International Civil Aviation Organization

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

Bangkok, Thailand, 3 – 6 November 2020

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

b) SWIM Infrastructure – Task 1-8

AN APPROACH FOR APAC REGIONAL SWIM IMPLEMENTATION

(Presented by Japan)

SUMMARY

This paper analyzes the benefits and challenges of Common aeRonautical Virtual Private Network (CRV) to support APAC regional SWIM implementation during present and future states. In addition, this paper proposes a strategic approach for CRV based regional SWIM construction and implementation within transition period by considering the global harmonized development of SWIM.

1. INTRODUCTION

1.1 During the transition to a global SWIM environment, legacy systems and SWIM-enabled systems will have to coexist for a longer period of time. To assure the interoperability, SWIM-enabled system is required to implement information services not only according to SWIM but also supporting the legacy systems. This is especially important during the transition period, because a legacy system may not have the capability to adapt to the new approaches introduced by SWIM. As the legacy AFTN/AMHS is used by nearly all member states, it is necessary for the SWIM Technical Infrastructure (TI) to support the message transport between the SWIM-enabled systems and AFTN/AMHS using legacy systems.

1.2 Currently, in the APAC region, a Common arRonautical Virtual Private Network (CRV) that is IP based VPN using a private commercial network to provide service for the exchange of AMHS data and potentially other types of data has been constructed. In addition, as a strong candidate to provide the network connectivity service for SWIM, how to support regional SWIM implementation has been discussed during CRV OG/5 in January 2019 and the CRV OG/6 & SWIM TF/3 joint session in May 2019.

1.3 The main objective of SWIM is not only to achieve seamless integration among geographically distributed systems in the air transportation field but also to enable seamless information sharing among the multiple stakeholders in the ATM domain. Therefore, as the backbone for ATM modernization by delivering the right information to the right decision-maker at the right time and location, the high-capacity IP network is needed. Moreover, the implementation of SWIM has also opened the door for a variety of new, non-traditional aviation information sharing partners, seeking to introduce innovative

solutions using data and information that became available after applying SWIM. These requirements have presented challenges as well as uncovered needs for the development and implementation of regional SWIM by CRV as follows:

- provide high-speed IP network connection with large bandwidth and low latency for various kinds and a large mass of information exchange among SWIM-enabled systems;
- provide an open and easy connected platform not only for traditional aviation partners but also for multiple non-aviation enterprises for the initial development of SWIM;
- provide a cross-border network connections not only for member states in the APAC region but also to other common networks that have been deployed in other ICAO regions.

1.4 The current existing Legacy TI is not sufficient and will need to be upgraded or replaced by the SWIM TI. Due to the current transition period, the performance based, vendor neutral and technological flexible approach of the SWIM implementation, different solutions are possible. According to the practical tests in other tasks, the different models have been analysed at the Task 1.8 - SWIM Architecture. In this paper, a strategic approach for CRV based regional SWIM implementation by considering the global harmonized development of SWIM is proposed.

2. DISCUSSION

2.1 In the APAC region, the number of member states have different levels of operational needs and sophistication; therefore, the transition period and interoperability arrangements can be different for the different implementation levels. Some member states may update or replace their legacy systems with SWIM-enabled systems by themselves. Others will continue to use legacy systems and shift to SWIM capable infrastructure provided by third-party SWIM service providers. It might be the case that a limited number of legacy systems never transit to SWIM because of a very low number of air traffic or information consumers.

2.2 Each aviation stakeholder will exchange data and information with all other stakeholders by directly or indirectly connection. As discussed at the third meetings of SWIM Task Force (SWIM TF/3), two optional models are available for regional SWIM implementation. If there is no common agreements and governance between local SWIM-enabled systems and public/private SWIM service providers, the direct connection will be a main way to achieve interoperability during transition. These connections are not limited to the all Air Navigation Service Providers (ANSPs) or ATM Service Providers (ASPs), but also include the thousands of Airspace Users (AUs), airports, and other organizations supporting those AUs. This could create a potentially unsupportable point-to-point ecosystem between all these stakeholders.

