REPORT OF

TWENTY NINTH MEETING OF THE COMMUNICATIONS/NAVIGATION AND SURVEILLANCE SUB-GROUP (CNS SG/29) OF APANPIRG

Bangkok, Thailand
16-20 June 2025

The views expressed in this Report should be taken as those of CNS SG/29 Meeting and not of the Organization.

Approved by the Meeting
Published by the ICAO Asia and Pacific Office, Bangkok

HISTORY OF THE MEETING

Introduction.....i-5

Attendance i-5

Opening of the Meeting i-5

Officers and Secretariat.....i-5

Organization, working arrangement, language and documentation.....i-5

Conclusions and Decisions – Definition……...….....i-6

List of Conclusions/Decisions from CNS SG/29……...…...i-6

REPORT ON AGENDA ITEMS

Agenda Item 1: Adoption of agenda……1

Agenda Item 2: Election of Co-Chair……1

Agenda Item 3: Review outcomes of APANPIRG, APAC ANSP Committee, ATM Sub-group, MET Sub-group and other meetings and global CNS Updates……..1

Agenda Item 4: Aeronautical Fixed Service (AFS)……6

4.1 Review Report of the Twelfth Meeting of the Aeronautical Communications Services Implementation Coordination Group (ACSICG/12) including:

- Report of the Thirteenth Meetings of Common aeRonautical VPN Operations Group (CRV OG/13)
- Report of ICAO APAC CRV PSIDS Workshop

4.2 Other AFS related matters

Agenda Item 5: Information Management (IM) ……..11

5.1 Review Report of the Tenth Meeting of System Wide Information Management Task Force (SWIM TF/10)

5.2 Review Report of the First and Second Working Session of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1 and SIPG WS/2)

5.3 Outcomes of SWIM Seminar

5.4 Other IM-related matters

Agenda Item 6: Aeronautical Mobile Communications Service and Aeronautical Electromagnetic Spectrum Utilization…….....……..…16

6.1 Outcomes of WRC-27 Workshop

6.2 Review Report of the Ninth Meeting of Spectrum Review Working Group (SRWG/9)

6.3 Update on the status of datalink applications and VHF capability sharing by States

6.4 Other issues related to aeronautical communications service and aeronautical radio spectrum management, especially on 5G implementation and potential impacts on aircraft radio altimeters

Agenda Item 7: Navigation ……..……..23

7.1 Review Report of the Seventh Meeting of GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7)

7.2 GNSS Interference and Mitigating Measures

7.3 Outcomes of Flight Inspection and Procedure Validation Seminar

7.4 Other navigation-related matters

Agenda Item 8: Surveillance ……..……...27

8.1 Review Report of Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10)

8.2 Other surveillance-related matters

Agenda Item 9: Automation ……..……30

9.1 Review Report of the Sixth Meeting of ATM Automation Systems Task Force (ATMAS TF/6)

9.2 Other automation-related matters

Agenda Item 10: Regional implementation review and updates ……..……32

10.1 State's National ANP and Elements related to CNS in Seamless ANS Plan

10.2 Delhi Declaration implementation related to CNS

10.3 Contingency Planning for CNS/ATM Infrastructure

Agenda Item 11: Review the status of CNS deficiencies (APANPIRG Deficiency List) …….…….37

Agenda Item 12: Capacity Building, including Human Factors and Air Traffic Safety Electronics Personnel (ATSEPs) related training ……..……..……..……..37

Agenda Item 13: Cybersecurity of CNS/ATM systems ……..……..……39

13.1 Updates on ICAO International Aviation Trust Framework

13.2 Other Cybersecurity related matters

Agenda Item 14: Innovation and New Technologies ……..……..….41

Agenda Item 15: Review of ToR and action items …..……..……43

Agenda Item 16: Any Other Business ……..……44

Agenda Item 17: Date of next meeting ……..……..45

LIST OF APPENDICES

Appendix A: SOP for Dispute Resolution for CRV Matters

Appendix B: SOP to update the AMC AFTN/AMHS Routing Table in APAC

Appendix C: Educational material to manage the distribution of IWXXM information

Appendix D: Checklist for IWXXM implementation

Appendix E: Revised ToR of SIPG

Appendix F: APAC Common SWIM Information Services

Appendix G: FIXM v4.3 Extension

Appendix H: Guidance Document for Implementation of SBAS in the Asia Pacific Region

Appendix I: List of Recommendations for GNSS RFI Mitigations

Appendix J: Workflow for Process and Requirements of IC Coordination and Assignment for APAC

Appendix K: Air Traffic Management Automation System Implementation and Operations Guidance Document Edition 1.5

Appendix L: AIDC Implementation and Operations Guidance Document (IGD) Edition 2.0

Appendix M: Table of AIDC Implementation Status in APAC

Appendix N: Updated List of CNS-Related Deficiencies

Appendix O: ICAO APAC Guidance Material for Addressing Human Factor Issues of ATSEP v2.0

Appendix P: ToR of CNS SG

Appendix Q: CNS SG/29 Action Items

Appendix R: CNS Point of Contact

LIST OF ATTACHMENTS

Attachment 1: List of Participants

Attachment 2: List of Information and Working Papers

HISTORY OF THE MEETING

1. Introduction

1.1 The Twenty Ninth Meeting of the Communications, Navigation and Surveillance Sub-group (CNS SG/29) of APAC Air Navigation Planning and Implementation Regional Group (APANPIRG) was held at the ICAO APAC Regional Office, Bangkok, Thailand, from 16-20 June 2025.

2. Attendance

2.1 The Meeting was attended by **100** participants from **23** Member States/Administrations, **2** International Organizations and **3** industry partners, including Australia, Bhutan, Brunei Darussalam, China, Hong Kong China, Macao China, Fiji, France (New Caledonia), India, Indonesia, Japan, Lao PDR, Malaysia, Maldives, Mongolia, New Zealand, Pakistan, Philippines, Republic of Korea, Singapore, Thailand, USA, Viet Nam, IFATSEA, Aerovision Technology Limited, AIREON, Harmony Tech Innovation Limited, and ICAO. The List of participants is provided in **Attachment 1**.

3. Opening of the Meeting

3.1 The Meeting was opened by Dr. Soniya Nibhani, Regional Officer, ANS (CNS) Implementation. Dr. Nibhani informed about the key agenda items and expectations from the Meeting. She extended her appreciation and gratitude to all participants and their contributions, along with the submission of various papers on essential agenda items to discuss during the Meeting. She shared that the discussions and decisions at CNS SG Meetings are crucial for all stakeholders and Member States and play a significant role in shaping the future of air navigation services in the APAC region.

3.2 The former CNS SG Chair, Mr. Richard Wu, shared with the meeting his appreciation and heartfelt gratitude for the strong support and collaborations received from fellow colleagues of member States/Administrations, as well as the ICAO Regional Office, to address the challenges since he took up the position in 2017 to 2024. He also highlighted the key accomplishments of the CNS SG and the major challenges lying ahead. He looked forward to the election of the new Chair to continue the momentum and lead the CNS SG to reach new heights.

4. Officers and Secretariat

4.1 The Meeting was chaired by Mr. M H Hui, Assistant Director-General of Civil Aviation, Civil Aviation Department, Hong Kong China.

4.2 Dr. Soniya Nibhani, Regional Officer ANS (CNS) Implementation and Mr. Zhang De, Regional Officer CNS, acted as the Secretary of the Meeting with the support of Ms. Xu Jian, Associate Programme Officer (CNS) Implementation and Ms. Varapan Meefuengsart, the Programme Assistant from ICAO Asia and Pacific Regional Office.

5. Organization, working arrangement, language and documentation

5.1 The working language was English, including all documentation and this report. The Sub-group met as a single body to handle all the agenda items.

5.2 The Meeting considered **35** Working Papers, **14** Information Papers, and **7** Presentations. A List of Working Papers, Information Papers and Presentations is provided in **Attachment 2**.

6. Conclusions and Decisions – Definition

6.1 The Sub-groups of APANPIRG record their actions in the form of Draft Conclusions, Draft Decisions, Conclusions and Decisions with the following significance:

1) Draft Conclusions deal with matters which, by the Sub-Group's Terms of Reference, require the attention of States or actions by ICAO following established procedures;

2) Draft Decisions relate solely to matters dealing with the internal working arrangements of APANPIRG and its contributory bodies;

3) Conclusions: Those Conclusions adopted by the Sub-group on behalf of APANPIRG on technical matters; and

4) Decisions relate solely to matters dealing with the internal working arrangement of the Sub-group only.

Note: *In accordance with APANPIRG Procedural Handbook and by Conclusion APANPIRG/29/28: Empowerment to adopt Conclusions and Decisions on purely technical/operational matters by APANPIRG's Sub Groups: Sub-groups are empowered to adopt Conclusions and Decisions on any amendment to Terms of References (ToR), including an extension of time of Working Group/Taskforce formed under relevant Subgroup; and on all technical and operational aspects of Subgroup's work within its ToR. Additionally, APANPIRG Subgroups or Taskforce/Working Groups are empowered to make Conclusions/Decisions related to regional guidance material for publication on the ICAO APAC website.*

7. List of Conclusions/Decisions from CNS SG/29

	Reference Number		Title of (Draft) Conclusions/Decisions
1.	**Draft Conclusion CNS SG/29/01**	-	Implementation of CRV for small Pacific Islands and small ANSPs in the region using CRV Solution, CRV SLA Package D+
2.	**Conclusion CNS SG/29/02**	-	Adopt the CANSO Standard of Excellence in Cyber Security for CRV
3.	**Decision CNS SG/29/03**	-	Adoption of SOP to update the AMC AFTN/AMHS Routing Table in the Asia/Pacific Region
4.	**Conclusion CNS SG/29/04**	-	Educational material to manage the distribution of IWXXM information for COMM experts in the event of primary link failure
5.	**Conclusion CNS SG/29/05**	-	Checklist of steps required for operational IWXXM exchange
6.	**Draft Decision CNS SG/29/06**	-	Adoption of APAC Common SWIM Information Services, v1.0
7.	**Draft Conclusion CNS SG/29/07**	-	Asia/Pacific Regional FIXM version 4.3 Extension

8.	**Decision CNS SG/29/08**	-	Guidance Document for Implementation of SBAS in the Asia/Pacific Region
9.	**Conclusion CNS SG/29/09**	-	Workflow for the request and coordination of IC codes with the ICAO APAC Office
10.	**Decision CNS SG/29/10**	-	Adoption of the Air Traffic Management Automation System Implementation and Operations Guidance Document Edition 1.5
11.	**Decision CNS SG/29/11**	-	Adoption of the AIDC Implementation and Operations Guidance Document (IGD) Edition 2.0
12.	**Conclusion CNS SG/29/12**	-	Update the CNS Tables of ICAO APAC e-ANP Vol II
13.	**Decision CNS SG/29/13**	-	Adoption of Regional Guidance Material for Addressing Human Factor Issues of ATSEP v2.0
14.	**Decision CNS SG/29/14**	-	Creation of ANS Information Assurance Task Force (ANSIA TF)

– – – – – – – – – – – – –

REPORT ON AGENDA ITEMS

Agenda Item 1: Adoption of the Agenda

Adoption of Agenda - Sec (WP/01)

1.1 The provisional agenda presented in **WP/01** was adopted by the Meeting.

Agenda Item 2: Election of Co-Chairs

2.1 The ICAO Secretariat shared the key motivation for the need for two co-chairs of the CNS SG. It was informed that based on the experience of the last few years, the role and responsibilities of CNS SG have increased significantly. With more requirements of ICAO related to innovative ANS implementation, such as SWIM, FF-ICE and other associated requirements to enhance air navigation capacity and efficiency and ANS infrastructure accordingly, more agenda items are added to the current meeting. Accordingly, the key issues handled by CNS SG, including the associated depth of discussion, are enhanced. To meet augmented expectations, the workload sharing among the two co-chairs will support the smooth and efficient operation of the meeting.

2.2 Nominated by China and seconded by Australia, Japan, Lao PDR, New Zealand, Singapore, Thailand, and USA, Mr. M H Hui, Assistant Director-General of Civil Aviation, Civil Aviation Department, Hong Kong China, was unanimously elected as a Co-Chair of CNS SG of the APANPIRG.

2.3 The floor was then opened for nomination of another Co-Chair position. However, no other nomination was received at the Meeting and the position was not filled. If needed, an election could be held at a future CNS SG Meeting.

2.4 Mr. M H Hui, Assistant Director-General of Civil Aviation, Civil Aviation Department, Hong Kong China, the Chair of CNS SG, expressed his gratitude for the trust and confidence vested in him for taking up the Chair position. He also extended heartfelt gratitude to the former Chair, Mr. Richard Wu, and the ICAO Regional Office for their leadership and contributions, which have laid a solid foundation for the CNS SG to continue the work. As the Asia-Pacific region is at the forefront of global air traffic growth, Mr. Hui looked forward to collaborating with fellow colleagues of member States/Administrations and the ICAO Regional Office to address the challenges ahead and achieve the shared goals for a safer, more efficient and sustainable CNS infrastructure to support the aviation growth in the future.

Agenda Item 3: Review outcomes of APANPIRG, APAC ANSP Committee, ATM Sub-group, MET Sub-group and other meetings and global CNS updates

Review of Relevant Meetings – Sec (WP/02)

3.1 This paper summarized key outcomes from relevant ICAO Asia/Pacific meetings held in 2024, particularly APANPIRG/35 and CNS SG/28. It highlighted conclusions and decisions that are related to this meeting.

3.2 The CNS SG/28 meeting adopted **4** Conclusions and **2** Decisions. In addition, based on the outcome of discussions on various agenda items, the CNS SG/28 meeting developed **4** Draft Conclusions and **1** draft Decision for consideration by APANPIRG/35 Meeting, which were further adopted by APANPIRG/35. The Meeting noted the Conclusions/Decisions adopted by the CNS SG/28 and the APANPIRG/35 and discussed the follow-up.

Air Traffic Management Outcomes – Sec (WP/03)

3.3 This paper presented key outcomes from the technical working groups established under the oversight of the Air Traffic Management Sub-Group of APANPIRG, as well as other information relevant to the CNS Sub-Group. The Meeting was informed that the Twelfth Meeting of the ATM Sub-Group of APANPIRG (ATM/SG/12) was held from 23 to 27 September.

3.4 The Meeting noted that the Project 30/10 was presented during the Fourteenth Air Navigation Conference (AN-Conf/14, Montreal, Canada, 26 August – 06 September 2024). ICAO proposed Project 30/10 (AN-Conf/14 WP/10) as an initiative to focus attention and encourage implementation of longitudinal separations of 55.5 km (30 NM) or less in oceanic and remote airspace, and 19 km (10 NM) or less elsewhere. It was expected to be a regionally based, coordinated effort for seamless reduction of excessive separation minima where this has not already been achieved.

3.5 The ATM/SG/12 was informed that one of the AN-Conf/14 information sessions was about *USOAP CMA evolution update – an outlook for this triennium and beyond* (https://www.icao.int/Meetings/anconf14/Documents/Information%20Sessions/PPT05.pdf), which provided information on the 2024 PQ amendment and integration of State Safety Programme Implementation Assessment (SSPIA) into traditional activities.

3.6 In ATM SG/12, the Secretariat provided information on the ICAO Universal Safety Oversight Audit Programme (USOAP) Continuous Monitoring Approach (CMA Protocol Questions (PQs) used to assess a State's safety oversight system) and an annual update of ANS USOAP status. The Meeting noted the APAC region's average ANS Effective Implementation (EI) was 63.44% as of September 2024, based on the EI ratings for ANS-related PQs of the 37 APAC States that had been audited or received USOAP activity.

3.7 The ATM/SG/12 noted that the ATM/SG Data Analytics Ad-Hoc Group (DAG), established at ATM/SG/11, had held three meetings consisting of two virtual sessions and one physical meeting. The Ad-Hoc group agreed on its Terms of Reference, task list, and a framework for measuring and reporting eight key performance indicators (KPIs) aligned with the Global Air Navigation Plan (GANP). The eight selected KPIs, covering Capacity, Efficiency, and Predictability, were based on six core data elements and aligned with the ATM Performance Measurement Framework endorsed by APANPIRG. A data collection guide was made available, and States were encouraged to report on major airports, particularly those experiencing high traffic volumes or integrated into regional flows.

3.8 The Meeting was informed that the ICAO APAC FF-ICE Ad-Hoc Group conducted its inaugural workshop, including a tabletop exercise (TTX), from 18 to 21 June 2024 at the ICAO Asia/Pacific Regional Office in Bangkok, Thailand. The workshop marked the first step in delivering the group's objectives through presentations, discussions, and hands-on exercises. Participating ANSPs shared their phased implementation plans for FF-ICE Release 1 (FF-ICE/R1), with many targeting initial service rollout between 2025 and 2030, while other States were still in the planning phase and sought guidance. The Meeting also noted that ATM/SG/12 agreed to the Draft Conclusion ATM/SG/12-3: Agree on the adoption of FIXM Ver. 4.3.0 in the Asia Pacific Region as the standard format**.**

3.9 It was added that the Ad-Hoc group holds the Second Asia/Pacific FF-ICE Ad-Hoc Group Meeting and Workshop in Bangkok, Thailand, from *18 to 20 March 2025*. It was noted that the Ad-Hoc group was drafting the Regional FF-ICE Implementation Framework, which was expected to be presented for endorsement at the ATM/SG/14 in 2026.

3.10 The ATM/SG/12 acknowledged the significance of GNSS interference and its major impact on Air Traffic Services (ATS) and airspace users. As a result, it was advised that States/Administrations develop standard operating procedures for air traffic controllers to manage GNSS interference, as well as reporting processes for airspace users to the relevant ATS. Recognizing

the necessity for a comparable mechanism, the *Decision ATM/SG/12-8: Establish Procedures for GNSS and Data Link Disruption Ad-Hoc Group* was established. The ad-hoc group was established to collect data on GNSS and data link disruption in the APAC Region and develop procedures for GNSS and data link disruption.

3.11 Regarding the progress of work done by the *GNSS and Data Link Disruption Ad-Hoc Group* since its formation, it was stated that the kick-off meeting was planned for February 2025, which was not conducted due to unforeseen circumstances. It was added that the ICAO Secretariat is currently working with the ATM SG Chair to start the work assigned to this Ad-hoc Group. Japan shared concerns about the delay this group made in beginning to work, considering the significance of GNSS RFI issues in the APAC Region. The USA informed that the delay occurred because the USA previously agreed to be a Rapporteur of the Ad-Hoc group, but could not progress further due to the restructuring of the FAA. The Meeting requested that the ICAO Secretariat escalate the resolution of the issue, preventing further work progress by this group, so that the deliverables expected by the Ad-Hoc Group can be completed with priority.

3.12 On the question of the reason for the name of the group as *GNSS and Data Link Disruption Ad-Hoc Group* and the interrelation of GNSS issues with Data Link disruption, it was informed that Data Link disruption issues had been discussed in past ATM SG meetings. It was added that Data Link disruption issues also result in increased ATC separation till the issue is resolved. In addition, the Ad Hoc Group was required to develop a procedure for both Air Traffic Controllers (ATCOs) and pilots in the event of GNSS or Data Link disruption. Therefore, the formed Ad Hoc Group undertook both areas under a unified Terms of Reference (ToR).

3.13 The ATM/SG/12 was informed of the joint efforts by JCAB, FAA, and IATA in the NOPAC Redesign Project, which introduced new ATS routes with 23 NM lateral separation to improve efficiency. In Phase 2, routes were compressed to allow more User Preferred Routes (UPRs). While most aircraft met Performance-based Communications and Surveillance (PBCS) and RNP 4 requirements, data link outages remained a challenge. The group emphasized the need for contingency procedures to maintain reduced separation during connectivity disruptions.

3.14 It was noted that data link failures required reverting to larger separation minima, increasing operational complexity and risk. Frequent VHF Data Link (VDL) to satellite transitions, particularly in the Anchorage FIR, were identified as a major source of connectivity issues. Despite these challenges, the project showed the value of collaboration in enhancing airspace capacity in the Asia/Pacific Region.

3.15 The CNS SG/29 meeting noted Conclusion ATM/SG/12-4: Amendment to the Asia/Pacific Regional Plan for Collaborative AIM and Conclusion ATM/SG/12-5: Revised Guidance on the Issuance of SNOWTAM.

3.16 The ATM/SG/12 was updated by the ICAO APAC SWIM TF Task Team on Information Services regarding ongoing work to identify business functions supported by APAC Common SWIM Information Services to meet regional operational needs. Recognizing the need for further discussion on the initial list of recommended services, the ATM/SG/12 agreed to establish an Ad-Hoc group to address both technical and operational aspects, with the *Decision AAITF/19-3: Establish APAC Common SWIM Aeronautical Information Services Ad-Hoc Group.* Following its establishment, the APAC Common SWIM Aeronautical Information Services Ad-Hoc Group convened five meetings to review and discuss the message sets proposed by the System Wide Information Management Task Force (SWIM/TF). As a result of these discussions, the initial set of outcomes developed by the Ad-Hoc Group was submitted in advance to SWIM TF/10 as a working paper in order to ensure timely input and alignment with their ongoing work.

3.17 The outcomes from the APAC Common SWIM Aeronautical Information Services Ad-Hoc Group were also presented at the Tenth Meeting of the Asia/Pacific Search and Rescue Workgroup

(APSAR/WG/10, Siem Reap, Cambodia, 27 – 30 May 2025). The APSAR/WG was encouraged to actively engage with the APAC Common SWIM Aeronautical Information Services Ad-Hoc Group and SWIM TF from an early stage, particularly regarding the SAR service message set once further details became available.

3.18 Noting concerns raised by some States at APSAR/WG/10 regarding limited understanding and expertise within the SAR community on SWIM implementation and its impact on SAR services, the APSAR/WG agreed that the ICAO Secretariat arrange a dedicated session with the SWIM TF Co-Chairs and/or experts from the APAC Common SWIM Aeronautical Information Services Ad-Hoc Group at the next APSAR/WG meeting (tentatively in the first or second week of May 2026). This session is expected to provide a detailed presentation on expectations and the impact of SWIM on SAR services.

3.19 The Meeting noted the request shared by the APSAR/WG/10 Meeting for a dedicated session with the SWIM TF Co-Chairs and/or experts from the APAC Common SWIM Aeronautical Information Services Ad-Hoc Group and requested both groups to coordinate through the ICAO Secretariat.

Relevant Outcomes from MET SG and other relevant meetings – Sec (WP/04)

3.20 This paper presented outcomes from the MET meetings involving communication-related matters, such as IWXXM and SWIM, which were relevant to the CNS SG. It was informed that the Twenty-eighth Meeting of the Meteorology Sub-group (MET SG/28) and the Twenty-Third Meeting of the Meteorological Information Exchange Working Group (MET/IE WG/23) were held in Bangkok, Thailand, in 2024 and 2025, respectively. MET SG/28 focused on the implementation of ICAO Standards and Recommended Practices (SARPs) for disseminating meteorological information in the ICAO Meteorological Information Exchange Model (IWXXM) form, highlighting the need for access to the Air Traffic Service (ATS) Message Handling System (AMHS) with File Transfer Body Part (FTBP). The meeting adopted conclusions to review the IWXXM implementation status in the APAC region and emphasized the necessity for full IWXXM data exchange before 2030. MET/IE WG/23, on the other hand, discussed the readiness of AMHS to support IWXXM dissemination and agreed on actions to develop an update and notification process for the Online Register of APAC IWXXM Exchange Status.

3.21 The Fourteenth Meeting of the Meteorological Requirements Working Group (MET/R WG/14) was also held in Bangkok. MET/R WG/14 included a seminar on Meteorology and Air Traffic Management and a joint plenary session with the APAC Air Traffic Flow Management Steering Group. The meeting focused on updating regional guidance documents. Key decisions included publishing updated documents on the ICAO APAC eDocument website and proposing updates to business functionalities for APAC Common SWIM Information Services. Key discussions and outcomes from different meetings were shared with the CNS SG/29 Meeting.

Global Developments Related to CNSS & GIS – Sec (SP/02)

3.22 ICAO HQ could not join the meeting; therefore, the presentation prepared by ICAO HQ was delivered by the ICAO Secretariat. ICAO Secretariat shared the progress made in 2024-25 by various panels at the HQ level for Communications, Navigation, Surveillance, Spectrum, Integrated CNS and Spectrum, other CNS Activities, and relevant updates from Global Interoperable Systems included in the presentation. The Meeting was requested to consider information provided in the paper during the future planning process of the CNS/ATM infrastructure and ANS services.

Updates of APAC ANSP Committee

3.23 As the Secretary of the APAC ANSP Committee (AAC) was not able to attend the Meeting, the Meeting requested all Work Stream Leads or key contributors to share updates about the progress made by AAC from 2024-25.

3.24 Hong Kong China reported the progress of various tasks of Work Stream-1 (WS/1). It was reported that 4 out of 9 tasks agreed by WS/1 have already been completed. With respect to Task 2, two workshops were held in China in 2024, and one more workshop is planned for September or October 2025 in Chengdu, China. It was added that for Task 4, China, Singapore, and Thailand reached an agreement to start the cross-border trials with ATFM on SWIM. For Task 9, Hong Kong China has developed a template for the "Library of Guidance Material for Planning, Procurement and Implementation of ANS Systems." For Tasks 3 & 7, AEROTHAI has held the "Next Wave APAC Aviation Technologies through Synergy" Workshop on 17-21 February 2025, which aimed to explore new technology for regional ANS modernization and share experiences and best practices for ANS procurement and whole life management. It was noted that an "Asia Pacific ANS Life Cycle Management Survey" is being prepared to gather experiences and best practices from all AAC members.

3.25 Thailand provided an update on the progress of Workstream 2 (WS/2). The Meeting was informed that WS/2 has focused on four key tasks. For Task 1, to review the current landscape and exploration of approaches to facilitate more effective implementation of ANS, notable initiatives under consideration include the proposal to establish a Next-Generation ATFM Working Group to develop a long-term vision and associated principles for regional ATFM operations, a gate-to-gate efficiency study, and the development of a regional data management framework. For Task 2, collaboration to establish key TBO building blocks, including SWIM and FF-ICE, in support of TBO development and implementation in the APAC region, the APAC TBO Pathfinder project is a key initiative, and its details were provided in IP/02. For Task 3, collaboration on the implementation of additional operational concepts, including remote towers, User-Preferred Routes (UPR), and Free Route Airspace (FRA), is being done, and for Task 4, provision of support to APAC ANSPs to strengthen their ATFM capabilities, with the overall objective of enabling broader and more active participation in the APAC Cross-Border Multi-Nodal ATFM Collaboration (AMNAC), in alignment with the ICAO "No Country Left Behind" initiative, is in progress.

3.26 USA shared information about the progress made in Work Stream-3 (WS/3) after the CNS SG/28 Meeting. It was informed that WS/3 is focused on delivering an enhanced Asia/Pacific Regional Contingency Framework (i.e., Version 4.0), including "how to" on coordination procedures and exercises of operational contingency plans for continuity of service. The Meeting noted that the current Asia/Pacific Region ATM Contingency Plan Version 3.0 needed a complete overhaul. WS/3 members have partnered with the ANB Regional Coordinator, ICAO Headquarters and the Regional Officer ATM of the ICAO APAC Regional Office in the development and delivery of a new regional contingency framework. It was informed that the draft Asia/Pacific Region ATM Contingency Plan Version 4.0 was delivered to ICAO Headquarters in June 2024 as part of the ICAO APAC/MID ATM Contingency Planning Workshop and APAC ATM Contingency Tabletop Exercise event. Since then, the members of WS3 have continued to meet monthly while waiting for the return of the draft framework to continue their efforts. It was added that WS/3 is waiting for the final version of the new contingency arrangement framework from ICAO Montreal. It was informed that recently, WS/3 members contacted the ICAO APAC Regional Office and proposed facilitating an APAC contingency arrangements workshop in October-November 2025. However, the ICAO APAC Regional Office suggested deferring to this event until the global framework is finalized.

3.27 India was requested to share the updates of Work Stream 4 (WS/4), if possible. India shared information about Continuous Climb and Descent Operations in India, while updates on WS/4 were not shared during the meeting.

Agenda Item 4: Aeronautical Fixed Service (AFS)

4.1. Review Report of the Twelfth Meeting of the Aeronautical Communications Services Implementation Coordination Group (ACSICG/12) including:

- Report of the Thirteenth Meetings of Common aeRonautical VPN Operations Group (CRV OG/13)

- Report of ICAO APAC CRV PSIDS Workshop

Review of Outcomes of The Twelfth Meeting of The Aeronautical Communication Services Implementation Coordination Group (ACSICG/12) – Sec (WP/05)

4.1. The paper summarized relevant information and updates on the outcomes of AMC Workshop and the Twelfth Meeting of the Aeronautical Communication Services Implementation Coordination Group (ACSICG/12) held at the ICAO APAC Regional Office, Bangkok, Thailand, from 25 to 28 March 2025, including the outcomes of CRV Workshop for PSIDS held from 3-4 March 2025 and the Thirteenth Meeting of the Common aeRonautical Virtual Private Network Operations Group of APANPIRG (CRV OG/13) held from 5 to 8 March 2025.

4.2. It was noted that the CRV OG/13 meeting reviewed the outcomes of the First Working Session of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1) held from 14 to 17 January 2025.

4.3. The CNS SG/29 Meeting noted the Conclusion CRV OG/13/01- Standard Operating Procedures (SOP) for Dispute Resolution on CRV Matters; the adopted SOP is provided in Appendix A. It was informed that SOP has been incorporated in CRV OG OM v1.4, adopted by CRV OG/13 by Decision CRV OG/13/02 - Publish the updated APAC CRV Operations Manual. The latest version of the CRV OG Operational Manual will be published on ICAO APAC e-docs under CNS, ICAO APAC CRV Secure portal, and on the CRV portal hosted by Airways New Zealand.

4.4. The CNS SG/29 Meeting was informed that the procedure for adding SWIM services over CRV could be defined by the CRV OG meeting once the APAC SWIM architecture is finalized and other necessary details for SWIM implementation are available.

4.5. The latest updates presented on the planning and implementation status of CRV during the CRV OG/13 Meeting were as follows:

- **Under Operation**
  Australia, Bhutan, Cambodia, China, Hong Kong China, Fiji, French Polynesia, India, Indonesia, Japan, Macau China, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Philippines, PNG, Republic of Korea, Singapore, Sri Lanka, Thailand, USA and Vietnam

- **Under Provisioning**
  New Caledonia and the Maldives

- **Hot Prospects in 2025**
  Bangladesh, Brunei, Cook Islands, Lao PDR, Oman, Niue, Samoa and Tonga

- **Not joined yet**

Afghanistan, DPRK, Kiribati, Marshal Islands, Micronesia, Nauru, Palau, Solomon Islands, Timor Leste, Tuvalu, Vanuatu, Russia, ICAO MID States

4.6. The CRV OG/13 Meeting reviewed the APAC CRV Implementation Table and agreed that, after the Telecommunication Infrastructure Table, CRV Implementation Table updates are not required. The meeting updated the Telecommunication Infrastructure Table, which can be accessed on the New Zealand-hosted CRV Portal.

4.7. Due to the confidentiality of the CRV contract management process, the report under agenda item 7 was published on the ICAO APAC CRV Secure portal under the CRV group.

4.8. The CRV OG/13 Meeting was presented with information about ongoing work on the addition of CRV implementation status in AMC by Eurocontrol. It was added that Eurocontrol informed that it aimed to align with the PENS approach by May 2025 and will notify ICAO upon completion.

4.9. It was noted that Hong Kong China presented at the CRV OG/13 a study on the bandwidth used for the ADS-B data transmitted over the SWIM/CRV environment and shared the analyzed outcomes. The CRV OG/13 was requested to encourage States/Administrations using SWIM/CRV to share their experience in conducting similar monitoring and analysis. The CRV OG/13 appreciated the study done by Hong Kong China and agreed that it was beneficial to the CRV OG/13 and that the formula used to calculate bandwidth would be helpful for CRV Users to evaluate the bandwidth requirements for ADS-B data. Hong Kong China would continue working on deriving a formula based on this analysis to compute the bandwidth required for surveillance data sharing and would suggest it to the CRV OG Ad-hoc Expert Group for incorporation into the CRV OG Operations Manual.

4.10. Fiji proposed CRV SLA Package D+ for PSIDS and small ANSPs in the APAC region for the implementation of CRV. The following Draft Conclusion was adopted by ACSICG/12 for CNS SG/29 and APANPIRG/36 consideration, which was endorsed by CNS SG/29 Meeting for APANPIRG/36 adoption:

<table>
<tr><td colspan="3">Draft Conclusion CNS SG/29/01 (ACSICG/12/02 (CRV OG/13/06)) - Implementation of CRV for small Pacific Island and small ANSP in the region using CRV Solution, CRV SLA Package D+</td></tr>
<tr><td colspan="2">What: That, the CRV OG agreed to the following to assist small Pacific Islands & small ANSPs in APAC in the implementation of CRV:
a) CRV SLA Package D+ is reliable and addresses lead time for acquiring spares and the CRV Service Provider to import licenses and clearance for customer sites
b) Small Pacific Island and small ANSP in the region to consider using CRV SLA package D+ as the CRV solution to implement CRV for the exchange of voice & AMHS services
c) With a target date to implement CRV by 2025, it was recommended that the CRV OG work closely with the small Pacific Islands, small ANSPs in the region and the CRV Service Provider on a cost-effective CRV solution to implement CRV.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☒ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To facilitate the implementation of CRV for the small Pacific Islands & small ANSPs in the region</td><td colspan="2">Follow-up: ☒Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Draft to be adopted by PIRG</td></tr>
</table>

Who:	☒Sub groups ☒APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: CRV OG

4.11. The CRV OG/13 was informed by New Zealand that PCCWG built a "pseudo-CRV" (using Package D connections with 2 Mbps bandwidth) to support the SWIM TF, SIPG, and S3TIG in conducting SWIM trials and demonstrations. The SWIM TF found pseudo-CRV beneficial for SWIM-related tests, and its use was extended twice until 30 March 2025. PCCWG was asked by CRV OG/13 for indicative pricing to continue supporting pseudo-CRV for APAC States/Administrations. In response, PCCWG provided two additional options for pricing of the current Package D. PCCWG expressed that they were willing to negotiate the proposed prices with each State/Administration needing the Pseudo CRV, and they also offered to provide support to new members wishing to join the pseudo-CRV network. It was agreed that CRV OG would discuss the expected timelines for the future pseudo-CRV setup and plans with SWIM TF. PCCWG shared their willingness to extend the availability of pseudo-CRV until June 2025 to facilitate CRV OG in conducting discussions with SWIM TF.

4.12. The CANSO Standard of Excellence in Cyber Security, endorsed by ACSICG/12 for CNS SG/29 adoption by a Draft Conclusion was adopted by CNS SG/29 with slight changes in the title and body of the conclusion to clarify that the proposed framework is recommended for the CRV network only:

Conclusion CNS SG/29/02 *(Draft Conclusion ACSICG/12/03 (CRV OG/13/07))*- Adopt the CANSO Standard of Excellence in Cyber Security for CRV	
What: The CRV OG adopts the CANSO Standard of Excellence in Cyber Security for CRV and recommends that: a) CRV OG prefers an acceptable maturity level of Target Score 'C.' in carrying out the maturity assessment on the CRV. b) The CRV Service Provider carries out the maturity assessment. c) Each participating State/Administration carries out the maturity assessment. d) CRV OG/Each participating State/Administration creates a plan to address the gaps in the maturity score for the CRV.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: To have a standard Cyber Security maturity applied to the CRV.	Follow-up: ☒Required from States
When: 20-Jun-25	Status: Adopted by Subgroup
Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☐Other: CRV OG	

4.13. The CRV OG/13 Meeting noted that many States/Administrations have their own cybersecurity framework and standards to follow. However, it was agreed that the proposed maturity assessment on the CRV is not time-consuming and challenging, and it is recommended that all CRV users do it. The ACSICG/12 Meeting discussed concerns about further actions for States/Administrations where the maturity assessment on the CRV is below Target Score 'C.' It was recommended that CRV OG create guidelines for the next steps in these cases, including associated timelines to achieve Target Score 'C.'

4.14. CNS SG/29 Meeting noted Mr. Augustine Lau, Head (Communications Systems), Civil Aviation Authority of Singapore, was unanimously elected as a Co-Chair of the Aeronautical Communication Service Implementation Group of APANPIRG.

4.15. It was recommended that any proposed modifications to the AFTN/AMHS Routing

directory be preceded by thorough coordination with all concerned States/Administrations by the proposer. If any assistance is needed, States/Administrations were advised to seek support from the ICAO APAC Office. The ACSICG/12 Meeting reviewed and modified the proposed SOP that CNS SG/29 endorsed and adopted by the following decision:

Decision CNS SG/29/03 *(Draft Decision ACSICG/12/04)* **-** Adoption of SOP to update the AMC AFTN/AMHS Routing Table in the Asia/Pacific Region	
What: The proposed Standard Operating Procedures (SOP) in **Appendix B** for all ICAO Asia/Pacific (APAC) members who operate as CCC Operators (Coordination COM Centres) or External COM Centre Operators to update the AMC AFTN/AMHS Routing Table in the Asia/Pacific Region is adopted.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: Enhance coordination between COM centers and ensure quality service for ATS Messaging.	Follow-up: ☒Required from States
When: 20-Jun-25	Status: Adopted by Subgroup
Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☒Other: ACSICG	

4.16. Australia, Fiji, Hong Kong China, Singapore, and the USA provided educational material for COM Centre operators to understand that distribution of IWXXM information requires links to possess specific capabilities, and in the event of a primary link failure, any alternate/secondary links must also possess the same or similar specific capabilities. The ACSICG/12 Meeting adopted the draft educational material as a living document and endorsed the following draft conclusion for consideration by CNS SG/29, which was adopted by CNS SG/29:

Conclusion CNS SG/29/04 ***(Draft Conclusion ACSICG/12/05)*** - Educational material to manage the distribution of IWXXM information for COMM experts in the event of primary link failure	
What: The educational material to support COM/MET experts in managing the distribution of IWXXM in case of primary link failure, provided in **Appendix C**, is adopted as a living document.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: Educational material that identifies the required link capabilities to maintain IWXXM message distribution in the event of a primary link failure is necessary for uninterrupted service.	Follow-up: ☐Required from States
When: 20-Jun-25	Status: Adopted by Subgroup
Who: ☒Sub groups ☒APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: ACSICG	

4.17. It was recalled that during the joint session of ACSICS/11 and MET IE/22 in 2024, the Meeting acknowledged the necessity to support the prompt implementation of capable primary and, where relevant, secondary links for the exchange of IWXXM messages. A team of Communications and Meteorological experts from Australia, Hong Kong China, Fiji and Singapore (lead) volunteered to create a checklist to facilitate the operational implementation of IWXXM message exchange. The ACSICG/12 Meeting reviewed and modified the checklist based on the comments received from the participants. The following Draft Conclusion was adopted by ACSICG/12 for CNS SG/29 consideration, which was adopted by CNS SG/29:

Conclusion CNS SG/29/05 ***(Draft Conclusion ACSICG/12/06)*** - Checklist of steps required to operational IWXXM exchange		
What: A checklist to facilitate the operational implementation of the IWXXM message exchange, provided in **Appendix D,** is adopted as a living document.		Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: To support the prompt implementation of capable primary and, where relevant, secondary links for the exchange of IWXXM messages	Follow-up:	☐Required from States
When: 20-Jun-25	Status:	Adopted by Subgroup
Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☒Other: ACSICG		

4.18. It was recalled that recognizing a lack of information on the AMHS to SWIM transition at the Asia/Pacific regional level, ACSICG/11 in 2024 formed an APAC AMHS to SWIM transition Correspondence Group (ATSCG to study the AMHS to SWIM transition strategy. The ATSCG Terms of Reference (ToR) were drafted and reviewed by the SWIM TF Task Leads. The ACSICG/12 meeting reviewed and adopted the ATSCG ToR through Decision ACSICG/12/07 - Terms of Reference for the AMHS to SWIM Transition Correspondence Group.

4.19. The CNS SG/29 Meeting was informed that due to the confidentiality of the CRV contract management process, the report under this agenda was published on the ICAO APAC CRV Secure portal under the CRV group. The CNS SG/29 Meeting noted that the CRV OG/13 Meeting agreed on the need to organize the Special Session- CRV OG/14 as an In-Person Meeting for 5 days to progress to the next stage of the CRV contract management process from 27-31 October 2025 in Tokyo, Japan. The invitation letter has been issued. The Special Session- CRV OG/14 will discuss the way forward for the CRV contract. The decision will need to be shared with the APANPIRG/36 meeting, which is planned to be held in November 2025, to ensure that the CRV contract management process is completed on time. The CNS SG/29 discussed the way forward to get endorsements of the decision made by CRV OG/14 from ACSICG and the CNS SG. It was agreed that the ICAO Secretariat would share the decision made by CRV OG/14 with delegates of member States/Administrations participating in ACSICG/12 and CNS SG/29 to seek their endorsement on the decision, and feedback/comments, if any, by email. ACTION ITEM 29-1

4.2 Other AFS-related matters

Future Bandwidth Requirements for CRV Based on Outcomes of a Demonstration Event Hosted by Hong Kong China – Hong Kong China (WP/31)

4.20. This paper presented the key findings from a bandwidth study conducted by Hong Kong China, based on the outcomes of the Joint Event of SWIM over CRV Demonstration and Surveillance Data Sharing in the SWIM Trial held in May 2024. The study explored future bandwidth requirements for surveillance data sharing, particularly ADS-B data, over a simulated SWIM environment. Key findings included that messages containing both aircraft tracking and flight planning information are generally larger in size; an average message containing detailed surveillance data is approximately 1.2 KB. During peak hours, if Hong Kong's system were to share data for 300 aircraft per second, approximately 3 Mbps would be required.

4.21. As the region prepares for the next CRV tender, the Meeting noted that it is essential

to consider future bandwidth growth driven by surveillance and SWIM applications. This involves ensuring scalability and flexibility in CRV specifications to accommodate emerging technologies and aligning CRV development with ICAO's global and regional plans. The Meeting also recognized the significance of CRV's strategic role in providing a common telecommunications infrastructure that expedites SWIM implementation and supports emerging technologies in accordance with the Delhi Declaration (Section 4.2(d) & (e)).

Agenda Item 5: Information Management (IM)

5.1. Review Report of the Tenth Meeting of System Wide Information Management Task Force (SWIM TF/10)

Review Report of Tenth Meeting of System Wide Information Management Task Force (SWIM TF/10) – Sec (WP/06)

5.1 The paper presented the report of the Tenth Meeting of the System Wide Information Management Task Force (SWIM TF/10) held from 20 – 23 May 2025 in the ICAO APAC Regional Office, Bangkok, Thailand.

5.2 For the SWIM TF Co-Chair election, no nomination was received at the Meeting. As a result, the position remains vacant. It was suggested that the election be held again at a future SWIM TF Meeting.

5.3 Hong Kong China presented the report of the Joint Event of SWIM over CRV Demonstration and Surveillance Data over SWIM Trial, held from 28 – 29 May 2024. The report captured the details of the Joint Event, including (*i*) the SWIM services developed; (*ii*) the SWIM infrastructure used; (*iii*) the development and testing process; (*iv*) the data format for surveillance data sharing; and (*v*) the observations and lessons learnt.

5.4 The SWIM TF/10 Meeting noted that a total of two (2) SWIM TF Task Leads (TLs) coordination meeting was held after SWIM TF/9 to review the outstanding SWIM TF/7 and SWIM TF/8 action items. In addition, a total of four (4) Joint Meetings of the CRV OG experts and SWIM TF TLs were conducted on 12 June 2024, 17-20 September 2024, 12 November 2024, and 13 March 2025. Out of four meetings, the 17-20 September 2024 meeting was an in-person meeting entitled the *ICAO Workshop for the preparation of new CRV requirements and specifications for future System Wide Information Management (SWIM)/other aviation services.*

5.5 The CNS SG/29 Meeting noted the **Decision SWIM/TF/10/01**- *Revised Terms of Reference of the SWIM Implementation Pioneer Ad-hoc Group;* the adopted ToR is provided in **Appendix E**.

5.6 The SWIM TF/10 Meeting reviewed SIPG's discussions on Internet connectivity options for the Asia/Pacific SWIM, which was in line with the SWIM TF's mandate to build SWIM over CRV and other IP-based networks, including the Internet. Three architecture options were considered: Option 1 is to have one or more Edge EMSs connect to the CRV as well as the Internet. The Edge EMS can then publish and consume services from both the Internet and CRV. Option 2 is to have the SWIM TI constructed over both the CRV and the Internet. Each Gateway EMS provider will need to span the Gateway EMS over both CRV and the Internet with an appropriate security mechanism to segregate between the two zones. Option 3 is to have the CRV service provider also provide the connectivity to the Internet. SWIM TF/10 agreed to further evaluate Options 1 and 2, with a preference for Option 1 as an early implementation path. SIPG was tasked with defining the functionalities and requirements for Edge and Gateway EMSs to guide States. Further discussion on Option 2's routing implications was also planned.

5.7 It was noted that SWIM TF/10 discussed and adopted the following 4 recommendations on SWIM transition in the APAC region, which were raised by SIPG:

Recommendation 1: Reach out to relevant expert groups that govern the various data types being transmitted on AMHS for their SWIM migration strategy and proposed sunset date. (e.g., AAITF, FF-ICE ad-hoc group, MET/IE, ATFM ad-hoc group, etc.)

Recommendation 2: Work closely with the ACSICG AMHS and the SWIM Transition Group to map out a transition plan together. One topic of interest is the need for AMHS to SWIM conversion and how that should be managed.

Recommendation 3: Consider the possible use of any other data formats, in addition to AIXM, FIXM, and IWXXM, in the Asia-Pacific SWIM. This is to enable existing data to be quickly onboarded onto SWIM. The ATM Information Reference Model should be used to maintain semantic interoperability.

Recommendation 4: Inform the ATM Automation Systems Task Force (ATMAS TF) of the need for ATM automation systems to be SWIM compatible.

5.8 For recommendation 1, the SWIM TF/10 Meeting was informed that the ATFM SG/14 meeting endorsed the draft conclusion, which was later adopted by APANPIRG/35 as Conclusion APANPIRG/35/4, on the adoption of FIXM v4.3 as the standard format for cross-border ATFM information exchange in the SWIM environment from Q3/2026.

5.9 Due to the need for clear guidance to States/Administrations on the proposed first version of Common SWIM Information Services, and the Common SWIM Information Services will involve various domains, such as ATM, CNS and MET etc., under the APANPIRG, the following Draft Decision was adopted by SWIM TF/10 and CNS SG/29, and will be submitted to APANPIRG/36 for consideration and adoption. After APANPIRG/36's adoption of the proposed Draft Decision, the list of APAC Common SWIM Information Services will be uploaded to the ICAO APAC e-document portal.

<table>
<tr><td colspan="3">Draft Decision CNS SG/29/06 (SWIM TF/10/02) - Adoption of APAC Common SWIM Information Services, v1.0</td></tr>
<tr><td colspan="2">What: The first version of APAC Common SWIM Information Services, provided in Appendix F, be adopted for immediate use by APAC States/Administrations. The set of APAC Common SWIM Information Services and the associated performance of SWIM Technical Infrastructure underpinning these services are not specified to support the provision of aircraft separation.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To assist APAC States/Administrations in planning and implementing their SWIM information services.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</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: MET SG, ATM SG, AOP SG</td></tr>
</table>

5.10 The APAC Common SWIM AIS Ad-Hoc Group presented the outcomes of the discussions held within the Ad-Hoc Group. The SWIM TF/10 Meeting was informed that the Ad-Hoc Group discussed and agreed to adopt *AIXM 5.1.1 as the common regional version for APAC*.

5.11 The SWIM TF/10 Meeting noted the Roadmap for Meteorology in SWIM (MET-SWIM Roadmap) adopted by the 6th Meeting of METP. It was agreed that forming an action or task to

progress this work from an APAC perspective falls outside the scope of the SWIM TF. In addition, the Meeting discussed that the SWIM TF is not in a position to comment on the possible options of the SWIM aggregator for MET information services, as the discussion is still ongoing at the global level. It was considered that such evaluations would be appropriately conducted by relevant operational experts/user groups. The SWIM TF/10 Meeting was also informed that METP has endorsed a guideline for MET-SWIM Implementation, which will be distributed to the PIRGs to support SWIM Implementation.

5.12 The SWIM TF/10 Meeting was informed about the modified version of the hierarchical architecture, with a limited number of Gateway EMSs, optimized multi-connections between Gateway EMSs and redundant connections between Gateway EMS and Edge EMS. Based on this architecture, ANSPs will be required to deploy the Gateway EMS on a separate device from their internal EMS. This configuration was presented as an effective model as it effectively transforms the ANSP's internal EMS into an Edge EMS, thereby fundamentally altering its operational dynamics and ensuring the integrity and security of the overall system architecture.

5.13 The SWIM TF/10 Meeting noted that to achieve SWIM implementation by 2030, APAC SWIM architecture needs to consider not only the Publish/Subscribe MEP but also the Request/Reply MEP. Given the current emphasis on the regional SWIM prototype architecture using an EMS being developed by SIPG in the APAC region, the primary issue is to discuss how the Request/Reply MEP should be implemented. The SWIM TF/10 Meeting was recommended to consider that future implementation of the Request/Reply MEP in APAC SWIM architecture should be strategically planned with API GW topology that reflects and complements the architectural direction of GEMS.

5.14 The SWIM TF/10 Meeting was presented with the update on FIXM version 4.3 Extension development, and the following draft conclusion was endorsed by the SWIM TF/10 Meeting for APANPIRG/36 adoption through CNS SG/29 endorsement. The CNS SG/29 Meeting endorsed the Draft Conclusion.

<table>
<tr><td colspan="3">Draft Conclusion CNS SG/29/07 (SWIM/TF/10/03) – Asia/Pacific Regional FIXM version 4.3 Extension</td></tr>
<tr><td colspan="2">What: The FIXM version 4.3 Extension described in SWIM/TF/10/WP30 and provided in Appendix G to the report be:

a) adopted as the Asia/Pacific FIXM version 4.3 Extension;
b) uploaded to the ICAO Asia/Pacific Regional Office website for use by Asia/Pacific Administrations to support cross-border ATFM operation, A-CDM, ATFM/A-CDM integration, and traffic synchronization; and
c) presented to the FIXM CCB for review and publication on the FIXM official website.</td><td>Expected impact:
☐ Political / Global
☒ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To provide the information exchange model necessary to support cross-border ATFM operation, A-CDM, ATFM/A-CDM integration, and traffic synchronization in the Asia/Pacific Region, in line with Conclusion APANPIRG/35/4.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</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>

5.15 The SWIM TF/10 Meeting was presented with the current SWIM TF's ToR, the revised SWIM TF's work plan, and the Action List to reflect the latest work status achieved. To ensure that the objectives set in the ToR can be achieved, the Statement of Work (SOW) of each Task was updated by the Meeting. The SWIM TF/10 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)~~ Yosuke MORO (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	Young Jin Ha (ROK) Mark Kaplun (USA), ~~Yasushi Iwasawa (Japan)~~ Yosuke MORO (Japan) Xiaodong Lu (Japan), Honglei Gao (China)
Information Services	6	Information services	Marco Kok (Hong Kong, China) Jeremy Bienkowski (Australia)
Validation & Demonstration	7	SWIM Demonstration	David Leow (Singapore) Amornrat Jirattigalachote (Thailand)
	8	SWIM services and application validation	Yosuke MORO (Japan) Xiaodong Lu (Japan), Honglei Gao (China), Young Jin Ha (ROK)
Coordination and Promotion	9	Monitoring of Panels' work	~~Yasushi Iwasawa (Japan)~~ Yosuke MORO (Japan)
	10	Regional coordination and SWIM-related information sharing	John Moore (IATA)
	11	SWIM implementation education and promotion (New task)	~~Thomas Green (USA)~~ Vacant

Table 1- The current Task leads

5.16 Hong Kong China highlighted the latest status on the updating of the ICAO Meteorological Information Exchange Model (IWXXM) and the publication plan in connection with the proposed changes to ICAO Annex 3 from the 5th Meeting of the ICAO Meteorological Panel (METP/5). It also briefly mentions the development direction regarding new Annex 3/PANS-MET requirements brought up for discussion at METP/6. The SWIM TF/10 Meeting reminded States/Administrations to ensure that systems being developed or procured will work with current and upcoming versions of IWXXM.

5.2. Review Report of the First and Second Working Sessions of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1 and SIPG WS/2)

Review Report of the First and Second Working Sessions of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1 and SIPG WS/2) – Sec (WP/07)

5.17 The SWIM Implementation Pioneer Ad-Hoc Group (SIPG) held two in-person working sessions—WS/1 in January 2025 and WS/2 in May 2025—to advance the Asia/Pacific regional SWIM prototype. Early discussions focused on information security under ICAO Doc 10204 (MAIS) and the Trust Framework Panel's (TFP) development of PKI guidance (ACCP and Trust Framework Implementation manuals). SIPG agreed to propose responsibilities for PKI rollout across safety-critical SWIM use cases, trial self-signed certificates, and inform the CRV Operations Group of certificate needs.

5.18 In-depth architecture debates contrasted fully meshed and hierarchical models. After reviewing proposals by Singapore (SIPG lead), China, Japan, and CANSO, SIPG endorsed a modified hierarchical architecture that addresses prior demo-trial issues. Gateway EMS requirements were specified—messaging, routing, failover, high availability (> 99% uptime), and potential AMHS/SWIM conversion services—and Edge versus Gateway roles were clarified. Performance metrics (latency, throughput) and differentiated services code points (DSCP "AF21") for CRV traffic were also defined. Internet connectivity options were narrowed to an interim Edge EMS dual-connect model while longer-term approaches are refined.

5.19 SIPG also reviewed the transition challenges between AMHS and SWIM. Four recommendations were captured and adopted with refinement: engage expert groups on migration strategies and sunset dates (e.g., FIXM v4.3 adoption by Q3 2026), develop joint AMHS–SWIM transition plans with ACSICG, onboard additional data formats beyond AIXM/FIXM/IWXXM using the ATM Information Reference Model, and notify ATMAS TF of SWIM compatibility needs. Conflicting guidance on AFTN/AMHS versus direct SWIM adoption was noted as a source of State confusion.

5.20 At WS/2, SIPG prioritized eleven tasks—ranging from defining Edge/Gateway EMS functionality (Priority 1) to integration testing, performance measurement, and operationalization conditions (Priority 2–3). Trials of message-topic versus message-property routing, self-signed certificate continuation pending ACCP publication, and governance linkages were assigned to task leads, with a target to complete Tasks 1–10 by end-2026 and Task 11 (operational test procedures) by April 2027. An updated work plan diagram and Task Leads roster were agreed upon. SIPG will reconvene in January 2026 to review progress and prepare its next report to SWIM TF.

5.3. Outcomes of the SWIM Seminar

Outcomes of the SWIM Seminar – Sec (WP/08)

5.21 The paper reviewed the outcomes of the ICAO Asia/Pacific System-Wide Information Management (SWIM) Seminar 2025, held in Bangkok on 19 May 2025. The theme of the Seminar was **Establishing SWIM – A Key Enabler for FF-ICE**. The Seminar emphasized the urgency of SWIM implementation ahead of the 2034 sunset of the 2012 flight plan format, with regional efforts targeting 2032. Seven presentations were delivered by experts from JCAB, CAAS, AEROTHAI, CANSO, IATA, and Frequentis, sharing national SWIM/FF-ICE progress, use cases, technical architectures, and challenges. Key recommendations included forming multidisciplinary teams, harmonizing regional SWIM/FF-ICE mandates, and exploring centralized SWIM infrastructure. Minimum SWIM capabilities were defined for airlines (AIXM/IWXXM/FIXM processing, SWIM connectivity, dynamic

NOTAM integration) and ATM providers (flight-data connectivity, CRV/Internet access, cybersecurity, governance, and SWIM TI functions).

5.4. Other IM-related matters

APAC TBO Pathfinder - FF-ICE/R1 Laboratory Demonstration – Thailand (IP/02)

5.22 Singapore, Thailand, and the USA presented an overview of the APAC TBO Pathfinder project, a regional initiative aimed at identifying the capabilities required for TBO in the APAC region. It shared information about three workgroups, each focused on progressing specific goals and deliverables. It was informed that in line with Recommendation 3.2/2 of the 14th Air Navigation Conference (AN-Conf/14), which calls for a transition to FF-ICE services and cessation of ICAO 2012 flight plan by 2034, WG2 has identified its first key milestone as the execution of FF-ICE/R1 laboratory demonstration which will showcase the operational benefits of FF-ICE/R1 and provide firsthand experience in developing the necessary technical capabilities. Two levels of participation: Level 1: Participants with no FF-ICE/R1 services prototype and Level 2: Participants with FF-ICE/R1 services prototype were introduced.

5.23 The Meeting was informed that the FF-ICE/R1 laboratory demonstration is scheduled to take place from 22 to 24 July 2025 in Hanoi, Viet Nam. It will showcase operational scenarios involving flights between the following city pairs:

- Guam → Bangkok,
- Tokyo → Bangkok,
- Bali → Bangkok, and
- Auckland -> Singapore.

5.24 Technical capabilities to be demonstrated include:

- FF-ICE/R1 services, i.e., planning service, filing service, trial service, flight data request service, and notification service, using FIXM version 4.3 FF-ICE messages;
- Message integrity validation through security services aligned with the ICAO Trust Framework;
- SWIM technical infrastructure and SWIM information services.

5.25 It was added that lessons learned from the demonstration will be shared with relevant APANPIRG contributory bodies, such as the SWIM Task Force and FF-ICE Ad-Hoc Group, to support their ongoing discussions and developments. To further build up capabilities towards TBO implementation, FF-ICE/R2 (post-departure trajectory negotiation and revision) activities, including technical interchange meetings, tabletop exercises, technical trials, and a laboratory demonstration, are planned for 2025 – 2026.

5.26 The Meeting noted key achievements made by the TBO Pathfinder Project and encouraged States to participate at level 1 or level 2 based on their capabilities. It was suggested to consider taking advantage of the level 1 participation as an observer and take the opportunity to learn, interact, and exchange information.

Agenda Item 6: Aeronautical Mobile Communications Service and Aeronautical Electromagnetic Spectrum Utilization

6.1. Outcomes of WRC-27 Workshop

Outcomes of WRC-27 Workshop – Sec (WP/09)

6.1 The Workshop on ITU World Radiocommunication Conference 2027 (WRC-27 Workshop) was held in the ICAO Asia and Pacific Regional Office, Bangkok, Thailand, from 24 to 25 February 2025. The Workshop was organized in conjunction with the Twentieth Working Group Meeting of the Frequency Spectrum Management Panel (FSMP-WG/20), which was held from 27 February to 7 March 2025. The objective of the Workshop was to provide the background and information to States/Administrations in preparing their delegations for the WRC-27 and address other spectrum issues of vital importance to the international aviation community. The Workshop focused on agenda items of major concerns for the aviation community and action plans to be implemented at the national levels, regional preparations for WRC-27, radio altimeter and 5G issues, the issue of GNSS interference, and current practices and new challenges in APAC.

6.2 Noting strong concerns from different participants on the progress of WRC-27 Agenda item 1.7 and its relevant ITU-R studies, the States/Administrations were urged to follow ICAO Assembly Resolution A41-7 to strongly support both the ICAO frequency spectrum strategy and position at WRCs. Specifically, the States/Administrations were encouraged to communicate with radio regulatory authorities to ensure, to the maximum extent possible, that the ICAO position was accounted for in the development of national positions. It was highly recommended that delegations to regional conferences, ITU study groups and WRC include experts from their civil aviation authorities and other civil aviation stakeholders who are fully prepared to represent aviation interests.

6.3 Concerns were raised about the potential interference from 5G to the radio altimeter. The Workshop was informed of the increasing number of incidents of observed GNSS interference globally and the implications for air navigation safety and security. Serious concerns regarding the impact of GNSS interference on the safety and security of air navigation systems were expressed by the participants of the Workshop and States/Administrations were encouraged to monitor the issues and take into account a comprehensive and well-coordinated approach to address this pressing issue.

6.4 The Workshop noted that, along with the progress of the studies, there might be some updates to the ICAO position. Therefore, participants requested that it would be better for the aviation community to organize an additional remote workshop/webinar in 2027 to understand such updates.

6.5 The Meeting acknowledged the significance of the preparatory Workshop for WRC27 and shared appreciation with the ICAO APAC Office. The Meeting advised States/Administrations to follow up on the changes made in the ICAO position over time and take appropriate action.

6.6 The Meeting was informed that the Asia-Pacific Telecommunity (APT) will organize the 2nd Meeting of the APT Conference Preparatory Group for World Radiocommunication Conference 2027 (APG27-2) from 28 July to 1 August 2025 in Pattaya, Thailand. The APG27-2 will be organized by the APT as a physical meeting with remote participation. It was informed that APG27-2 is an important meeting for WRC-27 preparations. The APG27-2 Meeting will discuss the ICAO Position for WRC-27, which will be presented by ICAO HQ. It will also help to learn the Spectrum/WRC relevant issues and to help network and promote understanding of aeronautical issues to National Spectrum Regulators within the APAC Region.

6.2. Review Report of the Ninth Meeting of the Spectrum Review Working Group (SRWG/9)

Review the Report of the Ninth Meeting of the Spectrum Review Working Group (SRWG/9) – Sec (WP/10)

6.7 The paper presented the report of the Ninth Meeting of the Spectrum Review Working Group (SRWG/9) of APANPIRG, which was held in the ICAO APAC Regional Office, Bangkok, Thailand, on 5 – 7 May 2025.

6.8 Nominated by China and seconded by India and Singapore, Mr. Arthur Kin Hei Lau, Electronics Engineer, Civil Aviation Department, Hong Kong, China, was elected as the Chair of the Spectrum Review Working Group (SRWG).

6.9 The SRWG/9 Meeting was informed that Resolution **COM5/5** (WRC-23) was changed by ITU to **RESOLUTION 676 (WRC-23),** "Prevention and mitigation of harmful interference to the radio navigation satellite service in the frequency bands 1 164-1 215 MHz and 1 559-1 610 MHz". It was announced that ICAO was finalizing the ICAO position for WRC-27, which included a recommended modification action related to this resolution under Agenda Item 4 of WRC-27. States were encouraged to monitor the progress of the work in the ITU closely in order to ensure the continued availability of navigation capabilities.

6.10 The SRWG/9 Meeting noted the status of the implementation of the revised APAC VHF COM Frequency Allotment Plan in the Frequency Finder tool. The Secretariat notified CNSS/ANB to update the FF tool, which was revised in February 2025 and will be released as Frequency Finder 2025.01. ICAO Doc 9718 Volume II is also being updated. States were urged to review/upload frequency data, and the new FF version is expected in Q3 2025.

6.11 The SRWG/9 Meeting discussed the suggestion of frequency band reduction of AOC and the proposal of China to add an item to the Action list. It was agreed that the ad-hoc group formed in SRWG/7(15 – 17 February 2023) *to review the VHF COM Frequency Allotment Plan for APAC in terms of effective use of frequencies in the region* will discuss the proposal along with other potential ways for effective utilization of the VHF COM Frequency band, including the AOC band in APAC region. The ad-hoc group will share its report at the next SRWG meeting.

6.12 The CNS SG/29 Meeting noted an HF ad-hoc group led by Indonesia surveyed APAC States on aeronautical HF usage and international regulatory compliance. Established in 2023 to follow up on SRWG/7 Action 7-3, the group combined two databases into "HF APAC 2024" to document operational HF challenges. ICAO issued a questionnaire on 6 August 2024; by December, 15 of 29 States (Afghanistan, Australia, China, Hong Kong China, Macao China, India, Indonesia, Japan, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Singapore, Thailand) had responded. The ad-hoc group presented the following conclusions.

1) Out of 29 States/Administrations, 15 responded; 14 confirmed HF usage, and one did not. **HF bands are used not only by ANSPs but also by airlines, SAR, and others**, referencing Appendix 27 of the ITU Radio Regulations. Some States also **use Appendix 26 allocations**, though this band is **not meant for safety-of-life services**. ICAO guidance currently focuses on Appendix 27 only.

2) Responses revealed that **many Administrations have not registered HF allocations in the Master International Frequency Register (MIFR)**, risking international recognition and protection of the aviation spectrum. MIFR registration is emphasized in ICAO Doc 9718 as vital for protecting aviation interests in future spectrum discussions.

3) Operational issues highlighted include **severe frequency congestion** (e.g., 8879 kHz between Brisbane and Mumbai)**, unassigned frequencies in designated allotment areas** (e.g., Indonesia), **and ongoing voice quality problems due to ionospheric interference**. Some States now limit HF use to domestic contexts without VHF.

4) After WRC-23, Appendix 27 was amended to update channel characteristics but not the allotment areas. Existing allocations in ICAO APAC ANP Vol. II (last updated 2017) now requires revision to reflect the latest ITU framework**.**

5) Looking ahead to WRC-27, **Agenda Item 1.9 proposes updates to Appendix 26** to

support HF modernization. ICAO calls on States to safeguard aviation HF safety communications and avoid regulatory changes that might compromise Appendix 27 protections.

6) The Ad-Hoc group recognizes the need for the inclusion of the allotment plan information presented in both WP/15 of SRWG/8 and this Working Paper, subject to approval by the Meeting, into the Asia/Pacific Regional Frequency Management Manual v1.1.

6.13 Recommendations included mandatory MIFR registration, revising HF Network Designators in APAC ANP Vol II, encouraging non-responding States to complete the survey, and drafting updated HF allotment material for inclusion in the Asia/Pacific Regional Frequency Management Manual v1.1.

6.14 Thailand proposed allocating a dedicated frequency within 121.55–121.9917 MHz (Aerodrome Surface allotment) or 117.975–136.875 MHz for direct rescue and firefighting (RFF) communication with flight crews during ground emergencies. Currently, no specific RFF frequency exists. The proposal sought to amend the Asia/Pacific Regional Frequency Management Manual v1.1 accordingly. During SRWG/9, some States noted existing national RFF allocations and argued that assigning a uniform regional band was unnecessary; each State should choose frequencies per local needs and ICAO SARPs. The Meeting agreed that frequency selection for RFF communication remains a State prerogative, with no mandatory regional assignment.

6.15 The CNS SG/29 Meeting noted recent enhancements to the Frequency Finder (FF) tool, including updated VHF-COM allotments for APAC, new data protection in VHF-COM/NAV and SSR modules, and additional SSR capabilities. The revised FF will be distributed after testing, and States are encouraged to provide feedback. Improvements requested by the SRWG/9 Meeting include adding a “first-allocation” date column, reducing synchronization time and bandwidth usage, implementing automated “request” and “approve” buttons that generate official ICAO notifications, and adding an NDB frequency assignment feature. The Secretariat will relay these proposed modifications to ICAO HQ and report back at the next SRWG meeting.

6.16 The Meeting noted the outcomes of the Seminar on Frequency Use held in Bangkok, Thailand, from 16-18 September 2024, as well as the outcomes of the ICAO APAC Radio Navigation Symposium held in New Delhi, India, from 07-09 April 2025.

6.17 Australia reported VHF long-range interference during extreme atmospheric conditions in December 2023 and February 2024, affecting co-channel services like 119.7 MHz and 118.2 MHz. Such events are seasonal and not limited to international borders; affected States should coordinate via updated SRWG PoC lists and switch to alternative frequencies when necessary. Other States were encouraged to share experiences and mitigation measures in SRWG meetings.

6.18 China presented Edition 1.1 of the Asia/Pacific Regional Frequency Management Manual (formerly the Aeronautical Radio Frequency Management Guidance Material), adopted via Conclusion SRWG/8/6. Key amendments include updating the title, reducing VDL channel spacing, adding backup frequencies, TIBA provisions, and GBAS/VDB frequency assignment planning. The remaining proposed changes require further review and will be brought to SRWG/10. India requested the inclusion of NDB frequency assignment criteria.

6.19 The SRWG/9 Meeting was informed that India’s 2021–2030 VHF COM frequency simulation showed 67% of the projected 445 spots (117.975–137 MHz) were implemented by early 2025, suggesting 25 kHz channels suffice through 2030. However, increased adjacent-country usage could strain capacity, especially for higher flight levels. India plans another review in three years, with the Meeting recommending a region-wide spectrum analysis in 2028 to anticipate congestion and potential 8.33 kHz spacing adoption. It was suggested that as accurate predictions rely on an up-to-date

Frequency Finder database, States/Administrations must verify and correct entries, remove unused frequencies, and update range and power details. Additionally, the Secretariat will liaise with the FSMP secretary to determine tentative publication timelines for space-based VHF SARPs, as these will influence APAC's VHF allocation and future simulations.

6.20 The SRWG/9 Meeting observed that the current ToR of SRWG requires further amendments to include other tasks being taken care of by SRWG, such as working on interference issues, WRC coordination, etc. It was suggested that the ICAO Secretary, along with the chair, revise the ToR and present the draft of the revised ToR in the SRWG/10 meeting for consideration.

6.21 The SRWG/9 Meeting noted a lack of GNSS RFI incident reports since the release of the reporting form, hindering cross-border interference management. It was recommended that APAC States/Administrations submit incident details at SRWG/10 to assess the interference scope. Based on collected data, the need for an ad-hoc GNSS RFI group will be evaluated. Additionally, the ICAO Secretariat will liaise with existing regional ad-hoc GNSS RFI groups to clarify their scopes and prevent overlapping efforts, reporting findings at SRWG/10.

6.22 The CNS SG/29 Meeting agreed to defer to the SRWG to study the need for a group under CNS SG to assess and analyze the incidents shared by APAC Member States/Administrations and GNSS and Data Link Disruption Ad-Hoc Group to develop mitigation strategies, considering the global development in this domain. The ICAO Secretariat will share this information with SRWG. **ACTION ITEM 29-2**

6.3. Update on the status of datalink applications and VHF capability sharing by States

Accelerating the LDACS Technique Development for Civil Aviation Application – China (WP/33)

6.23 China informed about the L-band digital aeronautical communication system (LDACS) properties, its advantages in the application of civil aviation, and the progress of international standardization and the development status in China. The Meeting noted that the validation of LDACS was conducted within the framework of ICAO panels, the Single European Sky ATM Research (SESAR) Programme, etc. Various platforms were built in the CNS/ATM Lab of CAAC, aiming to test the compatibility between LDACS and DME, GNSS L5/E5a/B2a signals, ADS-B and SSR. Test results were summarized and presented in past ICAO meetings.

6.24 China informed that the LDACS compatibility test remained an urgent task. It was envisaged that the necessary testing would be completed to derive compatibility criteria between LDACS and legacy L-band systems by the end of 2025. Based on these results, LDACS standardization activities can be continued and completed. China encouraged more entities to conduct LDACS compatibility tests through international collaborations and provide comments on the possible applications of LDACS in civil aviation.

6.25 The Meeting admitted that LDACS is an innovative project that will bring a revolution to aviation communication infrastructure. In response to a question about experience by other States/Administrations for LDACS, no other States/Administrations expressed they had such experience.

Research and Application of Air-Ground Data Link-Based Landing Information Interaction Technology for Inbound Flights – China (IP/10)

6.26 China informed about the operational concept and practical application of LID (Landing Information Deliver), a pre-release function for landing information on inbound flights based on the air-ground data link. It was shared that the LID function enabled advanced transmission of

Standard Terminal Arrival Routes (STAR) and Arrival Runways (ARWY) to flight crews during the cruise phase, establishing an efficient, precise, and two-way digital communication channel between pilots and ground controllers.

6.27 The Meeting noted that current feedback from airlines highlighted priorities to optimize cargo flight allocation logic, resolve conflicts between automated and manual assignments. Furthermore, it was added that plans are underway to extend LID functionalities to departure phases through taxi path delivery and departure data verification, aiming to streamline workflows for controllers and flight crews while enhancing future airspace management efficiency.

6.28 In response to a question about additional onboard equipment requirements for LID in avionics, China informed that any additional onboard equipment is not required.

6.29 The Meeting requested that China share more statistics and details about LID in future CNS SG Meetings.

Research and Application of Airport Surface Safety Technology based on AeroMACS – China (IP/11)

6.30 China introduced the implementation of the new-generation AeroMACS 2.0 technology at Shanghai Hongqiao Airport, focusing on its application in runway incursion prevention and visualized aircraft taxiing guidance. The Meeting noted that the AeroMACS 2.0-based visual taxi guidance system enables continuous path guidance, reduces reliance on voice instructions, and lowers taxiing error rates. However, challenges remained regarding airborne system compatibility, airworthiness constraints, and certification timelines. It was informed that CAAC will focus on expanding the adoption of next-generation AeroMACS-driven surface safety technologies across other airports, providing valuable experience for promoting AeroMACS technology across the Asia-Pacific region.

6.31 A clarification was requested for the aircraft taxiing guidance display at the airborne end, as presented in Figure 9 of IP/11. It was asked if the display is standard onboard equipment in aircraft or a separate application. China informed that the existing airborne EFB terminal has been loaded with the test application. Some Chinese aircraft have already accessed this application directly. The AeroMACS 2.0 transceiver is a separate device.

6.32 The Meeting noted that the Beidou update rate is equal to the ADS-B update rate of 1 Sec. China added that every airside vehicle in China at Shanghai Hongqiao Airport has an MLAT ADS-B installation.

6.4. Other issues related to aeronautical communications service and aeronautical radio spectrum management, especially on 5G implementation and potential impacts on aircraft radio altimeters

Outcomes of Survey for assessment of readiness for Amendment 91 to Annex 10, Volume III on Selective Calling (SELCAL) Codes Implementation – Sec (WP/27)

6.33 The paper shared information about a survey conducted by the ICAO APAC Office to assess the readiness of ANSPs' Flight Plan (FPL) processing systems handling SELCAL32. The Meeting was reminded about the survey on the readiness of APAC States/Administrations' flight plan processing systems handling SELCAL32 in 2024 by State Letter Ref.: T 8/4.3: AP072/23 (CNS) 6 June 2024. The objective of the survey was to evaluate the preparedness of ICAO member States for the implementation of Annex 10 Amendment 91 concerning the SELCAL that became applicable on November 3, 2022, and identify any associated challenges.

