International Civil Aviation Organization

Workshop and One Day PSIDS meeting for preparation of new-CRV requirements and specifications for future SWIM/other aviation services
Guam, USA, 17-20 September 2024

Agenda Item 2: Lessons Learned from Joint Events of SWIM-over-CRV Demonstration and Surveillance Data Sharing in SWIM Technical Trial
Agenda Item 3: New CRV Technical Specification including SWIM requirements

SWIM IMPLEMENTATION PIONEER GROUP LESSONS LEARNT AND EXPECTATIONS FOR NEW CRV

(Presented by SIPG)

SUMMARY

This paper gives a summary of the work that the SWIM Implementation Pioneer Group (SIPG) has done in support of the SWIM over CRV demonstration and Surveillance Data Sharing in SWIM technical trial joint event and the lessons learnt from both events. It also presents expectations that the SIPG has on the CRV with respect to SWIM implementation in the Asia/Pacific Region

1. Introduction

1.1 The SWIM Implementation Pioneer Group was proposed and formed at the 7th meeting of the SWIM Task Force (SWIM TF/7).

1.2 The terms of reference as presented in flimsy 02 (SWIM TF/7 – Flimsy 02) states that the first deliverable of the SIPG is to build a SWIM Technical Infrastructure prototype according to the architecture as decided by the SWIM task force using the CRV as the IP based network.

1.3 This paper presents the work done by the SIPG to support the SWIM over CRV demonstration and Surveillance Data Sharing in SWIM technical trial joint event as well as the lessons learnt from the event.

1.4 This paper also presents the expectations of the SIPG on the new CRV.

2. Discussion

2.1 It was decided at the SWIM Task Force 7 meeting the SIPG should use the SWIM over CRV and Surveillance Sharing over SWIM joint event as the target for the construction of the APAC SWIM prototype.

2.2 The SIPG deliberated on the appropriate SWIM architecture to use for the demonstration based on the decisions reached during the task force meetings and it was decided that further elaboration was necessary to make the architecture useable for the purpose of the Joint Event.

2.3 The result of the deliberation is a hierarchical SWIM architecture. This is illustrated in the figure below:

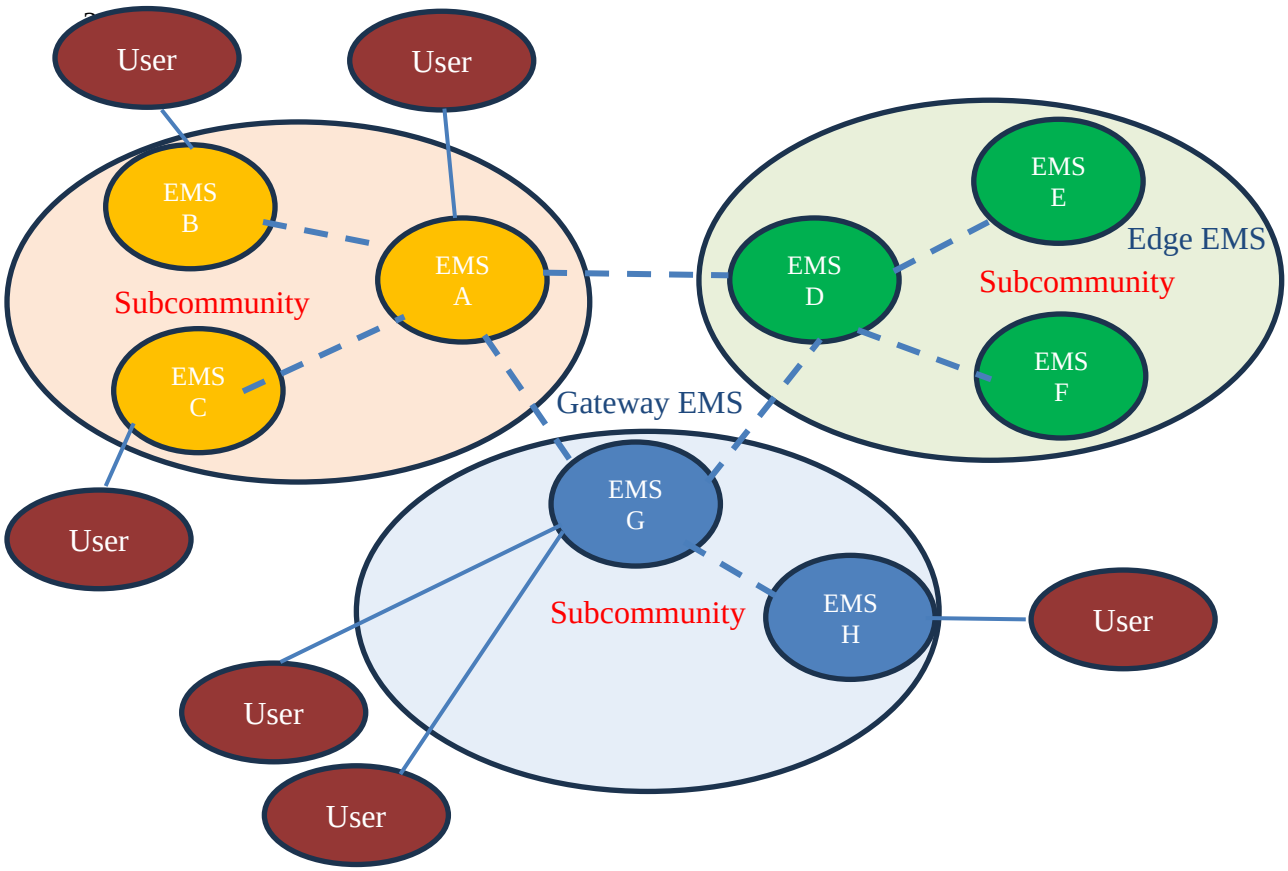

Figure 1: Hierarchical SWIM Architecture

2.5 The SIPG arrived at this design after deliberating over several others that would also fit into the model decided at the SWIM Task force level. This design offers the best compromise between connectivity and simplicity.