2.3 Therefore, in the APAC region, considering interoperability between SWIM and legacy AFTN/AMHS systems, the cooperation between CRV and SWIM service providers is required to satisfy the current and future needs of different stakeholders. The regional SWIM will be progressively implemented by different stakeholders and aligned with the implementation of the services it supports. To assure the performance of CRV for conventional AFTN/AMHS applications and improve the flexibility required for reginal SWIM implementation, it is recommended to divided the CRV communication and SWIM communication into different layers.

2.4 According to different sophistication and implementation levels, Figure 1 shows an interoperable architecture, which is a possible approach for CRV based regional SWIM implementation to satisfy information exchange between legacy and SWIM-enabled applications. Some stakeholders

(ANSPs, ASPs, AUs or third-party partners) will have the capacity to become SWIM service providers by establishing common agreements and creating a collaborative environment at the regional level or between different regions. In this approach, it is important for all SWIM service providers to agree on using a common set of standards to ensure information exchange between different systems. The Local Router provides the function of connectivity between CRV and SWIM TI for local legacy systems and SWIM-enabled systems. SWIM service providers may be connected by CRV or other secure connection methods on IP-based network. As a SWIM service provider, it will be able to provide the SWIM TI service to SWIM-enabled ASPs and AUs.

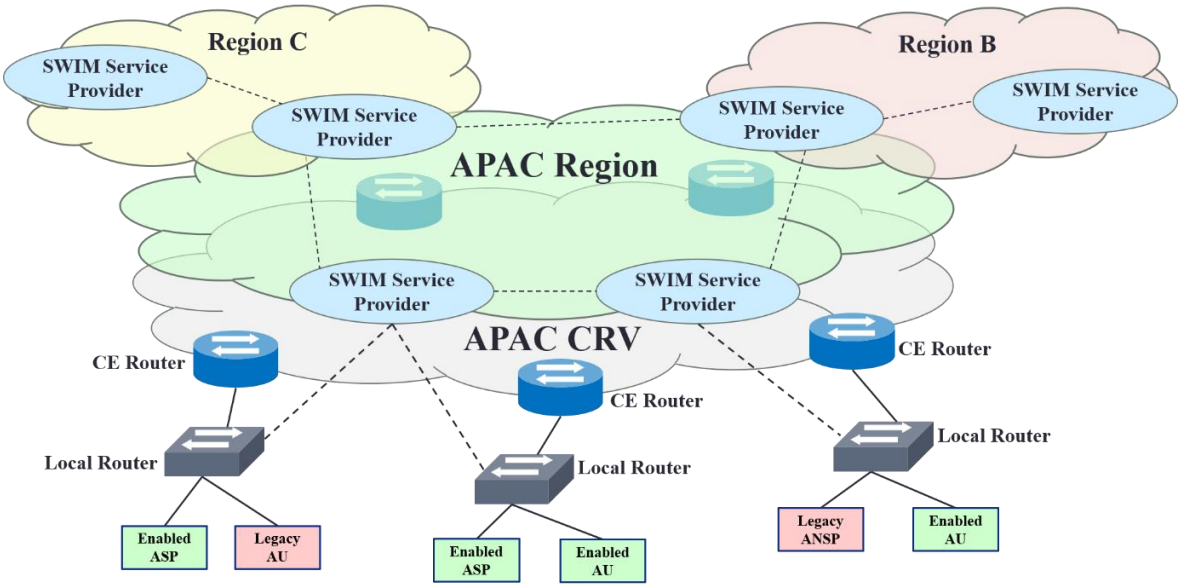

Figure 1. Interoperable Architecture

2.5 Figure 2 shows an interoperability scenario between a SWIM-enabled application and a legacy application. In this case, the System A of SWIM-enabled ASP represents an upgrade or replacement of a legacy system. This system can interoperate with the System B of SWIM-enabled AU via SWIM communication. As both are in the same SWIM region and have implemented their information services as agreed for the SWIM region. Both will be able to take advantage of advanced functionalities provided by SWIM services.

