International Civil Aviation Organization

Twenty Eighth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/28) of APANPIRG

Bangkok, Thailand, 1 July – 5 July 2024

Agenda Item 4: Information Management (IM)

4.1 Review Report of the Eighth and Ninth Meeting of System Wide Information Management Task Force (SWIM TF/8 and SWIM TF/9)

REVIEW REPORT OF THE EIGHTH AND NINTH MEETING OF SYSTEM WIDE INFORMATION MANAGEMENT TASK FORCE (SWIM TF/8 AND SWIM TF/9)

(Presented by the Secretariat)

SUMMARY

This paper presents the discussions and relevant outcomes on System Wide Information Management Task Force (SWIM TF) Meetings of APANPIRG for meeting review.

1. INTRODUCTION

1.1 The Eighth Meeting of the System Wide Information Management Task Force (SWIM TF/8) was held *from 8 to 10 November 2023* in ICAO Asia and Pacific Regional Office, Bangkok, Thailand. The Meeting was attended by **79** participants from **15** States/Administrations, 3 International Organizations and **1** telecommunication service provider. The SWIM TF/8 meeting report, working papers, information papers, and other resources can be accessed by https://www.icao.int/APAC/Meetings/Pages/2023-workingSessionandSWIMTF8.aspx

1.2 The Ninth Meeting of the System Wide Information Management Task Force (SWIM TF/9) was held from **14 to 17 May 2024** in ICAO Asia and Pacific Regional Office, Bangkok, Thailand. The Meeting was attended by **110** participants from **18** States/Administrations**, 4** International Organizations and **2** industry partners. Variflight positioned an exhibition booth during the SWIM Seminar and SWIM TF/9 Meeting. The meeting report, working papers, information papers, and other resources can be accessed by the following link:
https://www.icao.int/APAC/Meetings/Pages/2024-SWIM-Seminar-and-SWIM-TF9.aspx

1.3 This paper summarised relevant information and updates with a highlight on the outcomes of SWIM TF/8 and SWIM TF/9 meetings to be reviewed by the Twenty-Eighth meeting of Communications, Navigation, and Surveillance Sub Group (CNS SG/28) of APANPIRG and the

Thirty-Fifth Meeting of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/35).

2. DISCUSSION

2.1 The summary of the discussion in the Meeting is given in the following paragraphs.

Outcomes of the Eighth Meeting of the System Wide Information Management Task Force (SWIM TF/8)

Proposal of Technical Memorandum of Cooperation (TMC) Document for ATM Information Exchange through SWIM – Malaysia (WP/02)

2.2. Malaysia presented the proposal to develop the SWIM Technical Memorandum of Cooperation (TMC) for ATM Information Exchange in response to Action Item SWIM/TF/SIPG/AI-05 from the SWIM Implementation Pioneer Ad-Hoc Group (SIPG) Meeting for potential inclusion in the APAC SWIM Implementation Guidance material. It was informed that, as the SWIM implementation is nearly similar to the AMHS/ATN implementation philosophy, the draft SWIM TMC clauses were drafted based on the AMHS/ATN TMC clauses. Malaysia added that as the technicality of SWIM implementation is very different compared to AMHS/ATN implementation, the test procedures specific to SWIM needed to be established to generate supporting information, which will be attached to the SWIM TMC document. It was suggested that the test procedures should be created independently from the SWIM TMC and should also become part of the ICAO APAC SWIM Implementation Guidance Document (ICAO APAC SWIM IGD).

2.3. Thailand supported the preparation of the draft TMC template. However, Thailand shared that, considering the current status of SWIM implementation within the region, it was still premature to adopt the use of TMC at this stage. It was also added that, based on Thailand's experience in implementing AMHS TMC, signing TMC is a critical and lengthy process and it should be executed once bilateral operations of information exchange over SWIM are ready.

2.4. New Zealand shared that there is a need to consult with the legal experts of respective States before adopting the TMC at the Meeting. The Meeting was informed that the document is only a template presented for further revision by SWIM TF. The finalised template will be part of the ICAO APAC SWIM IGD, which will then be presented for adoption by SWIM TF and, consequently, endorsement by CNS SG in the future. States/Administrations will have an opportunity to review and provide their feedback before such adoption and endorsement.

2.5. The Meeting noted needs raised by some States/Administrations for consultation with their respective legal experts and for discussion with their relevant stakeholders on the scope of the proposed TMC template, which covers the sharing of ATM information. Considering that these consultation and discussion processes take time, the Meeting thus agreed to defer consideration of the proposed Draft Decision to the **SWIM TF/9** Meeting to be held from **13-17 May 2024**.

Updates of APAC SWIM Technical Infrastructure Profiles – Japan (WP/03)

2.6. Japan, Task 2 Lead, presented the updated draft of the APAC SWIM Technical Infrastructure Profiles document incorporating comments received from SWIM TF task leads and members after the SWIM TF/7. The modifications done on the previous draft version presented at the SWIM TF/7 were highlighted and the future plans were also shared.

2.7. Singapore shared a list of comments on the draft APAC SWIM TI Profiles document. The Meeting reviewed and discussed each comment. Some of the comments required further deliberation among other related stakeholders and experts within States/Administrations. The Meeting agreed on the following action items to obtain feedback for additional modifications to the draft APAC SWIM TI Profiles document, if needed.

Action Item Reference No	**Reference to the draft APAC SWIM TI profile document**	**Action Item**	**Deadline**
ACTION ITEM 8-4	Table 3. Profile Package of SDCM Version 3.0.0	States/Administrations to review SDCM Version 3.0.0 and inform Task 2 Lead, Japan, of: • Comments/observations on the current draft content of this Table 3; and • Requirements for additional mandatory fields, if any.	**15 December 2023**
ACTION ITEM 8-5	Table 9. Message Capabilities Table 11. TI Management Capabilities	States/Administrations to provide Task 2 Lead with: • Feedback on whether "Persistence" should be included as part of Message Capabilities (Table 9) or TI Management Capabilities (Table 11) or both (Tables 9 and 11); • Comments on the description of "Persistence."	**15 December 2023**

2.8. The Meeting requested the ICAO Secretariat to share the revised document after the Task 2 Lead finishes revision work in December 2023, with the Task 5 group and SIPG of the SWIM TF as well as CRV OG for further deliberation.

2.9. In response to the clarifications about the term *limited capabilities of CRV*, Task 2 lead notified that the current available CRV subscription packages come with limited bandwidth and that there is a user type restriction to join CRV. ICAO Secretariat informed that CRV OG has already modified the definition of CRV users to include also others who are not ANSPs and that the non-ANSP users can join CRV following the procedure described in the CRV OG Operations Manual. PCCWG, the current CRV provider, shared that CRV has no bandwidth limitation. CRV users subscribing to any available packages can request more bandwidth at an additional cost based on their needs. The Meeting agreed to submit the request, through the ICAO Secretariat, to CRV OG to consider deliberating the enhancement of CRV bandwidth and the cost optimisation associated with supporting operational SWIM implementation over CRV.

Progress Update by S3TIG for the Joint Event of SWIM Demonstration over CRV and Surveillance Sharing in SWIM Trial – Hong Kong China (WP/06)

2.10. The paper presented the progress update of the joint event of SWIM Demonstration over CRV and Surveillance Data Sharing in the SWIM Trial (the Joint Event). The Meeting noted that the survey questionnaire prepared by SURSG/3 was shared with States by the ICAO APAC Office on 12 June 2023. A total of 16 questionnaire responses were received from 8 States to participate as surveillance data contributors and/or consumers, while 7 States were observers. A summary of the progress made between June and October 2023 in preparing for the Joint Event was also presented. It was highlighted that the surveillance data to be shared in the Joint Event will be mainly ADS-B data and the surveillance data payload will be in both ASTERIX and JSON formats. Additionally, the Meeting noted that to increase the appeal of the Joint Event and to promote SWIM, a self-service and purpose-built platform to support aviation community users is being explored for incorporation into the Joint Event, subject to availability and technical readiness. The Meeting was requested to provide input on future/potential SWIM services/applications for the Joint Event. Sri Lanka and Vietnam expressed interest in joining the Joint Event as observers.

Proposal of Regional Candidate Standard for Service Discovery - Governance Task (WP/07)

2.11. The paper proposed the SWIM Discovery Service (SDS) specification [https://discovery.swim.aero/] as a candidate standard for the APAC region. The paper suggested that, as APAC SWIM is also part of the ICAO's larger initiative, the global aspect of service discovery should be considered rather than a regional scope. The Meeting was requested to request the Information Management Panel (IMP) to consider adopting the SDS as a global standard for globally interoperable service discovery, ask the FAA to confirm the license agreement of the SDS specification document, and request SWIM TF to position the SDS specification as a candidate standard of APAC SWIM for adaptation and keep in the loop for updates to the specification. Reference information is explained at: https://discovery.swim.aero/IMP-WG_G11_APAC%20SDS_AJv1.pdf

2.12. After detailed deliberation on the need for global standards on SDS, the following **Draft Decision** was adopted by SWIM TF/8 for CNS SG/28 and APANPIRG/35 consideration:

<table>
<tr><td colspan="3">Draft Decision SWIM TF/08/01 IMP consider adoption of SWIM Discovery Service as a Global Standard for Globally Interoperable Service Discovery</td></tr>
<tr><td colspan="2">What: To propose to the Information Management Panel (IMP) to consider adopting the SWIM Discovery Service (SDS) as a global standard for globally interoperable service discovery.</td><td>Expected impact:
☒ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: Considering that Asia/Pacific regional SWIM will also be part of global SWIM and that SDS was studied and tested by the SWIM TF, the consideration of IMP on the possible adoption of SDS as a global standard is required to ensure cross-regional interoperability of SWIM service discovery,</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 5-Jul-24</td><td colspan="2">Status: Draft to be adopted by PIRG</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☒ICAO APAC RO ☒ICAO HQ ☒Other: SWIM TF</td></tr>
</table>

2.13. Considering the current job card of the IMP regarding SWIM Service Registry Interoperability, specifying 2026 as the expected timeline for deliverable, the Meeting requested the IMP members within Asia/Pacific to consider presenting the SDS to the respective working groups under IMP, i.e., Governance Working Group and Information/Services Working Group, for further deliberation.

2.14. After thorough discussion and careful consideration of the need to have a candidate baseline standard for SDS to support Asia/Pacific SWIM implementation within the 2024-2030 target implementation timeframe, the following **Draft Decision** was adopted by SWIM TF/8 for CNS SG/28 consideration:

<table>
<tr><td colspan="3">Draft Decision SWIM TF/08/02 Candidate Baseline SWIM Discovery Service Standard for Asia/Pacific</td></tr>
<tr><td colspan="2">What: To position the SWIM Discovery Service (SDS) specification as a candidate baseline standard for Asia/Pacific SWIM implementation.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: A candidate baseline standard for SDS is needed to support Asia/Pacific SWIM implementation within the regionally-agreed target implementation timeframe of 2024-2030.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 5-Jul-24</td><td colspan="2">Status: Draft to be adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: SWIM TF</td></tr>
</table>

2.15. The Meeting noted that once IMP adopts the SDS as a global standard for globally interoperable service discovery, there will be no requirement to request the FAA to confirm the license agreement of the SDS specification document.

Proposed Business Functionality of APAC Common Swim Information Services and the Information to be Exchanged – Hong Kong China (WP/08)

2.16. The paper presented the updates on the work of the SWIM TF Task 6 group to prepare the catalogue of basic data elements to be shared and exchanged via APAC SWIM and propose business functionality to be supported by APAC Common SWIM Information Services for addressing the operational needs in APAC. With suggestions on the additional potential list of information from the SWIM TF/7 meeting, the revised data catalogue was shared for further consideration by the Meeting, which included information to be exchanged via APAC Common SWIM Aeronautical Information Services, Flight Information Services, Meteorological information services, and Surveillance Information Services. Furthermore, the draft list of the business functionality of APAC Common SWIM Information Services was developed and introduced. The Meeting was requested to review the proposed data catalogue and the list of proposed business functionality of APAC Common SWIM Information Services and provide inputs and comments for further refinement.

2.17. The Meeting reviewed the data catalogue and suggested adding *filed trajectory* and *desired trajectory* to the data catalogue under Flight Information Services. Regarding business

functionality, the Meeting suggested adding *GUFI Service* to the initial APAC Common SWIM Information Services list. Additionally, it was recommended that the flight plan service be modified to the **FF-ICE Filing Service** to align with FF-ICE services as identified in ICAO FF-ICE provisions. The Meeting requested States/Administrations to provide suggestions on additional information, if any, that should be exchanged through APAC Common SWIM Information Services to Task 6.

2.18. The Meeting also agreed to review the list of proposed business functionality of APAC Common SWIM Information Services provided in the following Table and provide inputs and comments for further refinement by filling out the online voting for proposed APAC Common SWIM Information Services accessible via this link before 15 December 2023.

2.19. During the Meeting, a total of **26** responses to the online voting were received. The preliminary results of the received responses were shared by Hong Kong China with the Meeting. As the responses were only the initial ones, it was agreed that States/Administrations would share the link of online voting for proposed APAC Common SWIM Information Services with related experts within their States/Administrations to support the collection of a more comprehensive result to be used as an input for identifying and further refining the first version of APAC Common SWIM Information Services list. ICAO Secretariat shared State letter Ref.: T 8/13.1: AP163/23 (CNS) 17 November 2023 on Subject: Submission of Online voting for proposed APAC Common SWIM Information Services and their business functionality.

Update of the work done by the SWIM Implementation Pioneer Group – Singapore (WP/04)

2.20. The paper presented the work done by the SWIM Implementation Pioneer Ad-Hoc Group (SIPG) since the SWIM TF/7 Meeting in May 2023 to develop and deploy a prototype/initial version of the regional SWIM by June 2024. A work program and timeline were prepared, considering the timeline and objectives of the joint SWIM over CRV demonstration and the S3TIG Surveillance Sharing over SWIM trial. The Meeting noted that the work progress has not gone according to plan and urgent action is required to ensure that the goals of having a regional SWIM prototype by the SWIM TF/9 meeting as well as the SWIM infrastructure to support the joint event can be achieved. As such, it was proposed that the SIPG postpone some of the activities in the timeline to a later date and focus on the activities that directly contribute to the demonstration and trial so that the Q1/2024 target timeline of this joint event can be met. However, it also means that, to complete all the identified activities, the work of the SIPG will likely extend beyond the SWIM TF/9 meeting.

2.21. The Meeting deliberated the work programme and timeline presented in the paper and agreed to adopt a hierarchy approach for EMS architecture as presented in WP/05. The Meeting noted that, based on the received questionnaire responses as presented in WP/06, **nine States/Administrations**, including **Australia, China, Hong Kong China, Japan, India, Malaysia, the Republic of Korea, Singapore, and Thailand,** would provide EMS for the joint event.

2.22. The discussion on the selection of gateway EMS in the hierarchy approach was initiated and the following initial criteria for the selection of gateway EMS provider were formulated.

- Gateway EMS provider must already have a pseudo-CRV installed.
- Gateway EMS providers must have EMS ready for deployment.
- Gateway EMS provider must be able to configure their EMS to process message headers to be agreed upon.
- Gateway EMS providers must have the capability to support the message routing for edge EMS.

2.23. The Meeting agreed that the nine States above would assess their readiness against the criteria mentioned above and share their willingness to be gateway EMS providers to the ICAO Secretariat before 22 November 2023.

2.24. Based on the responses received, the EMS-to-EMS connection strategy will be discussed at the next SIPG/S3TIG meeting to be held via video teleconference on 27 November 2023. It was also agreed that the performance requirements for gateway EMS and edge EMS for the purpose of supporting the joint event will be deliberated at the next SIPG/S3TIG meeting.

2.25. The Meeting discussed and agreed on the following tasks, which were identified as high priority, together with the respective timelines.

Timeline	**Task**	**Task owners**
November 2023	EMS-EMS connection test over Pseudo CRV	India, Malaysia, ROK, Singapore, and Thailand
December 2023	Identify gateway EMS providers and edge EMS provider	SIPG/S3TIG
January 2024	Gateway EMS-Edge EMS connection test	All participating States/Administrations of the joint event
February 2024	Edge EMS-Edge EMS message test	All participating States/Administrations of the joint event
March 2024	Scenario test and dry run	All participating States/Administrations of the joint event

2.26. The Meeting suggested that SIPG/S3TIG may continue to work on developing message headers and metadata in parallel with conducting the November 2023-January 2024 tasks stated above. It was also agreed to review the status of the re-prioritised work on 22 December 2023 to finalise the date of the joint event to be hosted by Hong Kong China so that an invitation letter can be issued in advance to prepare the on-site joint event.

Proposal for detailed Enterprise Messaging Service architecture and its impact on the use of message headers – Japan, Singapore, and Thailand (WP/05)

2.27. The paper presented and described three proposals, i.e., a decentralised approach, a centralised approach, and a hierarchy approach, for a detailed EMS architecture. For each proposal, the need for the use of message headers and metadata for message routing was shared. Comparing the pros and cons of the decentralised approach, centralised approach, and hierarchy approach, the Meeting noted that the hierarchy approach avoids the issue of having a single point of failure present in the

centralised approach while at the same time avoiding the case of a very complex topology in the decentralised approach.

2.28. The Meeting discussed the similarities between the hierarchy approach and the BBIS/BIS architecture being followed in ATN in the APAC region. After a detailed discussion on the pros and cons of the proposed three approaches, the Meeting adopted the hierarchy approach for the detailed EMS architecture as the approach for APAC regional SWIM implementation. Additionally, as the hierarchy approach would require message headers to route messages, SIPG was requested to define the message header format and contents. It was also discussed that once SIPG delivers the message header format and contents, SWIM TF may consider proposing this message header deliverable and sharing lessons learned to the IMP for further consideration to develop a global deliverable to support the inter-regional message routing.

2.29. The Meeting encouraged States/Administrations to join the SIPG as it will be an excellent opportunity to learn from other group members and, in turn, will contribute to the implementation of SWIM in their respective States/Administrations. Moreover, increased participation will also allow for a broader range of views within the region to be obtained and addressed early on while the group builds a regional SWIM prototype. Sri Lanka and Vietnam shared the intention of joining the SIPG.

2.30. Japan and Malaysia shared the progress of SWIM implementation in their states.

Implementation Status of Surveillance Messaging Service for S3TIG Demonstration – ROK (IP/04)

2.31. The paper presented the Republic of Korea (ROK) implementation status of the surveillance messaging service for the S3TIG demonstration. The Meeting was informed that the ROK joined the S3TIG demonstration as an information service provider and will provide real-time surveillance (scenario #1) and MET information (scenario #2) during the demonstration. The latest implementation status to support scenarios for the S3TIG demonstration was also shared.

ICAO Meteorological Information Exchange Model (IWXXM)-Based MET Scenario for S3TIG Demonstration – ROK (IP/05)

2.32. The paper presented a proposed scenario for the IWXXM-based MET information exchange using the SWIM messaging service to be conducted during the S3TIG demonstration. The topology, defined messaging headers, payload, and examples of each MET information type of this scenario were explained in detail. SWIM TF Co-Chair suggested utilising the latest version of IWXXM, IWXXM version 2023-1, rather than IWXXM 2.0. In this regard, Hong Kong China shared that the information exchange model version to be supported by demonstration participants depends solely on the participant's decision. It was also added that demonstrating the use of different versions may be beneficial to showcase the interoperability.

Outcomes of the Ninth Meeting of the System Wide Information Management Task Force (SWIM TF/9)

Election of Co-Chair

2.33. Nominated by Singapore and seconded by USA, Dr Amornrat Jirattigalachote, Strategic Planning Manager (Engineering), Policy and Strategy Management Bureau of AEROTHAI, was re-elected as a Co-Chair of SWIM TF.

Review of Relevant Meetings – Sec (WP/02)

2.34. The paper summarised relevant information and updates highlighting the outcomes of the Thirty-Fourth Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/34), the Twenty-Seventh Meeting of Communications, Navigation, and Surveillance Sub Group (CNS SG/27), the Third Meeting of the Surveillance Study Group (SURSG/3), the Seventh and Eighth Meeting of the APAC SWIM Task Force (SWIM TF/7 and SWIM TF/8) and the Eighth Meeting of the Surveillance Implementation Coordination Group (SURICG/8).

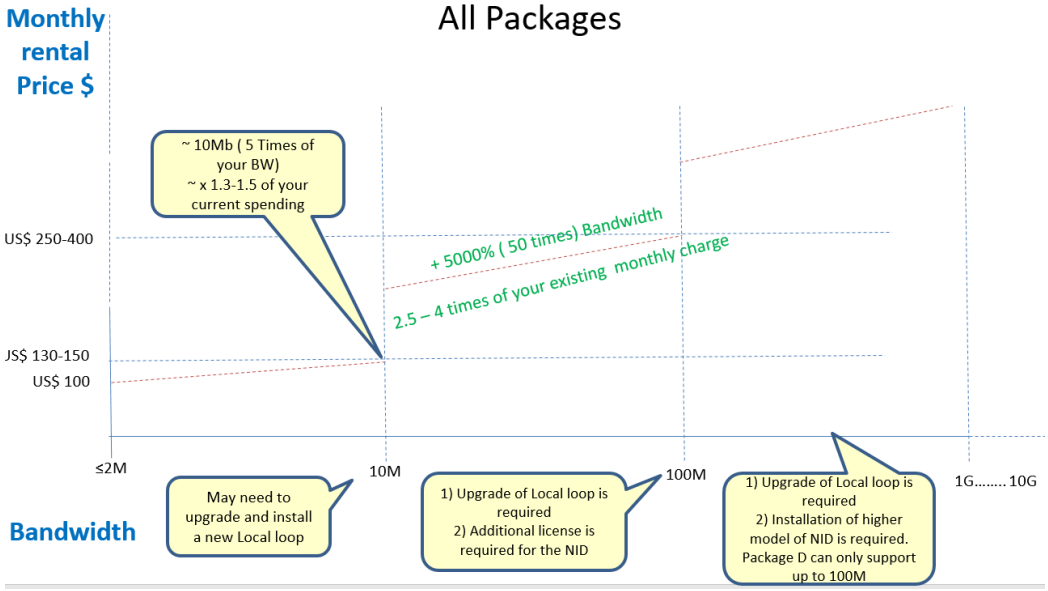
2.35. Regarding ICAO Secretariat Action Item 7-12, *"the SWIM TF/7 Meeting discussed the utilisation of Mode S DAPs in developing an integrated SWIM service incorporating MET information derived from Mode S DAPs. It was informed that the detailed consideration on exchanging MET information derived from Mode S DAPs through IWXXM should be done in consultation with MET SG (MET/IE WG). ICAO Secretariat will coordinate with the Secretariat of MET SG (MET/IE WG) to explore options on this matter,"* ICAO Secretariat suggested that SWIM TF representatives should present a paper on this topic in MET/IE WG as the available information in the working paper is insufficient for ICAO Secretariat to share details to another contributory body, explain the issues, and participate in further discussion.

2.36. The meeting discussed under WP/16 the potential inclusion of **MET information derived from Mode S DAPs** in the **APAC Common SWIM Meteorological Information Services** list. However, as Mode S DAPS are considered a source of MET data, the Meeting suggested that further discussion in relevant MET groups is required to determine the justifiability of including this information service in the APAC Common MET Information Services list.

Outcomes of ACSICG/11 Meeting – Sec (WP/03)

2.37. The paper summarised relevant information and updates on the outcomes of the Aeronautical Communication Services (ACS) Implementation Coordination Group (ACSICG/11) held at ICAO APAC Regional Office, Bangkok, Thailand, from *19 to 22 March 2024*, including outcomes of the Twelfth Meeting of the Common aeRonautical Virtual Private Network Operations Group of APANPIRG (CRV OG/12) held from 23 to 26 January 2024 in Denarau Island, Fiji. It was noted that the CRV OG Ad-hoc Expert group is developing the process for testing new SWIM services and the steps required to add a new service to the CRV.

2.38. The Meeting noted that SWIM TF/8 requested CRV OG to consider deliberation on enhancing CRV bandwidth and the associated cost optimisation to support operational SWIM implementation. It was informed that in the CRV OG/12 meeting, PCCWG shared that bandwidth up to 2MB was quoted in the tender in 2015 to suit the initial requirement to build the CRV network. Other than the 2MB options mentioned in the PCCWG price book, more pricing and bandwidth options can be provided for States/Administrations' consideration on request. As a rule of thumb, PCCWG presented the following diagram, clarifying the bandwidth upgrade cost concept. The CRV OG/12 meeting requested that Member States/Administrations review the CRV bandwidth requirement and estimate the cost based on the conceptual diagram provided in the figure. States/Administrations may contact PCCWG directly for further commercial discussion as needed. With this proposal, the request shared by SWIM TF/8 to CRV OG for considering deliberation on enhancement CRV bandwidth and the associated cost optimisation to support operational SWIM implementation is considered completed.



2.39. The Meeting was informed about the new CRV contract management process and a workshop to be hosted by USA in Guam, USA, from 17-20 September 2024. The workshop's objectives would be for SWIM and CRV experts to review the outcomes of the joint SWIM-over-CRV Demonstration and Surveillance Sharing in SWIM Technical Trial (the joint event) to be held in Hong Kong China on 28-29 May 2024, analyse CRV performance and other crucial information to finalise the list of requirements and other technical specifications for the new CRV contract management process.

