



ICAO

International Civil Aviation Organization

**THE FIFTEENTH MEETING OF THE COMMON
AERONAUTICAL VIRTUAL PRIVATE
NETWORK OPERATIONS GROUP (CRV OG/15)**

Mumbai, India, 15-19 June 2026

Agenda Item 2: Review outcomes of relevant meetings

**REVIEW OF OUTCOMES AND ACTION ITEMS FROM THE ICAO APAC CRV-SWIM
EXPERTS WORKSHOP: REVIEWING OF CRV II SPECIFICATIONS AND ICAO APAC
SWIM ARCHITECTURE IN SEPTEMBER 2025**

(Presented by the Secretariat)

SUMMARY

The paper presents the key outcomes of the ICAO APAC CRV-SWIM experts Workshop: Reviewing of CRV II Specifications and ICAO APAC SWIM Architecture, held in Bangkok, Thailand during 01-05 September 2025.

1. INTRODUCTION

1.1 The ICAO APAC CRV-SWIM Experts Workshop: Reviewing of CRV II Specifications and ICAO APAC SWIM Architecture was held from **1 – 5 September 2025** in the ICAO APAC Regional Office, Bangkok, Thailand. The Workshop was attended by **44** participants from **Twelve** (12) Member States/Administrations and **Two** (2) International Organizations. The Meeting report and other documents of the Workshop can be accessed at the ICAO APAC Meeting webpage at: <https://www.icao.int/APAC/MeetingDocs?fid=584>

1.2 This paper summarized the discussion of the CRV-SWIM Experts Workshop for the Meeting review.

2. DISCUSSION

2.1 The summary of the Workshop is given in the following paragraphs.

Opening of the Workshop

2.2 The Workshop was opened by Mr. Vaughan Hickford, Manager Enterprise Architecture and Network, Airways New Zealand, CRV OG Co-Chair (Asia) and Dr. Amornrat Jirattigalachote, Expert (Director Level), Aeronautical Radio of Thailand Ltd. (AEROTHAI), SWIM TF Co-Chair.

2.3 Mr. Vaughan Hickford welcomed all participants, recalled the objectives achieved by last year's in-person Workshop held in Guam, USA and shared the motivation to organize the second Workshop.

2.4 Dr. Amornrat Jirattigalachote, Expert (Director Level), Aeronautical Radio of Thailand Ltd. (AEROTHAI), SWIM TF Co-Chair, also warmly welcomed all participants and expressed gratitude for the efforts of all parties involved. She emphasised the significance of the joint Workshop in fostering a better understanding between CRV and SWIM experts.

2.5 Dr. Soniya Nibhani, Regional Officer, ANS (CNS) Implementation, extended a warm welcome to all participants and expressed deep appreciation for the efforts of the CRV OG and SWIM TF Co-Chairs for leading the Workshop and providing necessary guidance and support for effective CRV Implementation and building APAC SWIM Architecture in the APAC region.

Day 1 and the first half of Day 2

2.6 Day 1 and the first half of Day 2 were dedicated to outstanding topics from SWIM TF experts that required clarification and suggestions from CRV experts.

2.7 The Workshop recalled that, based on the SWIM Task Force’s Terms of reference, the APAC regional SWIM is to be constructed principally over the Common aeRonautical Virtual private network (CRV) and other Internet Protocol (IP) based networks, including the Internet.

2.8 An overview of the revised hierarchical architecture for regional SWIM implementation was shared with the Workshop. The discussion has been captured in this paper, as it has already been covered in other working papers.

2.9 A diagram on SWIM architecture over CRV and the Internet initiated the discussion on the need to identify data types to be transmitted over CRV and the Internet. ICAO Secretary shared that the need for a list of data types required to be transmitted over CRV has been presented by SWIM TF and ACSICG in various operational expert group meetings. However, it was recognised that this topic may be challenging for operational experts to discuss, due to their limited technical understanding of how information transmission differs between these two networks when using SWIM TI. In addition, operational experts expressed a preference not to define which data types should be transmitted over CRV or the Internet, but rather to follow global guidelines and ICAO SARPs, if available.

2.10 It was suggested **that ICAO Annex 10 specifies a list of high-priority messages, which should be transmitted over a secure network or CRV rather than the Internet.** However, it was discussed that, with the operational changes introduced by FF-ICE, message priorities may evolve in the future. Accordingly, in designing APAC SWIM Architecture, it was recommended to assume that some data types will be transmitted over CRV and others via the Internet. It was also highlighted that the same data type transmitted over CRV by one ANSP may, in some cases, be transmitted via the Internet by another ANSP.

2.11 The Workshop noted that multiple approaches to SWIM implementation are possible within APAC. Some States/Administrations may prefer to build (develop) their own SWIM, others may choose the build-and-buy option, and some may opt to buy (procure) one. Similarly, the establishment of SWIM capabilities may vary, including on-premises deployment, cloud-based solutions, or a hybrid model. It was clarified that **SWIM TF’s role is to define the regional framework and technical specifications, while the choice of implementation method remains at the discretion of individual ANSPs/SWIM users.**

2.12 The Workshop further discussed the possible interconnection at the network layer for routing SWIM data between CRV and the Internet. It was agreed that the Internet could be used as long as appropriate security mechanisms, such as IPSEC, TLS, etc., are implemented. **It was decided that SWIM TF will share considerations on the security requirements for using the Internet to transport SWIM data to CRV. ACTION ITEM 2-1**

2.13 The Workshop was presented with a significant timeline from the SWIM perspective, which included the development and implementation of SWIM TI, SWIM information services and SWIM-enabled applications. The timeline, shown in Figure 5, is based on discussions from other relevant meetings and both current and future test plans.

Significant Timeline

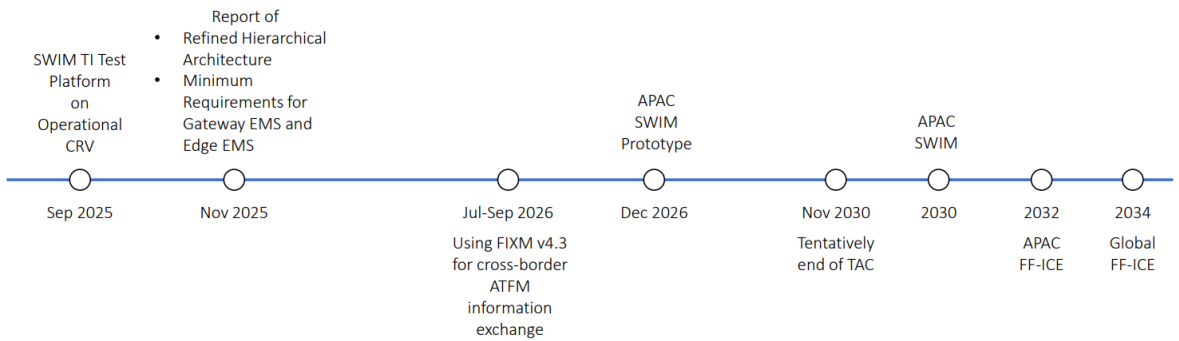


Figure 1- SWIM Implementation Timelines

2.14 CRV experts shared that currently, the CRV II Request for Information (RFI) is in progress. CRV OG/14 Meeting in October 2025 will decide based on the response evaluation of CRV II, if further extension of the CRV contract will be made for 5 years or a new CRV Request for Proposal (RFP) process will be initiated. It was informed that CRV OG will prepare a well-planned and clear migration plan for the CRV to CRV II transition. It was added that the final decision will be shared with APANPIRG/36 in November 2025.

