International Civil Aviation Organization

The Fourth Meeting of System Wide Information Management Task Force (SWIM TF/4)

Web-conference, 3 – 6 November 2020

Agenda Item 5: Updates on the assigned tasks by task leads/contributors including progress Report and issues

b) Task 2 Regional SWIM Infrastructure

PRESENTATION OF PCCW SWIM TECHNICAL OVERVIEW (CENTERED AROUND CRV)

(Presented by PCCW Global Limited)

SUMMARY

This information paper describes the system architecture of PCCW SWIM service. It is a managed SWIM solution which can be deployed with the preference of each member States and is proposed to run on CRV network.

1. INTRODUCTION

1.1 ICAO APAC CRV has been built leveraging PCCW Global's high-speed international IP network, with mission-critical connections running across a diversified infrastructure to support multiple aviation-specific applications. PCCW Global, the CRV provider, is keen to develop value-added service on CRV to demonstrate our commitment to the Aviation industry.

1.2 PCCW Global has been developing the SWIM service on a private and scalable platform in partnering with one of leading aviation vendors - FREQUENTIS. PCCW Global owned network infrastructure & hosting facilities combining with FREQUENTIS proven knowledge & experience in aviation industry will formulate an alternative solution for ANSPs to facilitate the SWIM initiatives. It provides an alternative approach for States to immediate access the available SWIM services without high initial investment.

1.3 PCCW SWIM infrastructure could be one of the global/commercial EMS nodes to deliver SWIM services or qualified third party services. The managed SWIM services include managed network, system maintenance and continuous software & platform development.

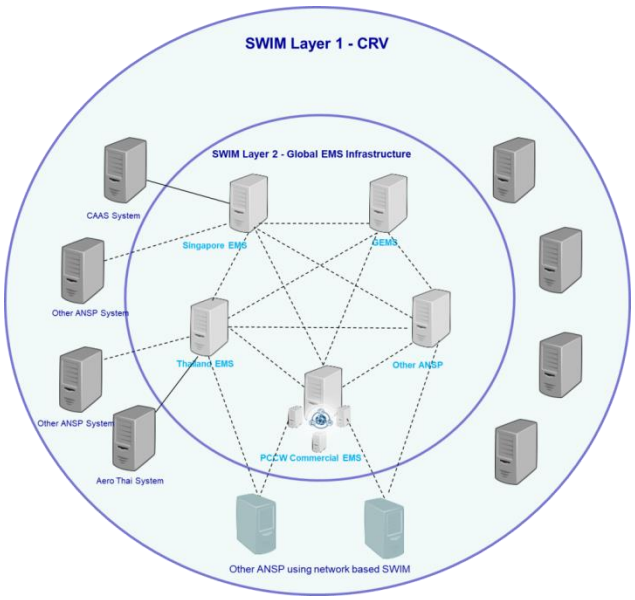

Figure 1- Global EMS Infrastructure

1.4 The initial SWIM service release has been built based on ICAO standards and current requirements. PCCW Global will evolve the service according to your specifications. Suggestions and comments are welcome.

2. DISCUSSION

2.1 Deployment Options

PCCW SWIM deployment options include on-premise deployment, network based as well as hybrid model. This enables flexibility to meet individual State requirement.

a) On-Premises

PCCW SWIM can be deployed in a traditional on-premises model when State prefers to own the SWIM system within its premises.

b) Network Based (Managed Service)

The network based option is a scalable, flexible managed service in OPEX model such that CRV users could utilize the SWIM as a service at their own discretion without high investment.

c) Hybrid model

Combination of on-premises and network based options.

