registry should use a common Uniform Resource Identifier (URI) (i.e., [http://registry.swim."civil aviation authority ".aero](http://registry.swim.civilaviationauthority.aero)) to easily identify each SWIM registry and improve the discoverability of a SWIM registry. (See Appendix A)

3. CONCLUSION

3.1 As the result of the study on the pros and the cons of SWIM registry deployment models, the one centralized registry model could be the ideal for the APAC region where there are many countries, but due to the practical problems such as financial issues for operation and implementation, governance, it would be difficult to adopt this model. Therefore, Task 1-5 proposes to adopt the interoperable registry model, that could exchange information between registries and be irrelevant to problems what the one centralized registry model has in terms of cost, operation, and governance.

3.2 Task 1-5 proposes to use the Service Overview to exchange information between registries. The service description document should be available to provide detail information to consume a service, and it should be directly provided, or link or attachment also can be provided at a SWIM registry. Contents of the service description document have to offer minimum information set what Task 1-5 proposes at least. However, there are different views on two key points a) what amount of service metadata should be made available by a SWIM registry, and b) how this metadata should be provided to a registry user, i.e. to a potential service consumer, so this topic should be sufficiently discussed and coordinated in the APAC SWIM TF.

3.3 Task 1-5 proposes to define a set of controlled vocabulary to enable a common understanding of service information registered in different registries in the APAC region,

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and Task 1-5 also proposes to use the common URI rule for an APAC SWIM to improve accessibility.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) discuss any relevant matter as appropriate

5. REFERENCE

[1] Manual on System Wide Information Management (SWIM) Concept (Doc 10039), ICAO

[2] .aero the domain of aviation, <https://information.aero/about>

[3] IANA Root zone database, <https://www.iana.org/domains/root/db>

APPENDIX A. APAC SWIM REGISTRY IDENTIFIER

1. An absence of the common URI rule for a SWIM registry would cause an environment where all SWIM registries have a different access URI. Therefore, a standardized identification rule for a SWIM registry domain should be defined to improve the accessibility of an individual SWIM registry.
2. The SWIM registry URI consists of three domain levels [2][3]. The top domain level of a SWIM registry URI could be:
 - A. .aero : which is the top domain for the aviation industry; or
 - B. .asia : which is the representative domain for the Asian region;

As standard information exchange models such as FIXM, AIXM, and WXXM already use [.aero] for their top-level domain and [.aero] is the representative top-level domain for the aviation industry, it is better to use [.aero] than [.asia]. However, for the 2nd level domain, the domain name [.swim] has been occupied by the Eurocontrol, so it would be hard to use [.swim] for the 2nd level domain. Instead of it, the abbreviation for each state's civil aviation authority could be the 2nd level domain. And, [registry.swim] could be the 3rd level domain.

3. The SWIM registry representing each country could be accessed by the URI as follow:
 - http://registry.swim."civil aviation authority ".aero
 - e.g.,) Korea SWIM registry: http://registry.swim.koca.aero
 - Singapore SWIM registry: http://registry.swim.caas.aero
4. Some states would prefer a unique URI for their own registries, in this case, domain forwarding could be used to register more than one domain name.

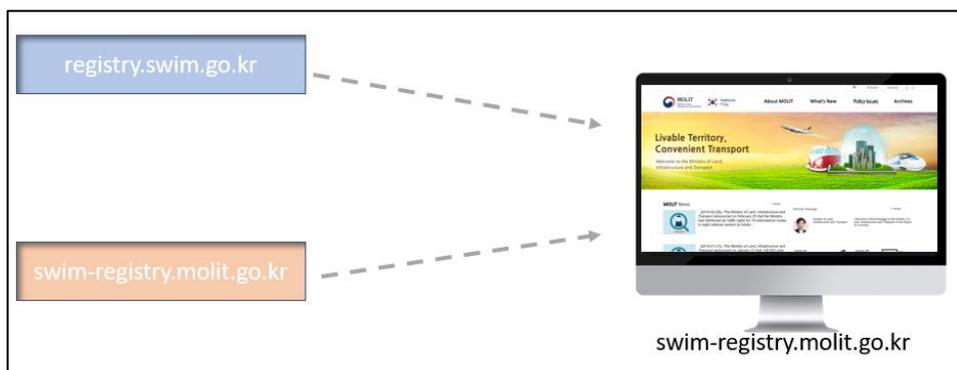


Figure 1. Domain Forwarding

APPENDIX B. APAC SWIM REGISTRY DEPLOYMENT MODEL

Three models could be considered for an APAC SWIM registry deployment.