2.15 The proposed SWIM timelines were updated to add CRV timelines. Revised timelines are as follows:

Significant Timeline

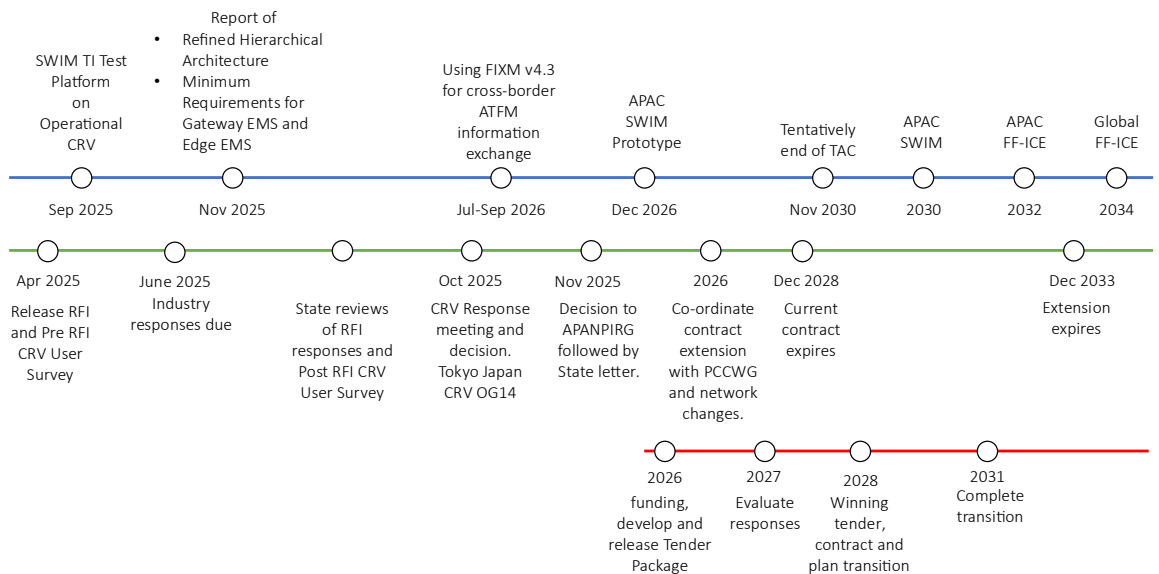


Figure 2- Joint Timelines of CRV and SWIM Implementation

2.16 The Workshop shared that a test report for cross-border ATFM information exchange using **FIXM v4.3** planned for **July-September 2026** should be prepared and submitted to CRV OG for further decision on moving the cross-border ATFM information exchange to operational CRV when the APAC SWIM TI Prototype is ready in December 2026. **ACTION ITEM 2-2** CRV

OG may request additional information before approving the move. It was noted that currently, a cross-border ATFM information exchange test is planned to be conducted among four APAC States/Administrations, namely China, Hong Kong China, Singapore, and Thailand.

2.17 The Workshop discussed DSCP marking for SWIM data. It was shared that CRV currently uses 3 main classes:

- Gold class: Used for voice traffic (DSCP marking EF);
- Silver class: Used for AFTN/AMHS data (DSCP marking AF21); and
- Bronze class: Used for other traffic (DSCP marking DF).

2.18 It was also noted that many States/Administrations do not currently use DF marking. Moreover, it was added that different queues are based on Service and IP addresses. To set up more queues, the Service details and IP addresses would be needed to accommodate the different DSCP markings. This will need to be agreed with the CRV Service Provider and documented in the System Design Document.

2.19 The Workshop shared SWIM TF's decision to use AF21 for consolidated SWIM data. However, since AFTN/AMHS data already use AF21, the need for a separate marking, such as AF41, was discussed at the Workshop. Additionally, a suggestion was made by CRV OG to use a different marking, DF, for test SWIM data. The workshop also deliberated how the SWIM EMS would support the segregation of operational and test SWIM data using different DSCP markings at the network layer.

2.20 CRV experts shared the need to share approximately bandwidth consumption for all types of SWIM data for CRV experts' calculation of availability of residual bandwidth to support SWIM testing.

2.21 For the discussion of the need for a SWIM testing environment for all States/Administrations, CRV OG Co-Chair (Asia) reminded about how Proof-of-Concept (PoC) was made for the CRV network when it was introduced. It was informed that PoC was conducted on a subset of all APAC States/Administrations. Once PoC was successful in a user state, it was concluded that CRV is validated. It was suggested to apply a similar principle for SWIM testing.

2.22 SWIM experts shared that such a principle may be applicable for SWIM TI testing; however, for SWIM information services validation, each service is required to be validated.

2.23 Further discussion on the SWIM TI test environment was made. It was recalled that Doc 10199 PANS-IM specifies only the need to validate information service using one of the validation methods, including independent validation, collaborative validation, user validation, and self-validation. However, it does not prescribe a specific SWIM TI test environment or approach. Consequently, the decision on whether to establish a separate SWIM platform for testing SWIM TI functions and validating information services, in order to segregate operational and test SWIM traffic, rests with individual APAC States/Administrations. The potential need for a regional SWIM test platform requires further deliberation within the SWIM TF. It was also informed that SWIM TF/10 agreed that China, Japan, and ROK would develop the SWIM information service validation process and present it at the SWIM TF/11 meeting for further consideration.

2.24 **The draft requirements and functionalities document for the Regional SWIM Sandbox**, provided in **Appendix A**, was presented to the Workshop. It was acknowledged that the benefits of SWIM lie in improved performance of operational ATM services requiring timely and quality information exchanged via SWIM. However, while a few APAC States/Administrations have made good progress in SWIM implementation, many continue to face challenges due to limited understanding of the SWIM concept, its operational requirements and technical implementation processes. To help States meet the APAC SWIM implementation timeline, it was proposed to establish

a regional SWIM Sandbox. This platform would allow States/Administrations to gain hands-on experience in SWIM development, addressing challenges in formulating technical and operational requirements, and assessing potential implementation impacts. The Sandbox would also provide a simulated environment for States/Administrations to test and experience SWIM, and to better understand the initial investment needed for SWIM implementation.

2.25 After sharing details of expected functions and specifications, the Workshop noted that the **proposed scope of the Sandbox aligns more closely with the demonstration phase of software development**, whereas a sandbox typically refers to the development and/or pre-production phase. Therefore, it was suggested to rename the **Regional SWIM Sandbox** to a name better reflecting its intended role, such as the **Regional SWIM Development Environment**

2.26 The Workshop also discussed network options, either CRV or the Internet, for establishing the regional SWIM sandbox. **It was concluded that the Internet would be the preferred option, as it offers better accessibility for users.** Moreover, the Workshop deliberated on a phased approach to developing the SWIM development/test tool/environment, e.g., Phase I to promote understanding of SWIM within the region, Phase II to support validation of SWIM information services. It was recommended **that SWIM TF continue discussions on the draft document and on the phased development of such a SWIM development/test tool/environment.** **ACTION ITEM 2-3** Meanwhile, States/Administrations were encouraged to use existing platforms, such as the USA-hosted [FAA SWIFT Portal](#), to gain initial hands-on experience with SWIM.

2.27 CRV OG Co-Chair (Asia) informed about a webinar hosted by CANSO under the title *CANSO Academy: Accelerating SWIM Readiness: A Practical Introduction to SWIM*, planned on **11 September 2025 from 0600 PM to 0800 PM BKK time.**

The second half of Day 2, Day 3 and Day 4

2.28 The second half of Day 2, Day 3 and Day 4 were dedicated to outstanding topics from CRV OG experts that required clarification and/or suggestions from SWIM experts.