6.34 The Meeting noted that a total of *thirteen responses* from Australia, China, Hong Kong China, Macau China, Fiji, French Polynesia, India, Indonesia, Japan, New Zealand, Pakistan, Singapore, and Thailand were received. Based on responses received, it was concluded that most APAC States/Administrations that participated in the survey are ready to implement ICAO provisions Amendment 91 to the International Standards and Recommended Practices, Annex 10 — Aeronautical Telecommunications, Volume III — Communication Systems. However, it was highlighted that only 13 States/Administrations participated in the survey, which makes it difficult for us to assess APAC region readiness. The Meeting requested that APAC States/Administrations that have not responded to the survey share their readiness with the ICAO APAC Office. **ACTION ITEM 29-3**

AeroMACS 2.0 Project Progress in China – China (WP/34)

6.35 China summarized its AeroMACS 2.0 project progress from the perspective of standardization, application and demonstration. Profiting from the high spectrum efficiency, low latency, and massive connectivity of the AeroMACS 2.0, the potential application scenarios at the airport, including runway incursion prevention, runway status light control, collision prevention in low-visibility conditions, Level V visual taxiing guidance, and airport surface resource management, were explained to the Meeting. States/Administrations were invited to actively support and participate in the CP-DCIWG-WG-M AeroMACS subgroup to update the respective standards.

6.36 On the question about the difference between 5G and AeroMACS usage at the airport, it was clarified that AeroMACS uses the protected aeronautical spectrum, i.e., 5091- 5150 MHz, rather than the commercial 5G spectrum. As such, the safe and efficient airport operation can be guaranteed with restricted interference from other systems.

Space-based VHF Update – Australia (IP/03)

6.37 Australia provided an update on Space-Based VHF and the progress within ICAO since the new spectrum allocation was achieved at the World Radiocommunications Conference 2023. It also provided a brief overview of the technology, the challenges associated with frequency planning and the need for cooperation at the regional and inter-regional levels when implementing Space-Based VHF.

6.38 The Meeting noted that the SB-VHF CG is working closely with PT-SBV and both groups are planning to start inter-panel coordination of the PfAs with the Air Traffic Management Operations Panel (ATMOPS), Separation and Airspace Safety Panel (SASP), Communications Panel - Operational Datalink Specific Working Group (CP-OPDLWG) and the Flight Operations Panel (FLTOPSP) in the 2nd half of 2025.

6.39 It was anticipated that in October 2025, the FSMP-WG will endorse the PfA items relating to Annex 10 Volume V, and in December 2025, the CP-DCIWG will endorse the PfA items relating to Annex 10 Volume III. Following this, the ICAO secretariat will present the PfA for the Air Navigation Commission (ANC) review, and there will be an ICAO State Letter requesting comments on the PfA before the ANC endorses the PfA to go to the ICAO Council for approval in March 2028. This may result in an Applicability Date of November 2028.

6.40 The Meeting noted that SASP and OPDLWG are considering whether additional separation standards are required and how Required Communications Performance (RCP) could be applied to Space-Based VHF; however, no formal work in this area has started. It is expected that testing and operational trials will begin in late 2026 or early 2027, including in the APAC region. Once the SARPs are published and the regional coordination process is agreed upon, multiple service providers are expected to provide a space-based VHF and space-based ADS-B service for the aviation industry.

6.41 The Meeting noted that the standardization process has incorporated issues of ionospheric and scintillation effects on space-based VHF, and associated thresholds have been defined by expert panels.

6.42 It was noted that WRC-23 approved a new allocation for the Space-based VHF band specifically for Low Earth Orbit (LEO) satellites.

6.43 A question about the need for deployment of 8.33 KHz channel spacing in the APAC region in the near future, when space-based VHF will be implemented, was raised. It was also shared that there is a need to assess the effect of the deployment of space-based VHF on terrestrial VHF systems in the APAC region. The Meeting agreed that SRWG should discuss the proposed needs and share updates with CNS SG at the next meeting. **ACTION ITEM 29-4**

Research Progress and Implementation Plans for VoIP Air-Ground Communications in China – China (IP/12)

6.44 China presented the research and validations carried out in recent years in the field of VoIP air-ground communications, as well as the implementation plans for the next stage. China informed that it has formulated a series of VoIP standards consistent with the standards recommended by ICAO and based on rich experimental practice and operational experience. It was informed that China is promoting the application of VoIP technology in recent projects of 9 ACCs in the emergency scenario. In addition, ATMB encouraged qualified ATC units to gradually promote the practical application of VoIP, transitioning from emergency and short-term applications to main and long-term applications. It was added that manufacturers in China are also actively carrying out research on VoIP and will launch the new VCS system based entirely on IP structures complying with VoIP standards as soon as possible

6.37 The Meeting noted that VoIP systems are compatible with both China's standards and Eurocae standards for VoIP ATM components.

Agenda Item 7: Navigation

7.1. Review Report of the Seventh Meeting of GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7)

Review Report of the Seventh Meeting of GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7) - GBAS/SBAS ITF Co-Chairs (WP/11)

7.1 The paper reviewed the outcomes of the Seventh Meeting of the ICAO Asia/Pacific GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7) held in Bangkok from 14 to 16 May 2025.

7.2 Expected Implementation Priority for ASBU NAVS Block 0 Elements within the APAC region in Asia/Pacific Seamless Air Navigation Service (ANS) Plan Version 4.0, adopted by APANPIRG last November 2024, was reviewed. The Meeting supported the following proposal:

"Keep priority 2 for NAVS-B0/1 GBAS and NAVS-B0/2 SBAS as some APAC States do not have access to such systems, and to change the priorities of NAVS-B0/3 ABAS and NAVS-B0/4 Nav. MON to Priority 1".

Functional Category	Element	Description	Priority	Responsibility for Review
Technology	NAVS-B0/1	GBAS	2	CNS SG
	NAVS-B0/2	SBAS	2	
	NAVS-B0/3	ABAS	1	
	NAVS- B0/4	Nav. MON	1	

7.3 The Meeting reviewed the final draft of the guidance document for the implementation of SBAS. The following Draft Decision was endorsed by GBAS/SBAS ITF/7 for CNS SG/29 consideration, which was adopted by the CNS SG/29 Meeting:

<table>
<tr><td colspan="3">Decision CNS SG/29/08 (GBAS-SBAS ITF 07/01) - Guidance Document for Implementation of SBAS in the Asia/Pacific Region</td></tr>
<tr><td colspan="2">What: The draft guidance document for implementation of SBAS in the Asia/Pacific Region, developed by the APAC GBAS/SBAS ITF and provided in Appendix H, is adopted.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: To provide guidance to States for the implementation of SBAS</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒CNS Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other:</td></tr>
</table>

7.4 The GBAS/SBAS ITF/7 Meeting noted the updates on the GBAS/SBAS implementation status in the APAC region from Australia, Fiji, India, Japan, Pakistan, the Republic of Korea and Singapore. It was noted that at present, 57 LPV approaches are in various stages of implementation, while 23 of them have already been published.

7.5 The CNS SG/29 Meeting noted that there were four high-priority pending action items in the Action Item List. It was informed that one was the development of SBAS Implementation Guidance, which is closed as the CNS SG endorsed the final draft of the guidance document. The second pending action item is the workshop on GBAS/SBAS for airspace users, which will be closed after conducting the workshop in October 2025 in India. The remaining two action items will be a specific meeting with APAC regulators interested in GBAS/SBAS and the action item for GBAS/SBAS performance demonstration.

7.6 Japan suggested that currently, the content added in the Guidance Document for Implementation of SBAS in the Asia/Pacific Region is simplified content that does not contain very detailed technical aspects of SBAS Implementation. However, in the future, the document can be enhanced to include the monitoring of SBAS implementation in the Asia/Pacific Region, along with assisting States in implementing SBAS/GBAS.

7.2. GNSS Interference and Mitigating Measures

Outcomes of Radio Navigation Symposium – Sec (WP/12)

7.7 Ms. Muna Alnadaf, Technical Officer, CNSS, ICAO HQ and Navigation System Panel (NSP) Secretary, presented key outcomes of the Radio Navigation Symposium by WP/12 and recommendations arising from the Symposium by WP/28.

7.8 The ICAO APAC Radio Navigation Symposium was held in New Delhi, India, from 07–09 April 2025. The theme of the Symposium was ***GNSS RFI: Collectively Bridging Gaps and Shaping the Path Forward.*** The Symposium aimed to provide a collaborative platform to exchange experiences and insights on GNSS RFI, analyze its impact and challenges, and facilitate in-depth discussion on mitigation measures and future development to build a resilient aviation system. The Symposium developed recommended actions to guide future efforts in managing GNSS RFI. It also addressed the USOAP Radio navigation flight inspection requirements and the latest developments. Detailed information about different discussions made in the symposium and other resources can be accessed at: https://www.icao.int/APAC/Meetings/Pages/Radio-Navigation-Symposium.aspx

7.9 The summary of the discussion made by different panels during the three days of the Symposium was shared with the meeting.

Recommendation from Radio Navigation Symposium - Sec (WP/28)

7.10 The Meeting recalled that ICAO, in collaboration with ITU and IMO, has recently issued a joint statement on the protection of the radio navigation satellite service from harmful interference. The ICAO/ITU/IMO statement called for five (5) key actions, which the Symposium reaffirmed and outlined a set of recommended actions and best practices containing six objectives and associated recommendations for all aviation stakeholders, provided in **Appendix I**. The list of recommendations was explained in detail at the meeting.

7.11 The Meeting was informed that as part of ICAO's engagement with ITU, the existing GNSS RFI reporting procedure between the two agencies has been reviewed to explore potential enhancements. A new account for ICAO will be created on ITU's online tool, the Satellite Interference Reporting and Resolution System (SIRRS), to facilitate reporting and improve the tracking of cases where analysis determines a significant impact on air navigation with an international scope. In such cases, ICAO will promptly transmit the results to ITU. Additionally, the system will facilitate keeping ICAO informed about the progress in applying the procedure outlined in Article 15, Section VI, of the Radio Regulations for cases of harmful interference to GNSS identified by ICAO. ICAO will also be notified as soon as the interference incident is deemed resolved.

7.12 An update about GNSS RFI- related NOTAM was shared with the Meeting. It was recalled that the 14th Air Navigation Conference (AN-Conf/14) acknowledged the absence of a standardized NOTAM Q-code for GNSS interference events and subsequently requested ICAO to develop additional NOTAM codes to enhance consistency and operational efficiency. GNSS RFI-related NOTAMs contain varying Q-Codes and inconsistent significations. IATA reported that eighteen (18) different Q-Codes are used worldwide, rendering filtering mechanisms ineffective. Furthermore, it has been noted that different text is used for Item E, such as "GPS Unreliable," "GPS Jamming," "GPS signal interference," and "GNSS interference,". This diversity created challenges for operators attempting to identify and search in NOTAMs for information about GNSS interference events.

7.13 It was informed that two (2) Q-codes and recommended Item E text have been identified by the ICAO navigation systems panel (NSP) and will be incorporated in relevant ICAO documents. Furthermore, guidance on how pilots should interpret NOTAM is being developed.

7.14 In response to a question about tentative dates for incorporation of new provisions in relevant ICAO documents for States' use, it was shared that it may be Q1-2026.

7.15 Japan shared that the provided list of recommendations and the ANConf/14 recommendation suggested that States/Administrations detect GNSS jamming and spoofing, while there are several methods to detect GNSS RFI. Japan asked if there is any guidance material from ICAO for States/Administrations to help them get information about how to do such detection. Alternatively, is there any plan from ICAO to develop such guidance material?

7.16 ICAO HQ informed about an ongoing work of developing a concept of operation for detection and downlinking GNSS RFI onboard the aircraft so that the aircraft uses ADS-B to detect GNSS RFI and download the status to the ATC Centre through the ADS-B 1090 MHz.

7.17 Regarding GNSS RFI detection, it was shared that NSP is developing an iPACK, which is a standardized implementation package for mitigation of the impact of GNSS RFI, and one of the aspects that the iPACK plans to cover is the detection and monitoring tools. Currently, there are various tools available within the States or commercially, from a very simple online tool to a very sophisticated tool that can be installed in an airport or through the FIR. Alternatively, States can compare ADS-B data with SSR and detect GNSS spoofing or jamming. Currently, there is no plan from

ICAO to work on Guidance Material for GNSS RFI detection tool/system, as there are other priorities such as Resilient Operation Network (RON) and complementary PNT in addition to authentication features for core constellation and SBAS. In addition, GNSS reporting is a pending task for NSP.

7.18 China suggested that avionics manufacturers and SATCOM service providers should also be incorporated to conduct cybersecurity, as mentioned in recommendation 6.2. ICAO HQ agreed with the proposal and emphasized the security by design system. It was clarified that by the proposed recommendations, the intention is for States/Administrations to proactively assess all aviation services using satellites and take mitigation measures based on risk analysis outcomes, as jamming and spoofing may be encountered in other satellite systems in the future.

7.19 Considering the significance of the list of recommendations presented to the Meeting, the Meeting suggested that ICAO consider publishing them at the global level and sharing them with all States/Administrations officially. **ACTION ITEM 29-5**

7.3. Outcomes of Flight Inspection and Procedure Validation Seminar

Outcomes of Flight Inspection and Procedure Validation Seminar – Sec (WP/13)

7.20 The paper summarised the discussion of the Flight Inspection and Procedure Validation (FIPV) Seminar held in Bangkok, Thailand, from 30 July to 1 August 2024. A total of fourteen (14) presentations were delivered by Experts from various States/Administrations and Industries.

7.21 The Seminar emphasized that ICAO documents (Docs 8071, 10068, 9906) are guidance only and that States must follow their own regulatory frameworks for instrument flight procedure (IFP) design, validation, and periodic review (maximum of five years). The Minimum Operational Network concept and the complementary role of conventional navaids alongside GNSS were highlighted due to interference concerns. Participants agreed that flight inspection must incorporate multi-constellation and anti-jamming technologies for GNSS-challenged environments. The APAC Flight Procedure Programme's Phase 5 strategy was shared to build sustainable IFP capabilities.

7.22 An open discussion on RPAS for flight inspection identified regulatory fragmentation, technical and operational challenges, and uncertain business cases; however, RPAS can support ground inspections and enhance NAVAID monitoring. A GNSS RFI session covered detection, mitigation, and the need for robust regulations governing in-band radiators. As an outcome, ICAO APAC will update its Catalogue of Flight Inspection and Flight Validation Service Providers, incorporating RPAS capabilities, based on survey responses from 16 States. Results underscored the need for standardized RPAS use and potential new guidance (e.g., a job card or Doc 8071 chapter) for UAS-based flight inspection.

7.23 ICAO HQ informed that during the ANConf/14, China presented a paper on using drones for flight inspection, and later, NSP requested China to present a draft of the job card on the topic. During the JWGs14 (29 April - 8 May 2025) of NSP, China prepared a proposal, which was discussed and agreed upon by the panel. However, the job card has not been endorsed yet by the Air Navigation Commission (ANC). The job card will be presented to ANC after the NSP meeting in January 2026. It was clarified that the title of the document would be "UAS-based flight inspection."

7.24 In response to a question, ICAO HQ clarified the difference between the three different dates: The adoption date, applicable date, and effective date mentioned in the State letter related to the amendment to any SARPs. More information can be accessed by this link.

7.4. Other navigation-related matters

Establishment and Validation of Australia's Backup Navigation Network – Australia (IP/04)

7.25 Australia informed about a Backup Navigation Network (BNN), which is intended to support the safe completion of flights in the event the GNSS is unavailable. The Meeting noted that the number of Navigation Aids prior to and following the establishment of the BNN reduced from 394 to 209. Since the BNN was established in 2016, a further four ground-based Navigation Aids have been decommissioned based on consultation with the aviation community and an extensive safety assessment. Australia informed that the safety argument was validated through fault tree analyses with the top-level events of Mid-Air Collision (MAC) and Controlled Flight into Terrain (CFIT) over a number of scenarios in the GNSS environment, indicating that the reduced aid network maintains acceptable safety standards, validating the design of the BNN in the context of GNSS operations.

7.26 The Meeting noted that Australia continued to review the composition of the BNN to ensure it remains fit for the purpose. It was added that Australia is considering the various factors in the future composition of the BNN, including a) the increasing number of instances of GNSS interference and spoofing being observed at other locations in the world, b) the need for the state to consider economic resilience and mitigation to the potential for mid and long term GNSS disruptions or corruption; c) instances of GNSS interference observed and reported locally, d) instances of GNSS unavailability to pilots due to avionics failure or malfunction, e) evolution of aircraft capabilities that will improve GNSS resilience, and f) evolution of regulatory requirements for PBN including the requirements for flight planning and avionics fitment.

7.27 The Meeting encouraged States/Administrations to share their readiness for Minimum Operational Network (MON) to mitigate GNSS RFI issues in future CNS SG meetings.

Application of LDACS in Aviation Navigation Network – China (IP/13)

7.28 China proposed an operational concept for applying LDACS in the aviation navigation network. China informed that utilizing LDACS broadband communication capabilities can mitigate threats of ionospheric anomalies and satellite navigation signal interference faced by GBAS. By establishing a two-way air-ground data link, the concept enabled bidirectional information sharing between airborne and ground systems, thereby supporting air-ground collaborative ionospheric threat refined modeling and wide-area interference monitoring and positioning.

7.29 The Meeting found the information very useful and encouraged China to present this information at the GBAS/SBAS ITF meetings. **ACTION ITEM 29-6**

GBAS Status Update in CHINA – China (IP/14)

7.30 China introduced the deployment and test evaluation progress of the GBAS Ground Station in China. It was noted that the GBAS equipment has been deployed at Zhoushan Putuoshan Airport to meet the performance requirements for GAST-C, and manned aircraft flight tests have been carried out for verification. In addition, a DFMC GBAS Ground Station has been deployed at Dongying Shengli Airport, and the accuracy performance evaluation of the GBAS ground station for BDS B1C and B2a frequencies has been carried out. The Meeting encouraged China to present this information at the GBAS/SBAS ITF meetings.

Agenda Item 8: Surveillance

8.1. Review Report of Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10)

Review Report of Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10)– Sec (WP/14)

8.1 The paper reviewed the outcomes of the Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10) held in Bangkok, Thailand, from 21 to 23 April 2025.

8.2 The paper presented the key outcomes of the ICAO APAC ADS-B Implementation Workshop, which was held from 14 to 16 August 2024 in Bangkok, Thailand. The SURICG/10 Meeting shared its appreciation to the ICAO APAC Office, New Zealand and Singapore for organizing and supporting the Workshop and recommended organizing more events in the future.

8.3 The SURICG/10 Meeting reviewed the proposed initial set of APAC Common SWIM Surveillance Information Services→**Surveillance data sharing services**. With assistance from Hong Kong China, the list was modified and further consulted with SURSG/4 delegates by email. After incorporating all inputs, the ***final list of APAC Common SWIM Surveillance Information Services*** was prepared by the SURICG/10 meeting.

8.4 Hong Kong China shared the progress of the work of SURSG after 2024. It was informed that SURSG has started to prepare the last deliverable of the Study Group (i.e., guidance material), based on the proposed framework. The complete draft is planned to be ready by mid-2025 to seek further comments from SURSG members. The finalized version is targeted for endorsement by SURICG/11 in 2026. During the discussion of the next meeting date of SURSG, it was stated that the next Meeting will be planned before the SURICG/11 Meeting in 2026.

8.5 Hong Kong China presented the critical role of the ADS-B Central Data Processor System (CPS) in enhancing air traffic surveillance. Hong Kong China highlighted that the implementation of an ADS-B CPS could be effective in addressing the issues of falsified target displays caused by GNSS spoofing and encouraged States to consider its implementation based on their needs.

8.6 The Meeting noted that a Performance-Based Surveillance Sub-Group (PBSSG) is discussing using a cooperating surveillance system for separation, not for non-cooperative systems. The future versions of the RSUR manual could be modified to add guidance for this. USA will provide outcomes of the discussion in future SURICG meetings.

8.7 The Meeting reviewed the reports on the Sub-regional ADS-B implementation plan/projects presented by BOB and SEA Ad-Hoc working groups, as well as the updated table on ADS-B Data Sharing Implementation Status.

8.8 The Meeting reviewed the process for States to request and coordinate interrogator codes (IC) for mode S interrogators. The following Conclusion was adopted by the Meeting.

<table>
<tr><td colspan="3">Conclusion CNS SG/29/09 (SURICG/10/02) - Workflow for the request and coordination of IC codes with the ICAO APAC Office</td></tr>
<tr><td colspan="2">What: Interrogator Codes (IC) of Mode S interrogators in the Asia Pacific region are to be coordinated and assigned through the ICAO APAC Regional Office. States/Administrations requiring ICs should request to the ICAO APAC Regional Office following the approved workflow as per Appendix J to facilitate the request.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td colspan="2"></td><td>Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Adopted by Subgroup</td></tr>
</table>

Who: SURICG	☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☐Other:

8.9 The Meeting noted the **Decision SURICG/10/03** – Adoption of Mode S DAPs Implementation and Operation Guidance Document Edition 6.0 was adopted by the SURICG/10 meeting. The Mode S DAPs Implementation and Operation Guidance Document Edition 6.0 were modified to add the general strategy on the assignment of and migration to SI code and some information about the management of the 1030/1090 MHz utilization to update the general strategy on the assignment of and migration to the SI code was adopted during the 35th APANPIRG meeting.

8.10 The Meeting was informed about the latest work, enhancements, and functionalities brought to the SSR module of the Frequency Finder tool to assist ICAO Regional Offices and States in managing and coordinating SSR Mode S II/SI codes.

8.2. Other surveillance-related matters

ADS-B Quality Performance Monitoring – Japan (WP/24)

8.11 Japan informed that with a plan to integrate ADS-B data to expand the area of higher accuracy and higher update rate, Japan has developed an ADS-B quality performance monitoring tool. This tool continuously acquires C/N0 data for each GPS satellite from the 80 GPS-based Control stations nearest to each airport, switching between them at regular intervals. If the C/N0 value falls below a set value, the tool will alert to the possibility of GNSS jamming. Currently, these tools have been evaluated for official operation. Japan proposed collaborations among APAC States to improve the ADS-B quality performance of aircraft and promote collaborations among APAC States to share information on methodologies for GNSS RFI monitoring.

8.12 The Meeting shared the significance of the information shared in the paper and suggested that Japan present this information in future SURICG Meetings. **ACTION ITEM 29-7**

ADS-B GNSS Performance Issues in Australia– Australia (IP/05)

8.13 Australia shared recent unique ADS-B problems experienced in Australia relating to the interaction between avionics and GNSS, affecting some aircraft, which resulted in ADS-B tracks being dropped from air traffic controller screens. The Meeting was informed that Airbus had advised ongoing monitoring of ADS-B surveillance loss events. Airservices Australia (ANSP), in conjunction with the regulator CASA, has continued to monitor the issue and is working with Airbus to resolve it. It was added that Airbus planned to integrate findings from these events into future ADIRU and AESS standards to enhance resilience against the impacts of satellite signal degradation.

8.14 The Meeting deliberated on the deficiencies of ADS-B and suggested that such issues must be presented in the SURICG Meeting. The Meeting requested that the SURICG Co-Chair share information about any discussion being held in SURICG on these topics. SURICG Co-Chair informed that SURICG has an agenda for a report on surveillance ground systems, avionics performance monitoring, and improvement in compliance, under which ADS-B and other surveillance sensors issues are discussed. It was informed that the ICAO APAC office manages the ADS-B avionics problem reporting database. In addition, the Surveillance Panel (SP) maintains the FAA No Services Aircraft List (NASL), which is the list indicating all aircraft that do not comply with minimum ADS-B requirements. The SURICG Co-Chair informed that SURICG is discussing the need to maintain the proposed databases, and the outcomes will be shared at the CNS SG meeting. **ACTION ITEM 29-8**

Agenda Item 9: Automation

9.1. Review Report of the Sixth Meeting of ATM Automation Systems Task Force (ATMAS TF/6)

Review Report of the Sixth Meeting of ATM Automation Systems Task Force (ATMAS TF/6) – Sec (WP/15)

9.1 The paper summarised the discussion of the Sixth Meeting of the APAC Air Traffic Management Automation System Task Force (APAC ATMAS TF/6) held in Bangkok, Thailand, from 2 to 4 June 2025.

9.2 The Meeting recalled that at CNS SG/28, ATMAS TF was tasked (Action Item 28-1) to provide a pictorial map showing the latest AIDC implementation status and regional hotspots for CNS SG/29. The ICAO Secretariat coordinated with the ATMAS TF Co-Chairs to follow up. Singapore confirmed it would update the chart and noted that the original version came from the AIDC Task Force, now part of ATMAS. Singapore also requested the list of LHD updates. It was noted that RASMAG publishes an annual report (see RASMAG/29 Appendix G), which includes LHD data and hotspot details. These were shared with Singapore, which then updated the AIDC Implementation Chart as requested.

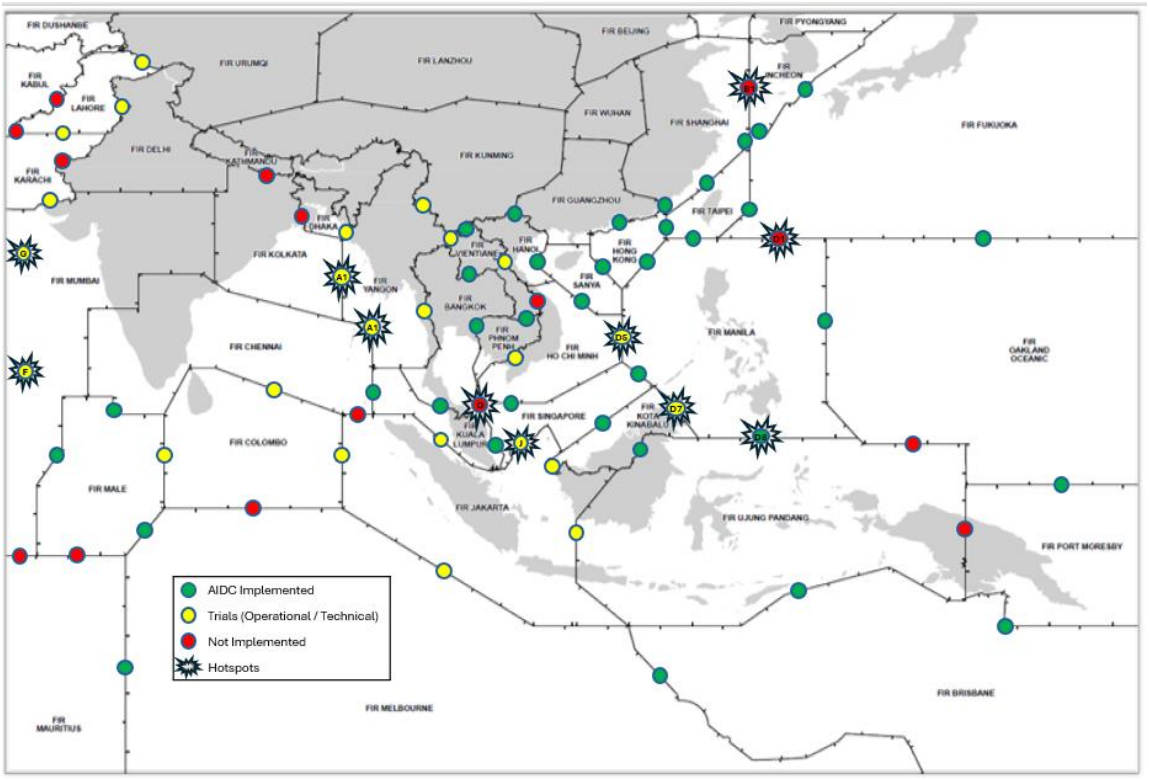


Figure 1- AIDC Implementation and RASMAG Hotspot Chart

9.3 Users of the chart should be aware of the following:

1) FIR boundaries may not be fully accurate.
2) AIDC implementation and hotspot data are based on ACSICG/12 WP/08 (March 2025) and RASMAG/29 Appendix G (August 2024). In case of any discrepancy, the papers should be considered the official reference.

9.4 The Meeting agreed that the chart is useful for a quick overview of AIDC implementation and hotspots. The Meeting noted New Zealand offered to do internal coordination and

collate the required information for the future to include the South Pacific States.

9.5 It was noted that hotspots may not be solely caused by AIDC issues but by other contributing factors. Suggestions included updating the chart regularly or after RASMAG identifies new hotspot trends or ATMAS TF notes major updates. The ICAO Secretariat will coordinate internally and inform the ATMAS TF of any significant changes.

9.6 The Meeting was updated on the progress of SWIM implementation in the Asia/Pacific region, led by the SWIM Task Force and SIPG. Key outcomes from recent meetings emphasized the need for close coordination to support the transition. APANPIRG/33/09 endorsed a SWIM implementation timeframe of 2024–2030 and its inclusion in the Seamless ANS Plan v4.0. SWIM will support both current and future operations, such as ATFM, FF-ICE, and TBO, making regional harmonization essential.

9.7 Given recent updates to ICAO Doc 4444 introducing FF-ICE and the recommendation to phase out FPL2012 by 2034, ATMAS TF was invited to assess its readiness to process new message formats (e.g., eFPL via SWIM) and integrate data models like FIXM, IWXXM, and AIXM. Transition efforts, including protocol and data format conversion, were discussed.

9.8 The Meeting noted the regional adoption of FIXM v4.3 for cross-border ATFM from Q3/2026, and that the FPL2012 sunset date is expected by 2032. Successful FIXM v4.1 trials via SWIM/CRV were conducted by China, Hong Kong China, Singapore, and Thailand. States were urged to ensure new ATMAS acquisitions support SWIM/FF-ICE and to share capability assessments at future meetings.

9.9 The Meeting was informed that following the Conclusion of ATMAS TF/05/01, Edition 1.4 of the ATMAS Implementation and Operations Guidance Document (IGD) was adopted by ATMAS TF/5. China informed that regarding the enhanced function of ATMAS and implementation experience of the system, China cooperated with the Ad-hoc working group to develop the draft (Edition 1.5) of the ATMAS IGD. China circulated the revised draft (Edition 1.5) of the ATMAS IGD to Member States/Administrations for review and comments on 30 April 2025. Suggestions from Hong Kong, China, and New Zealand were received and adopted.

9.10 The ATMAS Implementation and Operations Guidance Document (Edition 1.5) was reviewed and endorsed by the ATMAS TF/6 Meeting, which was adopted by CNS SG/29:

<table>
<tr><td colspan="3">Decision CNS SG/29/10 (ATMAS TF/06/01) – Adoption of the Air Traffic Management Automation System Implementation and Operations Guidance Document Edition 1.5</td></tr>
<tr><td colspan="2">What: The Air Traffic Management Automation System Implementation and Operations Guidance Document, Edition 1.5, provided in Appendix K, is adopted.</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: New subsections have been added in the revised draft.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: ATMAS TF</td></tr>
</table>

9.11 The Meeting was presented with the results of the AIDC IGD Ad-Hoc Review Group reviewing core AIDC messages and addressing implementation challenges. The group proposed the removal of ABI from the recommended core messages and identified CDN and REJ messages as valuable additions to the recommended set. The proposed amendments to Chapter 4.4 of the AIDC IGD were presented. It was informed that these amendments were intended to streamline recommendations

towards low-effort, high-value AIDC implementations. It was informed that the proposed addition of new CDN and REJ messages was adopted from the Pan Regional Interface Control Document for ATS Interfacility Data Communications (PAN AIDC ICD). It was advised that States should retain full discretion to implement and exchange AIDC messages beyond the recommended message set where operationally beneficial, provided such implementation adhered to the published Interface Control Document (ICD).

9.12 The Meeting reviewed and adopted the proposed amendments to the AIDC IGD:

<table>
<tr><td colspan="3">Decision CNS SG/29/11 (ATMAS TF/06/02) – Adoption of the AIDC Implementation and Operations Guidance Document (IGD) Edition 2.0</td></tr>
<tr><td colspan="2">What: The AIDC Implementation and Operations Guidance Document (IGD) Edition 2.0 provided in Appendix L be adopted</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: New subsections have been added in the revised draft.</td><td colspan="2">Follow-up: ☐Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☒Other: ATMAS TF</td></tr>
</table>

9.13 The Meeting noted the latest repository of AIDC Implementation Status in the APAC region and invited States/Administrations to review and continue to update the AIDC implementation status and Focal Point for AIDC Implementation if necessary. The updated Table of AIDC Implementation Status in APAC is provided in **Appendix M** of this Report.

9.14 The Meeting noted that an ad-hoc group consisting of China, Hong Kong China, India, New Zealand, Singapore, Thailand, and the USA was formed to review and modify the ATMAS TF ToR to accommodate the latest needs of ATMAS TF, such as accommodating FF-ICE and SWIM requirements. The revised draft ToR will be presented by the ad-hoc group in the ATMAS TF/7 Meeting.

9.2. Other automation-related matters

9.15 There is no paper under this sub-Agenda Item.

Agenda Item 10: Regional implementation review and updates

10.1. State's National ANP and Elements related to CNS in Seamless ANS Plan

APAC Seamless ANS Plan V4.0 Update – Sec (WP/16)

10.1 ICAO Secretariat recalled the steps taken in past CNS SG meetings to provide inputs for Seamless ANS Plan v4.0, which was adopted by the Thirty-Fifth Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/35) held at the ICAO Asia and Pacific Regional Office in Bangkok, Thailand, from 25 to 27 November 2024 by Conclusion 35/1.

10.2 The Meeting was informed that recently, it was observed that the priorities of some CNS ASBUs finalized by CNS-related ASBUs Review Ad-hoc Group for the Next Edition of the Seamless ANS Plan were not correctly reflected in the published Asia/Pacific Seamless ANS Plan Version 4.0. This discrepancy might result from editorial errors during the gathering of voluminous feedback from all sources.

10.3 Recognizing that the review of ASBU NAVS falls under the responsibility of the CNS SG, the ICAO Secretariat proactively prepared and submitted a working paper for consideration at the Seventh Meeting of the Asia/Pacific GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7, Bangkok, Thailand, 14–16 May 2025). This initiative was undertaken to solicit comments and feedback from navigation experts regarding the appropriate prioritization of the NAVS Block 0 elements prior to proposing amendments to the CNS SG.

10.4 It was agreed in GBAS/SBAS ITF/7 Meeting that not all ASBU NAVS Module Block 0 elements should be accorded the same level of priority within the Asia/Pacific Region. The ICAO Secretariat proposed the subdivision of these elements from a consolidated 'Thread' into discrete individual elements. This approach was aimed at ensuring that appropriate prioritization is assigned to each element accordingly. The CNS SG/29 meeting deliberated and agreed on the following proposal:

"Keep priority 2 for NAVS-B0/1 GBAS and NAVS-B0/2 SBAS as some APAC States do not have access to such systems, and to change the priorities of NAVS-B0/3 ABAS and NAVS-B0/4 Nav. MON to Priority 1".

Functional Category	Element	Description	Priority	Responsibility for Review
Technology	NAVS-B0/1	GBAS	2	CNS SG
	NAVS-B0/2	SBAS	2	
	NAVS-B0/3	ABAS	1	
	NAVS- B0/4	Nav. MON	1	

10.5 It was agreed that the ICAO Secretariat will incorporate these changes as a corrigendum to the existing Asia/Pacific Seamless ANS Plan Version 4.0, and submit it to APANPIRG/36 for endorsement.

10.6 In addition, States/Administrations were reminded of **Conclusion APANPIRG/34-1**, which required States/Administrations to report on the progress of the *Asia/Pacific Seamless ANS Plan* implementation via the Seamless ANS Plan Reporting Tool at least once annually, with a submission deadline of 28 February.

10.7 The Meeting noted that the ICAO Asia/Pacific Regional Office is currently working on updating the Seamless ANS Plan Reporting Tool to align with the most recent version of *Asia/Pacific* Seamless ANS Plan Version 4.0, which is expected to be completed by the end of Q2 2025.

10.8 A question was asked about the expectation to submit reporting by States/Administrations once a year or twice, as in the ANS Reporting Tool currently, the report period is the first half of a year and the second half of a year. It was informed that ICAO expects States to submit updates up to the end of last year "at least once annually", preferably before 28 February of the year. It was added that the report period column would be modified so that States/Administrations could submit updates at least once annually. **ACTION ITEM 29-9**

10.9 As only a few States/Administrations have submitted their information on the reporting tool, it was suggested that all remaining States/Administrations submit their information about 2024 so that the ICAO Secretariat can make further analysis of the 'as-is' status before the ATM SG/13 meeting planned in August 2025. **ACTION ITEM 29-10**

Updates in e-ANP Vol II – Sec (WP/17)

10.10 This paper highlighted the urgent need to update the ICAO APAC e-ANP Volume II, particularly the CNS-related tables, many of which are currently outdated. It was informed that the

ICAO Secretariat has been presenting papers at various CNS contributory bodies' Meetings in the last 2 years to request States/Administrations to update the CNS tables mentioned in e-ANP Vol II, as most tables are outdated. However, no significant updates were shared by the States/Administrations. This year, the need to update information in e-ANP Vol II was shared with different contributory bodies, including CRV OG/13, ACSICG/12, SURICG/10, and SRWG/09, which have endorsed draft Conclusions to update tables under their responsibilities.

10.11 As there was no dedicated contributing body for navigation aids, CNS SG/29 was requested to urge States/Administrations to update the following table:

TABLE CNS II-APAC-2 RADIO NAVIGATION AIDS

10.12 Therefore, the proposed update of the CNS Tables of ICAO APAC e-ANP Vol II was reviewed and adopted by the CNS SG/29 Meeting:

<table>
<tr><td colspan="3">Conclusion CNS SG/29/12 (ACSICG/12/01(CRV OG/13/04), ACSICG/12/08, SURICG/10/01, SRWG/09/01) - Update the CNS Tables of ICAO APAC e-ANP Vol II</td></tr>
<tr><td colspan="2">What: The following tables of ICAO APAC e-ANP Vol II are outdated and require immediate updates.

<u>General Regional Requirements</u>

TABLE CNS II-1 AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK (AFTN) PLAN
TABLE CNS II-2 REQUIRED ATN INFRASTRUCTURE ROUTING PLAN
TABLE CNS II-3 ATS DIRECT SPEECH CIRCUITS PLAN
TABLE CNS II-4 HF NETWORK DESIGNATORS

<u>Specific Regional Requirements</u>

TABLE CNS II-APAC-1 ATS INTER-FACILITY DATA COMMUNICATION (AIDC) IMPLEMENTATION PLAN
TABLE CNS II-APAC-2 RADIO NAVIGATION AIDS
TABLE CNS II-APAC-3 SURVEILLANCE</td><td>Expected impact:
☐ Political / Global
☐ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why: The current TABLEs related to CNS are outdated and require immediate updates in order to update e-ANP Vol II.</td><td colspan="2">Follow-up: ☒Required from States</td></tr>
<tr><td>When: 20-Jun-25</td><td colspan="2">Status: Adopted by Subgroup</td></tr>
<tr><td colspan="3">Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☐Other:</td></tr>
</table>

10.13 It was informed that the ICAO Secretariat will issue a State Letter to all States/Administrations for necessary action after the CNS SG/29 meeting. States/Administrations are requested to update the required information in ICAO APAC e-ANP Vol II. **ACTION ITEM 29-11**

ANS Reporting tool updates – Sec (SP/03)

10.14 ICAO Secretariat informed that the ICAO Asia/Pacific Seamless ANS Reporting Tool was launched in 2024 to support regional implementation monitoring. Following APANPIRG/34 Conclusions, States/Administrations were expected to submit reports by 30 June 2024 and annually by 28 February thereafter. The ICAO Secretariat informed that as of 10 June 2025, only 9 States/Administrations have updated information using the reporting tool. However, there are several

inconsistencies in the submitted information. The data submitted by 9 States/Administrations, along with key issues found, were shared with the Meeting. It was added that despite all APAC States having initiated the reporting process, data submissions show inconsistencies, including incomplete fields, missing updates, and blank "applicable/non-applicable" sections. States were encouraged to share obstacles and suggestions for further tool enhancement to ensure more accurate and comprehensive reporting across the region.

10.15 The Meeting was informed that the ICAO Workshop on APAC Seamless ANS Reporting Tool was conducted from 17 April to 19 April 2024, in which several States/Administrations participated. It was suggested that delegates contact participants from their States/Administrations and submit data using the ANS Reporting tool with their help. It was also added that the guidance on filling out the reporting tool is available on the workshop webpage.

10.16 Hong Kong China shared inconsistencies it observed in the ANS Reporting Tool in the "Seamless Plan or ASBU Reference" column and the corresponding column in "Seamless Plan Explanation." It was requested that while updating the reporting tool for Seamless ANS Plan 4.0, the ICAO Secretariat consider a comprehensive review of all ASBUs and associated descriptions/definitions for States/Administrations to refrain from adding wrong interpretations. **ACTION ITEM 29-12**

10.2. Delhi Declaration implementation related to CNS

Delhi Declaration implementation related to CNS – Sec (WP/19)

10.17 The Second Asia Pacific Ministerial Conference on Civil Aviation was held from 11 - 12 September 2024 in New Delhi, India. In the Conference, the APAC Ministers reviewed commitments made under the Beijing Declaration and agreed to another set of commitments to high-priority aviation strategic objectives in the form of the Asia Pacific Ministerial Declaration on Civil Aviation (Delhi). The Conference endorsed the Second Asia and Pacific Ministerial Declaration on Civil Aviation (Delhi), also known as the Delhi Declaration. The Meeting noted that the Delhi Declaration generates the political will needed to support the organization's various objectives for an effective and efficient aviation system.

10.18 The comparison of commitment under the ANS between the Beijing and Delhi Declarations and corresponding indicators was shared with the meeting in the following Table:

SN	Commitments in the Delhi Declaration	Corresponding Commitments in the Beijing Declaration	Indicators
1)	Performance-Based Navigation (PBN) implementation in accordance with ICAO Assembly Resolution A37-11 on Global PBN Goals;	Performance-Based Navigation (PBN) implementation;	Percentage of PBN Approach procedures on international runway ends. Percentage of PBN SIDs/STARs on international runway ends
2)	Common Ground/Ground Telecommunication Infrastructure to support ANS applications	Common ground/ground telecommunication infrastructure to support Air Navigation Services (ANS) applications;	Status of connection to Common aeRonautical VPN (CRV) and Aeronautical Message Handling System (AMHS)

3)	Expediting the implementation of ICAO provisions related to System Wide Information Management (SWIM);	New	Under Preparation
4)	Enhanced Surveillance capability for improved Safety and Efficiency;	Enhanced surveillance capability, including Automatic Dependent Surveillance-Broadcast (ADS-B) technology;	Number of States providing ADS-B based surveillance service either for separation or situation awareness

10.19 It was informed that the Tenth Meeting of the System Wide Information Management Task Force (SWIM TF/10) was held from 20 – 23 May 2025 in the ICAO APAC Regional Office, Bangkok, Thailand. The Meeting was invited to collaborate towards achieving the targets of the Delhi Declaration and to share the latest implementation status of commitments with the ICAO APAC Office for accurate progress tracking. It was added that as the ANS commitments in the Delhi Declaration constitute an element related to SWIM, indicators are required to be developed to measure this commitment for 2025-2026.

10.20 The SWIM TF/10 Meeting discussed various potential indicators to assess the progress of SWIM implementation within the APAC region. Suggestions included measuring the level of involvement of APAC States/Administrations in SWIM-related demonstrations or trials, the existence of national SWIM activities, plans, or policies, as well as enhancements in ANS infrastructure aimed at meeting SWIM requirements. Additionally, the Meeting discussed a simplified categorization approach to classify States' SWIM implementation progress into three levels, i.e., "In Preparation/Planning", "Under Development/Implementation," and "In Operation".

10.21 The Meeting agreed that the proposal required more deliberation, and the task was assigned to the SWIM Co-Chair and the ICAO Secretariat. It was agreed that the ICAO Secretariat would inform the DGCA/60 Conference that indicators to measure SWIM implementation in the APAC region are under development, and the latest status of APAC States/Administrations' readiness for SWIM implementation will be shared with the DGCA/61 Conference. ACTION ITEM 10-31 SWIM TF Co-Chair and ICAO Secretariat will define the first draft of indicators by the end of 2025 and share them with SWIM TF Task Leads for review. A survey will then be conducted in Q1 2026 to finalize the preferred indicators for the APAC region.

10.22 The latest status of various indicators related to CNS was shared with the meeting. The Meeting suggested that APAC States/Administrations collaborate and work towards achieving the targets of the Asia Pacific Ministerial Declaration on Civil Aviation (Delhi). It was recommended that States/Administrations share their latest implementation status of Delhi Declaration commitments with the ICAO APAC Office so that progress can be tracked and the status reported accurately in future meetings.

10.3. Contingency Planning for CNS/ATM Infrastructure

Building a Disaster-Resilient Network – Japan (WP/25)

10.23 Japan informed that the Air Navigation Information Network in Japan, known as CAS.net, is contracted with telecommunications carriers to maintain and manage communications necessary for air traffic control services. It was shared that CAS.net is a circuit network for reliable and stable aviation-secured operations and is designed and operated as a network dedicated to the Civil

Aviation Bureau, which helps prevent unauthorized access from systems outside the bureau. It was added that in Japan's disaster-prone environment, enhancing the resilience of both aeronautical information networks and radio facilities is vital. The Meeting noted that to safeguard against increasing cyber threats, CAS.net employed a dedicated communication network using VPN technology, isolating it from public lines to enhance security.

10.24 The Meeting suggested that Member States/Administrations consider building resilient networks and encouraged information exchange on resilience and cybersecurity within the ICAO framework for reliable networking and technical cooperation.

Agenda Item 11: Review the status of CNS deficiencies (APANPIRG Deficiency List)

Review the status of CNS deficiencies – Sec (WP/21)

11.1 ICAO Secretariat presented the Air Navigation Deficiencies in the CNS field, which was reviewed in APANPIRG/35. The Meeting noted that the only outstanding issue was the unreliability of AFS communication between Afghanistan and Pakistan. Last year it was informed that Pakistan had joined CRV and was actively coordinating with Afghanistan to restore the communication link. Pakistan shared the expectation of restoring the connection by the end of 2024 in the CNS SG/28 Meeting. Pakistan was requested to provide updates on outstanding deficiencies.

11.2 Pakistan informed that the AFS communication link between Pakistan and Afghanistan remains non-operational due to the absence of a functioning AFS system on the Afghanistan side. Pakistan is fully prepared and available to activate the link as soon as Afghanistan establishes the required AFS infrastructure. Afghanistan had not given any tentative timelines. Therefore, it was requested that this deficiency be removed from Pakistan's side. **ACTION ITEM 29-13** The current list of Air Navigation Deficiencies in the CNS field was reviewed in CNS SG/29 and is provided in **Appendix N** of this Report.

Agenda Item 12: Capacity Building, including Human Factors and Air Traffic Safety Electronics Personnel (ATSEPs) related training

Supervisory and Managerial Roles of ATSEP – Proposed – IFATSEA (WP/20)

12.1 IFATSEA presented the work done following its proposal in the CNS SG/28 meeting regarding human factors issues and their countermeasures pertaining to ATSEP while playing supervisory and managerial roles. It was stated that the additional chapter for consideration to be added to the regional ATSEP human factor guidance material was sent for comments/inputs to the member states as per Action Item 28-15 of CNS SG/28. However, NIL comments were received by the Ad-hoc group. Therefore, it was concluded that the group accepted the proposed content in the chapter.

12.2 The Meeting noted after addition of the proposed one, the total chapters of the guidance material will now be (1) Introduction, (2) Reference Documents, (3) People Resourcing, (4) Job, Role and Skills Analysis and Competency Modelling, (5) Knowledge Management, Talent Management, Learning and Development, (6) Induction of New Systems and Maintenance Philosophy, (7) Work Environment, Well-being, Performance, and Reward (8) Motivation, Commitment, and Engagement, (9) Behavioural and Role Specific Competencies, (10) Safety Culture Promotion, and (11) Supervisory and Managerial Role of ATSEP.

12.3 With the abovementioned, the Meeting reviewed the proposed chapter and adopted the following decision:

Decision CNS SG/29/13 - Adoption of Regional Guidance Material for Addressing Human Factor Issues of ATSEP v2.0	
What: a) ICAO APAC Guidance Material for Addressing Human Factor Issues of ATSEP v2.0 provided in **Appendix O** is adopted.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The Guidance material for the improvement of the existing human resource management process towards ATSEP for addressing the factors adding stress and fatigue, improving their job performance and achieving organizational resilience and cost benefits has been modified by adding a new chapter on "Supervisory and Managerial Role of ATSEP".	Follow-up: ☒Required from States
When: 20 Jun 2025	Status: Adopted by Subgroup
Who: ☒Sub groups ☐APAC States ☐ICAO APAC RO ☐ICAO HQ ☐Other: XXXX	

Support for the Build Sustainable Capacity – Japan (WP/26)

12.4 Japan presented its efforts to build sustainable capacity in the APAC and Africa region under the "No Country Left Behind" ICAO initiative. Representative examples of ongoing international cooperation activities include the JICA (Japan International Cooperation Agency) technical cooperation project, the GNSS Implementation Plan Training in ASEAN2.0, and the JCAB capacity developing project in Pacific Small Island Developing States (PSIDS), which were shared at the Meeting.

12.5 The Meeting noted the JICA "Knowledge Co-Creation Program" scheme of technical cooperation, through which JICA carries out training in Japan. It was informed that this program has received many participants across the world so far and provided ANS-related programs as well, such as "PBN Instrument Flight Procedure Design" to acquire enough knowledge and expertise to design air traffic services routes and PBN procedures, which was conducted once a year from 2013 to 2019 with the support of JCAB. Also, a new program titled "Introduction and Management of Air Navigation Services (ANS) Technology," which includes a broad range of knowledge on navigation and surveillance systems, was conducted once a year from 2023 to 2025. The Meeting appreciated Japan's efforts and noted the importance of inter-regional/state cooperation in the APAC region. States/Administrations were encouraged to share best practices for support in the ANS field.

12.6 Lao PDR expressed their deep appreciation and gratitude to the assistance provided by ICAO, China and Japan, while the Philippines expressed their deep appreciation and gratitude to the assistance provided by Japan, under the ICAO's "No Country Left Behind" initiative, in enhancing the air navigation capacity and efficiency of those States who are in need of such assistance.

Hong Kong China's initiatives in supporting the ICAO Next Generation Aviation Professionals Programme – Hong Kong China (WP/35)

12.7 Hong Kong China informed that in view of the global challenge of the shortage of skilled aviation professionals, the ICAO has launched its Next Generation Aviation Professionals (NGAP) Programme. The Meeting noted that Hong Kong China has been providing full support to this ICAO Programme and established the Hong Kong International Aviation Academy (HKIAA), which offers a comprehensive aviation-related curriculum that caters to the training needs of aviation professionals in various domains both locally and regionally. In particular, the HKIAA provides

competency-based training to the young generation, gearing them up as professional Air Traffic Safety Electronics Personnel (ATSEP). Hong Kong China shared its various initiatives and experiences and encouraged States/Administrations, ANSPs, aviation academia and communities to steer their further effort in supporting the ICAO NGAP Programme.

12.8 In answering the questions raised by Japan and USA, Hong Kong China and Japan shared their strategies to use new technologies to promote and attract the young generation to consider joining the ATSEP as their career option. An example of promoting it through social media or making a video sharing the significance and benefits of the ATSEP job was shared and discussed in the meeting.

Agenda Item 13: Cybersecurity of CNS/ATM systems

13.1. Updates on the ICAO International Aviation Trust Framework

Update on Trust Framework Activities – Sec (SP/01)

13.1 Mr. Michael Goodfellow, Technical Officer GIS, Trust Framework Panel (TFP) Secretary, presented the key initiatives advanced by the TFP. It was announced that the Aviation Common Certificate Policy (ACCP), establishing baseline PKI interoperability requirements and profiles (including SBAS authentication), is undergoing coordination and targeting the July 2025 publication. The Manual on Aviation Information Security (MAIS Doc 10204) provides risk assessment and security objective guidance; its first edition has been released, with some sections pending further coordination. Development of a Manual on Trust Frameworks has begun, outlining how to form Trust Framework Instances (TFIs) for secure aviation communications, with an editorial group formed. Technical progress includes demonstrations of connected aircraft concepts (ENRI) and drone identification work (IETF). Future meetings are scheduled for TFP-WG/3 in November 2025 and the full panel in 2026.

13.2 In response to a question about the expected publication date of Doc 10169, it was stated that intern panel coordination is ongoing and will be published in a few months.

13.3 Nothing TFP has made significant progress in the last few years, the meeting requested the TFP plan for implementing the TFP framework worldwide. Mr. Goodfellow informed that in the past, before the TFP formation, the Trust Framework Study Group (TFSG) was intended to explore the possibility of creating a large global trust framework for aviation. There were several operational and mostly political challenges to achieving that goal which resulted into the concept “Trust Framework Instances (TFI)”. Currently, States/Administrators have multiple trust frameworks that are based upon common standards that would allow them to interoperate. Therefore, ICAO decided not to build a monolithic trust framework but to provide a standard set of principles that will enable others to develop their trust frameworks and simplify interoperability across domains as required.

Need for the Creation of an APAC Contributory Body for the Management and Implementation of ICAO ANS Cybersecurity Provisions - CRV OG and SWIM TF (WP/18)

13.4 CRV OG and SWIM TF presented recommendations for the creation of a new APAC contributory body for the joint management and implementation of cybersecurity provisions. The recommendation resulted from detailed discussion and deliberation held in first Working Session of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1) held from 14 to 17 January 2025, the Thirteenth Meetings of Common aeRonautical VPN Operations Group (CRV OG/13) held from 5-8 March 2025, the Twelfth Meeting of the Aeronautical Communication Services (ACS) Implementation Coordination Group (ACSICG/12) held from 25 to 28 March 2025, the Second Working Session of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/2) held from 26 to 30 May 2025, and the Tenth Meeting of the System Wide Information Management Task Force (SWIM TF/10) was held from 20 – 23 May 2025.

13.5 As PKI-based approaches impact all communications in aviation, it was critical to ensure seamless integration with SWIM-enabled systems, ATC networks, and airborne systems. The issuance and management of digital certificates for SWIM entities (ATM Service Providers, Airspace Users, Information Services, and relevant devices) were essential to securing SWIM-based operations. Additionally, the use of digital signatures for cross-border and multi-regional SWIM message exchanges strengthens data integrity and communication trust.

13.6 The Meeting noted it is necessary to establish a new working group or task force to explore the development of a regional federated PKI architecture that ensures secure interoperability across multiple states and regions. Additionally, a technical community was needed to support the implementation of Trust Framework Instances for various applications. Collaboration with the SWIM TF was also considered essential to support the implementation of a Trust Framework Instance for SWIM, enabling secure, interoperable, and resilient aviation information exchange and flight operations.

13.7 SWIM TF Co-Chair shared that APANPIRG/33 adopted its Conclusion APANPIRG/33/09 to set the Asia/Pacific SWIM implementation timeframe to be between 2024 and 2030, with 2030 being the target timeline for implementation completion and emphasized the need for the creation of the group. She highlighted that the self-signed certificate trial being taken by SWIM TF is only a temporary solution due to the absence of the appropriate digital certificate infrastructure in the APAC region. This underscored the need for this proposed group to begin its work.

13.8 Malaysia strongly supported the recommendations and added that achieving stringent performance standards necessitates some applications, such as SWIM, specialized expertise to develop and refine a common PKI standard tailored for SWIM. Malaysia recognized the critical need for a dedicated APAC contributory body, as proposed, to harmonize the implementation of cybersecurity provisions, including PKI and digital certificates, across the region. It was suggested that this body would ensure interoperability, security, and resilience in SWIM-based information exchanges, aligning with ICAO's cybersecurity frameworks, such as the Manual of the Public Key Infrastructure (PKI) Policy for Aeronautical Communications (Doc 10095) and the Aviation Common Certificate Policy (Doc 10169).

13.9 China, Fiji, Thailand, Singapore and the USA supported the proposal. Mr. Goodfellow informed that PKI is more than a set of technologies. He shared the need for discussion on many complex matters, such as who would issue certificates, how the certificates would be issued, and the assessment criteria under which they would be assessed to make sure that they follow the agreed procedures. It was advised that there are higher-level governance and procedural questions that need to be addressed, along with technical aspects.

13.10 The Meeting deliberated at length about the name of the proposed group. After deliberation, it was agreed to initially name the group "**ANS Information Assurance Task Force (ANSIA TF)."**

13.11 **Australia, China, Japan (TBC), Malaysia, New Zealand, Singapore, Thailand and the USA** volunteered to join the group. It was agreed that the ANSIA TF would prepare the draft Terms of Reference (ToR), its key deliverables, and plan in close coordination with CRV OG, ACSICG, SWIM TF, TFP Secretary and Information Management Panel Secretary. **ACTION ITEM 29-14.** It was also agreed that the first meeting would be conducted in Q1-2026. **ACTION ITEM 29-15** Other Member States/Administrations who wish to join the Task Force could liaise with the ICAO Secretariat after the meeting.

13.12 With the abovementioned, the following draft decision was proposed, which was endorsed and adopted by the CNS SG/29 Meeting.

Decision CNS SG/29/14 - Creation of ANS Information Assurance Task Force (ANSIA TF).	
What: To ensure consistent implementation of the requirements of ANS information security in the APAC region in accordance with the various manuals and guidance documents published by the ICAO and other international organizations, especially Certificates and PKI, a contributory body is proposed to be created under the CNS Sub-group to manage this using personnel experienced in the management and provisioning of ANS cybersecurity.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: To provide consistent implementation of the requirements.	Follow-up: ☒Required from States
When: 20-Jun-25	Status: Adopted by Subgroup
Who: ☒Sub groups ☒APAC States ☒ICAO APAC RO ☐ICAO HQ ☒Other: ACSICG, CRV OG, SWIM TF	

13.2. Other Cybersecurity related matters

13.13 There is no paper under this sub-Agenda Item.

Agenda Item 14: Innovation and New Technologies

AirNav Maintenance Facility – Indonesia (IP/06)

14.1 Indonesia presented the implementation of the AirNav Maintenance Facility, which was established in 2025 to enhance the readiness and reliability of air navigation facilities in Indonesia by providing services in repair, innovation, and development of CNS equipment. Key services included the repair of equipment modules, logistics support through spare parts availability, and the development of solutions for issues such as part obsolescence. It was informed that the facility is staffed by 11 specialized personnel, organized into managerial and technical functions, ensuring compliance with industry standards, quality assurance, and effective repair processes. The meeting noted that since its founding until the end of May 2025, AMF has repaired 38 modules comprising various types of CNS & Electrical equipment. The achievement of 38 repaired modules indicates a positive trend toward meeting AMF's annual target.

14.2 The Meeting suggested that it would be helpful if the scope of work could be extended to receive repair orders from other States/Administrations.

Trials of Using Two-phase Immersion Cooling – Hong Kong China (WP/29)

14.3 Hong Kong China outlined the pioneer application of a Two-phase Immersion Cooling System (ICS) for Air Navigation Services (ANS) systems. It was informed that Hong Kong China has successfully completed trials of ICS in 2024 for a High-Performance Control Tower Simulator (CTS) image generator workstation. The Meeting noted that this innovative technology offers a superb heat transfer rate compared to the traditional forced-air cooling approach, with significant energy savings in system cooling, stable system operation, and extended equipment operational life. This solution aligned with the ICAO's sustainability and operational resilience goals. Noting the international recognition of the technical excellence of the application of ICS technology to ANS systems, the paper proposed broader adoption of the ICS technology in global aviation infrastructure, aimed to share the experience of Hong Kong China in conducting trials and applying this technology to enhance ANS systems performance and energy efficiency, and encouraged States/Administrations to consider its applications and share relevant experience.

Real-time Tracking of Outdoor Activities to Improve Safety and Emergency Response – Hong Kong China (WP/30)

14.4 Hong Kong China shared its experience in conducting trials of a tracker application for outdoor activities, leveraging the Government-Wide IoT Network (GWIN), which enabled real-time tracking and monitoring of outdoor activities. It was reported that this has improved the safety of outdoor activities and strengthened search and rescue operations as well as emergency response capabilities. The Meeting noted the initiatives of Hong Kong China in applying a Government-Wide IoT Network (GWIN) to improve tracking and monitoring of outdoor activities in a real-time manner and emergency response capabilities, and the international recognition of the technical excellence of the tracker application with GWIN. States/Administrations that have undertaken similar feasibility studies and trials were encouraged to share their experiences and lessons learned.

14.5 The Meeting noted that in the absence of registration and GWIN tracker, the traditional search and rescue methods, relying on mobile coverage to trace location of the individual in need, would be followed.

Connected Aircraft – USA (SP/04)

14.6 USA introduced the Connected Aircraft (CA) concept, which is based on the Global Air Traffic Management Operational Concept (GATMOC). It emphasized establishing performance requirements aligned with operational needs, identifying failure conditions, and implementing robust communication systems. It was stated that the CA concept envisioned loading messages into the FMS, like what CPDLC does today while respecting requirements for data integrity and segregation, thereby reducing crew workload and eliminating transcription errors. It utilizes additional commercial pathways to support real-time capabilities and updates to the ATCO, information regarding the current state will be sent to both the ATM and the FOC. An aircraft with communications capabilities will have implications on both airborne and ground-based systems, as well as the establishment and maintenance of multiple active links, which will require new management techniques to ensure safe and effective operations. The USA also outlined technical Considerations and regulatory considerations related to the CA. Some of the use cases of CA, including Trajectory negotiations, avoiding a weather constraint, commercial link used in conjunction with aviation link, UAS location sharing, Information on vehicle state (speed, location, direction of flight) sent to the ground, and Information consolidated and a traffic picture is sent back to RPICs for improved real-time situational awareness were shared with the Meeting.

14.7 The Meeting noted that EFBs play a notable role in the CA concept, providing a potential interface for the AU to take advantage of additional efficiency, flexibility, and cost-effectiveness in the delivery and display of certain kinds of information, supplementing and enhancing the information provided by the FMS. In addition, the Aircraft domain guard function - Protection mechanism(s) between the Aircraft Control Domain (ACD) and Airline Information Services Domain (AISD) and the Aircraft data gateway enables the exchange of aircraft avionics data in other protocols and services consistent with COTS technologies.

14.8 It was suggested that interoperability is critical to achieving widespread adoption of these capabilities. One means of achieving interoperability is to standardize CA services without reference to the underlying data link technology. Such standards would include service functional descriptions, end-to-end performances, and operational safety assessments without any reference to the communication path, enabling stakeholders or CSPs to select the best data link technology for the service.

14.9 The Meeting noted the recommendations made by AN-Conf/14, namely Recommendation 4.1/1 –Validation, standardization and implementation of the connected aircraft concept and air-ground connectivity strategy.

14.10 In response to a question about the need for use cases mentioned in the presentation about UAS while the C2 link is already available, it was informed that on the UAS, there are multiple links, and the use of the C2 links is mainly for the command and control for the remote pilot to the aircraft. There is a need for situational awareness to report regularly about vehicles' positions, such as intended directions, which is non-safety critical. For such use cases, using a different commercial link to segregate and avoid overusing the C2 link was suggested by speaker.

Intelligent Baggage Thermal Detection and GNSS Interference Monitoring System – Aerovision (SP/06)

14.11 Aerovision Technology Limited introduced the Intelligent Air Cargo and Baggage Thermal Detection System, along with the GNSS Interference Monitoring System. It was shared that the solution can be automated, which integrates with existing systems, and provides early warnings to prevent fires, thereby contributing to enhanced air cargo safety. In addition, it was shared that the GNSS Interference Monitoring System tracks all flights within a specific region and monitors for any signs of GNSS interference. The Meeting noted that the system is being deployed to monitor the threats of GNSS interference in a real-time manner.

Low-altitude Economy Status & Characteristics and Low-altitude Traffic Management – Harmony (SP/07)

14.12 Harmony Tech Innovation Ltd. presented a development of Low-altitude economy, where there are low-flying activities to improve the quality of life of citizens while enhancing operational efficiencies. To address the potential threats to flight safety and operational efficiency arising from the increasingly frequent and dense low-flying activities, Harmony Tech Innovation Ltd introduced various technologies related to the development of a Smart Low-altitude Traffic Management System, together with a service platform with real-time detection and management of low-flying activities.

Agenda Item 15: Review of ToR and action items

Review of ToR and action items – Sec (WP/23)

15.1 The Meeting noted that the CNS SG Terms of Reference (ToR) were first adopted under APANPIRG/22 in 2011 and became effective with the 2013 meeting cycle. The ToR established the scope, objectives and reporting lines for CNS SG and its contributory bodies in support of APANPIRG's CNS work.

15.2 The Meeting reviewed the Terms of Reference of CNS SG effective from 2013 and noted that the ToR has not been modified for more than ten years. It was agreed that several changes have been made in the last 10 years, including the role and responsibilities of CNS SG, which should be reflected in the revised ToR. In addition, the current ToR missed the detailed information about composition, chairpersonship, and other essential data usually incorporated in standard ToR. It was agreed to form **an Ad-Hoc group** composed of members from **China, Hong Kong China, Thailand and the USA**. In reviewing the ToR, the ad-hoc group was advised to refer to the CNS ToR of other regions. The revised ToR will be presented by the ad-hoc group at the next CNS SG meeting. **ACTION ITEM 29-16** The current ToR is provided in **Appendix P**.

15.3 The Meeting reviewed and updated the Action Items List for CNS SG/28. A total of **16** action items were identified during the CNS SG/29 Meeting. A summary of the action items is provided in **Appendix Q** of this report.

Agenda Item 16: Any Other Business

CNS Point of Contact – Sec (WP/22)

16.1 This paper reviewed the CNS Points of Contact of Member States listed at the APAC Regional Office and requested States/Administrations to update the points of contact of CNS contingency planning and administrative support for effective and efficient coordination in the CNS aspect. ICAO Secretariat informed that as of May 2025, the ICAO APAC Office received information from **29** States/Administrations. However, many States have not yet shared this information with the ICAO Secretariat. States/Administrations that have yet to provide their CNS Points of Contact were urged to provide the required information by sending it to the ICAO APAC Regional Office at apac@icao.int with a copy to vmeefuengsart@icao.int. States/Administrations that had already provided the information were requested to update it as needed. The updated CNS Point of Contact is provided in **Appendix R.**

Implementation of a new CNS&ATM Workshop and Training program – China (WP/32)

16.2 China presented a new CNS&ATM workshop and training program, which would be hosted in Chengdu, China, in October or November 2025, aiming to strengthen technical exchange and cooperation among ANSPs in the APAC region. Each ANSP can send a maximum of five attendees, with preference given to those with relevant work experience. The Meeting noted there are currently over 20 spots available. Interested ANSPs could email hlgao_atmb@foxmail.com before July 4, providing the estimated number of attendees and contact details for the invitation letter. Details and the invitation letter will be sent to the interested ANSP in August 2025. It was stated that there will be no registration fees or training expenses; however, attendees are responsible for their transportation to/ from the host city in Chengdu, as well as their own accommodation and insurance. The Meeting expressed appreciation to China for their significant efforts in organizing the CNS&ATM workshop and training program, which is in support of the ICAO's initiative of "No Country Left Behind", while enhancing the ANS capability and collaborations for the APAC region.

16.3 Singapore shared its experience of attending such training in the past, and considered that the training was highly structured and beneficial to the trainees, and they encouraged States/Administrations to consider attending the training program.

Invitation to the 60th Conference of Directors General of Civil Aviation, Asia and Pacific Region in Sendai, Japan from 28 July to 1 August 2025 – Japan (IP/07)

16.4 Japan informed that the 60th DGCA Conference will be held in Sendai, Japan, from 28 July to 1 August 2025 under the topic of "The sustainable skies of the Asia-Pacific region: towards increased economic prosperity and social well-being by air transportation of people and goods in the region." It was added that the Japan Civil Aviation Bureau, the host administration, has set up a conference website at https://dgca60.mlit.go.jp/ and information, including registration, visa, access, and accommodation, is available.

Shaping the Future of Airspace – Airspace Asia Pacific 2025 – CANSO and Hong Kong China (IP/09)

16.5 Hong Kong China, on behalf of CANSO and Hong Kong China, highlighted the details of the CANSO Airspace Asia Pacific 2025 to be held from 9 to 11 December 2025 in Hong Kong China. The Meeting encouraged States/Administrations to support and participate in the CANSO Airspace Asia Pacific 2025, share information about it with interested organizations/companies and academia/research institutions, and invite their attendance and/or exhibit at the event. More details can be found on the event website: https://airspaceasiapacific.com.

16.6 The Meeting noted that another CANSO event, named "CANSO APAC Conference 2025", was planned to be held on 8 December in Hong Kong China. In addition, the AAC/5 Meeting is also planned to be held in Hong Kong China in December 2025, with a preparatory meeting to be held one day before the Meeting.

Agenda Item 17: Date of Next Meeting

CNS Meeting Plan for 2026 – Sec (IP/08)

17.1 The paper shared the following tentative schedule for the CNS contributory bodies' Meetings to be held in 2026 for Meeting information and action. The schedule was revised by the meeting as follows. The ICAO Secretariat will inform Member States about the exact dates, mode and venue of the Meeting while issuing invitation letters at least three months before the event.

No.	Name of meeting	Dates (in 2026)	Mode of Meeting	Location
1.	SIPG WS/3	26-30 January	In-Person	Bangkok
2.	CRV OG/15	January/February	In-Person	Bangkok
3.	SRWG/10	4–6 February	In-Person	Bangkok
4.	ANSIA TF/1	Q1 2026	In-Person	Bangkok
5.	SBAS/GBAS ITF/ 8	March	In-Person	Bangkok
6.	SURSG/4	March	In-Person	Bangkok
7.	SURICG/11	23-25 March	In-Person	Bangkok
8.	ACSICG/13	20-24 April	In-Person	Fiji
9.	PBNICG/13	May	In-Person	Bangkok
10.	SWIM Activity	25 May (Tentatively)	In-Person	Bangkok
11.	SWIM TF/11	26- 29 May or 25-29 May	In-Person	Bangkok
12.	ATMAS TF /7	1-4 June	In-Person	Bangkok
13.	CNS/SG/30	06-10 July	In Person	Bangkok

Note of appreciation

17.2 The Chair expressed his appreciation to all participants from Member States/Administrations, International Organizations, and sponsoring industries for their full support and active participation in making the Meeting a successful and fruitful one. The Chair summarized the CNS sub-group's achievements and highlighted the key issues discussed and addressed.

17.3 The ICAO Secretariat appreciated Mr. M H Hui, the Chair of the CNS Sub-group, for operating the CNS SG/29 Meeting promptly and efficiently. Lastly, the ICAO Secretariat expressed gratitude for the contribution and support from APAC Member States, international organizations, and industry partners.

Standard Operating Procedure (SOP) for Engaging Support from ICAO Secretariat & CRV Operations Group (CRV OG) in Dispute Resolution

1. Introduction

This SOP provides a structured process for Member States to engage the support of the ICAO Secretariat and CRV Operations Group (CRV OG) before executing the terms and conditions for dispute resolution, mediation, and arbitration.

The ICAO Secretariat and CRV OG act as third-party advisors to assist Member States in navigating complex disputes, ensuring that all actions taken are in compliance with international standards and best practices.

2. Purpose

The purpose of this SOP is to ensure that member States are adequately supported by the ICAO Secretariat and CRV OG before entering into formal dispute resolution mechanisms. This support is designed to provide expert guidance, facilitate discussions, and offer recommendations that may prevent the escalation of disputes.

3. Applicability

This SOP applies to all Member States engaged in disputes related to the CRV, where the States have agreed in writing to seek guidance from the ICAO Secretariat and CRV OG before initiating formal dispute resolution processes such as mediation or arbitration.

4. Process for Engaging Support

4.1 Request for Support

i. **Initiation:** Any member State involved in a dispute may initiate a request for support from the ICAO Secretariat and CRV OG. The request should be made in writing and should include a brief description of the dispute, the specific issues requiring guidance, and any relevant documentation.
ii. **Submission:** The written request should be submitted to the designated contact point within the ICAO Secretariat and CRV OG.

4.2 Evaluation of Request

i. **Review:** Upon receipt of the request, the ICAO Secretariat and CRV OG will review the details of the dispute and determine the appropriate level of support required.
ii. **Assignment of Advisors:** If necessary, the ICAO Secretariat and CRV OG will assign subject matter experts to assist the Member State. These experts may include legal advisors, technical specialists, or other relevant professionals.

4.3 Provision of Support

Guidance and Recommendations: The assigned advisors will provide the member State with guidance and recommendations based on the specific issues raised.

This may include:

1. **Legal Guidance**: Advising on the interpretation of contractual terms and conditions, relevant laws, and international regulations.
2. **Dispute Avoidance Strategies:** Recommending strategies to prevent the escalation of the dispute and encourage amicable resolution.
3. **Facilitation of Discussions:** Assisting in the facilitation of discussions between the disputing parties to achieve a mutual understanding and potentially avoid formal dispute resolution processes.
4. **Documentation:** All guidance and recommendations provided by the ICAO Secretariat and CRV OG will be documented and shared with the requesting member State.

4.4 Follow-Up and Feedback

i. **Monitoring:** The ICAO Secretariat and CRV OG will monitor the progress of the dispute following the provision of support. The Member State may be required to provide updates on the status of the dispute and the effectiveness of the guidance received.
ii. **Feedback:** The Member State will be asked to provide feedback on the support received, which will be used to improve future assistance provided by the ICAO Secretariat and CRV OG.

4.5 Facilitation and Advisory Support in Negotiation

i. **Facilitation Role:** While ICAO and CRV-OG will not directly act as negotiators, they may facilitate negotiations by providing logistical support, organizing discussions, and offering technical and legal guidance as needed.
ii. **Advisory Support:** ICAO and CRV-OG will remain available to offer expert advice during negotiations, ensuring that all parties have access to the information required to make informed decisions. This support will be provided in a manner that maintains their neutrality and impartiality.

5. Confidentiality

i. **Confidentiality Assurance:** All communications and documents shared during the support process will be treated as confidential. Both the ICAO Secretariat and CRV OG, as well as the member State, are required to adhere to strict confidentiality protocols.
ii. **Non-Disclosure Agreements (NDAs):** All parties involved in the support process, including any advisors assigned by the ICAO Secretariat and CRV OG, shall sign an NDA to ensure that all information remains confidential.