1. Independent Registry Model

Each registry has its own repository, and it independently stores and manages service information. An interface to exchange information between registries is not offered as each registry is independently operated.

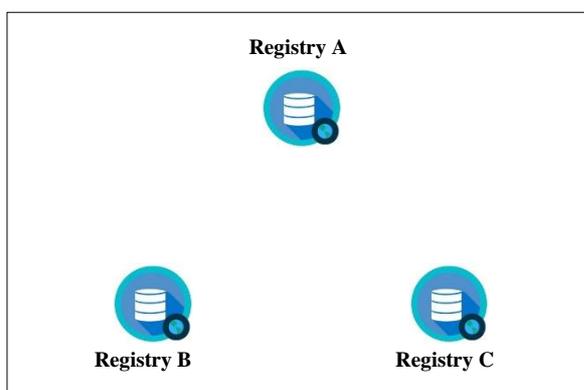


Figure 1 Independent Registry Model

2. Interoperable Registry Model

Each registry is connected with other registries like a mesh network, and they are not subordinated to another registry. Each registry stores service information in its own repository and exchanges information between another registry through the common interface.

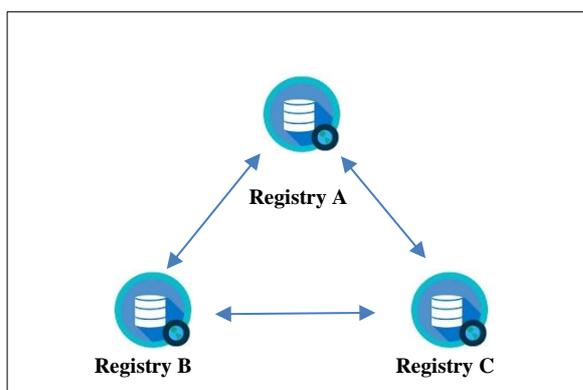


Figure 2 Interoperable Registry Model

3. One Centralized Registry Model

The central registry is connected with multiple, but independent registries. When the service provider registers service information in one of the sub-registries, service information is automatically transmitted to the central registry. Some services, which covers sensitive information, could be filtered and excluded from information sync.

