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 6: Regional SWIM Technical Infrastructure over CRV

GUIDANCE MATERIAL ON USING THE RESIDUAL BANDWIDTH OF THE OPERATIONAL CRV FOR TESTING OF SWIM/NEW SERVICES

(Presented by the Secretariat)

SUMMARY

The paper presents draft Guidance Material on using the Residual Bandwidth of the Operational CRV for New Services/SWIM services Testing, prepared during the joint Meeting of SWIM and CRV experts in September 2025, for meeting adoption.

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1.2 This paper presents draft Guidance Material on using the Residual Bandwidth of the Operational CRV for New Services Testing, prepared during the joint Meeting of SWIM and CRV experts in September 2025, for meeting adoption.

2. DISCUSSION

2.1 The Workshop recalled that, based on the SWIM Task Force's Terms of reference (ToR), 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.

2.2 SWIM TF has formulated the SWIM Implementation Pioneer Group (SIPG), which is working on building a SWIM prototype for the APAC Region.

2.3 It has been shared by SWIM TF/SIPG that they did not intend to continue Pseudo CRV (used Joint Event of SWIM over CRV Demonstration and Surveillance Data Sharing in SWIM Trial) for further testing of SWIM information services planned within SIPG.

2.4 SWIM TF/SIPG has shared its intention to use either the internet or the residual bandwidth of operational CRV, as per the preference of different SIPG members.

2.5 To start using operational CRV residual bandwidth for SWIM testing, SWIM TF/SIPG has requested guidance from CRV OG, along with the request to formalize the procedure in the relevant CRV documentation. It will support States preferred to use operational CRV for SWIM testing.

2.6 This topic was deliberated in depth in a joint in-person workshop conducted in September 2025.

2.7 In the workshop, the definition of residual bandwidth of CRV 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'.

2.8 It was added that 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.

2.9 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.

2.10 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.

2.11 To summarize 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.

2.12 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.

2.13 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.

2.14 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 A**, was named "**Template for sharing CRV Bandwidth Results of SWIM Testing**".

2.15 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 B**, 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. In the meantime, SIPG may already refer to this document for its SWIM-related testing.

2.16 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.

2.17 With the aforementioned background information, the meeting is requested to review both documents provided in the appendices and consider adoption of both by following the draft decision:

<table>
<tr><td colspan="3">Decision CRV OG/15/xx – Adoption of Guidance Material for using the Residual bandwidth of the Operational CRV and template for sharing CRV Bandwidth Results of SWIM Testing for SWIM TF</td></tr>
<tr><td colspan="2">What: The Guidance Material for using the Residual bandwidth of the Operational CRV and template for sharing CRV Bandwidth Results of SWIM Testing for SWIM TF, provided in Appendix A and Appendix B, be adopted.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: SWIM TF has requested to provide Guidance Material for using the Residual bandwidth of the Operational CRV and a template for sharing CRV Bandwidth Results of SWIM Testing, for testing being conducted by SIPG under SWIM TF.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 19-Jun-26</td><td colspan="2">Status: To be adopted by CRV OG</td></tr>
<tr><td colspan="3">Who: ☐Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: CRV OG</td></tr>
</table>

2.18 Following the adoption of both documents, the CRV OG Ad-Hoc Expert Group may consider incorporating both documents into the CRV OG Operational Manual.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information given in the paper;

b) review draft Guidance Material for using the (Residual) bandwidth of the Operational CRV and template for sharing CRV Bandwidth Results of SWIM Testing for SWIM TF provided in **Appendix A and Appendix B**;

