International Civil Aviation Organization

The Tenth Meeting of System Wide Information Management Task Force (SWIM TF/10)

Bangkok, Thailand, 20 – 23 May 2025

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

f) Validation and Demonstration

EXPECTED CAPABILITIES OF CRV FOR APAC SWIM IMPLEMENTATION

(Presented by JAPAN/ENRI)

SUMMARY

To clarify the required capabilities of CRV in supporting APAC SWIM construction, the Joint Event of SWIM over CRV Demonstration and Surveillance Data Sharing in SWIM Trial was held on May 28~29, 2024, at HKCAD. This working paper presents the validation results of message exchange using the hierarchical SWIM architecture built on the pseudo CRV. Additionally, based on the QoE (Quality of Experience) from the demonstration, the expected capabilities and QoS (Quality of Service) parameters required for CRV to meet APAC SWIM requirements are analyzed.

1. INTRODUCTION

1.1 According to the Procedures for Air Navigation Services - Information Management (PANS-IM, Doc 10199), SWIM shall be implemented over a suitable Internet Protocol (IP) based network. The key requirement of such a network would be full end-to-end IP connectivity between all parties in the network.

1.2 In the APAC region, the CRV (Common aeRonautical VPN) has been established as a secured, aviation centric IP network to address potential security prior to a unified, endorsed ICAO trust framework. The CRV is thus a potential candidate IP network upon which SWIM can be implemented. To clarify the required capabilities of CRV in supporting APAC SWIM construction, the Joint Event of SWIM over CRV Demonstration and Surveillance Data Sharing in SWIM Trial was held on May 28~29, 2024, at HKCAD (Hong Kong Civil Aviation Department).

1.3 This working paper presents the validation results of message exchange using the hierarchical SWIM architecture constructed on the pseudo CRV. Additionally, based on the QoE (Quality of Experience) from the demonstration, the expected capabilities and QoS (Quality of Service) parameters required for CRV to meet APAC SWIM requirements are analyzed.

2. DISCUSSION

2.1 Based on the discussion of the SWIM Implementation Pioneer Group (SIPG), the hierarchical SWIM architecture shown in Figure 1, was adopted for the demonstration. In this architecture, several EMSs (Enterprise Messaging Services), which are key components for constructing the regional SWIM TI (Technical Infrastructure), connect to form a sub-community. A Gateway EMS is an EMS that acts as an interconnecting EMS with other sub-communities. This approach avoids the issue of having a single point of failure present in the centralized approach while at the same time avoiding the issue of a very complex topology in the decentralized approach.

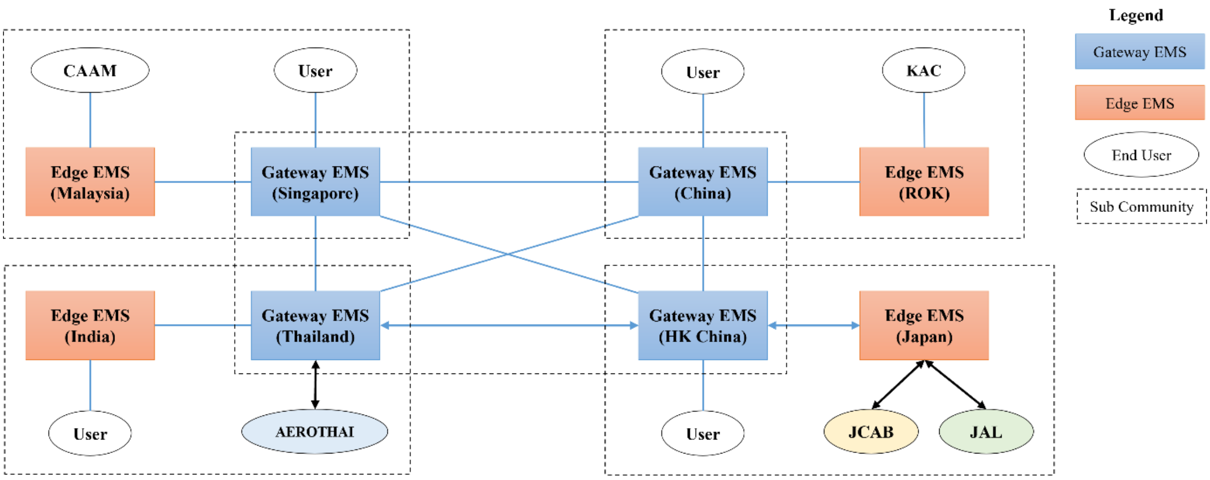

Figure 1. Hierarchical SWIM Architecture for Demonstration

2.2 To validate the capabilities of CRV and hierarchical SWIM architecture, an FF-ICE scenario was demonstrated between JCAB (Japan Civil Aviation Bureau) and AEROTHAI (Aeronautical Radio of Thailand Ltd.), who acted as SWIM and FF-ICE-capable ATM Service Providers (eASPs). This scenario involved a Japan Airlines (JAL) flight (JAL707X) flying from Tokyo Narita International Airport (RJAA) to Bangkok Suvarnabhumi International Airport (VTBS) and focused on the pre-departure phase with trajectory planning, sharing, negotiation and updating.