6. Escalation and Settlement of Dispute

i. **Settlement of Dispute:** In cases where the dispute is resolved through the support process or formal dispute resolution, the settlement should be documented in a written agreement. This settlement should include:

   a) **Resolution Terms**: A clear outline of the terms agreed upon by the parties involved, including any actions to be taken or changes to be implemented.
   b) **Implementation Plan**: A plan for implementing the agreed-upon terms, including timelines and responsibilities for each party.
   c) **Monitoring and Compliance:** Procedures for monitoring compliance with the settlement terms and resolving any issues that may arise during implementation.
   d) **Confidentiality and Non-Disclosure:** Assurance that all aspects of the settlement and related documents remain confidential, with appropriate non-disclosure agreements in place.

   The settlement should be signed by all parties involved and shared with the ICAO Secretariat and CRV OG for record-keeping and oversight purposes.

ii. **Escalation Process:** If the dispute remains unresolved after the support provided by the ICAO Secretariat and CRV OG, the Member State may escalate the matter to the next stage of formal dispute resolution, including mediation or arbitration.

7. Conclusion

This SOP ensures that Member States have access to expert guidance and support from the ICAO Secretariat and CRV OG before engaging in formal dispute-resolution processes. By following this procedure, States can make informed decisions that align with international standards, reduce the likelihood of disputes escalating, and preserve relationships between parties.

STANDARD OPERATING PROCEDURE (SOP) FOR UPDATING AMC AFTN/AMHS ROUTING TABLE IN ASIA/PACIFIC REGION

1. INTRODUCTION

This procedure makes reference to the EUROCONTROL AMC Procedure. At present, AEROTHAI operates as the regional contact point for the AMC operation in the Asia/Pacific (APAC) Region for all ICAO members who operate as Cooperating COM Centre (CCC) Operators or External COM Centre Operators in the APAC Region.

2. Objective of Asia/Pacific AMC Procedure

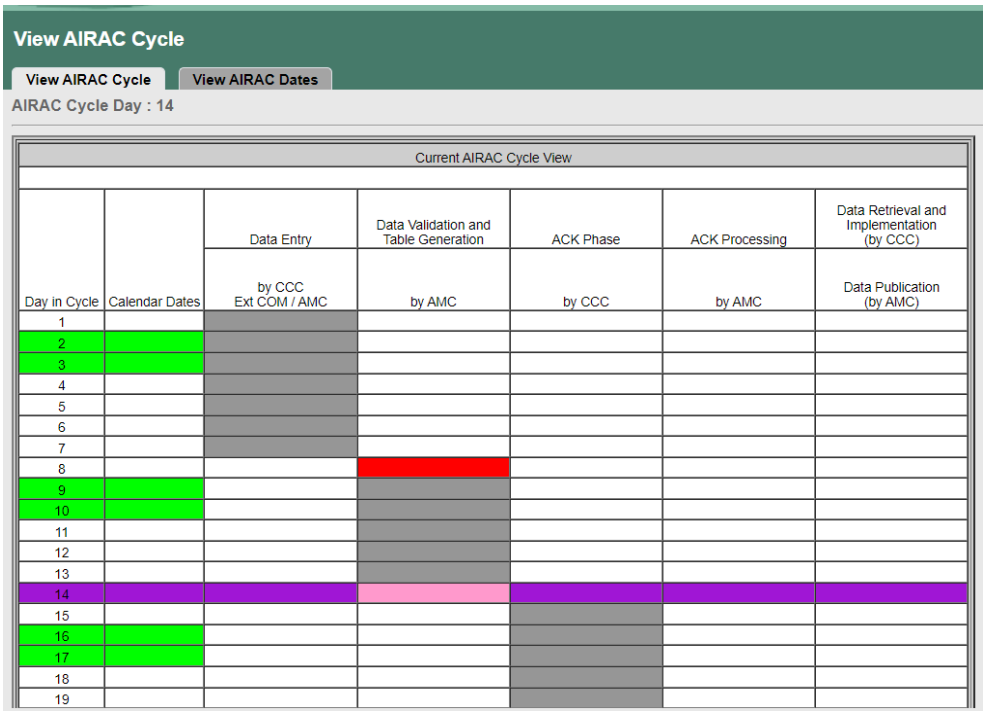
This procedure is for all ICAO APAC members who operate as CCC Operators / External COM Centre Operators and AEROTHAI as APAC AMC regional contact point to update the AFTN/AMHS Routing Table on the AMC Website.

3. AMC Operational Procedures

3.1 General

This procedure uses the AIRAC cycle as the time reference. The AIRAC cycle is separated into five phases. The interactions between AMC Operator tasks and CCC Operator / External COM Centre Operator tasks are based on the use of triggers and messages in the AMC Bulletin Board.

A general view of the procedure highlighted in all AIRAC cycle phases is provided in the Figure below. The milestones are presented at the end of activities in the procedure.



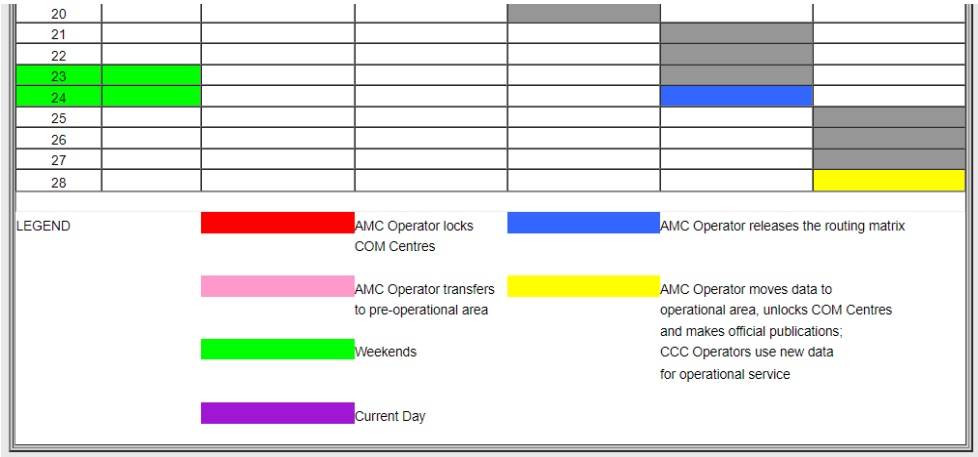


Figure 1: The AMC phases *Cr: OneSky Online Webiste*

Normally, CCC Operators and External COM Operators have a similar role. There are however two significant differences as far as operating procedures are concerned:

• External COM Operators have limited accesses to functions. Typically, in the beginning External COM Operators can participate in network inventory, address management and user capabilities management. However, the access may evolve in the future by the AMC. For example, the AMC Operator may use "Assign Functions to User Types" to assign function to specific group of users.

• Due to the limited access, External COM Operators are not involved in Acknowledge (ACK) phase as described in Figure 1.

3.2 AMC Phases Description following AIRAC Cycle

There are 5 AMC phases in an AIRAC cycle (28 Days cycle) as follows:

Phase	Periods	Task	
		CCC Operators / External COM Operators	AMC Operator (EUROCONTROL)
1. Data Entry	Day 1-7	Data entry in the background area for network inventory, network planning, intra-MD address, user capabilities, and statistics.	Data entry in the background area for MD Register and on behalf of Participating COM Centres, data entry for network inventory, network planning, intra-MD address, user capabilities, statistics.
2. Data Validation and Processing	Day 8-14	Coordination with AMC Operator	Lock COM Centres. Create/modify routing tables. Process statistic data. Propose new data to the CCC/External COM Operators by moving background data into the pre-operational area.
3.Acknowledgement	Day 15-20	Check new data in the pre-operational area and acknowledge (ACK)/no acknowledge (NACK)	None
4.Acknowledgement Processing	Day 21-24	Coordination with AMC Operator	Check all ACKs. If there are NACKs, then coordinate with those COM Centres. Release the routing matrix.

5. Data Retrieval and Implementation	Day 25-28	Retrieve new data in the preoperational area, implement address and routing data at midnight (00.00) UTC in the systems.	Inform the Participating COM Centres about the acknowledged data. Move pre-operational data to operational area on day 28 at 1100 UTC. Unlock the COM centres. Inform the ICAO about address modifications.

4. Routing Directory update

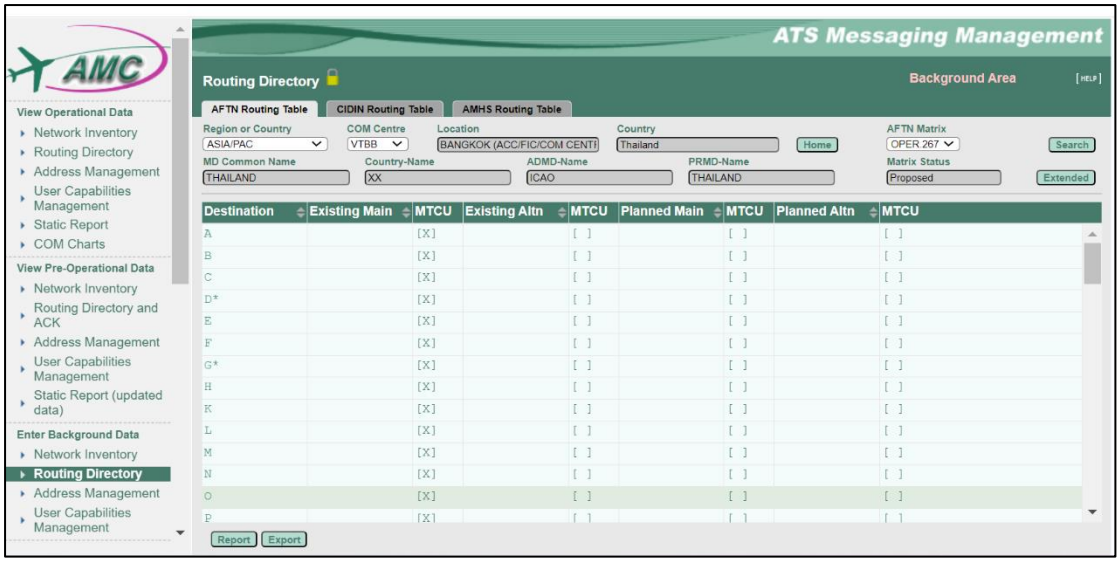
4.1 Routing Change Procedure

When any parties would like to change AFTN/AMHS routing that effect to other parties, they should be

- Check the whole picture of routing network concerned (COM Chart); the routing, the states
- Coordinate with all concerned parties to discuss the necessary actions. It is recommended to keep ICAO in copy (snibhani@icao.int)
- Make a consensus decision among parties with the checklist form **(Attachment A)**
- Update AMC Form if necessary **(Attachment B)**
- Download the report AFTN/AMHS table from Enter Background Data Area in AMC to get Background_RoutingDirectory_AFTN/AMHS Table
- Update the Excel AFTN/AMHS Table
- Send all documents to APAC AMC regional contact point for updating AMC Routing Tabel by email (Jittima.as@aerothai.co.th) and also copy to APAC ICAO
- **The documents required:**
  - **The Check list Form**
  - **The AMC Form**
  - **The updated AFTN/AMHS Table (can be downloaded from AMC portal)**
- APAC AMC regional contact point will update the information following the AIRAC cycle described in Figure 1.
- APAC AMC regional contact point will send the updated information (Routing Table report) to confirm with the owner.
- APAC AMC regional contact point will confirm with AMC Operator in the ACK Phase
- The Routing Table will be updated in the next AMC AIRAC cycle
- In case the involved parties are CCC Operators / External COM Operators who can update the AMC themselves, please update the routing table following the AIRAC cycle and email the information updated to APAC AMC regional contact point and APAC ICAO.

4.2 Routing update in AMC for CCC Operators / External COM Operators (In accordance with AMC User Manual)

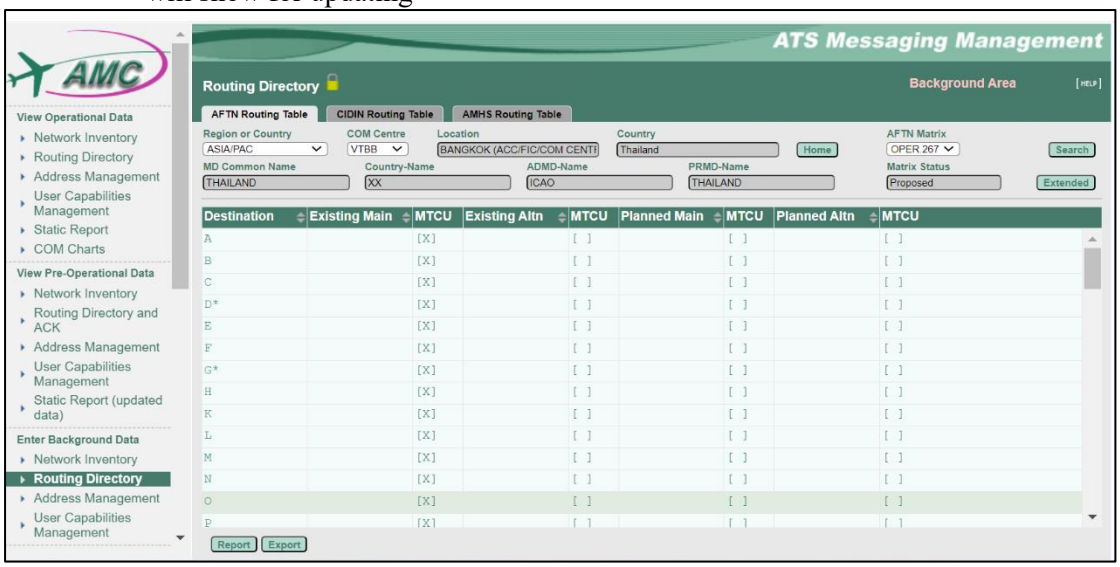
In the Data Entry phase, use “Enter Background Data Menu --> Routing Directory” menu. There are 3 tables menu bar to input data: AFTN Routing Table, CIDIN Routing Table and AMHS Routing Table.

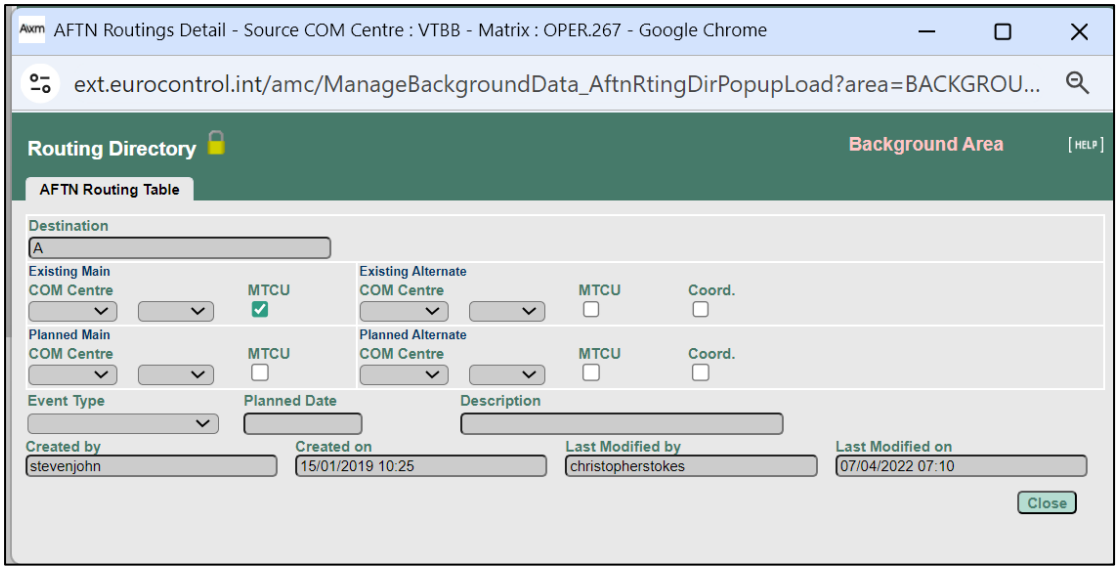


To update the tables, a CCC Operators or External COM Operators account is required. Typically, APAC States will focus on AFTN and AMHS Routing Tables

4.2.1 AFTN Routing Table updating

- In the Menu: Regional or country, Choose ASIA/PAC
- In the Menu: COM Centre, Choose your own COM Centre
- Destination column, choose the destination to update. Then the pop-up window will show for updating



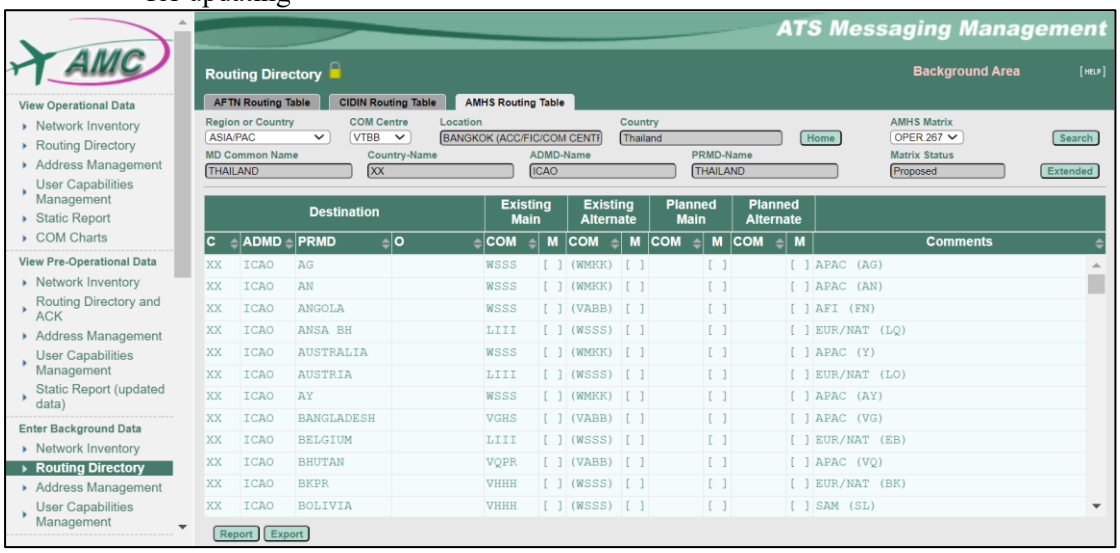


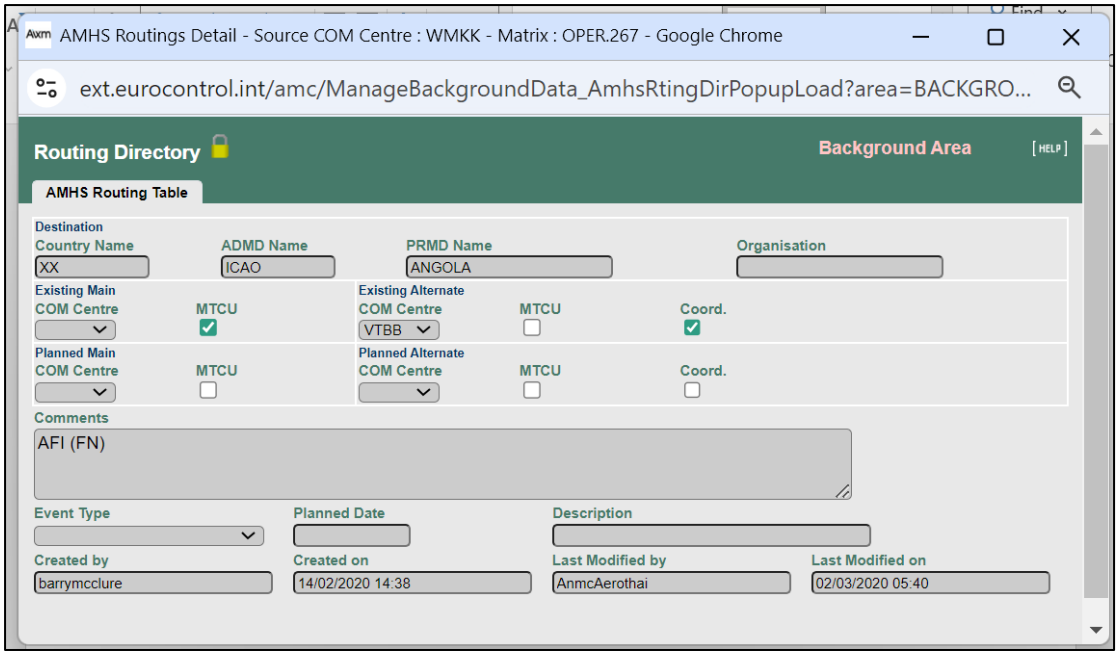
Destination

1. Present Routing (Existing)
   - Existing Main COM Centre for the Main route
   - Existing Alternate COM Centre for the Alternate route
   - Choose MTCU in case of using gateway for exchanging
   - Choose Coord. in case of necessary for coordination with concerned COM Centres
2. Planned Routing (If there is…)
   - Planned main COM Centre for the main route
   - Planned Alternate COM Centre for the Alternate route
   - Choose MTCU in case of using gateway for exchanging
   - Choose Coord. in case of necessary for coordination with concerned COM Centres
   - Choose Event type: Add, Change, Remove
   - Planned date and other description

4.2.2 AMHS Routing Table updating

- In the Menu: Regional or country, choose ASIA/PAC
- In the Menu: COM Centre, Choose COM Centre
- Destination column choose the PRMD to update, The pop-up window will show for updating





Destination

1. Present Routing (Existing)
   - Existing Main COM Centre for the Main route
   - Existing Alternate COM Centre for the Alternate route
   - Choose MTCU in case of using gateway for exchanging
   - Choose Coord. in case of necessary for coordination with concerned COM Centres
2. Planned Routing (If there is…)
   - Planned main COM Centre for the main route
   - Planned Alternate COM Centre for the Alternate route
   - Choose MTCU in case of using gateway for exchanging
   - Choose Coord. in case of necessary for coordination with concerned COM Centres
   - Comment

P.S. See more information from "Help" Function in AMC Website

---

Updated 25 MARCH 2025

Attachment A: Routing Table updated Check List Document

	Activities List	
1.	The Updated Main Routing List ……	
2.	The Updated Alternate Routing List …….	
3.	The parties concerned for changing Routing List ……	
4.	Activities Check List	
●	Coordinate with all concerned	☐
●	Fill in AMC Form	☐
●	Download the report AFTN/AMHS table	☐
●	Update AMC and inform the APAC AMC regional contact point and ICAO ….or….	☐
●	Send the updated routing table and Routing Table updated Check List Document to APAC AMC regional contact point	☐

Sender ……..

State …….

Date ..…….. /……/……..

****

AMC Network Inventory

Part 1 : Persons & Contacts & COM Centre

Persons & Contacts

1	Country	*VTBB*
2	COM Centre Location	*Bangkok COM Centre*
3	First name	
4	Surname	
5	Local title	*Mr. / Miss / Mrs.*
6	Personal Role	*Ex.: External COM Centre*
7	Phone	
8	Fax	
9	E-mail	
10	Telex	
11	AFTN	
12	SITA	
13	COM Postal Address	
14	Remark (others)	

COM Centre Applications

- ☐ AFTN/AMHS Gateway
- ☐ ATS Message Server
- ☐ CONV AFTN
- ☐ OPMET
- ☐ SITA
- ☐ Gateway to SITA

Part 2 : AFTN Capabilities

Please select one of the following options below:

1. Ax – VCG Mapping Capability
   - ☐ Automatic
   - ☐ Manual
2. Ax – VCG Mapping Actual Used
   - ☐ Automatic
   - ☐ Manual
3. Ad – Ax Mapping Capability
   - ☐ Automatic
   - ☐ Manual
4. Ad – Ax Mapping Actual Used
   - ☐ Automatic
   - ☐ Manual
5. Long Message Processing
   - ☐ Yes
   - ☐ No

Part 3 : AMHS Capabilities

ATS Message Server

1. MTA Name: ……..
2. Maximum Content Length: ……..
3. Extended Encoded Information type in Support of:
   Please select on the following options
   - ☐ IA5
   - ☐ FTBP
   - ☐ General Text Body Part (ISO646)
   - ☐ General Text Body Part (ISO8859-1)
4. Message Lifetime (Minutes)
   - Urgent: ……
   - Non Urgent: ……
   - Normal: ……...
   - Report: ……

AFTN/AMHS Gateway

- Currently Authorized Message Length :
  ……
- Maximum Number of Address :
  ……
- Converted General – Text Body Part
  Please select on of the following options
  - ☐ ISO646
  - ☐ ISO8859-1

5. Protocol Capabilities
   - Protocol ……
   - P – SEL ……
   - S – SEL ……
   - T – SEL ……
   - Network Address (NSAP or IP) :
     …….…….
6. Operational Status:
   - ☐ Operate
   - ☐ Non-operate

Part 4 : Connections

Existing Connections (Only International Connections)

1. Remote COM : ……
2. Protocol :
   - ☐ AMHS/TPO-X.25
   - ☐ AFTN X.25
   - ☐ AMHS
   - ☐ AMHS/TCP-IP
   - ☐ CIDIN PVC
   - ☐ CIDIN SVC
   - ☐ CONV. AFTN
   - ☐ WMO
3. Network Address :

   ……
4. Link type : ……*CRV*……
5. Capacity : …… *bandwidth available on the link*……..
6. Supplier : …….
7. Circuit Type:
   - ☐ L-Landline
   - ☐ M-Multiplexer
   - ☐ N-Network
   - ☐ R-Radio
   - ☐ S-Satellite
8. ☐ Active / ☐ Not Active
9. Remark : ……

***1 sheet for 1 connection**

Part 4 : Connections

Planned Connections (Only International Connections)

1. Remote COM …….
2. Protocol :
   - ☐ AMHS/TPO-X.25
   - ☐ AFTN X.25
   - ☐ AMHS
   - ☐ AMHS/TCP-IP
   - ☐ CIDIN PVC
   - ☐ CIDIN SVC
   - ☐ CONV. AFTN
   - ☐ WMO
3. Network Address :

   ……
4. Link type : ……*CRV*……
5. Capacity : …… *bandwidth available on the link*……..
6. Supplier : …….
7. Circuit Type:
   - ☐ L-Landline
   - ☐ M-Multiplexer
   - ☐ N-Network
   - ☐ R-Radio
   - ☐ S-Satellite
8. ☐ Active / ☐ Not Active
9. Remark :

   ……

***1 sheet for 1 connection**

Updated 25 MARCH 2025

Attachment A: Routing Table updated Check List Document

	Activities List	
1.	The Updated Main Routing List ……	
2.	The Updated Alternate Routing List …….	
3.	The parties concerned for changing Routing List ……	
4.	Activities Check List	
●	Coordinate with all concerned	☐
●	Fill in AMC Form	☐
●	Download the report AFTN/AMHS table	☐
●	Update AMC and inform the APAC AMC regional contact point and ICAO ….or….	☐
●	Send the updated routing table and Routing Table updated Check List Document to APAC AMC regional contact point	☐

Sender ……..

State …….

Date ..…….. /……/……..

****

AMC Network Inventory

Part 1 : Persons & Contacts & COM Centre

Persons & Contacts

1	Country	*VTBB*
2	COM Centre Location	*Bangkok COM Centre*
3	First name	
4	Surname	
5	Local title	*Mr. / Miss / Mrs.*
6	Personal Role	*Ex.: External COM Centre*
7	Phone	
8	Fax	
9	E-mail	
10	Telex	
11	AFTN	
12	SITA	
13	COM Postal Address	
14	Remark (others)	

COM Centre Applications

- ☐ AFTN/AMHS Gateway
- ☐ ATS Message Server
- ☐ CONV AFTN
- ☐ OPMET
- ☐ SITA
- ☐ Gateway to SITA

Part 2 : AFTN Capabilities

Please select one of the following options below:

1. Ax – VCG Mapping Capability
   - ☐ Automatic
   - ☐ Manual
2. Ax – VCG Mapping Actual Used
   - ☐ Automatic
   - ☐ Manual
3. Ad – Ax Mapping Capability
   - ☐ Automatic
   - ☐ Manual
4. Ad – Ax Mapping Actual Used
   - ☐ Automatic
   - ☐ Manual
5. Long Message Processing
   - ☐ Yes
   - ☐ No

Part 3 : AMHS Capabilities

ATS Message Server

1. MTA Name: ……..
2. Maximum Content Length: ……..
3. Extended Encoded Information type in Support of:
   Please select on the following options
   - ☐ IA5
   - ☐ FTBP
   - ☐ General Text Body Part (ISO646)
   - ☐ General Text Body Part (ISO8859-1)
4. Message Lifetime (Minutes)
   - Urgent: ……
   - Non Urgent: ……
   - Normal: ……...
   - Report: ……

AFTN/AMHS Gateway

- Currently Authorized Message Length :
  ……
- Maximum Number of Address :
  ……
- Converted General – Text Body Part
  Please select on of the following options
  - ☐ ISO646
  - ☐ ISO8859-1

5. Protocol Capabilities
   - Protocol ……
   - P – SEL ……
   - S – SEL ……
   - T – SEL ……
   - Network Address (NSAP or IP) :
     …….…….
6. Operational Status:
   - ☐ Operate
   - ☐ Non-operate

Part 4 : Connections

Existing Connections (Only International Connections)

1. Remote COM : ……
2. Protocol :
   - ☐ AMHS/TPO-X.25
   - ☐ AFTN X.25
   - ☐ AMHS
   - ☐ AMHS/TCP-IP
   - ☐ CIDIN PVC
   - ☐ CIDIN SVC
   - ☐ CONV. AFTN
   - ☐ WMO
3. Network Address :

   ……
4. Link type : ……*CRV*……
5. Capacity : …… *bandwidth available on the link*……..
6. Supplier : …….
7. Circuit Type:
   - ☐ L-Landline
   - ☐ M-Multiplexer
   - ☐ N-Network
   - ☐ R-Radio
   - ☐ S-Satellite
8. ☐ Active / ☐ Not Active
9. Remark : ……

***1 sheet for 1 connection**

Part 4 : Connections

Planned Connections (Only International Connections)

1. Remote COM …….
2. Protocol :
   - ☐ AMHS/TPO-X.25
   - ☐ AFTN X.25
   - ☐ AMHS
   - ☐ AMHS/TCP-IP
   - ☐ CIDIN PVC
   - ☐ CIDIN SVC
   - ☐ CONV. AFTN
   - ☐ WMO
3. Network Address :

   ……
4. Link type : ……*CRV*……
5. Capacity : …… *bandwidth available on the link*……..
6. Supplier : …….
7. Circuit Type:
   - ☐ L-Landline
   - ☐ M-Multiplexer
   - ☐ N-Network
   - ☐ R-Radio
   - ☐ S-Satellite
8. ☐ Active / ☐ Not Active
9. Remark :

   ……

***1 sheet for 1 connection**

Distribution of IWXXM when the primary AMHS link fails

1 Purpose

This document provides educational material about a capability-based approach to thinking about *ICAO Meteorological Information Exchange Model* (IWXXM) message distribution for Asia Pacific (APAC) Com Centre (COMM) operators in the event of a primary link failure.

2 Assumptions

Link and connection enablement and establishment are pre-requisites to this educational material.

IWXXM message is assumed to be fully correct and compliant.

IWXXM message structure and content details are not required knowledge.

IWXXM/TAC Translation services are out of scope, due to data loss resulting from message conversion.

Originator capabilities for IWXXM handling are assumed to be fully compliant.

Recipient capabilities for IWXXM handling are assumed to be fully compliant.

COMMs are expected to ensure and provide assurance that data loss and data corruption do not occur when transiting their own COMM and network.

Full end-to-end delivery enablement for IWXXM is the objective, but not within scope of this document.

3 IWXXM Message Transfer Considerations

3.1 Message Addressing and Routing

APAC States are using **address-based routing** for IWXXM messages.

APAC States are not using content-based routing nor pathname-based routing for IWXXM messages.

Address-based routing provides some flexibility to the COMM operator to optionally divert IWXXM messages down a specific alternate link, while all other AMHS traffic can be diverted via a separate alternate link.

Address-based routing simplifies COMM operator assessments of alternate connections, since this shifts more decision-making to a coarser link-level decision instead of fine-grained content-based or pathname-based decisions.

3.2 Link Capabilities

AFTN links for IWXXM should not be used, because:

- IWXXM message sizes can far exceed AFTN message sizes
- IWXXM character sets are generally incompatible with AFTN connection character sets
- Down-converting IWXXM messages for transmission via AFTN has high risk of **data loss** and/or **data corruption**

Care should also be taken to consider any internal COMM links that may prevent unmodified IWXXM message traversal.

AMHS links should meet the following minimum requirements:

- Message size supported up to a maximum 4MB
- FTBP supported
- IHE supported
- Link speeds higher than 64kbps are recommended, required bandwidth is dependent upon connection use

Information about AMHS connection capabilities is stored at the AMC.

The AMC can store information about AMHS connection capability (linked via “Network Inventory”, then in the “AMHS Capabilities” tab), allowing for future retrieval.

However, there may be limitations with AMC data accuracy and freshness.

Outside of the AMC, connection capabilities prior to commissioning by the COMM should already be known, recorded, and kept fresh.

3.3 Message Structure and Content

When compared to TAC products, IWXXM messages have complex message structures and complex content requirements.

However, so long as the AMHS connection capabilities are satisfied, IWXXM message transfer can occur.

MTS supporting IWXXM transfer do not need to be able to parse IWXXM message contents.

4 Actions

In the event of a primary link failure, the COMM operator will now have sufficient background knowledge to be able to assess whether an alternate link is acceptable for transferring IWXXM messages.

In all circumstances,

- AFTN links are excluded from consideration
- Alternate links should have similar or better connection capabilities to the failed primary link

The following four major actions can be used:

- Link-based diversion
- Address-based diversion
- Content-based diversion / pathname-based diversion
- Traffic hold

4.1 Link-based Diversion

This is simply diverting all traffic via an alternate same-type link.

This is a common diversion tactic currently accomplished via the RQP mechanism.

4.2 Address-based Diversion

APAC IWXXM messages currently utilise address-based routing, for which specific address-based diversions can be activated.

Recipient addresses within APAC are listed in the Online Register of APAC IWXXM Exchange Status (Link: https://docs.google.com/spreadsheets/d/1WEcGfMRZq2dgHsfdpFhiefJEcA8OeMhfbCJHTqA7NX0/edit#gid=0).

This means that IWXXM messages can be routed via a suitable alternate AMHS link, whilst all other traffic is routed via a different alternate AMHS link.

This may be useful to load-balance traffic between different alternate AMHS links.

4.3 Content-based Diversion / Pathname-based Diversion

Content-based and pathname-based diversions follow similarly to address-based diversions, but may require additional functionality.

4.4 Traffic Hold

Given the importance of meteorological information, data loss should be avoided as much as reasonably possible.

Where no alternate exists, then a traffic hold may be considered.

CHECKLIST FOR IWXXM IMPLEMENTATION

1. ATS MESSAGE HANDLING SYSTEM (AMHS) CHECKLIST

☐	Preparation - Ensure all stakeholders (e.g. COMMS and MET experts) are informed and involved.
☐	Preparation - Review ICAO guidelines for IWXXM exchange implementation (i.e. Guidelines for the Implementation of OPMET Data Exchange using IWXXM, Fifth Edition – October 2023 (*IWXXM Guidelines*))
☐	System Requirements - Verify that your AMHS supports File Transfer Body Part (FTBP) feature. A total size of AMHS message (including FTBP) up to 4MB is required. The support by User Agents (UAs) of Interpersonal Messaging (IPM) Heading Extensions (IHE) is required.
☐	System Requirements - Verify that the IPM body shall contain exactly one body-part which is an FTBP (*IWXXM Guidelines, Appendix A, Section 2.3 refers*).
☐	System Requirements – Verify there is sufficient bandwidth to support the new addition of IWXXM traffic.
☐	System Requirements - Ensure components in the processing and exchanging chains are able to handle payloads in IWXXM and their compressed counterparts in gzip formats.
☐	Network Configuration – Configure network settings to support IWXXM data exchange (e.g. configure firewalls to allow IWXXM data traffic).
☐	Network Configuration – Ensure secure and reliable network connections. The available bandwidth for each 'hop' in the network should be considered by COM Centres when switching to AMHS FTBP operations.
☐	Network Configuration – Ensure P1 AMHS connection(s) (direct and alternate paths) with neighbouring COM Centres.
☐	Network Configuration – Ensure the support of IWXXM exchange for P3 connection(s).
☐	Testing – Conduct initial tests with internal stakeholders (e.g. local meteorological service provider) to ensure successful data exchange.
☐	Testing – Conduct initial tests with external stakeholders (e.g. connecting COM Centres) to ensure successful data exchange.
☐	Testing – Verify data integrity and accuracy with internal and external stakeholders.
☐	Documentation – Maintain detailed records of the implementation process.
☐	Documentation – Document any issues and resolutions for future reference.
☐	Distribution – Only distribute operational IWXXM AMHS messages to APAC ROCs and IROGs who have indicated to be ready for receival in the "IWXXM - Online Register of APAC IWXXM Exchange Status".
☐	Operation – Ensure all stakeholders are informed with commencement, taking into consideration Aeronautical Information Regulation and Control (AIRAC) and the use of METNO.

2. IWXXM DATA GENERATION CHECKLIST

☐ Data Collection - Gather meteorological data (observations, forecasts).

- ☐ Data Collection - Ensure data is sourced from reliable meteorological services.
- ☐ Data Collection - Confirm the completeness of required elements (temperature, wind, visibility, etc.).
- ☐ Data Encoding - Encode data in IWXXM format as per IWXXM schema. Compress the IWXXM message with gzip, a globally agreed compression technique for meteorological data. Give the output file a name in accordance to the file name conventions mentioned on Page 138 of WMO No.386[1].
- ☐ Data Encoding - Validate the IWXXM message against the IWXXM schema (XML Schema Definition (XSD) and schematron (SCH) files with a suitable XML validator.
- ☐ Data Encoding - Ensure compliance with IWXXM TAC-to-XML-Guidance.
- ☐ IWXXM Elements - Include required IWXXM elements: **Metadata**: Identifier, issue time, etc. **Observation**: Current weather conditions. **Forecast**: Forecast data, including start and end times. **Significant Weather**: Any notable weather phenomena.
- ☐ IWXXM Elements - Ensure proper units of measurement (e.g., meters, degrees Celsius).
- ☐ Quality Control - Perform quality checks on the data for accuracy.
- ☐ Quality Control - Review for consistency and coherence in message content.
- ☐ Quality Control - Verify that timestamps and time zones are correctly formatted.
- ☐ Testing - Test the IWXXM message with parsing tools.
- ☐ Testing - Simulate real-world scenarios to ensure robustness.
- ☐ Testing - Conduct interoperability tests with recipient systems, including internal and external stakeholders (refer to AMHS Checklist).
- ☐ Final Review - Have a second party review the IWXXM message.
- ☐ Final Review - Confirm compliance with relevant regulations and standards.
- ☐ Distribution - Prepare for distribution through appropriate channels (e.g. AMHS).
- ☐ Distribution - Ensure proper encoding and transmission protocols are followed.
- ☐ Monitoring and Feedback - Monitor reception and processing of IWXXM messages.
- ☐ Monitoring and Feedback - Collect feedback from users and stakeholders for continuous improvement.

3. ADDITIONAL CONSIDERATION

- ☐ Stay updated on changes to ICAO IWXXM specifications. Also refer to the IWXXM FAQs under ICAO Asia Pacific Document portal if needed.
- ☐ When planning the implementation of IWXXM, consider the IWXXM package compatibility table to determine the appropriate version of IWXXM messages. Also, plan a regular review to ensure compliance with this table.
- ☐ Document any anomalies or issues encountered during generation and testing with internal and external stakeholders.
- ☐ Update the IWXXM – Online Register of APAC IWXXM Exchange Status for your state when ready.
- ☐ Those States using IWXXM extensions to provide optional information for national use should make available relevant schemas and documentations for all intended consumers.

[1] https://library.wmo.int/viewer/35800/download?file=386_2023-edition_en.pdf&type=pdf&navigator=1

"TERMS OF REFERENCE

SWIM IMPLEMENTATION PIONEER AD-HOC GROUP

Objective

To implement a seed/prototype version of the Asia/Pacific SWIM within 2026 as a means of kick-starting SWIM adoption in the region.

Responsibilities

Deliverables for this group are as follows:

1) A regional SWIM Technical Infrastructure (TI) prototype built on the architecture that utilizes the CRV and the Internet. The architecture has been agreed by the SWIM Task Force;

2) Evaluation of the capability of the prototype SWIM TI using a selection of representative SWIM Information Services; and

3) Provide recommendations to the SWIM Task Force on the viability and performance of the SWIM TI.

Composition

- Experts from ATM, AIM, MET, and CNS Service Providers from at least three Asia/Pacific States having the following desirable characteristics:

  1) Having access to or will have access to the Common aeRonautical VPN (CRV);

  2) Having implemented an EMS or having access or will have access to an EMS;

  3) Able to provide some of the common information services agreed by the SWIM Task Force; and

  4) Able to provide or have access to a SWIM registry.

- Any other international organizations such as IATA and ICCAIA and industries

Conduct of the Work

The group will conduct its work through regular web conferences, other electronic means of communications, and face-to-face meetings.

----------"

Business Functionality of APAC Common SWIM Information Services
(Updated by MET SG/28, FF-ICE/2, MET/IE WG/23, SURICG/10, AAITF/19 and ATFM SG/15)

First Version (May 2025)

(Editorial note – changes arising from MET SG/28, FF-ICE/2, MET/IE WG/23, SURICG/10, AAITF/19 and ATFM SG/15 are indicated with ~~strikethrough~~ and highlighted text.)

Purpose.– This list of APAC Common SWIM Information Services, including associated priorities, provides States/Administrations with guidance on anticipated services to support their planning and implementation of SWIM.

Notes.– Priority of Recommended ~~s~~Services in ~~i~~Initial APAC Common SWIM Information Service (IS) ((1)/(2)/(3)):

- Priority (1): Recommended for region-wide implementation for region-wide benefits
- Priority (2): Recommended for implementation as much as practicable
- Priority (3): Additional information services without common regional requirements and not included as a part of common regional information services

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of Recommended sService in iInitial 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,~~ Availability or activation/deactivation or temporarily change of airspace, restricted area, danger area, search and rescue regions	AIXM	Pub/Sub or Req Reply	2

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of~~ ~~Recommended s~~Service in ~~i~~Initial ~~APAC Common SWIM IS~~ (1) / (2) / (3)**
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, and other airspace not limited to restricted area, prohibited area, danger area, search and rescue regions (Remarks – Other data published in the AIP may be included)	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 or Req Reply	2
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
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 or Req Reply	2
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.~~	~~CLDT, TOBT, CTOT, CTO, TTOT, TSAT, etc.~~	~~FIXM~~	~~Pub/Sub Req/Reply~~	~~1~~

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of Recommended sService in iInitial APAC Common SWIM IS~~ (1) / (2) / (3)**
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 Pub/Sub	1
FF-ICE ~~data~~ publication service	Provides harmonised sharing of flight ~~plan~~ information in a global standard supporting common situation awareness.	Flight ~~plan~~ information 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, a copy of flight plan or supplementary 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 Req/Reply	1
FF-ICE planning service	Allows operators to submit preliminary flight plans for early Air Traffic Flow Management (ATFM) planning and to obtain feedback regarding restrictions/constraints affecting the flight.	Preliminary flight plan for early ATFM planning	FIXM	Req/Reply Pub/Sub	2
Flight-Specific ATFM Measure Service	Supports *notification* of information related to "flight-specific" ATFM measures, i.e. measures whose control mechanisms apply to a single flight. An example is the Ground Delay Program (GDP), whose control mechanism is a Calculated Take-Off Time (CTOT), or an ATFM measure for airborne flight,	CTOT, CTO, CLDT, and fields currently included in APAC	FIXM	Pub/Sub Req/Reply	1

Business functionality of the information service	Brief description of the service	Type of information to be exchanged	Information exchange model / Message type	Message exchange pattern	Priority ~~of Recommended sService in iInitial APAC Common SWIM IS~~ (1) / (2) / (3)
	whose control mechanism is a Calculated Time Over (CTO). Recipients of this information should take actions to comply with the ATFM measure contained herein.	AFTN/AMHS-Based ICD for ATFM[1]			
ATFM/A-CDM Integration Service	Supports exchanges of flight-specific ATFM measure information and A-CDM milestone parameters among stakeholders, including arrival/departure ATFM units, airspace users, and airport operators, to integrate A-CDM process with ATFM operations.	ATFM measure information: CTOT A-CDM departure planning information: TOBT, TTOT, TSAT	FIXM	Pub/Sub Req/Reply	1
APAC Common SWIM Meteorological Information Services					
FOR AERODROME					
METAR/SPECI ~~information~~ service	Provides ~~of~~ IWXXM-formatted METAR/SPECI product specified in ICAO Annex 3.	Provision of the existing Annex 3 product via an information service ~~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
Aerodrome Meteorological Observation Information Service ~~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 84~~83~~) in Nov 2030~~2027~~ tentatively (Note: Level of standardisation needs to be considered, as different	IWXXM	Pub/Sub or Req/Reply	2*

[1] Based on the conclusion from ATFM/SG/15, an amendment to this ICD will be proposed in which a more structured use of REGUL and REGCAUSE fields will be introduced. This proposal is expected to be tabled at the upcoming CNS/SG meeting.
* Will become Priority (1) when it is introduced as recommended practice in Annex 3 tentatively in Nov 2030

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of~~ ~~Recommended s~~Service in ~~i~~Initial ~~APAC Common SWIM IS~~ (1) / (2) / (3)**
Aerodrome Meteorological Forecast Information Service ~~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.	aerodrome information services may be required for different use cases.)	IWXXM	Pub/Sub or Req/Reply	2*
FOR ENROUTE					
SIGMET ~~information~~ service	Provides ~~of~~ IWXXM-formatted SIGMET product specified in ICAO Annex 3.	SIGMETs for thunderstorm, tropical cyclone, turbulence, icing, mountain wave, duststorm, sandstorm, volcanic ash and radioactive cloud	IWXXM	Pub/Sub Req/Reply	1
AIRMET ~~information~~ service	Provides ~~of~~ IWXXM-formatted AIRMET product specified in ICAO Annex 3.	Provision of the existing Annex 3 product via an information service	IWXXM	Pub/Sub Req/Reply	~~1~~2
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
Volcano Observatory Notice for Aviation	Provides ~~of~~ IWXXM-formatted VONA specified in ICAO Annex 3. Provision of VONA ~~will become the~~		IWXXM	Pub/Sub Req/Reply	2

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of~~ ~~Recommended sService in iInitial APAC Common SWIM IS~~ (1) / (2) / (3)**
(VONA) ~~information~~ service	is a recommended practice in Annex 3 (Amd 82) ~~in 2025~~. (Designated provider: States with a designated State Volcano Observatory)				
Quantitative volcanic ash ~~(QVA)~~ concentration information (QVA) service	Provides detailed information of significant 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~~ Volcanic Ash Advisory Centre (VAAC))	QVA ~~grids grid point~~ gridded forecasts including probabilities~~,~~ and IWXXM QVA objects. ~~To be introduced as~~ A recommended practice for significant ash clouds in Annex 3 (Amd 82) ~~in Nov 2025 tentatively~~ for VAACs in a position to do so from Nov 2025, and for all VAACs from Nov 2026.	Gridded data (e.g. NetCDF), IWXXM	Pub/Sub ~~or~~ Req/Reply	~~1~~2[#]
WAFC (World Area Forecast Centres) gridded ~~grid point~~ forecast service	Provides global gridded weather forecasts. (Designated provider: WAFCs (UK and US))	Global gridded forecasts of CB, icing, turbulence, 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 GRIB2	Pub/Sub ~~or~~ Req/Reply	1
WAFC significant weather (SIGWX) forecast service	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
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

[#] Will become Priority (1) from Nov 2026

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of~~ ~~Recommended s~~Service in ~~i~~Initial ~~APAC Common SWIM IS~~ (1) / (2) / (3)**
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 **only** sharing service	Provides surveillance data of aircraft. ~~Provides three-dimensional position, time and identification of aircraft and other data as appropriate.~~	~~Position~~ latitude, longitude, ~~altitude,~~ flight level, ground speed (optional), ~~track angle,~~ magnetic heading (optional), ~~call sign, Mode S address,~~ target identification, target address, **mode 3/A code** (optional), **date**, time of message reception for position, ~~data quality~~, quality indicators, ~~Mode S DAP~~, **SAC, SIC**	ASTERIX Cat 21 (payload in JSON or RAW format)	Pub/Sub	~~2~~1
Surveillance data with flight plan information sharing service	Provides surveillance data of aircraft with flight plan information.	globally unique flight identifier, aircraft identification, departure aerodrome, destination aerodrome, aircraft type (optional), wake turbulence category **(optional)** latitude, longitude, flight level, ground speed **(optional)**, magnetic heading **(optional)**, target identification, target address, mode 3/A code **(optional)**, date, time of message reception for position,	ASTERIX Cat 21+FPL (payload in JSON or RAW format)	Pub/Sub	2

Business functionality of the information service	**Brief description of the service**	**Type of information to be exchanged**	**Information exchange model / Message type**	**Message exchange pattern**	**Priority ~~of~~ ~~Recommended s~~Service in i~~Initial APAC Common SWIM IS~~ (1) / (2) / (3)**
		quality indicators, SAC, SIC			

Appendix A

FIXM version 4.3 Core Data Attributes to Support Cross-Border ATFM Information Exchange

Data Attribute	FIXM version 4.3 Core
EOBT (Estimated Off-Block Time)	FlightType.departure.estimatedOffBlockTime = (EOBT)
ETO (Estimated Time Over)	FlightType.routeTrajectoryGroup.desired.element.point4D.time = (ETO) FlightType.routeTrajectoryGroup.desired.element.elementStartPoint = (point at which ETO is specified)
ELDT (Estimated Landing Time)	FlightType.routeTrajectoryGroup.desired.element.point4D.time = (ELDT) FlightType.routeTrajectoryGroup.desired.element.point4D.pointProperty.propertyType = WHEELS_ON FlightType.routeTrajectoryGroup.desired.element.elementStartPoint.aerodromReferencePoint.locationIndicator = FlightType.arrival.destinationAerodrome.locationIndicator
EIBT (Estimated In-Block Time)	FlightType.routeTrajectoryGroup.desired.element.point4D.time = (EIBT) FlightType.routeTrajectoryGroup.desired.element.point4D.pointProperty.propertyType = IN_BLOCKS FlightType.routeTrajectoryGroup.desired.element.elementStartPoint.aerodromReferencePoint.locationIndicator = FlightType.arrival.destinationAerodrome.locationIndicator
CTOT (Calculated Take-Off Time)	FlightType.routeTrajectoryGroup.negotiating.element.constraint.time.timeSpecification.timeValue = (CTOT) FlightType.routeTrajectoryGroup.negotiating.element.point4D.pointProperty.propertyType = WHEELS_OFF FlightType.routeTrajectoryGroup.negotiating.element.elementStartPoint.aerodromReferencePoint.locationIndicator = FlightType.departure.aerodrome.locationIndicator
CTO (Calculated Time Over)	FlightType.routeTrajectoryGroup.negotiating.element.constraint.time.timeSpecification.timeValue = (CTO) FlightType.routeTrajectoryGroup.negotiating.element.elementStartPoint = (point at which CTO is specified)
CLDT (Calculated Landing Time)	FlightType.routeTrajectoryGroup.negotiating.element.constraint.time.timeSpecification.timeValue = (CLDT) FlightType.routeTrajectoryGroup.negotiating.element.point4D.pointProperty.propertyType = WHEELS_ON FlightType.routeTrajectoryGroup.negotiating.element.elementStartPoint.aerodromReferencePoint.locationIndicator = FlightType.arrival.destinationAerodrome.locationIndicator

Appendix B

FIXM version 4.3 Extension Data Attributes

Data Attribute	FIXM version 4.3
EOBT (Estimated Off-Block Time)	Core
ETO (Estimated Time Over)	Core
ELDT (Estimated Landing Time)	Core
EIBT (Estimated In-Block Time)	Core
CTOT (Calculated Take-Off Time)	Core
CTO (Calculated Time Over)	Core
CLDT (Calculated Landing Time)	Core
TOBT (Target Off-Block Time)	Extension
TSAT (Target Start-up Approval Time)	Extension
TTOT (Target Take-Off Time)	Extension
TTO (Target Time Over)	Extension
TIBT (Target In-Block Time)	Extension
AOBT (Actual Off-Block Time)	Extension
ATO (Actual Time Over)	Extension
AIBT (Actual In-Block Time)	Extension
Taxi time*	Extension
REGUL* (designation of the ATFM measure affecting the flight)	Extension
REGCAUSE* (reason for the ATFM measure)	Extension
REASON* (reason to explain an action by ATFM personnel, e.g. rejection, cancellation)	Extension
COMMENT* (additional information for ATFM purpose)	Extension

**For more information, refer to Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0*

Appendix C

APAC XSD Description

Namespace	Description
Apac	FIXM Extension containing data attributes to support cross-border Air Traffic Flow Management (ATFM) operations, the integration between ATFM and Airport-Collaborative Decision Making (A-CDM), and traffic synchronization in accordance with Distributed Multi-Nodal ATFM Network concept and the Airport-Collaborative Decision Making operations in the Asia/Pacific region.

Class	Definition	Reference/Remark
ApacDepartureType	Class containing flight data related to departure aerodrome	This class is to be included in extension field under DepartureType class.
Data Attribute	**Definition**	**Reference/Remark**
actualOffBlockTime	A time the aircraft is pushed back / vacates parking position (equivalent to airline/handlers ATD – Actual Time of Departure and ACARS=OUT)	ICAO Doc 9971 Manual on Collaborative ATFM, 3rd Edition, 2018
targetOffBlockTime	A time that an Aircraft Operator or Ground Handler estimates that an aircraft will be ready to receive start-up approval/push-back clearance	ICAO Asia/Pacific Regional Framework for Collaborative ATFM, Version 4, October 2022
targetStartupApprovalTime	A time provided by ATC taking into account TOBT, CTOT, and/or the traffic situation that an aircraft can expect start-up/push back approval	ICAO Asia/Pacific Regional Framework for Collaborative ATFM, Version 4, October 2022
targetedTakeOffTime	A time that an aircraft is targeted to be airborne, taking into account TOBT, TSAT, and other factors such as EXOT, wake turbulence, SID, etc.	● ICAO Asia/Pacific Regional Framework for Collaborative ATFM, Version 4, October 2022 ● EUROCONTROL A-CDM Implementation Manual, Version 5.0, March 2017
taxiTime	The difference in time between the ‘off blocks time’ and the ‘take-off time’. The times referred to could be actual or estimated depending upon the context.	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0

Class	Definition	Reference/Remark

ApacArrivalType	Class containing flight data related to destination aerodrome	This class is to be included in extension field under ArrivalType class.
Data Attribute	Definition	Reference/Remark
actualInBlockTime	The time that an aircraft arrives in-blocks (equivalent to airline/handler ATA – actual time of arrival, ACARS = IN)	ICAO Doc 9971 Manual on Collaborative ATFM, 3rd Edition, 2018
targetInBlockTime	A time, calculated by an automation system, that an aircraft is expected to be at its first parking position	This time value is not EIBT (Estimated In-Block Time) – The estimated time that an aircraft will arrive in blocks (Ref. EUROCONTROL A-CDM Implementation Manual, Version 5.0, March 2017)

Class	Definition	Reference/Remark
ApacRouteTrajectoryElementType	Class containing flight data related to specific element	
Data Attribute	Definition	Reference/Remark
actualTimeOver	An actual time of the aircraft over a fix, waypoint, or particular location	
targetTimeOver	A time, calculated and issued by an ATS unit, that an aircraft is requested to be over a fix, waypoint, or particular location	Use case: a time progressively calculated and issued by arrival management (AMAN) system

Class	Definition	Reference/Remark
ApacRouteTrajectoryGroupContainerType	Class contains actual trajectory information	
Data Attribute	Definition	Reference/Remark
actual	A list of actual trajectory	

Class	Definition	Reference/Remark
ApacAtfmMeasureCodeType	Indication of the cause of the ATFM measure	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(a)

Class	Definition	Reference/Remark
ApacAtfmMeasureLocationType	Indication of the constraint location for which the ATFM measure is implemented	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(b)
Class	Definition	Reference/Remark
ApacDelayCodeType	Indication of IATA numeric delay code	Asia/Pacific Regional AFTN/AMHS-based Interface

		Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(d)

Class	Definition	Reference/Remark
ApacRegulationConstraintAreaType	Area of constraint. Format: [A-Z]{4}	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0

Class	Definition	Reference/Remark
ApacRegulationConstraintLocationType	Location of constraint. Format: [A-Z0-9]{1,5}	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0

Class	Definition	Reference/Remark
ApacRegulationCauseType	Class contains the cause of the ATFM measure	This is equivalent to REGCAUSE field in the Slot Allocation Message (SAM) as per Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
Data Attribute	Definition	Reference/Remark
atfmMeasureCode	Indication of the cause of the ATFM measure	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(a)
atfmMeasureLocation	Indication of the constraint location for which the ATFM measure is implemented	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(b)
iataDelayCode	Indication of IATA numeric delay code	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0, section 3.2.1.15(d)

Class	Definition	Reference/Remark
ApacRegulationIdType	Class contains the designation of the ATFM measure	This is equivalent to REGUL field in the Slot Allocation Message (SAM) as per

		Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
Data Attribute	Definition	Reference/Remark
effectiveDate	The date and month when the ATFM measure is effective	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
version	The version of the designation of the ATFM measure	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
constraintArea	A constrained area	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
constraintLocation	A specific constrained location	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0

Class	Definition	Reference/Remark
ApacRouteTrajectoryConstraintType	Class contains the ATFM measure information	
Data Attribute	Definition	Reference/Remark
comment	Additional ATFM measure information	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
reason	Reason to explain an action by the FMP (e.g. rejection, cancellation, etc.).	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
regulationCause	The information indicates the reason for the ATFM measure to assist in post-operations analysis.	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic Flow Management, version 3.0
regulationId	The information indicates the designation of the ATFM measure, including the specific location of the	Asia/Pacific Regional AFTN/AMHS-based Interface Control Documents for Air Traffic

	constraint, affecting the flight.	Flow Management, version 3.0

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema targetNamespace="http://www.fixm.aero/ext/apac/4.3"
xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:apac="http://www.fixm.aero/ext/apac/4.3"
xmlns:fx="http://www.fixm.aero/flight/4.3" xmlns:fb="http://www.fixm.aero/base/4.3"
elementFormDefault="qualified" version="4.3.0">
	<xs:annotation>
		<xs:documentation>The Apac package contains information used in Asia Pacific
region.</xs:documentation>
	</xs:annotation>
	<xs:import namespace="http://www.fixm.aero/flight/4.3"
schemaLocation="../../core/flight/Flight.xsd"/>
	<xs:import namespace="http://www.fixm.aero/base/4.3"
schemaLocation="../../core/base/Base.xsd"/>
	<xs:import namespace="http://www.fixm.aero/base/4.3"
schemaLocation="../../core/base/Types.xsd"/>
	<xs:import namespace="http://www.fixm.aero/base/4.3"
schemaLocation="../../core/base/Extension.xsd"/>
	<xs:import namespace="http://www.fixm.aero/flight/4.3"
schemaLocation="../../core/flight/flightroutetrajectory/RouteTrajectory.xsd"/>
	<xs:simpleType name="ApacAtfmMeasureCodeType">
		<xs:annotation>
			<xs:documentation>Indication of the cause of the ATFM measure, based on
APAC AFTN/AMHS-Based ICD for ATFM v3.0, section 3.2.1.15(a).</xs:documentation>
		</xs:annotation>
		<xs:restriction base="xs:string">
			<xs:enumeration value="A"/>
			<xs:enumeration value="C"/>
			<xs:enumeration value="E"/>
			<xs:enumeration value="G"/>
			<xs:enumeration value="I"/>
			<xs:enumeration value="M"/>
			<xs:enumeration value="N"/>
			<xs:enumeration value="O"/>
			<xs:enumeration value="P"/>
			<xs:enumeration value="R"/>
			<xs:enumeration value="S"/>
			<xs:enumeration value="T"/>
			<xs:enumeration value="V"/>
			<xs:enumeration value="W"/>
		</xs:restriction>
	</xs:simpleType>
	<xs:simpleType name="ApacAtfmMeasureLocationType">
		<xs:annotation>
			<xs:documentation>Indication of the constraint location for which the ATFM
measure is implemented, based on APAC AFTN/AMHS-Based ICD for ATFM v3.0, section
3.2.1.15(b)</xs:documentation>
		</xs:annotation>
		<xs:restriction base="xs:string">
			<xs:enumeration value="A"/>
			<xs:enumeration value="D"/>
			<xs:enumeration value="E"/>
		</xs:restriction>
	</xs:simpleType>
	<xs:simpleType name="ApacDelayCodeType">
```

```
                <xs:annotation>
                        <xs:documentation>Indication of IATA numeric delay code, based on APAC
AFTN/AMHS-Based ICD for ATFM v3.0, section 3.2.1.15(d)</xs:documentation>
                </xs:annotation>
                <xs:restriction base="xs:string">
                        <xs:enumeration value="81"/>
                        <xs:enumeration value="82"/>
                        <xs:enumeration value="83"/>
                        <xs:enumeration value="84"/>
                        <xs:enumeration value="85"/>
                        <xs:enumeration value="86"/>
                        <xs:enumeration value="87"/>
                        <xs:enumeration value="88"/>
                        <xs:enumeration value="89"/>
                        <xs:enumeration value="98"/>
                        <xs:enumeration value="99"/>
                </xs:restriction>
        </xs:simpleType>
        <xs:simpleType name="ApacRegulationConstraintAreaType">
                <xs:restriction base="fb:CharacterStringType">
                        <xs:pattern value="[A-Z]{4}"/>
                </xs:restriction>
        </xs:simpleType>
        <xs:simpleType name="ApacRegulationConstraintLocationType">
                <xs:restriction base="fb:CharacterStringType">
                        <xs:pattern value="[A-Z0-9]{1,5}"/>
                </xs:restriction>
        </xs:simpleType>
        <xs:complexType name="ApacRegulationCauseType">
                <xs:annotation>
                        <xs:documentation>Class contains the cause of the ATFM measure. This is
equivalent to REGCAUSE field in the Slot Allocation Message (SAM) as per the APAC
AFTN/AMHS-Based ICD for ATFM v3.0</xs:documentation>
                </xs:annotation>
                <xs:sequence>
                        <xs:element name="atfmMeasureCode"
type="apac:ApacAtfmMeasureCodeType" minOccurs="1" maxOccurs="1"/>
                        <xs:element name="atfmMeasureLocation"
type="apac:ApacAtfmMeasureLocationType" minOccurs="1" maxOccurs="1"/>
                        <xs:element name="iataDelayCode" type="apac:ApacDelayCodeType"
minOccurs="1" maxOccurs="1"/>
                </xs:sequence>
        </xs:complexType>
        <xs:complexType name="ApacRegulationIdType">
                <xs:annotation>
                        <xs:documentation>Class contains the designation of the ATFM measure.
This is equivalent to REGUL field in the Slot Allocation Message (SAM) as per the APAC
AFTN/AMHS-Based ICD for ATFM v3.0</xs:documentation>
                </xs:annotation>
                <xs:sequence>
                        <xs:element name="effectiveDate" type="fb:DateUtcType" minOccurs="1"
maxOccurs="1"/>
                        <xs:element name="version" type="xs:int" minOccurs="1"
maxOccurs="1"/>
```

```
                        <xs:element name="constraintArea"
type="apac:ApacRegulationConstraintAreaType" minOccurs="1" maxOccurs="1"/>
                        <xs:element name="constraintLocation"
type="apac:ApacRegulationConstraintLocationType" minOccurs="0" maxOccurs="1"/>
                </xs:sequence>
        </xs:complexType>
        <xs:complexType name="ApacRouteTrajectoryConstraintType">
                <xs:annotation>
                        <xs:documentation>Class contains the ATFM measure
information</xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                        <xs:extension base="fb:RouteTrajectoryConstraintExtensionType">
                                <xs:sequence>
                                        <xs:element name="comment"
type="fb:CharacterStringType" minOccurs="0" maxOccurs="1"/>
                                        <xs:element name="reason" type="fb:CharacterStringType"
minOccurs="0" maxOccurs="1"/>
                                        <xs:element name="regulationCause"
type="apac:ApacRegulationCauseType" minOccurs="1" maxOccurs="1"/>
                                        <xs:element name="regulationId"
type="apac:ApacRegulationIdType" minOccurs="0" maxOccurs="2000"/>
                                </xs:sequence>
                        </xs:extension>
                </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="ApacArrivalType">
                <xs:annotation>
                        <xs:documentation>Class containing flight data related to destination
aerodrome. This class is to be included in extension field under ArrivalType
class.</xs:documentation>
                </xs:annotation>
                <xs:complexContent>
                        <xs:extension base="fb:ArrivalExtensionType">
                                <xs:sequence>
                                        <xs:element name="actualInBlockTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
                                        <xs:element name="targetInBlockTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
                                </xs:sequence>
                        </xs:extension>
                </xs:complexContent>
        </xs:complexType>
        <xs:complexType name="ApacRouteTrajectoryElementType">
                <xs:complexContent>
                        <xs:extension base="fb:RouteTrajectoryElementExtensionType">
                                <xs:sequence>
                                        <xs:element name="actualTimeOver"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
                                        <xs:element name="targetTimeOver"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
                                </xs:sequence>
                        </xs:extension>
                </xs:complexContent>
```