Outcomes of the Ninth Meeting of the Surveillance Implementation Coordination Group (SURICG/9) and updates on the fourth Meeting of Surveillance Study Group (SURSG) – Sec (WP/04)

2.40. The Ninth Meeting of the Surveillance Implementation Coordination Group (SURICG/9) was held at the ICAO APAC Regional Office, Bangkok, Thailand, from 7-10 May 2024. The meeting report, working papers, information papers, and other resources can be accessed via the following link:

https://www.icao.int/APAC/Meetings/Pages/2024-SURICG-9.aspx

2.41. The Fourth Meeting of the Surveillance Study Group (SURSG/4) is planned to be held in Hong Kong China, as an in-person meeting from 30 to 31 May 2024 after the joint event planned to be held from 28-29 May 2024 in Hong Kong China. The meeting report, working papers, information papers, and other resources can be accessed via the link: https://www.icao.int/APAC/Meetings/Pages/2024-SURSG-4.aspx

2.42. The Meeting was informed that, as per the current plan, most deliverables except one *Guidance material for the sharing and access of surveillance data* allocated to SURSG have been completed and most objectives have been achieved. It is planned that the proposal to dissolve the SURSG will be discussed at the SURSG/4 meeting if the joint event is successful and after the completion of the remaining deliverables. If SURSG/4 concludes the dissolution of SURSG, the decision will seek the endorsement of SURICG and then CNS SG accordingly next year.

Outcomes of SWIM TF Task Leads (TLs) Meetings and Joint CRV OG Ad-hoc Expert Group and SWIM TF TLs Meetings after SWIM TF/7 – Sec (WP/08)

2.43. The paper presented outcomes of SWIM TF TLs Meetings and Joint CRV OG Ad-hoc Expert Group and SWIM TF TLs Meetings after SWIM TF/7.

Outcomes of ATFM SG/14 Meetings – WP/20

2.44. The paper provided updates on the fourteenth meeting of the Asia/Pacific Air Traffic Flow Management Steering Group (ATFM/SG/14) held in Bangkok, Thailand, from 22 to 26 April 2024. The meeting noted that the APANPIRG/34 adopted FIXM version v4.2 with APAC extension in December 2023 after a nearly one-year formal recommendation-and-adoption process. During this period, the FIXM Change Control Board (CCB) also released FIXM Core v4.3.0 to support the FF-ICE/R1 requirements identified by the ICAO ATM Requirements and Performance Panel (ATMRPP).

2.45. During the ATFM/SG/14 meeting, it was agreed to establish a standard FIXM version for exchanging cross-border information between operational ATFM systems in the Asia/Pacific region. It was recognised that implementing a new system could be a time-consuming process, and changing the version during the implementation phase would only add complexity. The meeting was informed that a process for version change is needed to provide a platform for ANSPs to implement the capability to discuss their concerns regarding the change.

2.46. It was informed that the ongoing ATFM-on-SWIM trial has revealed that many ANSPs are still working towards implementing the ATFM system to be SWIM capable. However, the ATFM data exchange in FIXM via SWIM has yet to be operationalised. In light of this, the ATFM/SG/14 agreed that FIXM v4.3 be formalised as the agreed version for Cross-Border ATFM operations in the Asia/Pacific region from Q3/2026 as FIXM 4.3 could support the FF-ICE/R1 implementation, as recognised by the ICAO ATMRPP. Furthermore, the two-year period would provide ANSPs sufficient time to transition the ATFM-on-SWIM trial into an operational environment and implement any necessary changes. This generous transition period would ensure the new system's smooth and successful adoption, reassuring the ANSPs.

2.47. The Meeting was informed that the FIXM v4.1 with APAC Extension was chosen for the ATFM-on-SWIM trial. Considering significant effort was put into preparing for the trial, the ATFM/SG/14 agreed to use this version until Q2/2025. While recognising the need to adapt to a newer version, the ATFM/SG/14 decided to revise the version used for the trial from FIXM v4.1 to FIXM v4.3 from Q2/2025 onwards.

2.48. The Meeting noted that the ATFM/SG/14 agreed to establish a change process for revising the common FIXM version to support the information exchange among operational ATFM systems and the ATFM-on-SWIM trial. It was decided at the ATFM/SG/14 that, while a change process is required, it should not be too complex nor administrative intensive to avoid adding unnecessary steps for operational implementation. The ATFM/SG/14 will further develop this process, which starts with the preliminary step that States or Collaboration Bodies propose changes to ATFM/SG for further coordination with SWIM TF.

2.49. The Meeting requested ATFM SG to formulate the detailed change process to revise a commonly agreed FIXM version for the cross-border ATFM-related information exchange and share it with the SWIM TF/10 meeting next year for further deliberations.

2.50. The Meeting was informed that ATFM/SG/14 agreed that FIXM v4.3 should be formalised as an agreed-upon version to support information exchange between operational ATFM

systems. The draft conclusion ***Draft Conclusion ATFM/SG/14-01 – Asia/Pacific Regional FIXM 4.3*** was presented to SWIM TF. The SWIM TF/9 meeting provided support to the draft conclusion for further adoption by ATM SG/12**.**

2.51. The Meeting agreed that Task 4 leads, along with contributors, will evaluate FIXM v4.3's suitability to support ATFM, A-CDM, and integrated ATFM/A-CDM operations. Based on the outcomes of the analysis, a FIXM v4.3 extension may be proposed for consideration by the next meetings of ATFM SG and SWIM TF.

2.52. In response to a question regarding the stability of the information exchange model version, the Meeting noted that ATMRPP does not foresee further major changes in the proposed FIXM v4.3 for the next few years. Therefore, FIXM v4.3, along with a potential FIXM v4.3 extension, may be considered a stable information exchange format till the release of FF-ICE/R2. The Meeting also noted that, as per the Asia/Pacific Seamless ANS Plan v3.0, ATM systems should be supported by aeronautical information digital data exchange of, at a minimum, version AIXM 5.1. For IWXXM, the MET IE/WG Chair shared the following compatibility table showing IWXXM versions, associated report packages, and relevant ICAO Annex 3 requirements. The Meeting was also informed that the latest version of the compatibility table maintained by WMO can be accessed via https://github.com/wmo-im/iwxxm/wiki/Package-Compatibility

IWXXM Version	METAR/ SPECI	TAF	SIGMET	AIRMET	TCA	VAA	SWA	WAFS SIGWX F/C	VONA	QVA	Requirements
1.1	1.1.0	1.1.0	1.1.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Am76
2.1	2.1.1	2.1.1	2.1.1	2.1.1	2.1.1	2.1.1	N/A	N/A	N/A	N/A	Am77
3.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	3.0.0	N/A	N/A	N/A	Am78
2021-2	3.1.0	3.0.1	4.0.0	3.1.0	3.1.0	3.1.0	3.0.1	1.0.0	N/A	N/A	Am79 + Am80
2023-1	3.1.0	3.0.1	4.0.1	3.1.1	3.1.0	3.1.0	3.0.1	1.1.0	N/A	N/A	Am79 + Am80
2025-2	3.2.0	3.0.1	4.0.1	3.1.1	3.1.0	3.2.0	3.1.0	1.1.1	1.0.0	1.0.0	Am82

2.53. The Meeting noted that further discussion on AIXM 5.1 may be held in the Nineteenth Meeting of the ICAO Aeronautical Information Services − Aeronautical Information Management Implementation Task Force (AAITF/19) to be held from 10-13 June 2024 in the ICAO APAC Office. Further relevant updates, if any, will be provided by the ICAO Secretariat in the next SWIM TF meeting.

2.54. The Meeting discussed the possibility of including the latest applicable versions of AIXM, FIXM, and IWXXM in the common APAC information services list. However, during discussion under WP/16, it was concluded that the appropriate bodies to discuss and agree on this matter are ICAO AAITF, FF-ICE Ad-hoc Group and MET/IE WG. The Meeting agreed to propose to these contributory bodies to consider making a decision on the applicable version of information exchange models during a review of relevant common APAC SWIM Information Services to be submitted to them by SWIM TF.

Outcomes from ICAO APAC MET related Meetings – Sec (IP/05)

2.55. The paper presented a summary of outcomes of MET-related matters after the SWIM TF/8 meeting, including APANPIRG/34 and MET/IE WG/22 discussions on SWIM (including IWXXM)-related substances. The Meeting noted that additional updates on MET-SWIM Information Services discussions are provided in IP/07 of the SWIM TF/9 meeting.

Progress Update for the Joint Event – Hong Kong China (WP/05)

2.56. Hong Kong China shared that, with the consolidated effort made by SWIM TF and SURSG, the SWIM Demonstration over CRV and surveillance data sharing in the SWIM trial ('the Joint Event') will be held in Hong Kong China from 28-29 May 2024. The Joint Event will mainly consist of scenario-based demonstrations, including ATFM, surveillance data sharing, FF-ICE and MET. The Meeting was informed about the tasks completed, ongoing tasks, and items to be followed up after the Joint Event. The Meeting noted that, after completing the Joint Event, the current system setup will be accessible for 1-month until the end of June 2024 for participants to appreciate the SWIM environment and system HMI.

Comments on Draft TMC (Final) – New Zealand (WP/06)

2.57. New Zealand shared comments on the *draft Technical Memorandum of Cooperation (TMC) document for ATM Information Exchange through SWIM,* a guidance document that can be used as a template for discussion between ANSPs, in response to the SWIM TF/8 meeting Action Item 8-2 to provide feedback on draft TMC to ICAO by February 2024. The Meeting noted with appreciation that Malaysia had taken the time to draft the TMC to assist States in bilateral cooperation/agreement for ATM Information Exchange through SWIM.

2.58. New Zealand referred to Paragraph 10, section 10.1 of the draft TMC and suggested that a more structured dispute resolution clause may be required to help prevent prolonged disputes between States/Administrations, including the proposed number of days (which can be amended to suit each State/Administration). The suggested text was shown in clause 10 in the proposed version of the amended draft TMC.

2.59. In reference to Paragraph 11, section 11.1, New Zealand informed that there may be laws in countries that require an organisation to provide notification of a release/dissemination of documentation on specific information. Therefore, New Zealand proposed adding a sentence that explicitly allows for the release of the information 'where required by law' even without consent from the other State/Administration. Consideration of how the other State/Administration was informed of the 'released information' can be captured in the individual agreement, depending on the legal environment in each State. The suggested text was shown in clause 11 in the proposed version of the amended draft TMC attached.

2.60. The Meeting was informed that Paragraph 13, section 13.2 of TMC suggested a binding nature. New Zealand requested clarification of which legal jurisdiction would apply to these governing / binding paragraphs, given that original Paragraph 10 refers to no recourse to courts. It was informed that the intention is for the TMC to be a guidance document in which States/Administrations can make amendments to support the bilateral agreement. Therefore, the Meeting may not need to adopt this document. Additionally, New Zealand shared that there may be further changes to the draft TMC after the joint event scheduled for 28-29 May 2024. Thus, it was proposed that the finalisation of the TMC can be discussed at the next SWIM meeting.

2.61. The Meeting reviewed the draft TMC incorporated with New Zealand's comments. It was agreed that the SWIM TF/9 participants would share the latest revision of TMC with respective legal experts for comments and observations. Considering that this consultation process takes time, the meeting agreed to defer consideration of the proposed **Draft Decision: - *SWIM Technical Memorandum of Cooperation Document*** in the SWIM TF/8 meeting to the SWIM TF/10 meeting to be held in May 2025. To achieve this target, the meeting requested all States/Administrations to deliberate among their related stakeholders and provide feedback on the draft TMC template document to the ICAO Secretariat by February 2025.

Revision of APAC SWIM Technical Infrastructure Profiles – Task 2 Lead (WP/09)

2.62. The draft version of APAC SWIM Technical Infrastructure Profiles, reviewed at the SWIM TF/8, was further discussed in the Meeting. The document was further modified by the Meeting to incorporate different comments, including the addition of a Preface noting that the document is still a work in progress as several sections within it are continuing to mature. There was significant debate about the most appropriate SWIM architecture for the APAC region and agreed that the APAC SWIM TI Profile document would be less specific until consensus is reached.

2.63. Considering the benefits of making the draft document available for States/Administrations to refer to as guidance to assist in their SWIM development and implementation, the Meeting agreed to present the revised draft of APAC SWIM Technical Infrastructure Profiles, provided in **Appendix A** for consideration by CNS SG/28 through the following Draft Decision. After CNS SG/28's adoption of the proposed Draft Decision, the document will be uploaded to the ICAO APAC e-docs portal.

<table>
<tr><td colspan="3">Draft Decision SWIM TF/09/01 – Draft APAC SWIM Technical Infrastructure Profiles v1.0</td></tr>
<tr><td colspan="2">What: The draft APAC SWIM Technical Infrastructure Profiles v1.0 be adopted as a living document for immediate use by APAC States/Administrations.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To assist APAC States/Administrations in their SWIM development and implementation, guidance specific to the operational environment within APAC is required. The draft APAC SWIM Technical Infrastructure Profiles v1.0 is matured enough to be immediately used by APAC States/Administration.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 5-Jul-24</td><td colspan="2">Status: Draft to be adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: SWIM TF</td></tr>
</table>

2.64. The meeting agreed to provide the draft document to the related Task groups under SWIM TF, CRV OG, and ACSICG for further reference and observations.

SWIM Implementation Pioneer Group Progress Report – Singapore (WP/13)

2.65. Singapore shared a summary of the work that the SWIM Implementation Pioneer Ad-hoc Group (SIPG) has done to progress the implementation of an Asia/Pacific SWIM since the eighth meeting of the SWIM Task Force. The Meeting recalled that the SIPG was formed at the 7th Meeting of the SWIM Task Force (SWIM TF/7). The first deliverable of the SIPG was to build a SWIM Technical Infrastructure prototype according to the architecture as decided by the SWIM task force using the CRV as the IP-based network.

2.66. The Meeting noted that SIPG used the SWIM over CRV Demonstration and Surveillance Sharing in the SWIM Technical Trial, the joint event, as the target for constructing the APAC SWIM

prototype. To achieve this goal, the SIPG held a total of 12 virtual meetings before the SWIM TF/9. After deliberating over several options to identify the appropriate SWIM architecture for the joint event, the SIPG adopted a hierarchical SWIM architecture, considering that it would fit into the model decided at the SWIM Task Force level due to its best compromise between connectivity and simplicity.

2.67. To facilitate message transmission within this architecture, the Meeting was informed that it was necessary to use metadata to route messages, especially between edge EMS (Enterprise Messaging Service) of different sub-communities. To this end, the SIPG developed a set of metadata for routing messages during the Joint Event. The Meeting was informed that, after the joint event, the SIPG will need to carry on its work post-event to document the lessons learned from the setup and operation of this hierarchical SWIM architecture. There was a need to measure the amount of bandwidth used during the demonstration and trial, from which the potential bandwidth needed to support an operational Asia/Pacific SWIM will be estimated. The SIPG will also study the strengths and weaknesses of the implemented SWIM architecture. There may be a need to explore different SWIM architectures and further trials may be proposed. The Meeting was informed that the SIPG may expand its work to interconnect the registries within the SWIM architecture implemented.

2.68. The Meeting noted that the ICAO Trust Framework Panel has produced some guidance material for trusted message exchange. The guidance material references the Public Key Infrastructure (PKI) and the use of certificates to protect the messages being transferred. The SIPG plans to study this material and implement a version of it in the SWIM architecture. The SIPG will also investigate the identified common SWIM information services that could be implemented. It was highlighted to the Meeting that it is essential to specify use cases to support the implementation of the services.

2.69. Additionally, the Meeting was informed that, as the SWIM architecture continues to evolve, other States and parties may want to be onboarded as an edge EMS or gateway EMS in the architecture. Part of the continuing work of the SIPG would be to aid these States and parties in completing the onboarding and help confirm the connection and message routing. The SIPG will also look to other APANPIRG contributory bodies working on topics closely related to SWIM, e.g. FF-ICE and TBO, for collaboration opportunities.

2.70. The meeting discussed the SIPG's proposed work plan as presented in WP/13, taking into account also the information provided in WP/10 and IP/02. The meeting agreed that SIPG should include the suggestions presented in WP/10 and IP/02 in its work plan for the next 12 months. The revised work plan of SIPG, together with the activity priority, will be further discussed at SIPG's monthly meeting in June 2024. Furthermore, the Meeting noted that the SIPG meeting would be held on the last Monday of each month and encouraged States/Administrations to consider joining the SIPG.

Consideration on Guaranteed Message Delivery for Regional SWIM Architecture – ROK (WP/10)

2.71. ROK presented a consideration on guaranteed-message delivery in regional SWIM architecture (i.e. hierarchical architecture) and introduced vulnerabilities that possibly break guaranteed message delivery in this architecture as well as considerations to ensure reliable and guaranteed message delivery.

2.72. The Meeting recalled that, at the SWIM TF/8 meeting in 2023, a hierarchical architecture was proposed to avoid the issue of having a single point of failure presented in the centralised approach while at the same time avoiding the case of a very complex topology in the decentralised approach. To support message exchange in that architecture, SIPG was requested to define

the message header format and contents. ROK also informed that the hierarchical architecture is an implementation of edge or fog computing, and through it, this could enable efficient usage of bandwidth on a CRV network and prevent the propagation of failures. However, potential architectural vulnerabilities have been identified (e.g. guaranteed message delivery failure due to improper failover or message handling during the partitioning phase) during the implementation of the hierarchical architecture. These vulnerabilities could impair reliable messaging (i.e. provide support for various types of guarantees for message delivery), a core capability defined in the SWIM ConOps (Doc 10039).

2.73. Moreover, ROK shared that guaranteed message delivery is a capability commonly provided by Commercial, off-the-shelf (COTs) or Open Source (OS) message brokers. Still, in a hierarchical architecture in the APAC region, this is not applicable as it does not force the use of a specific message broker. In the practical implementation of the architecture, States in SIPG adopt the use of heterogeneous message brokers. Substantial architectural vulnerabilities identified during the implementation of the hierarchical architecture in terms of guaranteed message delivery were shared with the Meeting. The list of vulnerabilities identified were:

- Priority messaging is not possible depending on the importance of the information;
- Guaranteed message delivery is destroyed when malfunctioning of a message broker occurs in the message delivery chain;
- Compensation transactions cannot be performed to compensate for transaction failure in the message delivery chain;
- Detouring cannot be performed if a failure occurs in the message delivery chain; and
- The edge node does not know which message to resend when message loss occurs.

2.74. Potential resolutions were shared for each vulnerability. ROK concluded that implementing the hierarchical architecture in the APAC SWIM presents promising opportunities for enhancing efficiency and reliability in message delivery. However, adopting a hierarchical architecture with heterogeneous message brokers could introduce certain vulnerabilities, especially concerning guaranteed message delivery. Given the critical nature of SWIM operations and the need for reliable messaging to address these vulnerabilities effectively to ensure guaranteed message delivery within the hierarchical architecture, the list of considerations was suggested:

(1) Standardise common logic or process for message handling;
(2) Design failover mechanisms and redundancy both in technical and business aspects;
(3) Design common monitoring and notification mechanisms;
(4) Identify abnormal use-case and conduct testing and validation; and
(5) Conduct collaborative efforts and knowledge sharing;

2.75. The Meeting appreciated ROK's effort in listing vulnerabilities and possible solutions and deliberated on the proposed considerations in various aspects, including standard and governance, to ensure transparency in message delivery. Additionally, the Meeting suggested that message type and message usage should be considered when identifying that it would require guaranteed message delivery so as not to cause performance issues. It was concluded that technical solutions to address these vulnerabilities would have to be supported by strong governance and standardisation when implemented and should be captured accordingly.

2.76. It was discussed that SIPG would consider the information provided in WP/10 on the guaranteed message delivery for regional SWIM architecture. The Meeting agreed to incorporate

suggestions outlined in this WP/10 in the work program of SIPG. (action consolidated in ACTION ITEM 9-9 as shown in para 4.18)

2.77. The meeting encouraged other Member States/Administrations to analyse the issues faced during the joint event preparation and document lessons learned. It was suggested that, after the SIPG task is completed, all compiled lessons learned by SIPG can be shared with other contributory bodies at both regional and global levels to support global SWIM implementation.

Lesson learned and suggestions for SWIM Implementation Pioneer Group – China (IP/02)

2.78. China presented the summary of China's participation in the implementation of SIPG and suggestions for the subsequent work ideas and plans of SIPG. China informed that to better support the continuous and stable implementation of SIPG, China has completed the development and deployment of monitoring software for SWIM message exchange and carried out research and development on SWIM Discovery Service (SDS). Based on the experience gained from participation in SIPG, China presented three suggestions regarding the SWIM Service Registry, the SWIM Discovery Service (SDS), and Information Services Implementation for the subsequent work of SIPG.

2.79. The Meeting was reminded that the Interoperable Registry Model was the proposed model for the APAC region. Based on China's completion of the SWIM Service Registry development and deployment, China shared willingness to cooperate with SIPG to carry out the experimental work on the SWIM Service Registry to reduce documentation work required for the registration and discovery of Information Services and to further enhance the work efficiency.

2.80. With the adaptation and improvement of SDS jointly researched by USA/FAA, Korea/KAC, China/ATMB, and Japan/ENRI, China shared a willingness to participate in SDS's implementation and experimental work in SIPG. Regarding the implementation method of SDS, China presented that one consideration was to combine the existing hierarchical approach of SIPG EMS and deploy the SDS at each EMS node, where the Gateway EMS was responsible for responding and forwarding the SDS requests while the Edge EMS was responsible for responding to the SDS requests.

2.81. To continuously promote the establishment of the prototype of the regional SWIM, China suggested continuing to sustain the SWIM architecture and strengthen the sharing and coordination with the newly established FF-ICE Ad-hoc Group and other working groups. Additionally, China suggested further research on application scenarios and use cases of regional Information Services, a list of regional Common Information Services, the unified standards of regional Common Information Services, the Service Level Agreement (SLA) and Quality of Service (QoS) of regional Common Information Services.

2.82. The Meeting was informed that the Service Level Agreement (SLA) and Quality of Service (QoS) of regional Common Information Services are outside the scope of SIPG. It was suggested that SLA and QoS be considered under Task 5 and Task 6, respectively.

Updates from Editorial Task Ad-hoc Group – SP/01

2.83. The Editorial Task Ad-hoc Group recalled the priority of topics discussed and agreed to be addressed in the APAC Regional SWIM Implementation Guidance Document (IGD) at SWIM TF/7 and SWIM TF/8, including:

- SWIM TI specifications;

- Information exchange models;
- Registry model;
- Service specifications.

2.84. The meeting was informed about the current work status on the prioritised topics at SWIM TF and ICAO panels while preparing the IGD. Considering the SWIM-related maturing specifications and technologies, the time required to process the ICAO regional document, and the upcoming ICAO Doc 10203 Manual on SWIM Implementation planned to be published in Q3/2024, two options for way forward for IGD drafting were proposed. Namely, the first option was to fix versions/specifications of relevant SWIM components and continue drafting the IGD. The second option was to develop an online repository that would be modified with evolving versions/specifications.

2.85. The Meeting agreed that the second option was the most appropriate. It was suggested that, while preparing a graphical tree of topics to be included as the IGD, with relevant links on an online repository portal, different versions should be tracked. The tool to be used for online repository, repository host, and management of repository users will be discussed at future meetings of the Editorial Task Ad-hoc Group. The group may propose a draft decision to SWIM TF/10 for publication of the repository if ready. Additionally, it was shared that SWIM TF may wish to obtain the authority from CNS SG to update the online repository to timely update the repository with the latest information.

2.86. The Meeting requested the ICAO Secretariat to explore the possibility of hosting the online repository on the ICAO Secure Portal or in another platform such as Sharepoint. ICAO Secretariat informed about the resource constraints for hosting and managing the portal. However, the ICAO Secretariat agreed to explore the option and share information about the possibility of hosting and managing by ICAO after consultation with ICAO HQ.

SIPG Breakout Session

2.87. The SIPG breakout session planned for day four could not be conducted due to extensive discussion held during the review of the APAC SWIM TI Profiles document and APAC Common SWIM Information Services document.

Leveraging DNS for robust APAC SWIM Implementation – Indonesia (WP/17)

2.88. The paper explored the critical role of Domain Name System (DNS) in facilitating seamless information exchange and data sharing to obtain a robust and efficient DNS within the SWIM ecosystem. The Meeting was informed that a critical component of SWIM is the designation of Service Addresses (SAs) that uniquely identify information providers and consumers within the network. The DNS is pivotal in resolving these SAs into their corresponding Internet Protocol (IP) addresses, ensuring efficient data routing and access.

2.89. The Meeting was informed that service end-point addresses could be expressed in a human-readable format using SAs instead of complex IP addresses by leveraging DNS. This simplifies user interaction and reduces the risk of errors. SAs can be structured to be inherently informative, incorporating elements that convey the type of service or organisation they represent. Additionally, within the SA, the service provided can be further specified. DNS allows for the use of domain naming conventions to categorise service addresses. This enables users and systems to quickly identify the type of service based on the domain name. Lastly, DNS facilitates the dynamic update of service end-point addresses without requiring changes to all consumer or subscriber systems. This simplifies service maintenance and avoids potential disruptions caused by outdated address information.