2.2 Functional Description

a) Service Registry: PCCW SWIM includes a Service Registry for user to locate the available SWIM services in the platform. The service registry is one of the key components in aviation ecosystem as it allows publishers and subscribers of services to find each other. To further the goal of globally interoperable and synchronize service registries, developments are on-going to support future inter-registry interface standards such as the FAA/OGC SWIM Discovery Service (SDS) and the upcoming Eurocontrol SWIM Service Registry API.

b) Messaging: One of the core messaging technologies used in PCCW SWIM is a scalable, high performance AMQP 1.0 message broker.

c) ATM Interfaces: PCCW SWIM comes with connector (P1) to interface with AMHS.

d) Please reference to the Appendix for details.

Please visit below link to learn more about PCCW CRV & SWIM Services:

https://youtu.be/iPd941AV0pQ

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the information contained in this paper and Attachment; and

b) Discuss any relevant matter as appropriate

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International Civil Aviation Organization (ICAO)

Common Aeronautical Virtual Private Network (CRV)

Value Added Service :

PCCW Global Network Based SWIM Service

Version: 1.0

Preface

This document describes the high level PCCW Global SWIM solution for ICAO CRV network.

This document does not constitute a service specification. If there is any discrepancy between this document and the services defined in the contractual agreement between PCCW Global and CUSTOMER, then the latter will prevail.

Contents

1 Introduction

ICAO APAC CRV has been built leveraging PCCW Global's high-speed international IP network, with mission-critical connections running across a diversified infrastructure to support multiple aviation-specific applications.

During ICAO CRV OG/5 meeting in Jan 2019, it was concluded that the CRV is able to support SWIM implementation in APAC Region. PCCW Global, the CRV provider, is keen to develop value-added service on CRV to demonstrate our commitment to the Aviation industry. Having worked closely with ANSPs and partners as well as participated in pertinent ICAO meetings, PCCW Global scoped the preliminary requirements and started developing the SWIM service platform with industry leading vendor – FREQUENTIS. PCCW Global owned network infrastructure & hosting facilities combining with FREQUENTIS proven knowledge & experience in aviation industry will formulate an alternative solution for ANSPs to facilitate the SWIM initiatives.

PCCW SWIM services are provided on a private and scalable platform that assists the States in the Region to immediate access the available SWIM services without high initial investment. New services could also be deployed on this common platform and make available to the States in relatively short lead time.

PCCW SWIM infrastructure could be one of the global/commercial EMS nodes to deliver SWIM service or qualified third party services. It is a managed service that PCCW Global will manage the network infrastructure, system maintenance and development of the platform.