c) adopt the proposed draft decision; and

d) discuss any relevant matter as appropriate

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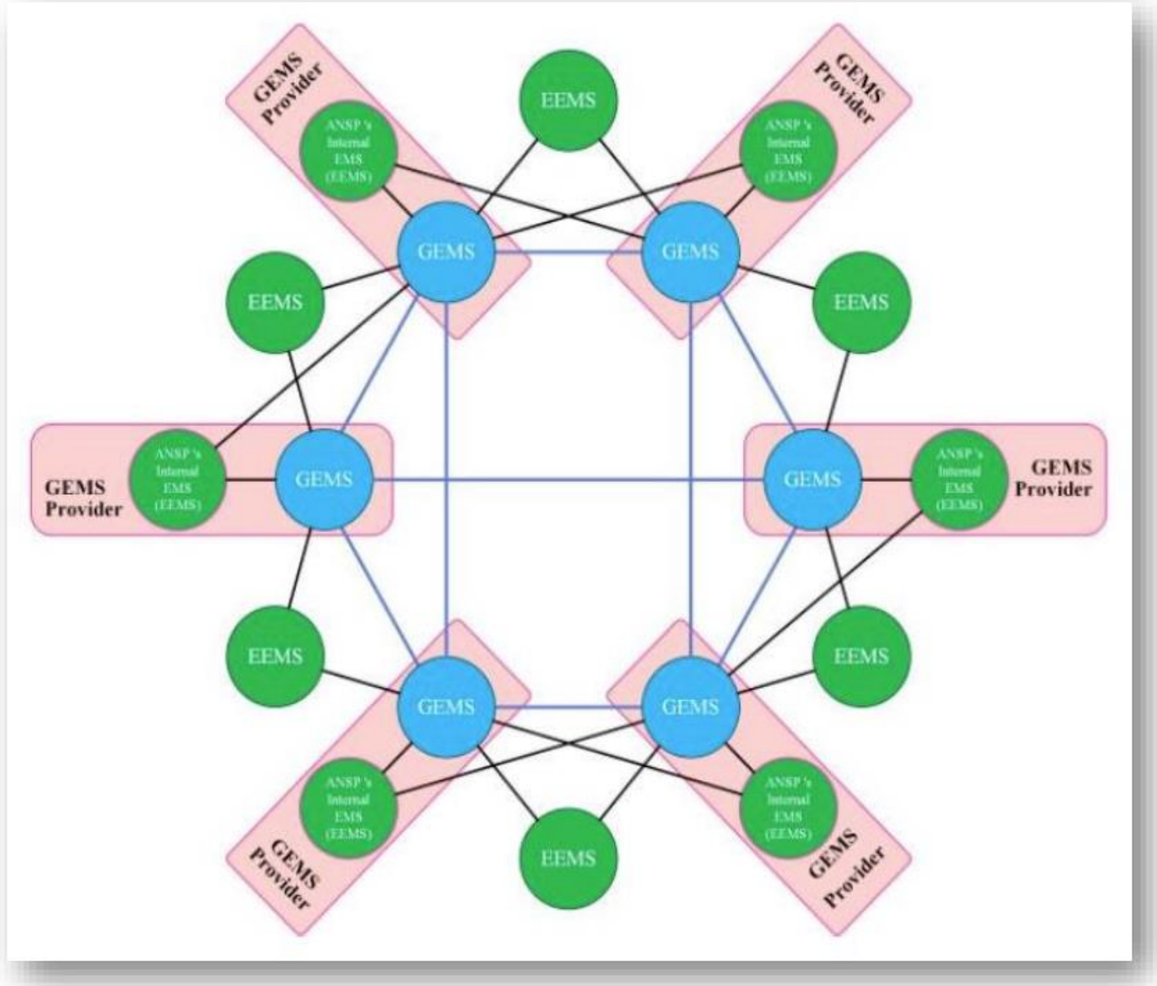
Test item	Test Objectives	Services tested	Bandwidth allocation	Additonal LAN port used Y/N		Test results (BW)		Peering		CRV OG Notified	Test start	Test Finish
				State 1	State 2	Expected	Actual	Primary State	State 2	dd/mm/yyyy		
SWIM TI	Validation of GEMS to GEMS SWIM TI services.	IDAM PKI/Cert SDS Topic/msg properties	200Kbps	N	N	35Kbps	48Kbps	Thailand	Singapore	9/4/2025	10/4/2025	12/31/2026

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	Sepang	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

CRVOG		
User	**Name**	**Email Address**

SIPG		
State	**Name**	**Email Address**

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 able to 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:

- **<u>Option A: Additional LAN Port Configuration (Recommended)</u>**

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.

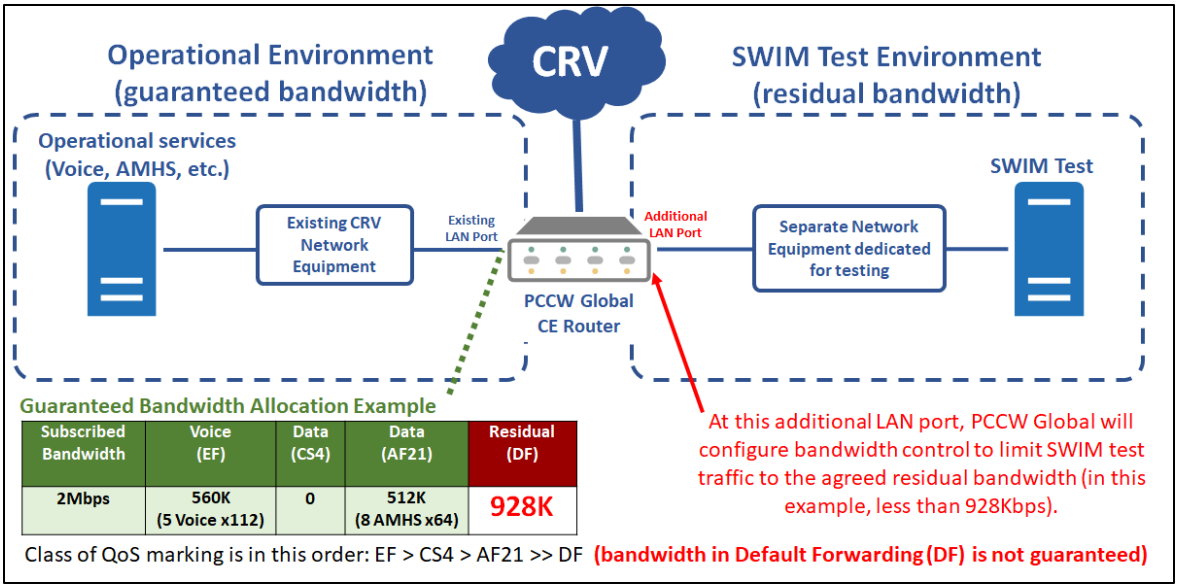


Diagram 1: Option A - Additional LAN Port Configuration with Dedicated Hardware

- **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