```
	</xs:complexType>
	<xs:complexType name="ApacRouteTrajectoryGroupContainerType">
		<xs:annotation>
			<xs:documentation>Class contains actual trajectory
information</xs:documentation>
		</xs:annotation>
		<xs:complexContent>
			<xs:extension base="fb:RouteTrajectoryGroupContainerExtensionType">
				<xs:sequence>
					<xs:element name="actual"
type="fx:RouteTrajectoryGroupType" minOccurs="1" maxOccurs="1"/>
				</xs:sequence>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
	<xs:complexType name="ApacDepartureType">
		<xs:annotation>
			<xs:documentation>Class containing flight data related to departure
aerodrome. This class is to be included in extension field under DepartureType
class</xs:documentation>
		</xs:annotation>
		<xs:complexContent>
			<xs:extension base="fb:DepartureExtensionType">
				<xs:sequence>
					<xs:element name="actualOffBlockTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
					<xs:element name="targetOffBlockTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
					<xs:element name="targetStartupApprovalTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
					<xs:element name="targetTakeOffTime"
type="fb:DateTimeUtcType" minOccurs="0" maxOccurs="1" nillable="true"/>
					<xs:element name="taxiTime" type="fb:DurationType"
minOccurs="0" maxOccurs="1"/>
				</xs:sequence>
			</xs:extension>
		</xs:complexContent>
	</xs:complexType>
</xs:schema>
```

1. Objectives and Scope of the Guidance Document

The objectives and scope of this document are to provide guidance on the implementation of a Satellite Based Augmentation System (SBAS) to support APV/precision approaches (LPV minima) at an airport or several airports in a continent or region and some terminal and en route operations.

This document provides guidance to States when implementing SBAS, certifying SBAS installation and approving SBAS based service within the APAC region. Its material contained in this document is based on the experience of States in the region, ICAO documentation, and other publicly available material.

2. Executive Summary

The approach and landing at airports are critical stages of flight. In adverse weather conditions, navigation guidance to support an approach provides for an additional level of safety for the activity. An SBAS improves the position and timing provided by a core satellite constellation, delivering enhanced integrity, accuracy, continuity and availability. SBAS can provide geometric vertical guidance independent of QNH and temperature down to a Decision Height of 200 ft at the most rigorous performance requirements specified in ICAO Annex 10. It also enhances horizontal guidance. SBAS could replace or complement ILS at airports, and enable procedures with lower decision heights at airports without ILS. While these enhancements are most critical for approach and landing, they are present in all phases of flight including enroute and terminal operations. Furthermore, these types of approaches can also help in providing improved access to terrain challenged airports, where ILS cannot be installed due to sitting issues.

3. Roles and Responsibilities of Stakeholders

Stakeholders are responsible for providing a safe service with optimal community benefit. The stakeholders listed below have been identified:

- SBAS Operator and Maintainer – To operate and maintain the infrastructure used to generate and broadcast an SBAS signal in space to end users
- SBAS Aviation Service Provider – To provide SBAS services in a given area. (Note: The entity could be a State or group of States, regional organization, ANSP or a company. This could be the same as the SBAS Operator and Maintainer.)
- ANSP – To implement SBAS service into the ATM operations and ensure its continued safety.
- National Aviation Authority – Conduct activities as per ICAO/National/Regional Standards for SBAS service implementation
- Airspace Users – To operate aircraft safely using SBAS services
- Aerodrome Operators – To make use of SBAS services to enhance the efficiency of aircraft operations at the airport.
- Flight Procedure Design Organization –To design, review, and maintain instrument flight

procedures based on SBAS service in accordance with state regulations and ICAO standards, for validation and promulgation by the relevant authorities.

4. Performance Indicators

Performance indicators are quantifiable indicators obtained by measurements/statistics to show the performance or progress towards the intended result(s). Each state should consider establishing a set of performance indicators against which the performance of SBAS is evaluated under post-implementation review. Examples of performance indicators established by states in the region include:

- Conformance with accuracy, integrity, continuity, availability, and time-to-alert performance requirements as per ICAO Annex 10 for intended operations
- Status of Ground equipment such as Reference Station, Uplink Station, Mission Control Centre etc.
- Operational availability of the SBAS in ANSP's perspective under local environment
- Number of SBAS approach procedures published within the service coverage
- Number of SBAS approaches performed into the aerodrome
- Operation and Maintenance costs
- Enhancement in airport access
- Fuel saving and environmental benefit

5. Implementation Process

a. Overview

The SBAS is a Global Navigation Satellite System (GNSS) based airspace navigation system, intended to support enroute, terminal and Approach with Vertical guidance (LPV minima) operations. It consists of the SBAS satellites and ground-stations that augment core GNSS satellite constellation signals. The system uses the concept of differential corrections to augment the satellite constellation signal to provide the required integrity, continuity,accuracy, and availability to support intended operations, such as approach procedures with vertical guidance (APV).

The SBAS consists of three segments:

Ground Segment

The ground segment comprises a network of reference stations used to monitor signals from GNSS satellites over a vast area, region, or continent. Each ground reference station contains a GNSS receiver installed at a very accurately surveyed location. The receivers compare their range or distance to each satellite, obtained by processing the GNSS signals, to the range determined from the surveyed position of the receiver and the satellite's reported position. Any difference in the two values is reported to master stations for further processing.

Master stations process the data collected from the ground reference stations to generate corrections for

clock and position of each GNSS satellite and ionospheric delay, together with integrity parameters. This information together with SBAS satellite position information is sent to satellite uplink stations for transmission to SBAS satellites in the Space Segment, from which it is broadcast to users.

Space Segment

The space segment consists of the GNSS satellite constellations which transmit the ranging signals and orbital parameters. SBAS ground reference stations and airborne systems use these ranging signals to determine their position.

The space segment also includes the SBAS satellites which relay information generated by the Master stations (SBAS messages) to airborne receivers. The SBAS satellites for the L1 SBAS service are geostationary satellites. In addition, non-geostationary SBAS satellites may be used for the dual-frequency and multi-constellation SBAS. The rent of the payloads may be subcontracted from satellite operators, like Inmarsat.

Some SBAS satellites transmit GNSS ranging signals and therefore serve as additional navigation satellites for the constellation, improving system availability.

Like the core GNSS constellation satellites, SBAS satellites are also assigned Pseudo Random Noise (PRN) codes on which SBAS messages are sent. These codes are transmitted in SBAS messages to enable GNSS receivers to determine which satellite the information is coming from.

Initially 19 PRN codes (i.e. 120 – 138) were allocated to SBAS satellites. With the increasing number of SBAS systems in service and plans for development of new systems, it was recognised that the number of codes would need to be expanded. This was done with the publication of DO-229E, where an additional 20 codes (139 – 158) were made available for SBAS.

Airborne Segment

SBAS capable GNSS receivers on aircraft process the signals from the GNSS satellites and apply the corrections broadcast by the SBAS satellites to improve the accuracy of the estimated position. Airborne receivers also use information from the SBAS satellites to perform integrity checks on the aircraft's estimated position, and to calculate horizontal and vertical protection levels which are used to determine whether an intended operation (as defined in ICAO Annex 10) can be supported.

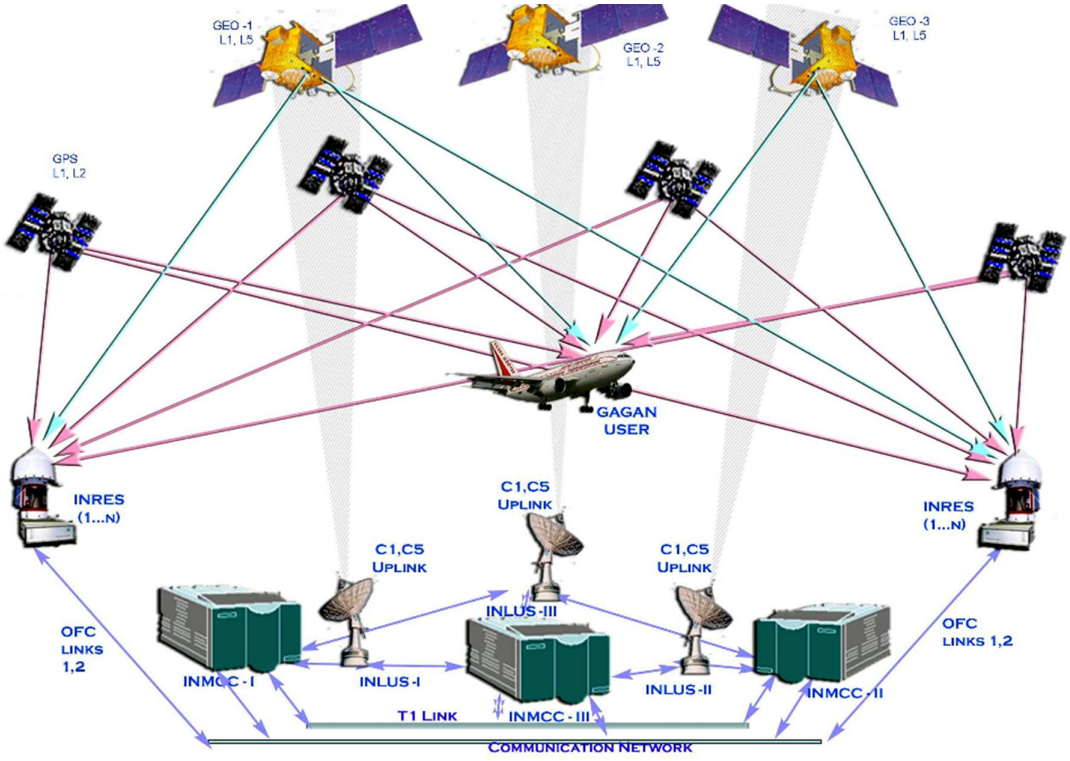
The improved performance allows the aircraft to conduct operations that require better navigation performance than the standard GNSS service can provide.

In addition to processing the GNSS signals, an SBAS capable receiver needs to receive and process the messages from the SBAS satellites. Not all GNSS receivers are SBAS capable. Standards for SBAS capable receiver are (E)TSO-C-145/146 based on RTCA DO-229D or later revisions

Technical Standard Order TSO-C145e/146e, which is based on DO-229E and includes the expanded code range, was published in May 2017. SBAS capable receivers manufactured to earlier TSOs will

only recognise the original range of PRN codes (i.e. 120 – 138). Hence these receivers will not process messages from SBAS satellites using PRN codes in the expanded range (i.e. 139 – 158).

Typical SBAS Architecture (GAGAN)



b. Framework, Phases and Elements of SBAS Implementation Process

i. Operational Need Analysis

When considering whether to implement an SBAS, it is important to consider how the SBAS will be used within the existing Air Traffic Management (ATM) environment and also the benefits that will deliver to the State and to other industries. This should be one of the first steps when deciding whether to implement SBAS. The analysis should involve a thorough examination of:

- existing navigation capability within the airspace including objectives, measurements of effectiveness, operational policies and constraints, existing capability description, modes of operation, and the existing support environment;
- the reasons for changing or supplementing the existing navigation facilities with an SBAS;
- concepts for the proposed SBAS capability including objectives, measurements of effectiveness, operational policies and constraints, proposed capability description, proposed modes of operation, integration issues within the existing ATM environment,

stakeholders and personnel interfaces and operational use cases;
- a high level of examination of the potential operational, safety and organizational impacts associated with implementing an SBAS; and
- a summary of the expected improvements, disadvantages, and limitations of implementing an SBAS, and alternative technologies.

The following provides examples of key considerations when performing the analysis:

- the design of SBAS procedures including whether the procedures intend to overlay existing approach procedures at the airport or are new procedures in their entirety;
- how the implementation of an SBAS aligns with the overarching navigation strategy for the state;
- industry desire for an SBAS installation;
- the level of performance/service proposed to be achieved by SBAS;
- the impact of implementing an SBAS on existing ATC procedures associated with instrument approach operations including any changes to pilot interactions, phraseology, and documentation;
- the application of proposed SBAS usage within the operational environment;
- the level of SBAS status monitoring to be provided to both ATS units and airspace users;
- what the envisaged technical support environment could look like including responsibility for maintenance and engineering support;
- different types of operational uses and expected responses under each use case;
- what additional training is required for staff to support the implementation of an SBAS capability;
- the limitations associated with implementing an SBAS within the State including aircraft capabilities (such as equipage rates, and compatibility), technology evolution, ionosphere limitations, and support capability; and
- alternative technologies available to deliver the desired capability.

ii. Cost-Benefit Assessment

The cost benefit assessment should be conducted as per following three cases of implementation of SBAS against the case without SBAS:

- Full SBAS implementation (Implementation Type A)
- Participating in existing SBAS system (Implementation Type B). By adding ground reference stations to improve the service area in a given area. Simulations of the service area should be launched with the existing SBAS system to ascertain the possibility of extension of service area.
- Utilizing existing SBAS service (Implementation Type C). A neighboring State fully or partly within the service area of an existing SBAS can take advantage of the SBAS service pending an agreement be signed between the SBAS Aviation Service Provider and the State.

In addition, a cost-benefit assessment should be performed to assess the viability, i.e. whether it is cost effective to implement an SBAS. The cost benefit assessment should consider:

- whole of life costs associated with SBAS implementation including acquisition, operation, maintenance, and disposal costs.
- whole of industry costs including costs associated with integration in existing ATM environment, staff training andequipping aircraft with the capability.
- identification of key benefits to be derived from the technology and translation into direct economic benefits.
- sensitivity analysis which takes into account the effect of uncertainty on key parameters and the overall effect on the Business Case. A key uncertainty specifically for SBAS is equipage rates of aircraft which would directly impact usability of the technology; and
- clear articulation of the assumptions used in the cost and benefits assessment and how these impact the Business Case.
- Identification of other non-aviation uses of SBAS and community benefits from the SBAS implementation.

There are three main benefit areas:

1. Increased network reliability –Due to possibility of Approach procedure with vertical guidance and reductions in decision heights, it may help in:

   - The increased operations to existing controlled and uncontrolled aerodromes from SBAS enabled lower approach minima and during unavailability of ILS system during maintenance or outages
   - Enabling improved access to aerodromes that do not have instrument approach procedures, by using SBAS enabled procedures
   - The positive safety impact of SBAS enabled LPV procedures at controlled aerodromes (LPV procedures are not dependent on signal broadcasted by ground equipment which could be damaged or signal could be interfered. Data integrity improvement as the Final Approach Segment is coded into a Data Block into the aircraft database with a high level of integrity through a CRC code, not dependent on QNH setting.)
   - Enhancement of performance-based navigation operations
   - Reduced costs by optimizing terrestrial radio navigation aids.
   - Possible benefits to unmanned aerial vehicle/remotely piloted aircraft system operations.
   - Recorded GNSS data in SBAS systems may be useful for accident/incident investigation.

   However, it may be advisable to retain some navigational aids to serve as a backup during periods when the SBAS is unavailable (e.g. due to RFI).

2. Reduced Incidence of Controlled Flight into Terrain (CFIT). SBAS provides enhanced vertical guidance allowing pilots to better understand their overall orientation relative to known hazards (enhanced situational awareness). By providing geometric vertical guidance, SBAS prevents QNH error setting which could occur during APV Baro. It can also enable the introduction of Approach Procedures with Vertical guidance at airports not otherwise equipped, this enhanced situational awareness means that pilots can land safely in different weather conditions and have a better understanding of their location with respect to the ground, reducing risks and incidents.

3. Increase in successfully completed rescue and medical flights, leading to reduced morbidity and mortality. The integrity of the signals, and the precision of vertical and horizontal positioning will allow rescue helicopters to operate in poor weather and remote locations. Emergency helicopter crews can make more accurate approaches, reach patients in challenging locations and weather conditions, and provide people with the medical treatment they need quickly.

iii. Technical Feasibility Assessment

The technical feasibility assessment should involve:

- an ionosphere threat assessment to quantify the effect of local ionospheric conditions on SBAS Integrity and Availability and whether local ionospheric conditions support the implementation of single frequency SBAS; DFMC could be one of the solutions if ionospheric conditions are such that a single frequency SBAS would not provide the required performance.
- an SBAS satellite performance assessment to assess SBAS satellite signal reception, multipath and interference;
- a desktop/simulator analysis against siting considerations to identify suitable locations where SBAS reference stations could be installed and their number; and
- Assessment of coverage and service area for the SBAS especially at the edges of the coverage and service area.

The following provides guidance in respect of various types of SBAS while performing the technical feasibility assessment as per ICAO Annex 10:

- Full SBAS implementation (Implementation Type A)

  - Satellite (transponder) deployment: SBAS satellite is usually hired from an outside agency called the satellite service provider which could be different from SBAS service provider or same. Each SBAS satellite may contain more than one navigation transponder with more than one SBAS Pseudorandom Noise (PRNs) code.
  - SBAS PRN coordination: SBAS Satellite Service provider agency should apply to US GPS PRN Coordination Office for a Pseudorandom Noise (PRN) code assignment for the SBAS satellite.
  - SBAS ID coordination: SBAS implementing agency should apply for Service Provider ID (SPID) to ICAO NSP Secretary.
  - Coverage and service volume: The SBAS coverage area corresponds to the union of transmitting satellite footprint areas. The SBAS service area is an area within the SBAS coverage where the signal performance meets the requirements for the intended operation. An SBAS system can have different service areas corresponding to different types of operation (e.g. APV-I, Category I-equivalent, etc.).
  - Service level: SBAS could be certified for various service levels like En-route, Terminal, LNAV, LNAV/VNAV, LP, LPV and CAT I-equivalent. Each service is associated with one unique value of Horizontal and Vertical Alert Limit (HAL and VAL) and time to alert.
  - Ground monitoring station siting: Ground monitoring station site is selected by conducting survey for obstruction, RF interference and multipath.
  - Master station and uplink station siting: The siting criterion for Master station and uplink station

should take into account the interference signal thresholds for qualifying the site.

- Robustness of communication link: Communication link is used for carrying data from reference station to master station in real-time and is crucial to ensure certified service level performance. Optical fiber and satellite link may be selected as primary and backup link to meet the Digital Communication Network (DCN) performance. The DCN should have sufficient availability, reliability, latency and redundancy to meet SBAS system performance requirements with no single point of failure.
- Maintainability aspect of the system: The SBAS system should have two types of maintenance capability i.e. Corrective & Periodic.

  - Corrective Maintenance Capability: - This capability describes the requirements for verifying anomalous conditions detected during nominal system operation, isolating faults to the LRU, supporting replacement of defective/faulty LRUs, restoring the component or equipment to full capability (including proper levels of redundancy), and performing required maintenance administration activities.
  - Periodic Maintenance Capability: - Periodic maintenance includes all mandatory activities performed on a routine or scheduled basis to maintain system performance, minimize service interruptions, and major system breakdowns, and extend the useful life of the equipment. The SBAS should be capable of supporting periodic maintenance activities without compromising either system operation or performance.

- Ionospheric impact study: Since ionospheric error is the dominant source of error in GNSS positioning, it becomes imperative to conduct study on ionosphere impact inside the service area of SBAS before deciding to provide SBAS services in that region. In general, ionospheric effects in mid-latitude regions are mild. In low-latitude regions, ionospheric effects are more severe. In high-latitude regions, ionospheric effects are more severe than in mid-latitude regions, but less severe than in low-latitude regions. In the DFMC SBAS, most of the ionospheric issues are addressed.

- Participating in existing SBAS (Implementation Type B)

  - Review of existing SBAS services: If coverage area of existing one or more SBASs is covering the area of interest of the concerned State/ANSP, then service area of the concerned SBAS may be extended by installing the SBAS reference station at the appropriate location.
  - Coordination with the SBAS provider: To install reference stations and to integrate with the existing SBAS, coordination with the concerned service provider is essential. However, each State is responsible for approving SBAS operations within its airspace. SBAS service provider will be responsible for NOTAM proposals to the appropriate Aeronautical Information Service providers of the State willing to implement SBAS based services.
  - Coverage and service volume: Same as given above for Type A scenario.
  - Service level: Same as given above for Type A scenario.
  - Ground monitoring station siting: Same as given above for Type A scenario.
  - Robustness of communication link, ensuring acceptable availability as a part of technical feasibility study: Same as given above for Type A scenario.
  - Maintainability aspect of the system: Same as given above for Type A scenario.

- Ionospheric impact study: Same as given above for Type A scenario.

- Utilizing existing SBAS service (Implementation Type C)

  - Review of existing SBAS services: If the service area of existing one or more SBASs is covering the area of interest of the concerned ANSP, then this approach may be adapted.
  - Coordination with the SBAS provider: Same as Type B above.
  - Coverage and service volume: Same as given above for Type A scenario.
  - Service level: Same as given above for Type A scenario.
  - Available services: The State/ ANSP who desires to implement SBAS services in its region, may conduct quantitative & qualitative analysis to ascertain the coverage of APV & RNP service and subsequently and certify the service accordingly in their airspace.

iv. Concept of Operations (CONOPS):

A Concept of Operations (CONOPS) is a description of the characteristics of the service from the users' (such as airline staff and air traffic controllers) perspectives. CONOPS should state the goals, strategies, policies and constraints affecting the service. It should include a clear statement of responsibilities of involved participants and stakeholders. Chapter 7.3 in ICAO Doc 9849 GNSS Manual provides reference about the elements, considerations and stakeholders involved for the development of CONOPS.

Based on the outcome of the three phases listed above i.e., Operational Need Analysis, Cost-Benefit Assessment and Technical Feasibility Assessment, a State may decide to introduce SBAS based operation at its airports. The outcome of analysis should culminate in the development of a Concept of Operations (CONOPS) document that is distributed to all potential stakeholders including however not limited to ATC operations, aerodrome operator, airline operators, airspace management, regulatory authority, maintenance, safety, and procedures design. The Concept of Operations is a useful document to enable all stakeholders to understand how the SBAS will be used within the existing ATM environment and the development of Operational Requirements.

State should form an SBAS Implementation Team comprising of members from the regulatory and service provider organizations as well as user representatives including however not limited to the regulatory authority, ATC operations, aerodrome operator, airline operators, airspace management, aeronautical information services, maintenance, safety, and procedures design. Getting aircraft manufacturers in this team would also be helpful. A wide cross section of participants can provide strategic guidance and detailed recommendations on SBAS implementation.

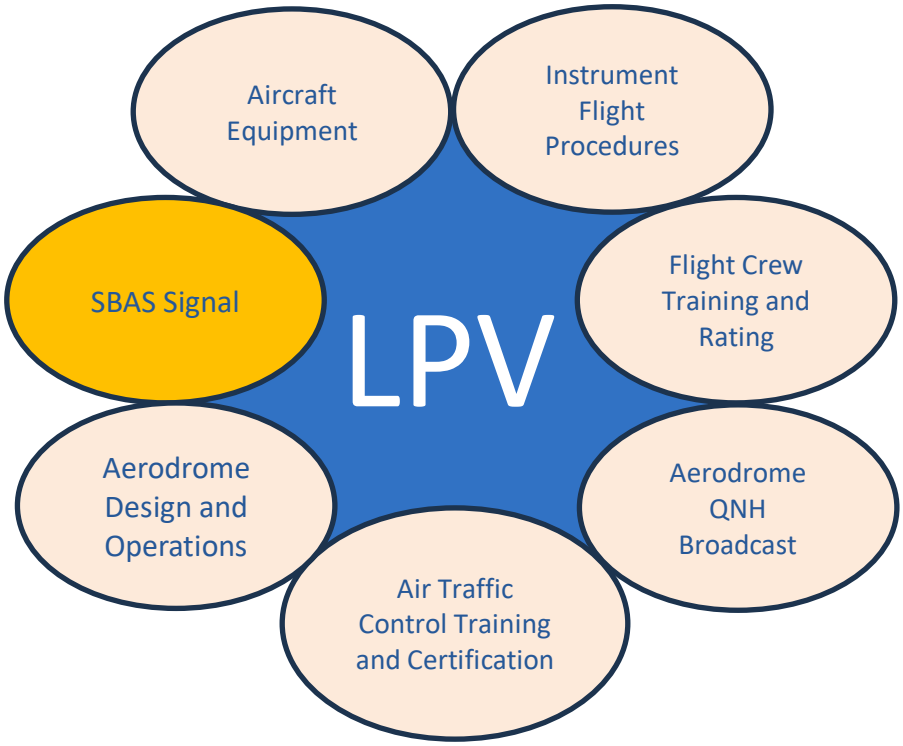
v. SBAS Solution Selection

For those States where the use of SBAS has been determined to be beneficial, the next step is to determine which runways/airspace should be prioritized for the implementation of the SBAS procedures. The following aspects may be considered:

1. Runways, where ILS is not feasible.

2. As a back up to ILS on runways equipped with ILS.
3. Heliports for SBAS based point in space (PinS) procedure for Helicopters.
4. En-route operations, namely RNP 0.3 en-route for helicopters, where SBAS can be used without RAIM.

Typical requirement for Implementation of an SBAS(LPV/250/200) procedures



ATC Procedure Development

When deploying an SBAS it is important that States consider changes to existing practices for ATC and procedures design staff. The following provides guidance on key areas to consider with the introduction of an SBAS:

- any changes to the information provided to pilots
- any information about predicted LPV unavailability to be provided to ATCOs
- any changes to existing documentation including any local instructions or training documentation.
- changes to ATC Human Machine Interfaces

Development of SBAS (LPV) Approach procedures:

SBAS (LPV) Instrument Flight Procedures are designed as per the provisions of DOC 8168 VOL II and ICAO PBN manual DOC 9613 by authorized procedure designer with latest survey reports and Obstacle

& Terrain data. The two key outputs of the Procedures Design process are the corresponding Approach Chart and Final Approach Segment (FAS) Data Block. The FAS Data Block contains the information detailed within ICAO Annex 10, Volume 1 defining the final approach path. Validation of the parameters contained within the FAS Data Block is critical to assuring the safety of the approach. Ground validation should be conducted to ensure that there is no significant error in the FAS DB. Flight Validation may be carried out for each instrument flight procedure either on a simulator or actual flight. This process from collecting obstacle data to publication of the procedure can take one year or more. It is suggested to appoint a national coordinator to follow up the planning of LPV procedures in one country.

Ground testing and flight test/inspection –

As per ICAO Manual on Testing of Radio Navigation Aids (Doc8071), there are two steps :

- Ground testing : Check data accuracy of FAS
- Flight test/inspection : Flight-testing/inspection of the GNSS and SBAS signals-in-space is not required. Flight test is concerned with:
  — validation of RNAV instrument flight procedures;
  — verification of adequate SBAS support for the specific procedure; and
  — testing for interference.

Since the implementation of SBAS flight procedures has already been covered in those ICAO manuals mentioned above, additional operational trial is considered non-essential. However, ANSP may consider conducting operational trial of SBAS procedures for familiarizing pilots, air traffic controllers and engineers with this relatively new technology in the APAC region.

vi. Safety Assessment

The Safety Assessment and Certification process should show that the Service provided will be acceptably safe during and after the SBAS implementation. The Safety Assessment process should comprise of two key components:

- System Safety. This should demonstrate that the system as designed and operated in accordance with approved practices is safe. Previous certification may allow States to leverage the existing certification evidence to expedite the System Safety assessment process. This Safety Case will be provided by the company who has developed the SBAS system and also by the operator of the SBAS system. Demonstration of Annex 10 performance requirements is essential.
- Service Safety. This should demonstrate that the Certified System installed within the local ATM environment will be acceptably safe.

vii. System Certification

Early engagement with the regulator on the approach to certification and the level of regulatory involvement in certification activities is critical to achieving a successful outcome. There are three stages in System Certification

- System Approval: System approval basically involves approving the design of the equipment. It spans activities ranging from Requirements Planning, System Acquisition, System Baseline, System Safety Assurance, etc.
- Facility Approval: This phase deals with the activities related to Equipment Installation & Approval of Installation. Typical activities which are part of this phase are Site Survey (RF & Multipath), Installation, conduct of SAT, Final System Integration Test, OT&E (Operational Test & Evaluation).
- Service Approval: This phase includes activities which lead to commissioning of the system. Basic activities like Aeronautical Survey, Flight Procedure Development, establishment of SBAS NOTAM system, Radio Frequency Interference Detection and Mitigation, Flight Inspection, Flight Procedure Approval, and publication of the same as per AIS process.

The key elements of the certification argument should comprise of:

- Concept Defined. Demonstration the concept of operations has been adequately defined and documented. This should address the question of how the SBAS will integrate and operate within the states Air Traffic Management System.
- Safety Assurance. Demonstration that safety assurance activities have been conducted for the system as a whole and that identified hazard controls have been incorporated into the design and implementation.
- Design and Implementation. Demonstration that the system has gone through adequate system design and implementation process. Demonstration that the design and implementation meet legislative requirements and conforms with relevant ICAO SARPs.
- Support Systems. Demonstration that the necessary sustainment systems are in place, which are adequately defined with acceptable controls in place to reduce the level of risk to an acceptable level.
- Operational Testing. Demonstration that Operational Testing has been adequately defined, completed and that the level of risk is acceptable. Any lessons learnt from Operational Testing have been integrated into operations.

viii. Development of Regulations Related to SBAS for Aviation

Regulators, service providers and aircraft operators should all ascertain that an SBAS based operation is safe before it is introduced. This requires a systematic use of engineering and management tools to identify, analyze and mitigate hazards during all phases of the system's life cycle. The process is defined as a given task to be performed by a combination of people, procedures, technologies (hardware and software) and data within a given environment.

It is a state's responsibility to authorize SBAS operations in its airspace and to specify any limitations on proposed operations.

It is necessary to have a collective understanding among all the relevant aviation stakeholders regarding the SBAS implementation and SBAS based services/procedures being utilized in civil aviation.

Regulations related to SBAS in civil aviation:

- SBAS should be certified by the State's regulatory authority, where applicable. In addition, SBAS procedure(s) should not be used for civil aviation unless approved by the State's regulatory authority, where applicable.
- The flight manual covering SBAS use for various phases of flight operations should be approved by the State's regulatory authority, if applicable.
- Aircraft operators should not utilize the SBAS based service/procedure unless the avionics requirement in terms of SBAS receiver equipage, pilot training requirements etc. are being met, as prescribed by the regulatory authority of the State.
- On-board SBAS receiver should be certified by the regulatory authority of the State.
- The SBAS service provider should carry out system checks and operational performance monitoring on a continuous basis. Reports in respect of accuracy, integrity, availability, and continuity should be prepared and shared with the regulator periodically. Any major degradation in service or breach of terms and conditions may lead to withdrawal/cancellation of certificate/approval.
- The State should also develop the approval and withdrawal process for SBAS based services/procedures.

The phased approach described below may be used for certification:

- Phase One: Pre-Application. The SBAS Operator and Maintainer or SBAS Aviation Service Provider should convene a meeting with the regulator (pre-application meeting) to ascertain all the requirements to be met, during the approval process.
- Phase Two: Formal Application. The operator should submit the formal application to the regulator, accompanied with all the relevant documentation.
- Phase Three: Review of Documentation. The regulator should evaluate the documentation to determine their conformance with ICAO SARPs and national regulations. As a result of this review and evaluation, the regulator may accept, suggest certain changes, or reject the formal application along with the documentation.
- Phase Four: Inspection and Demonstration. The regulator should carry out the physical inspection of SBAS facility and demonstration of intended capability including simulator and/or flight trial, if required. Once the regulator accepts or approves the changes made based on documentation review and the satisfactory outcome of Inspection and Demonstration, the relevant stakeholders should:

  - provide the respective training to its personnel
  - implement the operational demonstration.

- Phase Five: Approval. Once all the steps have been completed satisfactorily, the regulator should issue the relevant approval.
- Phase Six: Post-Implementation Review. The Post-implementation review should be carried out and the system and operational performance should be monitored on a regular basis. Reports in respect of accuracy, integrity, availability, and continuity should be prepared and shared with the regulator periodically. Any major degradation in service or breach of terms and conditions may lead to withdrawal/cancellation of certificate.

Requirement for new SBAS Service Providers

- Any new SBAS wishing to broadcast SBAS must register and obtain approval from the ITU and coordinate frequencies with other countries.
- PRN codes for SBAS satellites must be allocated in coordination with US.
- A new SBAS provider identifier must be obtained from ICAO.

ix. Training

The introduction of SBAS in any State represents a significant change for aviation, so it requires innovative approaches to regulation, provision of services and operation of aircraft, and personnel training is the key for the success of implementation. A Training Needs Analysis should be completed by the States to identify the training needs for all stakeholders involved in the operation, use and maintenance of the SBAS. Stakeholders included in the analysis include ATC staff, regulatory authorities, maintenance staff, engineering staff, pilots, and procedures designers. The Training Needs analysis should:

- identify the impact of SBAS implementation to the stakeholder and a determination of any delta training required;
- include an analysis of the skills and knowledge required to operate and/or maintain the SBAS; and
- include training resources, methods, and delivery requirements.

The following provides examples of training delivered for SBAS by some States:

- General Awareness training. General awareness involves training on the overview of GNSS and augmentation systems, principles of operation of an SBAS, differences between an ILS and SBAS based precision approach, the limitations, and advantages of an SBAS, and should be provided to all stakeholders.
- ATC. ATC staff should be provided with a briefing on the SBAS, changes to local instructions as a result of the introduction of an SBAS, changes to the information contained within a Flight Plan, any changes to endorsements/ratings, interpretation of SBAS monitoring indications, and training on any new systems introduced to support delivery of an SBAS-based approach capability.
- Regulators. Regulators should be provided with general awareness training and training pertaining to applicable SARPs for updating the regulation to include SBAS operations.

- Maintenance. Staff responsible for maintaining the SBAS should be provided with training on the fundamental principles of operation of an SBAS, specific equipment, operation of the equipment and maintenance practices for the equipment including routine maintenance activities to be performed and procedures for investigating of faults and failures. States may elect to develop aset of SBAS competency criteria against which the competency of maintenancestaff would be assessed.
- Engineering. Staff responsible for Engineering Management of the SBAS should be provided with training on advanced SBAS concepts, configuration management of the SBAS, and complex fault detection, resolution and analysis.
- Pilot. Pilot training will be driven by the airline and specific aircraft type. Pilot training may involve a different course between SBAS and ILS and corresponding simulator training.
- Procedures Design. Instrument Flight Procedure Designers may be provided with supplementary training on the differences between SBAS and ILS and information contained within a Final Approach Segment (FAS) data block.

X. Operation Certification

Certification and approvals for operation should be obtained before it can be put into operation.

Certification for SBAS Service Providers:

- As an SBAS service provider, the SBAS service provider should be confirmed to be in conformance with SARPs Annex 10 and should obtain approval.

Operational approval for Airlines:

- Airlines need to consult their national authority for operational approval requirements.

Xi. Post-Implementation Review

Subsequent to the Commissioning of an SBAS installation and after an appropriate period of operation States should consider conducting a Post Implementation Review. The Post Implementation Review should be conducted with the following objectives:

- It should provide assurance that the residual safety risks associated with the operation of the SBAS continue to be managed effectively.
- It should ensure that lessons learnt from the initial operating period are captured.
- It should be able to identify any issues experienced and remedial action to address those issues.
- It should ensure that any outstanding tasks for activities within the Safety Case have been appropriately addressed.
- It should validate that assumptions are still applicable.

The Post Implementation Review should involve the review of:

- Service Requirements and whether the SBAS has met those ServiceRequirements
- operational practices for the SBAS
- implementation process and areas for improvement
- hazards associated with the operation of the SBAS and whether existing risk assessments remain valid
- any occurrences or system related issues
- any safety related issues
- whether the safety benefits envisaged from the implementation of the SBAShave been met

6. Post-Implementation Activities

a. Operation and Maintenance Activities

Operation and Maintenance Activities are provided through an Operations and Maintenance Subsystem (OMSS). The Operations and Maintenance Subsystem provides an interface through which the controller/maintenance personnel access all the subsystems of SBAS for monitoring and controlling. This subsystem displays the operational status of the SBAS and also generates the event messages for various activities taking place within the system. These event messages provide information/warning/alerts, on corrective actions to be taken by maintenance personnel, if necessary. OMSS allows the maintenance personnel to configure the various subsystems in the SBAS including updating GEO and earth orientation parameters (EOP), to be used by the system.

b. Performance Indicators

States should assess the performance of the SBAS against the Performance Indicators established on a regular basis during the implementation and post-implementation phases. States may also regularly review the effectiveness of performance indicators established in evaluating the performance of SBAS.

c. Promulgation of Information in AIP

The information regarding implementation of SBAS and description of SBAS based services or approaches should be promulgated in State Aeronautical Information Publication (AIP).

d. Status monitoring and NOTAM

States should continuously monitor for changes to the satellite constellation and assess the impact of constellation changes on the performance of the SBAS, specifically on availability. Moreover, Air Navigation Service Providers (ANSP) are responsible for monitoring and reporting the status of navigation services. To support this requirement, navigation service providers should provide status information to ATS. If the status of a navigation service changes, pilots should be advised via direct

communications and/or via a NOTAM system.

Appendix 1 – Terminologies and Definition

ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
CAT-I	Category I
CONOPS	Concept of Operations
FAS	Final Approach Segment
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
LRU	Line Replaceable Unit
RNAV	Area Navigation
RNP	Required Navigation Performance
SARPs	Standards and Recommended Practices
SBAS	Satellite Based Augmentation System

[To be finalised]

– – – – – – – – – – – – –

Appendix 2 – Reference

1. *Relevant ICAO documents covering different aspects in SBAS implementation:*
   - a. *Global Strategy – Global Air Navigation Plan (Doc 9750)*
   - b. *Regional Strategy – Asia/Pacific Seamless ATM Plan*
   - c. *General Concept - Global Navigation Satellite System (GNSS) Manual (Doc 9849)*
   - d. *System Requirements and Testing*
     - i. *Annex 10 Vol I – Radio Navigation Aids*
     - ii. *Doc 8071 Vol II – Testing of Satellite-based Radio Navigation Systems*
   - e. *Procedure Design and Validation*
     - i. *Doc 8168 Vol II – Construction of Visual and Instrument Flight Procedures*
     - ii. *Doc 9906 Vol V – Validation of Instrument Flight Procedures*
   - f. *Operation*
     - i. *Doc 8168 Vol I – Flight Procedures*
     - ii. *Doc 9613 – PBN Manual*
     - iii. *Doc 9849 – GNSS Manual*
     - iv. *Doc 4444 – Air Traffic Management*
     - v. *Doc 9365 – Manual of All-Weather Operations*
     - vi. *Doc 9734 – Safety Oversight Manual*
     - vii. *Doc 9859 – Safety Management Manual*
   - g. *Ionosphere*
     - i. *SBAS Safety Assessment Guidance Related to Anomalous Ionospheric Conditions (APAC)*
     - ii. *Ionospheric Effects on GNSS Aviation Operations (ICAO NSP)*
   - h. *Miscellaneous*
     - i. *Presentations at GBAS/SBAS Implementation Workshop (Seoul, Republic of Korea, 3 – 5 June 2019)* (https://www.icao.int/APAC/Meetings/Pages/2019-GBAS-SBAS-.aspx)

2. *Relevant documents published by international organizations / States / Administrations relevant to SBAS implementation:*
   - a. *RTCA DO-229F - Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment*

– – – – – – – – – – – – –

Appendix 3 – Experience Sharing by States/Administrations

(a) GAGAN – Indian SBAS

Satellite Based Augmentation (SBAS)
-GAGAN in India

1. Introduction

All navigation and approach aids (NAVAIDs) must meet the requirements of accuracy, continuity, availability and integrity specified to each phase of flight.

As the air traffic flow increased, the conventional NAVAIDs were not able to provide the flexibility in airspace to absorb this growth fitting the needs of the requirements referred so above.

The development, initially by the United States, of a global system providing positioning and timing services allowed the introduction of an alternative to those conventional NAVAIDs with the possibility of using new concepts in air navigation capable of satisfying the new needs of the aeronautical community.

As the development of new concepts and systems occurred, the International Civil Aviation Organization (ICAO) introduced the Global Navigation Satellite System (GNSS), which allows navigation in all phases of flight and precision approach and, according to Volume 1 of Annex 10 to the Convention on International Civil Aviation (from here on referred to as Annex 10, vol.1), is comprised by:

I. Global Positioning System (GPS) that provides the Standard Positioning System (SPS);
II. Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA);
III. Galileo that provides a single- and dual-frequency Open Service (OS);
IV. BeiDou Navigation Satellite System (BDS) that provides the BDS Open Service (BDS OS);
V. Aircraft-based augmentation system (ABAS);
VI. Satellite-based augmentation system (SBAS)
VII. Ground-based augmentation system (GBAS);
VIII. Ground-based regional augmentation system (GRAS)
IX. Aircraft GNSS receivers.

The list above presents position generation systems (the core constellations), receivers (with these two groups always present in navigation), and augmentation systems, which will be present when the core constellations cannot support alone the requirements for the phase of flight.

2. Global Navigation Satellite System (GNSS)

As was briefly presented in the introduction, GNSS comprises the core constellations (GPS, GLONASS, Galileo & BDS), ABAS, GBAS, SBAS, GRAS and GNSS receivers.

In order to increase the understanding of SBAS and put it into the GNSS context, it is important to describe the other components of the system.

2.1. Core Satellite Constellations

This is, together with the receivers, the basic part of the GNSS. According to ICAO Annex 10, four core satellite constellations have Standards and Recommended Practices (SARPs) incorporated: the GPS from United States of America, GLONASS from the Russian Federation, Galileo from European Union and BDS from China.

The core constellations have the capability to provide accurate position and time information worldwide. The accuracy provided by these systems meets aviation requirements for en-route through non-precision approach, but not the requirements for precision approach.

Considering the importance of the core constellations, according to Annex 10, any change in the SARPs that requires the replacement or update of GNSS equipment require a six-year advance notice. Similarly, a six-year notice is required of a core or augmentation system provider who

plans to terminate the service provided.

2.2. GNSS Receivers

A GNSS receiver consists of an antenna and a processor which computes position, time and, possibly, other information depending on the application. Measurements from a minimum of four satellites are required to establish three-dimensional position and time. Accuracy is dependent on the precision of the measurements from the satellites and the relative positions (geometry) of the satellites used.

2.3. Augmentation Systems

Even though the core constellations and the receivers can provide accuracy, continuity, availability and integrity to meet from en-route to non-precision approach (NPA) requirements, for precision approach and procedures that require a greater degree of accuracy or integrity, it is necessary to have some source of augmentation for these parameters.

The augmentation systems that are listed in Annex 10 SARPs are ABAS, SBAS GBAS & GRAS.

2.3.1. Satellite-Based Augmentation System (SBAS)

An SBAS augments core satellite constellations by providing ranging, integrity and correction information via geostationary satellites. The system comprises:

a) a network of ground reference stations that monitor satellite signals;
b) master stations that collect and process reference station data and generate SBAS messages;
c) uplink stations that send the messages to geostationary satellites; and
d) transponders on these satellites that broadcast the SBAS messages.

2.4. GAGAN – Indian SBAS

GAGAN (GPS Aided GEO Augmented Navigation) is an Indian Space Based Augmentation System (SBAS) jointly developed by ISRO and AAI to provide the best possible navigational services over Indian FIR (Flight Information Region) with the capability of expanding to neighboring FIRs.

GAGAN is a system of satellites and ground stations that provide GPS signal corrections, giving better position accuracy.

GPS alone does not meet the ICAOs navigational requirements for accuracy, integrity and availability. GAGAN corrects for GPS signal errors caused by Ionospheric disturbances, timing and satellite orbit errors and also it provides vital information regarding the health of each satellite.

GAGAN provides augmented information for the GPS signals to enhance the accuracy and reliability of position estimates.

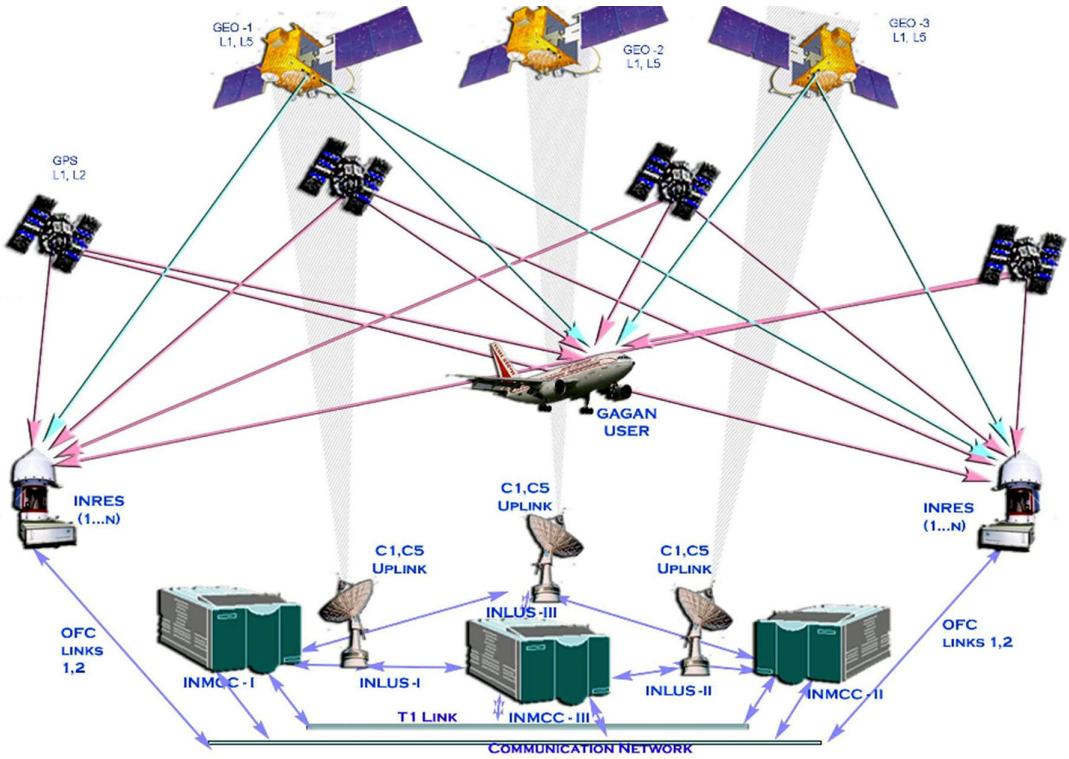
Airports Authority of India (AAI) in collaboration with Indian Space Research Organisation (ISRO) has developed the Indian SBAS called GPS Aided GEO Augmented Navigation (GAGAN) System to improve the accuracy, integrity and availability of GPS signals. GAGAN allows use of GPS as the aviation navigation system, from take-off through APV-I approach. GAGAN is a critical component of the AAI's strategic plan to establish a seamless satellite navigation system for civil aviation for enhancing capacity and safety. GAGAN provides a civil aeronautical navigation signal consistent with International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) as established by the Global Navigation Satellite System (GNSS) Panel.

The GNSS satellites' data is received and processed at widely dispersed Indian Reference Stations (INRESs), which are strategically located to provide coverage over the required service volume. Data is forwarded to the Indian Master Control Center (INMCC), which processes the data from multiple INRESs to determine the differential corrections and residual errors for each monitored satellite and for each predetermined Ionospheric Grid Point (IGP). Information from the INMCC is sent to the Indian Land Uplink Station (INLUS) and uplinked along with the Geostationary Earth Orbit (GEO) navigation message

to the GAGAN GEO satellite. The GAGAN GEO satellite downlinks this data via two L-band signal frequencies (L1 and L5), with Global Positioning System (GPS) type modulation. The INRES, INMCC, and INLUS communicate via a Data Communication Subsystem (DCSS).

The GAGAN system is a safety-critical system consisting of the equipment and software that augments the GPS SPS. The GAGAN system provides a Signal-In-Space (SIS) to GAGAN Users to support RNP 0.1 and APV-I phases of flight. GAGAN users include all aircraft with approved SBAS avionics using the GAGAN SIS for any approved phase of flight.

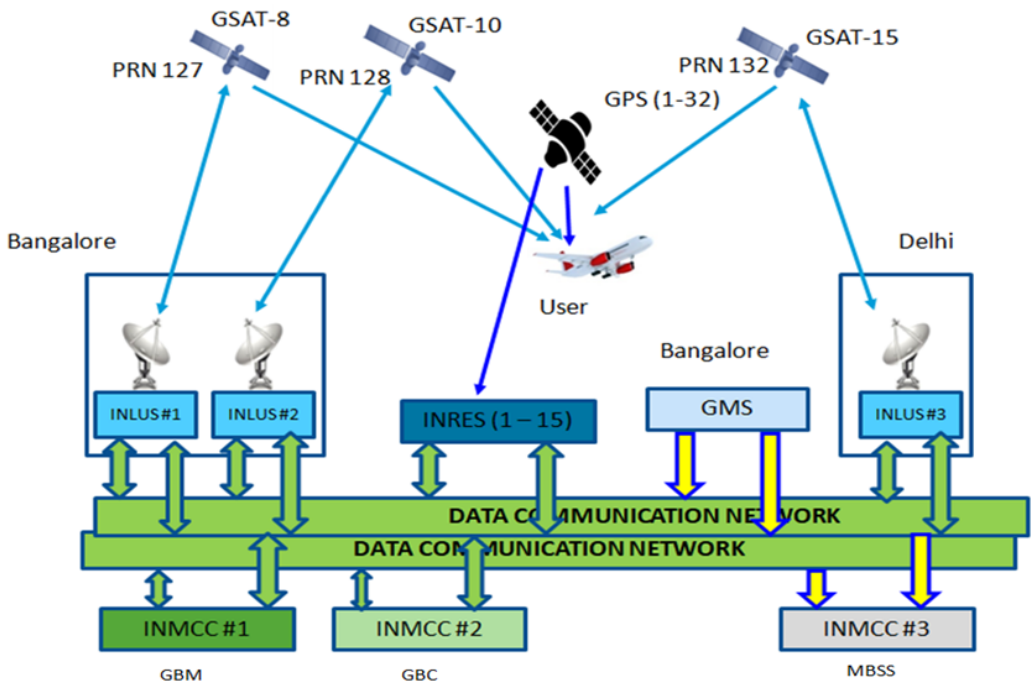
GAGAN system's architecture has two segments, one is ground segment and the other is space segment. At present the ground segment consists of 15 reference stations spread all over India and two master control centres and one MBSS (Minimal Basic Shadow System – INMCC-III). These 15 reference stations are stationed at various fixed positions which receive GPS signals. The locations of reference stations are precisely chosen by the survey so that any errors in the received GPS signals can be detected.



The GPS information collected by these 15 reference stations is forwarded to the INMCC by redundant terrestrial networks. At INMCC, GPS information is processed, and correction (augmentation) messages are generated.

These correction (augmentation) messages are sent to INLUS (Indian Land Uplink Station) which further uplinks them to three geostationary communication satellites GSAT-8, GSAT-10 and GSAT-15.

The GEO satellites broadcast these correction messages on a GPS like signal.



2.4.1. Certified GAGAN SIS Performance

GAGAN has been certified for two types of operations i.e., RNP 0.1 & Approach operations with vertical guidance (APV-I).

GAGAN's RNP 0.1 service has the following characteristics:

Parameter	**Value**
Horizontal Accuracy (95%)	72m
Vertical Accuracy (95%)	N/A
Integrity (per hour)	$1\text{-}1x10^{-7}$
Time-to-alert	10s
Continuity (per hour)	$1\text{-}1x10^{-4}$
Availability over Indian FIR	>99%
Vertical Alert Limit	N/A
Horizontal Alert Limit (185.2m = 0.1NM)	185.2m

GAGAN's APV-I/ service has the following characteristics:

Parameter	**Value**
Horizontal Accuracy (95%)	7.6m
Vertical Accuracy (95%)	7.6m
Integrity (per approach)	$1\text{-}2x10^{-7}$
Time-to-alert	6.2s
Continuity (over any 15 seconds)	$1\text{-}8\times10^{-6}$
Availability over 76% of the Indian land mass excluding the period of solar storms on nominal days	99%
Vertical Alert Limit	50m
Horizontal Alert Limit	40m

On stormy days, APV-I/ service will be degraded.

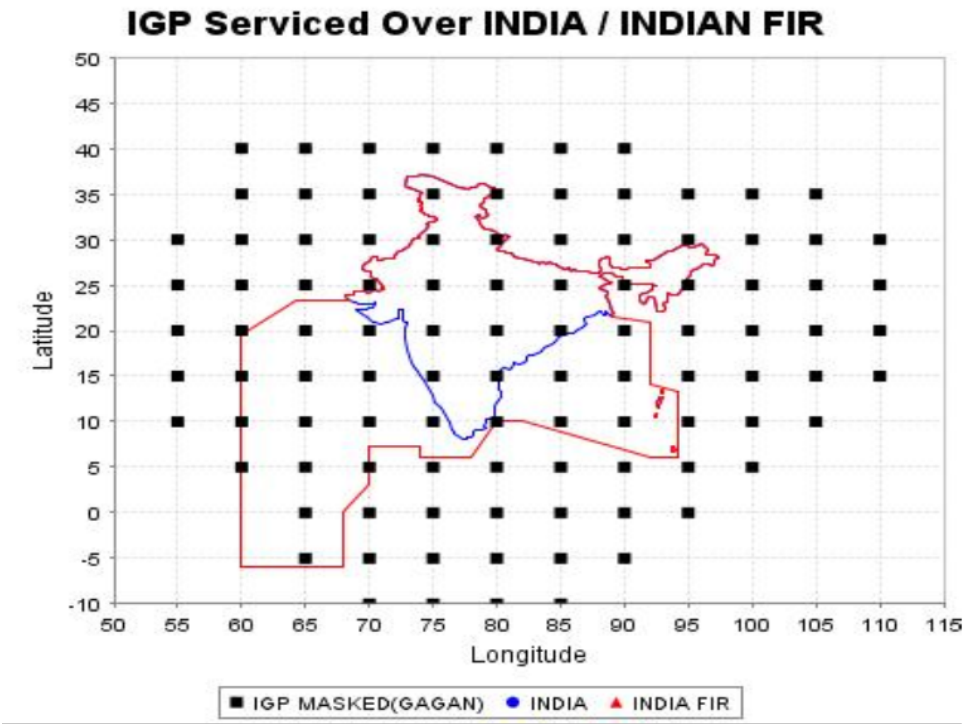
When measuring the APV-I performance parameters, the following rules apply:

1. Epochs (the entire period for all of India) which experience solar storms do not count against the availability requirement.
2. Nominal days are defined as days when the max chi^2 statistic is less than 3.
3. Solar storms are defined to be present when the GAGAN storm detector trips.

Actual Horizontal as well as Vertical position accuracy (95%) of GAGAN is better (around 1-2 meters) than certified accuracy.

2.4.2. IGPs Serviced by GAGAN

Ionospheric corrections are being provided for total 102 IGPs by GAGAN distributed across three Ionospheric Mask Bands i.e., 5, 6 & 7. Figure below shows the IGPs served by GAGAN over Indian FIR region.



2.5. DGCA Certification of GAGAN

Ionospheric corrections are being provided for total 102 IGPs by GAGAN distributed across three Ionospheric Mask Bands i.e., 5, 6 & 7. Figure below shows the IGPs served by GAGAN over Indian FIR region.



सत्यमेव जयते

GOVERNMENT OF INDIA
OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
DGCA COMPLEX, OPP. SAFDARJUNG AIRPORT, NEW DELHI-110 003

CERTIFICATE
Air Navigation Services Provider Certificate

No. ANS 2015/001

In exercise of the powers delegated under SO-727 E and part XII-A of the Aircraft Rules, 1937 notified on 14th January, 2015, this certificate is hereby issued to ***Airports Authority of India*** *by* ***The Director General of Civil Aviation***

Certifying the

GPS Aided GEO Augmented Navigation (GAGAN) System

for

Navigation Performance level of Approach with Vertical Guidance (APV-1) over India
&
Required Navigation Performance (RNP 0.1) within Indian Flight Information Regions

for a period not exceeding 60 months from the date of issue. This authorizes the certificate holder to provide the facility to operate as navigational aids to support air traffic services to all users on equal terms and conditions.

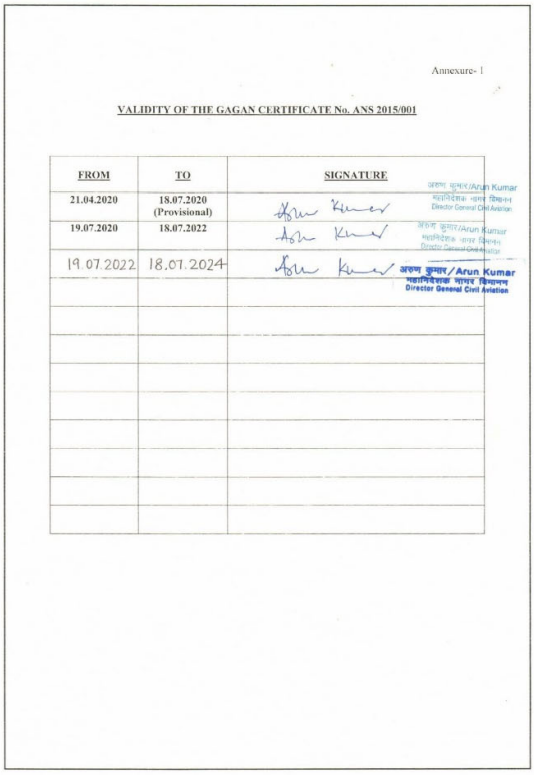
The certificate is liable to be suspended/ modified/ withdrawn or subject to any limitations or conditions, if any violation of the provisions of the Aircraft Act 1934 & the Aircraft Rules 1937, or any order/ direction/ requirements issued under the said Act/ Rules is observed.

This certificate is non-transferable.

Place : New Delhi
Date of Issue: 21.04.2015

CIVIL AVIATION DEPARTMENT

Director General Civil Aviation



Annexure- I

VALIDITY OF THE GAGAN CERTIFICATE No. ANS 2015/001

FROM	TO	SIGNATURE
21.04.2020	18.07.2020 (Provisional)	
19.07.2020	18.07.2022	
19.07.2022	18.07.2024	अरुण कुमार/Arun Kumar महानिदेशक - नागर विमानन Director General Civil Aviation

The details on GAGAN system are published in *ENR 4.3 – GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS)* of e-AIP India.

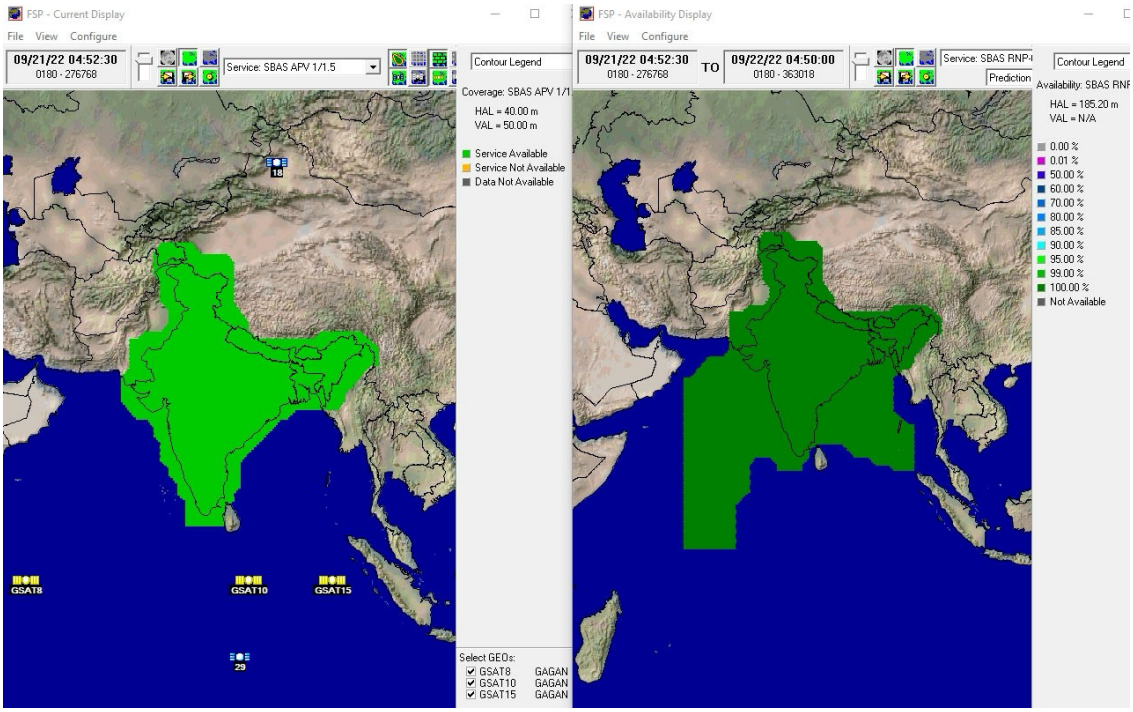
ENR 4.3 Global Navigation Satellite System (GNSS)			
Name of GNSS element	Frequency	Coordinates Nominal SVC area Coverage area	Remarks
GAGAN	L1=1575.42 MHz L5=1176.45 MHz	RNP 0.1: 99% of time over 100% of Indian FIR APV 1: 99% of time over 76% of Indian Landmass	Subject to availability of at least one GAGAN GEO Satellite

2.6. GAGAN Performance

The GAGAN is designed to achieve a performance level of APV 1.0 over the Indian land mass and RNP 0.1 over the oceanic region, within the Indian Flight Information Region (FIR).

APV-1 Performance

RNP 0.1 Performance



2.7. GAGAN Enabled Receivers

GAGAN signals are compatible with other Satellite Based Augmentation Systems like Wide Area Augmentation System (WAAS) of USA, Multi-satellite Augmentation System (MSAS) of Japan & European Geostationary Navigation Overlay Service (EGNOS) of Europe making all the systems interoperable.

To ensure global compatibility in civil aviation, the use of radio navigation aids is governed by the ICAO (International Civil Aviation Organization) Standards and Recommended Practices (SARPs). One of the most important requirements was to ensure that any properly equipped aircraft could benefit from these regional systems by installing a single receiver. RTCA Inc has developed the Minimum Operational Performance Standards (MOPS) for SBAS equipment. The main reference document is DO-229 version C/D. This document describes the standards for all GAGAN/EGNOS/WAAS/MSAS receivers. Receivers complying with these requirements, as determined by the appropriate Technical Standard Order (TSO) provide full GAGAN/EGNOS/WAAS/MSAS compatibility.

2.8. Development of SBAS (LPV) Approaches

SBAS(LPV) Instrument Flight Procedures are designed as per the provisions of DOC 8168 VOL II and ICAO PBN manual DOC 9613 by authorized procedure designer using automation tool with latest survey reports and Obstacle & Terrain data.

2.8.1. Data requirement and acquisition for Procedure Design

Current and complete survey data and information is crucial to the design of a safe IFP. Procedure designer collects from recognized sources, validate for resolution, integrity, reference geodetic datum and effective dates.

The obstacle survey for procedure design, the IFP designer should consider that:

a) All obstacles be accounted for. Items, such as trees and heights of tall buildings should be accounted for either by physical examination of the site or by addition of a suitable marginabove terrain contours; and

b) The accuracy of the vertical and horizontal data obtained may be adjusted by adding an amount equal to the specified survey error to the height of all measured obstructions and by making a corresponding adjustment for specified horizontal error.

2.8.2. Design of Instrument Flight Procedures

Instrument Fight Procedures are designed in accordance with the appropriate design processes, standards, guidelines, and aeronautical data quality requirements contained in the following:

a) ICAO Documents—

1) Doc. 8168, Procedures for Air Navigation Services Volume II, Construction of Visual and Instrument Flight Procedures;
2) Doc. 8697, Aeronautical Chart Manual;
3) Doc. 9365, Manual of All-Weather Operations;
4) Doc. 9613 Performance Based Navigation Manual — Volume I Concept and Implementation Guidance, and Volume II Implementing RNAV and RNP;
5) Doc. 9905 Required Navigation Performance Authorization Required (RNP Procedure Design Manual;
6) Doc. 9881, Guidelines for Electronic Terrain, Obstacle and Aerodrome Mapping Information; and
7) Doc. 9906, Quality Assurance Manual for Flight Procedure Design.
8) ICAO Doc. 10066, Aeronautical Information Management

b) Any other guideline or standard that that is applicable to a particular type of instrument flight procedure.

2.8.3. Ground Validation of Instrument Flight Procedures

Ground validation is a review of the entire instrument flight procedure package by a person(s) trained in procedure design and with appropriate knowledge of flight validation issues. The aim of ground validation is to reveal any errors in criteria application and documentation and assess the flyability of the IFP. This process is undertaken by an authorised procedure designer other than the one who has designed the procedure.

After successful ground validation of Instrument Flight Procedure, report is submitted to DGCA along with design package for the approval of flight validation.

2.8.4. Flight Validation of Instrument Flight Procedures

Flight Validation is carried out for each procedure on simulator and on actual flight after satisfactory simulator validation.

The objectives of the flight validation of IFP are:

1) to provide assurance that adequate obstacle clearance has been provided;
2) to verify that the navigation data to be published, and the data that used in the design of the IFP, are correct;
3) to verify that all required infrastructure, such as runway markings, lighting, visual aids and communications and navigation sources, are in place and operative for a new runway
4) to conduct an assessment of flyability to determine that the IFP can be safely flown; and
5) to evaluate the charting, required infrastructure, visibility and other operational factors.

A review of the results of the Ground validation and/ or simulator evaluations is completed before the flight evaluation.

2.8.5. Approval of Instrument Flight Procedures by DGCA.

Based on Design Package, successful Ground Validation and Flight Validation DGCA accords approval for promulgation of procedure. DGCA conveys approval for each procedure in writing.

2.8.6. Promulgation of Instrument Flight Procedures.

Instrument flight procedures designs/charts, are provided for publication in the AIP/AIP Supplement in accordance with provisions contained in the documents listed below:

a) ICAO Annex 4 – Aeronautical Charts
b) ICAO Doc 8168 Volumes II - Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS)
c) ICAO Doc 8697 – Aeronautical Chart Manual
d) ICAO Doc. 10066, Aeronautical Information Management

2.8.7. LPV procedure development in India

A total of 53 ICAO SBAS channel numbers for LPV procedures have been assigned to India as on May 2025.

a) AAI has published Twenty-three (23) LPV procedures for fifteen airports in India as on date.

b) AAI has developed Twelve (12) more LPV procedures for various airports in India. Simulator validation and flight trials of these procedures are in progress.

c) Eighteen (18) LPV Procedures are under design & development phase.

d) The published LPV procedures are available on the following link (Please select the applicable Aerodrome from AD_2 under section PART 3 - AERODROMES):
https://aim-india.aai.aero/eaip-v2-02-2025/index-en-GB.html

e) Additionally, list of published and planned LPV in India can also be seen on the following ICAO APAC web-link:
https://www.icao.int/APAC/Pages/GBAS-SBAS-MAP.aspx

AAI has also upgraded its Flight Inspection Unit aircraft for GAGAN LPV procedures validation and same has been certified by DGCA, India.

Outcome of the ICAO APAC Radio Navigation Symposium

New Delhi - India

7-9 April 2025

The ICAO APAC Radio Navigation Symposium reviewed existing Global Navigation Satellite System (GNSS) Radio Frequency Interference (RFI) mitigation strategies with the objective to identify gaps and offer insights into actions required to address the evolving challenges posed by GNSS RFI in terms of technological, procedural, and human-centric aspects of mitigation.

The Symposium reaffirmed the significance of the ICAO/ITU/IMO Joint Statement on the Protection of Radio Navigation Satellite Service (RNSS) from Harmful Interference and outlined a set of recommended actions and best practices to achieve the following objectives:

Objective 1: Minimize RFI occurrence through effective regulatory measures and enforcement.

1.1 **States should**:

1.1.1 ensure sufficient aviation representation in delegations of States to ITU WRC-27 preparatory meetings, to progress future improvements to ITU Resolution 676 and to ensure that future WRC updates of Radio Regulations do not adversely impact GNSS;

1.1.2 improve coordination with the military by facilitating the sharing of information on RFI testing and any relevant activities such as Counter-UAS operations;

1.1.3 possess the necessary technical capabilities to detect GNSS RFI, conduct Radio Frequency (RF) measurements, and geolocate the source of the RFI; and

1.1.4 utilise the ITU RR15 escalation procedure to ensure proper resolution for incidents of RFI with cross-border impact that cannot be solved nationally or internationally through routine procedures; States may also submit reports to the respective ICAO Regional Office, which can then forward those reports to the ITU Satellite Interference Reporting and Resolution System (SIRRS) for further action.

1.2 **Spectrum authorities** of States need to step up enforcement against GNSS jamming transmitters (GPS Jammers) while educating the general public about their illegality, without unintentionally exposing system vulnerabilities. Law enforcement should monitor and take action against online marketplaces selling such devices. Additionally, making jammer ownership illegal will help authorities to confiscate them more effectively and strengthen regulatory control; and

1.3 All stakeholders need to contribute to the development of further ICAO guidance to strengthen the link between operator reports, air navigation services provider (ANSP) confirmation,

Draft

and spectrum regulator engagement. The coordination and reporting processes must be efficient and simplified to ensure timely and effective management.

Objective 2: Support Air Crews in Operational Risk Reduction and Management

2.1 **ICAO should** consider the necessity of standardized radiotelephony phraseologies for specific scenarios. Establishing clear, standardized communications in these situations could greatly benefit both pilots and air traffic controllers, ensuring accurate and efficient responses;

2.2. **Airlines and aircraft manufacturers should**:

2.2.1 Integrate GNSS RFI factors into fuel and alternate planning to ensure contingency measures are in place for potential navigation disruptions, including refining dispatch decisions based on aircraft equipment and ensuring the aircraft's capabilities match the expected interference conditions;

2.2.2 ensure pilots maintain proficiency in conventional navigation methods, supporting operational resilience in GNSS-degraded environments. This includes:

2.2.2.1 providing training to ensure pilots can operate effectively using conventional procedures, enabling them to fly without reliance on GNSS when necessary.
2.2.2.2 encouraging position cross-checking using VOR radials for situational awareness; and
2.2.2.3 ensuring a full IRS alignment before departure if the aircraft experienced GNSS RFI during the previous flight, as indicated in the aircraft journey log;

2.2.3 clarify and streamline RFI reporting, potentially through EFB integration, to facilitate timely incident reporting;

2.2.4 ensure pilots understand space weather advisories, providing clear guidance on how to interpret and respond to relevant information; and

2.3 The symposium acknowledged IATA's initiative in providing the Turbulence Aware platform to support airline information sharing and encouraged the development of similar initiatives for RFI information exchange.

Objective 3: Ensure effective support to flight crews while maintaining safety

3.1 In line with ICAO provisions, **States should**:

3.1.1 ensure ATC readiness to provide radar vectors when requested, navigational assistance, and clock checks, and clearly define circumstances under which ATC may refuse vectoring;

Draft

3.1.2 prioritize suitable staffing levels, sector workload planning, and continuous monitoring of compliance with clearances to ensure effective air traffic management;

3.1.3 ensure comprehensive ATCO training and awareness programs focusing on response to abnormal situations and clearance deviations, equipping controllers with the necessary skills to handle unexpected events effectively;

3.1.5 enhance pilot awareness by providing near real-time GNSS RFI "Weather" updates via Electronic Flight Bag (EFB), aeronautical terminal information service (ATIS), or other channels, to support informed decision-making.

Objective 4: Ensure suitable CNS capabilities are available as required

4.1 **States should**:

4.1.1 ensure timely and effective communication regarding RFI incidents, warning could be issued via NOTAM, AIP (Aeronautical Information Publication), and/or ATIS as appropriate;

4.1.2 ensure ATSEP personnel receive training/awareness program on GNSS RFI detection, mitigation, and reporting. Simulation exercises and collaborative awareness programs could be implemented to enhance response capabilities and operational resilience;

4.1.3 establish a resilient operational network (RON) by ensuring availability of sufficient navigation infrastructure to support continuous Performance-Based Navigation (PBN) operations and by facilitating positional awareness through maintenance of a VOR/DME Network for reliable cross-checking;

4.1.5 implement GNSS jamming and spoofing monitoring using ADS-B Out (ground based or space-based) or wide area multilateration (WAM).

Objective 5: Strengthen capabilities to maintain PBN and optimize operational efficiency by leveraging current technology

5.1 **Aircraft and avionics manufacturers should**:

5.1.1 avoid cross-contamination of aircraft/avionics sensors due to GNSS RFI;

5.1.2 augment GNSS time with precision time sources to improve resilience and mitigate disruptions;

5.1.3 enhance GNSS robustness with rapidly deployable Multi-Mode Receivers (MMR) and strategic system upgrades; and

5.1.4 enable advanced RNP operations using DME through improvements to multi-DME navigation and clarifying the DME interrogator scanning and selection criteria.

5.2 **States should:**

Draft

5.2.1 implement spoofing monitors in surveillance trackers while conducting a comprehensive ADS-B to SSR/WAM comparison; and

5.2.2 optimise DME transponder network planning and coverage.

6: Achieve Robust Positioning, Navigation, and Timing (PNT) through long-term C-PNT development

6.1 **States should**:

6.1.1 conduct a comprehensive cyber risk assessment for all CNS/ATM systems, particularly space-based systems, and implement adequate mitigation measures; and

6.1.2 enhance GNSS resilience and improve cybersecurity defenses through standardization and implementation of advanced technical improvements such as authentication mechanisms, improved antennas (CRPA) for robust interference mitigation and enhanced signal reception, RFI detection systems and downlink enhancements to identify and counter RFI in real time and ensure secure and reliable data transmission across GNSS networks.

6.2 **ICAO should**:

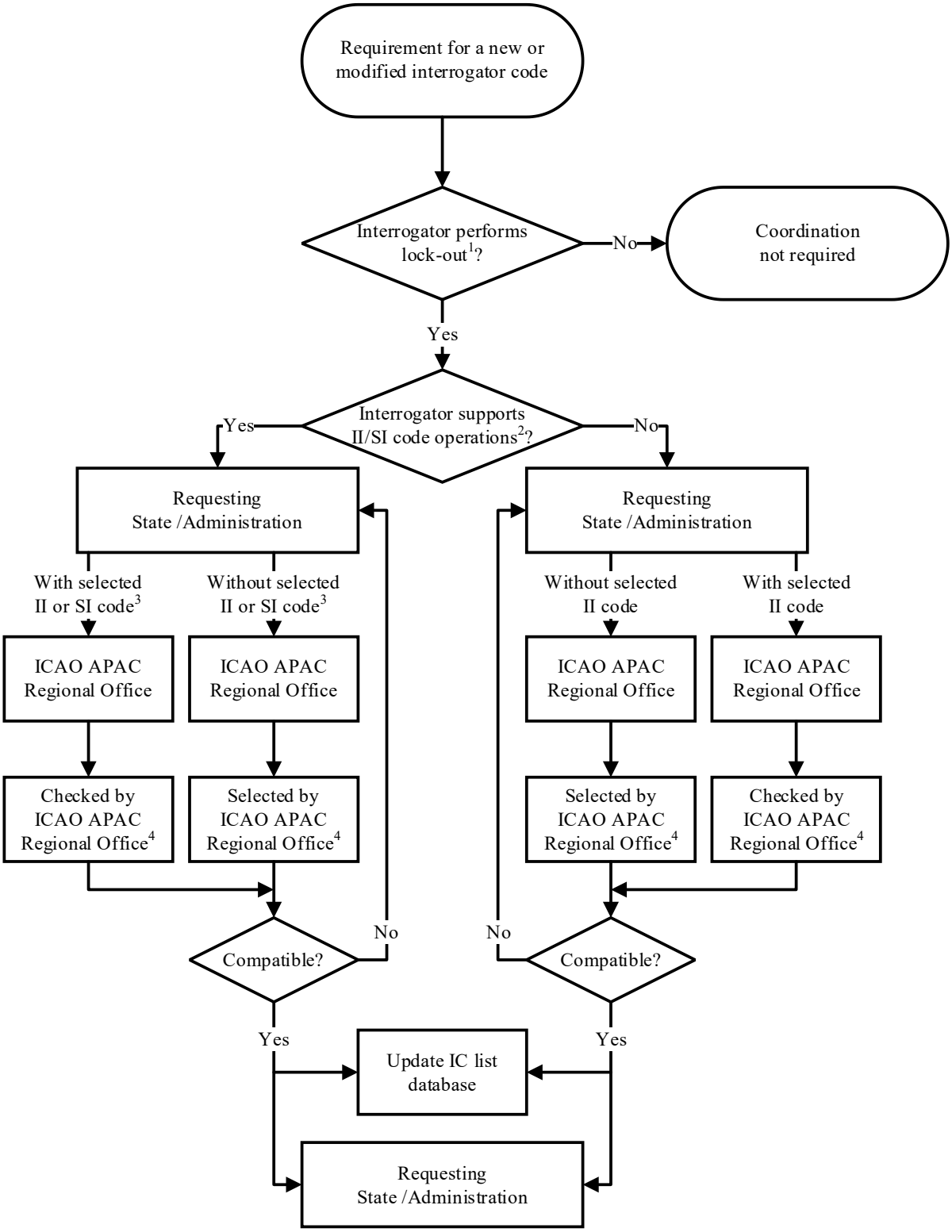
6.2.1 enhance L-Band spectrum utilization through standardization of enhanced DME (eDME) and assess other candidate PNT solutions;

6.2.2 establish a balanced CNS evolution roadmap, whereas ground, air, and space capabilities should work collaboratively within a unified framework that prioritizes spectrum efficiency as the fundamental driver; and

6.2.3 emphasize the core objective of the Integrated CNS, transforming common mode weaknesses into strengths through smart integration while maintaining independence across ground, air, and space systems.

Draft

WORKFLOW FOR THE REQUEST AND COORDINATION OF INTERROGATOR CODES



Note:

1) Interrogators that do not perform lock-out do not require coordination for IC. Example of such interrogator is the interrogator of an active MLAT
2) Interrogators must support II/SI code operations before it is allowed to use SI code.
3) States/Administrations are encouraged to use SI codes for interrogators that support II/SI code operations. But States/Administrations may choose to use II code for reasons such as safety assessment for the use of SI code has yet to be completed.
4) II=0, SI=16, 32 and 48 will not be assigned by ICAO APAC Regional Office.

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

AIR TRAFFIC MANAGEMENT AUTOMATION SYSTEM

IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT

Edition 1.5-June 2025

AMENDMENTS

The issue of amendments is announced, when an amendment has been agreed by a meeting of the ICAO Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF). The space below is provided to keep a record of such amendment.

RECORD OF AMENDMENTS

Amendment Number	Date	Amended by	Comments
0.0	Feb 2020	China	The framework of this document is firstly work out by China.
0.1	Sep 2021	China, Hong Kong China, Philippines	First completed draft based on the agreed document framework in ATMAS TF/1 for review and comment by States
1.0	Jun 2022	China, Singapore, Hong Kong China, New Zealand, Pakistan, United States	Revised the draft according to the inputs from States.
1.3	Jun 2023	China, Hong Kong China，Singapore, New Zealand, The Philippines	Add chapter 5 System Readiness.
1.4	Jun 2024	China, New Zealand, Hong Kong China，Singapore	Add some subsections 3.2.3.12 CFL Predicted Detection Advisory 3.2.4.2 DAPs Related Warnings d.QNH Mismatch Warning 4.8.3 Suggested Cyber Security Devices Configuration 5.1 Site Acceptance
1.5	Jun 2025	China, Hong Kong China, New Zealand	Add some subsections 3.2.5 Arrival and Departure Manager Functions 4.8.4 Filing of Cybersecuirty Level 5.3 Personnel Training 5.4 Safety Assessment

			Before Operation

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS VI

1. INTRODUCTION 1

1.1 PURPOSE 1
1.2 BACKGROUND 1
1.2.1 ATM Operational Concept 1
1.2.2 ATM System and Its Sub-system 2
1.2.3 Concept of ATMAS 3
1.2.4 Challenges and Solutions 3
1.2.5 Outcomes and Endorsements 4
1.3 ARRANGEMENT OF ATMAS IGD 5
1.4 DOCUMENT HISTORY AND MANAGEMENT 5
1.5 COPIES 5
1.6 CHANGES TO ATMAS IGD 5
1.7 EDITING CONVENTIONS 6

2. REFERENCE DOCUMENTS 8

3. SYSTEM FUNCTIONAL BASELINE 10

3.1 SYSTEM ESSENTIAL FUNCTIONS 10
3.1.1 Surveillance Data Processing Function 11
3.1.2 Flight Data Processing Function 14
3.1.3 Bypass Surveillance Data Processing Function 17
3.1.4 Correlation of Surveillance and Flight Data 18
3.1.5 Safety Net Function 19
3.1.6 Meteorological Information Processing Function 23
3.1.7 Air-Ground Data Link Function 24
3.1.8 System Parameter Management Function 25
3.1.9 ATS Inter-facility Data Communication Function 27
3.1.10 Human Machine Interface Function 28
3.1.11 Recording and Playback Function 33
3.1.12 System Monitoring and Control Function 35
3.1.13 GNSS Time Synchronization 36
3.2 SYSTEM OPTIONAL FUNCTION 36
3.2.1 Extended Surveillance Data Processing 36
3.2.2 Extended Correlation 37
3.2.3 Extended Alert, Warning, and Advisory Function 37

3.2.4 Downlink Aircraft Parameter Processing and Display *42*
3.2.5 Arrival and Departure Manager Functions *44*
3.2.6 System Log Management *47*
3.2.7 Enhancement Recording and Playback Function *48*
3.2.8 Enhanced Wake Turbulence Separation and Pairwise Separation Tools *48*
3.2.9 Operational Data Synchronization *52*
3.2.10 Statistics and Analysis Function *53*

4. SYSTEM DESIGN **56**

4.1 System Architecture 56
4.2 Position Roles and Types 57
4.3 Main and Fallback System Configuration 58
4.4 System Operation Mode 59
4.4.1 Normal and Degraded Modes *59*
4.4.2 Main and Fallback Modes *60*
4.5 Capacity and Performance 60
4.5.1 System Capacity *60*
4.5.2 Response Time *61*
4.5.3 Performance of Surveillance Data Processing *61*
4.5.4 Capacity of Recording and Playback *62*
4.6 External Interfaces 62
4.7 Systems Interoperability 64
4.8 Cyber Threats and Mitigation 65
4.8.1 General Description *65*
4.8.2 Cyber Security Management *65*
4.8.3 Suggested Cyber Security Devices Configuration *67*
4.8.4 Filing of Cybersecurity Level *68*

5. SYSTEM READINESS **70**

5.1 Site Acceptance 70
5.2 Flight Inspection 71
5.2.1 Planning of Flight Inspection *72*
5.2.2 Conducting of Flight Inspection *74*
5.2.3 Reporting of Flight Inspection *76*
5.3 Personnel Training 77
5.4 Safety Assessment Before Transition 79

6. SYSTEM TRANSITION **81**

6.1 Phases of System Transition 81
6.2 Transition Preparation 82
6.2.1 Transition Scheme *82*
6.2.2 Scheme Evaluation *83*
6.2.3 System Deployment *83*
6.2.4 Table Pre-rehearsal *83*

6.2.5 Other Preparations *83*
6.3 SYSTEM REHEARSAL/PRE-TRANSITION VERIFICATION 83
6.3.1 System Switch Steps Validation *84*
6.3.2 System Functions and External Interfaces Validation *84*
6.4 SYSTEM TRANSITION 84
6.5 POST-TRANSITION OPERATION 84

7. SYSTEM MAINTENANCE 86

7.1 SYSTEM MAINTENANCE PARTICIPANTS 86
7.1.1 System Supplier *86*
7.1.2 Maintenance Service Provider *88*
7.1.3 Air Navigation Service Provider *89*
7.2 RESOURCES REQUIREMENT 89
7.2.1 Staffing *89*
7.2.2 Documents *90*
7.2.3 Maintenance Tools *91*
7.2.4 Spare parts *91*
7.3 MAINTENANCE CONTENT 92
7.3.1 Periodic maintenance *92*
7.3.2 Troubleshooting *93*
7.3.3 Software Version and Requirement Management *93*

APPENDIX A 95

APPENDIX B 96

APPENDIX C 98

APPENDIX D 104

ACRONYMS AND ABBREVIATIONS

ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
ADEXP	ATS Data Exchange Presentation
AFTN	Aeronautical Fixed Telecommunications Network
AIDC	ATS Inter-facility Data Communication
AGDL	Air Ground Data Link
AMAN	Arrival Manager
ANSP	Air Navigation Service Provider
APP	Approach Center
APM	Approach Path Monitoring
APW	Area Proximity Warning
A-SMGCS	Advanced Surface Movement Guide Control System
AST	Approach Spacing Tool
ASTERIX	All-purpose Structured EUROCONTROL Radar Information Exchange Protocol
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATMAS	Air Traffic Management Automation System
ATO	Actual Time Over
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
AWOS	Automatic Weather Observation System
BSDP	Bypass Surveillance Data Processing
CA	Conflict Alert
CFL	Cleared Flight Level
CLAM	Cleared Level Adherence Monitoring
CPDLC	Controller-Pilot Data Link Communications
CRC	Cyclic Redundancy Check
CWP	Controller Working Position
DAP	Downlink Aircraft Parameter
DBS	Distance-based Spacing
DCL	Data Link Departure Clearance
DMAN	Departure Management
DPM	Departure Path Monitoring
ELDT	Estimated Landing Time
ETO	Estimated Time Over
ETO	Expected Time Over
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FDP	Flight Data Processing
FIR	Flight Information Region
GNSS	Global Navigation Satellite System

GRIB	Processed Meteorological Data in the Form of Grid Point Values Expressed in Binary Form
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
LAN	Local Area Network
METAR	Aerodrome Routine Meteorological Report(in Meteorological Code)
MSAW	Minimum Safe Altitude Warning
MSP	Maintenance Service Provider
MTCD	Medium Term Conflict Detection
NTP	Network Time Protocol
NTZ	No Transgression Zone
PBN	Performance Based Navigation
PCA	Predicted Conflict Alert
PDC	Pre-Departure Clearance
PMON	Position Report Monitoring
PSR	Primary Surveillance Radar
QNH	Altimeter Sub-scale Setting to Obtain Elevation When on the Ground
RAM	Route Adherence Monitoring
RVSM	Reduced Vertical Separation Minimum
SCA	Similar Callsign Advisory
SDP	Surveillance Data Processing
SID	Standard Instrument of Departure
SMAN	Surface Management
SMD	Software Management Department
SP	System Supplier
SPI	Special Position Identification
SSR	Secondary Surveillance Radar
STAR	Standard instrument Arrival
STCA	Short Term Conflict Alert
TBS	Time-based Spacing
TLDT	Target Landing Time
UTC	Universal Time Coordinated
VSP	Variable System Parameter
WAM	Wide Area Multilateration

1. INTRODUCTION

1.1 Purpose

Since the Air Navigation Conference held in 2012, ICAO has been exploiting a global roadmap in the Aviation System Block Upgrades (ASBU) under its Global Air Navigation Plan (GANP), with a focus on harmonization and interoperability leading to a global Air Traffic Management (ATM) system.

Following the framework of GANP and the timeline of ASBU, the Asia/Pacific Seamless ATM Plan was adopted by the 24th Meeting of the Asia/Pacific Planning and Implementation Regional Group (APANPIRG/25) in 2013. It defines goals and the means of meeting State planning objectives for a Regional seamless ATM performance framework, focusing on technological and human performance.4

To facilitate and harmonize the provision of robust, safe, efficient and orderly ATM services in the region, it is considered necessary to develop regional guidance materials with recommendations on the development and implementation of Air Traffic Management Automation System (ATMAS).

This Air Traffic Management Automation System Implementation and Operations Guidance Document (ATMAS IGD) provides guidance for the planning, design, testing, and implementation of the ATMAS in the Asia and Pacific Regions, with the purpose of ensuring continuous and coherent development of the ATMAS that is harmonized with adjacent regions.

The system requirements and operational procedures for the ATMAS are detailed in the relevant States' projects and AIP. This ATMAS IGD is intended to provide guidelines on the primary and the most important function as well as performance requirements of the ATMAS, based on the operations and maintenance practices.

1.2 Background

1.2.1 ATM Operational Concept

The global ATM operational concept presents the ICAO vision of an integrated, harmonized, and globally interoperable ATM system. The planning horizon is up to and beyond 2025. The baseline against which the significance of the changes proposed in the operational concept may be measured is the global ATM environment in 2000.

Vision Statement
To achieve an interoperable global air traffic management system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements.

While the operational concept is visionary and even challenging, many current practices and processes will continue to exist through the planning horizon. In this sense, this operational concept document should be seen as evolutionary.

A key point to note is that the operational concept, to the greatest extent possible, is independent of technology; that is, it recognizes that within a planning horizon of more than twenty years, much of the technology that exists or is in development today may change or cease to exist. This operational concept has therefore been developed to stand the test of time.

> Air Traffic Management