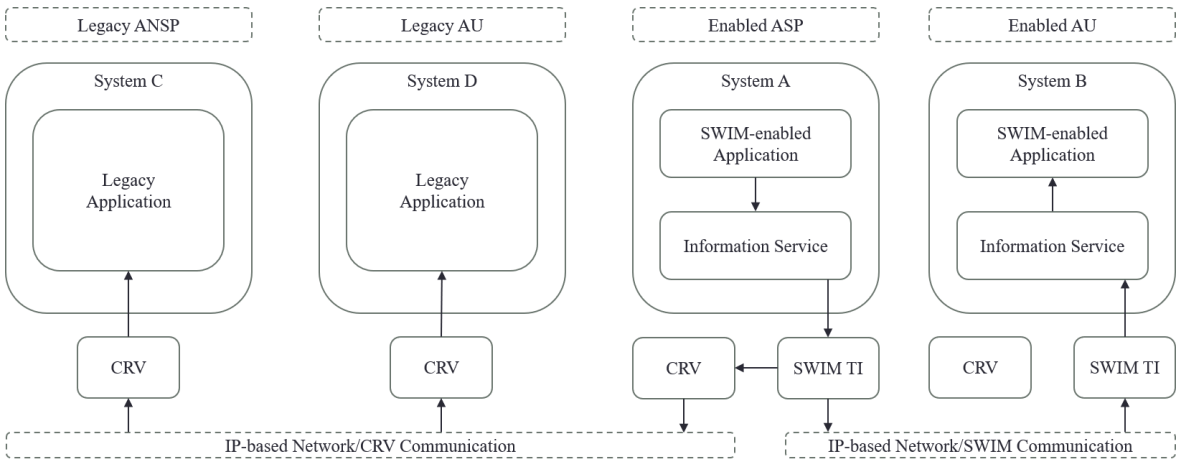

Figure 2. Interoperable Communication (Send messages from SWIM-enabled System)

2.6 On the other hand, as shown in Figure 2, to delivery messages from System A of SWIM-enabled ASP to System C of Legacy ANSP and System D of Legacy AU, the SWIM TI of System A is required to implement a mapping bridge of the new SWIM service messages to AMHS messages. In order not to break the information flow between SWIM-enabled systems and CRV-based legacy systems for the new implemented SWIM services, the specification of the mapping bridge shall take limitations of AMHS messages into account. The new SWIM service of System A shall be transparent for legacy System C and D. However, as long as System C and D do not update their legacy systems to SWIM-enabled systems, they cannot take advantage of advanced functionalities provided by SWIM services.

2.7 In addition, Figure 3 shows a message submitted from System C of Legacy ANSP to Legacy and SWIM-enabled systems via the communication on CRV. As AFTN/AMHS affects the information domains of MET (Meteorological Service), AIS (Aeronautical Information Service), and ATS (Air Traffic Service), it is expected that SWIM-enabled applications could receive these messages from legacy applications by a mapping bridge from AMHS messages to SWIM service messages. It is also possible for SWIM-enabled applications to get the information of MET or AIS from new information services provided by other SWIM service providers.

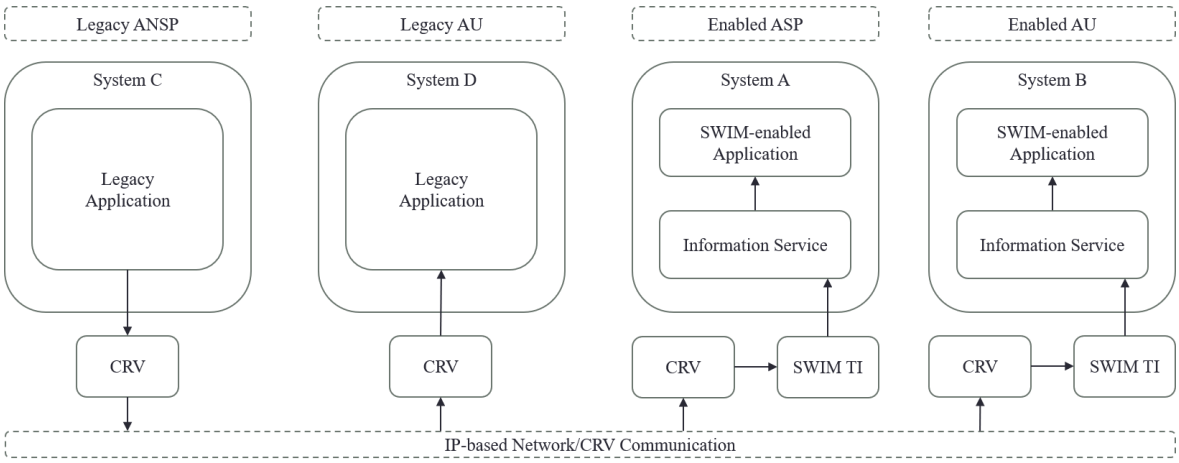

Figure 3. Interoperable Communication (Send messages from Legacy System)