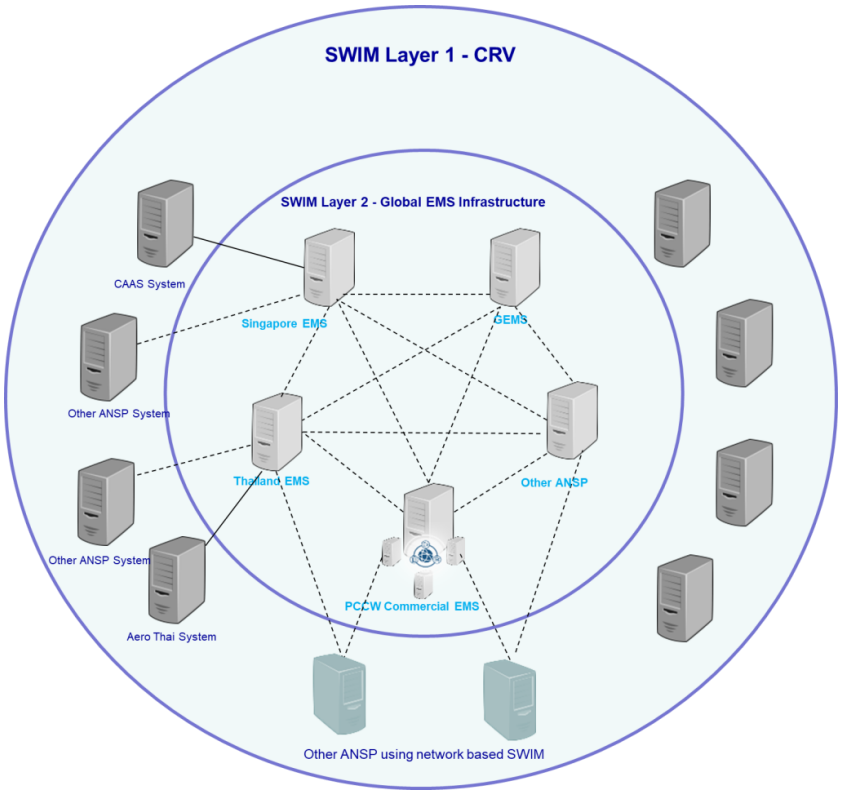

Figure 1 - Global EMS Infrastructure

2 System Architecture

PCCW SWIM service enables organizations to easily interface with legacy and third-party systems, allowing for the data to be freed from traditional storage silos and to be fused with different sources. PCCW SWIM is designed using a micro-services architecture resulting in a system that is highly modular and flexible allowing ANSPs to easily accommodate new data types, new functional requirements and increase in transactions.

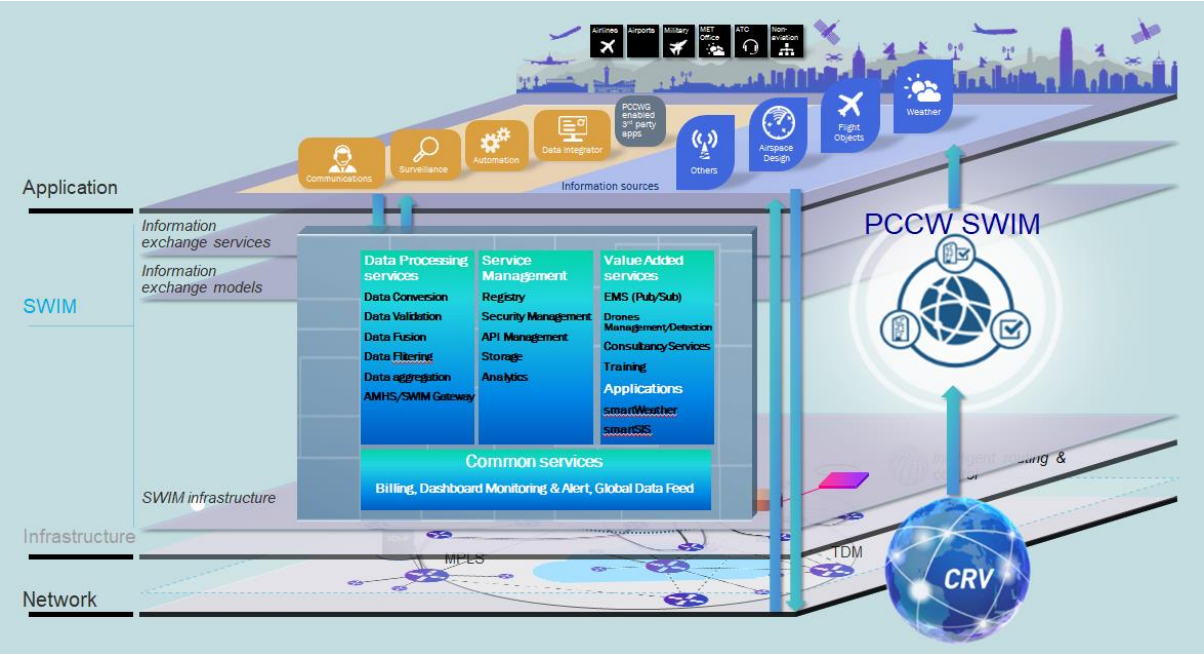

Figure 2 - PCCW SWIM Infrastructure

PCCW Global SWIM infrastructure provides the core services such as API management, request-reply and publish-subscribe messaging, service security and enterprise service management. The interoperability between PCCW SWIM and different SWIM implementations will be ensured either through common exchange standards or gateways at the appropriate levels.