> Air traffic management is the dynamic, integrated management of air traffic and airspace — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties.

1.2.2 ATM System and Its Sub-system

The objective of ATM is to provide safe, economic, efficient, and dynamic management of air traffic and airspace that includes Air Traffic Service (ATS), Air Traffic Flow Management (ATFM), and Airspace Management (ASM), as shown in Figure 1.2.2-1.

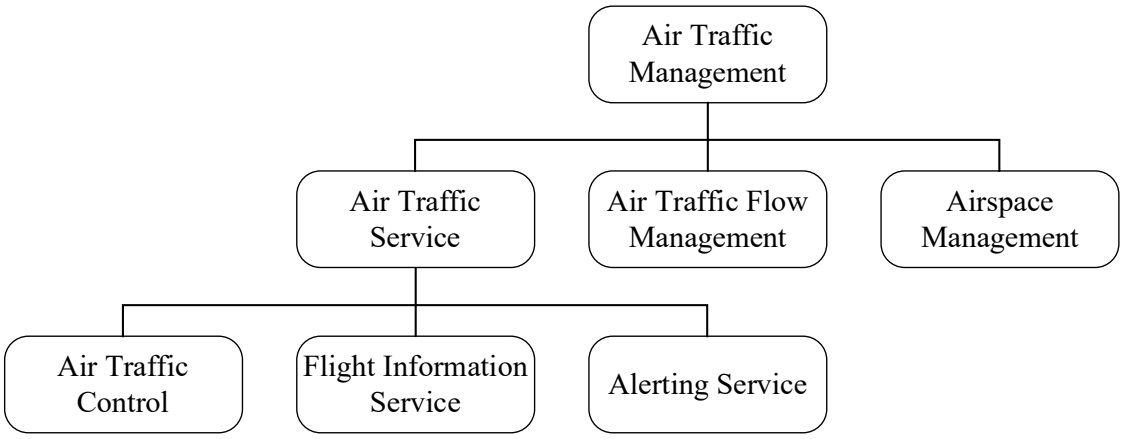


Figure 1.2.2-1 Composition of air traffic management

ATS is the central part of ATM, which includes Air Traffic Control (ATC), Flight Information Service (FIS), and Alerting Service (ALRS).

The Objective of:

a. ATC is to prevent collisions between aircraft and, on the maneuvering area, collisions between aircraft and obstructions. ATC also expedites and maintains the orderly flow of traffic.

b. FIS is to give advice and information useful for the safe and efficient conduct of flights.

c. ALRS is to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

1.2.3 Concept of ATMAS

The ATMAS mentioned in this document is mainly applied in ATC service, and offers assistance for ALRS and ATFM. It comprises a group of processing sub-systems dedicated to specific functions, which are integrated as one air traffic management system to provide functional capabilities to air traffic controllers in the Area Control Centers (ACC), Approach Control Unit, and Aerodrome Control towers. The ATMAS helps controllers keep conformance monitoring, hazard monitoring, and assuring safety separation to air traffic flow.

The ATMAS has a modular design and distributed architecture to ensure robustness under adverse operating conditions. The modularity enables modifications to the baseline product to be made with relative ease. The principle of distributed processing ensures the safe, uninterrupted provision of Air Traffic Services by controllers.

All processing and display sub-systems are interconnected via high-capacity redundant LANs. Computers providing common services (e.g., Flight Data Processing) may be duplicated, with each computer connected to each LAN providing a high degree of redundancy. Fail safe operation of the dual computer groups is achieved by multiple computation redundancy (parallel operation of the computer), or hot stand-by redundancy, to provide uninterrupted service to the controllers.

Typically, considering the safety and redundancy requirements, the ATMAS has two individual LANs, which are called working LANs, where the redundancy computers are connected. The working LANs keep sharing information and function as main and fallback modes. Air traffic control airspace with high-density traffic is recommended to use a third LAN, which is called service LAN. The latter's primary function is system trace collection, handling of recording and playback, etc.

1.2.4 Challenges and Solutions

Considering the framework for global ATM roadmap requirements and the current world situation, ATMAS is facing the following challenges:

a. The challenge for States to implement technologies as prescribed in the GANP and ASBU timeframes particularly is innovative concepts such as 4D trajectory and seamless ATM across FIRs. The seamless ATM Plan requires the individual ATMAS sharing a common set of accurate information in a timely manner, which needs to interface with each other seamlessly and work interoperability.

b. Traditional ATMAS procurement processes deliver systems that are not COTS but a baseline of core function and subsequent accumulation of bespoke design for previous ANSP applications. As the system functions and features continue to develop, the system is getting more and more complex. These cause long software/application development and practically, in most cases, these functions/features are seldom used. Consequently, the system is getting hard to maintain and costly to deploy.

c. Increase scrutiny of costs for ANSPs due to various reasons, including airspace user scrutiny, public oversight into spending, or constrained national budgets due to local or regional economic events. Significantly, public health emergencies have a devastating impact on the economy and the aviation industry worldwide. It will not be surprising that the ICAO member states, including those in the APAC Region, must reappraise both their capital and operational

expenses (CAPEX and OPEX) in the coming years, including the expenditure in the ATMAS.

To overcome the above challenges, it is important to come up with the ATMAS IGD that will provide the main functions and performances which is aimed at facilitating the implementation or provision of the robust, safe, efficient ATM automation systems. This will help the APAC region member states/CAAs/ANSPs to have an ATM automation system that shares common/core functions/performances while achieving seamless interoperability rather than investing more on CAPEX/OPEX to cope with future increase in air traffic. It is relatively more important to put focus on:

a. application of new/innovative technologies that would help make good business cases,

b. incorporating baseline/key optional features into their system design at an early stage, and

c. preparing for system completion affecting changes during low air traffic periods before full traffic recovery.

1.2.5 Outcomes and Endorsements

To ensure continuous and coherent development of the ATM automation systems harmonized with adjacent regions to enhance systems interoperability, and to keep abreast of the latest developments in ASBU and ATM automation systems, topics pertaining to ATMAS have been focusing and discussing in APAC Region since 2018.

The ICAO Asia Pacific Regional ATMAS Symposium (APAC RATMS) held in Nanjing, China, from 22 to 23 November 2018 successfully addressed Action Item 54/13 of 54th DGCA Conference on ATMAS where it also suggested for States/Administrations to consider establishment of a regional working group/task force under the ICAO CNS Sub-group of APANPIRG to deal with matters arisen from this symposium concerning ATM automation systems. The symposium agreed to formulate an action item for the 23rd meeting of CNS Sub-group in 2019 to review and consider whether such regional working group/task force is needed.

The SURICG/4 was held in Nanjing, China from 9 to 12 April 2019. The meeting reviewed and further discussed the outcomes of the ICAO APAC Regional ATMAS Symposium (APAC RATMS) and other SURICG/4 papers relevant to ATMAS, and endorsed the draft Decision of **"Draft Decision SURICG/4/5-Establishment of ATM Automation System Working Group (ATMAS/WG)"** for consideration by CNS SG.

The Twenty Third Meeting of the Communications, Navigation and Surveillance Sub-group (CNS SG/23) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) held at the ICAO Regional Office, Bangkok, Thailand, from 2 to 6 September 2019 considered the report of SURICG/4 with some other CNS SG/23 working papers and noted that a briefing on the proposal on establishing a working group to deal with ATMAS issue was also provided to ATM SG/7 meeting. Several States/Administrations expressed their willingness to support the work of the Task Force, including China, Hong Kong China, India, Indonesia, Nepal, Singapore, Thailand, and the USA. Hence, the meeting adopted the **"Decision CNS SG/23/13 (SURICG/4/5) - Establishment of ATM Automation System Task Force (ATMAS/TF)"**.

APANPIRG/30 meeting that was held from 4-6 November 2019 at ICAO APAC Office, Bangkok, Thailand. The APANPIRG/30 meeting noted with appreciation the work done and achievements by the CNS SG and the contributory bodies reporting to APANPIRG through the

SG pertaining to ATMAS. The panel noted that CNS SG/23 meeting had adopted 9 Conclusions and 4 Decisions on technical and operational matters, including the **"Decision CNS SG/23/13 (SURICG/4/5) Establishment of the Asia/Pacific ATM Automation System Task Force (ATMAS/TF)"**.

1.3 Arrangement of ATMAS IGD

This ATMAS IGD consists of the following parts:

Section 1	Introduction
Section 2	Reference Documents
Section 3	System Functional Baseline
Section 4	System Design
Section 5	System Readiness
Section 6	System Transition
Section 7	System Maintenance

1.4 Document History and Management

The framework of this document was first introduced in the first Working Group Meeting of ATMAS Task Force (ATMAS TF/1) video conference, which was held in October 2020. The Meeting agreed to further develop based on the proposed framework into a complete document for approval as a regional guidance document. A working team consisting of volunteers from China, Hong Kong-China, India, Japan, Malaysia, Philippines, Singapore, Thailand, and Vietnam was established during the Meeting to contribute to document's content. In August 2021, the completed draft of this document was ready for circulation among States for review and comment.

This document aims to supplement SARPs, PANS and relevant provisions contained in ICAO documentation, and it will be regularly updated to reflect evolving conditions. To support the ICAO in making specific recommendations and developing guidance materials, such as minimum functional/performance requirements and additional/local requirements, which aim at facilitating the implementation or provision of robust, safe, efficient, and orderly ATM services by the use of existing and/or new procedures, facilities, and technologies concerning ATMAS.

1.5 Copies

Paper copies of this ATMAS IGD are not distributed. Controlled and endorsed copies can be found at the following website: http://www.icao.int/APAC/Pages/edocs.aspx.

Copy may be freely downloaded from the website or by sending an email of request to APANPIRG through the ICAO Asia and Pacific Regional Office.

1.6 Changes to ATMAS IGD

Whenever a user identifies a need for a change to this document, a Request for Change (RFC) Form (refer to Appendix A) should be completed and submitted to the ICAO Asia and Pacific Regional Office. This form may be photocopied as required, emailed, faxed, or emailed to ICAO Asia and Pacific Regional Office +66 (2) 537-8199 or APAC@icao.int. The Regional Office will collate RFCs for consideration by the ICAO Communications, Navigation, Surveillance (CNS) Sub-group of APANPIRG.

When an amendment has been agreed by a meeting of the ICAO CNS Sub-group of PANPIRG, then a new version of the ATMAS IGD will be prepared, with the changes marked by an "|" in the margin, and an endnote indicating the relevant RFC for the traceability of the change. If the change is in a table cell, the outside edges of the table will be highlighted, for example, as follows.

Final approval for publication of an amendment to the ATMAS IGD will be the responsibility of APANPIRG.

1.7 Editing Conventions

1.8

（Intentionally blank）

2. REFERENCE DOCUMENTS

Id	Name of the document	Edition	Date	Origin	Domain
1	Annex 2 - Rules of the Air	10th Edition	2005	ICAO	
2	Annex 12 - Search and Rescue	8th Edition,	July 2004	ICAO	
3	Annex 11 — Air Traffic Services	15th Edition	2018	ICAO	
4	Annex 17 - Security	10th Edition	2017	ICAO	
5	PANS-ATM, or Procedures for Navigation Services – Air Traffic Management (DOC 4444)	16th Edition (Amendment 9 dated 5/11/20)	2020	ICAO	
6	Global Air Navigation Plan (GANP) (Doc 9750)	6th Edition	2020	ICAO	
7	Global Air Traffic Management Operational Concept (Doc 9854)	First Edition	2005	ICAO	
8	Manual on Air Traffic Management System Requirements (Doc 9882)	First Edition	2008	ICAO	
9	Manual on Global Performance of the Air Navigation System (ICAO Doc 9883)	First edition	2009	ICAO	
10	Doc 10031 Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes	First edition	2014	ICAO	
11	Restricted—Air Traffic Management Security Manual(Doc 9985)	First edition	2013	ICAO	
12	Air Traffic Services Planning Manual (Doc 9426)	4th Edition	2007	ICAO	
13	Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive (Doc 9574)	4th Edition	2013	ICAO	

14	Performance Based Navigation (PBN) Manual (Doc 9613)	4th Edition,	2013	ICAO	
15	Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689)	2nd Edition	2007	ICAO	
16	Manual of Air Traffic Services Data Link Applications (Doc 9694)	5thEdition	2010	ICAO	
17	Manual on Flight and Flow — Information for a Collaborative Environment （FF-ICE）(Doc 9965)	First edition	2012	ICAO	
18	Manual on Simultaneous Operations or Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643)	2nd Edition	2020	ICAO	
19	Pan Regional (NAT and APAC)Interface Control Document (ICD) for ATS Interfacility Data Communications (PAN AIDC AIDC)	Version 1.0	2014	ICAO PAN	
20	ICAO Asia/Pacific Regional ADS-B Implementation and Operations Guidance Document (AIGD)	Version 13.0	April 2021	ICAO APAC	
21	ICAO Asia/Pacific Regional Mode S DAPs Implementation and Operation Guidance Document	Edition 3.0	2021	ICAO APAC	

3. SYSTEM FUNCTIONAL BASELINE

The functional baseline, forming the core of the ATMAS, is broadly described as those involved with the processing and display of operational information that will be used in providing an alerting, flight information, and separation service to aircraft.

3.1 System Essential Functions

In order to provide controllers with the display of air situation, the ATMAS is suggested with the following essential functions.

a. Surveillance Data Processing Function (SDP). Chapter 3.1.1 introduces the essential surveillance data processing function. For the processing of enhanced surveillance data such as ADS-B, please refer to chapter 3.2.1.

b. Flight Data Processing Function.

c. Bypass Surveillance Data Processing Function.

d. Correlation of Surveillance and Flight Data function. Chapter 3.1.4 introduces the essential correlation function with mode 3/A code. The processing of using 24-bit address code etc., as the condition for correlation, please refer to chapter 3.2.2.

e. Safety Net Function. Chapter 3.1.5 introduces the essential Safety Net function. For the extended Safety Net function, such as Departure No Transgression Zone(DTZ), please refer to chapter 3.2.3.

f. Meteorological Information Processing Function.

g. Air-Ground Data Link Function (AGDL).

h. Variable System Parameter (VSP) Management Function.

i. ATS Inter-facility Data Communication Function.

j. Human Machine Interface Function (HMI).

k. Recording and Playback Function. Chapter 3.1.11 introduces the essential data recording and playback function. For the video recording and playback function, please refer to chapter 3.2.7.

l. System Monitoring and Controlling Function.

m. Software Version Management Function.

n. GNSS Time Synchronization.

3.1.1 Surveillance Data Processing Function

SDP is one core function of ATMAS. SDP should be able to integrate multi-sensor surveillance data and process the received data to generate a unique system track. System tracks contain accurate real-time positioning information, which correlates with flight plans and is displayed on HMI with specific track symbols.

Usually, SDP includes the following functions:

a. Access and process data from primary radar, secondary radar, primary and secondary combined radar, ADS-B, MLAT, and weather data from PSR radars.

b. Pre-process the surveillance data to monitor the data quality.

c. Process mono-sensor surveillance data and generate mono-sensor track.

d. Process multi-sensor surveillance data and generate continuous and smooth system tracks adopting advanced tracking filtering algorithms.

e. Manage the altitude tracking and perform conversion of Mode C derived data

f. according to QNH value.

g. Provide prompts in case of overload, filter received data, and discard extra data.

h. Process the special position identification pulse (SPI) and display using a unique indication.

i. Allow special area definition to improve system track accuracy.

3.1.1.1 Surveillance Data Pre-processing

The system is recommended to process standard radar formats, including ASTERIX format and related standards. It should automatically identify the form of surveillance data, then decompose and extract the data items according to the corresponding format specifications.

The system is encouraged to be able to monitor the received data quality and filter out the abnormal data to ensure the data fusion quality. The surveillance data quality check is suggested by considering the following factors:

a. CRC error.

b. Data frame error.

c. North messages lost.

d. Radar sector crossing messages lost.

e. Track lost.

f. Timestamp check.

3.1.1.2 Mono-sensor Data Processing

The system is recommended to perform syntactic and semantic checks on the received data against specifications, including the target attributes, identifier (SSR code, track number, address code, etc.), position, altitude, speed, time stamp, etc.

The system is suggested with time drift management to handle abnormal time stamping, and correct the timestamp by adding a time shift in received data.

The system handles target correlation for the purpose of generating a new track, or updating the existing, or deleting the dated, and then form a stable mono-sensor track in the end.

3.1.1.3 Multi-sensor Data Processing

The system fuses the accessed multi-sensor to generate a stable system track by associating the targets of multiple sensors, and forms a unique target identification mark. When the surveillance data are associated, the data and state attributes of sensor, including position, secondary code, altitude, speed, track characteristics, and other data, are considered.

The system associates the existing system track for updating or establishes a new track to ensure accuracy, continuity, and smoothing.The system track is provided to alert calculation, correlation process, and HMI display. In the track fusion process, the system records the quality of every surveillance sensor to estimate the quality of this sensor based on historical and real-time data. Abnormal data derived from some sensors should not impact system track quality.

3.1.1.4 Target Altitude Tracking and Processing

The system is suggested to provide altitude tracking by extrapolating the flight level according to the current mode C value and altitude change rate.

The system should support QNH area definition and correct Mode C values into barometric altitudes for all aircraft in a specific QNH area.

The system should discard abnormal altitude reported.

3.1.1.5 Special Pulse Identification Processing

When receiving SPI from radar track, the system is suggested to display a prompt on track identifier automatically.

3.1.1.6 Automatic Test Target Monitoring

The system is advised to be capable of monitoring the quality of radar via automatic Test Target Monitoring with fixed SSR Test Transponders.

3.1.1.7 Surveillance Data Overload Processing

The system should detect plots overload (i.e., the maximum number of plots per radar and per antenna revolution and the maximum number of plots per radar and per sector) to filter out excess plots.

The system is recommended to cope with surveillance data overloading processing as follows:

a. When the total number of targets processed by SDP reaches a certain threshold, the system will automatically generate a warning prompt.

b. When the total number of targets exceeds the load threshold, the system will give prompts to users and considers filtering or discarding the extra data.

3.1.1.8 Special Area Setting and Processing

The system is proposed to be capable of:

a. Defining areas of interest (AOI) for each sensor and discarding reports outside the AOIs.

b. Defining inhibition areas for each sensor and stoping track initialization but provide reports for exist track in the inhibition areas.

c. Defining distrust areas for each sensor, and discard reports in the areas.

3.1.1.9 Real-time Quality Control (RTQC) of Radar

Real-time quality control (RTQC) is used to monitor and control the quality of radar signals received by the system. It calculates the radar (sensor) correction factor and the fusion weight coefficient based on the results of monitoring and controlling. RTQC should manually and automatically compensate for the deviation in azimuth and distance of radars or sensors to improve the radar detection accuracy and provide the necessary fusion parameters for subsequent multi-radar tracking processing.

When the RTQC finds abnormal monitoring data, it gives a warning on the system monitor interface in real-time. When the quality of one or more data sources is abnormal or interrupted, the system will isolate it to ensure the system tracks in a normal work state. The system judges the availability of the data according to the confidence coefficient of source surveillance data.

3.1.1.10 System Tracks Output

d. The system should output the system tracks according to various specified radar formats (such as ASTERIXcat062, etc.).

e. The output system tracks can be adjusted within a reasonable range by modifying parameters, and its fastest update rate is the same as the track of ATMAS.

3.1.2 Flight Data Processing Function

Flight data processing (FDP) is one core function of the ATMAS. Data relevant to flight plan are received, stored, processed, and updated by FDP. FDP can also exchange data with other software modules.

Usually, FDP includes the following functions:

a. ATS messages processing, which processes ICAO, AIDC, OLDI, and other format messages.

b. Flight plan life cycle management to the flight plan.

c. 4D profile trajectory computation, including route analysis, profile calculation and time estimation, SID /STAR /runway automatic allocation.

d. SSR code management, including SSR code automatic assignment and manual SSR codes assignment by controllers;

e. Sector management and posting computation, post flight plans based on conditions, and provide electronic postings and paper flight strip printing at the designated position;

f. Flight plan data exchange with other external systems (such as Main/Fallback ATM automation systems, tower ATM automation systems, air traffic flow management systems, etc.). This part will be described in detail in section 5.7 of this document.

3.1.2.1 Flight Message Processing

The system should be capable of processing flight messages following ICAO PANS-ATM(Doc 4444) and AIDC and other related regulations, including FPL, CHG, CNL, DEP, ARR, DLA, CPL, EST, CDN, ACP, LAM.

The system is advised to perform semantic and syntactic checks on the received messages and create or update associated flight plans with correction. Messages that failed in semantic or syntactic checks are categorized and sent to the designated position for manual processing. Manually corrected messages will be processed again by the system.

The system is suggested to be designed with a messages manual transmission function and provide a default template for each type of message to be modified and confirmed by users.

The system is recommended to transmit messages according to the pre-defined conditions and addresses automatically. At least the following types can be sent: FPL, DEP, ARR, CHG, DLA, CPL.

3.1.2.2 Life Cycle Management

The system shall be able to manage the life cycle of flight plans. Flight plan states could be generally defined as INACTIVE, PREACTIVE, COORDINATED, ACTIVE, FINISHED, etc. Users can adjust the above states according to the operation requirement.

The evolution of the flight plan states could be triggered automatically based on time, message, correlation, etc., or by manual input.

Examples of the central state transition conditions and processing are as follows:

a. INACTIVE

When created, the flight plan state is INACTIVE.

Typically, all flight plans in INACTIVE state support manual modification or via ATS messages.

b. PREACTIVE

When the flight is approaching its execution and control airspace, the flight plan state will change to PREACTIVE.

At PREACTIVE state, the system is suggested to perform 4D trajectory and posting computation and send flight strips to relevant positions. The system could allocate SSR codes, departure runways, and SIDs for departure flights.

c. COORDINATED

When the flight is ready for control, the plan state will change to COORDINATED which can be triggered by manual operations or system events.

The flight plan in the COORDINATED state is qualified for correlation with system tracks.

d. ACTIVE

The flight plan state becomes ACTIVE when the flight is in the jurisdiction. Generally, the system calculates and updates 4D trajectory based on surveillance data, air-ground data, and manual commands. The flight plan in the ACTIVE state is qualified for correlation with system tracks.

e. FINISHED

When the flight plan is no longer used to assist in controlling the actual flight, the plan state becomes FINISHED.

At the FINISHED state, the system is suggested to:

- Release the SSR code.
- Stop the 4D trajectory calculation.
- Delete posting events and remove the electronic flight strip.
- Save the records for further analysis and statistics.

f. Other states

In addition to the above states, users can also define SUSPENDED, INHIBITED, and other states according to operation requirements. Under these states, FDP will stop updating the flight profile and suppress related alarms.

3.1.2.3 4D Profile Trajectory Calculation

It is recommended the system support 4D flight profile trajectory calculation. The profile calculation is continuous and generally divided into three stages: climb, level flight, and descent. The profile may start from the departure airport or the fixes before the FDRG entry, containing height and time information for each waypoint, and ends at the destination airport.

The profile calculation could refer to waypoint information, DEP/ARR airport, runway, requested altitude, cruise speed, aircraft performance parameter, GRIB, target position, real-time data input by controllers, etc.

The profile updates could be done at the change of flight attitude, passing waypoints, sector boundary points, system events, or controller inputs.

The system is proposed to automatically allocate departure runways and SIDs for departure flight plans and arrival runways and STARs for arrival flight plans. The system would provide the function of manual assignment, modification, and deletion to SID/STAR/runway.

3.1.2.4 SSR Code Management

Usually, the system is capable of manually and automatically assigning SSR codes.

The system is recommended to adopt specific SSR code group and allocation rules according to the type of flights (inbound and outbound).

The system is suggested to perform an SSR code retention check and use the SSR code in received messages (e.g., DEP messages) if the code is available. If not accessible, the system will allocate a new code from the free code list. In case of no free codes, the system could assign an SSR code from the given code list, and the earliest allocated code should have priority.

Generally, the system is not supporting special codes (such as 7700, 7600, 7500, etc.) assignment.

The SSR code will be released when the flight plan is finished.

The system is proposed to support manually modifying the flight plans' SSR. If the input code is already occupied, a prompt is suggested to be produced.

It is recommended that the system uses A1000 as Mode S conspicuity code. The flight plan with that code will use a 24-bit address or ACID to correlate with system tracks, and warnings/alerts should not be generated when SSR duplication occurs due to Mode S conspicuity code.

3.1.2.5 Sector Management and Posting Computation

Normally, the system can pre-configure the airspace into different sectors and enables the controllers to group or ungroup these sectors online.

The system is recommended to post the relevant electronic flight strip to the designated sector according to offline defined conditions. The electronic flight strip is suggested to display on the controlling sector and posted sector in specific colors.

The system is proposed to compute and insert posting events based on the waypoints or sectors in the flight plan. Posting conditions are tightly linked with the operational concept and control procedures, including waypoints, altitude range, ACID, airport, runway, flight rule, flight type, etc.

The system is advised to support the manual and automatic transfer of jurisdiction. The automatic transfer could be computed based on offline rules to get the timing and the target sector. The mechanical transfer conditions are similar to posting conditions.

3.1.3 Bypass Surveillance Data Processing Function

To further enhance resilience, bypass surveillance data processing（BSDP）could be implemented according to the operational need. BSDP is a redundancy module of SDP, which can independently receive, process and distribute surveillance data independently to SDP. When the SDPs fail, the system will switch to BSDP automatically. When the system switches to bypass mode, the HMI should clearly indicate if controller is working in BSDP mode.

BSDP is recommended to be capable of directly accessing various surveillance sources, using a different tracking algorithm with SDP.

BSDP should at least provide mono-sensor tracking function. Multiple-sensor data tracking function and alarm functions, such as Special Codes alert, Short Term Conflict Alert (STCA), Minimum Safe Altitude Warning (MSAW), Area Proximity Warning (APW), etc., could be considered as part of BSDP.

3.1.4 Correlation of Surveillance and Flight Data

The objective of the surveillance and flight plan correlation function is to establish an association between a surveillance track and a flight plan based on identifying codes and position checks. The way to develop association includes automatic and manual correlation.

3.1.4.1 Automatic correlation

Usually, the system performs an automatic correlation between the flight plan and the system track when pre-defined conditions are met, for example:

a. Specific flight plan status.

b. Identical SSR code.

c. Passing position and altitude check.

The flight plan in the system has two kinds of SSR codes:

a. ASSR (Assigned SSR code): currently assigned to the flight plan within the FIR.

b. PSSR (Previous SSR code): used for inbound flight, which was used in the previous FIR or the previous code used in the case of a code change within the FIR.

The position and altitude checks will improve the accuracy of correlation. The method of position and altitude checks are suggested as follows:

a. Whether the track position is in the route model. The route model is composed of airports, waypoints, and route corridors in the flight plan.

b. Whether the difference between the estimated flight plan position and the track position is within a certain range.

c. For take-off and landing system tracks, the altitude check is recommended to be performed.

3.1.4.2 Manual Correlation

The system is recommended to support manual correlation of a flight plan with a track by controllers, for example, using mode 3/A code as a criterion.

A warning message is suggested to be provided if the manual correlation is failed.

3.1.4.3 Cancel Correlation

The system is suggested to cancel correlation if the correlation conditions are no longer met, and automatically generate a warning prompt to designated position except Emergency Settings.

Under emergency settings, the system is advised to maintain the correlation when the SSR code is changed to 7500, 7600, and 7700.

3.1.4.4 Correlation Data Distribution

After correlation, the system is recommended to distribute correlation information to other modules and display correlated system tracks on the controller positions.

Usually, the system updates the flight profile according to the position and altitude information of the correlated surveillance track.

3.1.5 Safety Net Function

Safety Net Function serves to alert controllers of a potential, imminent or actual infringement of safety margins to prevent hazardous situations from developing into major incidents or even accidents. The aviation safety areas covered by Safety Net Function generally include:

a. Aircraft Separation.

b. Airspace Operation Requirement.

c. Conformance of Clearance.

d. Terrain Clearance.

e. Approach/Departure Path Conformance.

Alerts/warnings from Safety Net Function are generated based on different levels of severity of infringement and imminency with distinguishable visual and/or acoustic alarms with their prominence corresponding to the severity and imminency of the infringement.

During the planning stage, States/Administrations are encouraged to conduct a comprehensive study on the applicability of safety net features in ATMAS to their local environment considering system behavior, Human Machine Interface (HMI) design, and operational procedures. By design, the Safety Net Function in the ATMAS should be configurable with various parameters on activation/deactivation/acknowledgement of alarm adjustable by the users. Where applicable, references, especially on test strategy and system parameters, to successful cases of Safety Net implementation by other States/Administrations are suggested.

For actual implementation of Safety Net Function, a progressive approach is suggested with potential advantages as below:

a. Reducing risks in implementation and operation of one safety feature at a time as compared to deployment of all planned safety features in one go;

b. Reducing demand for resources and staff workload involved in the evaluation of the safety features; and

c. More time for air traffic controllers to evaluate the safety features and fine-

tune the parameters before further implementation.

A post-implementation review is recommended, including the collection of feedback and suggestions from frontline air traffic controllers, effectiveness and performance of the safety features (such as user-friendliness, alert timeliness, nuisance alerts), data analysis to gauge improvement in safety figures with a view to continuously fine-tuning of safety net parameters to reduce nuisance alerts.

3.1.5.1 Types and Priority

The system provides safety net to controllers with visual and/or acoustic indications, integrating surveillance data, flight plan data, and other operational data using different algorithms and rules.

The safety net includes Emergency, STCA, MSAW, APW, APMW, etc.

It is recommended that the system is capable of setting the priority of alerts. The priority of warning is higher than its corresponding pre-warning. The emergency should have the highest priority, including Unlawful interference (7500), radio communication failure (7600), emergency (7700), etc.

3.1.5.2 Emergency

Once the Emergency codes were received, the system is suggested to process it and display the Emergency on the concerned positions.

The emergency codes include:

a. 7500 (Unlawful Interference).

b. 7600 (Radio communication failure).

c. 7700 (Emergency).

Normally, the Emergency is displayed until the received Mode 3/A code is different from the emergency code.

3.1.5.3 Short Term Conflict Alert

Short Term Conflict Alert (STCA) is an important safety net feature of ATMAS as collision avoidance tool, or to provide a separation alert for a potential or actual infringement of separation minima between aircraft. STCA can work between targets associated with an FPL and unknown targets without an FPL.

The STCA function in ATMAS generates visual and/or acoustic alerts to controllers in air situation display if any aircraft is predicted to or is violating a pre-defined conflict or separation minimum in the STCA settings of the ATMAS. Controllers would need to resolve the conflict immediately once the alert has been generated.

Surveillance, flight plan, and environmental data are required for generating STCA in ATMAS. The following list of information could be considered to include in the STCA processing:

a. Aircraft position

b. Pressure altitude

c. Cleared flight level

d. Flight rule

e. RVSM status

f. Concerned controller jurisdiction

g. Separation standards of STCA areas

h. Look-ahead time

The Flight plan is not obligatory. Flight plan data, i.e., cleared flight level, flight rule, and RVSM status of the aircraft, could help improve the relevancy of alert generation so as to reduce cases of nuisance alerts. In addition, the implementation of STCA inhibition could be considered based on a definition of inhibition zones, SSR code groups, callsign, or other conditions applicable to the local operating environment and needs.

The STCA processing cycle is recommended to be at a frequency not less than once per track update of ATMAS. States/Administrations could also consider implementing STCA with two stages of alerts based on the situation of predicted and actual infringements, i.e., Predicted Conflict Alert (PCA) and Conflict Alert (CA).

For complex airspaces with different separation standards for respective sectors, the design of ATMAS is recommended to allow the configuration of multiple STCA volumes. Users could apply specific STCA parameters for a given STCA volume according to operational needs.

The performance of STCA is highly dependent on the optimization of the conflict detection algorithm and adapted parameters for the local environment. States/Administrations are suggested to work closely with system manufacturers to adapt the STCA detection according to the local environment. For successful implementation, regular review with controllers on the performance is necessary.

3.1.5.4 Minimum Safe Altitude Warning

Minimum Safe Altitude Warning (MSAW) is intended to assist controllers with alerts of the potential risk of an aircraft infringing a defined minimum safe altitude over a concerned region.

The MSAW function monitors the position and altitude of an aircraft against defined MSAW regions and minimum safe altitudes. The MSAW region can be defined by height or polygon. When the altitude of an aircraft is found or predicted to be lower than the applicable minimum safe altitude within defined the MSAW region, a visual and/or acoustic warning would be generated to alert controllers to take necessary actions to resolve the infringement.

For reference, examples of surveillance, flight plan, and environmental data are required for the MSAW functional module to generate alerts are:

a. Aircraft position.

b. Pressure altitude.

c. Cleared flight level.

d. Flight rule.

e. Concerned controller jurisdiction.

f. Terrain and obstacle model.

g. Look-ahead time.

To minimize nuisance alerts, flight rules and cleared flight levels in flight plan data can help improve the relevancy of MSAW alert generation. In addition, States/Administrations could consider implementing MSAW alert inhibition which suppresses MSAW alerts based on defined inhibition zones (such as final approach zones), SSR code groups, callsign, or other conditions applicable to the local operational environment.

The accuracy of MSAW alert is related to MSAW terrain/obstacle definition, look-ahead time setting, and inhibition strategy adopted for flights intentionally flying close to terrains/obstacles. Appropriate settings of the above are necessary for providing a reliable MSAW detection that controllers can rely on. Any unoptimized parameters would likely result in nuisance alerts or insufficient time for controllers to respond to the alert. It is important to perform tuning of MSAW parameters based on controllers' feedback for successful MSAW implementation.

3.1.5.5 Area Proximity Warning

Area Proximity Warning (APW) is a safety net for alerting controllers of any potential or actual unauthorized penetration of aircraft into Special Use Airspaces (SUA) including:

a. Danger airspace.

b. Prohibited airspace.

c. Restricted airspace.

d. Temporarily restricted airspace.

Each SUA volume could be defined in ATMAS as an area (e.g., circle, polygon, etc.) with upper and lower bounds on altitudes. The warning activation/deactivation of each SUA could be triggered automatically according to an online-defined schedule or by the manual action of controllers. The system should provide APW inhibition

function based on flight rules, SSR code groups, callsign, and other conditions applicable to the local environment and operational needs.

3.1.5.6 Approach Path Monitoring Warning

The Approach Path Monitoring Warning (APMW) monitors the aircraft's vertical and lateral deviation from the final approach profile in ATMAS, and generates visual and/or acoustic alerts when an aircraft exceeds or is predicted to exceed the defined tolerance of deviation. The system should allow multiple groups of glide path monitoring parameters to be defined.

An APM zone would generally be defined in ATMAS for performing APMW processing on flights. Examples of parameters on the definition of APM zone are:

a. Runway name and direction.

b. Touchdown point on the runway.

c. Horizontal angular extend from the touchdown point.

d. Vertical angular extend from the touchdown point.

e. Distance from the touchdown point.

f. Glide slope elevation.

g. APMW inhibition zone.

Surveillance, flight plan, and environmental data are required for generating APMW. The APMW prompt will be given on the HMI when the alarm conditions are met.

To minimize nuisance alerts, checking flight rules could help improve the relevancy of warning generation. In addition, an aircraft flying close to terrains/obstacles during the final approach which could easily trigger MSAW alert due to nearby terrains/obstacles. States/Administrations could consider suppressing MSAW alert generation in ATMAS within the APM zone or via the definition of inhibition zones if an aircraft's descent profile is already under the monitoring by APMW.

The performance of APMW is highly related to adapted APMW parameters for the local environment, look-ahead time setting and inhibition strategy adopted for flights that intentionally deviated from the optimal final approach path. Regular review of the performance is crucial for the tuning of APMW parameters based on controllers' feedback to increase its effectiveness.

3.1.6 Meteorological Information Processing Function

Generally, the system is capable of receiving, processing, and displaying meteorological information, including GRIB, QNH, and weather data derived from mono-radar. The meteorological information should be applied in surveillance data and flight data processing.

The system could process GRIB messages from the meteorological information system, which contains upper wind and temperature for accurate calculation and estimation of flight plan profiles.

The system is recommended to automatically extract and process QNH data from METAR and SPECI messages, as well as manual input.

The system is recommended to be capable of receiving and processing mono-radar derived weather data, and displaying it on the controller positions. From experience, the categorization of weather intensity level could be classified as no less than three levels. The parameters of display level and priority could be defined as required.

3.1.7 Air-Ground Data Link Function

The AGDL function mainly processes the information based on the data link communication, including ADS-C (Automatic Dependent Surveillance-Contract), CPDLC (Controller-Pilot Data Link Communication), and DCL (Departure Clearance), etc. States/Administrations could implement the Air-Ground Data Link Function according to the operational needs.

3.1.7.1 ADS-C Data Processing

The ADS-C data processing is recommended as follows:

a. The system automatically determines whether the aircraft enters the ADS-C area according to route information.

b. The ADS-C connection could be initiated by pilots or controllers.

c. The system receives and processes ADS-C messages, including periodic contract, event contract, emergency, current location, etc.

d. The system updates and manages ADS-C tracks with received ADS-C messages.

3.1.7.2 CPDLC Data Processing

From experience, the system is suggested to provide the following functions for CPDLC data processing:

a. Display CPDLC position report and flight data.

b. Display a CPDLC dialogue window.

c. Determine whether the aircraft enters the CPDLC area according to route information.

d. Allow initiating a CPDLC connection automatically or manually by the pilot or the controller.

e. Receive and process CPDLC downlink messages, send CPDLC uplink

messages, and manage the message status.

f. Allow to search CPDLC historical messages and display the messages in chronological order.

g. Provide prompts to controllers in the following cases: correct message transmission and reception, manual operation, and successful logon.

3.1.7.3 DCL Processing

The system is recommended to provide the following DCL functions:

a. Receive, process, and send DCL messages (ARINC 623, EUROCAE ED-85A, etc.).

b. Identify and process the RCD message and automatically send error messages to controllers suggesting voice-clearance in case of invalid RCD message.

c. Correlate the RCD message with a specific flight plan according to the callsign, departure airport, landing airport, and automatically reply with an FSM message.

d. Automatically send CLD messages according to the correlated FDR and manual input data and perform synthetic and semantic checks.

e. Check the compliance between the CDA and CLD message.

f. Be capable of displaying RCD information, including the callsign, SSR code, CLD processing identification, and enable the edition and transmission of CLD messages.

3.1.8 System Parameter Management Function

For the convenience of system maintenance, the system is proposed to be capable of managing the variable system parameters through a user/ops orientated adaptation interface used by trained adaptors.

3.1.8.1 Types of System Parameters

The system is recommended to be able to adapt system functional parameters for all functionality.

That parameters adaptation is highly preferential to software-code based system management, e.g., pre-set files.

Those parameters are designed to accommodate future performance loads to avoid errors or limitations brought on by inflexible value limits.

That parameters adaptation is orientated towards use by ATS operational orientated staff. Variables, their units of use, and values range should reflect the operational application.

Generally, the types of system parameters include the following:

a. Basic parameters: airspace, sectors, positions, routes, QNH areas, etc.

b. Surveillance data parameters: surveillance source parameters, fusion parameters, etc.

c. Flight data parameters: message processing and transmission rules, SSR code allocation rules, FDR parameters, etc.

d. System interface parameters: interface configuration parameters.

e. HMI parameters: sectorization parameters, electronic and paper flight strips formats, CFL popup values, system maps, etc.

f. Alert parameters: warning and inhibition area definition, warning condition parameters, etc.

g. Other maintenance parameters: recording parameters, warning messages, error messages, etc.

3.1.8.2 System Parameter Management

The system is recommended to support a graphical user interface tool, such as Database Management System (DBMS) to establish, delete, modify, display release, and validate the online/offline system parameters.

The DBMS tool is suggested to support accuracy check, provide error prompts and references according to parameters format, character length, and mold to ensure accuracy of parameters, and limit illegal input of the parameters. The system has the fallback function. If a step of parameters setting goes wrong, you can go back to the previous step.

3.1.8.3 System Parameter Activation

In order to balance the efficiency and safety, by experience, the system is suggested to support the following two ways to let the system parameters go into effect:

a. Online generate: for parameters allowed to be configured, selected, and generated online, without restarting the system.

b. Offline generate: for parameters to be generated after restarting the entire system or specific system modules.

3.1.9 ATS Inter-facility Data Communication Function

The system is recommended to incorporate an AIDC application that supports the ATS-related information exchanges within the ATMAS of adjacent Control Units and Flight Information Regions adopted in the Asia-Pacific region.

The AIDC function of the system should conform to the standards in the prevailing version of the following documents:

a. Pan Regional (NAT and APAC) PAN AIDC ICD; and

b. Procedure for Air Navigation Services-Air Traffic Management (PANS-ATM) (ICAO Doc4444).

3.1.9.1 AIDC message transmission and processing

The system should support the core AIDC messages recommended in Asia/Pacific Regional ICD, such as ABI, CPL, EST, MAC, CDN, ACP, REJ, TOC, AOC, EMG, MIS, LAM, and LRM.

The system should be configurable in supporting variations in AIDC processing and messages dependent on the mutual agreements with each adjacent Control Unit or FIR.

Commonly, the system is recommended to transmit AIDC messages automatically,and be capable of processing received AIDC messages automatically.

The system is suggested to transmit ABI, EST, PAC, and other messages automatically according to the AIDC handover conditions and the status of the flight plan.

The system is proposed to transmit TOC and EST messages manually through the HMI in specific cases. The flight data operation position (FDOP) is capable of processing erroneous and irrelevant messages manually.

For received messages that failed syntactic and semantic checks, the system should send such messages to a message queue to process by controllers manually.

The system is expected to alert controllers of any unsuccessful transmission of AIDC messages due to communication fault, rejection by the receiving adjacent Control Units or FIRs, or failure to receive an expected application response from the receiving Control Unit within a time threshold.

3.1.9.2 AIDC Handover

The system should be able to trigger AIDC handover automatically, depending on configured AIDC handover parameters, which may include handover points, height, time, adjacent Control Unit, etc.

The system could allow controllers to initiate AIDC handover manually.

3.1.9.3 AIDC Coordination Process

Generally, the AIDC handover is mainly fulfilled by exchanging a variety of messages. The AIDC procedure is composed of three phases forming a standard AIDC process:

a. Notification Phase;

b. Coordination Phase; and

c. Transfer of Control Phase.

The standard AIDC procedure could be simplified according to the handover agreement between adjacent Control Units. For example, taking advantage of several indispensable messages regarding EST/PAC, ACP, TOC, AOC, and LAM, the handover could be simplified into two phases coordination and handover. The procedure is shown in the figure below:

AIDC phase	ATS Control Unit A	Direction	ATS Control Unit B
Coordination	Send EST/PAC N minutes before the handover point	→	
		←	Automatically Reply with LAM
		←	Automatically Reply with ACP
	Automatically Reply with LAM	→	
Transfer of Control	Send TOC automatically/manully before the handover point	→	
		←	Automatically Reply with LAM
		←	Automatically/manually reply with AOC
	Automatically Reply with LAM	→	

Figure 3.1.9-1 Simplified AIDC procedure

The system could update the flight state of a flight as it transits through the AIDC coordination phases.

After completing a coordination process, the system could automatically update the concerned flight plan with the cleared flight profile.

The system is expected to alert controllers when coordination with an adjacent Control Unit or FIR is not completed within certain time thresholds before Estimated Time over Boundary RP, Estimated Time of Departure, etc.

3.1.10 Human Machine Interface Function

HMI (Human Machine Interface), as an important part of the ATMAS, is the medium for interaction and information exchange between the system and controllers. Operational users can monitor air traffic situations and modify flight plans and other relevant information through tphysical peripherals and/or onscreen control interfaces. Technicians can monitor the status of the ATMAS and perform technical maintenance operations as well. HMI design of ATMAS should consider the day-to-day operation

of air traffic controllers to provide a user-friendly interface for controllers to perform their duties effectively and efficiently. In general, the design should facilitate safe, efficient, and sustainable control of air traffic based on the following principles:

a. Accurate presentation of air traffic data

b. Timely presentation of air traffic data

c. Automatic data validity checking including operator input

d. Input options automatically limited to valid data selections

e. Allow a variety of user-friendly input methods (e.g., keyboard, number pads, mouse, etc.) for data entry by controllers

For friendly use,, the HMI function is recommended to include at least as follows:

a. Providing graphical interfaces and functions for different positions, such as supervisor position, controller position, flight data operator position, etc.

b. Providing multiple position modes (e.g., Normal, Degraded, Bypass, and Mono) if required.

c. Providing variable user modes (e.g., Operational, Free, Shadow, and Replay) if required.

d. Providing a complete set of HMI configuration, including track display, HMI layout, menu setting, color management, mouse/keyboard functional definitions, map management, etc.

e. Providing the operation interfaces for flight plan modification and control/management of onscreen information.

f. Providing warnings related to HMI.

3.1.10.1 Controller Position

The controller position provides controllers with relevant information required for air traffic control, helping the controller be fully aware of the situation and manage the aircraft in the responsible area. The specific functions are suggested as follows:

a. Display system tracks, multi-radar tracks, multi-ADSB tracks (if available), multi-WAM tracks (if available), flight plan tracks, and bypass tracks.

b. Enable interactive flight operations such as aircraft handover and acceptance, manual correlation, level assignment, and coordination status.

c. Allow screen operations such as zoom in, zoom out, off-center, measurement, window movement, label rotation, etc.

d. Manage map display.

e. Display and edit Flight plans.

f. Post and display electronic flight strips/flight data list.

g. Display system information.

h. Personalize position parameters and display.

i. Other relevant information required for operations.

3.1.10.2 Supervisor Position

The supervisor position typically has the same display and operation interface as the controller position. In addition, the system is advised to provide other functions on the supervisor position, such as online operation parameters settings and management, SSR code management, sector management, automatic handover setting, position alert management temporary/global map setting, etc.

3.1.10.3 Flight Data Operator Position

The flight data operator position is capable of displaying relevant flight plans in a flight list containing all the flight information fields, and enabling the online flight plan editing function and AFTN message display, query, error correction, and sending function.

3.1.10.4 Technical Management Position

The technical management position provides a graphic interface enabling efficient system maintenance and software management. The specific functions of the position are generally as follows:

a. Technical parameters management.

b. Operational parameters management.

c. Software configuration and management.

d. User Management.

e. Map generator.

3.1.10.5 Position Mode Switch

The system could be designed to provide controller positions with various user modes to cater to different operational needs. Below is an example of different user modes.

States/Administrations could define their own set of position modes according to the operational need.

a. Operational mode

The position in operational mode is allocated with sector and provides ATC service.

b. Free mode

The position in free mode is sector-free and functionally limited, such as read-only access to flight data.

c. Shadow mode

The position in shadow mode provides real-time monitoring of the operational position of specific sectors and the functionally limited, such as read-only access to flight data.

d. Replay mode

The system only provides playback function in replay mode and cannot be used for ATC service.

3.1.10.6 Track Display

The graphical representation of a track usually includes a track symbol located at the current position of the aircraft, a label, a label leader, a selectable velocity vector, and a selectable number of track history dots, etc.

The system should be able to display the accurate position of the track, generated and updated according to surveillance source.

From experience, the system can customize of the display of information in different layout types to show information on the label in different levels of detail depending on he operational needs.

The system is suggested to support label action such as CFL modification, handover request and acceptance, runway modification, STAR allocation, etc.

3.1.10.7 Map Display

The system is recommended to be capable of the offline definition of the system maps, the online creation of the local maps by individual controller position, and the online creation of the Global Map, temporary Restricted / Danger Area maps, etc. by the supervisor position.

The online created local map, global map, and temporary restricted / danger area maps could be saved and restored automatically during system restart.

Note: Controllers should use the online creation of maps with caution to avoid safety impact.

3.1.10.8 Flight Plan Window

The flight plan window is suggested to support displaying and modifying of the flight plan data fields such as SSR code, ACID, flight rule, aircraft type, wake category, departure airport, destination airport, requested flight level, route, field 18 data.

The flight plan window is recommended to enable at least the following flight plan functions: creation, deletion, modification, flight strip printing, etc.

3.1.10.9 Electronic Flight Strip Function (if applicable)

Electronic Flight Strip Function could be implemented as a part of HMI function, from which controllers can access to do handover, acceptance, filtering, and sorting function. The electronic flight strips can be sorted and displayed by flight plan state, route fixes, time information, etc.

3.1.10.10 System Information Display

It is recommended to provide in the HMI system information, including device failure, operational data, feedback of operation, system status information, etc., for controllers' awareness of system status.

3.1.10.11 Tracks Quick Search

It is recommended that the system has a quick search function to search a track with complete or partial search criteria of the callsign, SSR code, departure/destination airport, or other information. The matching track will be highlighted to the controllers.

3.1.10.12 Track/Label Filtering

It is recommended that the system provides a track and/or label filtering function.

The system could filter tracks based on upper/lower limitation of level or SSR code, and search the track label by part or entire of ACID.

Enabling and disabling the flight plan track display could also be achieved via the HMI.

3.1.10.13 Personalized Position Parameters Setting

The system is recommended to provide flexible configurations, including label layout, HMI colors, mouse and keyboard functions, color configurations of all elements, menus, and windows according to operational demand.

3.1.10.14 SSR Code Duplication Warning

When detecting multiple aircraft with the same SSR code in a certain area, the system is suggested to provide an SSR Code Duplication warning to the controller.

3.1.10.15 AIDC Coordination Failure Warning

On failure of AIDC coordination, the system is advised to provide visual indications to controllers on track labels and electronic flight strips.

3.1.10.16 SPI Indication

The system provides visual indications to controllers at the reception of SPI information transmitted by the aircraft.

3.1.11 Recording and Playback Function

The Recording and Playback function enables the recording of operational data of ATMAS. It allows synchronized playback of the air traffic situation, controller-pilot communication, and controller actions in the air situation display for incident analysis and investigation. The recording and playback could be implemented as part of ATMAS or via an external recording system. The design should aim at reconstructing the actual scenario as accurately as possible.

3.1.11.1 Recording Function

The Recording Function for ATMAS should maintain a continuous recording on all controller working positions. The following data and display could be considered to be recorded by the system:

a. Screen data of controller working positions, including an identical picture of windows, temporary maps, and any alert /warning, etc.

b. Surveillance data, including SDP track output, radar data, ADS-B data, etc.

c. Controller input actions on keyboard or mouse.

d. Messages of external interfaces such as AIDC messages, meteorological messages such as GRIB, AFTN, ICAO messages (including flight plan data), ADEXP messages, data links such as PDC, CPDLC, ADS-C.

e. System data such as system event data, system performance data, system log, etc.

The recording of data and display is suggested to be synchronized with a deviation of less than 1 second or an acceptable tolerance according to the local operational needs. The deviation is suggested to be as minimal as possible to allow the best reconstruction of the recorded scenario during playback.

The Recording Function should ensure no loss of data at all times during the operation of ATMAS, and the recording process should not render any degradation to the performance of other functions of ATMAS. Recorded data should be retained for at least 31 days or a duration which satisfies local regulatory requirements. Some States may require a longer recording period for other purposes e.g., requests for data from other organisations. Periods of 90 or 120 days may be more applicable for such needs. Appropriate warnings are needed for notifying maintenance personnel when storage capacity drops below a certain threshold so that appropriate action could be taken to resolve the situation.

3.1.11.2 Playback Function

The ATMAS or external recording system should allow the replay of recorded and archived data onto designated or idle controller working positions. In general, a playback session should be able to start up within a short period of time and allow continuous replay of recorded data for a considerable duration according to operational needs. The system shall support synchronized playback of voice data.

The following two modes of playback are suggested for implementation in ATMAS to cater to different investigation scenarios:

a. Passive Playback

   The system replays what was on the screen of controller position with recorded and archived data at the period of recording without interaction

b. Interactive Playback

   The system replays the air situation display of the controller' working position at the period of recording. Controller tools, such as change of display range, range, and bearing line, separation probe, quick look, altitude filtering, map selection, etc., are allowed to be used interactively during playback.

For both of the above playback modes, the system should allow synchronized playback of voice data in order to provide a complete picture of events for investigation purpose. To facilitate the playback, the following controls are recommended to be included in the playback function of ATMAS or external recording system:

a. Start / Pause (Resume) / Stop of a playback session.

b. Selection of different playback speeds at least real-time speed and a range of playback speeds faster than normal recording speed.

c. Allow to select a start time for playback in terms of minute.

d. Selection of playback mode.

The system is suggested to be capable of performing multiple playback sessions simultaneously to allow the playback of the same or different scenarios using different controller working positions. For the same playback session, synchronized replay of recording multiple controller working positions could be considered as part of the playback function to facilitate the investigation of events involving multiple control sectors.

The screen dump function is recommended to capture the screens during playback and store them as files for subsequent printing and exporting. The facility should be provided for exporting the screen dump file to external media using a common image format that could be viewed on computers using non-proprietary software readily available in the market.

3.1.11.3 Data Archiving

Data Archiving function is needed in ATMAS or external recording system for transferring recording data onto removable media for the backup or impounding purpose. The archiving process could be initiated in the system via manual action or configured automatic process based on criteria, e.g., periodic archiving process at a defined time interval or when remaining storage dropped below a certain threshold.

In general, the archiving process should not interfere with normal recording and playback processes in the system as well as other system functions. Appropriate warnings should be given whenever there is an error, or the archiving media is full during the archiving process.

3.1.12 System Monitoring and Control Function

The system is recommended to provide the monitoring and controlling function, and the failure of the monitoring and controlling function should not affect the operation of other modules.

3.1.12.1 Monitoring Function

The system is suggested to monitor in real-time the operational status of each module and display the significant events. Alerts could be raised in levels according to severity, and log files are generated accordingly. The system should be able to search, print, and export logs by time. Usually, the system monitoring function mainly includes:

a. Interface status monitoring.

b. Hardware operation status monitoring.

c. Software operation status monitoring.

d. Network equipment operation status monitoring.

e. Database operation status monitoring.

f. System capacity and resource usage monitoring.

g. Important system events monitoring.

3.1.12.2 Control Function

In general, the system controlling function mainly includes the operations of start, stop, restart, and switch as follows:

a. Start and stop the entire system.

b. Start and stop single surveillance source.

c. Start and stop a single server.

d. Start and stop network.

e. Switch between redundant equipment and networks

f. Start and stop software modules.

3.1.13 GNSS Time Synchronization

The system is suggested to be able to access an accurate time source, synchronize external GNSS signals, and calibrate internal system time based on the NTP (Network Time Protocol), so that the system time is consistent with the UTC.

The system is capable of receiving multiple external clock sources and switching among them automatically or manually.

If all the external clock signals are interrupted or lost, the system is proposed to synchronize with internal time correspondingly.

Unified time within the system is recommended to be shown on the HMI and provided for surveillance data processing, flight data processing, monitoring and controlling, recording and playback, etc.

3.2 System Optional Function

3.2.1 Extended Surveillance Data Processing

Except for PSR and mode A/C radar data, the extended surveillance data include Mode S radar data, ADS-B data, WAM, and other surveillance data, which contain more target information, such as DAP parameters and accuracy, etc.

The system is encouraged to be able to process the extended surveillance data to provide higher quality tracks and supplementary data.

The systems should be able to receive, process and display data from all the connected sources in an integrated manner. When extended surveillance data is connected, in addition to the essential surveillance data processing requirements (see 3.1.1), the following additional requirements is suggested to be met.

The system can filter anomalous data according to the sensor type. Anomalous data filtering can be carried out during pre-processing, mono-sensor data processing, and multi-sensor data processing. Some suggested anomalous data filtering is as follows:

a. The system should check the integrity of mandatory data items in the ADS-B message. And only ADS-B messages containing all mandatory data items will be processed. Refer to ICAO APAC's *GUIDANCE MATERIAL ON GENERATION, PROCESSING & SHARING of ASTERIX CATEGORY 21 ADS-B MESSAGES* for definitions of ADS-B mandatory data items.

b. The system should check the quality indicators of ADS-B data and position accuracy of WAM data to ensure that only the data meeting the operational requirements is used for track tracking and fusion.

c. Downlink aircraft parameters rely on airborne equipment besides surveillance system, and their data quality is affected by more factors. It is recommended that the system should perform the validity and consistency

check of downlink aircraft parameters.

d. Due to the anomalous Mode S SSR DAPs caused by BDS SWAP, it is recommended that the system performs additional verification for Mode S SSR DAPs, for example, cross-verification of SSR DAPs from different radar stations.

The system should be able to use the ICAO 24bit aircraft address and aircraft identification for track tracking and correlation.

The system should be able to process the extra emergencies beyond those indicated by codes 7500, 7600, and 7700, including lifeguard/medical, minimum fuel, and downed aircraft.

Note: DO-260 systems only transmit EMG and don't transmit a MODE A code. DO-260A systems broadcast Mode A information using a test message field. DO-260B systems can transmit the MODE A code. While emergency status can be transmitted by all version of ADS-B transponder. Considering aircraft equipped with DO-260/DO-260A ADS-B transponder in airspace covered only by ADS-B, ATMAS should be able to identify the aircraft's emergency status based on the emergency status of the ADS-B data only.

Mode S radar, ADS-B, and WAM systems can detect aircraft on the ground. The system should be able to process ground/air flags to filter unnecessary ground targets.

The system should be able to process Mode S conspicuity code. Mode S conspicuity code is a standard and non-discrete Mode 3/A code to tell the ATMAS that this is a Mode S equipped aircraft. ATMAS should not use Mode S conspicuity code to identify the aircraft, correlate the flight plans. Instead, the ATMAS should make of the Mode S interrogated information, such as aircraft identification or ICAO 24bit aircraft address, to identify the aircraft and correlate the flight plan. Asia Pacific region adopts "1000" as Mode S Conspicuity Code.

3.2.2 Extended Correlation

On the basis of the original automatic correlation conditions, the system could further perform correlation for a surveillance track and a flight plan based on the aircraft's 24-bit address or Aircraft Identification (ACID) provided by the aircraft downlink parameters.

The system is recommended to give prompts on the correlated track label when SSR codes, aircraft 24-bit address, or ACID of the flight plan mismatch the ones of the surveillance track.

3.2.3 Extended Alert, Warning, and Advisory Function

In addition to the Safety Net Functions stated in paragraph 4.1.5, States/Administrations could consider implementing the following extended set of alert, warning, and advisory functions in ATMAS according to the local environment and operational needs. These optional functions aim at enhancing operational efficiency and possibly reducing controller workload.

3.2.3.1 Departure No Transgression Zone (DTZ)

The Departure No Transgression Zone (DTZ) function informs the controller if a track is predicted to infringe a Departure No Transgression Zone area within a predefined time interval, or has already infringed a Departure No Transgression Zone area. The DTZ function also may suppress improper STCA generate between two normal flights in DMA(Departure Monitoring Area).

The DTZ is an offline defined volume capturing the departure path of aircraft taking off between two extended runway center lines which aircraft is not allowed to penetrate. It shall be possible to define DTZ area off-line by specifying associated DMA (Departure Monitoring Area).

When a track is predicted to infringe an DTZ area within a predefined time interval, or has already infringed an DTZ area, the system shall provide DTZ warning.

a. The system shall generate DTZ warning for a track predicted to infringe an active DTZ area within a predefined time interval.

b. Visual and acoustic signals shall be provided on concerned controller positions on DTZ warning is raised. The system shall enable operators to acknowledge the raised warning to cancel the acoustic alarm.

c. The system shall be allowed to define multiple DTZ areas and activate or de-activate online.

d. The system shall have STCA filtering function within an active Departure Monitoring Area.

3.2.3.2 No Transgression Zone Alert

In the context of parallel approaches, No Transgression Zone (NTZ) is generally defined as the corridor of airspace between two extended runway centerlines that aircraft are not allowed to penetrate. The purpose of the NTZ alert is to warn controllers of a predicted or actual unauthorized penetration of NTZ by aircraft during the final approach. An appropriate look-ahead of the predicted NTZ alert is important to allow enough time for controllers to respond to the situation.

When a track is predicted to infringe an NTZ area within a predefined time interval or has already infringed an NTZ area, the system shall provide an NTZ warning.

e. The NTZ warning function includes two parts: NTZ pre-warning and NTZ warning.

f. The system shall generate a pre-NTZ warning for a track predicted to infringe an active NTZ area within a predefined time interval.

g. The system shall generate an NTZ warning for a track having infringed an active NTZ area.

h. Visual and acoustic alerts shall be provided on concerned controller positions

on which pre-NTZ or NTZ warning is raised. The system shall enable operators to acknowledge the raised warning to cancel the acoustic alert. .

i. The system shall be allowed to define multiple NTZ areas and activate or de-activate online.

3.2.3.3 Medium Term Conflict Detection Advisory

Medium Term Conflict Detection (MTCD) is designed as a safety advisory tool that provides warnings to controllers for potential conflict for "aircraft-to aircraft" or "aircraft-to-airspace" encounters up to a looking ahead time. The aim of MTCD is to proactively provide possible conflict in advance during sector planning to reduce tactical workload.

States/Administration should consider the following factors to determine the applicability of MTCD to their local environment:

a. Suitability of local airspace structure to cater for long look-ahead time.

b. Local air traffic control procedures.

c. Whether airspace is under Free Route Operation.

d. CNS capability to support application.

MTCD advisory could be considered implemented in the following situation:

Potential or risk conflict detected based on current track trajectory and trial clearance/probe. While a controller inputs a clearance, the MTCD will be calculated, and conflict information, if any, will be provided to the controller and prompt for a confirmation to proceed or abort. If a confirmation to proceed is received, an MTCD warning would be generated to concerned controllers with the jurisdiction where conflict may occur.

The MTCD function shall generate visual and/or acoustic alerts to controllers in air situation display if any pair of aircraft is violating within a look-ahead time, which is a pre-defined separation minimum in the MTCD settings. If more than one type of conflict is implemented, different visual presentations are recommended for each type of conflict to avoid confusion of alerts. In addition, MTCD inhibition could also be implemented based on airspace, flight rule, SSR code groups, ACID, or other conditions applicable to the local environment and operational needs.

3.2.3.4 Route Adherence Monitoring

Route Adherence Monitoring (RAM) monitors if an aircraft (i.e., surveillance track) is following the planned route, as stated in the associate flight plan.

When an aircraft is detected to have deviated from the ATMAS trajectory by more than a defined tolerance, a visual/or acoustic warning shall be generated to alert controllers to take action on the situation.

In the case of the RAM caused by an incorrect Flight route, the warning may be suppressed after the controller amends the flight plan route to reflect the actual flight path by a user-friendly route modification interface (e.g., Graphical Re-route function).

The RAM warning can be acknowledged manually.

The RAM route model could be defined by the width of the corridor and the radius of the waypoint. It is recommended that the system is designed to allow the definition of different route model parameters for specific route segments.

3.2.3.5 Cleared Level Adherence Monitoring

Cleared Level Adherence Monitoring (CLAM) monitors the conformance of the Actual Flight Level (AFL) of an aircraft to the Cleared Flight Level (CFL) issued by the air traffic controller and provides warnings if the deviation between the two levels (i.e., Level Bust) was found after the aircraft has been level-off. To reduce nuisance alerts, the system could allow an adaptable tolerance on the deviation of AFL from CFL.

States/Administrations can consider including the use of Mode S DAPs, Selected Altitude, in the CLAM detection logic. Selected Altitude is the altitude inputted by the pilot at the aircraft cockpit based on the clearance from controllers. The checking of Selected Altitude with CFL in the CLAM logic could allow early detection of potential Level Bust and alert controller in advance.

3.2.3.6 Similar Callsign Advisory

Similar Callsign Advisory (SCA) provides advisory to alert controllers when an aircraft carries a similar callsign with another one in the same jurisdiction controlled by a controller. According to the operational environment and local needs, SCA checking rules could be pre-defined or pre-programmed at the design stage of ATMAS implementation. Adaptable SCA checking rules or look-up tables are preferred to allow modification of similar callsign checking process based on the latest requirement and feedback from controllers.

3.2.3.7 Reduce Vertical Separation Minimum Warning

Reduce Vertical Separation Minimum (RVSM) Warning provides alerts to controllers when a non-RVSM approved/compliant aircraft is within or is predicted to enter RVSM airspace.

To provide the warning to controllers, the volume of RVSM airspace would need to be defined in the ATMAS, and the Field 10 of ICAO flight plan would be checked to see if the aircraft is RVSM-approved. Visual indication would be generated if the aircraft did not match the airspace requirement on RVSM.

3.2.3.8 Position Report Monitoring

The ATMAS trajectory needs to update for every point inside the route model when the aircraft overflow this point. Position report permits a more precise calculation of the Estimated Time of Overflight (ETO) of subsequent points along the planned route.

The Position Report shall also include intent information from Surveillance reports for use in trajectory estimation.

To make the maintenance staff aware of the inconsistency in position reports, Position Report Monitoring (PMON) monitors ATO/ETO and provides warnings to controllers when:

a. Actual Time Over (ATO) and/or Estimated Time Over (ETO) of the next report point differs from that calculated by the flight trajectory by more than a defined time interval

b. The ETO of the respective waypoint differs by more than a defined time interval

c. No position report is received for a defined time interval after the ETO missed the position report

3.2.3.9 Last Known Position Display

Last Known Position Display occurs when correlated tracks, uncorrelated, or ADS-C tracks with critical alerts are lost.

The last known position of the track is displayed with a special track symbol to the dedicated position.

3.2.3.10 SSR Inconsistency Warning

For correlated flight plan tracks, when the Mode 3/A code in the surveillance data is inconsistent with the SSR code in the flight plan, the system is suggested to raise ASSR Inconsistency Warning.

NOTE: 24-Bit Code Mismatch Warning and Callsign Mismatch Warning, please refer to chapter 3.2.4.2.

3.2.3.11 PBN Capability Indication

The PBN function shall provide PBN indicator and/or PBN route mismatch indication for controllers in order to indicate whether the aircraft match the RNAV/RNP Route or Arrival.

When the PBN indicator is presented in the flight plan message, the system is suggested to determine the PBN capability of the aircraft and inform controllers of the PBN capability.

It is proposed that the system could define different priorities of PBN capability display for each logical position.

The PBN function shall provide PBN route mismatch indication to the controllers:

a. When PBN route is mismatch between offline defined and PBN of flight plan message.

b. It shall be raised at offline define time prior to the route segments.

c. It shall be able to offline turn on or off.

3.2.3.12 CFL Predicted Detection Advisory

In order to support controller assignment of CFL and further reduce tactical work load, CFL Predicted Detection (CPD) could be implemented as a Controller advisory tool.

With the similar calculation method used in MTCD, CPD uses a shorter look ahead time to pre-calculate all possible vertical trajectories based on adjacent flight levels and identify potential conflicts. When controllers open a clearance list, the results of CPD detection will highlight available CFLs for assignment and the conflict risk with each. Controllers can then assign an appropriate CFL in accordance with the overall tactical situation while aware of any additional action that the highlighted conflict may require.

3.2.3.13 Downlink Aircraft Parameters Related Warnings

Please refer to section 3.2.4.2 for Downlink Aircraft Parameters related warnings.

3.2.4 Downlink Aircraft Parameter Processing and Display

It is recommended that the system have the capability to process and display aircraft downlink aircraft parameters (DAPs) from Mode S radars, ADS-B and/or WAM to help controllers have a more integrated view of the aircraft's flight status in the air.

3.2.4.1 DAPs in Consistency Checks

The system is capable of making use of DAPs for report consistency checks, altitude and position tracking. The data in DAPs include the magnetic heading, true airspeed, selected altitude, barometric vertical rate, geometric vertical rate, roll angle, track angle rate, track angle, and ground speed, etc.