2.90. The Meeting noted that the ICAO Information Management Panel (IMP) was deliberating on the use of a Uniform Resource Identifier (URI) to identify information services. It was suggested to defer the discussion on DNS till the outcomes of the IMP discussion are available. Ms. Cropf, SWIM TF Co-Chair, will coordinate with IMP experts and provide updates to the future SWIM TF meeting about the progress of the URI discussion.

Updates on FIXM 4.2 Extension – Thailand and USA (WP/18)

2.91. Thailand and the USA presented the APAC FIXM version 4.2 Extension analysis results of the FIXM Development Team under the FIXM Change Control Board (CCB). Recommendations and feedback provided by the FIXM Development Team as well as the next steps to improve the Extension for the next version, were also discussed.

2.92. The Meeting was informed that it was specified in the Asia/Pacific Regional Framework for Collaborative Air Traffic Flow Management (ATFM), version 4 (October 2022), developed by the Asia/Pacific ATFM Steering Group (ATFM SG) that FIXM version 4.2 (or later), extended where necessary to accommodate additional requirements, was the agreed ATFM information exchange model for exchanging ATFM data between ATFM systems in the region. Based on the operational requirements obtained from ATFM SG and the scenarios developed for the Multi-Regional TBO (Trajectory-Based Operation) Demonstration, a set of data attributes was derived and examined against FIXM version 4.2 Core. With the finding that the data fields identified as necessary to support the requirements and the conduct of the Multi-Regional TBO Demonstration scenarios were not included in FIXM version 4.2 Core, the FIXM version 4.2 Extension was developed to include these data fields.

2.93. In December 2023, the FIXM version 4.2 Extension was adopted by APANPIRG/34 (Conclusion APANPIRG/34/9) to be the Asia/Pacific (APAC) FIXM version 4.2 Extension for use by Asia/Pacific States/Administrations to support the cross-border ATFM information exchange and the ATFM/A-CDM integration. This APAC FIXM Extension was also uploaded to the ICAO Asia/Pacific Regional Office website. Moreover, the Extension was forwarded to the FIXM CCB for review before publishing on the FIXM official website for use by other stakeholders.

2.94. A review of the APAC FIXM version 4.2 Extension was completed by the FIXM Development Team of the FIXM CCB in March 2024. The analysis resulted in several optional recommendations for data modelling and technical considerations. The FIXM Development Team's detailed recommendations and feedback ranked by priority, together with the discussion between the FIXM Development Team and the Extension Development Team, were shared with the Meeting. The Meeting noted that, for some recommendations, such as modelling design decisions, additional coordination between the FIXM Development Team and the Extension Development Team may be required.

2.95. The Meeting was also informed that the review resulted in no immediate required changes for the APAC Extension, and it will be presented to the FIXM CCB to raise awareness among members. Several items identified by the FIXM Development Team will be considered for improvement in the next extension version. Additionally, the teams will coordinate further to address several areas specified, including conceptual areas such as the usage of the actual trajectory as well as technical considerations of modelling decisions. In particular, the teams will continue to discuss the usage of the actual trajectory data elements. Based on the outcome of coordination so far, these elements could be recommended as a candidate for inclusion in the next version of FIXM Core. For technical-

related matters, the teams will continue coordinating to determine the most appropriate modelling to accomplish the use cases intended for the APAC Extension. Any changes would be targeted for the FIXM version 4.3 update to the Extension.

2.96. The Meeting noted that FIXM CCB met on 16 May 2024 during the ongoing SWIM TF/9 and the feedback on the analysis results of the FIXM Development Team was presented by Thailand and USA to the FIXM CCB. Based on the meeting results with the FIXM CCB on 16 May 2024, additional coordination is required. The meeting between the FIXM Development Team, the Extension Development Team, and the FIXM CCB was planned to be held to discuss observations from the FIXM CCB and then the APAC FIXM version 4.2 Extension will be considered for publication on the FIXM official website. Since no immediate required changes are needed, actions recommended by Conclusion APANPIRG/34/9 to forward the APAC FIXM version 4.2 extension to the FIXM CCB for review before publishing on the FIXM official website are considered completed.

SWIM Discovery Service Jump Starter Kit – ROK (WP/12)

2.97. ROK introduced the SWIM Discovery Service (SDS) Jump Starter Kit, which was developed by the ROK and aligned with the SDS specification v1.0 to contribute to a better understanding of and implementation of the SDS in the APAC region. ROK informed that the SDS is a web service that enables the exchange of metadata for a SWIM information service between independently managed SWIM programs. The SDS implementation specification v1.0.0 developed by the FAA addressed this need by defining a standard mechanism for exchanging service description information or metadata. It specified a web services interface, key interaction patterns, schemas, and message exchange formats required to exchange service metadata.

2.98. The Meeting was informed that the SDS Jump Starter Kit followed the Massachusetts Institute of Technology (MIT) license with permission, which is a permissive open-source software license. The Meeting noted that the SDS Jump Starter Kit is the implementation of the SDS specification v1.0 written in Typescript and operated in the NodeJS environment in the NestJS framework. It was added that the SDS Jump Starter Kit includes sample data in JSON format, and a user could modify sample data located in [/src/smxs/sample] directory. A user who wishes to use their own database could uncomment sample codes which bind and query to the database using GraphQL. The Meeting also noted that a database is not included in the SDS Jump Starter Kit, and a user needs to build their own database and configure the GraphQL server. In addition, ROK informed that the SDS Jump Starter Kit is available on GitHub (https://github.com/Korea-Airports-Corporation/SWIM-Discovery-Service-Jump-Starter-Kit).

2.99. The Meeting discussed that the latest version of the SDS implementation specification is v2.0, which was published in March 2024, and questioned whether this new release would impact the SDS Jump Starter Kit. In response, ROK agreed to verify whether differences between SDS implementation specifications v1.0 and v2.0 would result in the update required for the developed SDS Jump Starter Kit and will share finding with the future SWIM TF meeting.

2.100. The Meeting appreciated and congratulated ROK on developing the SDS Jump Starter Kit and providing it for others to use. Moreover, it was shared that this Jump Starter Kit will help accelerate SIPG's work.

Proposed Business Functionality of APAC Common SWIM Information Services – Hong Kong (WP/16)

2.101. Hong Kong China presented the updates on the work of the SWIM TF Task 6 team to identify the catalogue of basic data elements to be exchanged via APAC SWIM and proposed business functionality to be supported by APAC Common SWIM Information Services for addressing the operational needs in APAC. The Meeting recalled that a draft data catalogue was shared for consideration by the SWIM TF/8 meeting held in November 2023, which included information to be exchanged through the APAC Common SWIM Information Services. Furthermore, a draft list of APAC Common SWIM Information Services business functionality was developed and introduced in SWIM TF/8.

2.102. To further refine the draft list of the initial set of APAC Common SWIM Information Services, online voting was set up and promulgated to APAC States/Administrations through State Letters to collect more comprehensive inputs and comments from related subject matter experts within APAC States/Administrations from November to December 2023, particularly on the naming of the services, the message exchange patterns, whether the service should be considered as mandatory or optional in APAC SWIM, and other proposed common SWIM information services to be included in the list. There were 59 responses from 18 States/Administrations, 2 airlines, and the CRV provider received through the online survey. The results of the survey and the comments received were also shared in WP/16.

2.103. Based on the survey responses from States, the proposed initial set of APAC Common SWIM Information Services and the draft data catalogue were updated. The Meeting was informed that information services with proposed business functionalities were considered as recommended services in initial APAC Common SWIM Information Services in two categories: (1) higher priority and (2) lower priority. To clarify the proposed business functionality, a brief description for each service was drafted and added to the updated list of APAC Common SWIM Information Services. It was planned that further inputs and comments on the brief descriptions from subject matter experts from relevant APAC working groups or task forces would be sought.

2.104. The survey results were also discussed in the MET/IE WG/22 held in March 2024. Meanwhile, the MET/IE WG/22 noted that the ICAO MET Panel is working on developing advanced SWIM MET information services beyond the provision of legacy MET products at the global level. The Meeting was informed of the need to harmonise the suggested APAC Common SWIM MET Information Services with the relevant global development. The MET/IE WG/22 meeting suggested including an introduction to the high-level functional capabilities of SWIM MET information services being developed by MET Panel, e.g. aerodrome observation information service, aerodrome forecast information service and quantitative volcanic ash concentration information service, in the APAC SWIM Implementation Guidance Document being developed by SWIM TF.

2.105. The SWIM TF/9 Meeting suggested classifying the priority of listed information services into three levels instead of two levels, i.e. higher and low priority. Particularly, it was agreed that an initial set of APAC Common SWIM Information Services will be identified in three priorities, i.e. priority 1, priority 2, and priority 3. The definition of the three-level priority was discussed and added in the initial set of the APAC Common SWIM Information Services document.

2.106. The document provided in **Appendix B** was further reviewed and modified by the Meeting. It was agreed that Hong Kong China, together with relevant subject matter experts of SWIM TF, will present the finalised version to the next meeting of AAITF, ATFM SG, FF-ICE Ad-hoc group, MET/IE WG, SURSG, MET SG, AOP SG, and ATM SG. All comments received from all proposed groups will be presented to SWIM TF/10.

2.107. Additional discussion required on the finalised document is as follows:

1. Search and rescue services defined under APAC Common SWIM Aeronautical Information Services and its priority need further discussion in the relevant SAR groups with APAC. SWIM TF Secretary will coordinate with the secretary of the ICAO Asia/Pacific Search and Rescue Working Group (APSAR/WG) for this discussion.

2. The information exchange model for each APAC Common SWIM Information service will be discussed and finalised by the subject-matter-expert contributory bodies, i.e. AAITF for AIXM, ATFM SG and FF-ICE Ad-hoc Group for FIXM, and MET/IE WG for IWXXM.

3. As recorded under WP/02, MET information derived from Mode S DAPs was included in the APAC Common SWIM Meteorological Information Services list. However, as Mode S DAPS are considered a source of MET data, the Meeting suggested that further discussion in relevant MET groups is required to determine the justifiability of including this information service in the list of APAC Common MET Information Services.

4. Based on feedback received from different contributory bodies, the draft data catalogue provided in **Appendix C** will be further modified by the Task 6 group.

2.108. For the suggestion to incorporate the initial set of APAC Common SWIM Information Services into the initial version of the APAC SWIM Implementation Guidance Document, it was decided to add to the IGD after the details of this initial APAC Common SWIM Information Service list matured.

2.109. The Meeting noted that IMP is working on an Information Service Definition (ISD) template for subject-matter-expert Panels, e.g. ATMRPP, METP, to develop domain-specific ISDs that work well related to WP/16. It was suggested that the progress of these works in the IMP, ATMRPP, and METP be tracked to align regional descriptions with the global guidance.

Overview of MET Scenario (#3) for Joint event of SWIM over CRV Demonstration and Surveillance data over SWIM Trial – ROK (WP/11)

2.110. This paper presented an overview of the MET scenarios supported by ROK for the joint event of SWIM over CRV Demonstration and Surveillance Sharing in the SWIM Technical Trial. It was informed that, for one of the two scenarios in which ROK is involved, non-demonstration participants could self-try the scenario online by accessing SWIM services used for demonstration with Service Descriptions provided in WP/11.

IMP Updates – Japan (IP/06)

2.111. Japan presented some topics discussed in past IMP/WG meetings, the Twelfth Working Group Meeting of the Information Management Panel (IMP-WG/12) which was held at IATA HQ in Montreal, Canada, from 15 to 19 April 2024, and other related Panels.

2.112. The Meeting noted that the first edition of the Procedures for Air Navigation Services – Information Management (PANS-IM, Doc 10199) was approved by the Council at the fifth meeting of its 231st session on 18 March 2024 for applicability on 28 November 2024. A copy of it is available as an attachment to the electronic version of the State letter on the ICAO-NET (http://portal.icao.int). It was also informed that the Manual on the SWIM Concept (Doc 10039) had been published in English and that translation was ongoing. In addition, the Manual on SWIM Implementation (Doc 10203) was being edited, and an English version will be published shortly.

2.113. Draft ICAO Guidance Material on Protection of Information was considered by the Governance Working Group under the IMP (IMP WG-G) as mature enough (pending discussion during IMP WG/12, at the time of this paper writing) to be proposed for adoption during IMP/3. This document explains the SWIM Service Environment. It is a conceptual representation of the path that information takes between the information provider and the information consumer through various information service providers and consumers. Within the SWIM Service Environment, each intermediate stakeholder acts both as a consumer of information received from "upstream" and as a provider of information to "downstream" stakeholders. The IMP Meeting raised concerns about the legal implications of having this kind of text in an ICAO Manual.

2.114. The Meeting was informed that there are two main drivers for replacing the current NOTAM system and improving the aeronautical information update system. One is the necessity of accompanying the aeronautical digital datasets; the second is addressing commonly reported shortfalls. This NOTAM replacement system concept, known as the Digital Operational Reporting Information Service (DORIS) concept, must enable the tailored retrieval and presentation of information to minimise the impact of worldwide volume increases. It must enable graphical representations for optimal human use to avoid inaccurate mental models. It must also be interoperable between systems and between States to provide the maximum benefits. The IMP will continue to work on revising the document, but this concept should be promoted as contributing to safety.

2.115. The Forty-Fourth Working Group Meeting of the Air Traffic Management Requirements and Performance Panel (ATMRPP-WG/44), which was held in Seoul, Korea, from 29 April to 3 May 2024, highlighted the importance of ensuring a common understanding of the concept for TBO (Trajectory-Based Operations), FF-ICE (Flight & Flow Information for a Collaborative Environment), and connected aircraft. It also stressed the need for robust and open discussions to understand different limitations and expectations and to develop scalable and adaptable solutions that deliver tangible benefits.

2.116. The Meeting was informed of a trust framework being developed by the ICAO Trust Framework Panel (TFP). In particular, it was shared that a trust framework can be described as a set of policies, procedures, and technical requirements enabling organisations to share information and retain confidence that shared information is authentic, unaltered, and sufficiently protected. During the Second Meeting of the TFP (TFP/2) held in Montreal, Canada, from 29 April to 3 May 2024, the participants worked on developing the first edition of the Manual on Information Security, conducted the final review of the Aviation Common Certificate Policy, began development of Manual on Trust Framework Implementation, and continued to support the work of other panels.

2.117. The Meeting suggested participants refer to the already-published first edition of the PANS-IM (Doc 10199) and the Manual on SWIM Concept (Doc 10039) as well as the to-be-published Manual on SWIM Implementation (Doc 10203) to better understand the SWIM concept and to obtain information to support SWIM implementation that is well aligned with the ICAO global provisions.

2.118. Additionally, the Meeting noted that the Working Group – Information/Service under the IMP (IMP/WG-I/S) held its second meeting in Brussels, Belgium, from 27 February to 1 March 2024. It was shared that, at the meeting, the IMP/WG-I/S focused on finalising the Air-to-Ground SWIM job card and progressing the work on the SWIM Registry Interoperability Concept of Operations as well as the Information Service Definition template and framework.

2.119. IMP members, presented in the Meeting, provided clarification that the DORIS concept is not a replacement for the NOTAM system concept. Rather, it is a future concept for providing aeronautical information.

Key SWIM related activities being progressed by METP – Australia (IP/07)

2.120. Australia presented a summary of key activities undertaken by ICAO METP relevant to SWIM TF. The Meeting noted that the ICAO METP tasked its Working Group on MET Information Exchange (WG-MIE) to carry out the goals set forth in Job Card METP.004 *Inclusion of aeronautical meteorological information in the SWIM-enabled environment and further development of the SWIM concept relating to meteorology*.

2.121. The latest status of various amendments to ICAO Annex 3, their original expected applicability, and new expected applicability were shared with the Meeting. A list of the first ICAO meteorological SWIM (MET-SWIM) services to be introduced to the Annex, benefits of MET-SWIM, and progress on MET-SWIM Documentation were also informed at the Meeting. The Meeting noted the transition plan from traditional OPMET exchange to MET-SWIM, notifications procedures for changes to IWXXM, and updates to the IWXXM guidelines. Additionally, the Meeting was shared that the World Metrological Organization (WMO) IWXXM compatibility table that is maintained by WMO can be accessed by this link: https://github.com/wmo-im/iwxxm/wiki/Package-Compatibility

2.122. The meeting noted that WG-MIE is currently developing a draft version 3.0 of the *MET-SWIM Roadmap*, including revised transition capabilities and implementation schedules. WG-MIE has decided that the *Plan for Meteorology in SWIM* (MET-SWIM Plan) should be deprecated, and the contents of the current version (Version 2.3) should be brought into a new *Guidelines for MET-SWIM Implementation* (MET-SWIM Guidelines) document. The METP is planning to release the MET-SWIM Guidelines in Q2 2025.

Summary of SWIM Activities – IATA (WP/14)

2.123. IATA presented a brief on identified SWIM-related activities being undertaken in the APAC region outside of the ongoing direct SWIM discussions and initiatives. The Meeting noted the APAC TBO Pathfinder project being conducted under the APAC ANSP Committee (AAC) is developing a TBO education package expected to be finalised by Q2/2025 and preparing for a TBO trial with a target of 2028. The Meeting was informed that Airservices Australia convened an FF-ICE 'kick-off' Meeting in February 2024 intending to bring together relevant stakeholders in starting to understand what benefits it will provide to both the Airspace Users (AUs) and the Airspace Service Providers (ASPs), and how to unpack the concept at both a regional and State level.

2.124. For airline readiness, IATA informed that during April 2024, the twenty IATA member airlines of the APAC/NASIA Regional Coordination Group (RCG) met for the bi-annual meeting and were briefed on SWIM activities in this and other regions. Remainder members are then notified through the distribution of meeting minutes. It was informed that Qatar Airways (QR) had held open discussions with several vendors at ATM World 2024 for presentations on software applications and

the provision of datasets in AIXM format. Most applications are naturally orientated to AIS-AIM office usage, so potential customisation may be required. QR has also reported that AIS Doha has implementation targets for AIXM datasets of Q4/2024 for AIP and Obstacle Data, Q2/2025 for Airport Mapping and Q4/2025 for Instrument Flight Procedure Data. Digital NOTAMs are already viewable on their AIS website.

Review of SWIM TF ToR, Programme, Work Plan, and Outstanding Action Items – Sec (WP/07)

2.125. The paper presented the current SWIM TF's ToR, the revised SWIM TF's work plan, and the Action List to reflect the latest work status achieved. The Meeting reviewed the latest ToR of SWIM TF, which was adopted by CNS SG/26 through **Decision CNS SG/26/07** *(SWIM TF/06/05) – Revised SWIM TF Terms of Reference*, and agreed that no revision to the ToR is required.

2.126. To ensure that the objectives set in the ToR can be achieved, the Statement of Work (SOW) of each Task needed to be further reviewed to be consistent with the current SWIM TF ToR. It was agreed at the SWIM TF/8 meeting that all Task Leads would review and modify the SOW to accommodate the latest requirements from SWIM TF ToR and share it with the ICAO Secretariat.

2.127. The meeting was informed of the current Task leads as follows:

Groups	Task No.	Subject/Task	Task Leads
Implementation Planning	1	Regional implementation philosophy & roadmap	David Leow (Singapore) Amornrat Jirattigalachote (Thailand)
SWIM infrastructure	2	Regional SWIM infrastructure	Xiaodong Lu (Japan), Yasushi Iwasawa (Japan) Henry Chan (Hong Kong, China)
	3	Security service	Jim Laymon (USA)
Technical Architecture	4	Development and maintenance of regional information exchange models	Amornrat Jirattigalachote (Thailand) Wen Zhu (USA)
Governance	5	Regional SWIM Governance Framework	~~Dongkie Park (ROK)~~ YoungJin Ha (ROK) Mark Kaplun (USA), Yasushi Iwasawa (Japan) Xiaodong Lu (Japan), Honglei Gao (China)
Information Services	6	Information services	Marco Kok (Hong Kong, China) Vacant
Validation & Demonstration	7	SWIM Demonstration	David Leow (Singapore) Amornrat Jirattigalachote (Thailand)
	8	SWIM services and application validation	Yasushi Iwasawa (Japan) Xiaodong Lu (Japan), Honglei Gao (China),

Groups	Task No.	Subject/Task	Task Leads
			~~Dongkie Park (ROK)~~ YoungJin Ha (ROK)
Coordination and Promotion	9	Monitoring of Panels' work	Yasushi Iwasawa (Japan)
	10	Regional coordination and SWIM-related information sharing	John Moore (IATA)
	11	SWIM implementation education and promotion (New task)	Thomas Green (USA)

2.128. The Meeting was informed that Task 3 required a co-lead from the APAC region to be able to suggest better and incorporate the security requirements specific to the APAC region. Similarly, additional support was required for Task 6 and Task 11. As the current ToR of SWIM TF has significantly increased the work of SWIM TF, the meeting was encouraged to also nominate co-leads of Task 6 and Task 11 on a priority basis.

2.129. ICAO secretariat informed that after the retirement of Task 6 lead from Australia, Australia shared its intention to nominate a replacement. The Meeting requested Australia to reconsider sharing the nomination for Task 6 lead. Australia shared that they will discuss this internally and share nominations, if possible, before 14 June 2024**.**

2.130. The Meeting discussed the SWIM TF Task structure and SOW of each task. The proposal to remove Task 1 due to most of the work taken over by SIPG was considered. The Meeting agreed that Task 1 should be kept, as when the ToR of SIPG is completed, the relevant work under the Task 1 group will still require to be continued. Therefore, it was recommended that the SOW of Task 1 be modified to incorporate the need to develop a detailed SWIM roadmap and include the APANPIRG-approved APAC SWIM implementation timelines for 2024-2030. Task 1 leads will modify the Task 1 SOW and submit it to the ICAO Secretariat before 14 June 2024. The Meeting also requested all Task leads to provide feedback on the review of corresponding SOWs and submit it to the ICAO Secretariat SWIM TF/9 report updates by SWIM TF Co-chair to CNS SG/28 will incorporate the new SOW of all Tasks.

APAC Use Cases and User Requirements for SWIM-Based MET Information Services Supporting ATFM – MET/R WG Ad-hoc Group (WP/15)

2.131. The paper presented the recent updates on the work to identify and document use cases and user requirements for SWIM-based MET information services supporting ATFM in the APAC region in coordination with other APANPIRG contributory bodies. The paper invited SWIM TF to review the updated draft reference document already reviewed and modified by ATFM/SG/14 and MET/R WG/13, and provide any comments, particularly suggestions on the use cases and/or any other requirements. The Meeting reviewed the draft reference document and modified the name of Use case 7 as follows. Apart from this modification, no changes were made.

USE CASE 7: (*potential future use case*) Aircraft spacing management based on MET information and real-time surveillance information shared in SWIM

2.132. The Meeting noted that the document provided in **Appendix D** of the Report will be proposed for adoption by the MET SG/28 meeting.

FAA Strategic Decision: Leverage legacy technology investments to support ATC data exchange by prioritising internet-enabled SWIM for ATM information sharing – USA (WP/19)

2.133. USA informed that SWIM introduced several benefits in realising cost savings, achieving modernisation and global interoperability, and providing flexibility and scalability while ensuring a robust security posture. Although ATM information exchanges will increasingly and exclusively be shared over SWIM, the FAA shared that it remained committed to using AMHS for Air Traffic Control (ATC) messages, which is consistent with ICAO policy and compliance with international standards. Ultimately, this approach allowed the FAA to introduce more efficient and secure collaborative information exchange between aviation partners.

2.134. The Meeting was informed that the FAA strategically prioritised the internet-enabled SWIM data exchange platform as the primary method for sharing ATM services. As an internet-enabled technology, SWIM is compliant with industry standards, technical and security protocols, and governance enforcement points, supporting seamless integration across diverse systems. SWIM operates at an application layer (OSI layer 7) middleware that is compliant with Internet Protocol (IP) standards across diverse systems from ANSPs, vendors, etc. While SWIM users can choose dedicated network connections, they can also use the internet as network transport. This is especially important in the exchange of ANSP-to-ANSP SWIM information. FAA informed that the conclusion to prioritising internet-enabled ATM information exchange over SWIM demonstrates a prudent approach to managing resources while positioning to take advantage of modern technologies and shared multiple benefits.

2.135. The FAA shared that it will continue to invest in developing robust security protocols for SWIM with aviation partners to ensure the potential for creating a safer, more efficient, and globally connected ATM system. By embracing SWIM, the FAA positions itself for enhanced collaboration with international partners, cost-optimised operations, flexibility, and sustaining a robust security posture.

2.136. Several questions regarding security were raised and the Meeting was informed about the planned publication of the Manual on Information Security in 2024, which will be a useful reference document for aviation stakeholders. **Moreover, the Meeting noted the need for a dedicated group to support APAC Member States/Administrations in implementing recommendations being developed by the TFP. CNS SG/28 will be requested to provide guidance, especially for the group to be responsible for implementing information security provisions in the APAC region**.