2.3 The validation results of message exchange for both the FF-ICE scenario and surveillance data sharing are shown in Table 1. The bandwidth of each connection on the pseudo CRV is set to 2 Mbps. The response time of ping between two nodes on the pseudo CRV is less than 300 ms. For the demonstration of the FF-ICE scenario, the package delay between JAL and AEROTHAI is less than 3 seconds. This QoE is acceptable for most practical applications and operations.

2.4 However, for surveillance data sharing, the package delay of TRACK_RAW (binary ADS-B data with message headers) from KAC (Korea Airports Corporation) to JCAB is more than 1 minute. Additionally, the package delay of TRACK_JSON (ADS-B data in JSON format) from CAAM (Civil Aviation Authority of Malaysia) to JCAB is more than 10 seconds. This QoE cannot satisfy the requirement of practical applications and operations. The following reasons can be considered according to the analysis of test results.

- Due to the large number of TRACK_RAW and TRACK_JSON messages, the queue processing time of each EMS increased;
- As the package delay is calculated based on the TIMESTAMP of message headers, the time servers for different EMSs are not synchronized;
- Due to different settings, the queue processing time for binary message type in the Edge EMS of Japan is large.

Table 1. Validation Results of Message Exchange

Use Case	Message Type	Message Size	Response time of ping between two nodes	Package delay between two end users
FIXM message exchange	PRELIMINARY_FLIGHT_PLAN	28.3 kBytes	< 100 ms Between Edge EMS (Japan) and Gateway EMS (HK China) over CRV	< 3 s Between JAL and AEROTHAI
	SUBMISSION_RESPONSE	2.26 kBytes		
	PLANNING_STATUS	25.3 kBytes		
	FILED_FLIGHT_PLAN	28.3 kBytes		
	FILING_STATUS	25.3 kBytes		
	TRIAL_REQUEST	29.5 kBytes		
	TRIAL_RESPONSE	26.5 kBytes		
	FLIGHT_PLAN_UPDATE	29.6 kBytes		
	FLIGHT_DEPARTURE	3.42 kBytes		
	TRACK	2.03 kBytes		
	FLIGHT_DATA_REQUEST	2.49 kBytes	< 10 ms Between JAL and Edge EMS (Japan) over Internet	< 100 ms Between JAL and JCAB
	FLIGHT_DATA_RESPONSE	28.6 kBytes		
AIXM message exchange	NOTAM	20.0 kBytes	< 300 ms Between Edge EMS (Japan) and Gateway EMS (Thailand) over CRV	< 3 s Between JAL and AEROTHAI
Surveillance data sharing	TRACK_RAW	Message header: 1 kBytes Message body: 50 Bytes	< 300 ms Between Edge EMS (Japan) and Edge EMS (ROK) over CRV	> 1 m Between KAC and JCAB
	TRACK_JSON	Message header: 1 kBytes Message body: 256 Bytes	< 300 ms Between Edge EMS (Japan) and Edge EMS (Malaysia) over CRV	> 10 s Between CAAM and JCAB

2.5 According to the analysis of validation results, the following capabilities and QoS parameters for CRV are expected to support SWIM-based applications and operations (Table 2). As surveillance data sharing is a continuous and real-time service, a lower packet delay budget is expected.

However, because of its large volume and high frequence, a lower packet error rate and higher priority level are not required. Moreover, to avoid affecting other event-based SWIM messages including FIXM, AIXM and IWXXM messages, it is better to separate the surveillance data into a different logical network layer and message queue.

Table 2. Expected Capabilities and QoS Parameters for CRV

Network	Application		Capability
Bandwidth	For SWIM applications		> 10 Mbps
Latency	For SWIM information services		< 200 ms
Packet Loss	For SWIM information sharing		< 0.1%
QoS	Packet Delay Budget	For SWIM message	300 ms
		For surveillance data	200 ms
	Packet Error Rate	For SWIM message	10^{-3}
		For surveillance data	10^{-3}
	Priority Level	For SWIM message	High
		For surveillance data	Low

CONCLUSION

2.6 Based on the analysis of validation results from the joint demonstration and trial, the expected capabilities and QoS parameters required for CRV to support APAC SWIM-based applications and operations are identified. Furthermore, additional validation and evaluation tests will be conducted in cooperation with SIPG and other working groups, and the results will be reported at upcoming SWIM TF meetings.

3. ACTION BY THE MEETING

3.1 The SWIM TF/10 is invited to:

- Note and review the content of this working paper; and
- Discuss any relevant matters as appropriate.

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