3.2.4.2 DAPs Related Warnings

DAPs Related Warnings generally include:

a. 24-Bit Code Mismatch Warning

   For the correlated track, the system can provide an ICAO 24-bit code mismatch warning and present to the responsible controller when the downlink 24-bit code does not match the CODE in field 18 of the FPL message.

b. Callsign Mismatch Warning

   For the correlated track, the system can provide a callsign mismatch warning and present it to the responsible controller when the downlink callsign does not match the callsign in field 7a of the FPL message.

c. Predicted Level Mismatch Warning

The system is suggested to continuously monitor the consistency of Selected Altitude from the airborne equipment and the Cleared Flight Level from the controller. A predicted level mismatch warning will present to the responsible controller if the difference is greater than the pre-defined threshold.

d. QNH Mismatch Warning

The intention of such an alert is to highlight to controllers when there is a mismatch between a flight crew set QNH and that the QNH applicable to the airspace that the aircraft is operating in. This alerting uses DAPs provided QNH to compare against the ATMAS QNH value.

Like any alerting, QNH alerting can produce spurious alerts that can result in over or under reaction by controllers. States considering any display of QHN mismatch on the ATMAS HMI should consider:

- Risk/benefit-based implementation and assessment of alerting accuracy
- Limiting the application to areas of specific concern such as arrival or departure procedures that are affected by terrain or traffic density.
- Consideration of mitigations for when aircraft QNH and system QNH may be different but acceptable in application e.g., aircraft transiting from an Area QNH to and Aerodrome QNH for arrival.
- Alternatives to on screen alerting – such as summary daily reporting, that can be used to identify trends and areas of higher occurrence and appropriate operational or technical action.

e. Resolution Advisory (RA) alert indication

The system may provide a RA alert indication and present on the track label to the responsible controller when a RA report is received via the airborne ACAS system.

Note: The display of ACAS Resolution Advisory Report in ATM automation system can be turned on or turned off by user, and it is not recommended by IFATCA. The user is suggested to do the relevant safety evaluation before applying this function.

3.2.4.3 DAPs Display

The system is suggested to provide a downlink data window, which is used to display the downlink aircraft information. Displayable information is recommended to include: SSR code, Target aircraft address, Target aircraft identification, Magnetic heading, True airspeed, Selected altitude, Final state selected altitude, Barometric vertical rate, Geometric vertical rate, Roll angle, Geometric vertical rate, Track angle rate, Track angle, Ground speed, Velocity uncertainty, Position uncertainty, Indicated airspeed, Mach number, Barometric pressure setting, etc.

The information in the DAP Window can be configured per logical positions, such as the airborne downlink data to display and the unit of data items, etc.

3.2.5 Arrival and Departure Manager Functions

3.2.5.1 Arrival Manager

The purpose of Arrival Manager (AMAN) is an advisory tool to optimize the flight landing sequence with suggested arrival interval and reduce flight holding time in the air, thus minimizing delay and providing control actions and advisories. These are achieved by considering factors such as airport runway configuration, runway rate, weather conditions, stand arrangements, etc.

The essential functions of AMAN include flight sequencing, spacing, and delay advice.

a. Flight sequencing and spacing function

   According to the calculated four-dimensional trajectory, AMAN calculation takes into account the metering point or runway spacing and performs a sorting calculation to obtain the target landing time (TLDT) and the arrival sequence. The tool recalculates the TLDT, when it obtains a new estimated landing time (ELDT), or when ATC reissues a request to revise the metering point or runway spacing.

b. Delay advice function

   The delay advice generated by AMAN includes re-route, holding pattern, point merge system (PMS), and delay time indication. The system gives different delay advice according to the time of the delay.

AMAN may interact with ATFM or CDM system to follow a strategic plan to balance capacity and demand within different volumes of airspace and airport environments. There are many types of ATFM measures. Their lifetime typically spans the pre-tactical and tactical phases of the ATFM timeline. Fix balancing, Re-routing (mandatory or alternative), Level capping scenarios, and Collaborative trajectory options are included in the lateral aspect. For details and more information, please refer to DOC 9971.

3.2.5.2 Departure Manager Function

The basic function of Departure Manager (DMAN) shall include stakeholders to file Target Off-Block Time (TOBT) for a particular flight and ATC to calculate Target Take-Off Time (TTOT) which in turn issues a Target Startup Approval Time (TSAT). DMAN should also take in Calculated Take-Off Time (CTOT) from Flow Managers to apply ground delay programs.

The purpose of Departure Manager (DMAN) is to allow the operator to plan flights and share the planning decisions with other operators enabling Airport Collaboration Decision Making (A-CDM) to optimize departure sequence. This reduces fuel wastage by reducing taxiing and waiting time on taxiways.

a. Filing TOBT

   When operators and stakeholder file a TOBT, it enables ATC to know when the aircraft will be ready for pushback. This enables better predictability of flight readiness

b. Calculating TTOT and TSAT

   With a known TOBT, DMAN will calculate a take-off time for this flight. If take off time is free of conflict, TSAT will be TOBT. If take off time is occupied by another flight, DMAN will find the next available take off time base on system set departure interval and wake constraint, forming the TTOT. TTOT will be back calculated by deducting taxing time to runway and pushback time deriving a TSAT. In this case, TSAT is not the same as TOBT thus a delay advice in gate is issued.

c. Taking CTOT into consideration

d. If ground delay program is needed, Flow Managers will issue a specific CTOT to a flight. This will then replace TTOT of the flight and DMAN will back calculate by deducting taxing time to runway and pushback time deriving a TSAT. This CTOT shall be within system configured constraint and other non CTOT flights to be sequenced around it.

DMAN can be enhanced by introducing Surface Manager (SMAN) which will feed taxi times to DMAN based on ground sensors rather than a fixed system configuration table.

3.2.5.3 Integrated Arrival and Departure Manager

An Integrated Arrival and Departure Manager (IAD) with enhanced ATMAS to provide comprehensive advisories to air traffic controllers for their safe and efficient management of the arrival and departure traffic in an integrated manner.

3.2.5.3.1 Mixed-mode Runway Capacity Management

To optimize runway utilization and mitigate delays for an airport with runway in mixed-mode operations, the AMAN and DMAN functions in ATM automation system could be tightly integrated for the calculation of arrival and departure sequences of runways.

Without a tight integration, the AMAN and DMAN may create imbalances in the allocation under excessive arrivals or departures on a mixed-mode runway, causing undue delays for the opposite type of traffic. To address this, an Integrated Arrival and Departure Manager could be designed to allow dynamic adjustment of sequencing based on capacity thresholds. Through the input of the maximum arrivals and departures per hour for mixed-mode runways, excess traffic could be offloaded to available runways when necessary. This ensures balanced demand distribution, minimizes delays, and enhances overall airport throughput.

3.2.5.3.2 Handling Adverse Weather Operations in AMAN and DMAN

Thunderstorms or adverse weather conditions impact both arrival and departure operations, requiring specific system adaptations to maintain safety and efficiency.

For arrival traffic, adverse weather may block portions of airspace or arrival routes, forcing aircraft to deviate from published paths. Such deviations cause discrepancies between pre-defined Estimated Time Over (ETO) values and actual flight trajectories. To maintain sequencing stability, the AMAN may incorporate a weather mode that suspends trajectory updates for aircraft within affected airspace, preventing unnecessary recalculation of sequence due to sudden track changes.

For departure operations, severe weather may require temporary suspension of ground activities due to lightning hazards. During such events, affected aircraft must have their Target Start-Up Approval Time (TSAT) and Target Take-Off Time (TTOT) adjusted. The DMAN may incorporate functionality for users to input warning status

of the affected area, enabling automatic re-sequencing of flights and updates to TSAT/TTOT when operations resume.

3.2.5.3.3 **Display** of AMAN/DMAN Advisories

The operational efficiency could be further enhanced through **display** AMAN/DMAN advisories **within the HMI of ATM Automation System**. This **function** could be achieved by direct presentation of AMAN/DMAN advisory data ~~within the HMI of ATM automation system,~~ such as data blocks or flight lists, thereby eliminating the need for referring to separate a AMAN/DMAN display.

Essential information, such as Time to Lose (TTL) or Time to Gain (TTG), and holding advisories, could be considered to display in track labels and flight lists within the ATM automation system. In addition, synchronization of information such as runways and routes mechanism may also be established to ensure accurate and up-to-date information between AMAN/DMAN and ATM automation system.

A comprehensive integration could significantly enhance situational awareness, streamline decision-making processes, and provides air traffic controllers with a unified HMI that consolidates available information and tools.

3.2.5.3.4 Integration with Approach Spacing Tool (AST)

Further operational benefits could be achieved by extending the integration of AMAN/DMAN with the AST. The AMAN/DMAN could provide AST with flow constraints, such as departure slots for mixed-mode runways, special spacing requirements for VIP flights, etc.. These constraints, defined as relative gaps from leading aircraft, help AST to determine optimal spacing for arrival pairs. In addition, IAD could inform AST about runway availability constraints, such as closures or reservation slots, ensuring aircraft land after a specified time. The AST could then generate indicators for air traffic controllers, helping them manage arrivals in compliance with flow constraints and runway restrictions.

3.2.6 System Log Management

For the convenience of anomalies investigation, the system is recommended to be able to collect and manage operational logs and error messages. The operational logs include personnel commands, hardware logs, software logs, external interface logs, etc. The error messages consist of software and hardware error messages, etc.

The system is suggested to be capable to:

a. Record operational logs and error messages.

b. Display necessary logs on the dedicated positions.

c. Store logs on the disk and classifies by dependency. The user is allowed to sort logs by given conditions.

d. Backup logs automatically or manually, and the backup logs are readable.

e. Store logs on the disk for at least 31 days.

3.2.7 Enhancement Recording and Playback Function

Considering the convenience to user, the system is recommended to extend the capability to integrally record the screenshots of the HMI by way of frames and replay the recording onto designated positions and mobile devices in the form of video.

3.2.8.1 Video Recording Function

The video record refers to the continuous footage derived from the controller's screen as exactly the same as shown. The video recording data is recommended to output as common video formats.

The system is suggested to support the storage of video recording data over a period of time, such as 31 days. By reducing disk occupancy and transferring the data for the method, the system should not be impacted by storage overload.

3.2.8.2 Video Playback Function

It is recommended that the replay of the video record data could be performed on any designated controller position, and the video replay should be synchronized with the Audio.

The system is expected to be able to control the replay, including the selection of replay mode, retrieval replay, change replay speed, start, pause, forward, stop, etc.

3.2.8 Enhanced Wake Turbulence Separation and Pairwise Separation Tools

Amendment 9 of the PANS-ATM (Doc 4444) introduces a new enhanced wake turbulence separation scheme with an alternative set of wake turbulence groups and associated wake turbulence separation minima for approach and departure phases of flights. The new scheme is based on the studies performed by Federal Aviation Administration (FAA) and European Organization for the Safety of Air Navigation (EUROCONTROL) on the wake generation and wake resistance characteristics of different aircraft types, which allows a reduction in wake turbulence separation between some aircraft pairs depending on the leading and the following aircraft type, as well as increases in wake turbulence separation for the smaller and more vulnerable aircraft type.

The ICAO Flight Plan is not required to be updated with the new wake turbulence groups, while air traffic controllers will have to consider seven wake turbulence groups instead of four categories when applying the new wake turbulence separation minima. States/Administrations are recommended to implement Pairwise Separation

Tools function in ATMAS to assist air traffic controllers in the delivery of intended aircraft separation under the new scheme without memorizing all the separation pairs.

3.2.9.1 Wake Turbulence Groups and Airspace

The harmonized ICAO wake turbulence group categorizes aircraft into seven groups, Groups A to G, based on maximum certified take-off mass and wing span:

For the implementation of enhanced wake turbulence separation scheme, States/Administrations have the flexibility to determine the scope of applicability to their airspaces. Also, States/Administrations can consider introducing the reduced minima in total, or in part as the first step, or a combination of these with fewer groups, or updating the local minima based on a partial set of enhanced wake turbulence separation minima, whichever will provide the most benefit given the local traffic mixture.

To facilitate the transition from legacy to new scheme by air traffic controllers, the design of ATMAS should allow the flexibility to adapt the mapping of wake turbulence groups (A to G) to a custom set of abbreviations according to the local operational environment to minimize the impact to air traffic controllers in handling extra wake turbulence groups under the new scheme.

States/Administrations would need to define the specific volume of airspace that operates using ICAO enhanced wake turbulence separation, whilst other airspaces should continue to operate using legacy ICAO wake turbulence categories. For the implementation, the design of ATMAS should allow the use of both wake turbulence categories and groups in the system so that the appropriate wake turbulence categories/groups could be applied based on airspaces, controlling sectors, or controller's roles in accordance to operational needs.

3.2.9.2 Human Machine Interface of Wake Turbulence Groups

The abbreviation of wake turbulence categories/groups is normally displayed in the track labels of an aircraft in the HMI of ATMAS. Since the enhanced separation would only be implemented in the designated volume of airspace, the ATMAS should be configurable to display the appropriate wake turbulence categories/groups to air traffic controllers in accordance with the applied wake turbulence scheme of that airspace. The ATMAS could determine the appropriate scheme by referring to the location of the aircraft and/or roles of the controllers.

In addition, States/Administrations can consider implementing electronic cue cards on the pair-wise aircraft separation under wake turbulence groups in ATMAS to assist controllers in identifying the required separation for aircraft pairs during operation.

3.2.9.3 AMAN Optimization

With the implementation of ICAO enhanced wake turbulence separation, runway capacity is expected to increase in most cases due to a general reduction of wake turbulence separation in popular aircraft pairs of traffic mix. To benefit from the

increase in runway capacity, the AMAN would need to be optimized to provide plans with arrival rate matching the runway capacity. The optimization could involve a change in the AMAN logic on handling extra wake turbulence groups or fine-tuning of system parameters to increase the arrival rate of the landing sequence generated by AMAN to match with the theoretical runway capacity as far as possible.

3.2.9.4 Pairwise Separation Tools

To assist air traffic controllers in handling air traffic under enhanced wake turbulence separation and improve air traffic controllers' consistency in delivering the traffic according to the intended runway capacity, Pairwise Separation Tools are recommended to be implemented. There are several examples of such tools in use, the following tool, namely Approach Spacing Tool (AST), provides an example of the function and application of such tools. The AST could project and present the required spacing graphically between aircraft pairs along the approach sequence and provide advisories, in the form of graphical indicators on the Air Situation Display, to indicate the optimal positions of aircraft along the final approach path.

The AST could be operated in either Distance-based Separation (DBS) or Time-based Separation (TBS). Time-based Spacing could be helpful in safely managing the traffic without reduction in capacity when aircraft ground speed is generally reduced on the final approach due to strong and consistent headwinds. States/Administrations should assess separation standards by considering the performance/accuracy/reliability of local wind prediction, time-to-fly forecast, and other relevant ATC support tools.

Projection of Spacing

During the computation of spacing guidance, the AST should consider all the required separation criteria for a given aircraft pair, including wake turbulence separation minima, minimum radar separation, and dependent parallel approach separation. Then the tool would apply the most stringent criteria to ensure that none of the required separations is infringed.

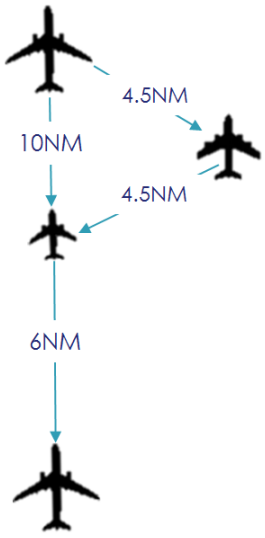


Figure 3.2.8-1 Minimum Separation

Apart from the required minimum separation, the AST would also consider other operational situations or parameters which could affect the optimal spacings between aircraft such as runway occupancy times, specific minimum separation defined for a runway, extra gap required between specific landing aircraft, etc. Together with the operational mode on the aircraft spacing and runway mode, the AST would consider all the above factors and provide spacing guidance in the form of graphical cues illustrated in the subsequent paragraphs.

AST Guidance Cues

Provision of visual guidance on the computed spacing, in the form of graphical indicators on the Air Situation Display, is recommended as part of the AST function. The purpose of visual guidance is to support air traffic controllers in delivering the traffic according to the intended capacity as far as practicable. Two guidance cues are recommended to be implemented by the AST:

a. Final Target Distance (FTD)

b. Initial/Intermediate Target Distance (ITD)

Final Target Distance (FTD) is the appropriate position for the following aircraft behind a leading aircraft at the required minimum spacing applied at the runway threshold. The follower shall always be behind its respective FTD indicator along the final approach path.

Initial Target Distance (ITD) is the optimal distance for the following aircraft to be positioned behind a leading aircraft with the consideration of the required minimum spacing and the deceleration compression buffer. The ITD should be calculated based on the estimated 3D trajectory, the estimated speed profile, environment data (including wind, temperature, etc.), and the target FTD.

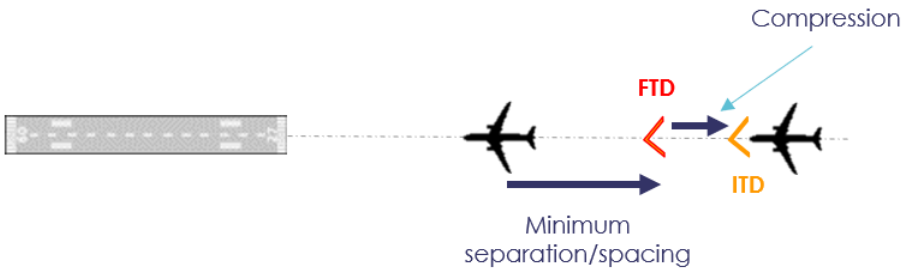
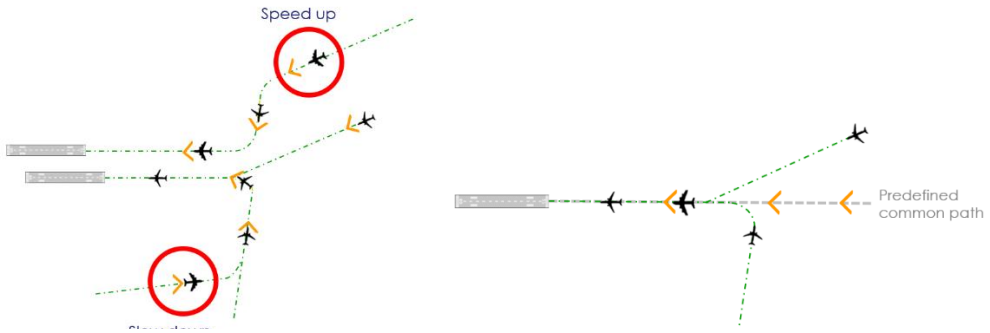


Figure 3.2.8-2 FTD and ITD Guidance

FTD and ITD guidance should be updated at every track update of ATMAS. Depending on the actual operational environment, the position of the FTD and ITD guidance cues could be chosen to implement in AST along:

a. Planned trajectory of the flight.

b. Predefined common path.



(a) Planned trajectory of the flight (b) Predefined common path

Figure 3.2.8-3: Guidance Cues

Final Approach Sequence Management

The planned Final Approach sequence is crucial in the generation of AST Guidance Cues by providing necessary information to the AST in determining the required wake turbulence separation between aircraft. Therefore, an accurately planned sequence is important for smooth AST operation.

If State/Administration has implemented Arrival Manager (AMAN) in its operation, its arrival sequence data would be the best candidate for processing by the AST. If AMAN is not available, an arrival sequence based on the flight trajectories from ATMAS would be an alternate option for AST processing.

Monitoring Aids in Approach Spacing Tool

To ensure the appropriate spacing between arriving aircraft can be delivered, the following monitoring aids could be implemented for aircraft under management by AST for detecting catch-up scenarios, infringement of aircraft spacing, arrival sequence mismatch, speed non-conformance, etc.

3.2.9 Operational Data Synchronization

In order to provide continuous ATM service in case of the ATMAS suffers from technical problems, system failures, or other critical anomalies, some ATM centers are

configured with two types of ATM automation systems, which work in main and backup mode.

The Operational Data Synchronization Function serves for both master and backup ATM automation systems deployed in the same ATM center. This function enables the system to synchronize operational data to the backup system when in master mode. This function also synchronizes the system when in backup mode with operational data from other master systems.

3.2.10.1 System Main/Fallback Mode

The system provided with the operation data synchronization function shall have two working modes at least: main and fallback mode. These two working modes can be switched manually.

In the main mode, all of the system functions operate normally and output synchronization data in real-time.

In the fallback mode, the system receives and processes the synchronization data in real-time. System functions run as usual, apart from the transmission of messages to external systems.

3.2.10.2 Synchronous Data

Data synchronous data between the main and fallback systems is recommended to include basic flight data and operational setting data as follows. Users can adjust the data to be synchronized based on the operation needs:

a. Basic flight data comprises flight plan information, allocated runway, SID/STAR, etc.

b. Operational setting data includes sector allocation, airport runway status, position settings, online area creation or modification, etc.

3.2.10.3 Synchronization Trigger

Data synchronization is recommended to carry out periodically at a pre-defined time interval. In addition to the periodic data synchronization, the synchronization could be triggered by pre-defined events, for examples:

a. Each item in the flight plan information changed.

b. Each flight plan state changed

c. Each operational setting changed.

3.2.10 Statistics and Analysis Function

Statistics and analysis function could be implemented for generating reports on the surveillance data, flight plans, alarm information, and traffic flow data.

Flight data that can be extracted from the ATMAS database at a minimum would have the following correlated data fields: aircraft ID[1], number of aircraft movements in the airspace sector and controlled airspace[2], flight rule[3], flight type[4], number of danger area infringements, number of rejected & accepted uplink messages, number of rejected & accepted downlink messages, number of uplink & downlink delivery timeouts, number of received and transmitted messages, number of AIDC messages[5] (transmitted, received, rejected, and accepted) and the total number of flights.

Presentation of correlated data fields would be in the form as shown in Appendix B: **Table 3.2.10-1A for Flight Specific Flight Data and Table 3.2.10-1B for Collective Flight Data,** where these are organized according to the date and/or time (in hour resolution[6]) of interest. The date and/or time window selection will allow flexibility in the period of data of interest. Hence, the correlated data will not be limited to fixed time periods, e.g., daily, weekly, or monthly. Nonetheless, a fixed time period can be the default setting and, in any case, the selected time period that defines the scope/coverage of the data that are being presented in the interface will always be visible to the user.

The data fields for **Collective Flight Data** will refer to the specified time periods. For example, data for the Total No. of Flights will be presented for the Day if the selected Time Period is set to Day; the Total No. of Flights will be shown in each sector for the Airspace Sector; and so on. Furthermore, the Total No. of Flights data need not be equal to the Total No. of Flights in the Airspace Sector when the Total No. of Flights in each Airspace Sector is summed together for the reason that the flight may have traversed more than one Airspace Sector. The same principle is applied in the presentation of other correlated data fields.

Correctness and accuracy of the information in the presented data should be verified prior to deployment of the ATMAS into live operation. This can be arranged as one of the test cases for each data field that the vendor must be able to comply verifying its performance.

Similarly, surveillance data correlated with flight data records can be retrieved from the ATMAS. These data are grouped into Flight Specific Surveillance Data.

Flight Specific Surveillance Data should be able to provide information on the type of surveillance track that is/are correlated to the flight. For instance, in a single flight data record, there is information if Secondary, Mode S, Multilateration and ADS-B tracks are correlated to the flight. This applies to an ATMAS interfaced with multiple surveillance technologies. For more than one source of the same type of surveillance

[1]ICAO 2012 strictly enforces that this figure should be letters and numbers only, devoid of dashes, spaces, or other punctuation.

[2]sorted into ARR, DEP, Overflight, and Domestic Flights

[3] "I" for IFR, "V" for VFR, "Y" for when the flight will be initially IFR followed by one or more subsequent flight rules changes, and "Z" for VFR first with any number of subsequent changes.

[4] "S" for Scheduled Air Service, "N" for Non-scheduled Air Transport Operation, "G" for General Aviation, "M" for Military, and "X" for everything else

[5] applicable to flights involving the exchange of AIDC messages with adjacent FIR/ATS Unit

[6] the selection of time period will allow up to values in hour, e.g., 19 March 2021 0900-1000 UTC

technology, information about the source of that correlated track data should be provided, e.g., ADS-B Source: 2 (ADS-B track data taken from the second ADS-B sensor defined in the system). Furthermore, information about the surveillance track quality should also be provided if coasting, normal, low or high. This track information shall be based on the time stamped track at the time of track distribution. The time stamp shall be the reference of the ATMAS for generating the Flight Specific Surveillance Data after selecting the time period of interest. Appendix B **Table 3.2.10-2** illustrates the presentation of **Flight Specific Surveillance Data**.

Considering the number of surveillance tracks generated as system tracks for the ATMAS from a single source alone for one target, it will be quite irrelevant to gather **Collective Surveillance Data. Flight Specific Surveillance Data** would be more useful for the analysis of information generated by the ATMAS.

Data records should be retained for at least 31 days to allow for accident/incident investigation processes. These records should be made available on request to the relevant State safety authority. Where data is sought from an adjacent State, the usual State to State channels should be used. These recordings shall be in a form that permits a replay of the situation and identification of the messages that were received by the ATS system[7].

The data can be used for pre- and post-analysis of Air Traffic Management situation. Peri-analysis process will allow the ATC Supervisor to make the necessary adjustment(s) in the operations, while post-analysis can provide guidance in improving the operational processes and activities complementary to the technical aspect of the operations.

[7] The excerpts from Chapter 7.7.1 of the ADS-B IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT, Edition 8.0 – September 2015 is hereby adopted for all surveillance data sources.

4. SYSTEM DESIGN

4.1 System Architecture

In general, ATMAS should be equipped with adequate redundancy to ensure full availability for all critical, essential, and routine operational functions for air traffic control. Its system architecture should allow extra redundancy to be deployed whenever considered necessary. The architecture of ATMAS should follow the design and implementation principles below:

a. The ATMAS software should adopt modular design and distributed architecture to ensure robustness under adverse operating conditions. For the key function modules, such as FDP and SDP, they should be at least deployed on dual redundant servers in hot standby configuration to ensure a safe and uninterrupted service of ATMAS.

b. To minimize the number of single point failures due to hardware or software, multiple system redundancy and distributed system architecture are recommended.

c. System elements running simultaneously on multiple servers/computers should communicate over redundant networks and the failure of any element should not affect the operation of other system elements.

d. The network of ATMAS should be built on redundant network elements. Each mainstream operational data should be transmitted over independent links and networks. Failure of any network element would not affect the delivery of the main data stream within ATMAS.

e. For large-scale ATMAS designed for handling large traffic volumes, it is recommended to separate the transmission of different types of system data into dedicated networks. For example,

   - Operational Network: for handling the exchange of operational data, including surveillance data, flight plans, etc., between all controller working positions and operational servers.
   - Maintenance Network: for the transmission control & monitoring data, maintenance-related data, system log, replay data as well as distribution of new software and adaptation updates to system elements.
   - Direct Surveillance Access Network: for direct distribution of surveillance data from surveillance sources to controller working

positions as the backup to the system track output of Surveillance Data Processor (SDP) of ATMAS.

- Data Synchronization Network: for synchronizing data between redundant systems of ATMAS.

f. High reliability through redundancy such that at least two identical system elements of the same function operate concurrently and the failure of either one should not affect the satisfactory operation of its counterpart and the system service.

g. Fault tolerant such that the system could continue its service, rather than failed completely, when some elements of the system failed.

h. With fail safe capability such that the system operation should switch over to the fallback system elements after failure or abnormal termination of operational system elements.

i. Apart from having redundant elements within ATMAS, it is encouraged to implement a separate set of ATMAS as the fallback system to main operational system for maintaining air traffic services in case of catastrophic events happen in the main system.

j. For ATMAS managing busy airspaces with high traffic volume, the main and fallback systems are recommended to be provided by different manufacturers to avoid common software faults to both systems.

k. The main and fallback systems are suggested to be physically located at different sites to prevent any single-site accident affecting the operation of ATMAS.

l. External interfaces of the system (such as radar, AFTN, etc.) shall be redundantly configured and the system support automatic/manual switch to the redundant interface channels in case of partial failure.

4.2 Position Roles and Types

Based on functionalities, positions of ATMAS can be categorized into the different types, e.g.

a. Controller Working Position.

b. Flight Data Operator Position.

c. Flow Management Position.

d. Technical Maintenance Position.

e. Data Management Position.

f. Search and Rescue Position.

States/Administrations is suggested to review their operational needs during the design stage of ATMAS in order to adopt the suitable set of positions for their operational environment.

Working positions can be further categorized based on the user roles. For example, in ATC Center, controller working positions are categorized into roles of Supervisors, Executive Controller, Planning Controller, and Assistants under Enroute, Terminal, and Approach Control Streams. In ATC Tower, controller working positions are categorized into roles of Supervisor, Air / Ground Controls, Clearance Delivery, and Assistant.

Access to different system functions by users would be controlled based on the assigned roles. Controllers would be assigned with controlling roles for flights under their jurisdiction, while maintenance engineers would be granted monitoring and control permission on system components of ATMAS. All the roles and permissions should be offline adaptable in the system database by authorized personnel. Once a role has been assigned to an individual, that person can access the data and functions based on the assigned permission.

States/Administrations could consider strategically deploying extra controller working positions as spare in ATC Center and Tower. If a controller working position fails for some reason, controllers can quickly move to a spare controller working position and continue the ATC operation. The design of ATMAS should allow the restoration of air traffic situation display, flight data, electronic flight strips, display settings, and preferences after controllers move to another position to continue their works.

The type and number of positions shall be deployed on each site according to the operational requirement. For the functions of each position, please refer to section 3.1.10.

4.3 Main and Fallback System Configuration

States/Administrations are encouraged to implement ATMAS in Main and Fallback configuration as the baseline in order to be capable of providing uninterrupted ATC service for their airspace. The Main and Fallback configuration can be achieved by two sets of ATMAS or redundant processors of the same system. The Fallback system should possess comparable system scale, configuration, and software functions with the Main system. In addition, the Main-Fallback data synchronization mechanism should be implemented to ensure the readiness of Fallback system for taking up the role as operational system for air traffic control in case of failures in Main system.

For ATMAS managing busy airspaces with high traffic volume, States/Administrations are encouraged to set up the Main and Fallback ATMAS with the same functionalities, capabilities, and capacities but in separated systems in order to enhance robustness and continuity in providing safe, efficient, and orderly ATC services. In busy airspaces, ATMAS failure could be a catastrophic event and cause disruption to air traffic. The Main and Fallback systems with data synchronization mechanism should allow the switch over between Main and Fallback systems

seamlessly when needed. In addition, since the system switch over due to unexpected failure could be a rare event, States/Administrations are suggested to perform the switch over between Main and Fallback systems regularly to get air traffic controllers and engineers familiar with the process.

To further enhance resilience and mitigate risks of complete ATMAS failure, Main and Fallback systems are recommended to be provided by different manufacturers to avoid common software faults encountered in both systems simultaneously. If Main and Fallback systems with the same functionalities, capabilities, and capacities were supplied by the same manufacturer, a full-fledged Ultimate Fallback system from a different manufacturer would need to be implemented such that the Ultimate Fallback system could take up the operation as last resort in case of common software faults in Main and Fallback systems. The Ultimate Fallback should be designed to have the same level of functionalities, capabilities, and handling capacity as Main and Fallback systems in order to sustain possible prolonged control of the airspace.

For the case of (1) Main and Fallback systems from the same manufacturer or (2) redundant processors of the same system, but without the deployment of Ultimate Fallback system, States/Administrations should conduct safety risk assessment on the overall system architecture to ensure that the risks of having common software faults in both Main and Fallback systems simultaneously have been mitigated to an acceptable level.

Real-time data synchronization function shall be implemented between the main and fallback systems to ensure the data consistency and smooth switch when technical failure. The operational data synchronization function can refer to section 3.2.9.

4.4 System Operation Mode

4.4.1 Normal and Degraded Modes

The ATMAS should be capable of operating in normal and degraded modes. Under the normal mode of operation, all the system elements of ATMAS are running normally with full redundancy. Whenever there is any key system function (such as FDP or SDP) fails, the ATMAS should maintain its service and automatically change to a degraded mode of operation. The degraded mode should allow controllers to maintain the provision of air traffic control service using limited system functionalities for a short period of time while the system issues are being fixed by maintenance staff or switching over to the Fallback system is still underway.

Under FDP failure, the ATMAS would be unable to process new incoming flight plans and existing flight data records in the system. Silent coordination across controller working positions may be unavailable as well. To mitigate the impact, controller working position should keep a local copy of system flight plan data at individual workstations so that flight plan association to the surveillance tracks could be maintained using local flight plan copy upon FDP failure. In this case, controllers could continue to identify tracks under their jurisdiction in their air situation display and maintain the control of traffic.

For SDP failure, the processed multi-surveillance track data from SDP would be unavailable in ATMAS. The system should maintain the display of air traffic situation

to the controllers by automatically switching to direct surveillance access mode in which individual sources of surveillance data are directly fed to the controller working positions without the need for an SDP. In this case, controllers can continue the air traffic control operation using directly fed surveillance data while the SDP issue is being investigated and fixed by the maintenance team.

In case of other failures, the system should display impacted functions and operate smoothly in the absence of degraded functions. When the failed function recovers, controllers are allowed to manually upgrade to the normal mode on the position.

4.4.2 Main and Fallback Modes

For the case with Main and Fallback systems in place, the system should be capable of configuring between Main and Fallback modes. In the Main operation mode, the system would be responsible for processing AFTN messages, assigning SSR codes, responding to controllers' input, communicating with external systems, and synchronizing data to the Fallback system. In the Fallback operation mode, the system would not process carry out the above processing but would receive synchronization data from the Main system and keep the system database up-to-date for operation switchover at any time. Since the Main-Fallback switchover involves the coordination across different controlling streams and technical maintenance team, it is suggested that user should manually switch the Main/Fallback modes at the dedicated position of ATMAS for centralized coordination on the switchover.

Regarding the HMI design, the operational modes should be shown at the controller working positions and technical maintenance positions with prominent indications in case of any degradation of system functionalities. For cases with Main and Fallback systems in operation, the ATMAS should clearly indicate the current mode of operation, Main or Fallback, in its HMI to ensure that controllers are working at the correct system.

4.5 Capacity and Performance

4.5.1 System Capacity

Normally, system capacity is used to describe the maximum processing capabilities, which is determined by the air traffic flow, operation requirements and system architecture, etc. It is suggested to include the following items at least:

a. System area.

b. Maximum number of sectors.

c. Maximum number of positions.

d. Maximum number of tracks displayed/correlated/under-controlled.

e. Maximum number of flight plans existing in the system.

f. Maximum number of flight plans activated simultaneously.

g. Maximum number of surveillance sensor inputs.

h. Maximum number of adjacent centers with AIDC protocol.

4.5.2 Response Time

Response time is used to measure the speed, stability and resource usage of hardware and software in the system, the following recommended criteria are listed by experience, States/Administrations are encouraged to consider during the system planning stage.

a. The duration to start up a single node should be not more than 5 minutes.

b. The duration to cold start up whole system should be not more than 30 minutes.

c. MTBF of surveillance data processing should be not less than 100,000 hours.

d. MTBF of a single workstation should be not less than 10,000 hours.

e. Maximum deviation of clock synchronization should be not more than 100 milliseconds.

4.5.3 Performance of Surveillance Data Processing

Performance of surveillance data processing is used to measure the accuracy and ability of the system surveillance data processing, the following suggested values would be considered for system planning.

Adhering to the RSUR-5NMSEP_ER_Tier- A in the RSUR manual as attached in Appendix C, recommended surveillance performance requirements for 5 NM horizontal separation are mainly as follows:

a. The surveillance Data Update Interval (DAT_{UI}) should be less than or equal to 5 seconds.

b. The Probability of Update (PoU) of horizontal position and pressure altitude should be greater than or equal to 97%.

c. The Horizontal Position RMS error (HPERMS) should be less than or equal to 230 m or the Horizontal position error distribution at 95% (HPE95%) should be less than or equal to 400 m.

d. The Pressure Altitude INTegrity (PAINT) and Mode A code Identity. (IDINT) should be less than 0.1%.

e. The Pressure Altitude INTegrity (PAINT).should be less than 0.1%.

f. Maximum Data Age of a parameter of Horizontal Position (HPMDA) should equal to 15s and Maximum Data Age of a parameter of Mode A code Identity. (IDMDA) should equal to 30s.

Adhering to the RSUR-3NMSEP_TMA_Tier- A in the RSUR manual as attached in

Appendix C, recommended surveillance performance requirements for 3 NM horizontal separation are mainly as follows:

a. The surveillance Data Update Interval (DAT_{UI}) should be less than or equal to 5 seconds.

b. The Probability of Update (PoU) of horizontal position and pressure altitude should be greater than or equal to 97%.

c. The Horizontal Position RMS error (HPERMS) should be less than or equal to 150 m or the Horizontal position error distribution at 95% (HPE95%) should be less than or equal to 260 m.

d. The Pressure Altitude INTegrity (PAINT) and Mode A code Identity. (IDINT) should be less than 0.1%.

e. The Pressure Altitude INTegrity (PAINT).should be less than 0.1%.

f. Maximum Data Age of a parameter of Horizontal Position (HPMDA) should equal to 15s and Maximum Data Age of a parameter of Mode A code Identity. (IDMDA) should equal to 30s.

4.5.4 Capacity of Recording and Playback

Generally, the capacity of recording and playback refers to the storage time of data in the system, and the following proposed values would be used as information during system design.

a. The minimum period for recording data archived in the system should be not less than 31 days.

b. The minimum period for system traces should be not less than 31 days.

c. The minimum period for raw surveillance data archived in the system should be not less than 7 days.

4.6 External Interfaces

External interfaces are used to communicate with other systems, including receiving and transmitting messages.

The selection, configuration, and design of external interfaces can be determined by environmental conditions, operational requirements, and long-term schemes.

States/Administrations can determine the external interface of the ATMAS. In general, ATMAS includes the following external interfaces:

a. Surveillance data interface

   - Radar interface

The system is recommended to manage dual inputs from individual radar with serial or Ethernet interface and be able to receive and process the plots/tracks in a standard format, including ASTERIX.

- ADS-B interface

  The system is suggested to manage dual inputs from individual ADS-B with serial interface or Ethernet and be able to receive and process ADS-B data in a standard ASTERIX CAT021format.

- WAM interface

  The system is recommended to manage dual inputs from WAM data processing center with Ethernet, and be able to receive and process WAM data in a standard format, including ASTERIX CAT020from Ethernet.

b. ICAO message interface

The system should be able to receive and transmit the ICAO messages automatically in IA5 or ITA2 format with the asynchronous serial interface.

c. AIDC Interface

The system should be able to exchange the AIDC messages compliant with the standard AIDC protocol on the AFTN line and/or dedicated line.

d. Meteorological interface

- QNH interface

  The system should be able to process the QNH data from the AWOS system with an asynchronous serial interface.

- GRIB interface

  The system should be able to receive and process the GRIB message from Ethernet.

e. Data synchronization and exchange interface

- System track interface

  The system should be able to receive and transmit the system tracks with serial interface and Ethernet in ASTERIX CAT 062.

- Flight data exchange interface

  The system should be able to receive and transmit flight data with serial interface and Ethernet in the message format agreed.

- Audio playback interface

The system is recommended to be able to provide the interface to synchronize the playback activities with the audio in an agreed data format through a serial interface or Ethernet, which can keep the playback of audio and situation awareness synchronization in time.

f. GNSS time interface

The system should be able to receive the GNSS time from the time reference system with Ethernet NTP protocol or serial interface.

g. CPDLC interface

The system is suggested to enable communication with external CPDLC equipment in compliance with the FANS1/A, ATN B1 data formats through Ethernet or serial interface.

4.7 Systems Interoperability

The system interoperability function enables ATMAS to exchange messages with other external systems to implement information sharing, and it is recommended to include the followings：

a. Data synchronization with fallback ATMAS

Please refer to Chapter 3.2.10.

b. Messages exchange with Tower systems

The system is recommended to be able to exchange messages with the integrated tower system, A-SMGCS, and tower electronic flight strip system. The followings are the major exchanging messages:

- flight plan message

  Providing synchronization information of flight plan messages between ATM system and tower system, including flight plans creation, modification, deletion, cancellation and flight plan life evolution, etc.

- SSR assignment message

  Providing synchronization information of SSR allocation and release between ATM system and tower system.

- Runway operational state

  Providing synchronization information of runway operational states between ATM system and tower system, including DEP, ARR CLOSE, and additional information such as inspection and construction temporarily, etc.

4.8 Cyber Threats and Mitigation

4.8.1 General Description

With the extensive deployment and closer interconnection of Commercial-Off-The-Shelf (COTS) Information and Communications Technology (ICT) Systems which is built on common standards rather than on the conventional proprietary equipment, Air Navigation Service Providers (ANSPs) have been facing increasing challenges in protecting their critical infrastructure and manage potential risks arising from cyber security threats.

To address the growing concerns on cyber security threats, ICAO has extended its SARPs with Annex 17 on Security, with the supplement as in ICAO Doc 8973 "Aviation Security Manual" which sets out the aviation security requirements, including cyber security in ATMAS. In addition, ICAO published Doc 9985 "ATM Security Manual" setting out the principles and guidelines for protecting ATC system infrastructure from cyber attacks. States/Administrations are encouraged to pursue the appropriate level of compliance to the cyber security control requirements as stated in the ICAO documents and make collaborative efforts to effectively address cyber security threats. ICAO and other international organizations have been promoting the importance of cyber security in ATC systems via their website, such as ICAO's Thematic Website on Cyber security (www.icao.int/cybersecurity) and CANSO's website on Standard of Excellence in Cyber security.

4.8.2 Cyber Security Management

States/Administrations are encouraged to develop cyber security management, which adopts a proactive and systematic approach for protecting the increasing digitization of ATS against cyber threats, through the establishment of Cyber Security Manual, Cyber Security Handbook and User Account Management Policy. The above-mentioned documents should be developed in accordance with relevant provisions in ICAO Annex 17 and Doc 9985 to provide protection of the safety-critical ATMAS against cyber threats and interference. Key elements of enhanced controls on cyber security are as follows for reference:

a. Cyber Security Policy

   States/Administrations should establish their own Cyber Security Policy to mitigate cyber threat. Dedicated committee or working group on cyber security with regular meetings is encouraged to set up for reviewing policies and steering the implementation of cyber security control measures throughout the whole life cycle of ATMAS.

b. Network Infrastructure Protection

   Interoperation among ATMAS and other ATS systems for information exchange is inevitable. Proactive protection of the backbone data network of ATMAS is essential to ensure its operation. Multi-tier defence-in-depth scheme for external TCP/IP unicast communication to other systems, comprising network equipment, firewalls, Network Intrusion Detection (NIDS) or Network Prevention System (NIPS), is suggested to strengthen the

protection of the network ATMAS against cyber threats from external connections. To further strengthen the above-mentioned scheme, data diode could be utilized to leverage on unidirectional communication for the dissemination of data from ATMAS to other systems.

During the project implementation stage of ATMAS, Virtual Private Network (VPN) is often suggested by the system manufacturer to allow their personnel to assist in the installation and configuration of the system remotely. Since the system is not yet in operational use and is isolated from other operational ATC systems, an external VPN connection to ATMAS is considered acceptable in general for facilitating the project implementation. States/Administrations should assess the cyber security risks involved in remote VPN access during the integration of data interfaces to other ATC systems and ensure that all the security risks have been mitigated to an acceptable level.

After the ATMAS is put into operational use, external VPN access by the system manufacturer is, in general, not recommended. If there are operational needs to keep the VPN access by system manufacturer, States/Administrations should assess the cyber security risks and safety risks involved and implemented all the necessary measures to mitigate the risks to an acceptable level.

c. User Account Management

To protect the ATMAS from the cyber security risk of access control, States/Administrations should establish a systematic and traceable process for the administration of user accounts applicable to authorized access to ATMAS.

d. System Development Life Cycle

To achieve the viability and sustainability of cyber security protection, the protection from cyber threats in mind throughout the system life cycle of the development of ATMAS is indispensable. States/Administrations could formulate a project procedures handbook, which includes cyber security requirements, to safeguard against cyber threats from an early concept and design stage of a project. Besides, Independent Network Security Risk Assessment (INSA) for ATMAS is encouraged to conduct at a different stage of the project cycle to assess the adequacy of the cyber security measures applied to the system development.

e. Removable Media Control

Removable media provides a common route for importing malicious content into an information system. To mitigate the potential risk posed by the use of removable devices or media in ATMAS, States/Administrations should consider refining their workflow to strengthen the security control, such that a removable media should be scanned for malicious content by the machine prior to uploading data to ATMAS.

f. Software Security Patch Management

Patching vulnerabilities for ATMAS is a key challenge maintaining the balance between security and performance. States/Administrations could set up a scheme to work closely with system manufacturers to evaluate system patches when considered appropriate.

g. Physical Security Measures

While cyber security measures are in place for dealing with cyber threats, States/Administrations should implement physical security measures to physically protect the infrastructure of ATMAS from physical threats. The physical security provision includes facility management, security guards, CCTV surveillance, access control, physical lock, USB blocker, etc., from perimeter security down to console/rack level.

h. Response to Cyber Security Incidents

States/Administrations are encouraged to collaborate with the relevant local authority responsible for the investigation and prevention of cyber crime closely. A direct reporting mechanism is recommended to establish in order to seek swift assistance from the local authority for handling cyber security incidents. States/Administration is encouraged to seek relevant authority for an independent assessment of cyber security measures implemented on ATMAS. Periodic drill exercises should be arranged to upkeep staff awareness and the robustness of the reporting mechanism

4.8.3 Suggested Cyber Security Devices Configuration

ATMAS (security command, control and dispatch systems) is identified critical cyber ICT systems software and hardware used in their ATM system infrastructure in DOC9985. Physical protection of such systems should begin at the design stage or as early as practicable to ensure that they are as robust as possible against cyber-attacks. This may be achieved using a multi-layered approach. Among them, cyber security devices is suggested to strengthen the protection of the network ATMAS against cyber threats from external connections.

Cyber security devices is suggested to be designed as a part of the ATMAS, and be implemented together with the system. The balance between security and economy cost should be considered to avoid excessive defense. The cyber security devices should be compatible with the ATMAS, as well as its scalability to accommodate upgrades and developments.

ANSPs can select corresponding devices in considering of the system scale, investment budget, and the requirements of national cyber-security policies. The security devices can be selected in the cyber security construction and upgrade of ATMAS, including, but not limited to:

a. Firewall

The firewall is suggested to be implemented as the preferred device at the border network of the ATMAS to isolate the system from the external network environment and block intrusions. By deploying security configurations on the

firewall, unauthorized access can be controlled and the internal network address of the ATMAS can be hidden. The firewall with intrusion detection/prevention (IDS/IPS) module and anti-virus (AV) module can be selected to strengthen the protection of ATMAS network against cyber threats.

b. Audit System

Audit systems can be used to achieve these functions: monitoring database access and operations; collecting and storing logs from servers, terminals, and switches. When a cyber security incident occurs, the records provided by the audit systems can be used for investigation.

c. Operation and Maintenance management system（Jumper）

The operation and maintenance (O&M) management system can be used to help operators conveniently authorize and manage accounts. It works as a jumper for administrators to access the internal network of the ATMAS to prevent security risks introduced by removable media.

d. Traffic Monitoring and Analysis System

The traffic monitoring and analysis system works as a higher-level security device to monitor and analyze the real-time network traffic data of the ATMAS, and provides alarms when detecting abnormal network behaviors. It assists administrators in discovering and handling cyber security incidents.

e. Endpoint Detection and Response（EDR）

EDR protection has been widely applied as a common network security technology. EDR devices monitor and protect servers and terminals as endpoints, thereby improving the security and reliability of the computing environment. Due to the consumption of system resources involved in the use of EDR devices, it is essential to conduct sufficient compatibility verification and evaluation before implementation. It needs to be confirmed that additional load will not be brought to cause a decrease in the performance or blocking of functionality of the ATMAS.

4.8.4 Filing of Cybersecurity Level

ICAO Doc 10204 Manual on Aviation Information Security provides guidance to States on how to determine the levels of confidentiality, integrity and availability protection required for a system based on the level of risk the State accepts. The approach, though system specific, considers integration and the risk of propagation.

States will need to determine the cybersecurity level for ATMAS, and file that cybersecurity level at the local cybersecurity department based on State/Administration regulations. Based on the guidance steps, States are suggested to:

a. Determine the cybersecurity level of the information system referring to the guidance and relevant State/Administration regulations.

b. Rectify and strengthen the information system in accordance with the relevant State/Administration regulations, from the aspect of physical environment, security devices, security technique, security management etc.

c. Entrust a qualified evaluation agency to test and evaluate the Cybersecurity Level of information system and form the evaluation report.

d. Submit the evaluation report to local cybersecurity department and finish the filing of system cybersecurity level.

When procuring systems, it is the responsibility of both Vendors and Customer parties to identify and determine cybersecurity levels for ATMAS. Such processes, determination and filing of cybersecurity level need be clearly specified in the procurement contract ensure system integrity when deployed.

5. System Readiness

Generally, a brand new or expanded ATMAS deployment includes the following stages: Planning, Requirement definition, Bidding, Implementation, Transition. Relevant activities in different phases refer to System Deployment Checklist as attached in Appendix D.

After completion of system deployment, before transition, it is necessary to prepare the system readiness. Based on appropriate assessment, Site Acceptance, Flight Inspection, Personnel Training and Safety Assessment can be important parts of the system readiness.

5.1 Site Acceptance

Site Acceptance is an essential validation step for a brand new or expanded ATMAS to guarantee operational safely and ensure any contractual obligations.

After completing system deployment, it is recommended to form a site acceptance working group jointly with the vendor to:

Confirm the scope of the Site Acceptance Test (SAT), test and safety plans, acceptance criteria, and agreed process for issue resolution during or post SAT i.e., the creation of a SAT Plan.

Conduct testing and verification of those items identified for SAT validation ensuring that the ATMAS meets the associated requirements of the bidding documents and the contract and any post contract changes or safety related requirements.

It is recommended that the relevant site acceptance indicators be clearly stated in the contract terms or SAT plan.

SAT areas for consideration include the following testing contents:

a. Performance testing – including identified load, integrity, reliability, and timeliness requirements.,

b. Interface testing – including data handling requirements, integrity, and associated system functionality.

c. ATMAS functionality that requires SAT integration to be conducted effectively including testing and verifying of system functions and external interfaces.

d. Abnormal data processing – including erroneous input data or processing output that relates to SAT configuration.

e. Cybersecurity testing, including tests of physical security, network security, device security, application security, data security and recovery, and etc.

f. Stability testing, it is recommended to conduct stability testing for an agreed

period that ensures all business as usually processes and expected system load conditions are incorporated. Stability testing should include a process for cessation, diagnosis, continuation, or re-set when issues are encountered during the stability period.

g. Regression testing commensurate for the size of issue identified during the SAT or agreed plan for post-SAT resolution for any items that are required to be resolved before go-live but do not require a re-set of the SAT.

It is recommended to record the problems discovered during the testing, and objectively and truthfully record the original data. If necessary, video, image and other recording methods can be used. Again, the parties of the site acceptance working group shall agree to the recording media and method of issues recording to ensure effective resolution.

After completing the testing, the site testing report is recommended to be compiled. The content of the report is suggested to include:

- The agreed criteria that were used for SAT validation
- Summary of test cases conducted, results and explanatory notations – this may include the testing time, testing personnel, testing item and testing conclusions,
- Issues identified during SAT and their course of resolution and status (Resolved/outstanding)
- Overall results and pass fail of the SAT against those criteria
- Any accompanying videos, images, and other content recorded during the testing that are required support the test report conclusions.
- Any other artifact documents that are used to support results or are used instead of testing during the SAT to verify SAT aspects.

5.2 Flight Inspection

Testing and validation of the main functions and technical indicators of an ATMAS is a critical part system implementation, Particularly for surveillance, identification, and safety net functions, States should carry out test regimes. This may include flight inspections.

Alternative methods may include:

- Targets of opportunity
- Recorded data
- Emulation system output

Flight inspection is strongly recommended for brand new, relocation, or updated major modules of ATMAS. With reference to Asia Pacific Flight Inspection Guidance Material 3.0 and considerable experience from common practices existing in Member States, this section describes general in relevant activities.

5.2.1 Planning of Flight Inspection

5.2.1.1 Responsibilities of Stakeholders

The stakeholders related to ATMAS Flight Inspection mainly comprise Flight Inspection Service Provider (FISP), Air Traffic Controller and Ground Maintenance Personnel. The main responsibilities of stakeholders describe as following for reference:

a. FISP

FISP is responsible for furnishing the Flight Inspection aircraft with the required airborne equipment, arranging the flight and crew to perform the inspection task, recording the airborne recorded data during the Flight Inspection, and providing the data to maintenance personnel and manufacturer for the purpose of analysis and evaluation.

b. ANSP - Air Traffic Controller

The air traffic controller is responsible for handling the inspection aircraft. Meanwhile, the controller takes charge of working closely with the Flight Inspection pilot, timely adjusting the flight route according to the actual situation, completing all inspection subjects according to the Flight Inspection programme on the condition of keeping the impact to normal traffic to a minimum.

c. ANSP - Ground Maintenance Personnel

Ground maintenance personnel are responsible for preparing for Flight Inspection in advance, observing and recording system performance during Flight Inspection in real time, analyzing the recording data and evaluating system major functions and technical indicators. Specific responsibilities include:

- Compile a complete Flight Inspection programme together with FISP and controllers, and discuss key contents such as flight check time, route and subjects.
- Ensure the system is operational and in a condition suitable for Flight Inspection, including system function and configuration, before the Flight Inspection.
- Maintain and adjust the system to solve issues encountered during the Flight Inspection
- Record data in the ATMAS for later analysis and evaluation according to the Flight Inspection programme, and maintain close cooperation with

the controllers.

- Complete the data record analysis and Flight Inspection report after Flight Inspection.

5.2.1.2 Communication of Stakeholders

The smooth conduct of Flight Inspection requires concerted efforts from all stakeholders. All parties involved shall clarify their responsibilities and fully communicate with each other. Main exchanges with stakeholders are listed as follows for reference.

a. Flight Inspection programme

The reasonableness of the Flight Inspection programme is the basis of Flight Inspection implementation. It shall be formulated by all stakeholders through consultation. The programme typically includes flight inspection time, aircraft type, task area, planning route, flight altitude, inspection subject, contingency plan, etc.

- Flight Inspection time

For busy airports, there is a trend to advance the Flight Inspection time to dawn or even earlier to avoid rush hours. For small and medium-sized airports, Flight Inspection time can be determined by joint coordination with the control unit.

- Flight Inspection aircraft equipment

The aircraft is supposed to be fully equipped for all the Flight Inspection subjects, such as GPS mode, mode S transponder, etc.

- Flight Inspection subject

Flight Inspection subjects shall be set in advance according to airspace conditions and flight routes. These subjects shall be able to verify all the main functions and technical indicators of the system through actual aircraft, analog signals or system parameters configuration, while not affecting the normal operation of air traffic control.

- Contingency plan

The contingency plan includes backup Flight Inspection date(s) due to unexpected ad-hoc event such as inclement weather or technical fault, could also be discussed with key stakeholders.

b. Kick-off meeting

Before the commencement of Flight Inspection, a kick-off meeting involving all key stakeholders is recommended to ensure that all are familiar with their roles and responsibilities in supporting the Flight Inspection as well as each issue required special attention. This also allows all stakeholders to exchange comments about the programme and arrangement, taking the flight profiles sequence for instance, and helps to spot early issues which would potentially hinder normal ATC operations and Flight Inspection.

c. Closing meeting

After the completion of the Flight Inspection, a closing meeting involving all stakeholders would share the results and resulting actions of the Flight Inspection, as well as to help all to strive for continuous improvements on the overall Flight Inspection arrangement, with parties sharing their views and suggestions

5.2.1.3 Implementation Preparation

Before the implementation of Flight Inspection, the following preparations shall be made:

a. Weather Condition Acquiring

The wind direction of the airport and meteorological conditions of the flight route on the day of Flight Inspection from the meteorological department shall be obtained in advance to ensure the implementation of Flight Inspection.

b. System Preparation

The setting of parameters in ATMAS, such as warning area and arguments, radar parameters, indication map, shall be completed before the commencement of Flight Inspection. Besides, the radar simulation script (relate to the STCA function verification) shall be prepared.

5.2.2 Conducting of Flight Inspection

Flight Inspection is usually carried out in accordance with the Flight Inspection programme. During the inspection, it is essential to document all records and maintain communication with all stakeholders.

During the inspection, ground maintenance personnel shall maintain and adjust the system according to the programme, keep communication with all parties, and record the system performance of each Flight Inspection subject in the prepared record form.

5.2.2.1 Flight Inspection Subjects and Categories

Usually, the Flight Inspection subjects are suggested to categorize into three types.

a. The first type is the surveillance coverage and the processing precision in ATMAS. This type of subject mainly checks whether the target trajectory in the ATMAS properly generates and disappears, whether the track information displayed matches the actual flight information from the crew, and whether the system track is continuously smoothing without loss, and also validates multi-radar tracking and accuracy for maneuvering and circular flight.

b. The second type is the functional verification of ATMAS, regarding whether the key functions of the system are normal, mainly including the correct coupling to the flight plan, QNH altitude level changing display, DAPs data application, RVSM function, the customized function validation, etc.

c. The third type is the warning function inspection of ATMAS. This part mainly checks whether the system warning can be correctly produced and disappeared under various settings. Those may at least include STCA, MSAW, DAIW, CLAM, RAM, Emergency codes (such as 7700, 7600, 7500), etc.

In order to verify the availability of the ATM automation system, 20 Flight Inspection subjects are listed by experience as follows. The subjects cover all the types above, and can be selected by states according to site requirements.

No.	Subject	Scheme
1	Takeoff and Landing	A. Take off: Observe the appearance of the target and correlate with the flight plan; B. Landing: Observe the disappearance of the target.
2	special code （ 7500 7600 7700 SPI）	During the flight, the aircraft turns on a special code to observe the system alarm.
3	CA	Observe the CA alarms between the inspection aircraft and the simulated target at different altitudes, such as in the same direction, at different altitudes in opposite direction, at different altitudes in lateral crossing, at the same altitude in lateral approach, at the same altitude in pursuit, at the same altitude in the same direction in approach.
4	RVSM	Verify that the system has the ability to identify the target with the RVSM function and the CA function of the target in RVSM airspace.
5	MSAW	Observe the MSAW in the system when an aircraft is approaching the MSAW warning area
6	DAIW	Observe the DAIW in the system when an aircraft is approaching the DAIW warning area
7	Radar data processing accuracy	Verify the accuracy, continuity and stability of radar data processing of various flight paths by linear, circular and S-shaped flight modes. Check on-boarding aircraft profile data at designated position.
8	Multi-radar processing	Observe the continuity of the system track in the multiple radar overlapping area
9	Correlation	Verify whether the flight plan correlation with the system track in time and the correlation after changing the SSR code of the aircraft.
10	QNH processing	Check the system display when the aircraft crosses TA and TL, under TA, outside the QNH area, and level flying through several different QNH areas.
11	CLAM	Observe whether the CLAM alarm is displayed normally according to the parameters set by the system.
12	RAM	Observe the RAM alarm after the aircraft is not following the planned route.
13	Primary radar signal	Observe the appearance of primary radar targets and the

	processing	marks of primary and secondary radar signals, when the aircraft takes off, as well as disappearance as the plane lands.
14	S-mode radar and ADS-B data processing	Observe the continuity of the system track in the area of S-mode radar coverage and ADS-B coverage.
15	NTZ	Observe whether the NTZ alarm is displayed normally according to the parameters set by the system.
16	DTZ	Observe whether the DTZ alarm is displayed normally according to the parameters set by the system.
17	APM	Observe whether the APM alarm is displayed normally according to the parameters set by the system.
18	accent/decent rate	Observe the system display rise/fall rate and record the actual rise/fall rate of the inspection aircraft.
19	PLM	Observe whether the PLM alarm is displayed normally according to the parameters set by the system.
20	Correlation mismatch alarms	Observe whether the system mismatch alarm is displayed normally when the flight track 24bit and callsign are inconsistent with the flight plan.

5.2.2.2 Implementation Suggestions

Generally, there are some suggestions for Flight Inspection implementation.

a. Flight Inspection time is recommended to choose in the low air traffic flow period for safety.

b. All participating parties, flight crew, air traffic controllers, and engineers shall be familiar with the responsibilities and Flight Inspection programme, carry out the work as assigned and collaborate in teamwork.

c. Ground maintenance personnel can set the analog signal script in advance to conduct the verification of STCA between the analog signal and inspection aircraft. Prepare the start time of the analog signal script in advance to ensure the success of STCA verification.

d. The virtual alarm area or obstacle height can be set to verify warning generation and disappearance, when the inspection aircraft enters into and steps out of the system warning area.

e. Usually, during Flight Inspection, ground maintenance personnel are responsible to record the ATMAS behaviors in the prepared record form, for all inspection types. This recording information will be used to analyze after the Flight Inspection.

5.2.3 Reporting of Flight Inspection

5.2.3.1 Flight Inspection Records

The inspection data used for analysis is derived from:

a. Flight Inspection aircraft data: data recorded by the airborne GPS module of the inspection aircraft and data output by the airborne aviation equipment;

b. Ground data: data recorded inside the ATMAS and the information recorded by ground maintenance personnel. The ground maintenance personnel can record the information of corresponding subjects in each flight stage and complete the relevant data recording through the ATMAS playback function.

5.2.3.2 Flight Inspection Analysis

Generally, after completion of Flight Inspection, engineers in charge of obtaining airborne recorded location data work together with the ATMAS manufacturer in carrying out data analysis as follows:

a. Complete the comparison and analysis of radar position accuracy, focusing on whether airborne equipment records location data and system track location data are consistent. Form a position accuracy analysis report based on system track data to ensure that the system meets the operating conditions.

b. Aggregates the recorded data in conjunction with the system playback to verify that the parameters of the system configuration match the relevant validation features and ensure that system functions achieve the prospective purpose.

c. Finish the Flight Inspection summary report according to the above data analysis.

5.2.3.3 Flight Inspection Report

The Flight Inspection report of the ATMAS is recommended to cover the time, route, subject, data record and conclusion of the Flight Inspection. The report matters whether the ATMAS is satisfied with and authorized on formal commission.

5.3 Personnel Training

Personal training is an essential element for any ATMAS implementation. ICAO provides extensive detail on ATC training via Doc 9868 and further guidance on competency-based training and assessment for both ATC, OJTI and Technical staff via Doc 10056 Vol I and II and 10057 respectively.

Particularly for Doc 10056 and 10057, as their guidance is not application specific and promotes effective training via competency assessment, States should refer to these documents for guidance on:

a. Training/Assessment planning

b. Training material creation

c. Trainer competency

d. Assessment processes

e. On-going training processes

Personnel-training may be included in the procurement contract for the vendor to provide or States may have the capability to create and conduct it themselves. Either way it needs to be structured to support effective training while not overtly impacting on-going operations - and be conducted before transition.

Based on the ICAO guidance, Vendors and/or States should decide on the type of training being conducted (for new ATMAS its most likely conversion training) and conduct a competency-based assessment of their current operations/systems and the new system to identify gaps and resulting topics for both theoretical and practical training.

This gap analysis and resulting topic list will then be included in Training and Assessment Plans. The Training Plan is the core document for training delivery and should include:

a. Identification of target audience, scope and training approach

b. Syllabus

c. Milestones

d. Training modules/events/sequence

e. Course Schedule

The resulting Training Plan should be user specific (ATS type or Tech) and would at least includes system functions, system processing mechanisms, system operations, hardware configurations, network configurations, software installation - as required for the target audience.

When planning, States should identify opportunities in scheduled project activity to help ATMAS users familiarize themselves with equipment performance and interface operations as soon as possible. These early opportunities are particularly important when creating a cadre of ATC or Technical instructors that will either create training material and or conduct or support operational orientated training. Opportunities could include development periods, FAT/SAT or identified factory and on-site training.

Moreover, controller and technician participation in equipment/system development and testing phases mean expert-level talents can be cultivated by this way to support training, transition and post-transition system management.

An Assessment Plan will also be required – either within or separate to the Training Plan. This plan will identify:

a. The methods to be used for assessment – written/oral/observation

b. Assessment milestones

c. Course numbers

d. Assessor qualification and conduct

e. Re-sit and failure processes

With the Training and Assessment Plans in place, training and assessment materials can be created.

Note - because of high degree of ATMAS software integration and adaptation, it is suggested that States assess their capability to support such activity and devise specialized training as a result. This training may include courses and assessment for offline data configuration (adaptation), validation (testing) and development (coding), ab initio controller training, and instructor qualification.

States should also consider the creation of operational familiarization periods. These periods are usually conducted after a system passes SAT and the cadre of instructors and unit (Sector/Tower/ATSS) representatives are sufficiently familiar with the system to operate the system. The intent of these periods is to facilitate:

a. Operational application of the system in a simulated environment

b. Unit specific design/adaptation needs to be identified

c. Unit specific training needs and materials to be identified/created