Progress update on SWIM implementation in Malaysia – Malaysia (IP/03)

2.137. Malaysia shared a progress update on the implementation of SWIM. The Meeting noted that to date, Malaysia has successfully completed the development of its SWIM Technical Infrastructure (SWIM-TI), which includes the upgrade of the national ground ATS communication network to a modern IP based network, establishment of SWIM EMS in two Tier-3 data centres and network interface preparation for future connection of SWIM EMS to the CRV. Malaysia has also started to develop its SWIM Information Service to kick-start the utilisation of information through SWIM. Most of the MET Malaysia information is now ready in the SWIM-TI in IWXXM format. Other ATS information services (e.g. FPL, NOTAM) are also made available in the SWIM-TI but using the legacy

format (encoded to standard XML) instead of the standard SWIM information exchange model (FIXM, AIXM). This is to support the transition plan from AMHS/AFTN to SWIM in the year 2030 for the APAC region, in which both AMHS/AFTN and SWIM will co-exist in the APAC ecosystem. It was added that Malaysia has also developed a document, namely the ATM Information Exchange Interoperability Framework (ATMIEIF), to guide the aviation stakeholder involved in information system development and usage of information to correctly design, develop, upgrade, or enhance their current or new system to ensure seamless interoperability with the Malaysia SWIM-TI.

2.138. In further developing the SWIM Information Service for Malaysia, the method and approach of interfacing and utilisation of the SWIM-TI shall be guided by the ATMIEIF Document. The framework document shall guide the stakeholders, including the system developer or integrator, on the process and technical requirements involved in subscribing to the information service or publishing information to the Malaysia SWIM-TI. It was also shared that, based on discussions held during the monthly meetings of the SWIM Implementation Pioneer Ad-hoc Group (SIPG), it was decided that one of the ways forward for SWIM implementation in APAC is for each EMS provider to have a SWIM Registry, which is discoverable by other EMS provider or information users. In line with the decision, Malaysia is willing to enhance its SWIM Service Directory Catalogue to become the Malaysia SWIM Registry by utilising standards and methods as agreed by SIPG. This is a work in progress and will be implemented after the joint event to be held in Hong Kong. With the readily available SWIM-TI and full support from the development team, Malaysia shared that it is keen to become one of the pioneering states contributing to Version 1.0 of the SWIM Asia Pacific.

2.139. The Meeting seeks the possibility of Malaysia sharing ATMIEIF documents with other APAC states/administrations. Malaysia informed that the document is a work in progress. After the document is finalised and the internal approval is obtained, it will be shared with other States/Administrations.

SWIM implementation status and future plan in ROK – ROK (IP/04)

2.140. ROK shared the current status of establishing an aviation communication network for real-time sharing of SWIM information in Korea to reduce defects in aviation communication and ensure efficiency in responding to SWIM development and implementation. The Meeting noted that in December 2023, the basic design of SWIM was completed, including establishing an aviation communication network for real-time sharing of domestic SWIM information. Through a detailed design that will be conducted from 2024 to 2025, one SWIM CENTER and four STDDS (SWIM Terminal Data Distribution System) implementation plans will be prepared, and SWIM implementation will be established by 2028.

2.141. ROK informed that using the National Integration Network, it plans to secure 5G bandwidth between bases with 6 locations as base areas and 1 to 2G bandwidth in other areas. Such a National Integration Network can be used free of charge in the backbone section, so users only have to pay for branch lines connecting to the National Integration Network. Consequently, lots of communication costs can be reduced. In addition, considering operational stability, it will be configured with a Ring Topology so that even if one connection is disconnected, it can reroute the path. The Meeting congratulated the ROK on the progress made on SWIM-related implementation and suggested that the ROK consider sharing information regarding the National Integration Network with ACSICG.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) review the outcome of the SWIM TF/8 and SWIM TF/9 Meetings and take any necessary follow-up actions;

b) adopt draft conclusions/decisions mentioned in sections 2.12, 2.14. and 2.63;

c) provide guidance, especially for the group to be responsible for implementing information security provisions in the APAC region discussed in 2.136; and

d) discuss any matters as appropriate.

CNS SG/28
Appendix A to WP/06

APAC SWIM Technical Infrastructure Profiles - Version 1.0

May 2024

Record of Revisions

Date	Revision	Submitter
May 2023	Draft Version 0.1 – Initial Draft for SWIM TF/7	Xiaodong Lu, JAPAN/ENRI
Nov. 2023	Draft Version 0.2 – Revised Initial Draft for SWIM TF/8 - Restructure Chapter 3 - Add Appendix A, B and C	Xiaodong Lu, JAPAN/ENRI
May 2024	Draft Version 1.0 – Revised Draft for SWIM TF/9 - Revised based on review outcomes	Xiaodong Lu, JAPAN/ENRI
May 2024	Version 1.0 – Revised formal version for SWIM TF/9 - Revised based on the discussions at the SWIM TF/9	Editorial Group: Elvin Liow, David Leow, Tim Hailes, Shayne Campbell, Yasushi Iwasawa, Xiaodong Lu

Preface

Note: This document describes the SWIM Technical Infrastructure to be used in the implementation of SWIM in the Asia-Pacific region. This document is still a work in progress and several sections within it are continuing to mature. These sections are listed in the table below. This document also makes reference to the Manual on Information Security (ICAO Doc 10204) which is still in draft as of the time of the nineth meeting of SWIM Task Force.

Section Number	Section Name	Remarks (What about it isn't mature)
2.1	Requirements	CRV may not be the only IP-Based network. The Internet is another potential option. Constraints arise from the SWIM TI requirements outlined in Table 1 that have not been fully met.
2.2	Service Description	At the ICAO level, the concept of Information Service Definition is still a work in progress. The SWIM Discovery Conceptual Model is likewise being developed and subject to further changes.
2.4	Architecture	The discussion of interoperable architecture is still a work in progress.

Table of Contents

Acronym and Terminology List

AFTN: Aeronautical Fixed Telecommunication Network

AIXM: Aeronautical Information Exchange Model

AMHS: Aeronautical Message Handling System

AMQP: Advanced Message Queuing Protocol

API: Application Programming Interface

ASP: ATM Service Provider

ASTERIX: All Purpose Structured Eurocontrol Surveillance Information Exchange

ATM: Air Traffic Management

AU: Airspace User

CRV: Common aeRonautical Virtual Private Network

EDR: Environmental Data Retrieval

FF-ICE: Flight and Flow Information for a Collaborative Environment

FIXM: Flight Information Exchange Model

HTTP: Hyper Text Transfer Protocol

HTTPS: Hyper Text Transfer Protocol Secure

ICT: Information and Communication Technology

IMP: Information Management Panel

IP: Internet Protocol

ICAO: International Civil Aviation Organization

IWXXM: ICAO Meteorological Information Exchange Model

JSON: JavaScript Object Notation

OAuth: Open Authorization

OGC: Open Geospatial Consortium

NOTAM: Notice To Airmen

SDCM: Service Description Conceptual Model

SIGMET: Significant Meteorological Information

SOAP: Simple Object Access Protocol

TCP: Transmission Control Protocol

TI: Technical Infrastructure

TFP: Trust Framework Panel

URI: Uniform Resource Identifier

WCS: Web Coverage Service

WFS: Web Feature Service

WMS: Web Map Service

WMTS: Web Map Tile Service

WPS: Web Processing Service

WS: Web Service

WSDL: Web Services Description Language

XML: Extensible Markup Language

1. INTRODUCTION

1.1 Purpose

In order to achieve technical interoperability between different implementations, it is essential that systems use standardised interfaces and have technical infrastructure capabilities to enable reliable, secure and efficient exchange of ATM related information. It is expected that these standards enable to eliminate technical barriers from the realization of regional SWIM.

This document contains basic requirements for the implementation of SWIM Technical Infrastructure (TI), optional system design models for the integration of the Common aeRonautical Virtual Private Network (CRV), and common Information and Communication Technology (ICT) standards for the specification of interface bindings to implement the regional SWIM during the transition period.

1.2 Scopes

This document focuses on the following scopes for SWIM TI implementation by considering the integration of CRV to achieve technical interoperability during the transition period in the APAC region.

- SWIM TI system design
- SWIM TI interface bindings
- SWIM TI capabilities

1.3 Prerequisite for Implementation

The main objective of SWIM is not only to enable seamless information sharing among the multiple stakeholders in the ATM domain but also to achieve interoperability and harmonization of global operation in the air transportation field. 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-based network is required. 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. Therefore, both operational interoperability and applicational flexibility should be considered for the development and implementation of regional SWIM. The required indicators for IP-based network that should be considered to construct the SWIM TI are shown in Table 1.

Table 1. SWIM TI Requirements

Indicator	SWIM TI Requirement
Performance	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
Accessibility	Open and easy connected platform not only for traditional aviation partners but also for new entrants for the initial development of SWIM

Connectivity	Cross-border network connections not only for other SWIM-enabled systems in the APAC region but also to other SWIM platforms that have been deployed in other ICAO regions
Cost	Reduced cost for conventional message exchange, and low cost or free of cost for SWIM information exchange and sharing
Cybersecurity	Protection for IP-based networks, SWIM-enabled systems and information from cyber threats

As aviation continues to become more digitalized and virtualized, cyber threats are becoming more of a concern for all stakeholders. To protect the safety of flight operations from these threats and ensure business continuity, all stakeholders agree that trusted information should be exchanged between trusted identities through trusted communication paths on a global basis. Since different States and regions have different security policies and governance, a common framework for cybersecurity and information security in civil aviation is required. As the aviation cybersecurity strategy has been discussed at the ICAO Cybersecurity Panel, the related issues of IP-based network for regional SWIM TI construction should be considered.

1.4 Principles

The SWIM TI contributes to achieving the SWIM benefits described in the Manual on SWIM (Doc 10039), by respecting the following principles shown in Table 2.

Table 2. SWIM TI Principles

Principle	Description
Managed technical diversity	Technical diversity is managed to minimize the significant costs to maintain expertise while allowing flexibility to accommodate new technologies and select technologies that best meet ATM needs.
Standards based TI	SWIM TI implementation is based on open standards that promote technical interoperability.
Established ICT standards	SWIM TI implementation is based on widely deployed and supported ICT standards that enable economical and efficient information services implementation and operation.
Modularity	SWIM TI implementation is modular, enabling progressive deployment of SWIM TI functional capabilities and bindings, which will allow a fit for purpose, flexible and agile implementation and evolution.
Platform independent interfaces	Interfaces between systems do not create dependencies imposed by implementation platforms, such as operating system or programming language.

1.5 Structure

Chapter 1 introduces the purpose and scope of this document, the requirements and principles for regional SWIM TI implementation.

Chapter 2 provides a high-level architecture and several optional system design models to construct the SWIM TI taking into account the integration of CRV for achieving interoperability.

Chapter 3 specifies common ICT standards for Interface Bindings, providing specifications for the implementation of service, network and infrastructure interfaces.

Chapter 4 specifies SWIM TI Capabilities, providing functional and non-functional requirements for the implementation of regional SWIM TI to ensure the reliable, secure and efficient information exchange between different stakeholders.

Appendix A provides system structure and functional building blocks of AMHS/SWIM Gateway.

Appendix B provides high-level architecture and package diagram of Service Description Conceptual Model (SDCM).

Appendix C provides some examples of possible message headers for FIXM, AIXM and IWXXM message exchanges using Advanced Message Queuing Protocol (AMQP) to explain message capabilities for achieving interoperability between different SWIM TIs in separate IP network segments. Moreover, examples of message headers for surveillance data are discussed. The common message headers for Global SWIM implementation are being discussed at ICAO Information Management Panel (IMP).

1.6 Maintenance

This document has been developed by the Task 2 group under the APAC SWIM TF. It will be updated and maintained by the APAC SWIM TF. It is accessible at SWIM Repositories of ICAO APAC SWIM Secure Portal.

1.7 References

[1] Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols, ICAO Doc 9896.

[2] Manual on System Wide Information Management, ICAO Doc 10039.

[3] Procedures for Air Navigation Services – Information Management (PANS-IM), ICAO Doc 10199.

[4] EUROCONTROL Specification for SWIM Technical Infrastructure, EUROCONTROL-SPEC-170.

[5] Service Description Conceptual Model (SDCM), Version 3.0.0 DRAFT, FAA, February 2023.

[6] AMHS/SWIM Gateway Specification, Version 1.0 Draft, AMHS/SWIM Gateway Study Group (SWAMWAY SG), 2022.

[7] Manual on Information Security, First Edition, ICAO Doc 10204.

2. SYSTEM DESIGN

2.1 Requirements

According to the Manual on SWIM (ICAO Doc 10039) SWIM should be implemented over a suitable Internet Protocol (IP) based network. The key requirement of such a network would be full end-to-end IP connectivity between all parties in the network.

In the Asia-Pacific region, the CRV has been established as a secured, aviation centric IP network to address potential security prior to a unified, endorsed ICAO trust framework. The CRV is thus a potential candidate IP network upon which SWIM can be implemented. The Internet, with the appropriate cybersecurity measures in place, may also be considered as another potential candidate IP network.

During the transition to a global SWIM environment, there will be a coexistence of legacy systems and SWIM-enabled systems for an extended period. To assure the interoperability, SWIM-enabled systems have to implement information services not only in accordance with SWIM standards but also in support of legacy systems. This becomes particularly crucial during the transition phase as legacy systems 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 TI to support the message transport between the SWIM-enabled systems and AFTN/AMHS based legacy systems. To facilitate the transition from AMHS to SWIM, the AMHS/SWIM Gateway Specification (Please refer to Appendix A) has been proposed and discussed by SWAMWAY SG.

Due to the different levels of operational needs and the requirements of SWIM TI shown in Table 1, various options can be considered for the transition period regarding interoperability. Some member states and third-party SWIM service providers have developed some information services on their local SWIM-enabled systems that cannot directly connect to the CRV at current stage. In addition, to support cost-effective and efficient utilization, some non-safety critical information services, such as less-sensitive meteorological information services, are expected to remain accessible on the Internet. Therefore, the different design models of the SWIM TI are required for the different services and implementation levels.

2.2 Service Description

From the perspective viewpoint of Service Oriented Architecture (SOA), the TI is one of SWIM services that provide the reliable, secure, and efficient information exchange service to SWIM users. As the service description is integral to establishing interoperability among SOA components and critical to supporting various aspects of SOA governance, a common and consistent service description model is also required for SWIM TI. PANS-IM (ICAO Doc 10199) provides some considerations at the concept level.

In the PANS-IM (ICAO Doc 10199), a set of information service metadata and a template for Service Overview are provided to promote service discovery and an initial evaluation of information services.

The Service Description Conceptual Model (SDCM) developed by the FAA SWIM Program has been applied to the implementation of the regional SWIM Discovery Service. It can serve as a reference and template, offering basic principles, common standards, methodologies, and best practices for regional SWIM TI service providers.

The elements that are required by PANS IM are also included as part of the profile package of SDCM. However, the consideration is required to maintain consistent definitions of metadata and templates for SWIM Registry across national, regional and global implementations.

2.3 Interface Bindings

Currently, there are three types of service providers in the APAC region for the regional SWIM implementation.

- IP network service provider: Provides the IP network connectivity to SWIM TIs;
- SWIM TI service provider: Provides information exchange and other infrastructure functions to SWIM information service providers and consumers;
- SWIM information service provider: Provides information services to ATM applications and consumers via SWIM TIs.

The SWIM TI enables the implementation of interfaces between systems, providing technical capabilities for secure, high performing and reliable information exchange. Based on the functional position of SWIM TI, not only network bindings and service bindings but also infrastructure bindings are required to achieve interoperability between different internal and external infrastructure systems.

- 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 ATM applications;
- Infrastructure Bindings: Specify the interface used by a SWIM TI to communicate with other infrastructure systems, including protocols for communication with internal and external services.

The relationships between service providers and interface bindings are shown in Table 3.

Table 3. Relationships between service providers and interface bindings

Service provider	Interface bindings
IP network service provider	Network bindings
SWIM TI service provider	Infrastructure bindings
SWIM information service provider	Service bindings

2.4 Architecture

The regional SWIM will be progressively implemented by the integration of different SWIM-enabled systems and aligned with the implementation of the services it supports. Additionally, to facilitate the transition from AMHS to SWIM, the AMHS/SWIM Gateway Specification has been proposed and discussed by other working groups. To ensure interoperability among regional SWIM participants and to support transition for non-SWIM capable entities, an IP-based network (either a private network e.g. CRV, or the public Internet) interoperable architecture is required for regional SWIM implementation.

Some stakeholders (e.g., ATM Service Providers (ASPs), Airspace Users (AUs) or third-party partners) will have the capacity to become SWIM TI service providers by establishing common agreements and creating a collaborative environment at the regional level or between different regions. It is important for all SWIM TI service providers to agree on using a common set of standards to ensure information exchange between different systems. The IP network service provider may provide the function of connectivity between CRV and SWIM TI for local legacy systems and SWIM-enabled systems. SWIM TI service providers may be connected by CRV or other secure connection methods on IP-based network. As a SWIM TI service provider, it will be able to provide the reliable, secure and efficient information exchange service to SWIM-enabled ASPs and AUs. The discussion and validation of the architecture is still a work in progress.

2.5 Design Models

According to the discussion of joint meetings between the CRV OG and SWIM TF, the implementation of the initial regional SWIM at the current stage can be accomplished through user-based access model and application-level integration. This approach ensures interoperability between the different SWIM-enabled systems developed by various stakeholders in different IP network segments.

Based on the availability of AMHS/SWIM Gateway and the infrastructure bindings between different systems, there are several connection ways to deal with a need of service consumers to access different services through AMHS, SWIM and the Internet. The following use cases are described for different requirements and capabilities.

2.5.1 Use Case 1

In this use case, as shown in Figure 1, due to the AMHS/SWIM Gateway and the infrastructure bindings are not available for the CRV-based SWIM TI, users must connect to each access point in separate IP network segments, such as AMHS, SWIM and the Internet using a broker or gateway. The SWIM-enabled ATM applications support users to transform messages and integrate information at the application level.

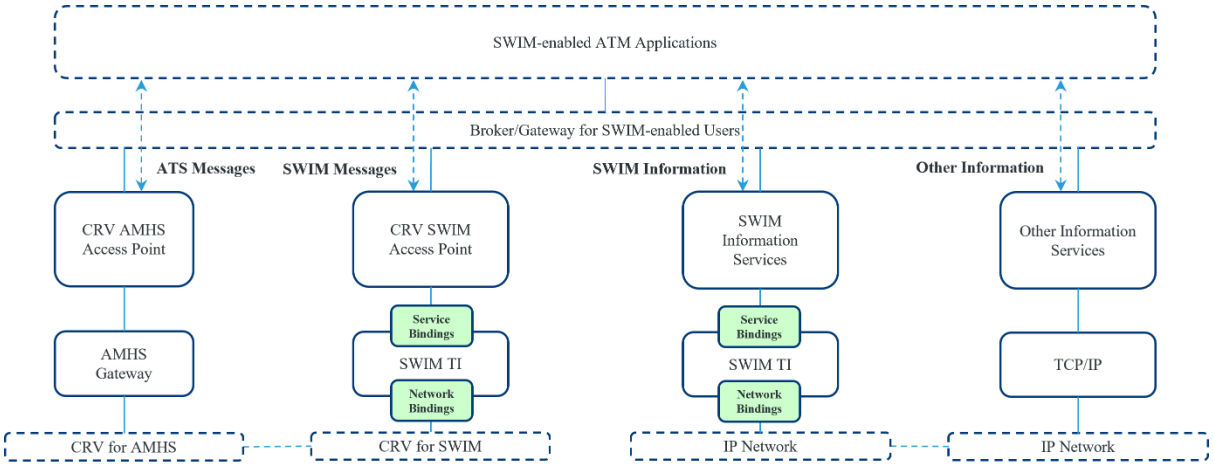


Figure 1. Use Case 1: Without AMHS/SWIM Gateway and Infrastructure Bindings

2.5.2 Use Case 2

The main difference between use case 2 (Figure 2) and use case 1 (Figure 1) is that infrastructure bindings are available between CRV-based SWIM TI and the user's local SWIM TI. This enables information exchange between different SWIM TIs in separate IP network segments when users connect to one SWIM access point. The SWIM-enabled ATM applications support users in message transformation and information integration at the application level.

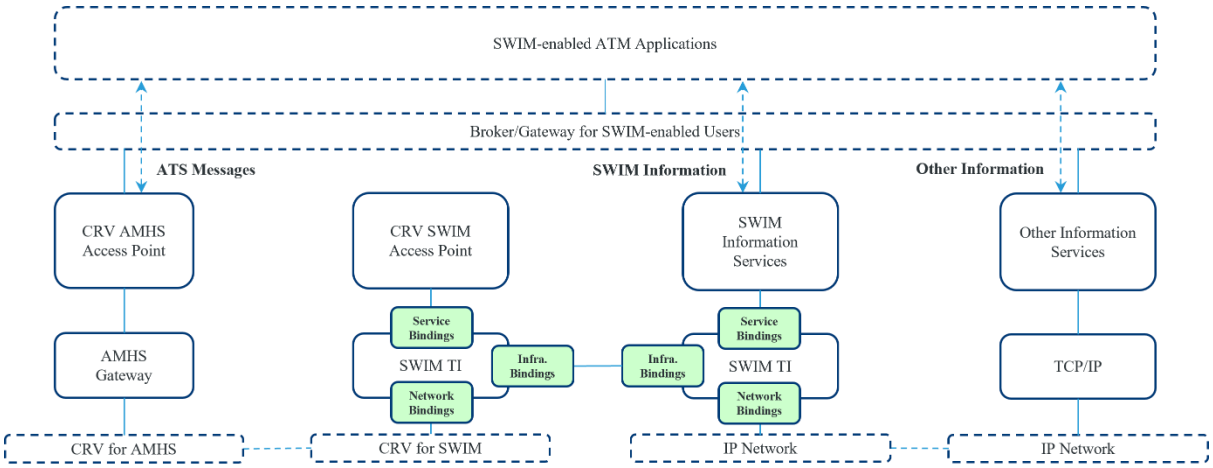


Figure 2. Use Case 2: With Infrastructure Bindings between SWIM TIs

2.5.3 Use Case 3

In this use case (Figure 3), as the AMHS/SWIM Gateway and the infrastructure bindings are available for the CRV-based SWIM TI, users would not need to connect to the CRV AMHS access point. The AMHS/SWIM Gateway will handle the exchange of information and the transformation of message between AMHS users and SWIM users. The SWIM-enabled ATM applications will be able to integrate SWIM information with other aviation-related information that is available on the Internet.

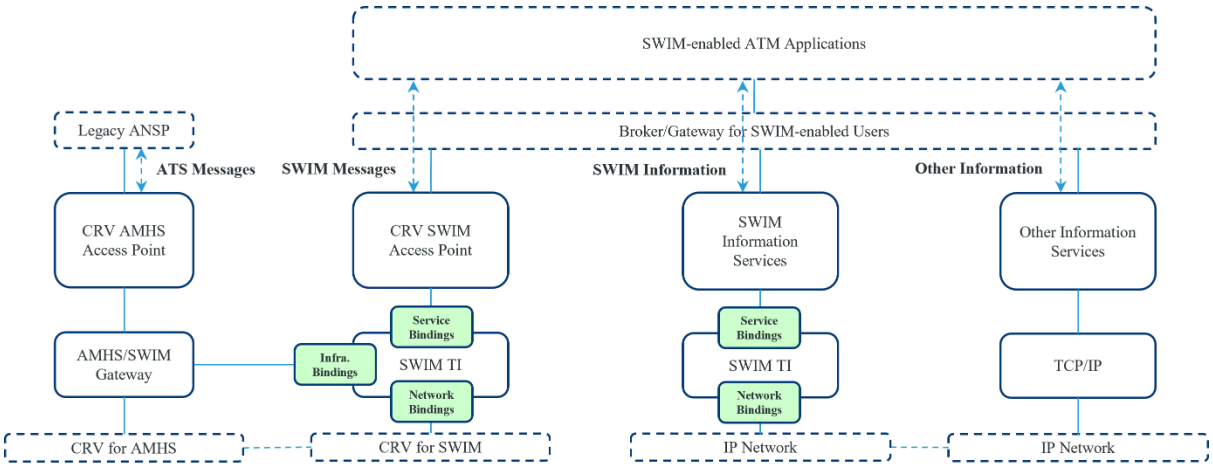


Figure 3. Use Case 3: With AMHS/SWIM Gateway and Infrastructure Bindings on CRV

2.5.4 Use Case 4

In the use case (Figure 4), as the infrastructure bindings are also available between different SWIM TIs in separate IP network segments, users only need to connect to one SWIM access point. The infrastructure bindings of SWIM TIs will cooperate with each other to achieve information exchange among SWIM users and support AMHS/SWIM Gateway to handle the massage exchange between AMHS users and SWIM users.