2.1 Deployment Options

PCCW SWIM deployment options include traditional high available on-premise deployment, network based model as well as a hybrid model. This enables flexibility to meet individual ANSP requirement.

- **On-Premises**

PCCW SWIM can be deployed in a traditional on-premise deployment model. The on-premises PCCW SWIM system is able to connect seamlessly with network-based SWIM (i.e. hybrid deployment), offering a way to start with a small scale solution that can grow with demand. This also allows customers to limit the initial system cost and plan future upgrades without making the initial investment obsolete in any way.

Figure 3 - On premise deployment

- **Network-based**

PCCW SWIM is a managed SWIM solution and is proposed to run on CRV network (*with ICAO Approval). ANSPs are able to consume the services produced by PCCW SWIM via secure network connectivity. The functions are same as the other two deployment models. PCCW SWIM operates as an overlay to CRV IP Networks using up-to-date open standards and ATM-defined data exchange models (e.g. AIXM, IWXXM, FIXM). It is built on a widely used set of open source components as core, while developing ATM/ATC solutions on top, in a way that minimizes dependencies, and allows for the easy change of technologies – be it for performance optimization, to grow with rising system demand, or simply because certain core technologies get replaced by new and improved alternatives.

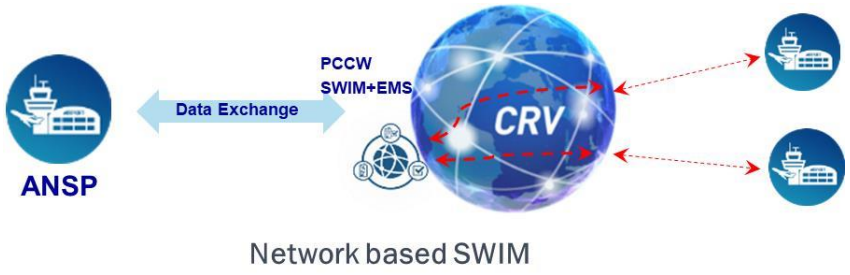

Figure 4 – Network based deployment

- **Hybrid**

PCCW SWIM allows for customers with an on-premise option to add network-based SWIM modular functions to the pool at any point in time. This can be done manually as well as automated on demand, based on overall system load or even as a redundancy measure. In addition, information confidentiality can be ensured in a hybrid deployment, and data boundaries can be defined such that sensitive information is kept within on-premise or PCCW SWIM systems and does not transgress to public. Interconnectivity between deployment types is via CRV secured network and it can be tailored to the available bandwidth and type of application.

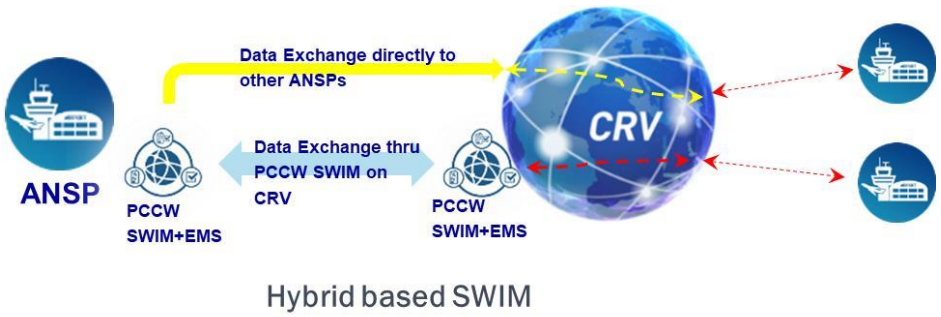

Figure 5 - Hybrid deployment

2.2 Functional Description of PCCW SWIM

Below diagram shows the main functional components of PCCW SWIM.