2.29 Mr. Vaughan Hickford shared the key outcomes of the ICAO Workshop for the preparation of new CRV requirements and specifications for future System Wide Information Management (SWIM)/other aviation services, which was held from 17-19 September 2024 in Guam, USA. The key messages and further information on outstanding agenda items were shared as presented in SP/02.

2.30 The Workshop was reminded of the concern raised by **CRV experts regarding the need for a clear definition of SWIM Service Provider, ANSP Provider/Subscriber or Subscriber.** **ACTION ITEM 2-4** CRV OG Co-Chair (Asia) explained that, prior to 2022, *CRV users* were defined solely as ANSPs in CRV contract documents. This definition created issues, including the inaccessibility of CRV for users other than ANSPs. In 2022, MET SG raised its concern on the use of the term non-aviation service providers, non-ANSPs, or aviation support service providers used for MET service providers to the ICAO Secretariat and SWIM TF/6 held from 17 May to 20 May 2022. The SWIM TF/6 meeting subsequently requested CRV OG to deliberate on the terminology and finalize appropriate terms for CRV users/subscribers other than ANSP.

2.31 Furthermore, two types of CRV Users, **CRV USER – State/Administration and CRV USER – Industry**, were defined and incorporated in the CRV documentation. It was added that any CRV Users-Industry must be sponsored by a CRV User- State/Administration to join CRV. Considering these experiences, CRV experts suggested that there may be a need for SWIM TF to sponsor a private/commercial SWIM TI service provider to enable access to the CRV network. **SWIM TF experts informed that, in addition to performance requirements for SWIM TI service providers,**

the possibility and appropriateness of SWIM TF in sponsoring such SWIM service providers should be raised and considered by SWIM TF at future meetings. ACTION ITEM 2-5

2.32 The technical specifications incorporated into CRV II RFI, based on outcomes of the discussion of the last joint in-person meeting, were explained to the SWIM experts.

2.33 The need for a formal document, such as a Letter of Agreement (LOA) or Memorandum of Understanding (MoU), to describe the respective roles and responsibilities of CRV OG and SWIM TF for interrelated topics, including APAC SWIM TI Architecture over CRV, was raised. It was agreed that further discussion will be undertaken **once progress has been made in defining the first prototype of APAC SWIM TI Architecture. ACTION ITEM 2-6**

2.34 CRV OG Co-Chair (Asia) shared details of Pseudo CRV and its key characteristics, along with the rationale why it was proposed as the preferred test network by CRV OG to SWIM TF. The workshop noted that the Pseudo CRV was designed to be a separate MPLS network platform built to support the demonstration in Hong Kong China as described in [WP08 SWIM DEMONSTRATION ON CRV presented at CRV OG/07](#). The network elements were equivalent to the CRV Package D but without SLA, including an IPSec gateway and NID provided by PCCW Global and also a dedicated internet provided by each state connecting the participants to the pseudo CRV network. The subscribed bandwidth was from 2 Mbps to 4 Mbps. However, the SWIM TF/10 meeting agreed to move with the decision to utilise the residual bandwidth of the operational CRV rather than the Pseudo CRV.

2.35 The Workshop noted that, following SWIM TF/10, some APAC States/Administrations have initiated processes to extend the bandwidth of their existing CRV packages to meet the anticipated SWIM TI testing requirements being developed by SIPG. While extending the bandwidth in the current package incurs a higher cost compared to retaining a Pseudo CRV for testing, it was shared that this approach provides greater confidence in validating SWIM TI over CRV. ICAO Secretary further informed that a similar discussion took place during SWIM TF/10 on the use of Pseudo CRV versus residual bandwidth on operational CRV. At that time, some States indicated that obtaining funding approval for a Pseudo CRV subscription was more difficult than for bandwidth extension, leading to a preference for using residual bandwidth rather than a Pseudo CRV.

2.36 Regarding the **decommissioning of Pseudo CRV**, the Workshop was informed that all APAC States/Administrations that used Pseudo CRV for the joint event conducted by S3TIG should formally inform the CRV Service Provider of their intention **to discontinue its use. ACTION ITEM 2-7** Upon receiving these notifications, the CRV Service Provider will coordinate with respective users to arrange the return of equipment supplied by the CRV Service Provider. In addition, all observer States/Administrations of S3TIG testing can discard the mobile SIM provided to them. **ACTION ITEM 2-8**

2.37 The definition of residual bandwidth was shared as follows:

The CRV residual bandwidth is the bandwidth allocated under operational CRV with Service quality marked through DSCP markings and QoS of 'DF'.

2.38 Based on this definition, the residual bandwidth will be calculated by States/Administrations by looking into their System Engineering Plan about the bandwidth allocation made under DSCP 'DF'. Therefore, even if there is spare bandwidth allocation within other DSCP markings such as 'EF' or 'AF21', it will not be counted under residual bandwidth. It was informed that States/Administrations have the option to re-tag their bandwidth with the support of the CRV services provider under 'DF', if they wish to do so, to increase bandwidth allocation under 'DF' to facilitate SWIM testing.

2.39 In response to a question, it was suggested to allocate DSCP 'CS4' for space-based ADS-B data. This is the allocated DSCP marking in the CRV System Design Document (SDD). The

information will be added to the standard operating procedure being developed by CRV OG to utilise space-based ADS-B over CRV. **ACTION ITEM 2-9**

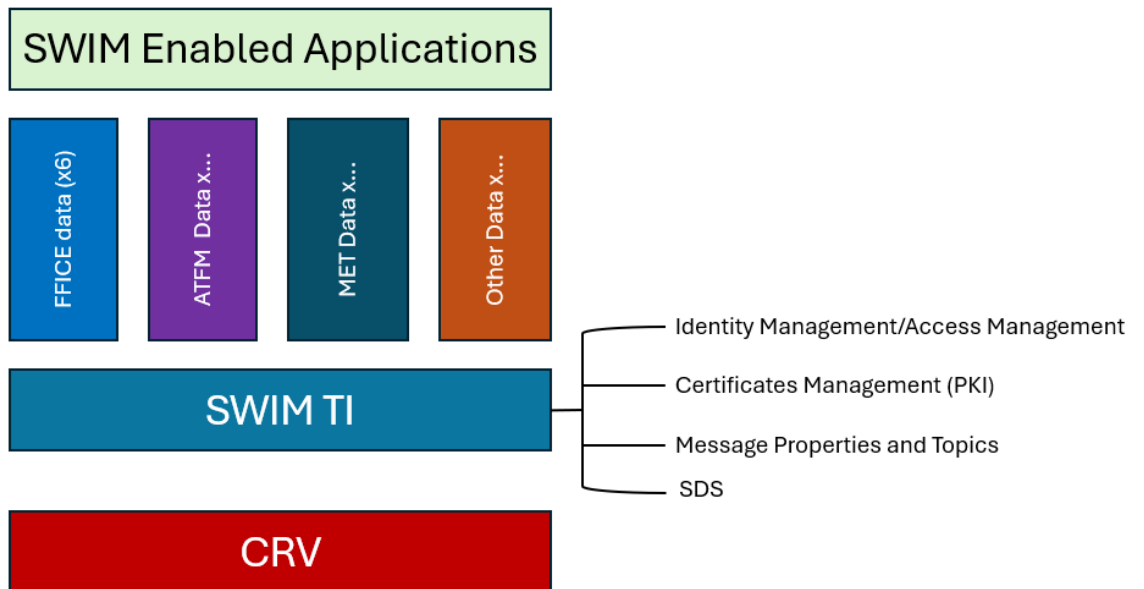
2.40 The Workshop noted that currently, there is **not enough data available to calculate the required bandwidth for space-based VHF operations in the future.**