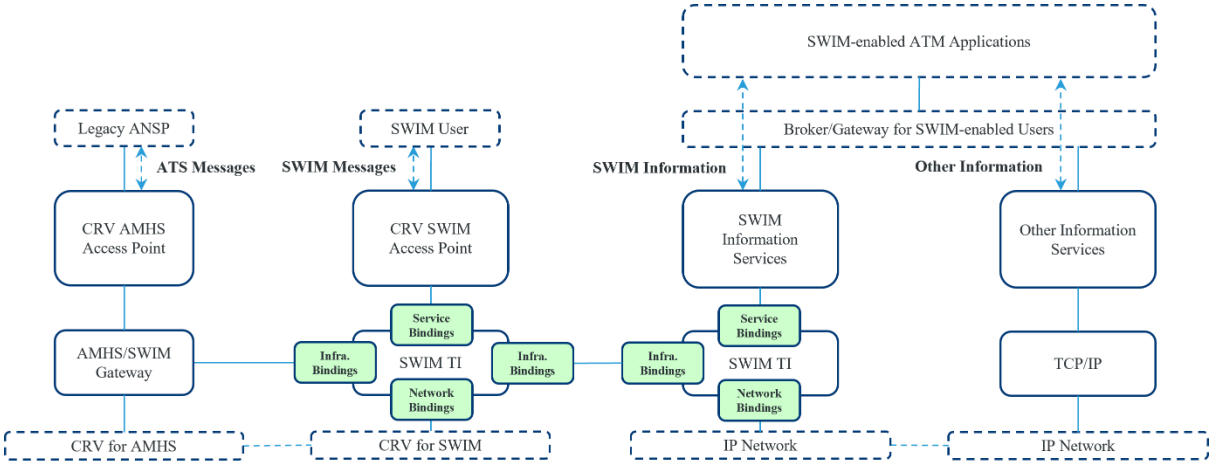


Figure 4. Use Case 4: With Infrastructure Bindings between Different Systems

To ensure interoperability, SWIM TI service providers should consider establishing common governance policies based on the trust framework discussed by ICAO TFP.

3. STANDARDS FOR INTERFACE BINDINGS

3.1 Introduction

The SWIM TI enables technical interoperability based on interface that use common ICT standards. The SWIM TI interface bindings specify the protocols for information exchange between systems. Interface bindings play a critical role in achieving technical interoperability within SWIM and are highlighted as specific TI components. This chapter specifies common technology standards for Interface Bindings, providing specifications for the implementation of service, network and infrastructure interfaces. These standards and specifications draw from both the EUROCONTROL Specification for SWIM Technical Infrastructure (TI) Yellow Profile and the ICAO Manual on System Wide Information Management.

3.2 Network Bindings

As IP-based network connectivity is essential for SWIM TI, Table 4 makes reference to TCP/IP related technology standards required for supporting the following network bindings of SWIM TI.

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

Table 4. Standards and Specifications for TCP/IP

Standard and Specification	Description	Reference
IP (Internet Protocol)	This standard defines the format and behavior of the IPv4 protocol, which is used for transmitting packets of data over the internet.	IETF RFC 791
TCP (Transmission Control Protocol)	This standard defines the format and behavior of the TCP protocol, which is used to provide reliable, connection-oriented data transmission over the internet.	IETF RFC 793
Internet Standard Subnetting Procedure	This standard defines the procedures for subnetting IPv4 networks, which allows for more efficient use of IP addresses.	IETF RFC 950
ICMP (Internet Control Message Protocol)	This standard defines the format and behavior of the ICMP protocol, which is used for error reporting and diagnostic messages related to IPv4.	IETF RFC 792
Security Architecture for the Internet Protocol	This standard defines the overall architecture for IPsec, including the components and protocols used to provide security for IP traffic.	IETF RFC 2401

IPv6 (Internet Protocol, Version 6)	This standard defines the next generation of the IP protocol, which uses a larger address space and includes other improvements over IPv4.	IETF RFC 2460
Security Architecture for the Internet Protocol Version 6	This standard extends the IPsec security architecture to support IPv6.	IETF RFC 4301
Internet Standard, Requirements for Internet Hosts-Communication Layers	This standard describes the requirements for Internet hosts and communication protocols, such as requirements for TCP/IP protocol implementations, network interface cards, host software, and Internet applications.	IETF RFC 1122
Guidelines for Specifying the Use of IPsec Version 2	This document provides guidance to developers and administrators on how to specify the use of IPsec version 2 in different contexts, such as network architecture, service level agreements, and security policies.	IETF RFC 5406

3.3 Service and Infrastructure Bindings

Interface type is a classification of services based on the type of technological solution that they deploy. According to the requirement of service and infrastructure bindings, three interface types are defined to indicate the method by which the underlying capabilities of the service are accessed. TCP/IP is the underlying protocol for all interface types.

- Message-oriented: An interface that exposes service capabilities through creating, sending, receiving, and reading messages exchanged by distributed systems. AMQP is a common technology standard that supports this interface type.

- Resource-oriented: An interface that supports the Representational State Transfer (REST) architectural style of interactions, that is, manipulation of XML representations of Web resources using a uniform set of stateless operations, usually a set of HTTP methods.

- Method-oriented: An interface that exposes service capabilities through a set of operations. Technologies that support this interface type are Web Service framework (WS) and Open Geospatial Consortium (OGC) Web Common Services.

3.3.1 Standards for Message-oriented Interface

3.3.1.1 AMQP

The following table makes reference to AMQP related specifications required for supporting service and infrastructure bindings of SWIM TI.

Table 5. Standards and Specifications for AMQP

Standard and Specification	Description	Reference
AMQP (Advanced Message Queuing Protocol)	The latest version is AMQP 1.0, which includes a secure profile that uses TLS for message encryption and authentication. It defines the messaging protocol, message format, and message exchange patterns.	https://www.oasis-open.org/standards#amqpv1.0 ISO/IEC 19464:2014 Information technology - Advanced Message Queuing Protocol (AMQP) v1.0 specification
AMQP Management	This is a standard extension to AMQP that provides a way for administrators to manage AMQP-based messaging systems securely. It includes support for authentication, authorization, and encryption.	https://www.oasis-open.org/standards#amqpmanagementv1.0
AMQP WebSocket	This is an extension to AMQP that allows AMQP messages to be exchanged over WebSocket connections.	https://www.oasis-open.org/standards#amqpwebsocketv1.0
TLS (Transport Layer Security)	This is a security protocol that provides encryption, authentication, and integrity protection for network communications. It is commonly used as the underlying security protocol for AMQPS.	IETF RFC 5246
SASL (Simple Authentication and Security Layer)	This is a framework for authentication and authorization used in AMQP and other network protocols. It provides a standardized way for clients and servers to authenticate each other and to negotiate security parameters.	IETF RFC 4422

3.3.2 Standards for Resource-oriented Interface

3.3.2.1 RESTful API

The following table makes reference to RESTful API related standards and specifications required for supporting the service or infrastructure bindings of SWIM TI.

Table 6. Standards and Specifications for RESTful API

Standard and Specification	Description	Reference
HTTP (Hyper Text Transfer Protocol)	This is the primary protocol used for communication between clients and servers in RESTful APIs. It defines a set of request and response methods (e.g., GET, POST, PUT, DELETE), as well as rules for message framing and authentication.	IETF RFC 7230-7235
HTTPS (Hyper Text Transfer Protocol Secure)	This is a standard that provides secure communication over the internet. It is a combination of the standard HTTP protocol and the security protocol SSL/TLS (Secure Sockets Layer/Transport Layer Security).	IETF RFC 2818, RFC 5246, and RFC 7540
URI (Uniform Resource Identifier)	URIs are used to identify resources in RESTful APIs. They provide a consistent, standardized way to reference resources across different systems.	IETF RFC 3986
OAuth (Open Authorization)	This is a standard protocol for authentication and authorization, which is used to control access to resources in RESTful APIs. It defines a set of roles, grant types, and endpoints that enable third-party applications to access protected resources on behalf of resource owners.	IETF RFC 6749
JSON (JavaScript Object Notation)	It is a lightweight data format used in RESTful APIs to represent structured data. It is widely used because of its simplicity and flexibility.	IETF RFC 7159
XML (Extensible Markup Language)	It is a data format commonly used in RESTful APIs. It provides a more structured and standardized way to represent data than JSON.	https://www.w3.org/XML/
OpenAPI	This is the primary standard for defining RESTful APIs using the OpenAPI specification format. It defines a set of rules and guidelines for creating, documenting, and sharing RESTful APIs.	https://spec.openapis.org/

3.3.3 Standards for Method-oriented Interface

3.3.3.1 OGC WCS

The Open Geospatial Consortium (OGC) has developed several Web Common Service (WCS) and Web API standards that define services for accessing and manipulating geospatial data in a web environment, such as aeronautical information and meteorologic information. The following table makes reference to some of the key standards and specifications required for supporting the service or infrastructure bindings of SWIM TI.

Table 7. Standards for OGC WCS

Standard and Specification	Description	Reference
WCS (Web Coverage Service)	This standard defines a service interface for accessing and manipulating geospatial raster data, including satellite imagery, digital elevation models, and other types of gridded data.	https://www.ogc.org/standards/wcs
WFS (Web Feature Service)	This standard defines a service interface for accessing and manipulating geospatial vector data, including points, lines, and polygons.	https://www.ogc.org/standards/wfs
WMS (Web Map Service)	This standard defines a service interface for accessing and delivering geospatial map images over the web.	https://www.ogc.org/standards/wms
WMTS (Web Map Tile Service)	This standard defines a service interface for accessing pre-rendered geospatial map tiles over the web, which are small image files that make up a larger map.	https://www.ogc.org/standards/wmts
WPS (Web Processing Service)	This standard defines a service interface for accessing and executing geospatial processing algorithms over the web.	https://www.ogc.org/standards/wps
OGC API-EDR (Environmental Data Retrieval)	This specification identifies resources, captures compliance classes, and specifies requirements which are applicable to OGC Environmental Data Retrieval API's.	https://ogcapi.ogc.org/edr/

3.3.3.2 SOAP

As most users have not applied SOAP to current web applications, this standard is not recommended for the development of SWIM services. The following table makes reference to SOAP related standards and specifications required for supporting the service bindings of SOAP applications.

Table 8. Standards and Specifications for SOAP

Standard and Specification	Description	Reference
SOAP (Simple Object Access Protocol)	This is a technology standard that defines a messaging protocol for exchanging structured data over the internet. It defines the basic structure and syntax of SOAP messages, including the use of XML to encode data and the use of HTTP/HTTPS or other protocols for message transport.	https://www.w3.org/TR/soap/
WSDL (Web Services Description Language)	This is a technology standard that is used to describe the structure and interface of a web service. It defines the types of data that can be exchanged, the methods that can be called, and the protocols and formats used for communication.	https://www.w3.org/TR/wsdl
WS-Security	This is a technology standard that provides a set of extensions to SOAP for securing web services. It defines a framework for adding digital signatures, encryption, and other security features to SOAP messages.	https://www.oasis-open.org/committees/ws-sx/ws-security-200702/
XML Signature	This standard provides a way to digitally sign an XML document.	https://www.w3.org/TR/xmldsig-core/
XML Encryption	This standard provides a way to encrypt and decrypt portions of the XML document.	https://www.w3.org/TR/xmlenc-core/

4. TI CAPABILITIES

SWIM TI capabilities are divided into functional and non-functional capabilities. While the TI functional capabilities can be conceptualized as functions that can be invoked or executed by a system and have inputs and outputs, the non-functional capabilities are derived characteristics of a system as a result of implementing functional capabilities or other contributing elements.

- SWIM TI functional capabilities are infrastructure functions (e.g., protocol transformation, encryption), not specific to a business area or information domain, that enable information exchange between systems.

- SWIM TI non-functional capabilities are SWIM TI characteristics that contribute to the quality of services (e.g., the availability of the SWIM TI has direct impact on the availability of the service it supports).

4.1 Functional Capabilities

The SWIM TI functional capabilities described in this section are common features widely supported by mainstream Commercial Off The Shelf (COTS) systems and services. Implementing a SWIM TI that supports all these capabilities is recommended. The SWIM TI functional capabilities can be grouped into three categories as follows:

Table 9. SWIM TI Functional Capabilities

Capability	Description	Related Technology
Messaging	This capability employs technologies that enable information exchange using various access methods (e.g., publish/subscribe, request/reply).	- Message brokers: such as Apache Kafka, RabbitMQ, ActiveMQ.
Security	This capability provides infrastructure security technologies that enable secured information exchange, including, but not limited to, identity access management, digital certificates, encryption.	- Trust Framework - Information Security Framework
TI Management	This capability monitors technical infrastructure for fault and performance, ensuring reliable and compliant information exchange.	- Configuration management tools - Monitoring and observability tools - Performance optimization tools - Backup and disaster recovery tools

In the functional capabilities of SWIM TI, the “security capability” pertains to information security, as discussed at the ICAO Trust Framework Panel (TFP). Furthermore, a draft of the Manual on Information Security (ICAO Doc 10204) has been developed by the ICAO TFP.

4.1.1 Messaging

In SWIM TI, a service interface, or an infrastructure interface defines operations and related input and output messages for those operations that consumers and providers exchange to implement the functionality offered by a service. The following table presents a list of currently defined messaging capabilities of the SWIM TI.

Table 10. Message Capabilities

Capability	Description
Connectivity	This capability enables message exchange according to well-defined protocols. The transport function will instantiate interface binding specifications (set of protocols) into adaptors or connectors to exchange information with other systems.
Message Distribution	This capability enables synchronous or asynchronous message processing. It uses information exchange resources (e.g., queues, topics) to decouple TI functions involved in message processing (connectivity, validation, etc.) based on configurable distribution rules (e.g., content/context-based routing). The components that provide this kind of functionality are message brokers.
Message Validation	This capability enables message validation to ensure they are syntactically well formed.
Policy Enforcement	This capability enforces messaging policy (e.g., routing and filtering policies, reliability policy) application.
Orchestration	This capability enables coordination between SWIM TI capabilities.

4.1.2 Security

The SWIM TI security capabilities are of high importance as they enable a trusted information exchange. The following table presents a list of currently defined security capabilities of the SWIM TI.

Table 11. Security Capabilities

Capability	Description
Identity Management	This capability enables identity management (e.g., identity creation, identity validation, federated identity retrieval).
Authentication	This capability enables credential verification and validity and their correspondence with an identity.
Authorization	This capability enables permission management associated to identities and, based on these, enforcing access control to SWIM TI services and resources.
Cryptography	This capability provides secure functions for encryption, decryption and hashing.
Key Management	This capability enables cryptographic keys' secure management.
Audit	This capability records contextual information related to security events.
Security Monitoring	This capability enables security related event monitoring, event handling and reporting.
Policy Enforcement	This capability enforces security policy application.
Boundary Protection	This capability provides functions to ensure infrastructure protection against external threats (e.g., firewall, rate limit management).

These capabilities are related to the information security that has been discussed at the ICAO TFP. SWIM TI security capabilities should align with the Manual on Information Security (ICAO Doc 10204) drafted by ICAO TFP.

4.1.3 TI Management

As supporting functions to messaging, the TI management capabilities ensure reliable and performant information exchange. The following table presents a list of currently defined TI management capabilities of the SWIM TI.

Table 12. TI Management Capabilities

Capability	Description
Resource Monitoring	This capability enables TI resources (e.g., processors, memory) monitoring.
Service Monitoring	This capability enables the TI service (e.g., status, uptime, and response times) monitoring.
Alerting	This capability enables management alerts regarding infrastructure-related events (e.g., threshold management) monitoring.
Logging	This capability enables the system event recording with the relevant contextual information.
Key Management	This capability enables cryptographic keys' secure management.
Audit	This capability records contextual information related to security events.
Replication	This capability enables system and data replication management, enabling different degrees of fault tolerance and failover.
Persistence	This capability enables data persistence management in the SWIM TI.
Load Balancing /Clustering	This capability enables load distribution management across SWIM TI resources, enabling horizontal scaling and high availability.
Common Time Reference	This capability provides a common time reference for time synchronization between different systems and services.

4.2 Non-Functional Capabilities

The SWIM TI non-functional capabilities directly contribute to the quality of SWIM services that use the SWIM TI. The SWIM TI non-functional capabilities addressed in this section are a consequence of using functional capabilities. The non-functional capabilities of the SWIM TI are based on ISO 25010 and are described in the following table.

Table 12. SWIM TI Non-Functional Capabilities

Quality	Characteristic	Related Capability
Performance Efficiency Qualities	- Time behavior, including response time and latency, can be directly correlated to the functional capability execution time of the TI. - Capacity (e.g., messages per second) is directly correlated to the functional capability execution time of the TI.	- Replication - Load balancing
Reliability Qualities	- Availability enables the SWIM TI to remain operational and accessible when required for use. - Recoverability enables the SWIM TI to recover the data directly affected by an interruption or a failure and re-establish the desired system state. - Fault tolerance enables the SWIM TI to operate as intended despite the presence of hardware or software faults.	- Replication - Load balancing
Security Non-Functional Qualities	- Confidentiality ensures that data is accessible only to those authorized to have access. - Integrity prevents unauthorized access to, or modification of data. - Non-repudiation ensures actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later. - Accountability ensures actions of an entity can be traced uniquely to the entity. - Authenticity ensures the identity of a subject or resource can be verified.	- Authentication - Authorization - Cryptography - Logging - Message Validation

APPENDIX A

STRUCTURE OF AMHS/SWIM GATEWAY

The AMHS/SWIM Gateway consists of following functional building blocks (Figure A.1):

- AMHS Component: Provides the X.400 connection to AMHS agent for exchange of aeronautical information with AMHS users.
- Information Transfer and Control Unit (ITCU): Provides functions to convert and transfer information and control the flow of information.
- SWIM Component: Provides the AMQP connection to SWIM TI for exchange of aeronautical information with SWIM information providers and consumers.
- Control Position (CP): Provides the function to receive reports on issues occurred during the automated processing by the other components of the AMHS/SWIM Gateway for appropriate action.
- Directory User Agent (DUA): Provides the connection to the ATN Directory.

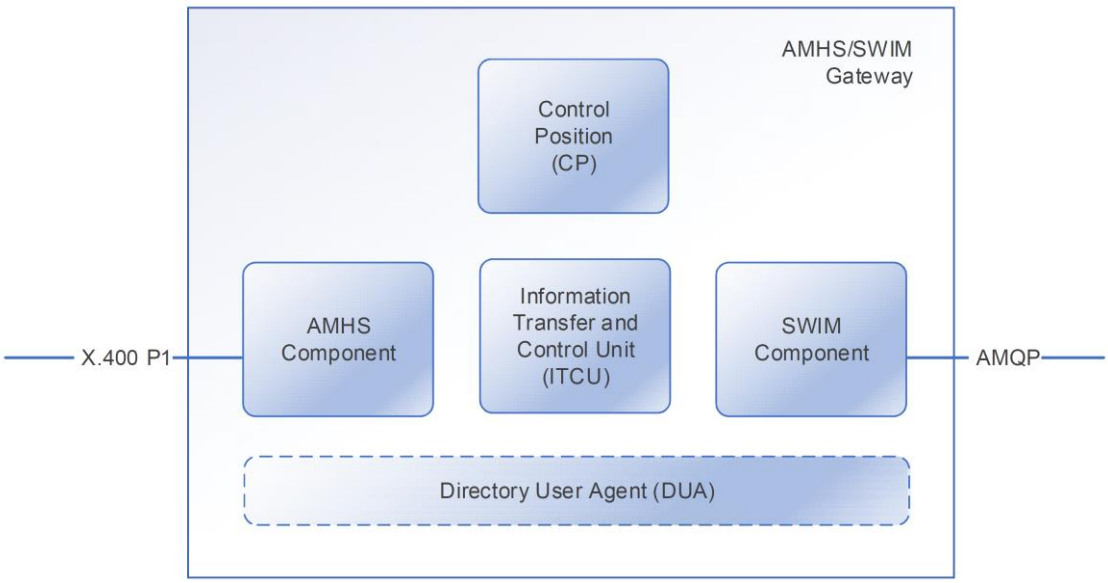


Figure A.1. Structure of AMHS/SWIM Gateway

Internally, each functional building block of the AMHS/SWIM Gateway has connections to other functional building blocks using local defined interfaces. Detailed information can be found in the "AMHS/SWIM Gateway Specification" document.

To achieve interoperability during the transition period, the function of the AMHS/SWIM Gateway can be provided by SWIM TI service providers or third-party SWIM service providers.

APPENDIX B

ARCHITECTURE OF SDCM

The Service Description Conceptual Model (SDCM) provides a graphical and lexical representation of the properties, structure, and interrelationships of all service metadata elements, collectively known as a Service Description.

The SDCM in its JSON formalization has been used to develop a SWIM Discovery Service (SDS), an international collaborative project currently supported by the FAA, the Korea Airports Corporation (KAC), the People's Republic of China's Air Traffic Management Bureau (ATMB), and Japan's Electronic Navigation Research Institute (ENRI) under the SWIM Task Force.

In the SDCM, packages and classes are two main Unified Modelling Language (UML) model elements. Packages are used to group classes into logical units, whereas classes represent specific concepts. Packages and classes are related in a variety of ways through UML-defined associations.

Figure B.1 shows the high-level architecture of the SDCM, where each part of the top, encompassing concept Service Description is shown as a package, which in its turn contains classes. The aggregation association between Service Description and Profile, Model, and Grounding indicates that these are all parts of the Service Description, and the dependency relationship between Utility and Service Description signifies that changes to Utility's classes affect classes in other packages.

- Service Description package: The information needed in order to use, or consider using, a service.

- Profile package: The part of a service description that advertises the service to potential consumers by describing the parties responsible for providing the service, what is accomplished by the service, and limitations on service applicability.

- Model package: The part of a service description that describes the service interface and its operations, including the contents of requests, message formats, data types, and how to construct an invocation message and interpret a response message.

- Grounding package: The part of a service description that describes the means by which the service is invoked, including the underlying technology protocols and network locations of the service.

- Utility package: The part of a service description that contains abstract classes for use by other classes.

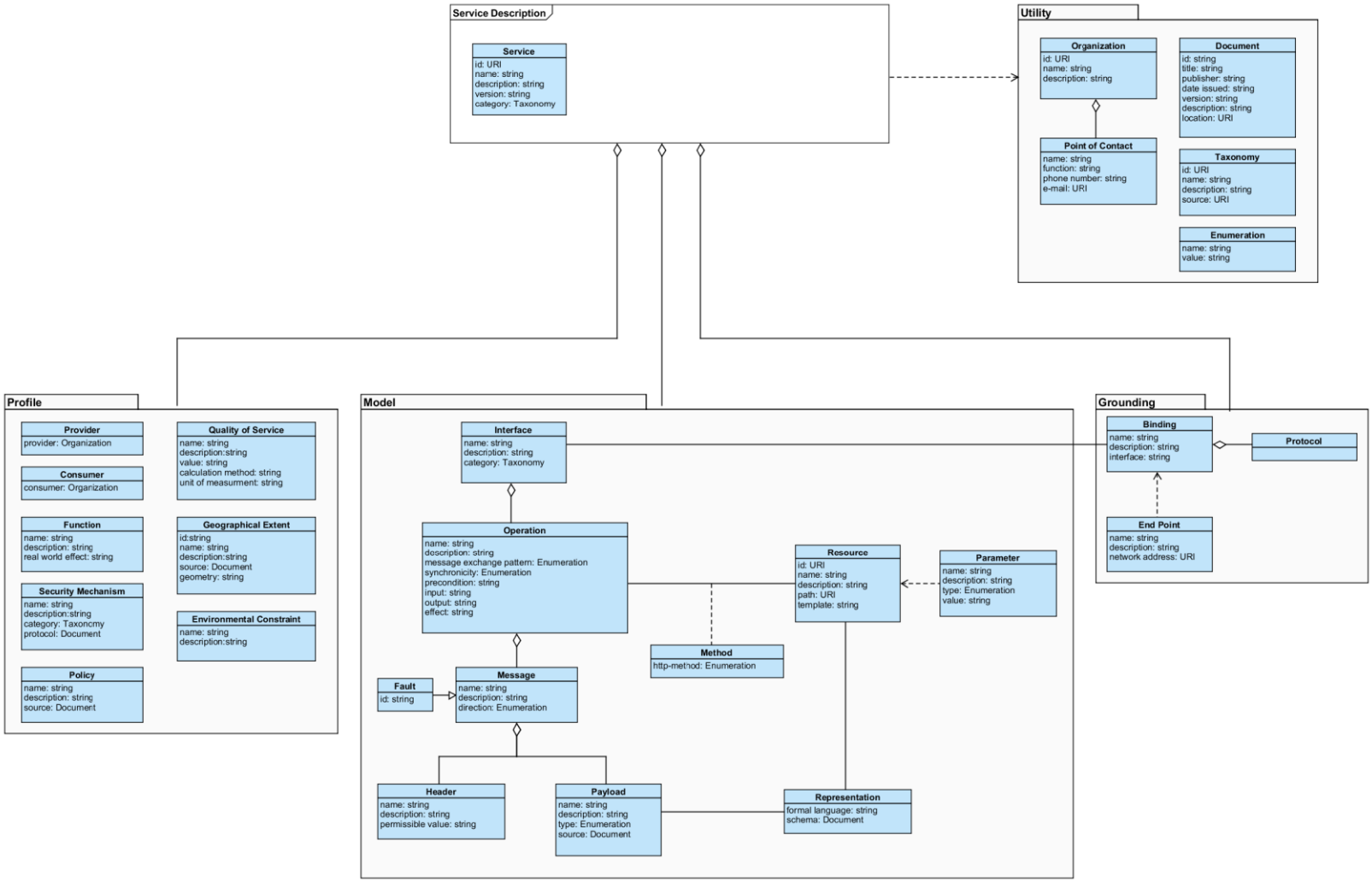


Figure B.1. Architecture of SDCM

APPENDIX C

EXAMPLE OF SWIM MESSAGE HEADERS via AMQP

C.1 Message Headers for FIXM FF-ICE Messages

The following table (Table C.1) shows an example of message headers for an FF-ICE Field Flight Plan message in FIXM format.