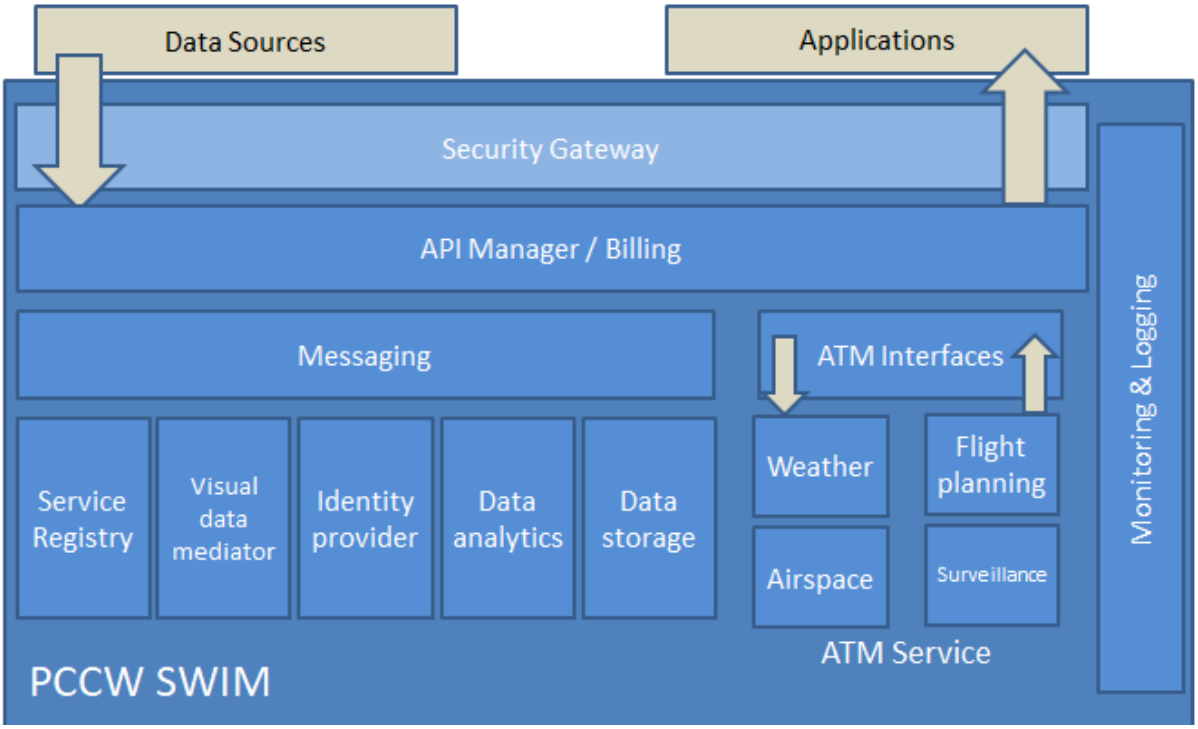

Figure 6- PCCW SWIM Infrastructure Components

Service Registry

PCCW SWIM offers a feature-rich Service Registry. The service registry is an important component of the aviation ecosystem as it allows publishers and subscribers of services to find each other as shown in the following figure.