2.41 The Workshop agreed that performance and usage of the internet in the aviation industry have expanded in the last few years. More stable and reliable technologies are available to provide reliable internet services. Aviation industries may leverage the potential of the internet with the exploration of the best options to use the internet for aviation services, which also meet security requirements. **It was suggested that appropriate contributory bodies under CNS SG may consider making guidance material for the usage of secure internet for aviation purposes. The ICAO Secretary will present this request for consideration to future ACSICG and CNS SG meetings and provide further updates to the CRV OG and SWIM TF meetings. ACTION ITEM 2-10**

2.42 The Workshop discussed the appropriateness of basing assumptions on aviation’s potential bandwidth usage in 2033 on current use cases and information exchanges. It was shared that, under the FF-ICE processes described in Doc 4444 PANS-ATM, significantly more messages will be exchanged between airspace users and ATM service providers, compared to the current FPL2012 flight planning process. Moreover, the richer trajectory information contained in FF-ICE FPL (eFPL) results in a larger message size than FPL2012. Taking these factors, along with other potential future traffic, into account, bandwidth requirements may increase to the 10Mbps to Gbps range. The Workshop agreed that the most appropriate approach would be to ensure flexibility in bandwidth allocation based on actual usage. **ACTION ITEM 2-11**

2.43 The Workshop discussed the information required by CRV OG from SWIM TF to support the decision-making on the use of residual bandwidth of operational CRV for SWIM tests. After detailed deliberations, it was agreed that the key parameters needed by CRV OG are the bandwidth requirements and the duration of SWIM testing. Additional considerations include the adoption of a separate class of service for test SWIM traffic, particularly during the peak traffic period.

2.44 Regarding DSCP tagging, the Workshop recalled the earlier agreement made during Day 1 discussion that the DF tag would be used for test SWIM traffic. To support the discussion on bandwidth estimation for SWIM testing, the following diagram was utilised.



2.45 Based on experience gained during the joint event conducted by S3TIG, it was informed that data transmissions from SWIM TI operations alone amounted to only a few kbps. However, the

S3TIG testing did not cover dynamic identity/access management, certificate management, or SDS testing. Additionally, it was shared that the test only included message routing by message properties, without incorporating topic-based routing. Therefore, when all these factors are considered in the SIPG test to be conducted, the required bandwidth may reach approximately **50 kbps per EMS**. As more EMSs are interconnected, the total bandwidth requirements would increase proportionally. It was further emphasised that these bandwidth calculations apply only to data exchange for SWIM TI operations. When more SWIM information services and SWIM-enabled applications are tested, higher bandwidth will be required.

2.46 CRV experts shared that there is a critical need to calculate and document bandwidth consumption during SWIM testing to be conducted by SIPG, and to share the results with CRV OG. This should include bandwidth requirements for both SWIM TI operations and information exchanges among SWIM information services. Such information will enable CRV OG to provide more accurate bandwidth estimates to meet future requirements. **All SIPG Members were requested to capture and share this information with CRV OG in the future. ACTION ITEM 2-12**

2.47 The Workshop requested guidance for States/Administrations to capture bandwidth data during the test. It was suggested to refer to [WP/21- MONITORING AND ANALYZING CRV NETWORK TRAFFIC IN HONG KONG, CHINA of CRV OG/12](#) and [WP/22-Future Bandwidth Requirements for ADS-B Data Based on Outcomes of Joint Event Hosted by Hong Kong China of CRV OG/13](#) to understand the setup and potential tools that can be used for this purpose. It was added that other potential tools that can support bandwidth capture and measurements are the [PRTG tool](#) and [Wireshark](#).

2.48 The Philippines expressed its intention to participate in SIPG, following the principle of *Starting Small*, and requested to share relevant documents that would help them understand the necessary preparations. SWIM TF Co-Chair informed that the first step is to establish a connection with Gateway EMS provider State/Administration to which the Philippines would like to connect. It was further noted that [the APAC SWIM Technical Infrastructure Profiles - Version 1.0 document](#) provides useful guidance on the basic requirements for the implementation of SWIM TI, optional system design models for the integration of the CRV, and common Information and Communication Technology (ICT) standards for the specification of interface bindings to implement the regional SWIM during the transition period. It was also suggested to begin with an offline sample message exchange before proceeding to an online test.

2.49 The Workshop was informed that, following the request from SWIM TF/10 for guidance on the use of residual bandwidth of the operational CRV, the CRV OG Ad-hoc Expert group drafted a guidance document through close collaboration among key CRV users via email and online meetings. The draft was shared with SWIM TF Task Leads for review and comment, which were subsequently considered and incorporated during the Workshop. It was clarified that the guidance document applies to any service testing, not only SWIM, using the residual bandwidth of the operational CRV. The Workshop discussed the document in detail and made further modifications.

2.50 The Workshop highlighted the need for updating the **System Engineering Plan (SEP)** document by the intended State/Administration **National CRV focal point**, which wants to do testing over residual bandwidth before initiating the testing, along with following the other procedures mentioned in the guidance document.

2.51 To summarise the process of getting approval to initiate testing of SWIM services over residual bandwidth, it was informed that the task can be started by confirming available bandwidth for testing with the State/Administration CRV National CRV focal point, updating the **CRV Bandwidth Results of SWIM Testing** and notifying the CRV OG focal point for SIPG testing. It was clarified that the CRV OG focal point is the CRV OG Secretary and the CRV OG Co-Chairs. After notification to CRV OG, the necessary process to set up the testbed over CRV can be initiated by the SIPG members in coordination with their CRV National focal point. Once set up and the other processes mentioned in

the guidance document are completed, the State/Administration CRV National focal point may provide approval to start testing to its State/Administration SIPG member.

2.52 The Workshop was advised to refer to [the APAC Guidance Document for AMHS Conformance Testing \(AMHS Manual\)](#) for SWIM testing, as this document has previously been used for AMHS testing during its implementation in the APAC region.

2.53 To support the timely update of information of mutual interest for CRV and SWIM experts related to SWIM testing, for the purpose of CRV OG information, visualisation, and related analysis, it was agreed that CRV OG Co-Chair (Asia) will facilitate a collaborative space on Airways New Zealand's hosted CRV portal. This space will also include, where possible, a messaging (chat) function to enable faster clarification of queries and exchange of required information. **ACTION ITEM 2-13**

2.54 A table was developed to record the required information on SWIM tests over the residual bandwidth of operational CRV, especially the CRV bandwidth allocated/used for these tests. The table, provided in **Appendix B**, was named “**CRV Bandwidth Results of SWIM Testing**”.

2.55 The Workshop reviewed the Guidance on using the (Residual) bandwidth of the Operational CRV, and agreed to recommend the amended version, as presented in **Appendix C**, for further adoption by CRV OG/15 in 2026. It was informed that the guidance document is a living document and will be further reviewed prior to its adoption at the CRV OG/15 plenary in 2026. **ACTION ITEM 2-14** In the meantime, SIPG may already refer to this document for its SWIM-related testing.