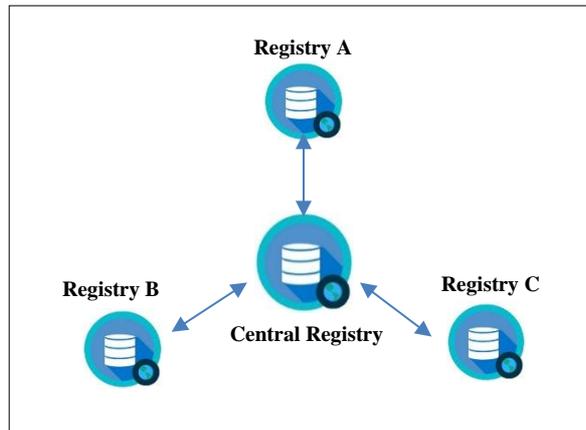


Figure 3. One Centralized Registry Model

4. Pros and Cons

	Pros	Cons
Independent Registry	<ul style="list-style-type: none"> - A registry can be implemented on the intention of implementor (e.g., state). - Common interface or additional infrastructure enabling information exchange among registries is not required - Easy to manage service information and control cybersecurity policy. 	<ul style="list-style-type: none"> - Data sharing between registries is not possible. - Hard to look available services that are registered in other registries.
Interoperable Registry	<ul style="list-style-type: none"> - Any malfunctioning of a single individual registry doesn't affect to whole registry network. - Additional infrastructure supporting information exchange among registries is not required, and it is less risky regarding operational cost and management. 	<ul style="list-style-type: none"> - Common exchange model and technical standards such as communication protocol and security have to be defined. - The complexity of network structure is escalated as all registries have to interact with any other registries to exchange information.
One Centralized Registry	<ul style="list-style-type: none"> - Only having access interface with central registry enables to get information stored in other registries. - The central registry can be the representative registry of affiliated registries. 	<ul style="list-style-type: none"> - Additional infrastructure (i.e., central registry) is required. - The single failure of the central registry would collapse the entire network. - Co-managed infrastructure can cause problem of ownership and distribution of cost sharing.

APPENDIX C. MINIMUM INFORMATION SET FOR APAC SWIM SERVICE DESCRIPTION

1. Minimum information set is a basic set to develop the APAC service description, and a service description document to be provided in the APAC region has to offer information defined in minimum information set.
2. Task 1-5 started to discuss minimum information set with 10 fields needed to advertise a service's existence, but Task 1-5 decided to extend the set to have 17 fields in the Service Overview to align with IMP work. Task 1-5 proposes 22 fields for minimum information set, which would be the basic set for the APAC service description, including 17 fields from the Service Overview, and 5 extra fields for the APAC region (i.e., Operation, Message Header, Message, Protocol, and Network Interface). The service description document could be provided directly from a service provider, or a service consumer could find a link or file at a SWIM registry.
3. Information defined in the Service Overview would be only exchanged between SWIM registries in the APAC region.

Minimum Information Set for APAC SWIM Registry

Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance
Service Name	Mandatory	The Service Name is a piece of identifying information that gives stakeholders a way to reference or identify a service.	<p>Rationale: Well named services will give an indication of the purpose of the service.</p> <p>Guidance: Include only the name of the service.</p> <p>Example – North Atlantic Flight Track Data Service\</p>
Service Version	Mandatory	The Service Version distinguishes which release of the service the information in the overview pertains to.	<p>Rationale: Allows distinction between versions of a service.</p> <p>Guidance: An indicator of version is always provided regardless of whether or not there are multiple versions of a service.</p> <p><i>Future Provision: Each version of a service should have its own completed overview</i></p>
Provider Organization	Mandatory	The name of the organization responsible for provision of the information service.	<p>Rationale: Providing a Provider Organization will assist a service consumer in identifying and gaining context on the information service.</p> <p>Guidance: Provide the name of the organization responsible for the information service followed by any abbreviated name by which the organization is known (if applicable)</p> <ul style="list-style-type: none"> ○ Example: Federal Aviation Administration (FAA) ○ Example: Aeronautical Radio of Thailand (AEROTHAI) ○ Example: Airport Support Services Corporation (ASSC)
Brief Description of the Service	Mandatory	A brief summary of the service offering.	<p>Rationale: This req. supports the consumer decision on whether the described service is suitable for use in a particular situation</p> <p>Guidance: The brief description of the service covers the following pieces of information</p> <ul style="list-style-type: none"> ○ The operational need being addressed by the service ○ What is the intended use of the information ○ The source of the information ○ Who is the intended consumer audience for the service)