d. New functionality to be used and training material created

Finally – States may need to consider any overarching State Regulator/Government department or auditory requirements for training development/conduct.

5.4 Safety Assessment before Operation

ICAO has extensive Safety guidance material in both Annex and Doc forms. States should establish effective Safety Management System frameworks to support effective ATMAS development, validation, training and implementation.

Specifically, Doc 9882 (Manual on ATM System Requirements) identifies overall safety requirements in Chapter 2 and specific criteria applicable to readiness in Section 2.1.2:

a. ensure application of the system safety approach to all life-cycle phases of the ATM system and its elements, supported by safety cases

b. ensure that ATM system safety is maintained during any transition

c. establish contingency plans at all levels of operation to deal with anomalies/disruptions and to ensure safety and appropriate level of operations

States should conduct a comprehensive safety assessment of the various aspects affected by the ATMAS transition; these include:

a. System validation and acceptance of functionality and operation

b. Operational readiness – both functional training/endorsements and operational application

c. Technical readiness – both functional training/endorsements and operational application

d. Failover/Contingency planning and operation

e. Stakeholder readiness – including and reduction in service during transition and contingency actions

f. Regulatory readiness – including any documentation changes and approvals

Such assessment should be conducted collaboratively and be inclusive of operations and maintenance teams, stakeholders, regulators, ANSP management, safety office expertise. ,. The safety assessment should at least cover the following aspects:

a. Scope and content of the evaluation

b. Departments and personnel involved in the assessment

c. Description of the current environment and system

d. Identification and risk analysis of potential hazards

e. Risk control measures

f. Conclusions of the safety assessment

It is recommended that States consider supporting safety assessment activities with tabletop and, if the new ATMAS is remote from the in-use system, actual readiness/transition process activities. Such activities may include:

a. System failover and contingency scenarios

b. Power failover and contingency

c. Network and Security testing

d. Overall transition process conduct

The conduct of such activities will support the ID of safety gaps, their mitigation and generation of an effective Transition plan. That plan should safely merge the various workstream steps to be conducted during transition. It also supports the identification of both readiness criteria (to commence transition activity) and go/no-go determination points through a transition. For detail guidance of the transition, please refer to section 6 System Transition.

6. System Transition

There are several scenarios in which ATMAS transition normally happens, ranging from minor to major changes, including:

a. Major software and/or hardware upgrade, including operating system upgrade and important modules upgrade such as SDP or FDP to provide new or enhanced functionalities. These cases may influence the system stability, so it is recommended to take a transition to guarantee the operation safely.

b. Overall system upgrade with new software and hardware equipment.

For a more complex transition that involves multiple stakeholders and equipment, change management, safety risk management, transition plan, rehearsal, and post-transition support are the key elements to ensure a smooth system transition.

6.1 Phases of System Transition

There are mainly four transition phases: transition preparation, transition rehearsal, system transition and post-transition operation.

a. Transition preparation: the necessary preparation for transition in this phase, transition scheme, safety assessment, equipment preparation, staff training, an manual update shall be completed.

b. Transition rehearsal: The main objective of this phase is to build confidence in the new changes and flag any possible issues before the actual transition. It can be achieved by running an online test of the new system during off-peak hours or in the backup system in parallel with the operational system. During the online test, the new system could be connected with external interfaces and systems progressively. The operational users and engineering staff will test the main functions and interfaces, and record necessary

optimization to the system as well as the rehearsal procedure. The frequency and duration of rehearsal shall be adjusted according to the complexity of the system transition.

c. System transition: In this phase, the new system will be put into operation. If the transition is complex with software and hardware upgrade, shadow operation is suggested, and the shadow operational period could last 1 or 2 weeks or even longer where appropriate. And according to the result of the shadow operation, the time point to start the transition shall be determined. If the transition fails, a decision on whether to repeat or roll back needs to be made.

d. Observing operation: In this phase, the new system operates on line, and an observation period of one month or more is suggested, depending on the complexity of the changes.

6.2 Transition Preparation

6.2.1 Transition Scheme

A complete transition scheme is necessary for a successful transition. Depending on the scale of the transition, the transition scheme is suggested to contain the followings:

a. The preliminary work to be finished, including:

- Review of acceptance testing results and equipment preparation.
- Review of the adequacy of change management and safety risk management.
- Review of training, including the competence of operational and engineering staff.
- Review of the change in ATC Procedures and update the operation manual.
- Other relevant work required.

b. Transition steps, procedures, and key points.

c. Checklist: used to check the system transition operation and verify system functions and performance during transition rehearsal and system transition.

d. Decision mechanism: transition institution shall be established to determine on the transitional key point.

e. Contingency plan: used to cope with the emergency situations and include the decision mechanism about roll back or transition delay, roll back plan,

and the emergency support team.

6.2.2 Scheme Evaluation

The scheme evaluation is necessary and proposed to include scheme feasibility, scheme completeness, scheme presumption, equipment and staff preparation, the stability of the new system, and the solutions to bugs discovered during the on-site test. According to all these elements, some improved suggestions should be raised to make the scheme more perfect. After the evaluation, recheck should be made to ensure the implementation of the suggestions.

6.2.3 System Deployment

To ensure the system rehearsal and transition smoothly, the technical staff should validate the new software version on the test platform to ensure the new version can work well. And then, the system maintenance department should deploy the new software and hardware in advance. Making sure all the new software and hardware deployed in the system will shorten the time of transition sufficiently.

6.2.4 Table Pre-rehearsal

Table-top exercise refers to the process in which the participants use maps, sand tables, flow charts, and other auxiliary means to interactively discuss and deduce the transition steps and emergency decision-making in the transition scheme.

Table-top exercise is recommended to ensure the feasibility of system switch steps, the smoothness of cooperation, the completeness of checklist, and the rationality of time arrangement.

6.2.5 Other Preparations

The operational and engineering manual should be updated, including system information, technical manual, notification process, and emergency plan.

Before the rehearsal, thesystem maintenance department should train staff about the transition scheme and the updated manual to help them understand the system transition, collaboration matters among departments and system new functions.

6.3 System Rehearsal/Pre-Transition Verification

The transition scheme, including the detailed transition procedure and steps, should be made familiar to the team through training activities prior to the system transition. Depending on the complexity, several system rehearsals are suggested to be performed during the off-peak hours. The purpose of the system rehearsal is to verify the transition procedure as well as to validate the functionality, reliability, and stability of the new system in a real operational environment.

6.3.1 System Switch Steps Validation

The transition procedures are recommended to be validated according to the overall transition rehearsal scheme. The procedure to be validated includes at least the following: system switching steps, operating contents, transition team, and reasonability allocation, notification and reporting process. A checklist is suggested to be developed and optimized according to the result of each rehearsal. The optimization should be verified at the next rehearsal.

During the rehearsal, the time spent on each step is advised to be verified and be used as a reference to support the decision making during the formal transition.

6.3.2 System Functions and External Interfaces Validation

The system functions and external interfaces are suggested to be tested and to ensure that they are functional as intended during the rehearsal. To ensure a smooth transition, the problems identified during the transition should be recorded in detail and corrected with the support of the SP.

6.4 System Transition

At the end of the above preparation activities, the transition management organization is suggested to decide to approve the date and time of the formal transition, based on the transition scheme evaluation report, the transition preparation status, and the result of the transition rehearsals.

For major system replacement or overall system upgrade transition, the shadow period is recommended to put the new system into operation during an off-peak time, to verify the system performance in a real operational environment, and to allow staff to gain familiarity and confidence in operating the new system. The duration of the shadow period is determined by controllers. 1~2 weeks shadow period is suggested to make every shift familiar with the new system. Appropriate rostering of staff is required such that all staff will be given the opportunity to gain experience in operating the new system.

Finally, the transition is recommended to be performed based on the pre-defined procedure at the pre-defined transition time. The new system should be put into operational use after the verification of the functioning of the system is confirmed following its transition.

However, suppose there are blocking or critical issues, such as ssues affecting safe operation occurring during the transition. In that case, decisions should be made according to the decision making strategy defined in the transition scheme, which may result in rollback or delay of the transition.

6.5 Post-Transition Operation

The post-transition operation phase is suggested as the run-in period of the system, which preferably requirs additional staffing from the MSP as well as SP to resolve teething issues. The issues identified during this phase should be timely analyzed,

corrected, and reviewed. In addition, the maintenance experience of the new changes will be accumulated.

The duration of the post-transition operation phase is recommended to be one month or longer. A formal assessment is suggested to be performed at the end of this phase. The assessment is proposed to include:

a. Issues reported during the observation period.

b. The cause analysis and possibly the avoidance and corrective methods of the issues.

c. Recommendations for future operation, matters-needs-attention, etc.

The system will enter the stable operation phase after the observation period.

7. System Maintenance

The ATMAS goes to the system maintenance phase after being put into operation. System maintenance is necessary for the entire service life of the system. Critical functions and equipment should normally work even as the environment changes through planned and organized maintenance. The purpose of system maintenance is to guarantee stable and continuous operation and to improve the performance of the system.

7.1 System Maintenance Participants

To handle the maintenance of complex and safety-critical ATMAS, robust and systematic maintenance management, and practice should be set up with close cooperation among system suppliers, Maintenance Service Provider (MSP), and the Air Navigation Service Provider (ANSP) to ensure the operation of the system.

Under the maintenance framework for ATMAS, the system supplier, MSP, and ANSP form a close coordination trio in operating and supporting the maintenance framework.

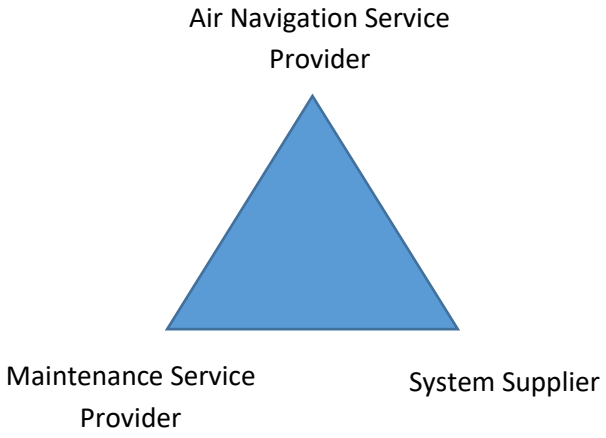


Figure7.1-1: Trio for Maintenance Framework

7.1.1 System Supplier

The design of system plays a critical role in the ease of maintenance during the operation stage of the system. Before system commissioning, the system supplier, as the entity with the most comprehensive know-how on the system, should provide sufficient maintenance documentation and training to ANSP and MSP, including

complete information for proper installation, setup, use, operation, support, and maintenance of the system.

The system supplier should provide documentation to the ANSP and MSP for aiding the use, application, and maintenance of the system and individual equipment, which should include:

a. Operation handbooks and user manuals for operating procedures and system functionalities for use by controllers, supervisors, assistants, and support specialists.

b. Technical literature for the full technical description of configuration and operation in the system as well as full details of each system component, block diagrams with data flow, mechanic and wiring schematic diagrams, as-built drawings, etc.

c. Service and maintenance manuals, including system setup, optimization and parameterization, preventive maintenance procedures (system checking and rebooting, calibration, cleaning, housekeeping, etc.) with recommended frequencies, and troubleshooting procedures in hardware and software (recommended solution and flow chart to identified issues, handling of alarms and error messages, etc.).

All documentation should be reviewed and endorsed by the relevant authority prior to use.

The system supplier should prepare training plans and training course materials for ANSP and MSP for review with sufficient time prior to critical milestones, such as commencement of design review, factory/site acceptance tests, and ATC operational train-the-trainer course. ANSP, in coordination with MSP, should set out the required training topics, which should be specific to different user groups, in the system contract.

Subject to actual needs, after ANSP and MSP have built up their own training capability, on-site maintenance review and assessment on MSP should be conducted by the system supplier after commissioning on a regular basis, with more frequent training/assessments during the start-up and run-in period after commissioning.

As ATMAS is a complex system, it is unavoidable that unexpected technical issues might emerge, especially teething issues during the early stage of operation. As such, the system supplier should be required to respond to requests from ANSP or MSP to provide timely assistance in dealing with and rectifying all faults or deficiencies in software and hardware within pre-defined response time according to the criticality of such faults or deficiencies as specified in the contract. Repeated faults should be handled and investigated with high priority by the system supplier to identify the root cause and implement corrective measures.

Since technology is changing rapidly, some system components might become obsolete and become difficult to source in the market. The system supplier should provide a list of obsolete equipment and its replacement models on a regular basis,

and the replacement model should be evaluated on-site for its compatibility prior to use as a spare for operation.

The performance of the system supplier has to be regularly reviewed in suitable forums, such as performance review meetings in conjunction with ANSP and MSP representatives.

The system supplier could consider forming user groups to allow sharing of users' experiences and gather feedbacks. The system supplier should facilitate regular hosting of user group meetings.

7.1.2 Maintenance Service Provider

The engagement of an MSP to perform frontline maintenance under the supervision of ANSP is a practical solution in leveraging skill sets and the latest technology available in private sector in order to facilitate the provision of reliable services with cost benefit.

Under the regime of compliance to all applicable ordinances and regulations, Safety Management System and Air Traffic Safety Electronics Personnel (ATSEP), the maintenance services provided by MSP should include watch-keeping of equipment, preventive/corrective maintenance, system/equipment minor modification/ replacement works, staff training, and procurement of spares and test equipment/ tools. Support services such as record-keeping on maintenance activities, preparation of statistics and reports and inventory control, etc., could be provided as part of the package from MSP.

MSP needs to perform maintenance according to the system supplier's established procedures at recommended intervals, including health checks on the system, servers, equipment and workstations, critical data backup, and log capture/review for hardware, software, user management, and other activities, system parameters and user preference checks and backup, regular clean-up, and reboots of hardware including servers and workstations, etc. Proactive system housekeeping procedures adopting industry best practices with the recommendation from system supplier and expertise from MSP, together with close monitoring of system healthiness/system resources and housekeeping of servers/workstations on a regular basis to upkeep the system performance, should be in place.

There could be cases that due to the local specific environment/operational status of the ATMAS, it would require extra steps or more frequent maintenance, e.g., more frequent clean-up/reboot of servers and workstations, on top of recommended maintenance procedures by system supplier.MSP, who looks after the system day-by-day and is familiar with local environment, would contribute their expertise in adapting the maintenance procedures to fit into the local needs after consulting the system supplier.

In addition, like any critical system running on a round-the-clock basis, ATMAS has no exception that it might encounter system fault where immediate attention from MSP is required. For example, a server breakdown after a software bug is hit with no or little pre-alerts. It is important that MSP has geared up with a full deck of operational instructions for their watch-keeping staff to handle all sorts of foreseeable system scenarios with proper initial and refresher training/drills on such scenarios.

The build-up of know-how and experience for MSP in dealing with urgent scenarios is crucial to smooth operations of the ATMAS.

Similar to system suppliers, the service level of performance of MSP has to be constantly monitored to meet the target levels set out in the contract and regularly reviewed in suitable forums, such as operations & maintenance review meetings in conjunction with ANSP representatives to ensure maintenance provisions could meet the service needs.

7.1.3 Air Navigation Service Provider

As the party to govern maintenance service performance by MSP and system supplier through various means discussed above, ANSP has to ensure the necessary support and resources to be provided to MSP and system supplier for fulfilling or even exceeding. The baseline maintenance requirements are set out in the contracts with these parties. Payment deduction might be incorporated into the contract to handle cases where performance does not meet requirements, but it might bear impacts on maintaining a good relationship with MSP or system supplier.

ANSP has to ensure the services provided by MSP and system suppliers are in compliance with ICAO standards and international best practices. ANSP is encouraged to share experience and best practices gained from ICAO and international meetings/ symposia/ seminars, as well as overseas facts-finding visits, with MSP and/or system suppliers with a view to enhancing the maintenance regime.

To allow ATC professionals to perform their work safely and satisfactorily, it is highly desirable for ANSP's engineering professionals to understand the operational needs such that the ATMAS could fully support their work. As such, constant communications with ATC professionals in addressing their needs via suitable steering forums and communication channels would be critical to the smooth operations of ATMAS. Following the system commissioning, a technical team comprising ANSP engineering professionals, system supplier, and MSP, could be established with ATC professionals to oversee system performance and deployment of new software builds and system data updates to ensure smooth operation of the ATMAS.

7.2 Resources Requirement

Necessary resources are mandatory for system maintenance, and the main considerations are as follows:

7.2.1 Staffing

MSP should ensure sufficient staff is employed to form a maintenance team and provide 24-hour operation and maintenance.

Before stepping into the system maintenance phase, MSP and ANSP should ensure the personnel is fully trained by the SP or certified trainers. This ensures that the personnel involved in the maintenance work grasp knowledge and skills related to the system. It is also recommended to arrange on-site training by SP for MSP and ANSP

after system installation. Before the training, the training plans and training course materials should be fully reviewed by ANSP/ MSP in accordance with contract requirements and define training topics for different users.

Before the system is put into operation, MSP and ANSP are recommended to send personnel to work in different phases for technical reserves in advance and enhance their comprehension and familiarity with the system, which will be conducive to the subsequent maintenance work:

a. System design phase

   MSP and ANSP are recommended to send personnel to participate in the design of the system to track the project development progress in SP factory, check the rationality and applicability of the design of each functional module of the system and put forward suggestions, and review technical documentation at the milestone, including the consistency of requirements, product design, handbooks, and acceptance test book.

b. Factory acceptance test phase

   MSP and ANSP shall send personnel to participate in factory acceptance test in accordance with the contract requirement. MSP and ANSP personnel shall review the acceptance test books provided by SP in advance. The acceptance test shall be executed according to the approved test book in the test environment, such as platform, signal, instrument, etc., prepared by SP, and the result shall be recorded in the report.

c. Installation phase

   After the work of on-site equipment installation starts, MSP should send personnel to participate in the whole process of hardware installation, software debugging, on-site acceptance tests, flight inspection, etc. At this stage, personnel should be well familiar with important information such as equipment installation location, cabling, signal routing, position layout, label , signs, etc. They also need to learn software debugging and testing methods, and master the knowledge of system's functions and performance during on-site testing and flight inspection.

Besides above all, MSP and ANSP should set up their own maintenance personnel training systems, maintenance personnel access mechanism, and regular assessment of personnel skills to ensure that qualified personnel can perform the operation, maintenance, and management of the system.

7.2.2 Documents

Before the start of the system maintenance phase, MSP and ANSP should make sure necessary documents are in place to run the system. The documents should include at least the following:

a. System Design Specification: a set of technical documentation including system architecture, interface control documents, function module principle,

etc.

b. Operational manual: an instruction manual that describes the function, performance, and user interface of the system software in detail so that the maintenance can understand how to use the operate the system.

c. Maintenance Manual: the service and maintenance manual includes system installation, parameters setting, maintenance suggestions, as well as troubleshooting procedures in hardware and software (it is recommended to provide a flow chart to locate and solve the problems and a method to identify the alarm and error, etc.)

d. User guides documentation: detailed description and operation guide of HMI for controllers, FIO, Flow.

e. Installation documentation: including details of each component of the system, cabinet layout, figure with data flow, mechanical and wiring schematic diagram, as-built drawing, etc.

f. Training documentation: including training materials or documents related to factory and on-site training.

g. Testing documentation: including achievement of acceptance criteria and identification of outstanding issues

h. Emergency response process documentation: in the event of sudden equipment failure, effective countermeasures can be taken in time to minimize the impact of equipment failure on air traffic control operations.

Besides, MSP and ANSP should work out their working procedures, maintenance plans, and contingency plan for unning the system.

All documents should be reviewed and approved before application which should be updated continuously to keep the accuracy according to the changes in system behavior during the long-term operation.

7.2.3 Maintenance Tools

MSP and ANSP are recommended to be equipped with instruments and maintenance tools required for system maintenance, for example, a simulator used to simulate track and message for system test, a software management tool for installation, rollback, and backup operation to software patch and release. Training for maintenance personnel shall cover the use of instruments, maintenance tools, and simulators by MSP and SP.

7.2.4 Spare parts

Sufficient hardware spare parts shall be reserved for the ATMAS, including servers, workstations, monitors, network equipment, etc. The percentage of spare parts is

related to the scale of the system. The mechanism of spare parts management should be set up, including periodically testing and checking the reserve status to make sure that the spare parts are sufficient and available.

Since it is very common that computer hardware will be updated frequently, ANSP/MSP should review the list of hardware and confirm with the SP a list of obsolete hardware and replacement solutions regularly. The replacement hardware should be reserved as spare parts after finishing the site compatibility assessment.

If conditions allow, ATMAS Test and Validate System (TVS) is recommended to be deployed for supporting new software testing, system parameter adjustment, personnel training, etc.

7.3 Maintenance Content

System maintenance is recommended to include the following at least:

7.3.1 Periodic maintenance

Periodic maintenance including daily, weekly and monthly, etc. Which maintenance matters should be worked out according to the real operational requirements. It is recommended to cover the followings:

a. Check the running status of the system software, dual nodes redundancy.

b. Check the running status and health of the system hardware, including network load and the usage of resources such as CPU, memory, and disk of servers, workstations, and network devices. Please refer to section 4.5.2 for the inspection standards.

c. Check the validation of external data, including surveillance data, AFTN, AIDC, meteorological data, GNSS, and the status of data interaction with the external system, if any.

d. Check the integrity of the recorded data to prevent the data lost.

e. Check the status of basic function on bypass server.

f. Perform active/standby switch between the redundant servers to ensure both servers can operate normally.

g. Backup critical files and data periodically, including the system configuration parameters, database, log, etc.

h. Manually clean and reboot the server and workstation regularly.

i. Check the physical system operating environment regularly, including temperature, humidity, equipment grounding, electromagnetic environment, etc.

j. Switch the backup system to operational mode regularly to achieve a balanced use for both main and backup systems.

7.3.2 Troubleshooting

MSP should promptly execute troubleshooting, correct system errors, and ensure that the system work normally by replacing components, updating software or parameter configuration, and other methods.

SP should respond in time to the requirements of MSP or ANSP after a failure occurs and assist MSP in handling and correcting the failure within the predetermined response time according to the severity.

MSP needs to record all the system problems in different kinds and problem-solving processes, and collect necessary system logs for analysis.

When a problem is judged as a software defect, MSP needs to register and track the problem. It is recommended to use a fixed PCRs form to register the system software problems, including supplier name, site location, software version number, failure time, failure content description, user investigation of relevant logs, the severity of the problem, etc.

After being confirmed by ANSP, MSP sends the PCRs to SP in time for problem analysis and software repair.

According to the information in PCRs, SP establishes the problem database, checks software code, locates and repairs software defects, and provides problem analysis reports.

The software defect repair plan is discussed by SP, MSP, and ANSP, and they jointly determine the delivery and implementation schedule of the software patch.

7.3.3 Software Version and Requirement Management

After the software is approved in site acceptance and put into operation, the software version and requirement management are managed by SP, MSP, and ANSP together throughout the service life of the system.

7.3.3.1 Baselines Establishment

Usually, SP will select a stable ATMAS software version defined as a Baseline, before SP develops a set of ATMAS based on the requirement of customers. The Baselines are defined for further software life cycle process activity and allow reference to, control of, and traceability between configuration items.

Baselines establishment is recommended to consider the factors as follows:

a. Baseline should be established for each set of ATMAS.

b. ATMAS Baseline is a stable software version that has been approved.

c. Once a Baseline is established, it should be protected from change.

d. In the service life of the system, the Baseline should have the check code and check method of the corresponding program to ensure the traceability consistency, and uniqueness of the program.

After the baseline version of the automation system is established, the customization of the automation system functions need to be fully discussed, researched, and agreed upon by SP, MSP, and ANSP. Then the SP carries out systematic research and development, and finally delivers the system software to users after passing factory acceptance and site acceptance.

7.3.3.2 System Requirement Management and Software Upgrade

The system function requirements usually come from the change of ATC procedures, the application of new technologies, etc., and the new functions are put into operation through software version upgrades.

ANSP may formulate a standard software requirements library according to operational needs, regularly maintain and update the requirements library, and guide the upgrading of software versions and the construction of new systems.

MSP is responsible for recording function requirements, analyzing and evaluating the description and scheme of the requirements, and submitting them to SP for development after being verified by ANSP.

SP completes the system software change and delivers it to MSP after passing the self-test, attaching the analysis of the impact scope of the software change.

MSP need to carry out functional improvement test and system stability test for software change. After ensuring that there is no defect, MSP shall jointly agree with ANSP on the effective time of software upgrade and implement the upgrade.

During the implementation of the software upgrade, MSP is recommended to backup the operating software. If there is any problem in the upgrading, MSP need to roll back the software to the previous version in time.

Note: If SP is responsible for the maintenance of system software throughout the service life of the system, the specific software maintenance contents may be defined in the contract which is agreed upon by all related parties.

Appendix A

ATMAS IGD Request for Change Form

RFC Nr:	

1. SUBJECT:			
2. REASON FOR CHANGE:			
3. DESCRIPTION OF PROPOSAL: [expand / attach additional pages if necessary]			
4. REFERENCE(S):			
5. PERSON INITIATING:		**DATE:**	
ORGANISATION:			
TEL/FA/X/E-MAIL:			
6. CONSULTATION	**RESPONSE DUE BY DATE:**		
Organization	**Name**	**Agree/Disagree**	**Date**
7. ACTION REQUIRE :			
8. AIGD EDITOR **9. FEEDBACK PASSED**		**DATE REC'D :** **DATE :**	

Appendix B

Table 3.2.10-1A Flight Specific Flight Data

Aircraft ID	Traversed Sector/s	Controlled Airspace	Flight Rule	Flight Type	No. of Danger Area Infringements	No. of Uplink Messages		No. of Downlink Messages		No. of Delivery Timeouts	
						Rejected	Accepted	Rejected	Accepted	Uplink	Downlink

[Selected Time Period]

Aircraft ID	No. of AIDC Messages		No. of AIDC Messages	
	Rejected	Accepted	Transmitted	Received

Table 3.2.10-1B Collective Flight Data

Day/Week/Month	Total No. of Flights	Airspace Sector				No. of Danger Area Infringements	No. of Uplink Messages		No. of Downlink Messages		No. of Delivery Timeouts	
		N	W	E	S		Rejected	Accepted	Rejected	Accepted	Uplink	Downlink

Day/Week/Month	Controlled Airspace				Flight Rule				Flight Type				
	ARR	DEP	OVF	DOM	I	V	Y	Z	S	N	G	M	X

Table 3.2.10-2 Flight Specific Surveillance Data

[Selected Time Period]

Aircraft ID	Surveillance Track Type				Source of Surveillance Track				Quality of Surveillance Track			
	Secondary	Mode S	Multilat	ADS-B	Secondary	Mode S	Multilat	ADS-B	Secondary	Mode S	Multilat	ADS-B
	o	o	x	o	1	2	-	2	Coast	Normal	-	High

Appendix C

Performance of Surveillance Data Processing in RSUR

RSUR Specifications define technical performance requirements of ATS surveillance systems used in support of a particular ATS application in a given airspace.

The RSUR-5NMSEP_ER_Tier-C specification are applicable to the delivery of surveillance data at the output of a surveillance system that is used to support 5 NM Separation service in en-route environment as described in PANS ATM (Doc 4444) section 8.7.3 in a Tier C environment.

Table 3-1: RSUR_5NMSEP_ER_TIER-C

	RSUR specification 5NM-SEP_ER_TIER-C							
	Coherence		Integrity			Time		Reliability
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤12s	**PoU** ≥97%	**HPE_{RMS}** <825m or **$HPE_{95\%}$** <1430m	**$RNBE_{LB}$**= 2714m **$RNBE_{UP}$**= 3644m	**HP_{INT}**	**HP_{MDA}** = 36.3s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}**= **30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD}** = **48s**	-
Flight Status (emergency, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 24.2s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.1% **SRV_{INT}** <10^{-5} per report					**SRV_{CNT}** = 0.999 /hour

The RSUR-5NMSEP_ER_Tier-B specification are applicable to the delivery of surveillance data at the output of a surveillance system that is used to support 5 NM Separation service as described in PANS ATM in en-route airspace (ICAO Doc4444) section 8.7.3 in a Tier B environment .

Table 3-2: RSUR-5NM SEP TIER B

	RSUR specification 5NM-SEP_ER_TIER-B							
	Coherence		Integrity			Time		Reliability
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤8s	**PoU** ≥97%	**HPE_{RMS}** <540m or **$HPE_{95\%}$** <940m	**$RNBE_{LB}$=** 1776m **$RNBE_{UP}$=** 2384m	**HP_{INT}**	**HP_{MDA}** = 24s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}= 30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD}** = 32s	-
Flight Status (emergency status, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 16s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Horizontal Velocity			VEL_{RMS} =					
Vertical rate								
Flight status ground/airborne							**FS_{MUD}** = 16s	
Aircraft Identification							**ID_{MUD}** = 32s	
ACAS capability					CAP_{INT} $<10^{-5}$			
ADS-B version number					CAP_{INT} $<10^{-5}$			
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.005% **SRV_{INT}** $<10^{-5}$ per report					**SRV_{CNT}** = 0.9999 /hour

The RSUR-5NMSEP_ER_Tier- A specification are applicable to the delivery of surveillance data at the output of a surveillance system that is used to support 5 NM Separation service as described in PANS ATM (ICAO Doc4444) in en-route airspace section 8.7.3 in a Tier A environment.

Table 3-3: RSUR_5NMSEP_ER_TIER-A

	RSUR specification 5NM-SEP_ER_TIER-A							
	Coherence		Integrity			Time		Reliability
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤5s	**PoU** ≥97%	**HPE_{RMS}** <230m or **$HPE_{95\%}$** <400m	**$RNBE_{LB}$=** 1262m **$RNBE_{UP}$=** 1695m	**HP_{INT}**	**HP_{MDA}** = 15s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}= 30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD}** = 32s	-
Flight Status (emergency status, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 10s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Horizontal Velocity			HVE_{RMS} < ?					
Vertical rate			VRE_{RMS} < ?					
Flight status ground/airborne							**FS_{MUD}** = 10s	
Aircraft Identification							**ID_{MUD}** = 32s	
ACAS capability					CAP_{INT} $<10^{-5}$			
ADS-B version number					CAP_{INT} $<10^{-5}$			
ADS-B in capability					CAP_{INT} $<10^{-5}$			
Data-link capability					CAP_{INT} $<10^{-5}$			
Resolution Advisory status						X_{MDA} <DAT_{UI} +2s		
Barometric pressure setting						X_{MDA} <DAT_{UI} +2s		
Expanded State vector (2.3.3.5)						X_{MDA} <DAT_{UI} +2s		
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.005% **SRV_{INT}** $<10^{-5}$ per report					**SRV_{CNT}** = 0.99999/h

The RSUR-5NMSEP_ER_Tier-C specification are applicable to the delivery of surveillance data at the output of a surveillance system that is used to support 3 NM separation service in TMA environment as described in PANS ATM (Doc 4444) section 8.7.3 in a Tier C environment.

Table 3-4: RSUR_3NMSEP_TMA_TIER-C

	RSUR specification 3NM-SEP_TMA_TIER-C							
	Coherence		Integrity			Time		Reliability
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤5s	**PoU** ≥97%	**HPE_{RMS}** <450m or **$HPE_{95\%}$** <780m	**$RNBE_{LB}$=** 1478m **$RNBE_{UI}$=** 1985m	**HP_{INT}**	**HP_{MDA}** = 15s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}= 30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD} = 20s**	-
Flight Status (emergency, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 15s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.1% **SRV_{INT}** <10^{-5} per report					**SRV_{CNT}** = 0.999 /hour

The RSUR Specification defines the performance of ATS surveillance systems used in the provision of Terminal Control Area TMA (see definition in PANS-ATM) (Doc4444) in Terminal Area section 8.7.3 in a Tier B environment.

Table 3-5: RSUR 3NMSEP_TMA_TIER-B

	RSUR specification 5NM-SEP_TMA_TIER-B							
	Coherence		Integrity			Time		Reliability
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤5s	**PoU** ≥97%	**HPE_{RMS}** <300m or **$HPE_{95\%}$** <520m (556m ADS-B)	**$RNBE_{LB}$=** 987m **$RNBE_{UP}$=** 1326m	**HP_{INT}**	**HP_{MDA}** = 15s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}= 30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD}** = 20s	-
Flight Status (emergency status, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 15s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Horizontal Velocity (VEL)			VEL_{RMS} =					
Vertical rate (VR)								
Flight status ground/airborne							**FS_{MUD}** = 15s	
Aircraft Identification							**ID_{MUD}** = 20s	
ACAS capability					CAP_{INT} $<10^{-5}$			
ADS-B version number					CAP_{INT} $<10^{-5}$			
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.004% **SRV_{INT}** $<10^{-5}$ per report					**SRV_{CNT}** = 0.9999 /hour

The RSUR Specification defines the performance of ATS surveillance systems used in the provision of Terminal Control Area TMA (see definition in PANS-ATM) (Doc4444) in Terminal Area section 8.7.3 in a Tier A environment.

Table 3-6: RSUR 3NM-SEP_TMA_TIER-A

	RSUR specification 5NM-SEP_TMA_TIER-A							
	Coherence		**Integrity**			**Time**		**Reliability**
DATA	Update Interval UI	Probability of Update	Core Error	Tail error	Integrity	Age	Delay	
2D Horizontal Position (HP)	**DAT_{UI}** ≤5s	**PoU** ≥97%	**HPE_{RMS}** <150m or **$HPE_{95\%}$** <260m	**$RNBE_{LB}$=** 1736m **$RNBE_{UP}$=** 988m	**HP_{INT}**	**HP_{MDA}** = 15s	-	-
Pressure Altitude (PA)			-	-	**PA_{INT}** <0.1%	**PA_{MDA}= 30s**	-	-
Mode A code Identity (ID)			-	-	**ID_{INT}** <0.1%	-	**ID_{MUD}** = 20s	-
Flight Status (emergency status, SPI = FS)	-	-	-	-	-	-	**FS_{MUD}** = 10s	-
Time of applicability	With HP	-	-	-	-	-	-	-
Horizontal Velocity			HVE_{RMS} < ?					
Vertical rate			VRE_{RMS} < ?					
Flight status ground/airborne							**FS_{MUD}** = 10s	
Aircraft Identification							**ID_{MUD}** = 20s	
ACAS capability					CAP_{INT} $<10^{-5}$			
ADS-B version number					CAP_{INT} $<10^{-5}$			
ADS-B in capability					CAP_{INT} $<10^{-5}$			
Data-link capability					CAP_{INT} $<10^{-5}$			
Resolution Advisory status						X_{MDA} <DAT_{UI} +2s		
Barometric pressure setting						X_{MDA} <DAT_{UI} +2s		
Expanded State vector (2.3.3.5)						X_{MDA} <DAT_{UI} +2s		
Service	In defined OCV **HP_{RTD}** <0.3s		**FGT_{DEN}**< 0.005% **SRV_{INT}** $<10^{-5}$ per report					**SRV_{CNT}** = 0.99999/h

Appendix D

CHECK LIST FOR ATMAS PROJECT MANAGEMENT

Phases	No.	Activities	Detail Activities	Check ☒	Check ☑
PRE-CONTRACT PHASE:					
Planning	1	**Definition of Scope of Work**	System Architecture		
			Level of redundancy required		
			Level of recording requirement		
			Mode of communications with external Stake holders		
			Power distribution requirement		
	2	**Project Cost Estimation**	Quoted price from Prospective suppliers		
			Latest version of Hardware & peripheral equipment (Monitors, Flight Strip Printers, Printers etc.)		
			Defining the level of Operational Maintenance support that is required during Operationalization		
	3	**Project Time-Line**	Defining all the activities and its duration		
			Defining parallel activities		
			The time of Site-readiness, availability of external systems like ASMGCS, AMSS/AMHS,Met system		
			The time of thorough software test in real environment undertake by the QA team, MP, and ANSP,and before putting the system into operation.		
			The time that Suppliers take to resolve the software issues designed as per customer requirement		
			Sufficient manpower available for testing the ATM Automation system during shadow mode of operation		
Requirement definition	4	**System requirement**	System requirement in terms of Controller		
			System requirement in terms of Technician		

			New technology			
Bidding	5	**Tender Evaluation and selection of bidder based on Quality cum Cost Based Selection (QCBS) criterion**	Quality assurance level requirement	Quality of Test in accordance with ISO-9001-20XX specifications		
				DO-278A/ED-109A assurance level		
				Valid CMMI Level xx		
				Dedicated Quality Assurance Program (QAP) manager who should be responsible for Quality of documentation		
				QAP Manager shall not be same person as the Program Manger		
			Qualified Technical proposal	finalized the Technical and Operational requirements of the system		
				evaluate and conduct Technical discussion on methodology of fulfillment of critical requirements		
				understand in depth the strategy to achieve the functional requirements		
			Qualified project team	Supplier should depute his manpower to complete the system software develop, system test, system document preparation, system database creation, system transition, and etc.		
POST CONTRACT PHASE :						
Implementation	6	**Project Monitoring Group**	There are different groups involved like ATSEPs, ATCOs, External system suppliers, Decision making Officers (Management), Safety officer and Regulatory authorities etc.			
			Dedicated Project Monitoring group (PMG) drawn from all the concerned stakeholders			
			The PMG will be responsible for monitoring various activates, Time lines, scheduling activities etc.			
			The PMG will be responsible for keeping a running record of the progress of implementation,with external stake holders and reporting the progress to Higher Management. a record of various decisions, coordination			
	7	**System Evaluation, HMI**	System requirement review (SRR)	Review the system requirement based on the bidding document		
			System Design Review (SDR)	Any gap in understanding the System requirement by		

		customization & prototype testing		supplier shall be mutually agreed and properly recorded		
			Factory Acceptance Test (FAT)	FAT procedures shall be well examined		
				FAT duration shall be realistic		
				Supplier shall resolve the System anomalies observed during FAT		
	8	**External Interface Integration & Installation Phase**	Dust free environment, Air conditioning system in place, Power supply source is in place,			
			Availability of External systems ASMGCS, AMSS, MET etc.			
			Surveillance data to be integrated is available & ATC Consoles are available			
			ICD Details of ASMGCS and ATMAS should be shared well in advance			
			Rationality of AIDC ICD version should be ensured and defined in scope of work.			
			Radar & MET radar data protocol should also be defined			
	9	**Database Creation Phase**	Supplier should prepare the Database Creation incoperate with controllers and technican			
			Database Creation should be completed in time before starting site testing phase			
	10	**Site Acceptance**	Quality Assurance Audit			
			Site Acceptance Test			
			System Reliability & Stability Test (SRST),			
			System Anomalies resolution			
	11	**Training**	Training to ATSEPS and ATCOs is normally provided before Factory Acceptance test as well as after installation of the System			
			Supplier provides the training to Trainers who will further provide the training to other Officers.			
	12	**Flight Inspection**	Planning	Identification of Stakeholders, form the Flight Inspection programme, and prepare the system and other conditions		
			Conducting	All stakeholders need to cooperate and record data following the Flight Inspection programme		
			Reporting	Analysis and report the recorded data, and form the conclusion of the Flight Inspection		

Transition	13	**Transition Preparation**	Transition Scheme		
			Scheme Evaluation		
			System Deployment		
			Table Pre-rehearsal		
			Other Preparations (Technical manual, notification process, emergency plan, etc.)		
	14	**System Rehearsal/Pre-Transition Verification**	System Switch Steps Validation		
			System Functions and External Interfaces Validation		
	15	**System Transition**	The shadow period is recommended to put the new system into operation during an off-peak time		
			performed based on the pre-defined procedure at the pre-defined transition time		
	16	**Post-Transition Operation**	Issues reported during the observation period.		
			The cause analysis and possibly the avoidance and corrective methods of the issues.		
			Recommendations for future operation, matters-needs-attention, etc.		

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

ATS Inter-Facility Data Communication (AIDC)
IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT

Edition 2.0 - June 2025

Table of Contents

Chapter 1: INTRODUCTION 4
1.1 Introduction 4
1.2 The Arrangement of AIDC IGD 4
1.3 Document History and Management 5
Chapter 2: ABBREVIATIONS 6
2.1 Introduction: 6
Chapter 3: REFERENCE DOCUMENTS 8
Chapter 4: AIDC MESSAGES 9
4.1 Introduction 9
4.2 Message Field Requirements 9
4.3 AIDC Message Groups 20
4.4 Core AIDC Messages 21
4.5 Application Management Messages 23
Chapter 5: AIDC IMPLEMENTATION CONSIDERATIONS 24
5.1 Introduction 24
5.2 Pre-implementation Checklist 24
5.3 Human Machine Interfaces 25
5.4 Handling Implementation Issues 26
5.5 HMI Considerations 28
Chapter 6: HARMONIZATION FRAMEWORK FOR AIDC IMPLEMENTATION 30
6.1 Introduction 30
6.2 Harmonization Framework 30
6.3 Template of Harmonization Framework for AIDC Implementation 32
Chapter 7: AIDC PERFORMANCE MONITORING AND VALIDATION 34
7.1 Introduction 34
7.2 AIDC Performance Criteria 34
7.3 AIDC Performance Monitoring 37
7.4 AIDC Validation 38
Chapter 8: AIDC TRAINING 40
8.1 Introduction 40

8.2 Training Objectives 40
8.3 Training Principles and Techniques 40
8.4 Training Procedure 40
8.5 Scope of Training 41

Appendix A

Sample Letter of Agreement (LOA) /Memorandum of Understanding (MOU) **44**

Appendix B

Sample of AIDC Interoperability Tests **48**

List of Tables

Table 4-1: Contents of Field 14 10
Table 4-2: Field 14 Crossing Information examples 11
Table 4-3: Field 14 Block Level examples 12
Table 4-4: Field 14 Mach Number examples 12
Table 4-5: Field 14 Mach Number removed example 13
Table 4-6: Offset Weather Deviation example 14
Table 4-7: Offset Weather Deviation removed example 14
Table 4-8: Contents of Field 15 15
Table 4-9: Field 15 examples 19
Table 4-10: AIDC Messages (PAN ICD AIDC Version 1.0) 20
Table 4-11: Core AIDC Messages 21
Table 4-12: Application Management Messages 23
Table 4-13: PAN ICD AIDC Version 1.0 Messages and their Field Composition 25
Table 5-1: Table of Common AIDC Issues 26
Table 6-1: Harmonization Framework for AIDC Implementation between ATSU1 and ATSU2 32
Table 7-1: Required Operational Response 35
Table 7-2: Performance Figures 36
Table 8-1: Scope of Operational and Technical Training 41

Chapter 1: INTRODUCTION

1.1 Introduction

1.1.1 The ATS Inter-Facility Data-Communication (AIDC) Implementation and Operations Guidance Document (IGD) is the result of the task entrusted to the Asia/Pacific ATS Inter-Facility Data-Link Coordination Task Force (APA/TF) by APANPIRG. This main objective of this document is to provide guidance, complementing relevant ICAO standards, on AIDC implementation within the APAC region. The ultimate goal is that countries within APAC region are able to meet the regional AIDC targets according to APAC seamless ATM plan and continue to advance on Flight and Flow Information for a Collaborative Environment (FF-ICE) according to GANPs ASBU.

1.1.2 The Communications, Navigation, Surveillance and Air Traffic Management (CNS/ATM) environment is an integrated system including physical systems (hardware, software, and communication network), human elements (pilots, controllers and engineers), and the operational procedures for its applications.

1.1.3 Recognized by ICAO under its Global Air Navigation Plan (GANP) and Aviation System Block Upgrades (ASBU) framework as an effective tool to reduce manual intervention and ground-ground coordination errors between adjacent ATSUs, the ATS Inter-facility Data Communications (AIDC) is a data link application that provides the capability to exchange data between air traffic service units during the notification, coordination and transfer of aircraft between flight information regions. It is an automated system that facilitates routine coordination by providing a reliable and timely data exchange between ATSUs in which accurate information can be derived directly from the system, thus effectively reducing controllers' workload and hence human errors.

1.2 The Arrangement of AIDC IGD

The AIDC IGD will define the following:

Chapter 1	Introduction
Chapter 2	Abbreviations
Chapter 3	Reference Documents
Chapter 4	AIDC Messages – Message sets to be used for AIDC Implementation
Chapter 5	AIDC Implementation Considerations – Information to support the implementation activities including checklist and how to handle implementation issues.
Chapter 6	Harmonization Framework for AIDC Implementation – Information on the harmonization framework on AIDC implementation activities and plan.
Chapter 7	AIDC Performance Monitoring and Validation – Information on the infrastructure supporting the AIDC implementation including performance criteria, validation, monitoring, etc.
Chapter 8	AIDC Training – Guidance on operations and technical training to support effective implementation

1.3 Document History and Management

This document is managed by the APANPIRG. It was introduced as draft to the First meeting of the ATS Inter-facility Data Communication Task Force Working Group on AIDC Implementation Guidance Document (APA IGD WG/1) in Bangkok in December 2016, at which it was agreed to develop the draft to an approved working document that provides guidance for States in the APAC region for effective implementation of AIDC . The first edition was presented to APANPIRG for adoption in September 2017. It is intended to supplement SARPs, PANS and relevant provisions contained in ICAO documentation and it will be regularly updated to reflect evolving provisions.

Chapter 2: ABBREVIATIONS

2.1 Introduction:

When the following abbreviations are used in the present document they have the following meanings. Where the abbreviation has "(ICAO)" annotated, the term has already been decoded in ICAO DOC 8400 (*PANS-ICAO Abbreviations and Codes, Eighth Edition-2010*).

Abbreviations	
ABI	Advance Boundary Information (AIDC Message)
ACC	Area Control Centre
ACI	Area of Common Interest
ACP	Acceptance (AIDC Message)
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATS Inter-Facility Data Communication
AMSS	Automatic Message Switching System
ANSP	Air Navigation Service Providers
AOC	Acceptance of Control (AIDC Message)
APAC	Asia and Pacific Office
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ASBU	Aviation System Block Upgrades
ASM	Application Status Monitor (AIDC Message)
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
CDN	Coordination Negotiation (AIDC Message)
COP	Change Over Point
CPL	Current Flight Plan (AIDC Message)
CRC	Cyclic Redundancy Check
CRV	Common aeRonautical Virtual private network
CWP	Air Traffic Controller Work Position
DBM	Data Base Management
EMG	Emergency (AIDC Message)
EST	Coordination Estimate (AIDC Message)

FDPS	Flight Plan Data Processing System
FF-ICE	Flight and Flow Information for a Collaborative Environment
FPL	Flight Plan
GANP	Global Air Navigation Plan
GPS	Global Positioning System
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
IGD	Implementation and Operations Guidance Document
LAM	Logical Acknowledgement Message (AIDC Message)
LHD	Large Height Deviation
LOA	Letter of Agreement
LRM	Logical Rejection Message (AIDC Message)
LTO	Logical Time Out Response
MAC	Cancellation of Notification and/or Coordination (AIDC Message)
MDT	Mean Down Time for the System
MTBF	Mean Time Between Failure
OEM	Original Equipment Manufacturer
ORCAM	Originating Region Code Allocation Method
PAC	Preliminary Activate (AIDC Message)
PANS-ATM	Procedures for Air Navigation Services – Air Traffic Management
PCA	Profile Confirmation Acceptance (AIDC Message)
PCM	Profile Confirmation Message (AIDC Message)
REJ	Rejection (AIDC Message)
SOP	Standard Operating Procedures
TF	Task Force
TOC	Transfer of Control (AIDC Message)
TRU	Track Update (AIDC Message)
UTC	Coordinated Universal Time
VVIP	Very Very Important Person

Chapter 3: REFERENCE DOCUMENTS

No.	Name of the Document	Reference	Date	Origin	Domain
i.	PAN-ATM (Doc 4444/ATM501)	Fifteenth Edition including Amendment 4 applicable on 15/11/12	2007	ICAO	
ii.	Pan Regional (NAT and APAC) Interface Control Document for ATS Interfacility Data Communications (PAN ICD AIDC)	Version 1.0	September 2014	ICAO	
iii.	Asia/Pacific Regional Interface Control Document (ICD) for ATS Interfacility Data Communications (AIDC)	Version 3.0	September 2007	ICAO APAC	
iv.	Manual of Air Traffic Services Data Link Applications (Doc 9694-AN/955)	First Edition	1999	ICAO	
v.	Safety Management Manual (Doc 9859-AN/474)	Third Edition	2013	ICAO	
vi.	ICAO Abbreviations and Codes (Doc 8400)	Eighth Edition	2010	ICAO	

Chapter 4: AIDC MESSAGES

4.1 Introduction

4.1.1 This chapter describes the permitted fields and formats of AIDC messages. AIDC message fields conform to ICAO definitions contained in PANS-ATM Appendix 3 except as described below for ICAO flight plans Fields 14 and 15, as well as a "Text" field that is used in some AIDC messages.

4.1.2 ATS data in AIDC messages is enclosed between parentheses. Only one ATS message is permitted to be included in each transmission.

4.1.3 Unless specified otherwise by the ATSU, the optional elements in the AIDC message fields defined in the relevant AIDC ICD versions should be made available in the system by the manufacturer and be user configurable. An example of the elements available is shown in Table 4-13 (PAN ICD AIDC Version 1.0).

4.2 Message Field Requirements

Fields in AIDC messages do not always require the full contents of the defined ICAO message field. This section specifies the usage of specific elements from message fields defined in the PANS-ATM as well as additional information that may be included in Fields 14 and 15.

4.2.1 Field 3 requirements.

4.2.1.1 All AIDC messages should use Field 3a (Message type) only.

4.2.1.2 Fields 3b (Message number) and 3c (Message reference data) are not used, since in AIDC messages the reference numbers contained in these fields are included in the Optional Data Field (ODF), option 2 and 3. See PAN ICD AIDC Version 1.0, Chapter 3, Para 3.2.3.2.

4.2.2 Field 7 requirements.

4.2.2.1 Where Field 7 is required in an AIDC message, Field 7a (Aircraft Identification) must be included. Fields 7b (SSR Mode) and 7c (SSR Code) are optional but should be included if the information is available and applicable.

4.2.3 Field 13 requirements.

4.2.3.1 Where Field 13 is required in an AIDC message only Field 13a (Departure aerodrome), is required. Field 13b (Departure time) is not to be transmitted. The use of ZZZZ in Field 13 is supported.

4.2.4 Field 14 requirements

4.2.4.1 The following section describes the allowed contents of Field 14 (Estimate data), as well as providing examples of how Field 14 data can be incorporated in an AIDC message.

4.2.4.2 Field 14 may contain a number of mandatory and optional items. The following Table 4-1 provides an overview on the type of information that may be included in Field 14.

Table 4-1: Contents of Field 14

Data	**Example**	**Mandatory/Optional**	**Comment**
Position (14a)	0034S10413E 0017S10452E ANITO	M	Normally a waypoint or system calculated position on or near the FIR or ACI boundary as agreed to through bilateral agreement. Field 14a is followed by an oblique stroke "/"
Estimated time (14b)	2200	M	The estimate for the position in 14a
Level (14c)	A090 F330 F330F370	M	The coordinated level of the aircraft While 14c is mandatory, the support for the block level format is Optional
Supplementary crossing data (14d)	A120 F350	Included when applicable	Use in conjunction with 14e to indicate that an aircraft may be on climb or descent at, or within tolerances of, the FIR boundary
Crossing condition (14e)	Example (A) Example (B) Example (C)	Included when applicable	(A) The aircraft may be on climb from the level specified in 14d (B) The aircraft may be on descent from the level specified in 14d (C) The aircraft is cruise climbing from the level specified in 14d. The support for the cruise climb format is optional

Mach Number	GM084 EM076 LM083	O	Used when a Mach Number speed restriction has been assigned to the aircraft by ATC.
Offset and weather deviation	W25R W100E O30L	O	When an offset or weather deviation is in effect, the position in14a should be a position on the flight planned route, rather than the offset route

Note1. Each item of optional information in Field 14 is separated from the previous item by an oblique stroke "/";
Note2. The order that the item is included in Field 14 is the order in which it is listed in Table 4-1. For example, if an AIDC message were to include an assigned Mach cc as well as a weather deviation, the Mach number information would precede the weather deviation information in Field 14.

4.2.4.3 Supplementary Crossing Data and Crossing Conditions in Field 14

4.2.4.3.1 Field 14 may contain information that an aircraft is on climb, descent or cruise climb to the specified level. This is achieved by including supplementary crossing data and crossing conditions in Field 14.

4.2.4.3.2 The inclusion of cruise climb information in AIDC messages should only be made following bilateral agreement.

Table 4-2: Field 14 Crossing Information examples

Field 14	Explanation
ANITO/2130F310F290A	The aircraft is estimating ANITO at 2130, assigned F310 and is climbing from (or "above") F290.
0034S10413E/0215F310F330B	The aircraft is estimating 30N160W at 0215, assigned F310 and is descending from (or "below") F330.
PARDI/1547F360F340C	The aircraft is estimating PARDI at 1547 and is cruise climbing from F340 to F360.

4.2.4.4 Block level information in Field 14

4.2.4.4.1 Field 14 may contain information that an aircraft is operating in a block level clearance. It is permissible to include supplementary crossing data and a crossing condition with a block level, but if this occurs the supplementary information may only be a single level (i.e. it cannot be a block level).

Table 4-3: Field 14 Block Level examples

Field 14	Explanation
DUDIS/2125F320F340	The aircraft is estimating DUDIS at 2125, and is operating in a block of levels between F320 and F340 (inclusive).
0700N10533E/0244F310F350F290A	The aircraft is estimating 0700N10533E at 0244, and has been assigned a block of levels between F310 and F350 (inclusive) and is climbing to the cleared block and will be at or above F290 at 0700N10533E.

4.2.4.4.2 The AIDC format does not support a cruise climb into a block clearance.

4.2.4.4.3 The inclusion of block level information in AIDC messages should only be made following bilateral agreement.

4.2.4.5 Mach Number information in Field 14

4.2.4.5.1 Field 14 may contain information that an aircraft has been assigned a speed restriction (Mach number). When included in an AIDC message, any Mach number information should always follow directly after the level information and be separated from the level information by an oblique stroke "/".

Table 4-4: Field 14 Mach Number examples

Field 14	Explanation
AKMON/0349F350/GM085	The aircraft is estimating AKMON at 0349 at F350 and has been instructed to maintain M0.85 or greater
0145N10354E/0215F310/EM076	The aircraft is estimating 0145N10354E at 0215 at F310 and has been instructed to maintain M0.76

4.2.4.5.2 The absence of speed information in Field 14 of an AIDC message provides advice that any previously notified speed has been cancelled.

Table 4-5: Field 14 Mach Number removed example

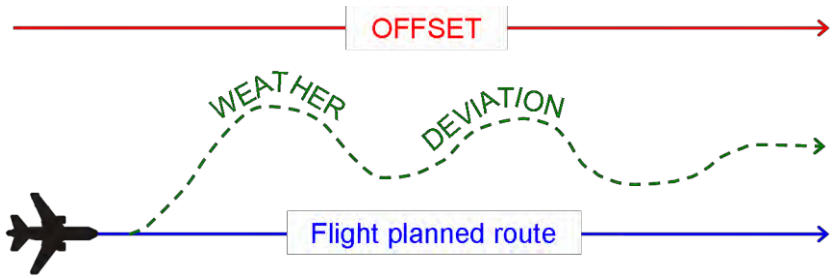
Field 14	Explanation
ESPOB/1237F310F330B/LM083	The aircraft is estimating ESPOB at 1237, assigned F310 and will cross ESPOB at or below F330, maintaining M0.83 or less.
Subsequently followed by: ESPOB/1238F310	The aircraft is now estimating ESPOB at 1238, is maintaining F310 (i.e. no longer on descent at ESPOB), and the Mach Number restriction has been cancelled.

4.2.4.5.3 The inclusion of Mach number information in AIDC messages should only be made following bilateral agreement.

4.2.4.6 Offset and Weather Deviation Information in Field 14

4.2.4.6.1 Field 14 may contain information that an aircraft is subject to either a weather deviation or offset clearance. When included in an AIDC message, any offset and weather deviation information should always be the last information in Field 14, and should be separated from preceding information by an oblique stroke "/".

4.2.4.6.2 It is important that the difference between an offset and a weather deviation is correctly understood. This difference is depicted in the diagram below.



4.2.4.6.3 An offset is a flight trajectory that is parallel to the original route, offset by a specified distance and direction. Once an aircraft is established on the offset, separation may be applied solely based on the offset path.

4.2.4.6.4 A weather deviation permits an aircraft to operate anywhere between the original route and the specified distance and direction from the original route. Separation must therefore be applied to the entire airspace in which the aircraft has been cleared to operate in.

4.2.4.6.5 The following examples show various combinations of weather deviations and offsets, combined with other optional information allowed in Field 14.

Table 4-6: Offset Weather Deviation example

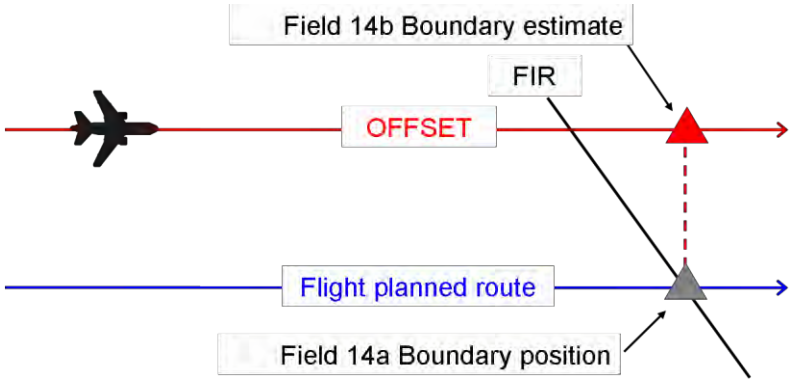
Field 14	Explanation
0856N11551E/0140F330/W20L	The aircraft is estimating 0856N11551E at 0140, maintaining F330, and has been cleared to deviate up to 20NM to the left of route.
TEGID/2330F310/GM084/O30R	The aircraft is estimating TEGID at 2330, maintaining F310, instructed to maintain M0.84 or greater, and has been cleared to offset 30NM to the right of route.
0949N11448E/0215F310F330/W25E	The aircraft is estimating 0949N11448E at 0215, is operating in a block of levels between F310 and F330 (inclusive), and has been cleared to deviate up to 25NM either side of route.
LAXOR/0215F310F350F370B/W100L	The aircraft is estimating LAXOR at 0215, and has been assigned a block of levels between F310 and F350 (inclusive), will cross LAXOR at or below F370, and has been cleared to deviate up to 100NM to the left of route.

4.2.4.6.6 The absence of offset or weather deviation in Field 14 of an AIDC message provides advice that any previously notified off-track information has been cancelled.

Table 4-7: Offset Weather Deviation removed example

Field 14	Explanation
0042N10216E/1519F330/W15R Subsequently followed by: 0042N10216E /1520F330	The aircraft is deviating up to 15NM right of track. The aircraft is back on track (and one minute later than previously coordinated).

4.2.4.6.7 When an aircraft is offsetting or deviating, the coordination point included in Field 14a should be a position based on the flight planned route rather than the offset route. The estimate included in Field 14b shall be the estimate for the "abeam" position for the position included in Field 14a.



4.2.4.6.8 The inclusion of offsets and weather deviation information in AIDC messages should only be made following bilateral agreement. Depending on their operational requirements, some ATSUs may choose to only implement the weather deviation format. If applicable, this should also be specified in bilateral agreements.

4.2.5 Field 15 requirements

4.2.5.1 The following section describes the allowed contents of Field 15 (Route), as well as providing examples of how Field 15 data can be incorporated in an AIDC message.

4.2.5.2 A number of different AIDC messages (e.g. ABI, PAC, CPL, CDN and PCM) may contain Field 15 (Route) information. Depending on the AIDC message being used, this route information may be either the current cleared route of the aircraft, or a proposed amendment to it.

4.2.5.3 While Field 15 may be optional in an AIDC message (refer Table 4-13), if it is included, all Field 15 sub-fields (15a, b and c) must also be included.

Table 4-8: Contents of Field 15

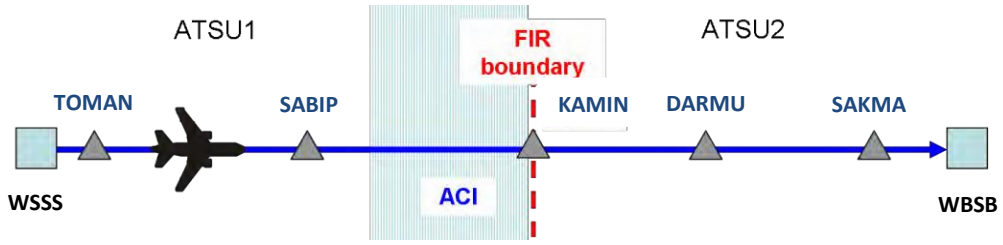
Data	Example	Mandatory /Optional	Comment
Speed (15a)	M084 N0488	M	(Included in a flight plan as the initial requested speed for a flight). In AIDC messaging: • if a speed has been specified in Field 14c, then the speed in Field 15a should be the same value; otherwise, • it should represent the expected speed of the aircraft at the coordination point included in Field 14a.
Level (15b)	F310	M	(Included in a flight plan as the initial requested flight level for a flight). In AIDC messaging: • if a block level has been specified in Field 14, then the level in Field 15a should be a single level within the block; otherwise, • it should be the level specified in Field 14c.

Data	Example	Mandatory /Optional	Comment
Route (15c)	• LAXOR • VMR • WSSS • 094937N1144829E • 033341N1065534E • L625, N884 • SJ235100 • M080F350 • M084 • F370 • M084F370 • 1230 • T • DCT	M	The route (or proposed route) of flight. It may contain any or all of the following elements: • Waypoint • Navigation aid • Aerodrome • Latitude/longitude • Latitude/longitude • ATS route • Place/bearing/distance • Speed/level changes (See Note 2) • Speed restriction • Level restriction • Speed/Level restriction (See Note 2) • Time associated with a restriction. May include a suffix of "A", "B" or "L" • Truncation indicator ('T') • Direct to

Note 1: The contents of Field 15c are defined in PANS-ATM Appendix 3, with the exception of level/time/speed restrictions which are described in PAN ICD AIDC Version 1.0 under paragraph 2.4 **Restriction Formats**. Planned speed/level changes from the filed FPL are included in some AIDC implementations although they do not reflect the current cleared profile of the aircraft.

Note 2: Flight planned speed/level changes and level/time/speed restrictions as defined in 2.4 **Restriction Formats** of PAN ICD AIDC Version 1.0, cannot both be included in Field 15 because in some cases they both use the same format. ATSUs should specify in bilateral agreements which group of information (if any) will be supported.

4.2.5.4 At the minimum, Field 15 in an AIDC message should commence at a position prior to the ACI associated with the adjacent FIR. Some ATSUs may include route information commencing at the Departure aerodrome.



4.2.5.5 Field 15 information transmitted by ATSU1 to ATSU2 should commence at (or before) SABIP. This permits ATSU2 to calculate the profile of the aircraft commencing at the ACI boundary.

4.2.5.6 ATS Route

4.2.5.6.1 An ATS route may only be preceded and followed by a waypoint that is defined to be on that ATS route.

4.2.5.7 Latitude/Longitudes

4.2.5.7.1 Latitude and longitude in Field 15 must either be both in whole degrees, or both in degrees and minutes.

4.2.5.8 Flight Planned Speed/Level Changes

4.2.5.8.1 Some ATSUs may include flight planned speed/level changes in Field 15c although they do not reflect the current cleared profile of the aircraft. An ATSU receiving Field 15c data containing planned FPL level speed changes should accept the information. However, the receiving ATSU may choose not to use the planned FPL level speed changes to update their flight plan, and may choose not to forward it in any subsequent AIDC messages.

4.2.5.9 Time/Speed/Level Restrictions

4.2.5.9.1 While the information in Field 14 defines the conditions for crossing the ACI or FIR boundary, ATSU1 may include in Field 15 time/speed/level restrictions that have been issued in a clearance to an aircraft. These clearances may include a requirement for an aircraft to cross a position at a specific time or to change level and/or speed at or by a specific time or position.

4.2.5.10 Truncation Indicator

4.2.5.10.1 While it is desirable for Field 15 to describe the entire route to destination, on occasions this may not be possible. If it is not possible to define the route to destination, it is necessary to truncate (delete the remainder of the route) and insert a truncation indicator ('T').

4.2.5.10.2 Bilateral agreements should define the use and meaning of the truncation indicator. For example the truncation indicator may represent:

i. the point at which the route in Field 15 rejoins the original flight planned route, or
ii. the end of the oceanic cleared route.

4.2.5.10.3 The truncation indicator should only follow a significant point in Field 15 and should not follow an ATS Route, or "DCT".

Note: A significant point also refers to a significant point followed or preceded by:

i. A speed/level change; or
ii. A speed and/or level and/or time restriction

Table 4-9: Field 15 examples

SY L521 AA	Navaid, ATS Route Note that both "SY" and "AA" are defined on airway L521
SY L521 GEROS 3425S16300E LUNBI AA	Navaid, ATS Route, waypoint, lat/long (ddmm)
SY GEROS GEROS045100 ESKEL L521 AA	Place/bearing/distance
SY L521 GEROS/M085F370 L521 AA DCT BB	Speed/level change, DCT
SY L521 LUNBI T SY L521 GEROS 3425S16300E T SY L521 LUNBI/M085F370 T	Truncation indicator
SY L521 GEROS/F370 L521 F370/LUNBI AA SY GEROS/2245L ESKEL/M085F390 AA SY L521 M084F350/GEROS/1230A ESKEL/M083 L521 AA	Restrictions

4.2.6 Field 16 Requirements

4.2.6.1 Where Field 16 is required in an AIDC message, only Field 16a (Destination aerodrome), is required. Field 16b (Total estimated elapsed time) and Field 16c (Alternate aerodrome/s) are not to be transmitted. The use of ZZZZ in Field 16 is supported.

4.2.7 Field 18 Requirements

4.2.7.1 Field 18 should contain other information from the current flight plan and is used to update the flight plan at the receiving ATSU.

4.2.7.2 When transmitting Field 18 in an AIDC message, all Field 18 indicators should be included, even if the change only affects data in an individual Field 18 indicator. However, ATSUs may agree by bilateral agreement to omit specific indicators (e.g. EET/) if required. If omitting indicators, ATSUs should have due regard to the potential effect to downstream ATSUs.

4.2.7.3 The contents of Field 18 in AIDC messages should be specified in bilateral agreements between ATSUs.

Note: Some legacy implementations allowed provision for the modification of individual sub fields by communicating only that specific subfield. This is not recommended practice.

4.2.7.4 In some AIDC messages, Field 18 may contain only a RMK/ indicator which is used to convey free text data information. This applies to the MAC, EMG, LRM and MIS messages.

4.3 AIDC Message Groups

4.3.1 From a technical and operational perspective it is advantageous to standardize AIDC implementation to the full extent possible. This document identifies a group of messages as a "core" message set in Table 4-10 (based on PAN ICD AIDC Version 1.0) which is recommended to be supported by all ATSUs. This will aid standardization of system and procedure development.

4.3.2 It is nevertheless acknowledged that even a limited message set implementation, such as only CPL and ACP, can bring significant benefits to ATSUs. Some ATSUs may, due to technical, financial, or operational reasons, have a need to gradually implement the AIDC message set or may even determine that not all messages in the core message set are required.

4.3.3 Unless specified otherwise by the ATSU, the non-core messages shown in Table 4-10 should be supported by the manufacturer in ground systems and their availability be configured by the ATSU as required.

4.3.4 The specific AIDC messages to be used between ATSUs should be included in bilateral agreements.

Table 4-10: AIDC Messages (PAN ICD AIDC Version 1.0)

Core	Non-core	Message Class	Message
X		Notification	ABI (Advance Boundary Information)
X		Coordination	CPL (Current Flight Plan)
X		Coordination	EST (Coordination Estimate)
	X	Coordination	PAC (Preliminary Activate)
X		Coordination	MAC (Coordination Cancellation)
X		Coordination	CDN (Coordination Negotiation)
X		Coordination	ACP (Acceptance)
X		Coordination	REJ (Rejection)
	X	Coordination	PCM (Profile Confirmation Message)
	X	Coordination	PCA (Profile Confirmation Acceptance)
	X	Coordination	TRU (Track Update)

Core	Non-core	Message Class	Message
X		Transfer of Control	TOC (Transfer of Control)
X		Transfer of Control	AOC (Acceptance of Control)
X		General Information	EMG (Emergency)
X		General Information	MIS (Miscellaneous)
X		Application Management	LAM (Logical Acknowledgement Message)
X		Application Management	LRM (Logical Rejection Message)
	X	Application Management	ASM (Application Status Monitor)
	X	Application Management	FAN (FANS Application Message)
	X	Application Management	FCN (FANS Completion Notification)
	X	Surveillance Data Transfer	ADS (Surveillance ADS-C)

4.4 Core AIDC Messages

4.4.1 This section lists down the basic core AIDC messages for the initial implementation phase (~~ABI,~~ EST, ACP, CDN, REJ, ~~AOC~~ TOC and ~~TOC~~ AOC) that are recommended to be adopted. These messages are also identified ~~are~~ as part of the ASBU B0 recommendations pertaining to AIDC implementation

Note.— Notwithstanding the capability of CDN messages to support amendments to multiple fields, the recommended initial implementation scope encompasses only amendments to Field 14 (a, b, c) within Field 22.

4.4.2 The complete list of AIDC messages, their purpose, message format and examples can be found in the relevant "AIDC Messages" chapter of the various versions of AIDC ICD.

Table 4-11: Core AIDC Messages

AIDC Message	Purpose	Message format
~~ABI~~	~~• An ABI message is transmitted to provide information on a flight to the receiving ATSU. The purpose of the ABI is to synchronize the flight plan information held between two ATS Units.~~	~~ICD documents can be referred to for the required message format and examples.~~

AIDC Message	Purpose	Message format
	~~• The transmission of the initial ABI will normally be triggered at an agreed time or position prior to the common boundary or ACI, or possibly by a change in flight state. Before coordination occurs, amendments to information contained in a previously transmitted ABI should be notified by the transmission of another ABI.~~	
EST	• An EST message is used to initiate coordination for a flight. • The transmission of the EST message is used in conjunction with (and generally following) an ABI message and is triggered at an agreed time or position prior to the common boundary or ACI, or possibly by a change in flight state. • The only valid response to an EST message is an ACP message, which closes the coordination dialogue.	Respective ICD documents can be referred to for the required message format and examples.
ACP	• An ACP message is used to confirm that the coordination proposed in a received CPL, CDN, EST or PAC message is acceptable and to close the coordination dialogue. The agreed coordination conditions are updated in accordance with the proposed coordination. • An ACP message is linked to the original AIDC message using message identifier and reference identifier information described in the PAN ICD AIDC Version 1.0, section 3.2 Message Headers, Timers and ATSU Indicators.	Respective ICD documents can be referred to for the required message format and examples.
CDN	• A CDN message is used to propose amendments to previously agreed coordination conditions or coordination proposed in a CPL message or a CDN message. • An initial coordination dialogue following a CPL message is always terminated by an ACP message; otherwise an ATSU receiving a CDN message can indicate that the proposed revision is not acceptable (by replying with an REJ message) or propose an amendment to the proposed coordination by replying with a CDN message.	Respective ICD documents can be referred to for the required message format and examples

AIDC Message	Purpose	Message format
	• If sent in response to another AIDC message, the CDN message is linked to the original AIDC message using message identifier and reference identifier information described in the PAN ICD AIDC Version 1.0, section 3.2 Message Headers, Timers and ATSU Indicators.	
REJ	• A REJ message is used to reject the coordination proposed in a received CDN message and to close the coordination dialogue. The previously agreed coordination conditions remain unchanged. • An REJ message may not be used to close an initial coordination dialogue. • An REJ message is linked to the original CDN message using message identifier and reference identifier information described in the PAN ICD AIDC Version 1.0, section 3.2 Message Headers, Timers and ATSU Indicators.	Respective ICD documents can be referred to for the required message format and examples
TOC	• The TOC message is sent to propose executive control of a flight to the receiving ATSU.	Respective ICD documents can be referred to for the required message format and examples.
AOC	• The AOC message is transmitted in response to a received TOC message to indicate acceptance of executive control of a flight.	Respective ICD documents can be referred to for the required message format and examples.

4.5 Application Management Messages

Table 4-12: Application Management Messages

AIDC Message	Purpose	Message format
LAM	• The LAM is transmitted in response to each AIDC message (except for another LAM or LRM) that has been received, and found free of syntax and semantic errors. • A LAM is linked to the original AIDC message using message identifier and reference identifier information described in the PAN ICD AIDC Version 1.0, Chapter 3 Communications and Support Mechanisms.	Respective ICD documents can be referred to for the required message format and examples.

AIDC Message	Purpose	Message format
	• Non-receipt of a LAM may require local action.	
LRM	• The LRM is transmitted in response to each AIDC message not eligible for a LAM to be sent. • An LRM is linked to the original AIDC message using message identifier and reference identifier information described in the PAN ICD AIDC Version 1.0, Chapter 3 Communications and Support Mechanisms. • The LRM will identify the first message field found that contains invalid information if this field information is available. • Receipt of an LRM may require local corrective action.	Respective ICD documents can be referred to for the required message format and examples.
ASM	• The ASM message is transmitted to an adjacent ATSU to confirm that end-to-end messaging is available with that ATSU. • The transmission of an ASM message normally occurs when no AIDC messages (including Application messages) have been received from the adjacent ATSU within a specified time as defined in bilateral agreement.	Respective ICD documents can be referred to for the required message format and examples.

Table 4-13: PAN ICD AIDC Version 1.0 Messages and their Field Composition

Message	**3** **a b c**	**7** **a b c**	**8** **a b**	**9** **a b c**	**10** **a b**	**13** **a b**	**14** **a b c d e**	**15** **a b c**	**16** **a b c**	**18**	**19**	**20**	**21**	**22**						