2.56 It was noted that the CRV OG Ad-hoc expert group needs to incorporate the guidance document and the new table into the CRV OG Operations Manual. The ad-hoc group will prepare the revised content and propose the amendments for adoption at the CRV OG/15 meeting. **ACTION ITEM 2-15**

2.57 SWIM TF Co-Chair expressed her appreciation to CRV OG Chairs and experts. She noted that the session provided SWIM TF with a better understanding of the requirements for building the APAC SWIM TI architecture over CRV. She acknowledged that, with the support of CRV OG experts, SWIM TF has gained a clearer comprehension necessary to conduct SWIM testing over CRV in preparation for its actual implementation. She reiterated the importance of continued close collaboration with CRV OG, as SWIM TF is a key user of CRV.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the outcome of the ICAO APAC CRV-SWIM experts Workshop;
- b) review all action items for CRV OG from this workshop provided in **Appendix D**;
- c) take any necessary follow-up actions; and
- d) discuss any relevant matter as appropriate

Regional SWIM Sandbox

High-level system requirements

- Support functions of Gateway EMS(s) and Edge EMS(s) in the agreed APAC Hierarchical Architecture constructed over IP-based network, e.g. the Internet
- Support routing mode using:
 - Message properties
 - Topic routing
- Support AMQP 1.0 (or AMQPS) and REST
- Credentials setup module to create user account to access EMS
- Queue/Topic configuration module
- Support Message Exchange Pattern (MEP) of Request/Reply, Publish/Subscribe and Fire-and-Forget

HMI

- Message publication screen for publisher with topic and message properties configuration
- Message subscription screen for consumer
- History screen for both publisher and consumer
- Routing configuration screen for SWIM administrator

Functionalities

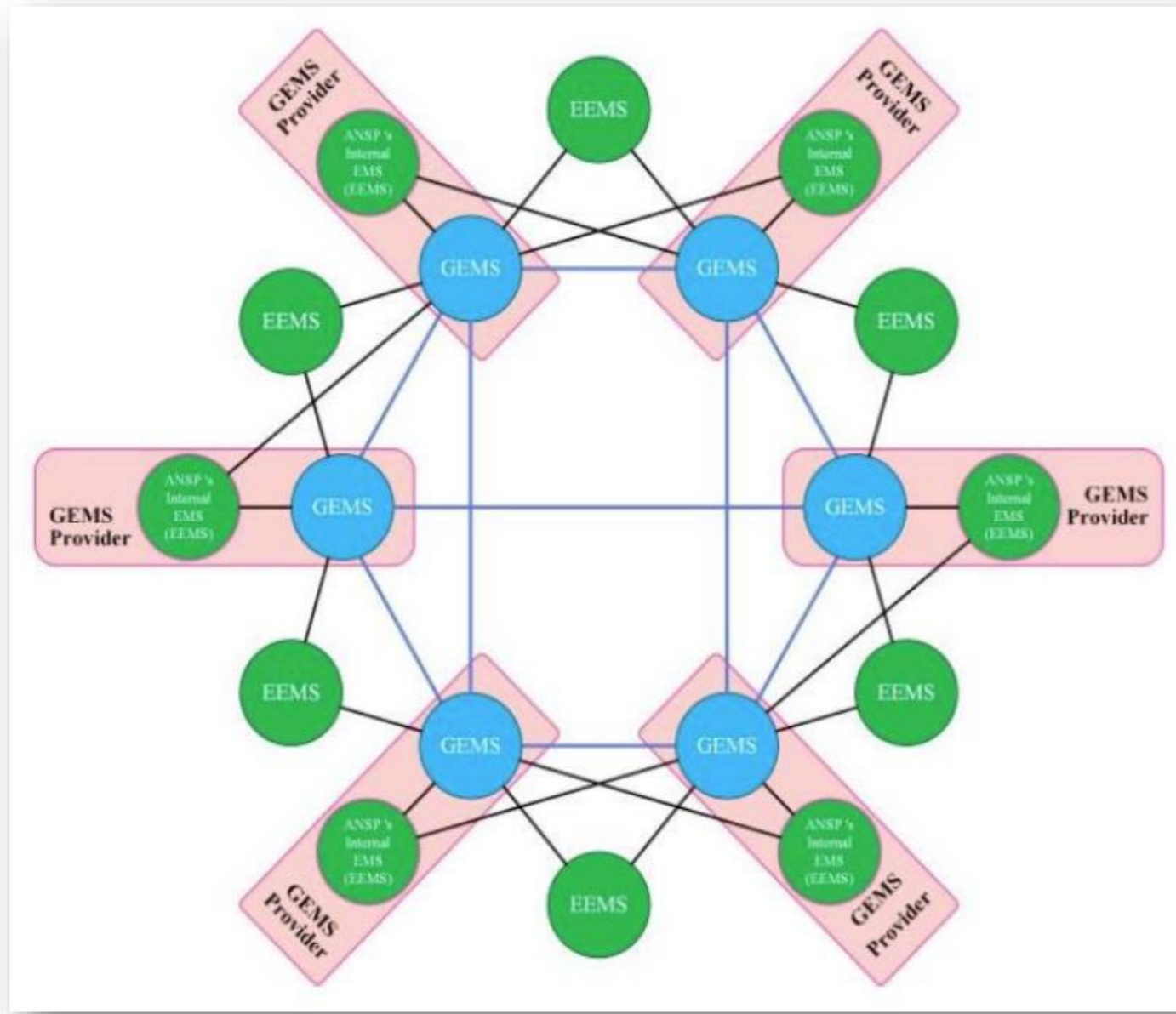
- Message sending and receiving module for simple message exchange
- Pre-configured demo scenarios using information exchange model e.g. FIXM, IWXXM

Documentation

- SWIM overview (with graphics/images)
- Routing configuration manual

CRV OG/15
Appendix B to WP/28

| Administration | City | Data Bandwidth (Kbps)(DF/CS0) |
|-------------------|------------------|-------------------------------|
| Aireon LLC | Washington | 10000 |
| Aireon LLC | Chandler | 10000 |
| Australia | Brisbane | 0 |
| Australia | Melbourne | 0 |
| Bhutan | Bhutan | 872 |
| Cambodia | Phnom Penh | 348 |
| China | Beijing | 2232 |
| French Polynesia | FAA'A | 2000 |
| Fiji | Nadi | 296 |
| Hong Kong, China | Hong Kong#1 | 928 |
| Hong Kong, China | Hong Kong#2 | 928 |
| India | Mumbai | 16 |
| Indonesia | Jakarta | 56 |
| Indonesia | Makassar | 56 |
| Japan | Tokyo | 1488 |
| Japan | Fukuoka | 768 |
| Japan | Fukuoka | 552 |
| Japan | Kobe | 552 |
| Japan | Tokyo | 776 |
| Japan | Kobe | 104 |
| Japan | Kobe | 216 |
| Japan | Fukuoka | 104 |
| Japan | Fukuoka | 104 |
| Japan | Fukuoka | 104 |
| Japan | Kobe | 552 |
| Macau, China | Macau | 1424 |
| Malaysia | Selangor | 440 |
| Maldives | Hulhule | 256 |
| Mongolia | Ulaanbaatar | 2000 |
| Myanmar | Yangon | 168 |
| Nepal | Kathmandu | 0 |
| New Caledonia | Tontouta | 2000 |
| New Zealand | Auckland | 56 |
| New Zealand | Christchurch | 56 |
| Pakistan | Karachi | 1000 |
| Papua New Guinea | Port Moresby | 64 |
| Papua New Guinea | Port Moresby | 64 |
| Philippines | Pasay | 172 |
| Republic of Korea | Seoul | 1872 |
| Republic of Korea | Incheon | 616 |
| Republic of Korea | Daegu | 504 |
| Singapore | Loyang | 176 |
| Singapore | Changi | 288 |
| Sri Lanka | Colombo | 256 |
| Thailand | Bangkok | 424 |
| Taiwan | Taoyuan | 2336 |
| Taiwan | Kaohsiung | 2336 |
| USA | Oakland | 0 |
| USA | Atlanta | 1680 |
| USA | Salt Lake | 1680 |
| Vietnam | Ho Chi Minh City | 96 |



To develop a regional SWIM technical infrastructure prototype over [CRV](#) and the [Internet](#)

| Gateway EMS |
|-----------------------|
| Australia (tentative) |
| China |
| Fiji |
| Hong Kong China |
| India |
| Japan |
| Republic of Korea |
| Singapore |
| Thailand |
| USA |

Guidance on using the Residual Bandwidth of the (Operational) CRV for New Services Testing

This document provides guidance on using the residual bandwidth of the operational CRV for SWIM testing purposes.