2.8 In summary, when considering interoperability between SWIM-enabled systems and CRV-based legacy systems, it should be noted that, while AFTN/AMHS are related mainly to the transport protocol, the content in the message body is transparent for the message and the message switching. SWIM standardization intends to cover up to the service level. Therefore, the interoperability and the associated implementation plans will depend on the specific information services to be defined and the different options available. To achieve interoperability during the transition period, the SWIM TI shall contain the service bindings and the network bindings. The following requirements shall be taken into consideration for an ANSP aiming at updating its infrastructure to SWIM:

- The SWIM TI will have two interface that enable the exchange of information with both CRV-based legacy systems and SWIM-enabled systems.
- SWIM-enabled systems need to receive/send different AFTN/AMHS message types (MET, AIS, and ATS) from/to CRV-based legacy systems according to information domain requirements.
- The SWIM TI is able to decouple CRV-based legacy and SWIM-enabled applications from external systems that implement different communication protocols.

3. CONCLUTION

3.1 During the transition there may be a need for a given state to support both legacy information exchanges as well as SWIM information services. There are two implementation models to connect legacy and SWIM-enabled systems. As the regional and global ATM is a highly federated environment, based on the number of stakeholders, new entrants and complexity of airspace services, a point-to-point direct connection from every user to each other could become unsupportable. To achieve interoperability during the transition period, it requires solutions that can scale to support the demand of seamless information exchange between all these stakeholders. Therefore, Task 1-8 proposes an interoperable architecture, which is a possible approach for CRV based regional SWIM implementation to satisfy information exchange between CRV-based legacy and SWIM-enabled applications.

3.2 Task 1-8 presents a high-level perspective for the implementation and evolution of SWIM on a global scale. Task 1-8 identifies relevant approaches for achieving interoperability at the SWIM TI level as described by the ICAO SWIM Concept and Implementation Guidance.

4. ACTION BY THE MEETING

4.1 The SWIM TF/4 is invited to:

a) Note and review the content of this working paper;

b) Discuss any relevant matters as appropriate; and

c) Agree on providing this document to the related groups for coordination.

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APPENDIX A. SWIM TI INTERFACE BINDINGS

1. The SWIM TI enables the implementation of interfaces between systems, providing technical capabilities for secure, high performing and reliable information exchange. It enables technical interoperability based on interface that use industry standards. The SWIM TI interface bindings specify the protocols for information exchange between systems. There are two types of interface bindings to be distinguished based on their position in the TCP/IP protocol suite (ICAO ATN/IPS provisions):

- Network Bindings: Specify what is expected by the SWIM TI to communicate over the IP network, including protocols from the network and transport layers;
- Service Bindings: Specify the service interface technical interoperability, including protocols to interface with the applications.

2. For CRV-based SWIM implementation, Task 1-8 expects that the following four network interface bindings should be supported.

- IPv4 Unicast
- IPv4 Secure Unicast
- IPv6 Unicast
- IPv6 Secure Unicast

3. For service interface bindings, applied technologies should be differentiated on the basis of required messaging and security characteristics. Task 1-8 recommends to consider following characteristics:

- Exchange cardinality: the information is intended to be sent from one endpoint to another or to several ones during the exchange (1 to 1, 1 to N).
- Time decoupling: the participating entities need to be available at the same time in order to exchange information.
- Process decoupling: the process originating the exchange remains blocked until there is a response from the entity addressed.
- Message Exchange Pattern (MEP): several types of MEP are expected to be supported, including synchronous request/reply, asynchronous request/reply, on-way (fire and forget) and publish/subscribe.
- Security: information exchanges are cryptographically protected ensuring their confidentiality and integrity and enforcing user authentication and authorization access.
- Other functional and non-functional capabilities.