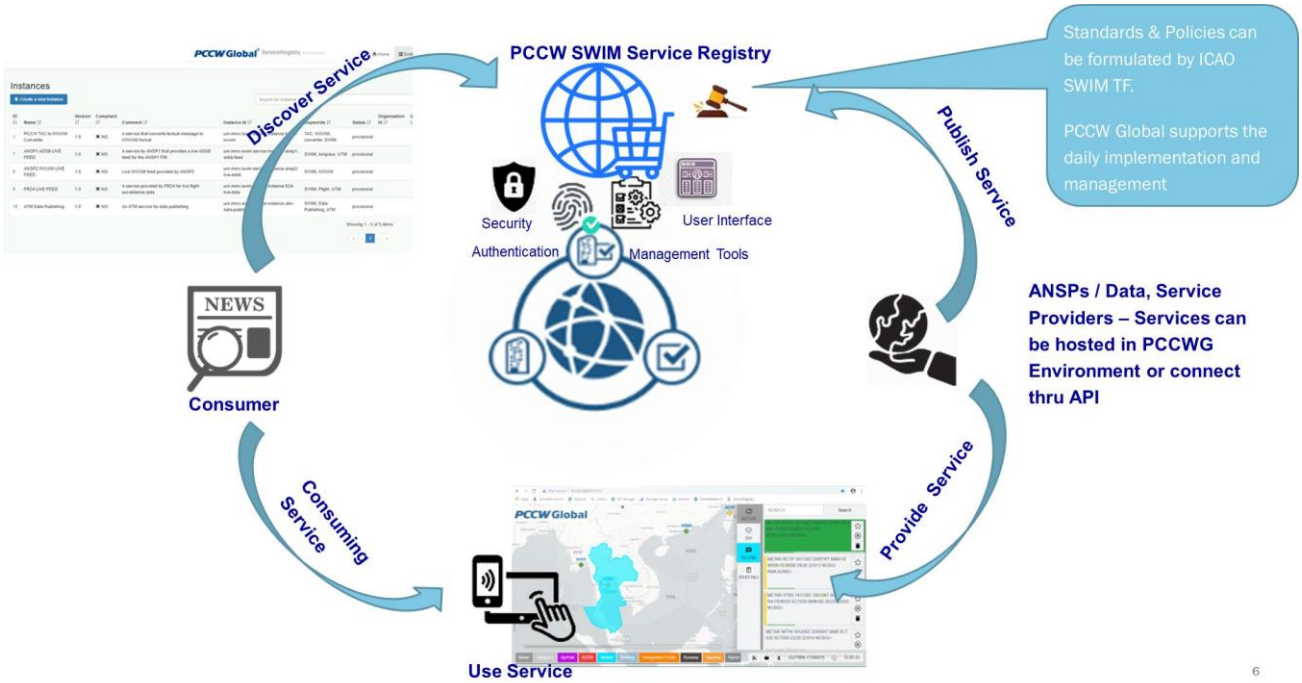

Figure 7- PCCW Service Registry

Service Registry stores run-time information, design, technical and management documentation as well as geographic coverage data of a given application or service, enabling the discovery of services that are relevant for a given location and context. The protocol and technology agnostic nature of the Service Registry makes it ideal not just for web based exchange technologies but also enterprise messaging services based communication. All mandatory and optional data fields specified by ICAO to be used by APAC SWIM Service Registries are supported, ranging from service provider data, message exchange pattern and protocol, service functions, operations, data models, point of contact, geographic service coverage as well as many other attributes.

The Service Registry is to also acts as a design-time registry, storing all artefacts related to customer service implementations. This includes the ability to store XML documents, XSD schema files, images, PDF and DOC/DOCX files. These files are referenced by the services they describe, and can be searched for based on service metadata like keywords, description, name, service ID, service type, geographic coverage matching, and other attributes.
This extensive implementation guidance material support along with its technology agnostic run-time information storage and lookup capability makes the Service Registry ideal for use in the Global Enterprise Messaging Service (GEMS).

In addition to the Service Registry's own web interface, both a REST API as well as a SOAP interface are provided to allow customer applications to interact with the registry and to store/retrieve documents. This greatly reduces the effort required for developers to on-board a new service and allows customers to grow an ecosystem of interconnected partners and services.

The Service Registry can be federated and integrated with other national and international service registries to provide a global, unified catalogue of services. To further the goal of globally interoperable and synchronizable service registries, developments are on-going to support future inter-registry interface standards such as the FAA/OGC SWIM Discovery Service (SDS) and the upcoming Eurocontrol SWIM Service Registry API. Information stored in the PCCW SWIM Registry today will be seamlessly discoverable via those interfaces across the globe.