1. General Guidelines

The following guidelines are recommended to be followed while deciding the use of residual bandwidth of CRV for any testing purpose.

1.1. Availability of Residual Bandwidth

The allocation of bandwidth for testing should follow these principles:

- **Base Determination:**

Each CRV User wishing to participate in testing will need to determine if they have any residual bandwidth available. If sufficient bandwidth is available for testing, as agreed with participating users, testing can proceed. If there is not sufficient bandwidth, the User will need to consider an upgrade to participate in the testing.

- **Individual Agreements:**

With the base for each user determined, participating CRV Users should establish their specific bilateral testing bandwidth based on their respective circuit capacities and operational requirements. It should be noted that this may mean that the bandwidth capacities for each user might be different when used in the testing.

- **Safety Buffer:**

Each CRV User should maintain a bandwidth reserve of their total capacity to accommodate operational requirements.

Example:

If the lowest circuit residual capacity in the network is 512Kbps and applying the safety buffer of 30% (for example), the maximum bandwidth available for testing network-wide would be limited to approximately 358Kbps (70% of 512Kbps). Participating CRV Users should establish their bilateral testing arrangements within this maximum limit.

1.2. Network Configuration Overview

Before proceeding with SWIM testing, CRV Users should ensure one of the following traffic control methods is implemented:

Recommended Approach:

- Implement an additional LAN port on the PCCW Global Customer Edge (CE) router.
- Internal network traffic segregation is implemented by using separate sets of physical or virtualised hardware for testing.
- On the CE router, all test traffic is prioritized as 'DF'.

Alternative Approaches if an additional LAN port on the CE router cannot be used:

- Server-end rate limiting or Layer 3 network device rate limiting is properly configured.
- Internal network traffic segregation is implemented via VLAN configuration.

- Rate limiting is configured on the test VLAN network gateway to restrict SWIM test traffic to the agreed residual bandwidth.
- On the CE router, all test traffic is prioritized as 'DF'.

1.3. Risk analysis

After ensuring the availability of bandwidth to conduct required testing, it is suggested to do a risk assessment along with getting necessary internal approval for the testing.

1.4. Operational Traffic Priority

Operational traffic must always take precedence over testing activities. Testing must not negatively impact the performance of primary operational services.

1.5. Monitoring

Users should actively monitor resource usage during testing. If any issues arise, especially those affecting operational traffic, testing must be stopped immediately.

1.6. Documentation

All testing activities should be thoroughly documented. Documentation should include:

- Bandwidth allocation (guaranteed for operations and residual for testing)
- Test items and objectives
- Test results, especially those pertaining to service bandwidth
- Peering States/Administrations
- Services tested (e.g., FIXM message on SWIM)

Details required by CRV OG:

1.7. Agreement with Peering States/Administrations

All participating parties should agree on the test setup, conduct tests as planned, and jointly review and confirm results.

1.8. Notification to CRV OG

Users must notify the CRV OG prior to utilizing residual bandwidth for testing purposes.

2. Network Configuration Options

2.1. Network Configuration Options

To implement SWIM testing using CRV residual bandwidth, States/Administrations have the following configuration options:

- **Option A: Additional LAN Port Configuration (Recommended)**

Implement an additional LAN port on the PCCW Global Customer Edge (CE) router. This approach ensures complete separation of SWIM test traffic from operational CRV traffic at the network edge and provides the most robust protection for operational services. This physical separation at the CE router level prevents any potential impact of test traffic on operational services. However, this option requires separate sets of hardware dedicated to testing.

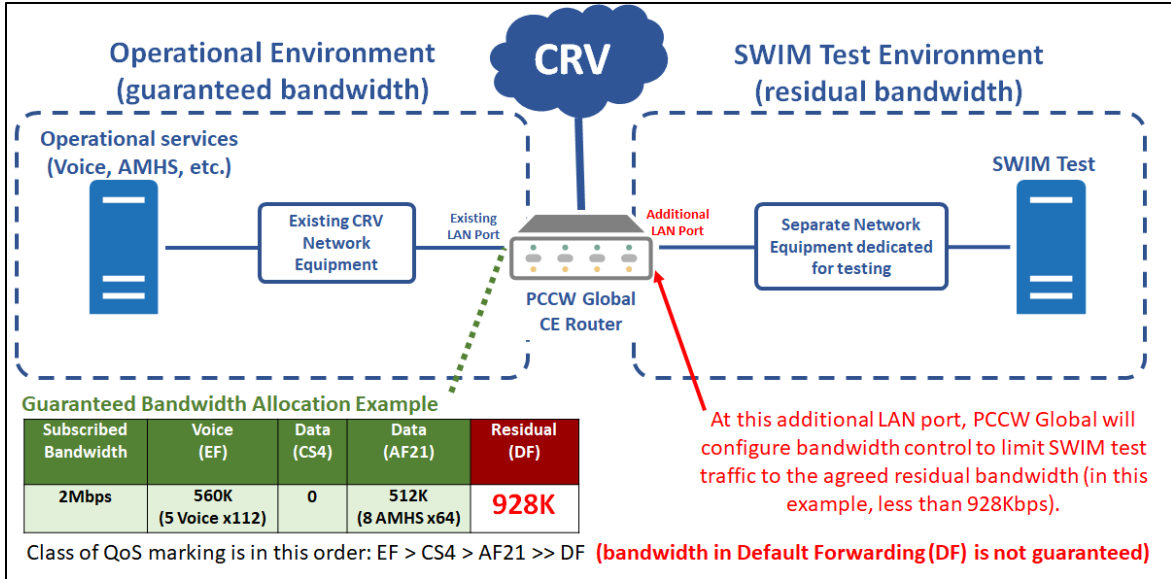


Diagram 1: Option A - Additional LAN Port Configuration with Dedicated Hardware

- **Option B: Alternative Traffic Control Methods**

For States/Administrations that choose not to implement or unable to have an additional LAN port on the CE router and do not have separate sets of hardware for testing, alternative traffic control methods can be implemented using existing hardware:

- **Option B1: Server-End Rate Limiting**

Apply rate limiting directly on the test server to control outbound traffic. Configure the server's network interface or application layer to enforce the agreed bandwidth limits for testing activities. This method provides granular control at the application level and ensures test traffic cannot exceed predetermined thresholds.

- **Option B2: Layer 3 Network Device Rate Limiting**

Implement rate limiting on the Layer 3 network devices where the test server network gateway is located. Configure these network devices to enforce bandwidth restrictions on traffic originating from the test server VLAN. This approach provides network-level control and can be managed centrally through existing network infrastructure.