Table C.1. Example of Message Headers for a Filed Flight Plan Message

Header Name	**Values**	**Descriptions**
SOURCE	RJ_JAL	Name of message publisher (ICAO Country Code_Organization Name)
RECIPIENT_LIST	RJ_JCAB,VT_AEROTHAI	Name list of recipients
SYSTEM	JAL	Name of system
CATEGORY	FIXM	Name of information exchange model (FIXM)
CATEGORY_VERSION	FIXM_4_2_FF_ICE	Version of information exchange model (FIXM 4.2 version for FF-ICE Messages)
MESSAGE_TYPE	FILED_FLIGHT_PLAN	Message type of information exchange model (FIXM FF-ICE message types)
FFICE_PHASE	FILED	Flight plan phase of FF-ICE (PRELIM or FILED)
DEP_AIRPORT	RJAA	Departure Airport
ARR_AIRPORT	VTBS	Arrival Airport
AIRLINE	JAL	Name of airline
ACID	JAL707X	Aircraft Identification
GUFI	0248982c-4384-49f4-bdb3-7956bd553383	Globally Unique Flight Identifier
EOBT	2023-02-01T03:00:00Z	Estimated Off-Block Time
TIMESTAMP	JAL_OUT:1675213637251	Timestamp of the message out or in the system

The following headers are mandatory for GUFI registration and validation.

- ACID
- DEP_AIRPORT
- ARR_AIRPORT
- EOBT

The following headers are required for content-based message routing between SWIM TIs. Message types should be consistent with the definition in each information exchange model.

- SOURCE
- RECIPIENT_LIST
- CATEGORY
- CATEGORY_VERSION
- MESSAGE_TYPE

The following headers are recommended for SWIM TI management.

- SYSTEM
- TIMESTAMP

C.2 Message Headers for AIXM Messages

The following table (Table C.2) shows an example of message headers for a NOTAM message in AXIM format.

Table C.2. Example of Message Headers for a NOTAM Message

Header Name	Values	Descriptions
SOURCE	RJ_JCAB	Name of message publisher
RECIPIENT_LIST	RJ_JAL,VT_AEROTHAI	Name list of recipients
SYSTEM	JCAB	Name of system
CATEGORY	AIXM	Name of information exchange model (AIXM)
CATEGORY_VERSION	AIXM_5_1	Version of information exchange model (AIXM 5.1)
MESSAGE_TYPE	NOTAM	Message type of information exchange model (NOTAM message)
TIMESTAMP	JCAB_OUT:1675213637251	Timestamp of the message out or in the system

C.3 Message Headers for IWXXM Messages

The following table (Table C.3) shows an example of message headers for a SIGMET message in IWXXM format.

Table C.3. Example of Message Headers for a SIGMET Message

Header Name	Values	Descriptions
SOURCE	RJ_JCAB	Name of message publisher
RECIPIENT_LIST	RJ_JAL,VT_AEROTHAI	Name list of recipients
SYSTEM	JCAB	Name of system
CATEGORY	IWXXM	Name of information exchange model (IWXXM)
CATEGORY_VERSION	IWXXM_3_0	Version of information exchange model (IWXXM 3.0)
MESSAGE_TYPE	SIGMET	Message type of information exchange model (SIGMET message)
TIMESTAMP	JCAB_OUT:1675213637251	Timestamp of the message out or in the system

In some local and regional demonstrations, the following headers have been used in NOTAM and SIGMET messages to indicate that specific aeronautical information or meteorological information affects a particular aircraft during either pre-departure or post-departure phase.

- ACID
- GUFI
- DEP_AIRPORT
- ARR_AIRPORT
- EOBT
- FFICE_PHASE

C.4 Message Headers for Surveillance Data

Currently, two common message formats are available for surveillance data exchange in the APAC region. One is using TRACK message type defined in the FIXM APAC Extension. The other is sharing surveillance data in ASTERIX format.

The following table (Table C.4.1) shows an example of message headers for a TRACK message in FIXM APAC Extension format.

Table C.4.1. Example of Message Headers for a TRACK Message in FIXM APAC Extension

Header Name	**Values**	**Descriptions**
SOURCE	RJ_JAL	Name of message publisher
RECIPIENT_LIST	RJ_JCAB,VT_AEROTHAI	Name list of recipients
SYSTEM	JAL	Name of system
CATEGORY	FIXM	Name of information exchange model (FIXM)
CATEGORY_VERSION	FIXM_4_2_APAC	Version of information exchange model (FIXM 4.2 APAC Extension)
MESSAGE_TYPE	TRACK	Message type of information exchange model (TRACK message)
DEP_AIRPORT	RJAA	Departure Airport
ARR_AIRPORT	VTBS	Arrival Airport
AIRLINE	JAL	Name of airline
ACID	JAL707X	Aircraft Identification
GUFI	0248982c-4384-49f4-bdb3-7956bd553383	Globally Unique Flight Identifier
EOBT	2023-02-01T03:00:00Z	Estimated Off-Block Time
TIMESTAMP	JAL_OUT:1675213637251	Timestamp of the message out or in the system

For consistent operation and data governance, the following headers are mandatory for information registration and validation by using FIXM format.

- ACID
- GUFI
- DEP_AIRPORT
- ARR_AIRPORT
- EOBT

The following table (Table C.4.2) shows an example of message headers for a TRACK message in ASTERIX format.

Table C.4.2. Example of Message Headers for a TRACK Message in ASTERIX

Header Name	**Values**	**Descriptions**
SOURCE	RJ_JCAB	Name of message publisher
RECIPIENT_LIST	RJ_JAL,VT_AEROTHAI	Name list of recipients
SYSTEM	JCAB	Name of system
CATEGORY	ASTERIX	Name of information exchange model (ASTERIX)
CATEGORY_VERSION	ASTERIX _CAT021	Version of information exchange model (Data Category of ASTERIX)
MESSAGE_TYPE	TRACK_RAW	Message type of information exchange model (ADS_B TRACK message)
DEP_AIRPORT	RJAA	Departure Airport
ARR_AIRPORT	VTBS	Arrival Airport
ACID	JAL707X	Aircraft Identification
TIMESTAMP	JCAB_OUT:1675213637251	Timestamp of the message out or in the system

These message headers have been applied and validated in various local and regional demonstrations. To achieve SWIM-based operations and ensure global interoperability, it is necessary to consider the definitions, naming rules, and maintenance approaches of these message headers.

Proposed business functionality of APAC Common SWIM Information Services
(Updated by SWIM TF/9)

Notes. – Recommended services in initial APAC Common SWIM Information Service (IS) ((1)/(2)/(3)):
(1) Recommended for region-wide implementation for region-wide benefits
(2) Recommended for implementation as much as practicable
(3) Additional information services without common regional requirements and not included as a part of common regional information services

Business functionality of the service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)**
APAC Common SWIM Aeronautical Information Services					
Airspace management service	Exchanges of airspace status information between ASM Support System and Air Traffic Control (ATC) System. The sharing of airspace availability and airspace structure in real-time will contribute to a more efficient execution of the flight as information impacting the trajectory will be exchanged.	Airspace availability, restricted area, danger area, search and rescue regions	AIXM	Pub/Sub	2
Airspace feature service	Provides the characteristics of the three-dimensional airspace, described as horizontal projection with vertical limits, and their relevance to air traffic.	FIR/UIR boundaries, waypoints, enroute ATS routes, SIDs and STARs, navaids, procedures	AIXM	Pub/Sub or Req Reply	2
Aerodrome feature service	Provides current and/or planned airport layout features, such as aerodrome mapping data, runway, taxiway, passenger facilities.	Runways, movement areas, aerodrome services, navaids, instrument landing systems, Aerodrome location, communication facilities (frequencies)	AIXM	Pub/Sub	2
Digital NOTAM distribution service	Provides aeronautical information in accordance with the Digital NOTAM Specification, such as runway closure.	Digital NOTAM (e.g. Special activity airspace (SAA) NOTAMs, or other types of NOTAMs)	AIXM	Pub/Sub	2

Business functionality of the service	Brief description of the service	Type of information to be exchanged	Information exchange model / Message type	Message exchange pattern	Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)
Runway Condition Report service	Provides runway surface conditions and contaminants (least to most slippery) that are directly correlated to aircraft take-off and landing performance.	Global Reporting Format (GRF) for runway surface conditions	AIXM	Pub/Sub or Req/Reply	2
ATIS distribution service	Provides continuous and automated broadcast of recorded aeronautical information in airport and terminal areas.	Current weather conditions, runway in use, available approaches, and other data relevant to arriving and departing aircraft, specific ATC procedures, and any airport construction activity that could affect taxi planning	TBD	Pub/Sub	2
Search and rescue service	Allows Rescue Coordination Centres (RCCs) to exchange information with neighbouring RCCs and ATS units for coordination during SAR operations.	Search and rescue regions, Registered aircraft operator details and contacts, ICAO Autonomous Distress Tracking (ADT) data, Location of Aircraft in Distress Repository (LADR) data, ICAO OPS CTRL database contact information, SAR Unit (SRU) location and capability data	TBD	Pub/Sub	3
APAC Common SWIM Flight Information Services					
GUFI service	GUFI (Globally Unique Flight Identifier) generation and provision	GUFI	FIXM	Req/Reply	1
ATFM/A-CDM integrated service	Allows exchanges of flight plans and A-CDM milestone parameters among different stakeholders (such as arrival/departure ATFM units, airlines and airport operators) to connect A-CDM process to ATFM operations.	CTOT, CTO, TTOT, TSAT, etc.	FIXM	Pub/Sub	1
FF-ICE filing service	Provides a means to submit, update or cancel flight plans through a SWIM-based interface using FIXM.	Flight plan for registration, update or cancellation	FIXM	Req/Reply	1

Business functionality of the service	Brief description of the service	Type of information to be exchanged	Information exchange model / Message type	Message exchange pattern	Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)
FF-ICE data publication service	Provides harmonised sharing of flight plan information in a global standard supporting common situation awareness.	Flight plan for publication	FIXM	Pub/Sub	2
FF-ICE trial service	Allows operators to test the effect of a potential change in a flight plan prior to committing to the change.	Proposed changes in a flight plan	FIXM	Req/Reply	2
FF-ICE flight data request service	Allows an operator to request the current status of a flight plan, or an ANSP can request an operator to submit the latest version of their flight plan.	Current status of a flight plan	FIXM	Req/Reply	1
FF-ICE notification service	Provides notification of a change in flight state, such as Departure (DEP) and Arrival (ARR) Air Traffic Service (ATS) messages.	ARR, DEP messages	FIXM	Pub/Sub	1
FF-ICE planning service	Allows operators to submit flight plans for early Air Traffic Flow Management (ATFM) planning and to obtain feedback regarding restrictions/constraints affecting the flight.	Flight plan for early ATFM planning	FIXM	Req/Reply	2
Traffic flow status service	Provides users with notification of any traffic flow management measures which are in affect and how they may affect their aircraft.	Demand and constraints, Miles-in-Trail (MIT), Minutes-in-Trail (MINIT), ATFM daily plan, Ground Delay Program (GDP)	TBD	Pub/Sub	2
APAC Common SWIM Meteorological Information Services					
METAR/SPECI information service	Provides of IWXXM-formatted METAR/SPECI product specified in ICAO Annex 3.	Provision of the existing product in Annex 3. Information service will be enabled through Amendment 81 to Annex 3 as recommended practice with applicability from Nov 2024.	IWXXM	Pub/Sub Req/Reply	1
TAF information service	Provides of IWXXM-formatted TAF product specified in ICAO Annex 3.		IWXXM	Pub/Sub Req/Reply	1
SIGMET information service	Provides of IWXXM-formatted SIGMET product specified in ICAO Annex 3.		IWXXM	Pub/Sub Req/Reply	1
AIRMET information service	Provides of IWXXM-formatted AIRMET product specified in ICAO Annex 3.		IWXXM	Pub/Sub Req/Reply	1

Business functionality of the service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)**
Tropical Cyclone Advisory information service	Provides of IWXXM-formatted Tropical Cyclone Advisory product specified in ICAO Annex 3. (Designated provider: States with Tropical Cyclone Advisory Centre)		IWXXM	Pub/Sub Req/Reply	1
Volcanic Ash Advisory information service	Provides of IWXXM-formatted Volcanic Ash Advisory product specified in ICAO Annex 3. (Designated provider: States with Volcanic Ash Advisory Centre)		IWXXM	Pub/Sub Req/Reply	1
Space Weather Advisory information service	Provides of IWXXM-formatted Space Weather Advisory product specified in ICAO Annex 3. (Designated provider: States with Space Weather Advisory Centre)		IWXXM	Pub/Sub Req/Reply	1
Observatory Notice for Aviation (VONA) information service	Provides of IWXXM-formatted VONA specified in ICAO Annex 3. Provision of VONA will become the recommended practice in Annex 3 in 2025. (Designated provider: States with Volcano Observatory)		IWXXM	Pub/Sub Req/Reply	2
Aerodrome observation information service	Provides continuous observations of weather parameters at an aerodrome. Advanced meteorological SWIM (MET-SWIM) service being developed by MET Panel.	To be introduced as recommended practice in Annex 3 (Amd 83) in Nov 2027 tentatively	IWXXM	Pub/Sub or Req/Reply	2
Aerodrome forecast information service	Provides information of the expected meteorological conditions, including probability, at an airport during a specified period. Advanced meteorological SWIM (MET-SWIM) service being developed by MET Panel.	To be introduced as recommended practice in Annex 3 (Amd 83) in Nov 2027 tentatively	IWXXM	Pub/Sub or Req/Reply	2

Business functionality of the service	Brief description of the service	Type of information to be exchanged	Information exchange model / Message type	Message exchange pattern	Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)
Quantitative volcanic ash (QVA) concentration information service	Provides detailed information of volcanic ash in the atmosphere, including probabilities of ash concentration thresholds over space and time. Advanced meteorological SWIM (MET-SWIM) service being developed by MET Panel. (Designated provider: States with VAAC)	QVA grids point forecasts including probabilities, QVA objects. To be introduced as recommended practice in Annex 3 (Amd 82) in Nov 2025 tentatively	Gridded data (e.g. NetCDF), IWXXM	Pub/Sub or Req/Reply	1
WAFC (World Area Forecast Centres) grid point forecast	Provides global gridded weather forecasts. (Designated provider: WAFCs (UK and US))	Global gridded forecasts of upper winds, upper-air temperatures and humidity, flight level and temperature of tropopause, and direction, speed and flight level of maximum wind	Gridded data in GRIB	Pub/Sub or Req/Reply	1
WAFC significant weather (SIGWX) forecast	Provides global WAFC SIGWX data sets with coverage expressed in polygons. (Designated provider: WAFCs (UK and US))	Significant weather forecast such as tropical cyclone, severe squall lines, turbulence, icing, etc.	IWXXM	Pub/Sub or Req/Reply	1
Special Air Report (ARS)	Provides reports of special observations made by aircraft when they encounter special weather phenomena, such as moderate/severe turbulence or icing.	Special aircraft observations of weather phenomena as specified in Annex 3, including turbulence, icing, mountain wave, thunderstorms, duststorm, sandstorm, volcanic cloud, volcanic activity / eruption	TBD	Pub/Sub or Req/Reply	2
MET derived from Mode S DAPs	Provides upper air winds and temperatures derived from Mode S Downlinked Aircraft Parameters (DAPs) (e.g. true airspeed, ground speed, magnetic heading, true track angle) and facilitates exchange of derived winds and temperatures among MET service providers.	Upper air winds and temperatures derived from Mode S DAPS	TBD	Pub/Sub or Req/Reply	3

Business functionality of the service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Recommended service in initial APAC Common SWIM IS (1) / (2) / (3)**
Satellite image service	Provides satellite observational information.	Satellite derived MET information (e.g. significant convection)	Gridded format (e.g. NetCDF) and image format	Req/Reply	2
Weather radar image service	Provides two- or three-dimensional radar observational information.	Weather radar reflectivity to visualise the intensity of convection	Gridded format (e.g. NetCDF) and image format	Req/Reply	2
APAC Common SWIM Surveillance Information Services					
Surveillance data sharing service	Provides three-dimensional position, time and identification of aircraft and other data as appropriate.	Position, altitude, ground speed, track angle, call sign, Mode S address, data quality, Mode S DAP	ASTERIX Cat 21 (payload in JSON or RAW format)	Pub/Sub	2

APPENDIX E

Proposed data catalog for potential APAC Common SWIM Information Services
(updates since SWIM TF/8 are highlighted with grey shading)

*(a) Information to be exchanged via **APAC Common SWIM Aeronautical Information Services**:*

Aerodrome
- Location of aerodrome reference point
- Elevation
- Runways
- Navigational aids and instrument landing systems
- Available aerodrome equipment

Airspace
- FIR boundary
- Restricted areas
- Prohibited areas
- Search and rescue areas
- Temporary flight restrictions

*(b) Information to be exchanged via **APAC Common SWIM Flight Information Services**:*

- Global Unified Flight Identifier (GUFI)
- Departure aerodrome
- Destination aerodrome
- Flight plan
- Planned route/trajectory
- Aircraft type
- Estimated Off-Block Time (EOBT)
- Estimated Take-Off Time (ETOT)
- Estimated Landing Time (ELDT)
- Estimated Elapsed Time (EET)
- Calculated Take-Off Time (CTOT)
- Calculated Landing Time (CLDT)
- Target Off-Block Time (TOBT)
- Target Start Up Approval Time (TSAT)
- Target Take-Off Time (TTOT)
- Actual Off-Block Time (AOBT)
- Estimated Time Over (ETO)
- Calculated Time Over (CTO)
- Actual Time Over (ATO)
- Flight Plan Amendments
- Flight Plan Cancellations
- Agreed Trajectory for TBO
- Desired trajectory for TBO
- Filed Trajectory for TBO

*(c) Information to be exchanged via **APAC Common SWIM Flow Information Services**:*

- Miles-in-Trail (MIT)
- Minutes-in-Trail (MINIT)

*(d) Information to be exchanged via **APAC Common SWIM Meteorological Information Services**:*

Aerodrome

Phenomena:
- Cloud amount and type
- Lightning/thunderstorm
- QNH
- RVR
- Surface wind and gusts
- Temperature and dew point
- Turbulence
- Visibility
- Windshear

Products:
- Radar data

Enroute

Phenomena:

- Thunderstorm
- Clear air turbulence
- Icing
- Wind
- Temperature
- Tropopause height

Products:

- WC SIGMET (thunderstorms, turbulence, icing, mountain waves, dust / sand storms, radioactive clouds)
- WV SIGMET (volcanic ash)
- WC SIGMET (tropical cyclone)
- Volcanic ash advisory
- Tropical cyclone advisory
- Space weather advisory
- Volcano Observatory Notice for Aviation (VONA)
- Quantitative Volcanic Ash (QVA) Concentration Information
- Satellite data

*(e) Information to be exchanged via **APAC Common SWIM Surveillance Information Services**:*

- Time
- Latitude/longitude
- Altitude
- Ground speed
- Track angle
- Callsign
- Mode S address
- Data Quality
- Mode-S DAP

APAC USE CASES AND USER REQUIREMENTS

FOR SWIM-BASED MET INFORMATION SERVICES

SUPPORTING ATFM

(Draft Version, May 2024)

(Note: Updates made after MET SG/27 are indicated with highlighted text.)

Table of Contents

Section 1

Introduction

Purpose

1.1 The purpose of this reference material is to document ATFM use cases and user requirements in the APAC region to promote the development of SWIM-based MET information services.

1.2 This reference document includes conceptual use cases to illustrate and publicise how SWIM-based MET information services and the associated SWIM-enabled MET applications could benefit ATFM in the APAC Region in the future. These examples would increase the awareness and understanding of both MET service providers and ATFM users in APAC on the operational benefits to ATFM to be brought by the exchange of meteorological information together with aeronautical and flight information in SWIM.

1.3 This document would be a living reference under regular review by the MET/R WG ad-hoc group. The collection of use cases could be further expanded or improved with known events.

1.4 This document does not infer any obligation on States to implement the SWIM-based MET Information Services described.

Background

1.5 The APAC Regional Framework for Collaborative ATFM has been developed and maintained by the Air Traffic Flow Management Steering Group (ATFM/SG) to provide, among other things, the performance improvement plan to address the ATFM implementation and operational issues in the region. The core concept of the Framework is the Distributed Multi-Nodal ATFM Network, i.e. a network of Air Navigation Service Providers (ANSPs) and/or Sub-Regional Groups leading independent ATFM operation within their area of responsibility and connecting to each other through information sharing framework. In the APAC region, the SWIM Task Force (SWIM TF) has been established since 2017 to develop SWIM-related components and supporting materials required for the implementation in the APAC region. The work of SWIM TF also includes the coordination with other Working Groups/Task Forces under APANPIRG to ensure that the operational requirements, particularly the ones specific to the region, are reflected and incorporated accordingly in the regional implementation strategies.

1.6 A SWIM Demonstration project was initiated in 2016 under the cooperation framework between Association of Southeast Asian Nations (ASEAN) and the USA. Since then, Singapore and Thailand had been working with the USA to plan out the Demonstration with the main objective to showcase the operational benefits enabled by SWIM in ASEAN and Asia/Pacific region. The SWIM in ASEAN Demonstration was conducted with great success in November 2019, in Bangkok, Thailand and Singapore, with wide participation of aviation stakeholders in ASEAN and Asia/Pacific region, including Civil Aviation Authorities (CAAs), Air Navigation Service Providers (ANSPs), airport operators, airlines, and international organizations such as ICAO APAC Office, IATA. The outcomes of the SWIM in ASEAN Demonstration were captured in detail in the Demonstration Report which covered the details

of the demonstration development, including (*i*) development of operational scenarios, including ATFM scenarios, (*ii*) SWIM infrastructure, information services, and SWIM-enabled applications design, development, and test, and (*iii*) observations and lessons learnt recorded.

1.7 SWIM TF/3 held in May 2019 agreed that the SWIM implementation to support cross-border ATFM operation should be given high priority. To prepare for the transition of the provision of MET information in a SWIM environment, a regional document for SWIM-based MET information services to support the specific operational mode of cross-border ATFM in APAC Region, as detailed in the aforementioned Framework, is proposed to be formulated at MET/R WG/8.

Section 2

Global Development

2.1 This section provides a brief introduction of globally standardized information exchange models to support the sharing of MET and ATFM information, exchange patterns, and relevant reference documents at global level.

Global and Regional SWIM Developments related to MET and ATM

2.2 According to the Sixth Edition of the ICAO Global Air Navigation Plan (Doc 9750 GANP) Aviation System Block Upgrades (ASBU) SWIM-B2 (2025-2030) [1], the communication based on System-Wide Information Management (SWIM) concept (refer to ICAO Doc. 10039 Manual on System Wide Information Management (SWIM) Concept) will improve the current human-to-human communication with machine-to-machine interconnection, enhancing efficiency in data distribution and accessibility through global interoperability among aviation stakeholders. In particular, dissemination of MET information using MET information services in SWIM is included as part of the Advanced Meteorological Information (AMET) thread in ASBU.

SWIM-based MET Information Services as described in MET-SWIM Plan

2.3 According to the MET-SWIM Plan, being developed by the ICAO Meteorology Panel Working Group on Meteorological Information Exchange (WG-MIE), the exchange of MET information between information producers and information consumers in the SWIM environment can be achieved using two main messaging mechanisms, namely request/reply and publish/subscribe information exchange patterns (Figure 1).

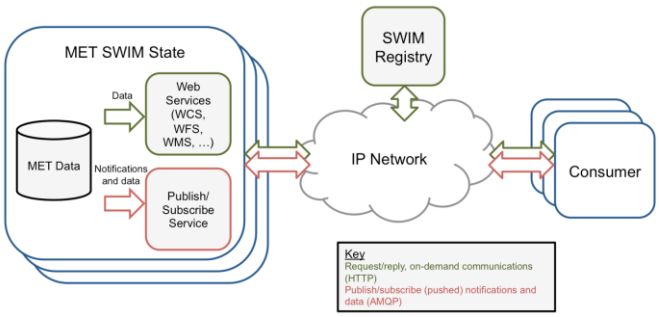


Figure 1: Possible mechanisms of SWIM-based MET Information Exchange Services.

2.4 MET information to be exchanged in SWIM includes ICAO Meteorological Information Exchange Model (IWXXM) messages, gridded products and imageries. IWXXM is the model for exchange of MET information including volcanic ash advisory information, tropical cyclone advisory information, space weather advisory information, METAR and SPECI, TAF, SIGMET and AIRMET. The METP WG-MIE has proposed actions with regards to harmonization of IWXXM with other Exchange Models (XMs) and with the ATM Information Reference Model (AIRM) to support interoperability in SWIM.