2.6 Due to the nature of the joint event, the operational CRV could not be used. This is to prevent the possibility of trial data accidentally disrupting any operations on the operational CRV. Therefore, PCCW, the provider of the CRV, setup a separate VPN that mirrors the CRV for the purpose of supporting this joint event. This new network was named the pseudo-CRV.

Assumptions and Restrictions

2.7 PCCW informed all participants that bandwidth per participant in the pseudo-CRV is limited to 2Mbs. However, this limit could be increased if necessary.

2.8 PCCW informed that for every pair of participants that want to communicate with each other, a connection needs to be created between them. This information influenced the design of the SWIM architecture.

Lessons Learnt

2.9 For the Joint Event, the EMS providers are organized into 4 gateway EMS with 4 corresponding edge EMS to form the 4 subcommunities. They are as follows

a) China as gateway EMS with Republic of Korea as edge EMS
b) Hong Kong – China as gateway EMS with Japan and PCCW as the edge EMS
c) Singapore as gateway EMS with Malaysia as edge EMS
d) Thailand as gateway EMS with no edge EMS.

2.10 The above architecture was constructed on the pseudo CRV and not on the actual operational CRV infrastructure. This was to avoid the possibility of trial or testing data from crossing over into the operational network and potentially interfering with operations. It is however assumed that the pseudo-CRV has the same performance characteristics as the operational CRV.

2.11 Additional metadata is necessary to route messages within this architecture. The gateway EMS will use the metadata to route messages to the appropriate downstream EMS.

2.12 Surveillance sharing at the update rate of 1 sec per update, the bandwidth of 2Mbps is insufficient.

2.13 In Singapore's case, there are occasions where the surveillance load peaks beyond 3Mbps and packets are dropped. Note Singapore is only supplying data from a single ADS-B sensor and have not included the rest of its surveillance sources in this trial. It is expected that the bandwidth needed will be significantly higher if all the sources are included.

2.14 For all other types of services this bandwidth limit sufficient.

2.15 It was found that for surveillance sharing, latency between the publication of the track message on the outgoing message queue to the time it is received in the incoming message queue can range from 2.00 secs to 0.024 secs. This implies that the surveillance information shared should not be used for the purpose of separating aircraft and is best suited to for monitoring or awareness type applications.

SWIM expectations of the new CRV

2.16 As a result of the work done so far, several expectations of the next iteration of the CRV can be stated.

2.17 It would be ideal if the new CRV could have different VPN partitions to segregate different types of network traffic. They should be separated into at least the following types: operational, test, and research and development.

2.18 Ideally the following VPN partitions should be provisioned for:

- SWIM Ops, Test, R&D – SWIM for all stakeholders
- ANSP SWIM Ops, Test, R&D – SWIM for ANSPs Only
- AMHS Ops, Test – Legacy
- Management Ops, Test – CRV managed devices, ANSPs read-only

2.19 This would allow services to be tested prior to deployment, or to run experiments and research for new services on the actual hardware.

2.20 It is expected that the new CRV will be able to support mesh type connections between all participants. This means that any participant within the new CRV will be able to reach any other participant in the new CRV without the need to activate the vendor to perform that connection.

2.21 Each ANSP has different uses and needs of SWIM and not all ANSPs will be sharing surveillance data over SWIM. It is expected that the new CRV contract should be flexible enough to support bandwidths ranging from 2Mbps to 1Gbps.

2.22 It is not expected that the surveillance information shared via SWIM will be used for separation of aircraft. Therefore, latency can remain around the 2.00 secs mark.

2.23 However, it would be preferable if the new CRV could offer the option of lowering latency for individual subscribers should there be a need for it.

2.24 The AMQP protocol that has been adopted for implementation in the Asia-Pacific SWIM is comparable to or potentially simpler than the X.400 protocol used by AMHS. Therefore, it is recommended that the jitter requirement of 250ms specified for data application on AMHS in the current CRV network should also be applied to SWIM in the new CRV network.

2.25 The new CRV provider should also provide the option for subscriber to lower the jitter requirement to 100ms if needed.

2.26 Subscribers should have the ability to independently verify, using various software tools, the latency value and bandwidth of their subscribed CRV connection. The new CRV providers should allow for this ability.

2.27 It is also expected that the new CRV should provide for some sort of network monitoring service for subscribers to monitor the status of their connection, usage metrics for latency, bandwidth and throughput (average, minimum, maximum and peak)

2.28 Even though there was no exploration work done to look into communications outside of the CRV, the new CRV should have provisions to allow for connection to other regions outside of the Asia-Pacific region, e.g. Eurocontrol’s NewPENS and others.

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

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