- **Important Considerations for Alternative Methods:**

When using alternative traffic control methods (Option B1 or B2), States/Administrations must ensure that:

- Rate-limiting configurations are thoroughly tested before commencing SWIM testing.
- Monitoring systems are in place to verify that bandwidth limits are being enforced.
- Emergency procedures are established to immediately halt test traffic if operational services are impacted.
- VLAN segregation is implemented to separate test traffic from operational traffic within the existing network infrastructure.

2.2. Internal Network Traffic Segregation Requirements

- **For Option A (Additional LAN Port Configuration):**

This approach requires dedicated hardware for SWIM testing to maintain complete physical separation from operational systems.

- **For Option B (Alternative Traffic Control Methods):**

When using existing infrastructure, both Option B1 and B2 require VLAN segregation to separate test traffic from operational traffic within the existing network infrastructure. The implementation differs as follows:

- **For Option B1 (Server-End Rate Limiting):**

- Implement VLAN segregation to isolate test traffic.
- Apply rate limiting at the server level (application or network interface).
- VLAN configuration provides traffic separation while server-based controls manage bandwidth.

- **For Option B2 (Layer 3 Network Device Rate Limiting):**

- Implement VLAN segregation to isolate test traffic.
- Apply rate-limiting controls at the network gateway level for the test VLAN.
- VLAN configuration combined with gateway-level rate limiting provides both traffic separation and bandwidth control.

2.3. CRV GRE Tunnel Traffic Segregation

States/Administrations must ensure proper traffic segregation at the CRV GRE tunnel level through:

Updating the PCCW Global System Engineering Plan (SEP) document to include:

- QoS configuration requirements for SWIM test traffic on CRV GRE tunnel using 'DF'.
- Bandwidth allocation details specifying the residual bandwidth for SWIM testing.
- 'DF' Test traffic marking and prioritization to ensure production traffic takes precedence.

Coordinating with PCCW Global to implement:

- 'DF' QoS configurations on the CRV GRE tunnel to segregate SWIM test traffic.
- Bandwidth controls to restrict SWIM test traffic to the agreed residual bandwidth.
- DF Test traffic prioritization to protect existing production traffic.

States/Administrations should ensure these configurations are properly documented and implemented before commencing SWIM testing to prevent any impact on existing operational services.

3. Documentation

3.1. All testing activities should be thoroughly documented to ensure traceability and future reference. Comprehensive documentation supports effective communication among stakeholders and facilitates troubleshooting. The documentation should include, at a minimum, the following elements:

- Network Configuration

Document that an additional LAN port has been implemented. If one has not, it is assumed that the alternative traffic control method (Option B1 or B2) has been implemented. Update the PCCW Global SEP document with GRE tunnel QoS configurations.

- Bandwidth Allocation
Clearly specify the bandwidth reserved for operational services and the residual bandwidth allocated for testing. Include details on how the bandwidth was measured and any changes made during the testing period.
- Test Items and Objectives
List all test scenarios conducted, along with their specific objectives. Describe what each test aims to validate, such as verifying bandwidth controls, ensuring QoS marking, or confirming interoperability between systems.
- Test Results
Record the outcomes of all tests, including relevant metrics, observed behaviours, and any issues encountered.
CRV Users should capture logs, screenshots, graphs, or packet captures (such as from Wireshark) as supporting evidence.
- Peering States/Administrations
Document all organizations, States, or Administrations involved in the testing process. Include contact information for key personnel and a summary of each participant's role.
- Services Tested
Provide a detailed list of the services evaluated during testing, such as specific data exchanges (e.g., FIXM messages over SWIM). Mention protocols, message types

For CRV-specific test understanding, the CRV Bandwidth Results of SWIM Testing document will be used to capture these details.

4. Agreement with Peering States/Administrations

4.1. Agree on Test Connectivity Between Peering States

Before testing, all participating States/Administrations should agree on the test connectivity setup. This includes:

- Confirming the selected network configuration approach (additional LAN port or alternative traffic control method)
- For alternative methods, confirming rate-limiting configurations and monitoring procedures
- Confirming GRE tunnel QoS configurations implemented by PCCW Global is DF.
- Agreeing on network parameters and interface points

This ensures a common understanding of the test environment and traffic segregation approach.

4.2. Conduct Testing According to Test Documentation

Perform tests using the established connections, following the agreed test plan and documented procedures. Ensure all test items are covered, and results are accurately recorded for analysis.

4.3. Confirm and Document Test Outcomes with Peering States

After testing, review the results together with all peering states. Reach an agreement on the outcomes, document any issues or follow-up actions, and ensure all parties formally acknowledge the findings.

5. Notification to CRV OG

5.1. Prior to initiating any SWIM testing or commissioning activities using the residual bandwidth of the operational CRV, all participating States/Administrations should notify the CRV OG. The notification should include:

- Detailed information about planned testing, including schedule and participating parties
- Specific services to be tested
- Updated PCCW Global SEP document status
- Bandwidth allocation for SWIM testing

5.2. The notification should also advise the CRV OG and all relevant peering States/Administrations that testing and/or commissioning activities will be taking place. This ensures that all stakeholders are aware of ongoing changes and can coordinate accordingly to safeguard operational traffic and network stability.

5.3. Upon completion of testing and/or commissioning, a summary of the activities undertaken, results achieved, and any observed issues or incidents should be submitted to the CRV OG and all relevant peering States/Administrations for record and further review, including:

- Results achieved
- Any observed issues or incidents
- Confirmation that traffic separation was maintained throughout testing
- Verification that production traffic was not impacted

Updated Subject/Tasks List

| Reference | Who | What | Due date | Status | Completed on | Result | Comment |
|-----------|------------------------------------|--|-----------|--------|--------------|---|---------|
| 1-1 | CRV OG Co-Chairs, ICAO Secretariat | It was recommended that the jitter requirement of 250ms specified for data application on AMHS in the current CRV network be lowered to 100ms in the new CRV network. This will need to be verified with PCCWG | CRV OG13 | close | | | |
| 1-2 | SWIM TF | SWIM TF Experts agreed to discuss and develop a set of considerations and specifications of both hardware and software required for EMS construction | SWIM TF10 | Open | | | |
| 1-3 | SWIM TF | CRV OG Co-Chairs informed SWIM TF Experts that any CRV Users-Industry must be sponsored by a CRV User- State/Administration to join CRV. In such a scenario, there may be a need for SWIM TF to sponsor a private/commercial SWIM TI service provider to enable access to the CRV network. SWIM TF Experts informed that in addition to performance requirements for SWIM TI service providers, the possibility and appropriateness for SWIM TF sponsoring such SWIM service providers will be raised and considered by SWIM TF at future meetings | SWIM TF10 | close | | replaced by action item from joint workshop in Sep 2025 | |
| 1-4 | ICAO Secretariat | To understand the performance requirements for the exchange of MET information, the Meeting requested that the ICAO Secretariat coordinate with MET SG and request the list of MET messages that are expected to be exchanged over CRV and over the internet | CRV OG13 | Open | | | |
| 1-5 | ICAO Secretariat | While analysing the validation results of Message Exchange and expected capabilities and QoS parameters for CRV, CRV OG Experts requested clarification on (i) how the Packet Loss parameter was estimated, (ii) how the Priority Level of different message types mentioned under QoS was identified, (iii) the meaning of different Priority Level identified. Japan will share clarifications with the ICAO Secretariat to share with CRV OG | CRV OG13 | close | 25.09.2024 | Explanation with revised figures were shared by Japan | |
| 1-6 | SWIM TF | The hierarchal architecture chosen for the joint event will be further reviewed by SWIM TF | SWIM TF10 | close | | Adopted by SWIM TF10 | |
| 1-7 | SWIM TF | It was discussed that for discussion topic (2), once the priority is agreed upon, the Common SWIM Information Services being finalised by SWIM TF should also contain this priority information | SWIM TF10 | close | | | |
| 1-8 | SWIM TF | The Meeting noted that to achieve operational SWIM implementation by 2026 on the operational CRV, a proposed set of criteria to justify the operationalisation readiness of SWIM on the operational CRV will be developed by SIPG in consultation with CRV OG. The draft will be presented to CRV OG and SWIM TF for adoption before being presented to CNS SG for endorsement | SWIM TF10 | Open | | | |
| 1-9 | CRV OG Co-Chairs, ICAO Secretariat | CRV OG informed that CRV OG is drafting a test procedure to test SWIM services over CRV to present in the upcoming CRV OG/13 Meeting in February 2025. After adoption by CRV OG/13, the document will be shared with SWIM TF | CRV OG13 | close | | Guidance document was finalised in Joint workshop in Sep 2025 for CRV OG/13 adoption. | |
| 1-10 | SWIM TF & CRV OG | The difficulties of getting permission from States/Administrations to use operational CRV for testing SWIM services were discussed. It was suggested that SWIM TF and CRV OG could together develop a safety case for testing SWIM services on the operational CRV | CRV OG13 | close | | Guidance document was finalised in Joint workshop in Sep 2025 for CRV OG/13 adoption. | |
| 1-11 | SWIM TF & CRV OG | Prepare necessary guidelines for States/Administrations to conduct a risk assessment and develop a safety case individually if required by individual States/Administrations' policy | CRV OG13 | close | | | |