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Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance								
Provider Point of Contact	Mandatory	A point of contact for the provider organization for the specific service.	<p>Rationale: The service overview has information limited to discovery of a service and as such it is important that a consumer have a point of contact in order to receive additional information.</p> <p>Guidance: Provide a POC (e.g. service@ICAO.org) to direct additional questions for the potential consumer.</p>								
Additional Service Information	Optional	Location at which more information on a service may be found.	<p>Rationale: The service overview has information limited to discovery of a service and as such a provider may want to direct a consumer to available documentation.</p> <p>Guidance: Provide link to a site where a user can find more information on the service offering (e.g. Interface Control Document, Service Description Documents (e.g. FAA WSDD))</p>								
Lifecycle Information	Mandatory	Indication of which phase of the service development lifecycle the service is in as well as lifecycle timeline.	<p>Rationale: Information on lifecycle timeline will be a factor in choosing to implement a service.</p> <p>Guidance: Specify the service lifecycle phase that the service version is currently in. List as one of three phases: Pre-operational, Operational, Retired. Provider may provide dates for lifecycle stages.</p> <p>Information may be represented through unformatted text or a table. E.g.:</p> <table border="1" data-bbox="974 928 1771 1091"> <thead> <tr> <th>Lifecycle Stage</th> <th>Date</th> </tr> </thead> <tbody> <tr> <td>Pre-Operational</td> <td>Date Initiated June 2016</td> </tr> <tr> <td>Operational</td> <td>Date Deployed July 2017</td> </tr> <tr> <td>Retired (planned)</td> <td>Date N/A</td> </tr> </tbody> </table> <p>Note: It is possible for both the operational and the retired phase to not have dates listed, though it is highly recommended that the planned date of retirement be listed whenever it is known to exist</p>	Lifecycle Stage	Date	Pre-Operational	Date Initiated June 2016	Operational	Date Deployed July 2017	Retired (planned)	Date N/A
Lifecycle Stage	Date										
Pre-Operational	Date Initiated June 2016										
Operational	Date Deployed July 2017										
Retired (planned)	Date N/A										
Geographical Extent of Information	Mandatory	Details of the geographic coverage of the information provided by the service.	<p>Rationale: Allow consumer to understand the geographical coverage of the information being provided.</p> <p>Guidance: Geographical coverage may be expressed in terms of ICAO region, FIR, Aerodrome, polygons, etc.</p>								

Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance
			<p>Note that listing more granular information (e.g. coverage at Airport X, FIR Y) may facilitate search responses when provided textual (vs. graphically).</p> <p>Note: Examples will be addressed as part of completed service overview in an appendix to Volume II.</p>
Quality of Service	Mandatory	Qualitative and quantitative information pertaining to the performance characteristics of a service.	<p>Rationale: Allow consumer to understand the performance of the service offering.</p> <p>Guidance: QoS may be expressed using the following parameters (or other applicable parameters) when relevant:</p> <ul style="list-style-type: none"> - Availability - Capacity - Response Time or Latency - Recoverability - Integrity - Confidentiality <p>Information of QoS parameters may be provided in a qualitative or quantitative way. <i>Note: Guidance on defining the calculation methods for the parameters needs to be included in the SWIM Manual.</i></p>
Access Restrictions	Mandatory	A description of any constraints on access to the service	<p>Rationale: Information for the consumer to understand whether they may be eligible to access the service as well as any relevant security constrains on access.</p> <p>Guidance: Specify the requirements and/or restrictions for each user type for accessing the data exchanged by the service which are considered to be sensitive for security or competition reasons.</p> <p>Specify under what conditions the restricted and non-restricted data elements generated by the service can be distributed to a consumer(s).</p>

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Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance
			Note: This information can be used to develop a governance policy for distribution of the data through a third party Any security mechanisms which affect information service access may be described.
Message Exchange Pattern	Mandatory	The Message Exchange Pattern used by the service.	Rationale: The Message Exchange Pattern helps the consumer understand how information interaction with service works. Guidance: Specify the message exchange pattern used by the service (request/reply, one way (“fire-and-forget”), publish/subscribe).
Exchange Models	Mandatory	The exchange models adhered to by the service.	Specify the format, standard (including extensions), and ATM Information Reference Model (AIRM) compliancy of the data provided by this service Guidance: If global exchange models are not (e.g., Aeronautical Information Exchange Model (AIXM), etc.) supported by the service, apply semantic definitions from the AIRM when possible.)
Service Functions	Optional	A business-level description of the service functions.	Rationale: The functions provide business and operational experts with a business view of the interactions with the service, without having to look at the interface details. Guidance: Describe the functionality of the service as a list of the functions and real-world effects. <i>Need to add new guidance text here.</i>
Filtering Available	Optional	An overview of which filters the provider offers to the consumer for the service.	Rationale: Filters allow users to narrow the content of data/information that they ingest. Guidance: List the filters that are available to a consumer of the service.
Sources of Information	Optional	A description of the origins of information provided by the service along with an indication whether there were any subsequent modifications.	Rationale: Provide the user with background on information source and modifications. Guidance: Specify origin of the information, and if any modifications were applied by the service provider.

Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance
Support Availability	Optional	An overview of whether any service support may be offered to consumers.	<p>Rationale: Consumer needs will vary and may require different levels of provider support.</p> <p>Guidance: Specify days and hours the service provider can be contacted by users requiring support for the provided service.</p>
Service Validation	Mandatory	Method of validation used to assess a service.	<p>Rationale: User needs to know how the information service was validated in order to have confidence in the service.</p> <p>Guidance: In addition to validation method used (User Validated, Self-Validation, Collaborative, and Independent), there is a need to provide information on how a potential consumer may obtain validation results. If a service has not yet been validated indicate that there is no validation information has been done.</p>
Operation	Mandatory	A named set of messages related to a single service action.	<p>Rationale: Allow a consumer to understand each operation that the service implements.</p> <p>Guidance: Each operation is described using four categories as a following information.</p> <ul style="list-style-type: none"> ○ Precondition: The state or condition should be satisfied to proceed with the operation. ○ In: This is a message that initiates an interaction. ○ Out: The data is produced in response to a request ○ Error message: This message could be generated in response to conditions that resulted in operation failure
Message Header	Optional	The part of a message that precedes the message body.	<p>Rationale: Header allows a message to contain message identification and routing information.</p> <p>Guidance: A predefined name-value pair that provides information about how the message should be processed or interpreted.</p> <p>Note: This information is called “message properties” in JMS.</p>

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Field	Mandatory/ Optional	Explanation of Field	Rationale and Guidance
Message	Mandatory	A basic unit of communication from provider and consumer sent in a single logical transmission.	<p>Rationale: This information is an aggregation of data used in communication between the consumer and provider.</p> <p>Guidance: Specify all input and output messages that are exchanged between service and consumer.</p>
Protocol	Mandatory	Protocol and data format to be used in transmitting messages	<p>Rationale: An agreed-upon format must be used in order to exchange data between a software agent.</p> <p>Guidance: Specify the format, standard provided by service. Protocols are described as the following information.</p> <ul style="list-style-type: none"> ○ Data Protocol is a formal set of rules governing data encoding and coordination for data exchange. ○ Message Protocol is a formal set of rules and conventions governing procedure calls and responses. ○ Communication Protocol is a formal set of rules governing message transmission and port handling.
Network Interface	Mandatory	Physical point at which a service may be accessed.	<p>Rationale: Allow a consumer to understand information for accessing the service on a physical network.</p> <p>Guidance: Specify a network address at which the service can be invoked.</p>

APPENDIX D. BASIC FUNCTIONALITIES FOR APAC SWIM REGISTRY

An APAC SWIM registry should provide the following basic functionalities;

- Registration: means by which service provider can register service information.
- Search: means by which users can look for available SWIM services. A categorization of SWIM service can facilitate a user to conveniently find a service. SWIM services can be categorized or distinguished as follows:
 - A. Information domain;
 - B. Service Coverage (or scope of a consumer); or
 - C. Life cycle stage;
- Filtering: ability to optimize the search through selecting criteria;
- Notification: providing information on updates to registry information based on user subscription;
- Access Control: set of rules setting providing the conditions for accessing information in a SWIM registry.
 - B. Authentication: a function that checks the identification of a user
 - C. Authorization: a function that validates the authentication of a user
 - D. Approval: a function that grants or rejects access to the SWIM registry and information according to access rules during operations
- Inter-Registry Communication: ability by which each registry can communicate with other registries to exchange information.