[1] Note that the current version of ASBU can be referred to https://www4.icao.int/ganpportal/ASBU

Section 3

Use Cases and User Requirements for SWIM-based MET Information Services to Support ATFM Operation in APAC

3.1 Overview

(i) This section provides examples of user requirements and use cases for SWIM-based MET information services to support ATFM operation in APAC. Use case refers to a specific operational scenario in which MET information or service could potentially be used in a real-world environment, including the details of activities conducted by each actor involving in the operation identified.

(ii) Some examples of use cases involve integration of MET and ATFM information in SWIM environment and its potential benefits in supporting cross-border ATFM in APAC. With the MET and ATFM data to be made available via SWIM-based Information Exchange Services, relevant MET data and ATFM data could be integrated to provide new fit-for-purpose information to better support ATFM in the region.

(iii) The following paragraphs provide seven examples of use cases:

- USE CASE 1: Reduced airport arrival capacity due to tropical cyclone, and the need for ground delay ATFM measure
- USE CASE 2: Airborne rerouting due to turbulence
- USE CASE 3: Volcanic ash avoidance based on digital Volcanic Ash Advisory and Volcanic Ash SIGMET
- USE CASE 4: Flight diversion due to fog
- USE CASE 5: Use of Quantitative Volcanic Ash Concentration Information in Trajectory-based Operation
- USE CASE 6: Weather impact assessment based on actual air traffic volume over Standard Terminal Arrival Routes (STARs)
- USE CASE 7: (*potential future use case*) Aircraft spacing management based on MET information and real-time surveillance information shared in SWIM

USE CASE 1: Reduced airport arrival capacity due to tropical cyclone, and the need for ground delay ATFM measure

3.1.1 In this use case, MET information in IWXXM is ingested in the decision supporting tool together with aerodrome information in Aeronautical Information Exchange Model (AIXM) to assess the crosswind at destination aerodrome within a specific time period. This can be used to evaluate the impact on airport capacity and the need for applying traffic regulating ATFM measure at the affected aerodrome. (Figure 2).

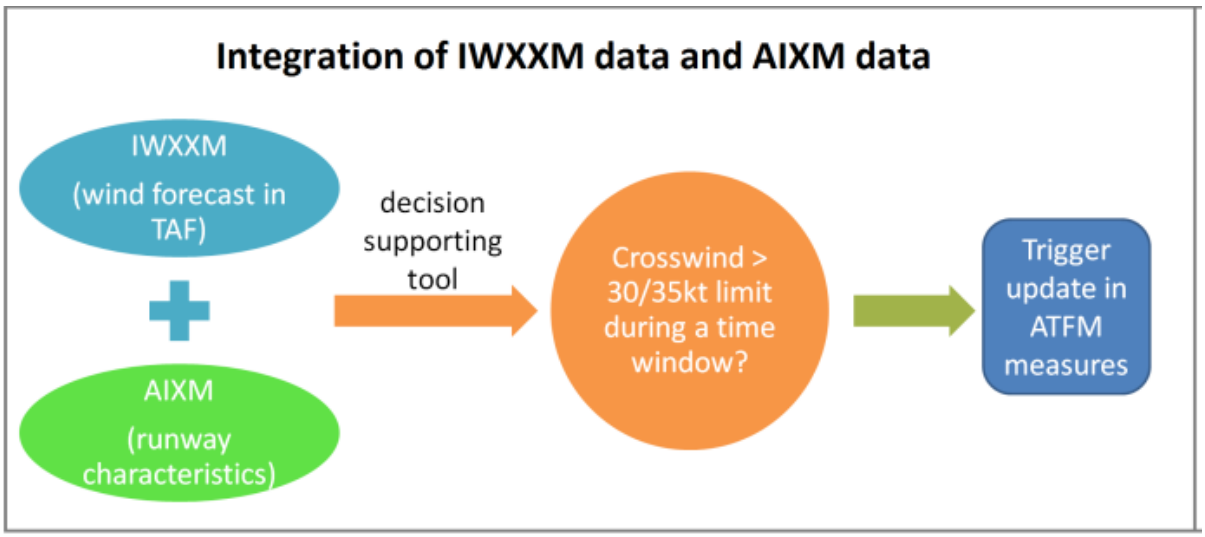


Figure 2: Integration of IWXXM and AIXM Data.

3.1.2 Figure 3 shows an example of SWIM-enabled MET-ATM Display. It provides a regional overview to allow Air Traffic Flow Management Units (ATFMUs) and Flight Operations Center (FOC) of airlines to monitor the change in weather impact over the region. It makes use of request/reply information exchange mechanism in SWIM and display how weather change based on users' requested time and flight level inputted.

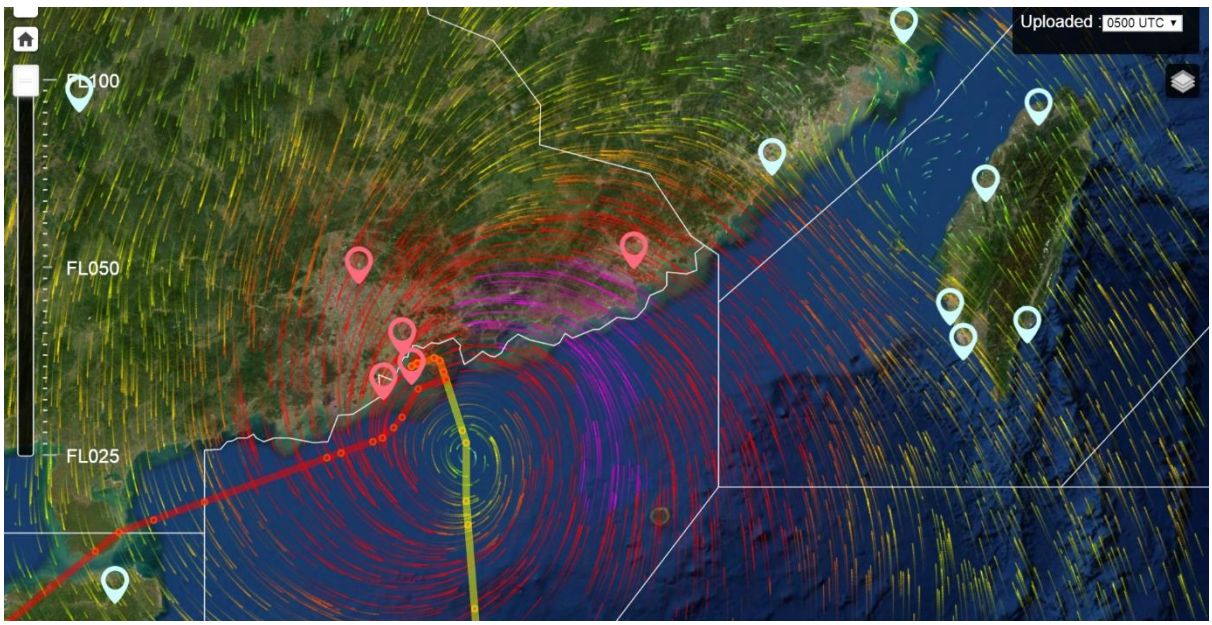


Figure 3: SWIM-enabled MET-ATM Display highlighting aerodromes with landing thresholds exceeded

3.1.3 In the SWIM-enabled MET-ATM Display, the constrained aerodromes could be highlighted if the weather conditions exceed user-specified operational landing thresholds (such as Visibility, Cloud base, Wind gust, Crosswind) (Figure 4). This facilitates ATFMUs and airlines to also monitor the landing condition also at alternate aerodromes.

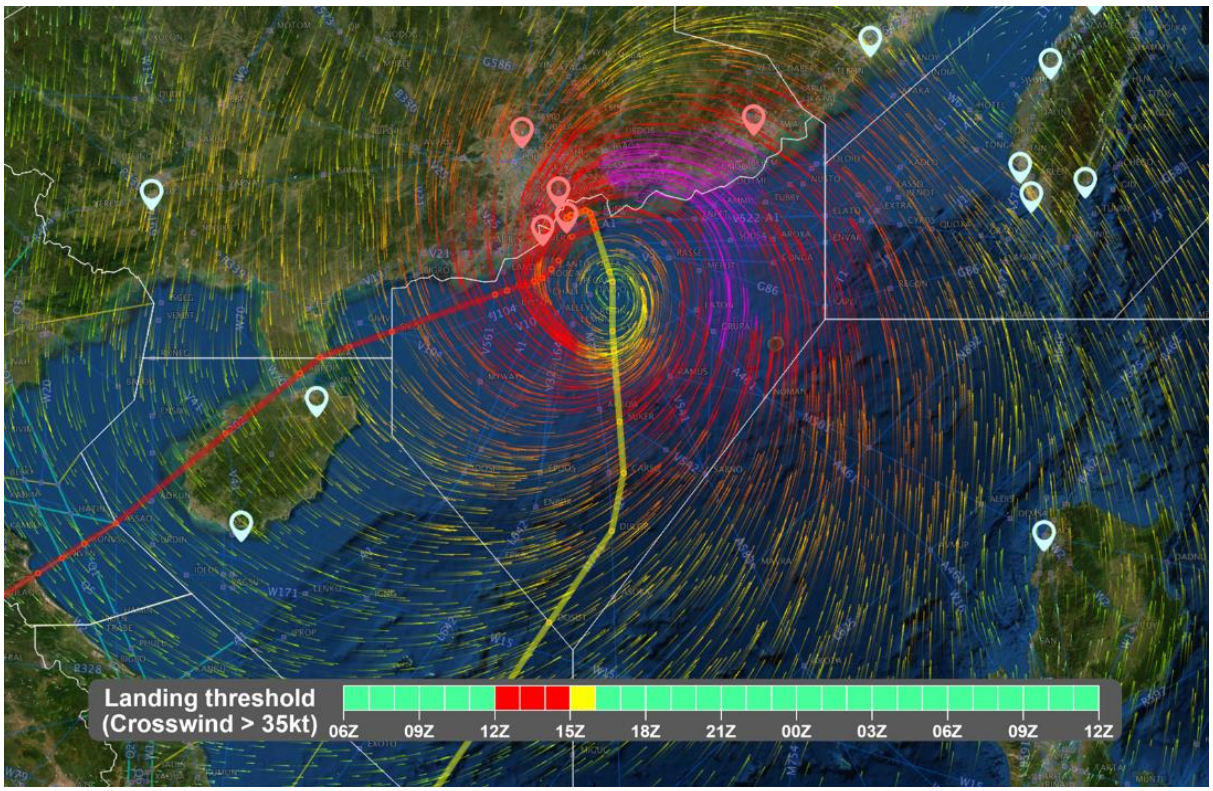


Figure 4: Timeline showing alerts of exceeding user-defined landing threshold

3.1.4 With the TAF messages exchanged in IWXXM, one of the benefits is that the automatic decision supporting tool could be developed to create awareness of the impact on the landing thresholds of aerodromes affected by weather, based on specific weather elements extracted from IWXXM. Figure 4 shows the timeline alerting the time window with expected crosswinds greater than 35 kts. This information would be used to estimate when the airport arrival rate would be reduced due to the TAF..

USE CASE 2: Airborne rerouting due to turbulence

3.2.1 MET information in IWXXM is integrated with flight information in Flight Information Exchange Model (FIXM) in the decision supporting tool to assess the number of flights crossing areas of significant weather phenomena mentioned in SIGMET reports (such as CBs and associated SEV TURB and SEV ICE) within a requested time period (Figure 5).

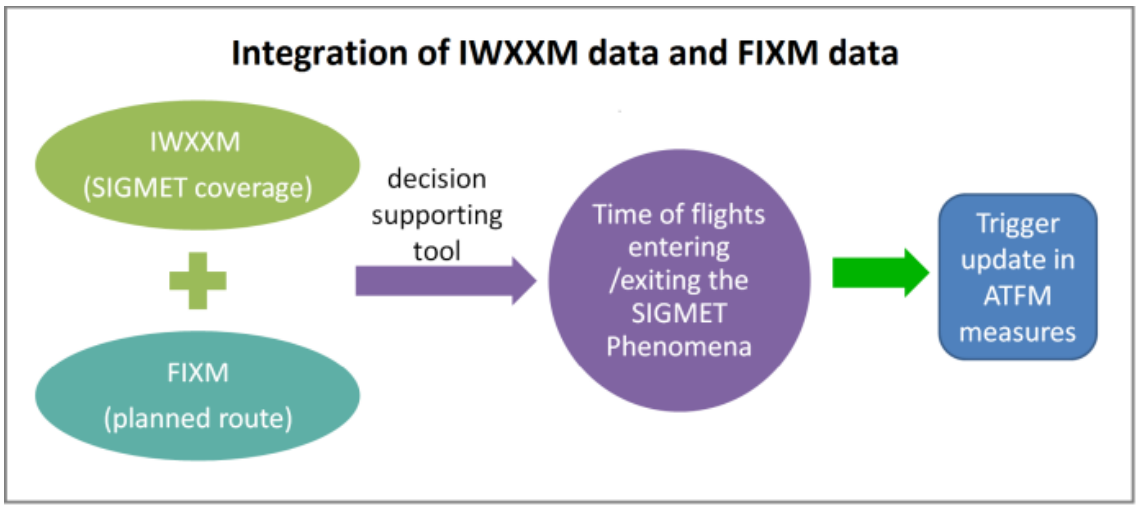


Figure 5: Integration of IWXXM and FIXM Data

3.2.2 ATFMUs or airlines with flight information could subscribe to the hazardous weather service via SWIM to access the weather impacts and the need to plan for flight routes to avoid the affected areas in FIXM. Meanwhile, MET service provider could also subscribe to the flight information exchange service of relevant ANSP to receive the flight plan published in FIXM and show this information on SWIM-enabled MET-ATM Display for situational awareness.

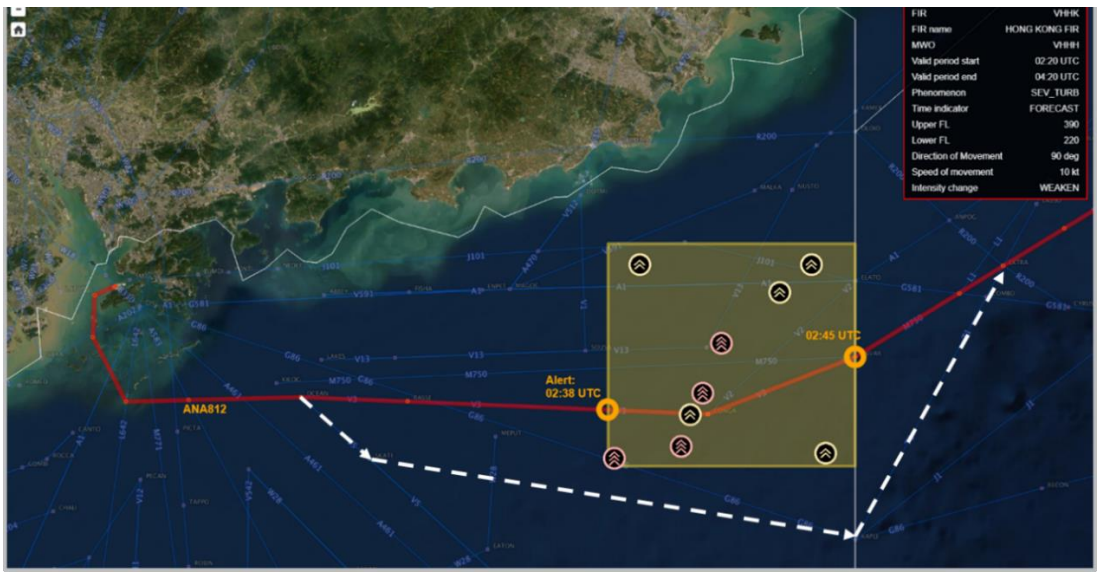


Figure 6: SWIM-enabled MET-ATM Display showing alerts of the estimated timing for a specific flight entering a SIGMET area and the timing for the flight to depart the SIGMET area

3.2.3 Figure 6 shows the turbulence reports received from the previous flights crossing the same area. Air Traffic Control (ATC) will relay the pilot report (PIREP) to aviation forecasters at MET office. After aviation forecasters analyze these actual turbulence reports together with

the model forecast, forecasters predicted severe turbulence is likely to persist for two more hours over the same region and issued the severe turbulence SIGMET.

3.2.4 With the flight plan and SIGMET exchanged in SWIM-based formats, one of the benefits is that flight and MET information could be integrated together in the automatic decision-supporting tool. The tool could provide flight-specific alerts of the estimated timing for the flight entering the turbulence area and the timing for the flight to depart the turbulence area. Such SWIM-enabled MET application could be used for situational awareness and allow the users to respond faster and better support the timely tactical decision making by the ATC and FOC of airlines.

USE CASE 3: Volcanic ash avoidance based on digital Volcanic Ash Advisory and Volcanic Ash SIGMET

3.3.1 This scenario explores gate-to-gate flight operations and where SWIM enabled ANSPs, airlines and MET Service Providers can enhance ATM System performance through timely sharing of interruptions and trajectory and flow updates. This provides downstream Area Control Centres (ACCs) and other ATM Stakeholders with SWIM capabilities, advance situational awareness of an incoming flight, which can then be used to support common situational awareness across stakeholders, create more accurate demand predictions and improve operational planning and predictability. For this scenario, a flight is planned from Bangkok (VTBS) to Sydney (YSSY).

3.3.2 One hour into the flight, a Volcano Observatory Notice for Aviation (VONA) is issued by the Observatories advising of an eruption of Mt Agung on Bali with ash cloud detected to FL400 moving swiftly and primarily to the west-north-west. A Volcanic Ash Advisory (VAA) was issued by Darwin Volcanic Ash Advisory Centre (VAAC) based on VONA, and subsequently a Volcanic Ash SIGMET was issued in IWXXM by the MET service provider based on the VAA. The IWXXM SIGMET is received by Brisbane and Melbourne Air Traffic Service Centres (BN ATSC and ML ATSC, respectively) and Airline Operations Centre (AOC).

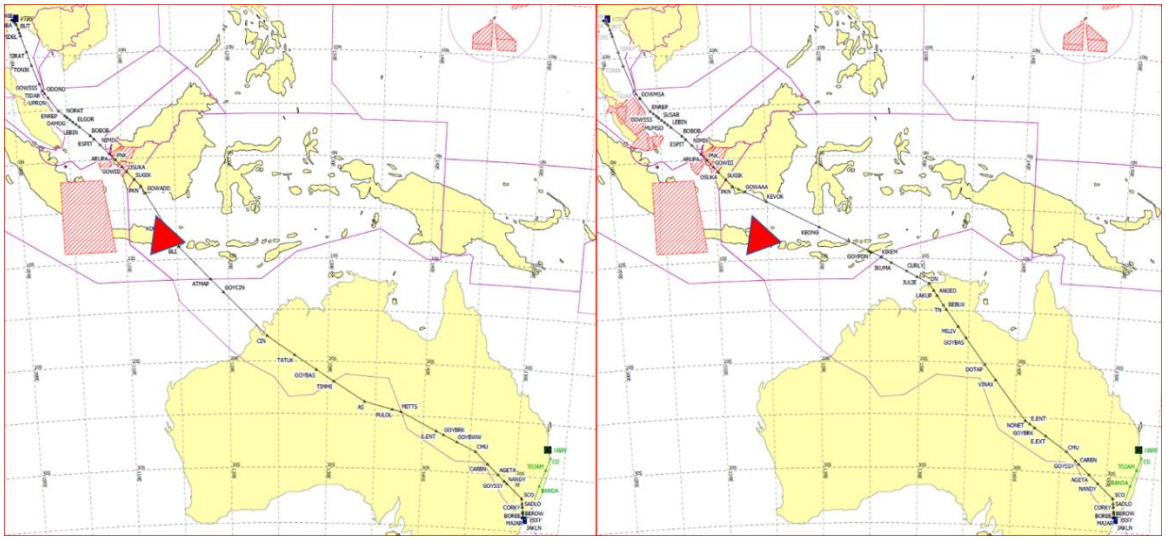


Figure 7: Route diversion for volcanic ash avoidance

3.3.3 FOC of the airline decide that the flight should track via a diversion route east of the ash cloud and that the diversion will preferably commence from a waypoint in WSSS airspace and follow a new track east of Bali to avoid the cloud. This will now take the flight directly into Brisbane FIR (YBBB FIR) and not entering into Melbourne FIR (YMMM FIR).

3.3.4 Flight OPS submits a proposed CHG to FPL in FIXM format via SWIM to all affected ANSPs. The pilot requests the amended tracking and is cleared by VTBB ATC. The flight re-cleared via new flight plan track. The Flight Management Computer (FMC) gets updated to send Flight OPS a new set of trajectory estimates, which are shared with BN ATSC in FIXM format via SWIM.

3.3.5 Because of the SWIM connectivity, the flight became aware of the volcanic event two FIRs prior to the disrupted airspace. The airline was able to identify an alternate route within the flight's fuel capability that would still enable it to reach its original destination. Furthermore, this provided additional benefit to all SWIM-enabled stakeholders, as a new clearance time was issued much in advance assisting in making early and informed decisions.

USE CASE 4: Flight diversion due to fog

3.4.1 For the same flight planned from VTBS to YSSY mentioned in Use Case 3 above, when the flight is approaching Lombok on the ash avoidance route, an Amended TAF for YSSY is published via SWIM, forecasting heavy fog starting prior to the flight's ETA and to last late into the morning with associated significant delays. Flight OPS considers the new expected holding requirement coupled with the additional fuel used for the ash avoidance and decides at that time to divert the flight to YBBN (Brisbane).

3.4.2 Flight OPS again publishes a proposed new route via SWIM and shares with the aircraft and BN ATSC and ML ATSC. The pilot makes the request to ATC directly and is cleared with the new route. The FMC gets updated to send Flight OPS a new set of trajectory estimates, which are shared in FIXM format with BN ATSC via SWIM.

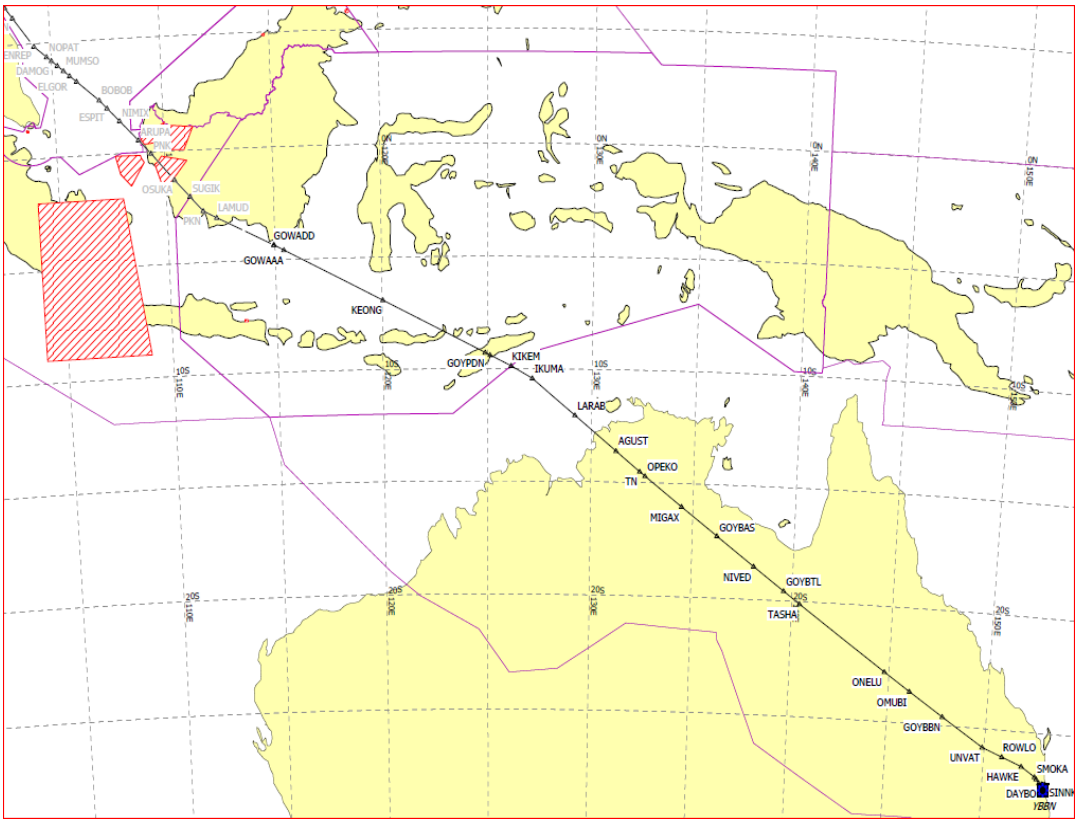


Figure 8: Early flight diversion from YSSY to Brisbane due to fog

3.4.3 BN ATSC analyses the new route of this flight due to the forecast fog in YSSY and modifies their long-range ATFM program for the morning to allocate a slot at Brisbane for this flight. The flight is allocated a gate time Calculated Time Over (CTO) for an arrival fix that requires 10 minutes delay from current estimate and this CTO is shared with Flight OPS. Flight OPS communicates with the flight proposing that they make a request to ATC for commencing a fuel-efficient speed reduction from their present position to absorb the delay as much as possible. Finally, BN ATSC applies a short set of vectors on descent for sequencing but no holding is incurred.