CRV OG/15
Appendix D to WP/28

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|------|---|---|-----------------------|-------|--|---|--|
| 1-12 | CRV OG Co-Chairs, ICAO Secretariat | The Meeting discussed the possibility of using the operational CRV for testing SWIM services after the decommission of the pseudo CRV in December 2024. CRV OG agreed to coordinate with the CRV service provider to seek the possibility of extending the availability period of the pseudo-CRV while permission to use the operational CRV for this purpose is being processed | CRV OG13 | close | | Extended till June 2025. SWIM TF/10 decided to not use Pseudo CRV | |
| 2-1 | SWIM TF | It was agreed that the Internet could be used as long as appropriate security mechanisms, such as IPSEC, TLS, etc., are implemented. It was decided that SWIM TF will share considerations on the security requirements for using the Internet to transport SWIM data to CRV. | SWIM TF11 | | | | |
| 2-2 | SWIM TF & CRV OG | The Workshop shared that a test report for cross-border ATFM information exchange using FIXM v4.3 planned for July-September 2026 should be prepared and submitted to CRV OG for further decision on moving the cross-border ATFM information exchange to operational CRV when the APAC SWIM TI Prototype is ready in December 2026. | 1-Sep-26 | | | | |
| 2-3 | SWIM TF | It was recommended that SWIM TF continue discussions on the draft requirements and functionalities document for the Regional SWIM Sandbox and on the phased development of such a SWIM development/test tool/environment. | SWIM TF11 | | | | |
| 2-4 | SWIM TF | A clear definition of SWIM Service Provider, ANSP Provider/Subscriber or Subscriber. | SWIM TF11 | | | | |
| 2-5 | SWIM TF | CRV experts suggested that there may be a need for SWIM TF to sponsor a private/commercial SWIM TI service provider to enable access to the CRV network. SWIM TF experts informed that, in addition to performance requirements for SWIM TI service providers, the possibility and appropriateness of SWIM TF in sponsoring such SWIM service providers should be raised and considered by SWIM TF at future meetings. | SWIM TF11 | | | | |
| 2-6 | SWIM TF & CRV OG | The need for a formal document, such as a Letter of Agreement (LOA) or Memorandum of Understanding (MoU), to describe the respective roles and responsibilities of CRV OG and SWIM TF for interrelated topics, including APAC SWIM TI Architecture over CRV, was raised. It was agreed that further discussion will be undertaken once progress has been made in defining the first prototype of APAC SWIM TI Architecture. | 1-Dec-26 | | | | |
| 2-7 | APAC States/Administrations CRV Service Provider ICAO Secretariat | All APAC States/Administrations that used Pseudo CRV for the joint event conducted by S3TIG should formally inform the CRV Service Provider of their intention to discontinue its use. | CRV OG15 | | | | |
| 2-8 | APAC States/Administrations CRV Service Provider ICAO Secretariat | Upon receiving these notifications (discontinue to use Pseudo CRV), the CRV Service Provider will coordinate with respective users to arrange the return of equipment supplied by the CRV Service Provider. In addition, all observer States/Administrations of S3TIG testing can discard the mobile SIM provided to them. | CRV OG15 | | | | |
| 2-9 | CRV OG | It was suggested to allocate DSCP 'CS4' for space-based ADS-B data. This is the allocated DSCP marking in the CRV System Design Document (SDD). The information will be added to the standard operating procedure being developed by CRV OG to utilize space-based ADS-B over CRV. | CRV OG15 | | | | |
| 2-10 | ICAO Secretariat | It was suggested that appropriate contributory bodies under CNS SG may consider making guidance material for the usage of secure internet for aviation purposes. The ICAO Secretary will present this request for consideration to future ACSICG and CNS SG meetings and provide further updates to the CRV OG and SWIM TF meetings. | CRV OG15 SWIM TF11 | | | | |

CRV OG/15
Appendix D to WP/28

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|------|----------------------------|--|----------|--|--|--|--|
| 2-11 | CRV OG | The Workshop agreed that the most appropriate approach would be to ensure flexibility in bandwidth allocation based on actual usage. | CRV OG15 | | | | |
| 2-12 | SIPG | CRV experts shared that there is a critical need to calculate and document bandwidth consumption during SWIM testing to be conducted by SIPG, and to share the results with CRV OG. This should include bandwidth requirements for both SWIM TI operations and information exchanges among SWIM information services. Such information will enable CRV OG to provide more accurate bandwidth estimates to meet future requirements. All SIPG Members were requested to capture and share this information with CRV OG in the future. | SIPG 3 | | | | |
| 2-13 | CRV OG Co-Chair (Asia) | To support the timely update of information of mutual interest for CRV and SWIM experts related to SWIM testing, for the purpose of CRV OG information, visualization, and related analysis, it was agreed that CRV OG Co-Chair (Asia) will facilitate a collaborative space on Airways New Zealand's hosted CRV portal. This space will also include, where possible, a messaging (chat) function to enable faster clarification of queries and exchange of required information. | | | | | |
| 2-14 | ICAO Secretariat | The Workshop reviewed the Guidance on using the (Residual) bandwidth of the Operational CRV, and agreed to recommend the amended version for further adoption by CRV OG/15 in 2026. It was informed that the guidance document is a living document and will be further reviewed prior to its adoption at the CRV OG/15 plenary in 2026. | CRV OG15 | | | | |
| 2-15 | CRV OG Ad-hoc expert group | The CRV OG Ad-hoc expert group needs to incorporate the Guidance on using the (Residual) bandwidth of the Operational CRV and the new table for recording the required information on SWIM tests over the residual bandwidth of operational CRV into the CRV OG Operations Manual. The ad-hoc group will prepare the revised content and propose the amendments for adoption at the CRV OG/15 meeting. | CRV OG15 | | | | |