Security

PCCWG network-based SWIM platform is hosted in PCCWG secure facility and is provided by managed routers with restrictive access controls to only allow the intended traffic on the CRV network.

CRV is a closed network administrated by PCCWG.

- Manages customer edge routers
- Manages access controls to ensure that only permitted network traffic flows
- Next-Generation Firewall protection and governance on maintenance and administration access
- Provides point to point tunnels between nodes to isolate traffic and protect the network

API Manager

The API Manager allows for the central management and monitoring of all external and internal APIs. The management functions include lifecycle management, enabling/disabling of APIs, statistics gathering, billing, as well as monitoring and alerting.

Messaging

Connectivity between components is provided by a selection of best-of-breed technologies for the specific microservices communicating with each other. One of the core messaging technologies used in PCCW SWIM is a scalable, high performance AMQP 1.0 message broker. Other messaging technologies include REST APIs for non time-critical uses such as statistics, weather and planning related communications. For surveillance, TCP and UDP based communications are used to provide critical low-latency data transfer. All communications can be made available to all components via all supported messaging technologies, for example surveillance data can be supplied via a REST API or AMQP messaging. This supersedes old concepts such as the classic Enterprise Service Bus and provides maximum decoupling between components.

ATM Interfaces

For AMHS, PCCW SWIM supports AMHS P1 and P3 connections and can process a variety of AMHS payloads, including weather data in TAC format, IWXXM and others. Others supported interfaces including EAD AIMSL, NM-B2B, AMQP 1.0, REST and Asterix.

ATM Services

Data Validation

A core requirement for processing ATM related information is to be able to validate the validity of messages and the data contained therein. PCCW SWIM allows for the validation of all types of data at any step in the processing and handling chain. This includes, but is not limited to, AIXM, FIXM, IWXXM and other XML based message formats, as well as all legacy message formats.

Data Fusion

The capability to bring many types of data into a single platform opens the possibility to fuse data in ways that would otherwise be complicated and time-consuming to achieve. Instead of having to integrate individual data sources for every single use case, PCCW SWIM enables the fusion of data at a single focal point, reducing the complexity and effort required.

Weather

The service supports the validation of Textual (TAC) data as well as the conversion between TAC and IWXXM data. The service also supports the Data Aggregation Function which combines individual reports of the same time and temporal validity into larger units of transmission called “Collectives” or “Bulletins” (collections of IWXXM and TAC reports).

Airspace

The service supports the validation of Textual NOTAM as well as the conversion between Textual NOTAM and Digital NOTAM (AIXM 5.1).

Flight planning

The service supports the validation of Textual Flight Plan as well as the conversion between the textual Flight Plan and FIXM.

Surveillance

PCCW SWIM provides surveillance data exchange capabilities as well as the merging of ATM surveillance and UTM drone telemetry into a combined picture of the air situation.

3 SWIM Compliance

PCCW SWIM is fully compliant and supports all the various standards, information- and service models defined in the ICAO Doc 10039 and the SESAR SWIM Profiles.

Layer of Framwork	Function of Sublayers	Standards, Models, Implementations
SWIM enabled-Applications		ATS, ATFM, Airline Ops
Information Exchange Services	Service Interoperability	No global standards as yet
	Interface Definition	OGC, WSDL, WADL, WFS, WMS, WCS
Information Exchange Models and Schemas	For aeronautical, MET, and flight information	AIXM, WXXM, IWXXM, FIXM
	Semantic interoperability	OWL, SKOS
SWIM Infrastructure	Enterprise Service Management	JMX, SNMP
	Policy	WS-Policy Standards
	Reliability	WS-RM & WS-RM Policy
	Security	WS-Security & SSL
	Data Representation	XML, XSD, GML
	Messaging	SOAP, JMS
	Transport	HTTP, JMS, MQ
	Boundary Protection	No global standards as yet
	Service Registry	UDDI, SWIM Service Registry Specification, IALA G1128
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

Table1 – Compliance to SWIM standards