3.4.4 Overall, early notice of the amended TAF published via SWIM and associated delays permitted the airline to identify the need for a diversion to alternate destination and to share and receive that amended clearance prior to entering Australian airspace so that any small track

efficiencies could be realised (no fuel wasted continuing towards MEL and then diverting later).

USE CASE 5: Use of Quantitative Volcanic Ash Concentration Information in Trajectory-based Operation

3.5.1 Quantitative volcanic ash concentration information (QVACI) is proposed for inclusion in the 82nd amendment to ICAO Annex 3. QVACI will be issued in gridded-data and IWXXM format to provide level of concentration and probabilities exceeding certain concentration thresholds.

3.5.2 In this scenario, a flight departs from Narita International Airport (RJAA) in Tokyo, Japan for Changi International Airport in Singapore, illustrating interaction among ANSPs and an aircraft operator in trajectory-based operations.

3.5.3 The aircraft reaches cruising altitude around 20 minutes after departing RJAA. Then, the crew is informed that Mt. Suwanosejima has just erupted. The volcano is located in the area where the flight plans passing over around one hour later. A PIREP issued by an aircraft near the volcano specifies a 20,000-feet ash plume. The ash cloud may cause a risk to the planned flight.

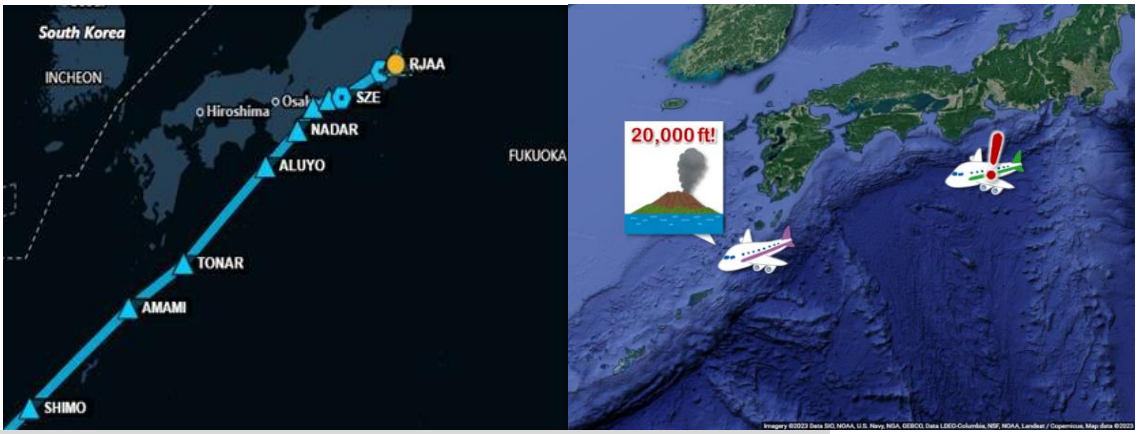


Figure 9: Planned flight path and the illustration of PIREP issuance

3.5.4 The VAAC Tokyo imminently issues QVA information. The information promptly becomes available on the crew's Electric Flight Bag (EFB). The crew starts interacting with their flight dispatcher via the EFB. Based on this chat message exchange, they conclude that only a low-concentration area would affect the planned flight path, so engine exposure to volcanic ash would be below the acceptable limit and therefore, detour wouldn't be required.

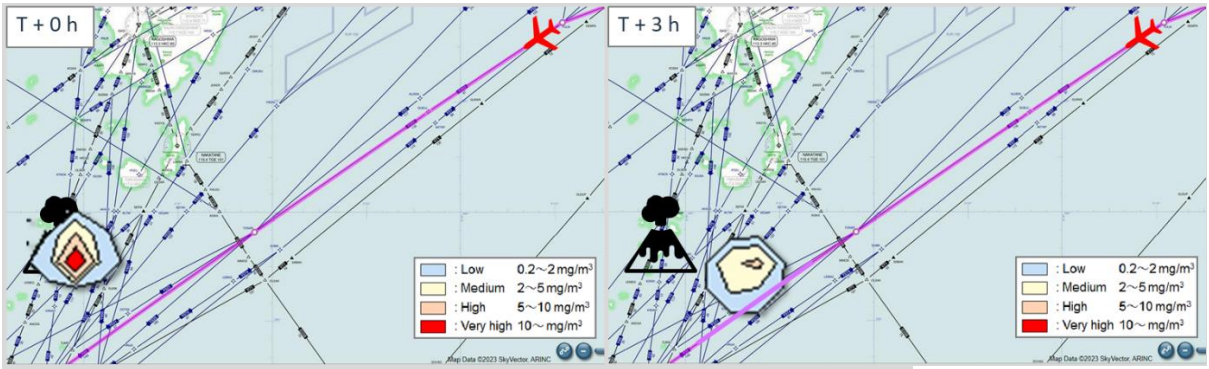


Figure 10: QVA concentration information near the planned flight path

3.5.5 Figure 11 illustrates that how advanced MET information such as QVACI with 4-D quantitative/probabilistic forecast could effectively support prompt decision-making in trajectory-based operations and benefit ATFM. It would lead to more efficient aircraft operations as well as time savings, reduced fuel consumption and lower greenhouse gas emissions.

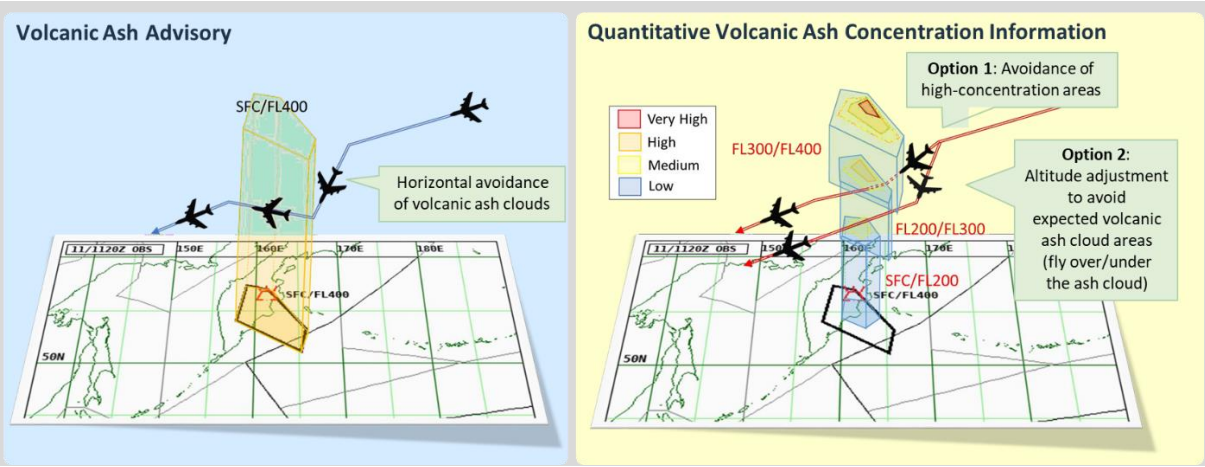


Figure 11: How 4-D QVACI quantitative / probabilistic forecast could support trajectory-based operations

3.5.6 SWIM is one of the key enablers of the trajectory-based operation. To make the best use of such 4-D quantitative/probabilistic meteorological information, all related information including aeronautical and trajectory information should be digitalized, updated as necessary and shared among the stakeholders in real-time basis in SWIM environment. Digitalized trajectory and QVA information shared via SWIM would allow the stakeholders to assess how much exposure would be expected for a specific flight.

3.5.7 Establishing convenience communication mechanism among the stakeholders is also essential. Operational systems/procedures/rules to allow such information sharing (including communication) and flexible in-flight trajectory changes are also important.

USE CASE 6: Weather impact assessment based on actual air traffic volume over Standard Terminal Arrival Routes (STARs)

3.6.1 MET service providers routinely share weather forecast and warnings with ANSPs that predicts timing of weather phenomena affecting airspace, including terminal control area where there is a relatively high volume of air traffic.

3.6.2 If ANSPs could share surveillance data and/or FIXM data with local MET service providers via SWIM, more advanced MET information service would become possible. In this case MET service providers could provide services for the targeted busy routes or airspace only. For example, the more advanced MET information service could provide ANSPs with the estimated time of approach of severe thunderstorms to specific Standard Terminal Arrival Routes (STARs) or the associated critical airspace (Figure 12).

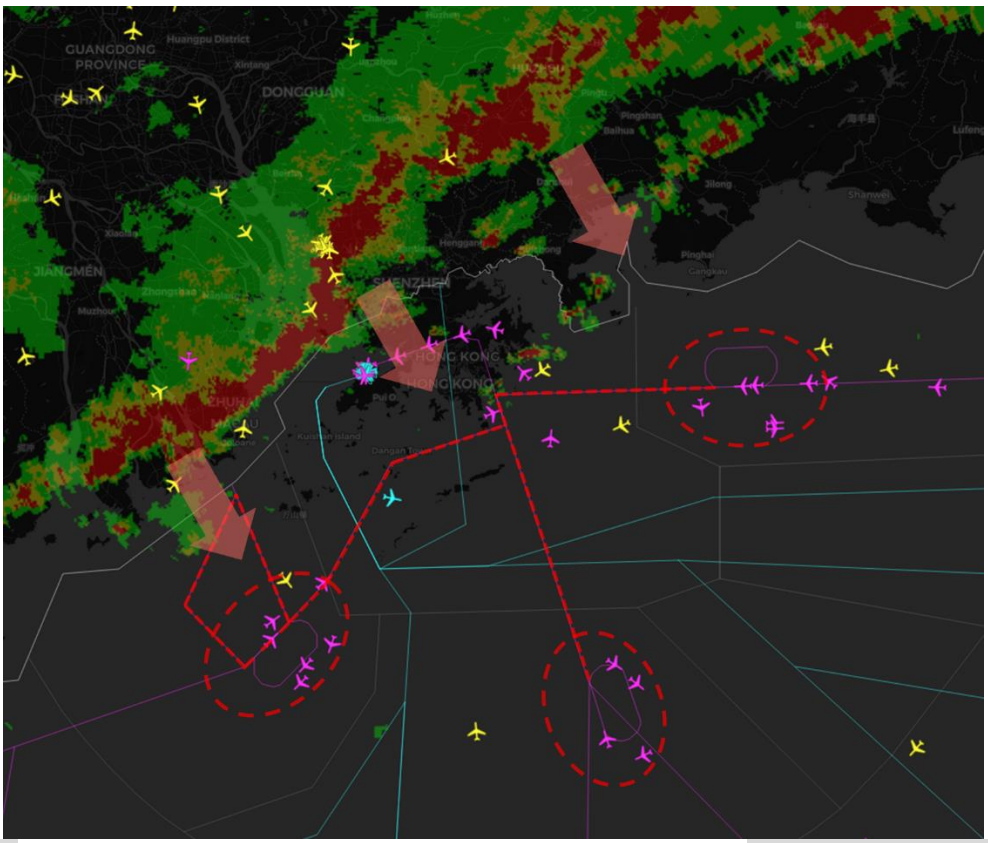


Figure 12: Illustration of severe thunderstorms approaching and posing potential impact on Standard Terminal Arrival Routes (dotted lines) and associated critical airspace (dotted ellipses) with high air traffic volume

3.6.3 When real-time surveillance data are shared in SWIM and integrated into the MET information services, new products such as weather impact risk matrix for air traffic could be developed (Figure 13) for determining the level of impact on aviation traffic based on the air traffic volume over the STARs or the associated critical airspace. For example, if the timing of severe thunderstorm matches with the timing with higher air traffic volume over STARs, the risk level of the weather impact on arrival would be higher, and vice versa. Such enhanced MET information services would better support ATM in the monitoring and assessment of the weather impact on the actual air traffic for ensuring the aviation safety and operational efficiency.

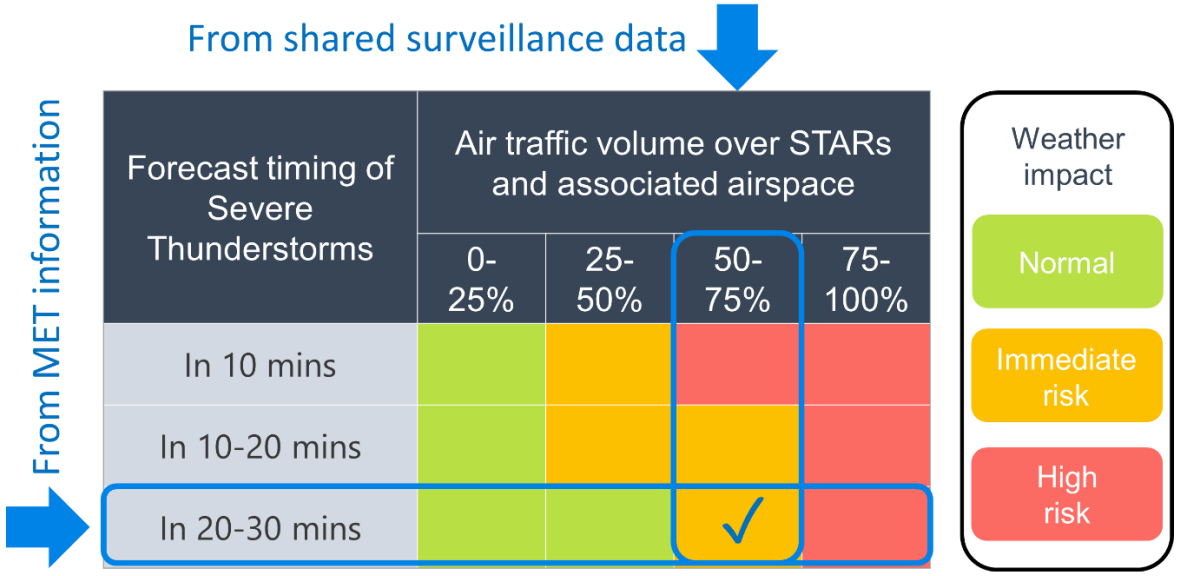


Figure 13: Risk matrix for accessing the risk level of weather impact on a Standard Terminal Arrival Route and the associated critical airspace if surveillance data could be integrated into MET information services in SWIM

USE CASE 7 (*potential future use case*): Aircraft spacing management based on real-time surveillance information shared in SWIM

3.7.1 To avoid aircraft being disrupted by wake turbulence created by preceding aircraft, flights are traditionally separated by certain distances depending on the pair of aircraft types and the wake vortex size created by the preceding aircraft. The stronger the headwind, the slower the ground speed will be and so it would take longer to travel the same distance. With distance-based separation, strong headwinds on approach could significantly reduce arrival rates and cause arrival delays.

3.7.2 Wake vortices generally dissipate faster in strong headwind conditions, so aircrafts could be separated by a shorter time. Also, the effect of wind on the arrival rate could be counteracted if the distance-based separation is replaced by time-based separation.

3.7.3 The benefits of time-based separation could be realised if live Mode-S Downlinked Aircraft Parameters (DAPs) or wind data from an aircraft could be downlinked, incorporated in the surveillance data and shared with MET system through SWIM. This would allow the SWIM-enabled MET system to dynamically generate the best estimation of actual wind profile along the approach path (Figure 11). The wind profile in high spatial and temporal resolution along the approach path could then be provided through the SWIM-based MET information service to ATC tool for determining the optimal safe time-spacing between arriving aircraft, allowing separation distances to be dynamically adjusted.

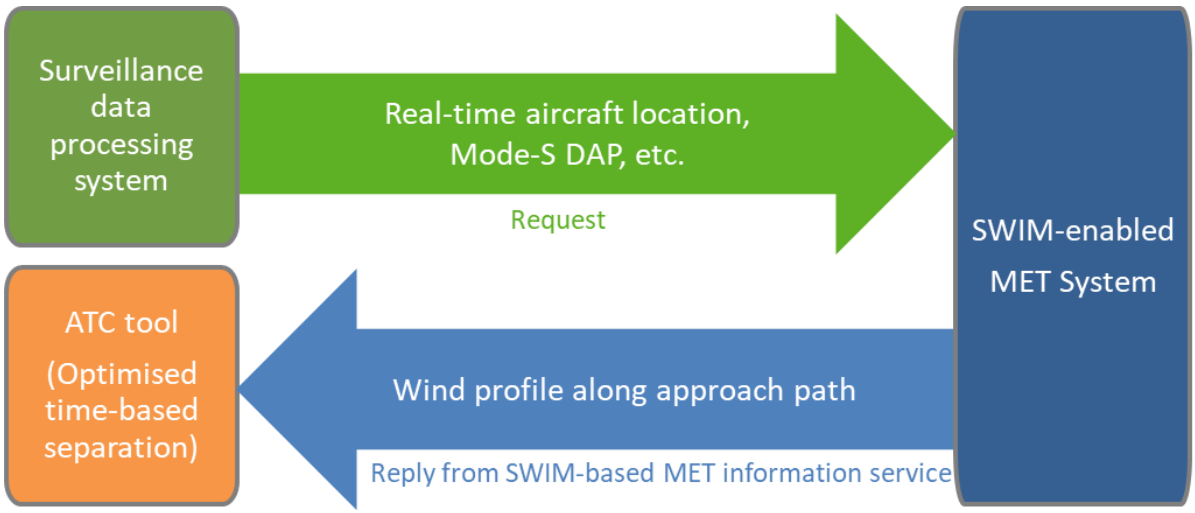


Figure 14: Conceptual data flow diagram showing the provision of SWIM-based MET information services for wake turbulence separation via request/reply

3.7.4 Such wind-dependent optimisation of separation would provide the opportunity to enhance traffic capacity. It could maximise the arrival rate and reduce the chance to activate ATFM measures due to strong headwinds on approach (Figure 12).

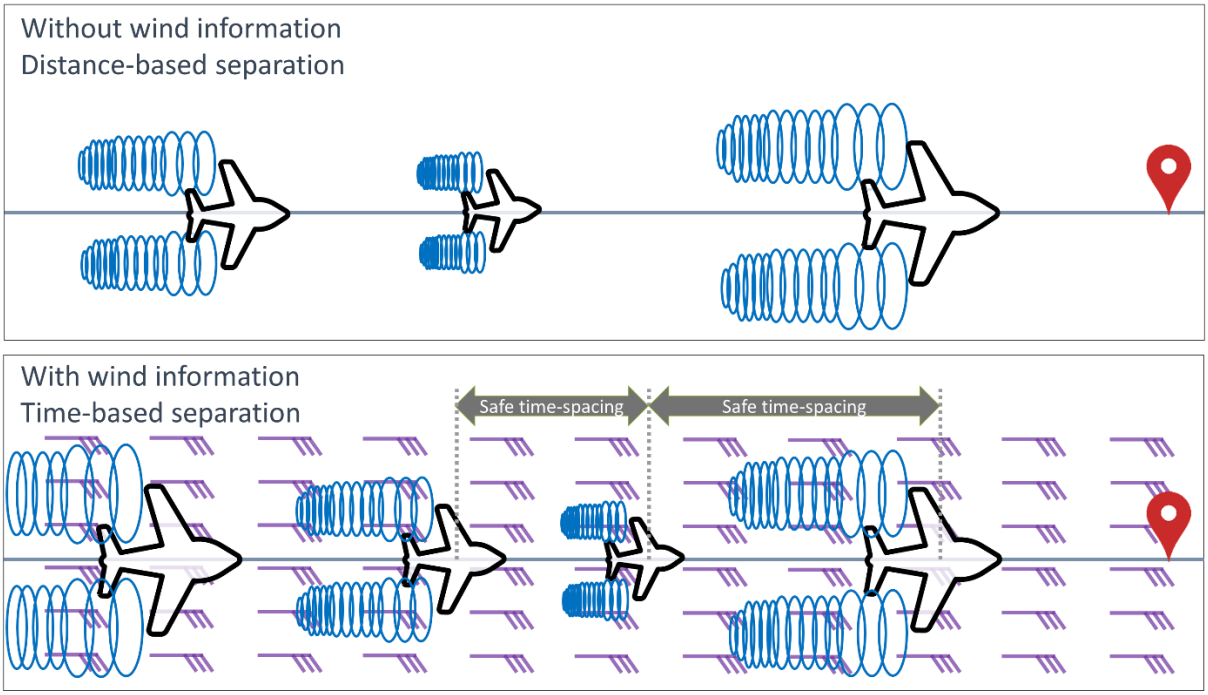


Figure 15: Illustration of the benefits of optimised time-based separation if the provision of high-resolution wind profile along the approach path is made available through SWIM information service

Section 4

MET Data Catalogue and ATFM Data Catalogue for SWIM-based Operation

4.1 The SWIM-based MET Information Exchange Services have the capability to geospatially and/or temporally filter a data set to provide the users' system with only the tailored information required to fulfill the specific users' needs.

4.2 The table below provides MET and ATFM data which could be exchanged using SWIM-based Information Exchange Services. Such data elements identified in the data catalogue could assist the SWIM TF in developing the relevant service catalogue for the APAC region.

MET data catalogue (draft)	ATFM data catalogue (draft)
Aerodrome Phenomena: • Cloud amount and type • Lightning/thunderstorm • QNHRVR • Surface wind and wind gusts • Temperature and dew point • Turbulence • Visibility • Windshear Products: • Radar data **Enroute** Phenomena: • Thunderstorm • Clear air turbulence • Icing • Wind • Temperature • Tropopause height Products: • WC SIGMET (thunderstorms, turbulence, icing, mountain waves, dust / sand storms, radioactive clouds) • WV SIGMET (volcanic ash) • WC SIGMET (tropical cyclone) • Volcanic ash advisory • Tropical cyclone advisory • Space weather advisory • Volcano Observatory Notice for Aviation (VONA) • Quantitative Volcanic Ash (QVA) Concentration Information • Satellite data	• Global Unified Flight Identifier (GUFI) • Departure aerodrome • Destination aerodrome • Flight identification • Planned route/trajectory • Estimated Off-Block Time (EOBT) • Estimated Take-Off Time (ETOT) • Estimated Landing Time (ELDT) • Estimated Elapsed Time (EET) • Calculated Take-Off Time (CTOT) • Calculated Landing Time (CLDT) • Target Off-Block Time (TOBT) • Target Start Up Approval Time (TSAT) • Target Take-Off Time (TTOT) • Actual Off-Block Time (AOBT) • Estimated Time Over (ETO) • Calculated Time Over (CTO) • Actual Time Over (ATO)

--- END ---

Attachment B

Members of MET/R WG Ad-hoc Group - Development of APAC Use Cases and User Requirements for SWIM-based MET Information Services Supporting ATFM

State / Administration / IO	Name	Position and/or Organisation	Expertise
Australia	Jesper Bronsvoort	Network Performance & Analysis Manager, Airservices Australia	ATFM
Australia	Ashwin Naidu	Aviation Customer Lead, BoM	MET
CANSO	Stuart Ratcliffe	Co-Chair, CANSO ATFM WG	ATFM
Hong Kong China	Marco Kok (**Rapporteur**)	Acting Senior Scientific Officer, HKO	MET/SWIM
Hong Kong China	Anfernee Poon	Acting Senior Operations Officer (Strategic Planning), HKCAD	ATFM
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Japan	IKEDA Michiko	Scientific Officer, JMA	MET
Pakistan	Fazal Ur Rehman	Sr Joint Director, PCAA	ATFM
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Republic of Korea	Jiwon, LEE	Assistant of Director, KMA	MET
Singapore	Zhang HuanBin	Head (ATM development), CAAS	ATFM
Singapore	Jack Toh	Head (ATM Info System), CAAS	ATFM
Singapore	Yeo Cheng Xun	Senior Meteorologist, MSS	MET
Thailand	Amornrat Jirattigalachote (Amo)	Strategic Planning Manager, AEROTHAI	ATFM/SWIM
Thailand	Dudsadee Sungthong	Executive ATFM Officer, AEROTHAI	ATFM
Vietnam	Nguyen Van Dung	Deputy Director of Department of Air Traffic Services, VATM	MET/ATFM

Attachment C

APAC USER REQUIREMENTS FOR SWIM-BASED MET INFORMATION SERVICES SUPPORTING ATFM

Terms of Reference

The scope and objectives of the work to be conducted by the MET/R WG ad-hoc group are:

(1) To document user requirements and use cases from ATFM in the APAC region to assist SWIM TF in the development of future SWIM-based MET information services specifically addressing the needs of ATFM in the APAC region;

(2) To supplement the global concept described in the MET-SWIM Plan, prepared by the METP WG-MIE, and the MET requirements being developed by the METP Working Group on Meteorological Requirements and Development (WG-MRAD) in a global sense and IWXXM development by METP WG-MIE for effective exchange of MET information supporting AFTM operation;

(3) To assist SWIM TF in identifying and developing the specifications of information services required to support ATFM operations based on user needs;

(4) To identify MET and ATFM data to be exchanged using SWIM-based Information Exchange Services in the region to enable the effective MET/ATM integration and to provide the baseline for further development of the regional SWIM data catalogue and service catalogue; and

(5) To identify other granular MET-related requirements from ATFM perspective such as update frequency and forecast lead time of MET information to better support the development of future MET Information Exchange Services in the Region.