														8 **a b**	**9** **a b c**	**10** **a b**	**14** **a b c d e**	**15** **a b c**	**18**	**Text**
ABI	M - -	MOO				M -	MMMOO		M - -					OO	MMM	OO		MMM	O	
CPL	M - -	MOO	MM	MM M	MM	M -	MMMOO	MMM	M - -	M										
EST	M - -	MOO				M -	MMMOO		M - -											
PAC	M - -	MOO				M -	MMMOO		M - -					OO	OOO	OO		OOO	O	
MAC	M - -	MOO				M -			M - -								OOOOO		O	
CDN	M - -	MOO				M -			M - -							OO	OOOOO	OOO	O	O
ACP	M - -	MOO				M -			M - -											
REJ	M - -	MOO				M -			M - -											
PCM	M - -	MOO				M -	MMMOO		M - -					OO	OOO	OO		OOO	O	
PCA	M - -	MOO				M -			M -											
TRU	M - -	MOO				M -			M - -											M
TOC	M - -	MOO				M -			M - -											

Message	**3** **a b c**	**7** **a b c**	**8** **a b**	**9** **a b c**	**10** **a b**	**13** **a b**	**14** **a b c d e**	**15** **a b c**	**16** **a b c**	**18**	**19**	**20**	**21**	**22**						
														8 **a b**	**9** **a b c**	**10** **a b**	**14** **a b c d e**	**15** **a b c**	**18**	**Text**
AOC	M - -	MOO				M -			M - -											
EMG	M - -	MOO								M										
MIS	M - -	MOO								M										
LAM	M - -																			
LRM	M - -									M										
ASM	M - -																			
FAN	M - -	MOO				M -			M - -											M
FCN	M - -	MOO				M -			M - -											M
ADS	M - -	MOO				M -			M - -											M

Legend:

M: Mandatory
O: Optional

Chapter 5: AIDC IMPLEMENTATION CONSIDERATIONS

5.1 Introduction

5.1.1 The effectiveness of AIDC functionality depends on many factors, including ATM automation systems, manufacturer of the equipment, Communication network, weather-related factors, operational and technical training, Airspace design, Coordination procedures between different ATSU's, etc. Some problems/difficulties observed during implementation/testing of AIDC procedures are of common nature irrespective of different OEM's and different States. Such problems, their possible cause and their solution evolved over time may be of great help to States in the process of implementing AIDC.

5.1.2 Every effort should be made to avoid common errors through sharing of experiences of ATSUs, who have successfully implemented AIDC.

5.1.3 All States/Administrations have been requested to designate a focal point for AIDC implementation. The updated list is available on ICAO APAC website. In case of any issues, support can be requested through these focal points.

5.2 Pre-implementation Checklist

5.2.1 Prior to the implementation of AIDC, following may have to be considered by ATSUs. ATSUs can choose to adopt these recommendations with their counterparts based on the local requirements.

No.	Considerations	Yes / No	Remarks, if any
i.	AIDC Version	N/A	Version of AIDC ICD adopted by ATSU
ii.	The communications network (e.g. AFTN, etc.) is able to support AIDC operations effectively without overloading the existing infrastructure.		
iii.	List of AIDC messages applicable between the two ATSUs (ABI, EST, CPL, etc.) and parameters are agreed.		AIDC parameters to be included in the LOAs.
iv.	AIDC parameters of ATM automation systems have been configured for the AIDC connection (e.g. parameters for Coordination messages, Enable/Disable AIDC etc.).		
v.	ATM automation systems and associated sub-systems are time		

No.	Considerations	Yes / No	Remarks, if any
	synchronized (GPS / UTC).		
vi.	Comprehensive tests with AIDC use cases completed with pairing ATSUs to ensure correct implementation and avoid unexpected responses.		
vii.	Check and ensure that the Change Over Point (COP) is consistent between the two ATSUs.		
viii.	Procedures to revert to Voice coordination have been defined by ATSUs in cases where deviations from COP cannot be handled by ATM automation systems.		
ix.	Contingency procedures have been published to cover AIDC failures. This procedure shall also address any increase in additional workload as a result of AIDC failure.		
x.	Operational and technical personnel are trained to handle AIDC.		
xi.	Communication network performance latency is monitored and recorded.		
xii.	Standard Operating Procedures (SOPs) for AIDC operations are published. Special cases where AIDC is not applicable have been identified (e.g. VVIP movements).		
xiii.	A Safety Assessment for the implementation of AIDC is carried out.		

5.3 Human Machine Interfaces

5.3.1 ANSPs should clearly specify requirements regarding Human Machine Interface (HMI) for a new ATM automation system or an upgrade. Generally, the following points may be considered:

i. *User friendliness*: choice of presentation in harmony with intended operators' environment (ATC centre), homogeneous and systematic presentation of interactions (similar actions required for similar inputs and similar feedbacks given, in all sub-elements/windows of the displays) ;

ii. *Ergonomics*: fatigue due to postural or musculoskeletal discomfort and eye focal length discomfort should be minimized, and adequate colours, font size, symbols, contrasts and brightness configured;

iii. *Efficiency*: efficient dialogues and guidance for inputs provided by the system, timely and appropriate feedback regarding operators' inputs and errors, efficient and appropriate alert and warning management avoiding unnecessary overload of the operator or the system (the latter due to non-acknowledged alerts/warnings);

iv. *Ease of Learning*: consistency and homogeneity of operators' actions through HMI.

5.3.2 With regard to AIDC, most interactions should be conducted through the label (air situation display) or electronic flight strip. It should not be done via a dedicated message box or flight plan presentation where actions to take/feedbacks/alerts could be overlooked and mis-association of the messages for flights could occur. The AIDC coordination status should also be displayed in Electronic Flight Progress Strips to increase situational awareness regarding the status of flight coordination. Any need to revert to voice communications should be clearly indicated.

5.4 Handling Implementation Issues

5.4.1 Over a period of time during testing and implementation of AIDC across ICAO-APAC region, several error messages and issues were encountered by different concerned ATSUs. Some of these issues are of common nature and some of them may be unique for a particular ATSU. Such messages compiled from various ATSUs are provided in Table 5-1 below, with a brief description of the errors, possible causes and recommended actions. These AIDC issues are not exhaustive and listed as reference only.

Table 5-1: Table of Common AIDC Issues

No.	Fault Category	Fault Description	Cause	Recommended Actions
i.	ATM Automation system	Rejection of AIDC messages by receiving system due to Error message 61, Cyclic Redundancy Check (CRC) Error.	Error is likely because sending ATM automation system is generating extra undesirable spaces	This error can be overcome by making changes in sender ATM automation system so as not to generate any extra spaces while transmitting AIDC messages.
ii.	ATM Automation/AFTN system	Coordination protocol dialogue timeout	Likely non-synchronization of time in the pairing ATM automation/AFTN systems	Automatic time synchronization through GPS servers in ATM automation/AFTN systems at both receiving and sending system is required to be done for smooth exchange of AIDC messages.

No.	Fault Category	Fault Description	Cause	Recommended Actions
iii.	Communication Network	a) Latency in communication network (AFTN link), resulting in message time-out errors b) Message timeout errors due to possible re-routing of messages in case of failure of direct AFTN link.	If due to network latency, no automatic system response is received by the sender system in a fixed time, then the sender system generates a LTO (time out response).	Expand the bandwidth of existing AFTN link or increase the message time-out parameter for all messages to avoid generation of time ou response.
iv.	Airspace Design/ Procedures	ABI messages of some of the aircrafts are not correlated with Flight plan available in ATM automation system	Rejection of ABI messages exchanged between system due to route error and mismatch in coordination timing. ATM automation system may reject the incoming ABI message because of unrecognised route portion (depends on how common airways are defined in the pairing systems - Some airways may be defined up to a certain extent in next FIR, while others may be defined only up to the FIR boundary)	Modification in airways (like imaginary points) may be considered in the database of both pairing ATSUs ATM systems for effective acceptance of AIDC messages.
v.	AIDC message format	AIDC messages in pre-2012 format		ATM system to be modified to support ICAO FPL 2012 format
vi.	AIDC message format	Some ATM automation systems rejected latitude/longitude represented up to seconds (041627N0733138E).	As per AIDC-ICD seconds is not part of the standard LAT/LONG format	ATM automation system may conform to AIDC ICD
vii.	AIDC message format /training	Incorrect route truncation. Truncated routes are not getting	ICAO route truncation indicator is not supported by many receiving ATSUs. The	Manufacturer and States must ensure that ATM automation system must

No.	Fault Category	Fault Description	Cause	Recommended Actions
		accepted by receiving ATSU.	Asia/Pacific ICD clearly states the rules required for truncating a route after the last known significant route point. If these rules are not followed there are significant risks associated with the transmission of incorrect route information to the receiving ATSU. While the majority of instances investigated are the result of human error, there have been occasions when the ATM automation system behaved unexpectedly. With the increasing use of route modifications, the accuracy of route handling and transmission between automated systems need to be ensured.	be designed/ changed as per APAC ICD mandated by ICAO. To avoid human errors, a comprehensive training backed up by regular refresher training is required to be imparted to controllers/system operators.
viii.	AIDC message flow	Non-receipt of ACP messages within designated time span results in unnecessary LRM messages	In some of the ATM automation systems, there is no provision of automatic acceptance of EST messages and messages are accepted manually at receiving ATSU.	It is recommended that AIDC messages like EST are accepted automatically to avoid frequent LRM messages.
ix.	AIDC message flow	Even after sending a rejection (REJ) or counter coordination message (CDN) by receiving ATSU, the transmitting ATSU continues to send the CDN message	Unnecessary/ multiple generation of automatic CDN messages by transmitting ATSU, without waiting for an acknowledgement, might be due to system getting into some loop or may be due to some other system problem	As per PAN-ICD protocol, transmitting system must wait to receive response for a CDN message. This response may be ACP, REJ or CDN. The temporary solution may be to stop automatic generation of CDN messages by the system.

5.5 HMI Considerations

ATSUs should consider the following recommendations for configuration of the ATM automation systems for AIDC HMI presentation:

i. AIDC HMI should allow some flexibility to initiate or respond to AIDC messages (if required).

ii. The ATM automation system should allow to define the mode of ~~Message~~ message exchange off-line for AIDC i.e. fully automatic or manual. For example, automatic/manual responses for the messages like EST, CPL, PAC, CDN, etc.

iii. The ATM automation system should allow users to specify which optional amendment fields of an AIDC message are to be exchanged.

iv. Dedicated AIDC message exchange window to display readily the current status and actual content of messages exchanged should be considered. In addition, AIDC message exchange status may preferably be considered to be displayed via the data block of individual aircraft on the Air Situation Display.

v. ATM automation system should allow the creation of flight data record on receipt of an ABI message, if a flight data record is not available to minimize the possibility of LRM messages in case flight plan is not available in the receiving ATSU.

vi. The use of colour to distinguish the various states of AIDC process may be considered.

Chapter 6: HARMONIZATION FRAMEWORK FOR AIDC IMPLEMENTATION

6.1 Introduction

6.1.1 This chapter describes the steps that should be taken to harmonize AIDC implementation between ATSUs. As the successful transmission and reception of AIDC messages are dependent on various external factors, the need to harmonize implementation plans and timelines if AIDC implementation is to be successful.

6.1.2 AIDC messages can be transmitted through existing AFTN networks or by the use of dedicated data channels between ATSUs. There may be a need to upgrade existing infrastructure to cater for sufficient bandwidth for handling AIDC messages.

6.1.3 The framework details and template are described in greater detail in the next section.

6.2 Harmonization Framework

The various items that will require harmonization between ATSUs are listed below. These are the minimum required and individual ATSUs may choose to include additional items as required. A coordinated approach to implementing AIDC is crucial to allow ATSUs to improve on coordination efficiency and remove associated errors that could arise with manual voice coordination.

6.2.1 Bilateral Agreements

6.2.1.1 The use of AIDC messages in the provision of ATC services will usually require harmonization of ATC procedures to allow ATSUs to take advantage of the message automation. This will require an update to existing bilateral agreements between ATSUs with regards to the coordination process and the various AIDC-related arrangements.

6.2.2 ATC Procedures

6.2.2.1 With the introduction of AIDC messages for use in the provision of ATC services, existing ATC procedures may need to be reviewed or modified to incorporate these AIDC messages as part of the ATC procedures. E.g.: the use of EST for coordination may reduce the need for voice coordination between ATSUs.

6.2.3 ATS Routes

6.2.3.1 AIDC messages are used to improve the coordination processes between ATSUs. These messages can be used selectively on specific ATS routes/waypoints as agreed by the ATSUs involved. The various ATS routes and coordination waypoints will need to be defined and agreed between the ATSUs to facilitate AIDC implementation.

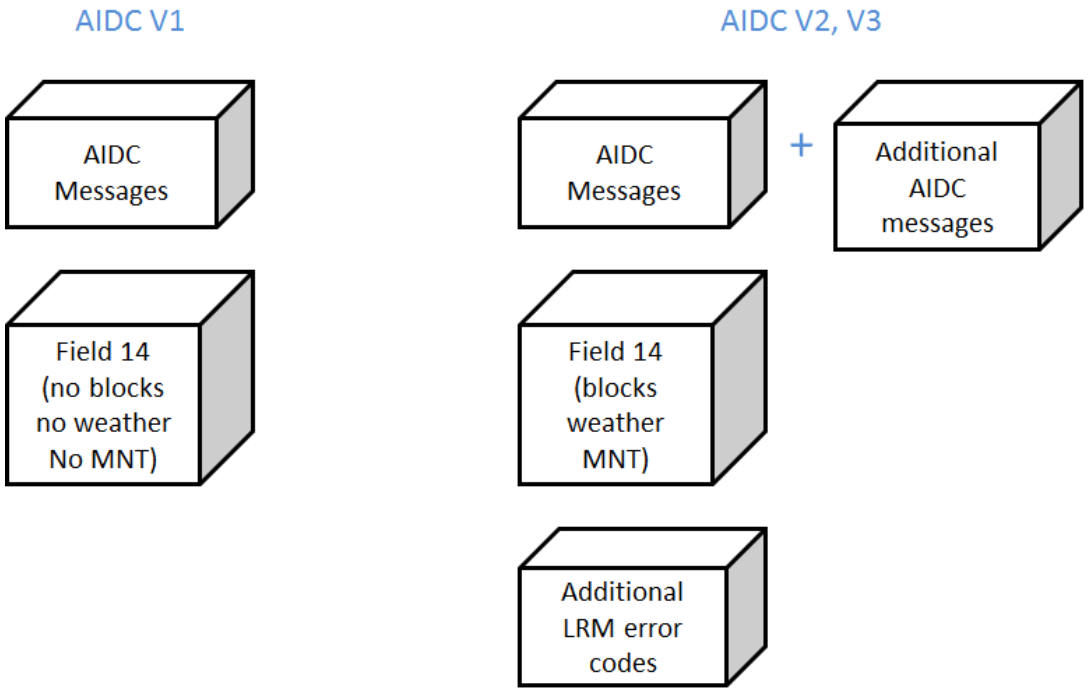
6.2.4 AIDC Version

6.2.4.1 Even though the latest AIDC version is backward compatible to a large extent, there may be instances where certain version-specific messages may result in errors between two ATM automation systems. Ideally both ATSUs should use the same AIDC version. If however different versions are deployed, the ATSUs should coordinate closely and reach an agreement for operating AIDC using a common set of messages.

6.2.4.2 The enhancements introduced during the development of AIDC ICD Version 2 and 3 were designed to permit continued interoperability with AIDC ICD Version 1. For example, when a block level format was defined for Field 14, it was explicitly stated that this was an optional format only to be used with agreement between the two ATSUs.

6.2.4.3 The following diagram depicts the significant differences between AIDC Version 1 and the subsequent AIDC versions. Compatibility of AIDC versions is covered in PAN ICD Version 1.0.

Figure 6-1: Differences between Versions of AIDC



6.2.4.4 The diagram shows that AIDC messages supported in AIDC Version 1 is included in AIDC V2 and V3. As such, an AIDC V1 ATSU is interoperable with an AIDC V2 or 3 ATSU. The additional messages in AIDC V2 and V3 are not supported by AIDC V1. However, this could easily be controlled procedurally by simply not sending these messages.

6.2.5 AIDC Messages

6.2.5.1 The implementation of AIDC does not require the use of all the defined AIDC messages. ATSUs will need to define the specific AIDC messages to be used for ATC services and also the related parameters that will be configured for these messages

6.2.6 Communication Network

6.2.6.1 The carriage of AIDC messages is facilitated through existing communication network (e.g. AFTN, AMHS, etc.). The type of network that will be used for AIDC message exchange will need to be defined, including the appropriate recovery/ contingency actions that will be adopted in abnormal situations.

6.3 Template of Harmonization Framework for AIDC Implementation

Table 6-1: Harmonization Framework for AIDC Implementation between ATSU1 and ATSU2

No.	Harmonization items	Description	Remarks
1	Bilateral agreements	• Date of implementation to be stated in bilateral agreement e.g. LOA or MOU between ATSUs. • AIDC messages and parameters to be implemented • ATS routes /coordination points to be determined • Agreed fallback procedures in the event of unsuccessful message exchanges • AIDC suspension conditions • Communication network for AIDC messaging (e.g. AFTN, dedicated line, etc.)	Sample LOA/MOU are available in Appendix A
2	ATC Procedures	• Agreed AIDC message parameters and activation conditions by both ATSUs. • Fallback procedures in the event of AIDC failure.	
3	ATS Routes	• ATS routes • Coordination points	

No.	Harmonization items	Description	Remarks
4	AIDC Version	• AIDC version to be used by ATSUs	If different versions are deployed, the ATSUs should coordinate closely and reach an agreement for operating AIDC using a common set of messages.
5	AIDC Messages	• List of AIDC messages to be exchanged	List of core messages
6	Communication Network	• Infrastructure required (e.g. communications connection) • Alternate/backup links in the event of failure of primary transmission channel.	

Chapter 7: AIDC PERFORMANCE MONITORING AND VALIDATION

7.1 Introduction

7.1.1 AIDC is recognized as an effective tool to foster better collaborative air traffic management between concerned ATSUs of adjacent FIRs, supporting the ICAO ASBU Module B0-FICE, identified as one of the regional priority modules under the ICAO Asia/Pacific Seamless ATM Plan.

7.1.2 In addition, safety issues relating to human errors in ATS transfer were identified by the 18th and 20th Meetings of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/18 and RASMAG/20 meetings) where AIDC was considered as an important means of mitigating Large Height Deviation (LHD*[Note 1]).

7.1.3 The procedures described in this section aim to ensure system performance by validation, reporting and tracking of possible problems revealed during system monitoring with appropriate follow-up actions.
**Note 1*: Large Height Deviation (LHD) means any vertical deviation of 90m/300ft or more from the flight level expected to be occupied by the flight.

7.2 AIDC Performance Criteria

7.2.1 The efficiency gained by adopting AIDC is significant. With continued growth in ATC traffic, higher efficiency and benefits from the introduction of AIDC can be anticipated.

7.2.2 However, if AIDC messages are not transmitted and received in a timely manner between ATM automation systems, potentially there will be increased risk if AIDC does not meet the performance criteria as aircraft might cross boundaries without coordination or transfer of control responsibility taking place.

7.2.3 In order to effectively use the AIDC application for the interchange of ATC coordination data, performance requirements need to be specified. These specified performance requirements need to be mutually agreed between neighbouring ATSUs implementing AIDC. The following are recommended performance parameters for application response time and operational response time

7.2.4 Application Response

7.2.4.1 Every AIDC message received by an ATSU, except a LAM or LRM, shall be responded to with a LAM or LRM. While no LAM is generated for a valid LRM, an ATSU may choose to respond to an invalid LRM with an LRM. Such a response is termed an Application Response, and is generated automatically by the ATM automation system. A LAM shall be transmitted when the receiving ATM automation system found the received message to be syntactically correct and the message data was accepted for further processing or presentation. Otherwise, an LRM message shall be transmitted.

7.2.4.2 The timeout value T_{alarm} associated with an application response should typically be less than 180 seconds measured from the transmission time of the original message and may be specified by bilateral agreement, corresponding to the nominal value associated with the accountability timer.

7.2.4.3 The transmission of an application response should be triggered after the semantic and syntactic checks have been performed on the incoming message. This is because the purpose of an application response is to indicate that a received AIDC message has both been received and is semantically and syntactically correct. Failure to receive an expected application response (i.e. a LAM or LRM) within Tr seconds ($\leq T_{alarm}$) shall result in a re-transmission (up to a maximum number Nr) of the original message. The timeout timer Tr shall be reset upon re-transmission. Failure to receive an application response within T_{alarm} seconds from the original transmission of the message shall result in a warning being issued.

7.2.4.4 The transmission of a LAM or LRM shall be triggered by the ATC application process, not the communications process. This is because an application response indicates that the received message was examined by the ATC application process(s), not just the communications functions. Note the distinction between an ATC application process, which implements a critical ATC function such as Coordination or Transfer of Control, and a communications process, which is responsible for the reliable delivery of data, but not data interpretation.

7.2.4.5 Receipt of an LRM should cause the ATSU to take a corrective action before re-transmitting the rejected message with a new message identification number. This corrective action may be automatic or manual.

7.2.5 Operational Response

7.2.5.1 Several AIDC messages require a response, in addition to the normal application response, by another AIDC message. Such a response is termed an Operational Response.

Table 7-1 below indicates the required response to a received message. AIDC messages not listed in Table 7-1 have no operational response.

Table 7-1: Required Operational Response

Received Message	**Required Operational Response**
CPL	ACP or CDN[Note]
EST	ACP
PAC	ACP
CDN	ACP,CDN, or REJ[Note]
PCM	PCA
TOC	AOC

Note.: An REJ is not available in an Initial Coordination Dialogue initiated by a CPL, EST or PAC. An REJ is only available in a CDN dialogue while an REJ is not a valid response to a CDN message within an Initial Coordination Dialogue.

7.2.5.2 Failure to receive a response within an adapted operational response timeout period T_{op} shall result in a warning being issued.

7.2.5.3 The value of T_{op} is dependent on whether manual processing is required to generate the operational response. In general, T_{op} should be less than a value when a manual action is required to trigger the operational response.

7.2.5.4 For example, the performance requirements specified in Asia/Pacific Regional Interface Control Document (ICD) v3.0 are as follow:

Table 7-2: Performance Figures

T_{alarm}	180 seconds
T_{op}	≤600 seconds

7.2.5.5 The performance of the AIDC will also rely on the performance of the communication network: AMHS/AFTN, and communication layer such as Common IP-based networks. In this connection, the following end-to-end communication requirements based on Common aeRonautical Virtual Private Network (CRV) may be considered between any two AIDC peers:

Maximum One-Way Latency (ms): 300 ms

Maximum Round Trip Time (ms): 600 ms

Normally, the latency of the communication network (in msec) is sufficient to support to the application of AIDC (in second), for example, each AIDC message sent will result in at least one technical response (LAM or LRM), and where necessary an operational response (e.g. EST/ACP, TOC/AOC). Some AIDC application timeout with reference to the agreed ICD as mentioned above is required to be set based on performance of the communications circuit.

7.2.6 Reliability

7.2.6.1 Reliability is a measure of how often a system fails and is usually measured as Mean MTBF expressed in hours. Continuity is a measure equivalent to reliability, but expressed as the probability of system failure over a defined period. In the context of this document, failure means inability to deliver AIDC messages to the adjacent ATSUs. This includes the failure of AIDC functions only. For the other factors such as the failures of communication link and the counterpart AIDC functions are not counted in this document. The reliability performance requirement of AIDC is given in ICAO Doc 9694 “Manual for Air Traffic Services Data Link Applications” (99.9%).

7.2.7 Availability

7.2.7.1 Availability is a measure of how often the system is available for operational use. It is usually expressed as a percentage of the time that the system is available.

7.2.7.2 Planned outages are often included as outages because the efficiencies provided to the Industry are lost, no matter what the cause of the outage. However, some organisations do not include planned outages because it is assumed that planned outages only occur when the facility is not required.

7.2.7.3 Availability is calculated as

Availability (Ao) = MTBF/(MTBF+MDT)

where MTBF= Mean Time Between SYSTEM Failure
MDT = Mean Down Time for the SYSTEM

The MDT includes Mean Time To Repair (MTTR), Turn Around Time (TAT) for spares, and Mean Logistic Delay Time (MLDT)
NB: This relates to the failure of the system to provide a service, rather than the time between individual equipment failures. Some organizations use Mean Time Between Outage (MTBO) rather than MTBF.

7.2.7.4 Availability is directly a function of how quickly the SYSTEM can be repaired, that is directly a function of MDT. Thus availability is highly dependent on the ability & speed of the support organisation to get the system back on-line. The availability performance requirement of AIDC is given in ICAO Doc 9694 "Manual for Air Traffic Services Data Link Applications" (99.996%).

7.3 AIDC Performance Monitoring

States/Administrations are encouraged to submit identified issues using the AIDC issues form to the ICAO Regional Office for consolidation.

7.3.1 The Monitoring Process

7.3.1.1 When problems/issues are discovered, the initial analysis should be performed by the organization(s) identifying the problem/issues. In addition, the problem/issue should be logged in the AIDC issues table. As some problems or abnormalities may involve more than one organization, the originator should be responsible for follow-up action to rectify the problem and take lead to record the information in the AIDC issues table. It is essential that all information relating to the problem/issue is documented and recorded and resolved in a timely manner.

7.3.1.2 The following groups should be involved in the monitoring process and problem/issue tracking to ensure a comprehensive review and analysis of the collected data:

i. ATS Providers;
ii. Organizations responsible for ATS system maintenance (where different from the ATS provider);
iii. Relevant State regulatory authorities; and
iv. Communication Service Providers being used (if appropriate).

7.3.1.3 To quantify the safety benefits of AIDC implementation, number of LHDs prior to and post AIDC implementation should be noted and recorded for analysis.

7.4 AIDC Validation

7.4.1 Validation Guidelines

7.4.1.1 ATSUs should conduct a validation process before introduction of their new AIDC functionality and procedures. Such processes shall include before and during implementation:

i. A system safety assessment for new implementations is the basis for defining system performance requirements. Where existing systems are being modified to utilize additional services, the assessment shall demonstrate that the ATS Provider's system will meet safety objectives;
ii. Integration test results confirming interoperability for operational use of AIDC messages; and
iii. Establishment of the Operational Instruction (OI)/ Letter of Agreement (LOA) or Memorandum of Understanding (MOU) between ATSUs and mutual agreement on the associated parameters for the set of AIDC messages to be implemented.

7.4.2 Safety assessment

7.4.2.1 In accordance with the provisions of ICAO SMS manual (Doc9859), the objective of the system safety assessment is to ensure the ATSUs that the introduction and operation of AIDC is safe. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

i. Identifying failure conditions;
ii. Assigning levels of criticality;
iii. Determining risks/ probabilities for occurrence;
iv. Identifying mitigating measures and fall back arrangements;
v. Categorizing the degree of acceptability of risks; and
vi. Operational hazard ID process
vii. HMI verification

7.4.2.2 Following the safety assessment, ATSUs should institute measures to offset any identified failure conditions that are not already categorized as acceptable. This should be done to reduce the probability of their occurrence to a level as low as reasonably practicable. This could be accomplished through system automation or manual procedures.

7.4.3 Integration test

7.4.2.3 ATSUs should conduct AIDC trials (both operational and technical) with adjacent ATSUs to ensure they meet the operational and technical requirements stated in the agreed test procedure. Examples of Interoperability tests and Technical trials are provided in Appendix A and B respectively.

7.4.3 Agreement for Validation

7.4.3.1 States should coordinate with pairing ATSUs to confirm that their tests procedures ensure harmonization of procedures during testing.

7.4.4 Distribution of information

7.4.4.1 It is important that information that may have an operational impact on other parties be shared by States/Administrations and distributed by the ICAO Regional Office, as soon as possible. In this way, each party is made aware of problems already encountered by others, and may be able to contribute further information to aid in the solution of these problems.

Chapter 8: AIDC TRAINING

8.1 Introduction

8.1.1 Training is one of the key elements for preparing operators on AIDC and to provide guidance on both AIDC technical and operational procedures. A comprehensive training program will ensure operational and technical personnel have a better understanding on how AIDC works, interface between AIDC and ATS system and skills required to operate AIDC. Training program should be reviewed and updated when changes are planned.

8.1.2 Air traffic controller training is defined with specified regulations, international and domestic, that prescribe minimum requirements for organizations certified for such a training. These requirements include creation of the:

i. Implementation Plan
ii. Operations Manual
iii. Technical Manual
iv. Training Program

8.1.3 In order to provide safe, orderly and efficient flow of air traffic and to ensure harmonized training process, each country needs to provide a sufficient AIDC training. This training should increase the performance of operational and technical personnel and improve overall air traffic safety and efficiency.

8.2 Training Objectives

8.2.1 Taking into consideration that operational and technical trainees come from various backgrounds and different levels of competency, a structured training program/module is recommended incorporating AIDC objectives. This would enable operational and technical personnel to have the acceptable level of understanding on how AIDC work. The objectives would be:

i. To instil knowledge by imparting AIDC concepts, , skills and techniques. To educate trainees on the benefits of AIDC and how it can reduce controller's workload.
ii. To increase efficiency and reduce human errors by incorporating AIDC automation.

8.3 Training Principles and Techniques

8.3.1 The following should be taken into consideration prior to conducting AIDC training:

i. Operational and technical personnel may come with different levels of experience, knowledge, skill, attitude and age.
ii. AIDC training includes theoretical and practical training.
iii. Participant evaluation/feedback for each training session is important to ensure trainees fully understand the principles and objectives of AIDC.

8.4 Training Procedure

8.4.1 It is recommended that following training procedure should be used as a guidance for AIDC training:

i. Instructor should be competent in AIDC as well as instructional techniques. On the basis of AIDC analysis and description, progressive lesson plan should be prepared.

ii. Human factors with regard to introduction of AIDC should be covered during the training. Trainees should be prepared to accept changes in their working environment. The loss of cognitive functions with the introduction of AIDC automation as compared to voice coordination should be emphasized.

iii. The training program with respect to structure, flow and sequence of AIDC functions should be clearly presented.

iv. All relevant documents such as appropriate version of AIDC ICD, local AIDC procedures, AIDC technical manuals etc., should be made available before conducting AIDC training session.

v. During the AIDC training, assessment of operational and technical personnel's competency in AIDC should be conducted.

8.5 Scope of Training

8.5.1 The scope of training would depend upon the categories of personnel to be trained. Training is a continuous process and not only needed for operational personnel but also for technical personnel involved in AIDC. The level of training will differ as operational personnel will focus more on operational aspects and technical personnel will focus more on technical aspects of AIDC.

8.5.2 Basic cross learning of operational and technical elements of AIDC will help both operational and technical personnel to identify and respond to any abnormality that may arise during AIDC operations.

Table 8-1: Scope of Operational and Technical Training

No	Scope of training	Operational Personnel		Technical Personnel	
		Theory	Practical	Theory	Practical
i	Introduction to AIDC	Essential	Essential	Essential	Essential
ii	AIDC phases, message flow and functions	Essential	Desirable	Recommended	Essential
iii	Communication network	Recommended	Desirable	Essential	Essential
iv	AIDC parameters	Essential	Desirable	Essential	Essential
v	AIDC outages.	Recommended	Desirable	Essential	Essential
vi	Contingency procedures	Essential	Essential	Essential	Essential

8.5.3 AIDC operations training should normally cover the following for both Theory and Practical. Practical training on AIDC HMI and message flow may be conducted on ATM automation system simulator or procedure trainer.

8.5.3.1 Introduction to AIDC:

i. AIDC reference documentation should be made available in advance prior to the training.
ii. Highlight the benefits of introduction of AIDC.
iii. Human factors with regard to introduction of AIDC.
iv. Highlight the contingency procedures in the event of AIDC failure/suspension..

8.5.3.2 AIDC phases, message flow and functions:

AIDC is divided into three different phases:

i. Notification phase (including pre-notification),
ii. Coordination phase and
iii. Transfer phase and each phase will operate with different AIDC messages.

Understanding of these phases will help operational and technical personnel to differentiate the usage of each AIDC message. Appropriate versions of ICDs may be referred to for detailed description of different AIDC phases and message flow. Practical training of AIDC functions on a simulator may be considered as appropriate.

8.5.3.3 Communication Network:

ATSUs use ATS Message Handling System (AMHS), Aeronautical Fixed Telecommunication Networks (AFTN) and/or any other medium as appropriate for exchanging data. Accordingly, the structure and routing details of the communication network should be made available during training for better understanding for both operational and technical personnel.

8.5.3.4 AIDC parameters:

Each AIDC message has its own parameters which will be based on mutual agreement between the participating ATSUs. Operational personnel should know the relevant AIDC message parameters to be configured. . Technical personnel should be able to understand and configure these parameters.

8.5.3.5 AIDC outages:

Reasons of common AIDC outages should be highlighted. Operational personnel should be able to recognize and react to the issue appropriately. Problems may be caused by hardware and/or software. Once AIDC issue is reported, technical personnel should follow recommended procedures to resolve the issue. Appropriate flow chart for fault isolation and resolution needs to be developed by the individual ATSUs.

8.5.3.6 Contingency procedures:

AIDC recovery and contingency procedures shall be the part of AIDC training program. Contingency procedures should be applied when any of the following conditions are faced:

i. ATM automation system outages
ii. AIDC connection issues,
iii. Adverse weather conditions,
iv. Any other conditions as agreed in the LOA.

Voice coordination is required if there is a tactical requirement to a particular aircraft such as 10 minutes separation with no closing speed, imposed Mach number to a particular aircraft etc.

.

Appendix A

Sample Letter of Agreement (LOA) /Memorandum of Understanding (MOU)

Auckland Oceanic – Brisbane ATS Centre

Letter of Agreement

Coordination – General

Transfer of Control Point	The Transfer of Control Point (TCP) should be either on receipt of an Acceptance of Control (AOC) to a Transfer of Control (TOC) or the common FIR boundary, whichever occurs first. The TCP should also be the point of acceptance of primary guard. All ATS units should coordinate an estimate for the FIR boundary at least thirty (30) minutes prior to the boundary. Such coordination constitutes an offer of transfer of responsibility. After the estimate for the FIR boundary has been sent, units should coordinate any revised estimate that varies by 3 minutes or more.
Communication Systems	Use of communications systems coordination between adjacent units should be in the following order of priority: a. ATS Interfacility Data Communication (AIDC) b. AIDC messages and procedures are specified in the following sections; c. ATS direct speech circuits; d. International telephone system; e. Any other means of communication available.
AIDC Messages	AIDC message format will be in accordance with the Pan Regional Interface Control Document (PAN ICD) for AIDC, as amended from time to time, unless described otherwise in the LOA. Successful coordination via AIDC occurs on receipt of an ACP message in response to an EST message. Each centre should advise the other of any known equipment outage that affects AIDC.
AIDC Message Parameters	The following table details the AIDC parameters and message to be used.

Message	Parameter	Notes
ABI	EUROCAT: 5-60 minutes prior to COP (Note: An updated ABI will	ABI is sent automatically and is transparent to controller. ABI automatically updates flight plan.

Message	Parameter	Notes
	not be sent once an EST has been sent) OCS: 40 minutes prior 50nm expanded boundary	
EST	EUROCAT: 40 minutes prior to COP OCS: 40 minutes prior 50mn expanded boundary	Any changes to EST level or estimate conditions as detailed in LOA to be notified by voice after initial coordination completed. See notes below on voice procedures. EST is required to track generation in EUROCAT.
ACP	EUROCAT: Sends automatic ACP on receipt of EST OCS: Sends automatic ACP on receipt of EST	EUROCAT: If ACP not received within 4 minutes the sending controller is alerted. Sending controller will initiate voice coordination if ACP is not received within 4 minutes of sending EST. Receiving controller will initiate voice coordination if proposed EST conditions are not acceptable. OCS: If ACP is not received within 5 minutes the sending controller is alerted. Sending controller will not initiate voice coordination if ACP is not received within 5 minutes of sending EST. Receiving controller will initiate voice coordination if proposed EST conditions are not acceptable.
TOC	EUROCAT: Sent automatically 5 minutes prior to boundary OCS: Sent automatically 2 minutes prior to boundary	
AOC	EUROCAT: Sent automatically on controller acceptance of a TOC OCS: Sent automatically on receipt of a TOC	
CDN	EUROCAT: Manually by the controller when required	• Responses to the CDN should be ACP or REJ only – there will be no CDN negotiations. • CDN messages will be sent by Brisbane only to revise coordination on eastbound flights. • CDN messages may be used to coordinate changes to estimate or assigned altitude only.

Message	Parameter	Notes
		• Only on CDN dialogue may be open per aircraft at any time. • Not to be used if the aircraft will not be maintaining the assigned altitude 10 minutes prior to the TCP.
MAC	As per ICD	
LRM	As per ICD. Controller alerted on receipt	
LAM	As per ICD. Controller alerted on non-receipt	

Amendment to Flight Data Record

Route amendment – routes/waypoints may be added/deleted as long as they do not change the original intent or integrity of the flight plan information.

Truncation – where route amendment outside the FIR unavoidable:

a. Terminate the route details at the farthest possible 'flight planned' point of the flight outside the FIR and enter "T" immediately following this.

b. If insufficient 'flight planned' point exist outside the FIR for truncation, insert the first 'defined' point in the adjoining FIR and enter "T" immediately following this.

c. The minimum acceptable truncation point must be at least the first point in the adjoining FIR.

d. Every effort is to be made to truncate the route at a minimum of one point beyond the adjacent international FIR to provide an entry track in to that FIR.

Address Forwarding and Next Data Authority

Brisbane ATSC and Auckland OAC should send automatic Next Data Authority (NDA) and Address Forwarding (CAD) for data link aircraft as per the following table:

Brisbane ATSC	Auto NDA sent 22 minutes prior to the FIR boundary Auto CAD sent 20 minutes prior to the FIR boundary
Auckland OAC	Auto NDA sent 40 minutes prior to the FIR boundary Auto CAD sent 35 minutes prior to the FIR boundary

Voice Coordination

Voice coordination is not required when AIDC messaging has been successful to offer and accepts transfer of control.

However, the receiving controller will initiate voice coordination if the proposed AIDC EST conditions are not acceptable.

If AIDC messaging is not to be sent following voice coordination, it should be stated as part of the voice coordination by use of the phrase "AIDC messaging will not be sent". A read back is required.

Voice Coordination is required for aircraft operating under any of the following conditions:

- block level clearance;
- weather deviations;
- offset track; or
- Mach Number technique.

Read backs should comprise all elements of the voice coordination passed by the transferring controller. Read back by the receiving unit confirms acceptance of the offer of transfer of control subject to any other conditions negotiated.

Hemstitch Flights

A hemstitch flight is any flight that will remain within the New Zealand FIR for less time than the NDA VSP (40 minutes) prior to the flight entering the Brisbane FIR.

Auckland AOC should voice coordinate any hemstitch flight.

Near Boundary Operations

ATS units should relay significant details of any flight which is, or intends operating within fifty nautical miles (50NM) of the common FIR boundary.

HF Frequencies

Brisbane ATC and Auckland ATC should update each other as to the current voice backup frequency for use by ATC data link equipped aircraft.

Appendix B

Sample of AIDC Interoperability Tests

Between Hong Kong New ATMS and Manila ATMS

1. Background

The Hong Kong new ATM System (ATMS) comes with fully integrated AIDC functionality. Hong Kong would like to arrange with Manila ACC to conduct AIDC technical and interoperability test prior to the new ATMS being put into live operation.

Subject to test result and mutual agreement, a plan for the commissioning of AIDC operations between Hong Kong and Manila can be formulated.

2. Scope

AIDC interoperability test for Hong Kong new ATMS with Manila ATMS is to be conducted. Selected AIDC messages (EST, ACP, LAM and LRM) are to be tested, using live or pseudo data, matching with both ACC's concept of operation.

3. Prerequisite

Technical test between Hong Kong new ATMS and Manila ATMS has been completed to ensure CRC algorithm is matched and connection is established. The full set of AIDC messages supported by the ATMS/Manila ATMS other than those selected for operation use will also be covered in the technical test.

4. Test Configuration

AFTN Address for AIDC Test

Hong Kong ATMS **VHHH[redacted]**

Manila ATMS **RPHI[redacted]**

CRC-CCITT Scheme

XMODEM (NULL_INIT)

Protocol and Message Type

AIDC Version: Version 3.0

Message Type: **EST, ACP, LAM, LRM**

Note: Block Level and Speed should not be used in EST

Figure 1 below summaries the AIDC interoperability test configuration:

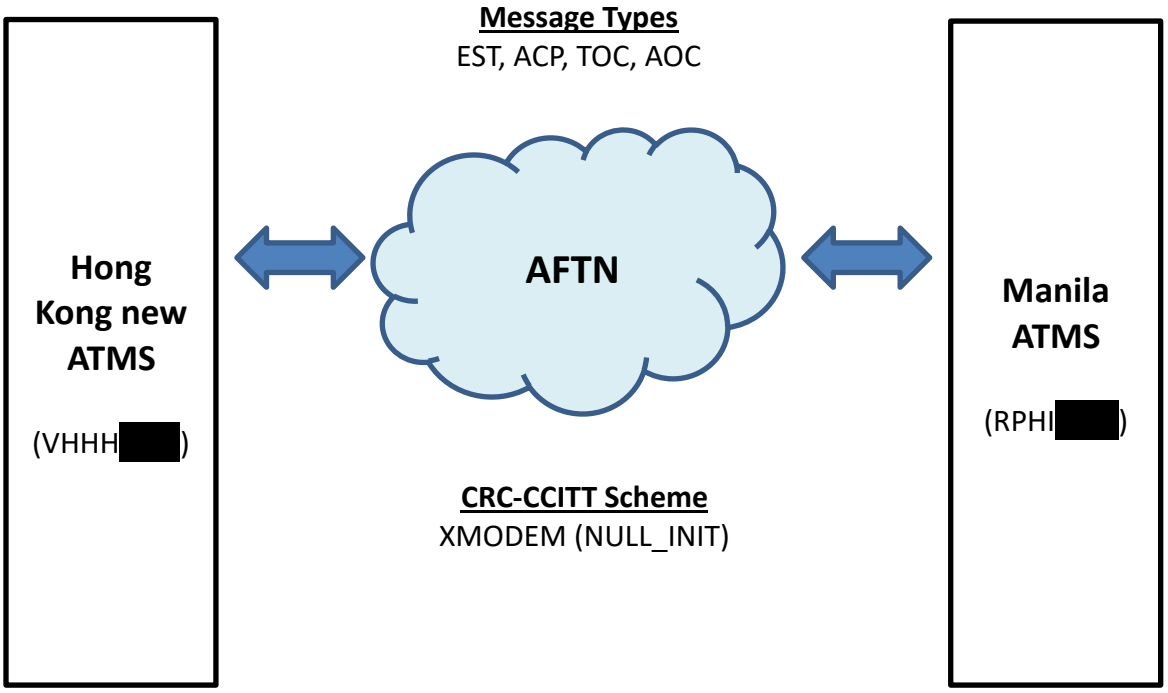


Figure 1 – AIDC Interoperability Test Configuration

5. Hong Kong New ATMS AIDC Operation and Parameters

- Accountability Timer (Application Response Time Out): 45 seconds
- No. of Retransmission upon Application Time Out: 2
- EST is sent automatically, at an adaptable time prior to Estimate Time Over (ETO) the FIR boundary fix for the flight. For test purposes, this adaptable time will be set to 16 minutes and the system check cycle is 1 minute , therefore it can be expected that the EST will be sent between 15 to 16 minutes prior to the flight's ETO the transfer fix.
- Upon receiving an EST, the system will respond with an ACP if the details match with a valid flight plan, otherwise a LRM will be sent.
- 'Revision' and coordination (such as weather deviation, non-FLAS/non-standard level requests etc.) are expected to be conducted verbally through the IASC circuit as per the current practice.

- Hong Kong would like to bring up the following scenarios and the corresponding proposed procedures for discussion. The aim is to reach consensus between Hong Kong and Manila for a mutually agreed operation procedure which could match both systems capability and mode of operation.

  (a) For a flight towards Manila ACC, if prior coordination is required (e.g. HK requests to use a non-standard level) before an EST is sent to Manila, HK will coordinate with Manila using IASC. If the request is approved by Manila, HK prefers to 'transfer' the flight to Manila verbally and no EST would be sent. Would this proposed workflow be acceptable to Manila?

  (b) In reverse, for a flight towards HK ACC, if prior coordination is required before an EST is sent to HK, if the request is approved by HK, HK prefers Manila to 'transfer' the flight to HK verbally and HK would manually enter the 'transfer' information into HK's new ATMS. Is it feasible for Manila not to send any EST to HK in this case?

6. Propose Test Schedule

Technical Test: 28 December 2015

Interoperability Test: 29 December 2015 (also as a backup for Technical Test)

7. Contact Points

Interoperability Test

	Hong Kong
Name	[redacted]
Telephone	[redacted]
Mobile	[redacted]
Email	[redacted]

	Manila	
Name	[redacted]	[redacted]
Telephone	[redacted]	[redacted]
Mobile	[redacted]	[redacted]
Email	[redacted]	[redacted]

Technical

	Manila
Name	[redacted]

Telephone	[redacted]
Mobile	[redacted]
Email	[redacted]

	Hong Kong	
Name	[redacted]	[redacted]
Telephone	[redacted]	[redacted]
Mobile	[redacted]	[redacted]
Email	[redacted]	[redacted]

8. Interoperability Test Procedure

- The test scenarios include inbound, outbound and overflights via NOMAN, SABNO and ASOBA under various situations.

- The proposed test scenarios use pseudo flight plans. Hong Kong new ATMS has live flight plan and surveillance data feeds and would prefer to use target of opportunity at the time of testing. If target of opportunity is not available, Hong Kong can still use pseudo flight plans as detailed in the test cases below.

- The Test Conductor / Point of Contact (POC) of Manila and Hong Kong shall log in the remarks box the time (HHMMSS in UTC) of each message being sent or received for AIDC messages latency checking.

- Effective and instantaneous communication is required during the AIDC test.

- Hong Kong suggests using generally available instant message applications such as Whatsapp (most prefer), Line, WeChat, Skype etc. between the POCs during the AIDC test for communication. As per Manila's suggestion, viber will be used.

8.1 Departure from VHHH to RPLL via NOMAN

Event Triggered by VHHH ACC	Event Triggered by Manila ACC	Confirmation	Remarks/Result
(FPL-TEST1-IS-A333/H-SDE3GHIJ4J5RWYZ/HB1-VHHH0200 -N0483F370 OCEAN V4 NOMAN A461 AVMUP W16 OLIVA OLI1A-RPLL0131 RPLC -PBN/A1B1C1D1O1S1 NAV/GBAS COM/CPDLC DOF/xxxxxx REG/RPC3343 EET/RPHI0029 SEL/LQEG PER/C)			
8.1.1 EST sent to MNL ACC		Coordinate with MNL's POC if **EST** message was received.	
	8.1.2 LAM sent to VHHH.	Coordinate with VHHH's POC if **LAM** message was received.	
	8.1.3 ACP sent to VHHH ACC	Coordinate with VHHH's POC if **ACP** message was received.	
8.1.4 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	

8.2 Departure from RPLL to VHHH via NOMAN

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST2-IS-A320/M-SDFGHIRWY/H-RPLL0200 -N0451F340 CAB1A CAB A461 NOMAN V531 BETTY-VHHH0152 VMMC -PBN/A1B1C1D1O1S2 NAV/GBAS SBAS DOF/xxxxxx REG/RPC3271 EET/VHHK0103 SEL/LSJP PER/C RMK/TCAS EQUIPPED)			
	8.2.1 EST sent to VHHH ACC	Coordinate with VHHH's POC if **EST** message was received.	
8.2.2 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	
8.2.3 ACP sent to MNL ACC		Coordinate with MNL's POC if **ACP** message was received.	
	8.2.4 LAM sent to VHHH ACC	Coordinate with MNL's POC if **LAM** message was received.	

8.3 Overflight Transiting VHHK and RPHI via SABNO

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST3-IS-A320/M-SDFGHIRWYZ/LB1-ZGSZ0200 -N0465F350 SIERA DCT ROCCA DCT SKATE V5 SABNO/N0461F370 A583 AKOTA M754 VINIK M522 NODIN DCT ALBIT DCT KAPRI DCT UBMIK DCT VJN DCT-WBKK0249 WBKL WBKS -PBN/A1B1C1D1O1T1 NAV/ABAS COM/AMDS DOF/xxxxxx REG/9MAQN EET/VHHK0004 ZGZU0005 VHHK0010 RPHI0049 WSJC0212 WBFC0215 SEL/ELQR CODE/7502AD PER/C RMK/TCAS EQUIPPED)			
8.3.1 EST sent to MNL ACC		Coordinate with MNL's POC if **EST** message was received.	
	8.3.2 LAM sent to VHHH.	Coordinate with VHHH's POC if **LAM** message was received.	
	8.3.3 ACP sent to VHHH ACC	Coordinate with VHHH's POC if **ACP** message was received.	
8.3.4 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	

8.4 Overflight Transiting RPHI and VHHK via ASOBA

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST4-IS-A332/H-SDE2E3FGHIJ2J4M1RWXYZ/LB1-WIII0100 -N0477F360 AMBOY P648 OSUKA/N0471F300 M772 ASISU/M077F300 M772 ASOBA/N0464F300 M772 DULOP/N0451F260 M771 DUMOL J103 PICTA DCT CH B330 TAMOT/K0837S0790 W68 IDUMA IDUO1A-ZGGG0422 ZSAM -PBN/A1B1D1L1 NAV/AUSEP DOF/xxxxxx REG/PKGPJ EET/WBFC0114 WSJC0156 RPHI0228 VHHK0325 ZGZU0406 SEL/GMCL OPR/GARUDA PER/C RMK/TCAS EQUIPPED)			
	8.4.1 EST sent to VHHH ACC	Coordinate with VHHH's POC if **EST** message was received.	
8.4.2 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	
8.4.3 ACP sent to MNL ACC		Coordinate with MNL's POC if **ACP** message was received.	
	8.4.4 LAM sent to VHHH ACC	Coordinate with VHHH's POC if **LAM** message was received.	

8.5 Departure from RPLL to VHHH, EST sent by Manila, HK has no FPL and returns LRM.

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST5-IS-A320/M-SDFGHIRWY/H-RPLL0200 -N0451F340 CAB1A CAB A461 NOMAN V531 BETTY-VHHH0152 VMMC -PBN/A1B1C1D1O1S2 NAV/GBAS SBAS DOF/xxxxxx REG/RPC3271 EET/VHHK0103 SEL/LSJP PER/C RMK/TCAS EQUIPPED)			
	8.5.1 EST sent to VHHH ACC	Coordinate with VHHH's POC if **EST** message was received.	
8.5.2 LRM sent to MNL ACC		Coordinate with MNL's POC if **LRM** message was received.	

8.6 Departure from VHHH to RPLL, RPLL has no FPL and returns LRM.

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST6-IS-A333/H-SDE3GHIJ4J5RWYZ/HB1-VHHH0200 -N0483F370 OCEAN V4 NOMAN A461 AVMUP W16 OLIVA OLI1A-RPLL0131 RPLC -PBN/A1B1C1D1O1S1 NAV/GBAS COM/CPDLC DOF/xxxxxx REG/RPC3343 EET/RPHI0029 SEL/LQEG PER/C)			
8.6.1 EST sent to MNL ACC		Coordinate with MNL's POC if **EST** message was received.	
	8.6.2 LRM sent to VHHH.	Coordinate with VHHH's POC if **LRM** message was received.	

8.7 Departure from RPLL to VHHH via NOMAN, Manila sends EST with a SSR code duplicates with a SSR code in-use in HK. [HK will accept the EST and assign another SSR to the flight concerned internally.]

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST7-IS-A320/M-SDFGHIRWY/H-RPLL0200 -N0451F340 CAB1A CAB A461 NOMAN V531 BETTY-VHHH0152 VMMC -PBN/A1B1C1D1O1S2 NAV/GBAS SBAS DOF/xxxxxx REG/RPC3271 EET/VHHK0103 SEL/LSJP PER/C RMK/TCAS EQUIPPED)			
	8.7.1 Request a SSR code in-use by HK	Coordinate with HK's POC to obtain a SSR code in-use by HK	

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
	8.7.2 EST (with a SSR code in-use by HK) sent to VHHH ACC	Coordinate with VHHH's POC if **EST** message was received.	
8.7.3 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	
8.7.4 ACP sent to MNL ACC		Coordinate with MNL's POC if **ACP** message was received.	(HK to check internally for duplicate SSR code alert and SSR code assigns to the flight)
	8.7.5 LAM sent to VHHH ACC	Coordinate with VHHH's POC if **LAM** message was received.	

8.8 Departure from VHHH to RPLL, HK sends EST with a SSR code duplicates with a SSR code in-use in Manila [*For Manila to consider whether this test case is deemed necessary and match with Manila's concept of operation. In this case, would Manila return a LRM or LAM+ACP?]*

Event Triggered by VHHH ACC	Event Triggered by MNL ACC	Confirmation	Remarks/Result
(FPL-TEST8-IS-A333/H-SDE3GHIJ4J5RWYZ/HB1-VHHH0200 -N0483F370 OCEAN V4 NOMAN A461 AVMUP W16 OLIVA OLI1A-RPLL0131 RPLC -PBN/A1B1C1D1O1S1 NAV/GBAS COM/CPDLC DOF/xxxxxx REG/RPC3343 EET/RPHI0029 SEL/LQEG PER/C)			
8.8.1 Request a SSR code in-use by MNL		Coordinate with MNL's POC to obtain a SSR code in-use by MNL	
8.8.2 EST (with a SSR code in-use by MNL) sent to MNL ACC		Coordinate with MNL's POC if **EST** message was received.	
	8.8.3 LAM sent to VHHH.	Coordinate with VHHH's POC if **LAM** message was received.	Or would MNL return a LRM instead?
	8.8.4 ACP sent to VHHH ACC	Coordinate with VHHH's POC if **ACP** message was received.	Should skip this step if MNL returns a LRM in step 8.8.3
8.8.5 LAM sent to MNL ACC		Coordinate with MNL's POC if **LAM** message was received.	Should skip this step if MNL returns a LRM in step 8.8.3

**TABLE OF ATS INTER-FACILITY DATA COMMUNICATION (AIDC)
IMPLEMENTATION STATUS IN APAC REGION**

Explanation of the Table

Column	Element	Explanation	Reason
1	State/Administration	Name of the State/Administration	
2	AIDC Implementation Status (Implemented or not)	AIDC has been implemented in the State/Administration or not (States have the technical capability implemented and at least one bilateral connection with adjacent ATS units in operational use will be regarded as implemented)	
3	Location of AIDC System ATSU1	the location of the AIDC end system under the supervision of State/Administration identified in column 1	
4	ATM Automation System	Make/Model of the ATM automation system used in this ATSU	
5	ATSU2 /Correspondent State/Administration – the correspondent AIDC System	ATSU2 – location of the correspondent AIDC end system Correspondent State/Administration – the name of the State/Administration responsible for management of the correspondent AIDC end system A "/" is placed between the ATSU2 and State/Administration	
6	Intraregional/Interregional	the connection is intraregional (inside APAC) or interregional	
7	Transmission Means	the transmission means used for the AIDC messages exchanged between the corresponding AIDC pair, AFTN, AMHS, etc.	The carriage of AIDC messages is facilitated through existing communication network (e.g. AFTN, AMHS, etc.). The type of network that will be used for AIDC message exchange will need to be defined, including the appropriate recovery/ contingency actions that will be adopted in abnormal situations
8	Frequency of Use (days in a week)	days of AIDC used in a week	to indicate how frequently the AIDC interface has been used
9	Main/Backup Circuit	the circuit is main or backup AIDC connection	if there is two circuits between the two ATSUs, it's better to identify which is main or backup
10	Communication Signal Speed	the communication signal speed for the AIDC messages exchanged (bps)	According to Pan Regional Interface Control Document (PAN ICD) for ATS Inter-facility Data Communications (AIDC) chapter 3.3.2.3, the communication signal speed between ATS systems using AFTN/AMHS should be greater than 2400 bps
11	Average Transmission Delay (One Trip Time Seconds)	the average transmission delay for exchanging AIDC messages	According to Pan Regional Interface Control Document (PAN ICD) for ATS Inter-facility Data Communications (AIDC), Average Transmission Delay (seconds) will influence the AIDC performance. In order to effectively use the AIDC application for the interchange of ATC coordination data, ATSUs should monitor the performance of the communication links to ensure the required performance is achieved. This monitoring should measure the latency of the AIDC message traffic between ATS systems in terms of the time measured between message transmission at the originating ATS system and receipt of the message at the receiving ATS system. The performance of the communications links should be such that 95% of all messages should be received within 12 seconds of transmission and 99.9% of all messages should be received within 30 seconds of transmission. In bilateral agreements, ATSUs, may agree on different performance requirements
12	Implementation Date or Target Date	date of implementation of the AIDC end system in the form of xQyyyy(quarter year), MON yyyy (Month) or yyyy	
13	Interface Status	the AIDC interface status, including Operational (already implemented), Testing (under progressing), Planned (under plan), No plan	
14	Interface Protocol /Version (OLDI or AIDC Version)	the AIDC service between the corresponding ATSUs	to show which AIDC version used and supported between two ATSUs and refer to Reason under Item 15

TABLE OF ATS INTER-FACILITY DATA COMMUNICATION (AIDC) IMPLEMENTATION STATUS IN APAC REGION			
Explanation of the Table			
15	List of AIDC Messages Applicable between the Two ATSUs	the AIDC messages can be exchanged between the two ATSUs, including ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG, MIS, TDM, ASM, FAN, FCN; ADS	According to Asia/Pacific Seamless ANS Plan V3.0, PASL Phase II (expected implementation by 07 November 2019) and APANPIRG/24 CONCLUSION 24/16, ATS systems should enable AIDC (version 3 or later), or an alternative process that achieves at least the same level of performance as AIDC, between en-route ATC units and terminal ATC units where transfers of control are conducted consistent with FICE-B0/1, unless alternate means of automated communication of ATM system track and flight plan data are employed (Priority 1). As far as practicable, the following AIDC messages types should be implemented: • Advanced Boundary Information (ABI); • Coordinate Estimate (EST); • Acceptance (ACP); • TOC; and • Assumption of Control (AOC). Note: States should note the necessity to utilise Logical Acknowledgement Message processing (LAM) when implementing AIDC
16	Coordination by CDN or Voice	the method used in coordination phase	to show if the AIDC process a totally automatic or not
17	Automatic or Manual EST	the EST is sent out automatically or manually	to evaluate the automatic level of AIDC
18	A Warning Message to Controller in Case of AIDC Failure	the warning message for AIDC failure is capable or not	According to Pan Regional Interface Control Document (PAN ICD) for ATS Interfacility Data Communications (AIDC), failure to receive an operational response within timeout period Top should result in a warning message being displayed to the controller. Non receipt of a response to an ASM may indicate either a communication link failure or an ATC system failure. If an ATSU that has sent an ASM message does not receive an application response within a specified time, a warning message should be displayed at an appropriate position so that local contingency procedures can be executed
19	Remarks	any additional information describing the AIDC connection, including issues faced if any, mitigation, and limitation	

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
AFGHANISTAN	**non-implemented**	Kabul ACC		Kabul ACC /Afghanistan	Intraregional	AMHS												
				Karachi ACC/Pakistan	Intraregional	AFTN												
AUSTRALIA	**Implemented**	Brisbane ACC	Thales ATM system	Oakland ARTCC /USA	Interregional	AFTN	7					Operational	ICD V.X.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, CDN, REJ, MAC, CPL	CDN	Automatic	yes	Up- and down conversion of AMHS and AFTN required as connection between Australian ATM system and national Message Transfer Agent is X25/AFTN.
				Auckland ACC /New Zealand	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, CDN, REJ, MAC, CPL, PAC	CDN	Automatic	yes	
				Melbourne ACC /Australia	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, ACP, AOC, EST, LAM, LRM, MAC, PAC, TOC	Voice	Automatic	yes	
				Ujung Pandang ACC /Indonesia	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, ACP, AOC, EST, LAM, LRM, MAC, TOC	Voice	Automatic	yes	
				Nadi ACC /Fiji	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, CDN, REJ, MAC, CPL, PAC	CDN	Automatic		
				Port Moresby/PNG	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
		Melbourne ACC	Thales ATM system	Brisbane ACC /Australia	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, ACP, AOC, EST, LAM, LRM, MAC, PAC, TOC	Voice	Automatic	yes	
				Colombo ACC / Sri Lanka	Intraregional	AFTN	N/A					No plan		N/A				
				Jakarta ACC /Indonesia	Intraregional	AFTN	N/A					No plan		N/A				
				Johannesburg ACC / South Africa	Interregional	AFTN	7					Operational	ICD V.X.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Male ACC / Maldives	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, ACP, EST, LAM, LRM	Voice	Automatic	yes	
				Mauritius ACC /Mauritius	Interregional	AFTN	7					Operational	ICD V.X.0	ABI, ACP, AOC, CPL, EST, LAM, PAC, TOC, LRM	Voice	Automatic	yes	
				Auckland ACC /New Zealand	Intraregional	AFTN	7					Operational	ICD V.X.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
BANGLADESH	non-implemented	Dhaka ACC	Thales ATM system (TopSky ATC)	Kolkata ACC /India	Intraregional	AMHS	7				~~4Q2023~~ 4Q2025	Testing	ICD V.1.0	ABI, SEP, EST, LAM	Voice	Automatic	yes	Implementation of AIDC is included in the "Modernization of CNS-ATM System of CAAB" project which is going on G2G agreement with French Government and likely to be implemented ~~by the end of 2023.~~ in last quarter of 2025
				Yangon ACC /Myanmar	Intraregional	AMHS	7				~~4Q2023~~ 4Q2025	Testing	~~ICD V.2.0~~ ICD V.1.0	ABI, SEP, EST, LAM	Voice	Automatic	yes	
BHUTAN	non-implemented											No plan						Currently not applicable. If required in the future, will decide after CRV implementation.
BRUNEI DARUSSALAM	non-implemented																	
CAMBODIA	Implemented	Phnom Penh ACC	THALES	Bangkok ACC /Thailand	Intraregional	AMHS	7	Main	64000		Oct 2020	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Vientiane ACC/Laos PDR	Intraregional	AMHS	7	Main	5Mbps		Jan 2020	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Ho Chi Minh ACC/Viet Nam	Intraregional	AFTN						Testing	ICD V.1.0	EST, ACP, TOC, AOC, LRM, LAM				Technical Trial was completed
		Beijing ACC	THALES	Ulaanbaatar ACC/Mongolia	Interregional	AFTN					Dec 2023	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
		Harbin ACC	AirNet	Khabarovsk/Russia	Intraregional						Dec 2024	~~Planned~~ Testing						
		Sanya ACC	~~NUMEN~~ BEST/AirNet	Hong Kong ACC / Hong Kong, China	Intraregional	AFTN					Dec 2007	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
				Hanoi ACC/Vietnam	Intraregional	AFTN					Jun 2024	~~Testing~~ Operational		EST, ACP, TOC, AOC, LRM, LAM				
				Ho Chi Minh ACC /Vietnam	Intraregional	AFTN					Dec 2023	~~Operational~~ No plan	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
		Kunming ACC	NUMEN	Vientiane ACC/Laos PDR	Interregional						Jan 2021	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
				Hanoi ACC/Vietnam	Intraregional	AFTN						Testing	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
				Yangon ACC /Myanmar	Intraregional	AFTN						~~Testing~~ Planned		EST, ACP, TOC, AOC, LRM, LAM				
		Lanzhou ACC	NUMEN	Ulaanbaatar ACC/Mongolia	Intraregional	AFTN					Dec 2023	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
		Lhasa ACC		Kathmandu ACC/Nepal	Interregional	AFTN												

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
CHINA	Implemented	Guangzhou ACC	THALES	Taibei ACC /China	Intraregional						Jan 2013	Cancel	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
				Hong Kong ACC / Hong Kong, China	Intraregional	AFTN					May 2018	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
		Taibei ACC		Hong Kong ACC / Hong Kong, China	Intraregional	AFTN						Operational	ICD V.3.0					
				Fukuoka ATMC/Japan	Interregional	AFTN						Operational						
				Manila ACC/Philippines	Interregional	AFTN												
		Shenyang ACC	NUMEN	Khabarovsk/Russia	Interregional						Oct 2019	Operational	OLDI	ABI, ACT, MAC, HOP, ACP, LAM, and LRM		Automatic	yes	
		Urumqi ACC	NUMEN	Lahore ACC /Pakistan	Intraregional	AMHS					Jun 2024	~~Testing~~ No plan						
			NUMEN	Alma-Ata/Kazakhstan								Testing						
			NUMEN	Bishkek ACC/Kyrgyzstan	Intraregional						Dec 2024	Planned						
		Nanning ACC	NUMEN	Hanoi ACC/Vietnam	Intraregional	AMHS					Dec 2023	Operational						
		Dalian ACC	NUMEN	Incheon ACC /Republic of Korea	Interregional						Oct 2016	Operational	ICD V.3.0 (trial operat	ABI, EST, ACP, TOC, AOC, LRM, LAM		Automatic	yes	
			NUMEN	Khabarovsk/Russia	Intraregional						Dec 2024	~~Planned~~ Testing						
		Shanghai ACC	NUMEN	Taibei ACC /China	Intraregional						Jan 2013	Operational	ICD V.3.0	LAM		Automatic	yes	
HONG KONG, CHINA	Implemented	Hong Kong ACC	Raytheon ATM system	Guangzhou ACC /China	Intraregional	AFTN	7	Main	2400	4	May 2018	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Sanya ACC /China	Intraregional	AFTN	7	Main	2400	4	Feb 2007	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Manila ACC /Philippines	Intraregional	AMHS	7	Main	up to 2M on CRV	1	May 2019	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Taibei ACC /China	Intraregional	AMHS	7	Main	up to 2M on CRV	1	Nov 2012	Operational	ICD V.3.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Shanghai ACC / China	Intraregional	AMHS	7	Main	up to 2M on CRV	1	May 2024	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Xiamen ATMS / China	Intraregional	AMHS	7	Main	up to 2M on CRV	1	May 2024	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
MACAO, CHINA	non-implemented	Macao ATZ										No plan						Not applicable because Macao, China has ATZ only
COOK ISLANDS	non-implemented																	
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA	non-implemented											Planned						
FIJI	Implemented	Nadi ACC	Adacel ATM system	Auckland ACC /New Zealand	Intraregional	AFTN						Operational	ICD V. 2.0	ABI, EST, ACP, TOC, AOC, CDN, CPL				
				Brisbane ACC /Australia	Intraregional	AFTN						Operational	ICD V.1.0	ABI, EST, ACP, TOC, AOC, CDN, CPL				
				Oakland ARTCC /USA	Intraregional	AFTN						Operational	ICD V. 2.0	ABI, EST, ACP, TOC, AOC, CDN, CPL				
FRANCE FRENCH POLYNESIA, NEW CALEDONIA	Implemented	Papeete ACC	THALES EUROCAT	Auckland ACC /New Zealand	Intraregional	AFTN					2009	Operational	ICD V.3.0					
				Oakland ARTCC /USA	Intraregional	AFTN					2009	Operational	ICD V.3.0					
INDIA	Implemented	Ahmedabad ACC	INDRA Aircon 2100	Karachi ACC /Pakistan	Intraregional	AFTN						Testing		ABI, EST				
		Chennai ACC	Raytheon Auto track-III +	Colombo ACC / Sri Lanka	Intraregional	AMHS					4Q2018	Planned						
				Jakarta ACC /Indonesia	Intraregional	AFTN					4Q2019	Planned						
				Kuala Lumpur ACC / Malaysia	Intraregional	AFTN					Jan 2021	Operational	ICD V.3.0	ABI, EST, TOC, AOC	Voice			
				Male ACC /Maldives	Intraregional	AFTN					Sep 2021	Operational						
				Yangon ACC /Myanmar	Intraregional	AFTN						Testing	ICD V.2.0					
		Delhi ACC	INDRA Aircon	Karachi ACC /Pakistan	Intraregional	AFTN					1Q2019	No plan						
				Lahore ACC /Pakistan	Intraregional	AFTN						Testing						
		Kolkata ACC	INDRA Aircon	Dhaka ACC /Bangladesh	Intraregional	AMHS					4Q2018	Planned						
				Yangon ACC /Myanmar	Intraregional	AFTN					4Q2018	Testing	ICD V.2.0					
				Kathmandu ACC /Nepal	Intraregional	AFTN												
				Karachi ACC /Pakistan	Intraregional	AMHS					1Q2019	Planned						

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Mumbai ACC	Raytheon Auto track-III	Male ACC /Maldives	Intraregional	AFTN					Nov 2021	Operational						
				Mogadishu ACC/Somalia	Interregional							Testing						
				Muscat ACC /Oman	Interregional	AFTN						Testing						
				Seychelles ACC / Mauritius	Interregional	AFTN												
		Trivandrum ACC	INDRA Aircon 2100	Male ACC/Maldives	Intraregional	AFTN					3Q2018							
		Varanasi ACC	INDRA Aircon 2100	Kathmandu ACC /Nepal	Intraregional	AFTN						Planned						
INDONESIA	Implemented	Jakarta ACC		Melbourne/Australia	Intraregional	AFTN					2025	Testing						
				Colombo ACC/Srilanka	Intraregional	AFTN					2024	Testing						
				SingaporeACC/Singapore	Intraregional	AFTN					2025	Testing	ICD V.3.0					
				Kuala Lumpur ACC/Malaysia	Intraregional	AFTN					2026	Testing	ICD V.3.0					
				Kota Kinabalu ACC/Malaysia	Intraregional	AFTN					2026	Testing						
		Ujung Pandang ACC		Brisbane ACC/ Australia	Intraregional	AMHS	7	Main	9600		Jul-27	Operational	ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	Voice	Automatic	Yes	
				Oakland ARTCC/USA	Intraregional	AMHS	7	Main	9600		2Q 2023	Planned	ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	CDN	Automatic	Yes	
				Por Moresby ACC/PNG	Intraregional	AFTN	7	Main	9600		2Q 2021		ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	Voice	Automatic	Yes	
				Kota Kinabalu ACC/Malaysia	Intraregional	AFTN	7	Main	9600			Operational	ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	Voice	Automatic	Yes	
				Jakarta ACC/Indonesia	Intraregional	AFTN	7	Main	19200		3Q 2022	Testing	ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	Voice	Automatic	Yes	
				Manila ACC/Philippines	Intraregional	AMHS	7	Main	9600		4Q 2020	Testing	ICD V.3.0	ABI,EST,ACP,TOC,AOC,LAM,LRM	Voice	Automatic	Yes	
JAPAN	Implemented	Fukuoka ATMC	JCAB/ADEX-19	Manila ACC /Philippines	Intraregional							Planned						
				Anchorage ACC /USA	Intraregional	AMHS	7	Main	64000		2005	Operational	ICD V.2.0		CDN	Automatic	yes	
				Incheon ACC /Republic of Korea	Intraregional		7	Main	64000		Jun 2009	Operational	ICD V.1.0	EST,ACP,TOC,AOC,LAM,LRM,CPL	CDN	Automatic	yes	
				Oakland ARTCC /USA	Intraregional	AMHS	7	Main	64000		May 2017	Operational	ICD V.2.0		CDN	Automatic	yes	
				Shanghai ACC /China	Intraregional	AFTN						Planned						
				Taibei ACC / China	Intraregional		7	Main	64000		2012	Operational	ICD V.3.0	ABI,EST,ACP,LAM,LRM,MAC	CDN	Automatic	yes	
		Tokyo ACC	JCAB/ADEX-19	Incheon ACC /Republic of Korea	Intraregional		7	Main	64000		2010	Operational	ICD V1.0	EST,ACP,TOC,AOC,LAM,LRM,CPL	CDN	Automatic	yes	
		Kobe ACC	JCAB/ADEX-19	Incheon ACC /Republic of Korea	Intraregional	AFTN	7	Main	64000		2012	Operational	ICD V.3.0					
KIRIBATI	non-implemented																	
LAO PEOPLE'S DEMOCRATIC REPUBLIC	Implemented	Vientiane ACC	THALES TOPSKY (EUROCAT-C)	Bangkok ACC /Thailand	Intraregional	AMHS	7	Main	9600		14-Jul-20	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	no	
				Hanoi ACC /Veitnam	Intraregional	AFTN	7	Main	9600		~~4Q2024~~ Jan-2025	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM				
				Phnom Penh ACC /Cambodia	Intraregional	AFTN	7	Main	9600		2-Jan-20	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	no	
				Yangoon/ Myanmar	Intraregional	AFTN	7	Main	9600		~~1Q2025~~ 1Q2026	Planned	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM				
				Kunming ACC /China	Intraregional	AFTN	7	Main	9600		23 November 202	Operational	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	no	
				Ho Chi Minh/ Vietnam	Intraregional	AFTN	7	Main	9600		~~4Q2024~~ 3Q2025	Planned	ICD V.2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM				
MALAYSIA	Implemented	Kuala Lumpur ACC	LEONARDO	Bangkok ACC /Thailand	Intraregional	AMHS	7	Main	9600	7	Mar 2020	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Singapore ACC /Singapore	Intraregional	AMHS	7	Main	9600	7	Nov 2019	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Chennai ACC /India	Intraregional	AMHS	7	Main	9600	7	Apr 2020	Operational	ICD V.3.0	ABI, EST, ACP, LAM, LRM, CDN, REJ,MAC,TOC,AOC	CDN	Automatic	yes	
				Ho Chi Minh ACC /Vietnam	Intraregional	AMHS	7	Main	TBA	TBA	~~3Q2024~~ 2026	Planned	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
				Jakarta ACC /Indonesia	Intraregional	AMHS	7	Main	TBA	TBA	~~3Q2024~~ 2026	Planned	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
		Kota Kinabalu ACC	THALES	Ujung Pandang ACC /Indonesia	Intraregional	AMHS	7	Main	TBA	TBA	~~2Q2024~~ 2025	Testing	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
				Manila ACC /Philippines	Intraregional	AMHS	7	Main	TBA	TBA	~~3Q2024~~ 2024	Operational	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
				Singapore ACC /Singapore	Intraregional	AMHS	7	Main	9600	1	Jul 2021	Operational	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	
											~~2Q2024~~ 2025	Testing	ICD V.3.0	TOC, AOC	Voice	Automatic	yes	

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
				Jakarta ACC /Indonesia	Intraregional	AMHS	7	Main	TBA	TBA	~~3Q2024~~ 2026	Planned	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
		Kuching ACC	THALES	Singapore ACC /Singapore	Intraregional	AMHS	7	Main	9600	1	~~Feb 2021~~ N/A	No plan	ICD V.3.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	No longer applicable due to the Jakarta FIR realignment
											~~2Q2024~~ N/A	No plan	ICD V.3.0	TOC, AOC	Voice	Automatic	yes	No longer applicable due to the Jakarta FIR realignment
				Jakarta ACC /Indonesia	Intraregional	AMHS	7	Main	TBA	TBA	~~3Q2024~~ 2026	Planned	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
MALDIVES	Implemented	Male ACC	LEONARDO	Mumbai ACC / India	Intraregional	AFTN	7	Main			3Q2021	Operational	ICD V.3.0	ABI, EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
				Chennai ACC /India	Intraregional	AFTN	7	Main			3Q2021	Operational	ICD V.3.0	ABI, EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic		
				Mauritius ACC/Mauritius	Interregional	AFTN						No plan						
				Melbourne ACC /Australia	Intraregional	AFTN	7	Main			TBA	Testing	ICD V.3.0		Voice			
				Colombo ACC/Sri Lanka	Intraregional	AFTN		Main	64K		TBA	Testing	ICD V.3.0		Voice			Colombo AIDC connection temporarily disabled due to request from VCCC
				Trivandrum ACC/India	Intraregional	AFTN	7	Main			3Q2021	Operational	ICD V.3.0	ABI, EST, ACP, LAM, LRM, TOC, AOC	Voice			
MARSHALL ISLANDS	non-implemented																	
MICRONESIA (FEDERATED STATE OF)	non-implemented																	
MONGOLIA	Implemented	Ulaanbaatar ACC	INDRA Aircon-2100	Irkutsk ACC/Russia	Interregional	FMTP	7	Main/Backup	4800	Less than a second	2Q2017	Operational	OLDI Ver. 4.2	ABI, ACT, LAM, REV, PAC, MAC		Auto		
				Krasnoyarsk ACC/Russia	Interregional	FMTP	7	Main/Backup	4800	Less than a second	4Q2018	Operational	OLDI Ver. 4.3	ABI, ACT, LAM, REV, PAC, MAC		Auto		
				Beijing ACC/China	Intraregional	Dedicated line	7	Main/Backup	4800	6	4Q2023	Testing	ICD V.3.0	EST, ACP, TOC, AOC, LAM, LRM, PAC, MAC		Auto		
				Lanzhou ACC/China	Intraregional	Dedicated line	7	Main/Backup	4800	7.4	4Q2023	Testing	ICD V.3.0	EST, ACP, TOC, AOC, LAM, LRM, PAC, MAC		Auto		
MYANMAR	Testing	Yangon ACC	THALES Automation system (Topsky ATC)	Bangkok ACC /Thailand	Intraregional	AMHS					4Q2020	Testing	ICD V.2.0					
				Kolkata ACC /India	Intraregional	AFTN					4Q2018	Testing	ICD V.2.0					Existing ATM system are likely to be upgraded in Lahore and Karachi ACC.
				Chennai ACC /India	Intraregional	AFTN					4Q2018	Testing	ICD V.2.0					
				Kunming ACC /China	Intraregional	AFTN						Testing	ICD V.2.0					
				Vientianne ACC /Lao PDR	Intraregional	AFTN					4Q2018	Testing	ICD V.2.0					
				Dhaka ACC /Bangladesh	Intraregional	AFTN					4Q2018		ICD V.2.0					
NAURU	non-implemented																	
NEPAL	non-implemented	Kathmandu ACC	ATM system from NEC	Kolkata ACC /India	Intraregional	AFTN												
				Varanasi ACC/India	Intraregional	AFTN												
				Lhasa ACC /China	Intraregional	AFTN												
NEW ZEALAND	Implemented	Auckland ACC	ADACEL OCS (Oceanic Control System)	Brisbane ACC /Australia	Intraregional	AFTN	7	Backup				Operational		ABI, CDN, EST, PAC, ACP, REJ, MAC, MIS, TOC, AOC, LAM, LRM	CDN	Automatic		
						AMHS	7	Main	IP?	1.5		Operational		ABI, CDN, EST, PAC, ACP, REJ, MAC, MIS, TOC, AOC, LAM, LRM	CDN	Automatic		
				Nadi ACC /Fiji	Intraregional	AFTN	7	Backup				Operational		ABI, CPL, CDN, PAC, ACP, REJ, MAC, MIS, TOC, AOC, LAM, LRM	CDN	Automatic		
						AMHS	7	Main	IP?	1		Operational		ABI, CPL, CDN, PAC, ACP, REJ, MAC, MIS, TOC, AOC, LAM, LRM	CDN	Automatic		
				Oakland ARTCC /USA	Intraregional	AFTN	7	Backup				Operational		ABI, CPL, CDN, PAC, ACP, REJ, MAC, MIS, LAM, LRM	CDN	Automatic		
						AMHS	7	Main	IP?	1		Operational		ABI, CPL, CDN, PAC, ACP, REJ, MAC, MIS, LAM, LRM	CDN	Automatic		
				Papeete ACC /French Polynesia	Intraregional	AFTN	7	Main	64k	5		Operational		ABI, CPL, CDN, PAC, ACP, REJ, MAC, MIS, TOC, AOC, LAM, LRM	CDN	Automatic		
				Chile	Interregional	AFTN	7	Backup				Operational		EST, ACP	Voice	Automatic		
						AMHS	7	Main	IP/??			Operational		EST, ACP	Voice	Automatic		
				Mumbai ACC /India	Intraregional	AMHS	7	Main	128 & 64Kbps		~~Jun 2025~~ Jun 2027	Testing	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	*Trial run carried out between Karachi and Ahmedabad. Partial connectivity between both systems is observed and Some issues regarding the auto acceptance of EST messages in
				Muscat ACC /Oman	Interregional	AFTN	7	Main	64Kbps		~~Jun 2025~~ Jun 2027	No Plan	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
PAKISTAN	Testing	Karachi ACC	Indra AIRCON 2100	Tehran ACC /Iran	Interregional	AFTN	7	Main	1 Mbps		~~Jun 2025~~ Jun 2027	No Plan	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	Karachi ATM need to be addressed *Trial run between Karachi and Mumbai was remained unsuccessful due to integration problems. * Trial run carried out between Lahore and Delhi ACCs in March 2021. Delhi ATM system rejects the ABI messages due to adding double space in FPL by Lahore ATM system (East bound Flights). Lahore ATM does not genenerate ACP message in responce to ABI message sent by Delhi ATM system (West Bound) Note :- Due to restructuring of Karachi ACC and Lahore ACC no need to AIDC testing /requirement between Karachi ACC and Delhi ACC. .*AIDC is not fully functional with neighbouring FIRs due to difference in AIDC version. AIDC will be fully functional up to ***June, 2027*** after replacement of ATM System at Karachi & Lahore ACCs.
				Ahmadabad ACC /India	Intraregional	AMHS	7	Main	Via Mumbai AMHS		~~Jun 2025~~ Jun 2027	Testing	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
				Kabul ACC /Afghanistan	Intraregional	AFTN	7	Main	1Mbps		~~Jun 2025~~ Jun 2027	No Plan	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
		Lahore ACC	Indra AIRCON 2100	Delhi ACC /India	Intraregional	AMHS	7	Main	VIA Mumbai AHMS		~~Jun 2025~~ Jun 2027	Testing	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
				Kabul ACC /Afghanistan	Intraregional	AFTN	7	Main	1 Mbps via Karachi AMHS		~~Jun 2025~~ Jun 2027	No Plan	ICD Version 2.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
		Islamabad ACC	Si ATM	Kabul ACC /Afghanistan	Intraregional	AFTN	7	Main	1 Mbps via Karachi AMHS			No Plan	ICD Version 3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
				Urumqui ACC /China	Intraregional	AFTN	7	Main	Via Beijing AFTN			No Plan	ICD Version 3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
				Tajakistan ACC /Tajakistan	Interregional	AFTN	7	Main	Via Tehran AFTN			No Plan	ICD Version 3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC	Voice	Automatic	Yes	
PALAU	non-implemented																	
PAPUA NEW GUINEA	Implemented	Port Moresby	Thales (TopSky-ATC)	Brisbane ACC/Australia	Intraregional	AMHS						Operational	ICD V.3.0					
				Ujung Pandang ACC/Indonesia	Intraregional	AFTN						Planned	ICD V.3.0					
				Oakland ARTCC /USA	Intraregional	AFTN						Testing	ICD V.3.0					
PHILIPPINES	Implemented	Manila ACC	THALES	Hong Kong ACC / Hong Kong, China	~~Intraregional~~	~~AFTN~~												
					Intraregional	AMHS	7	Main		74ms/15ms	May 2019	Operational		EST, ACP, LAM, LRM	Voice	Automatic		
				Singapore ACC /Singapore	Intraregional	AMHS	7	Main		25ms/18ms	Dec 2020	Operational		EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic		
				Taibei ACC/China	~~Intraregional~~	~~AFTN~~												
					Intraregional	AMHS	7	Main		21ms/17ms	Dec 2019	Operational		EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic		
				Kota Kinabalu ACC /Malaysia	Intraregional	AMHS	7	Main		24ms/19ms	2Q2024	Operational		EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic		
				Ho Chi Minh ACC /Viet Nam	Intraregional	AMHS						Planned						
				Oakland ARTCC /USA	Intraregional	AMHS	7	Main		194ms/17ms	Dec 2022	Operational		ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic		
				Fukoka ATMC /Japan	Intraregional	AMHS						Planned						
				Ujung Pandang ACC /Indonesia	Intraregional	AMHS	7	Main		22ms/18ms	4Q 2020	Operational		EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic		
REPUBLIC OF KOREA	Implemented	Incheon ACC	Leidos System	Fukuoka ATMC /Japan	Intraregional	Dedicated L	7	Main	64000	1	2010	Operational	ICD V.1.0	CPL, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Shanghai ACC/China	Intraregional						3Q2023	Planned						
				Dalian ACC /China	Intraregional	Dedicated L	7	Backup	64000	1	Nov 2016	Operational	ICD V.3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
		Daegu ACC	Leidos System	Fukuoka ATMC /Japan	Intraregional	Dedicated L	7	Backup	64000	1	2010	Operational	ICD V.1.0	CPL, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Shanghai ACC/China	Intraregional						3Q2023	Planned						
				Dalian ACC /China	Intraregional	Dedicated L	7	Main	64000	1	Nov 2016	Operational	ICD V.3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
SAMOA	non-implemented																	
				Ho Chi Minh ACC /Vietnam	Intraregional	AMHS	7	Main	9600	1	Jul 2014	Operational	ICD V.1.0	EST,ACP,LAM,LRM	Voice	Automatic	yes	

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SINGAPORE	Implemented	Singapore ACC	THALES	Manila ACC /Philippines	Intraregional	AMHS	7	Main	9600	1	Nov 2019	Operational	ICD V.3.0	EST,ACP,LAM,LRM,TOC,AOC	Voice	Automatic	yes	
				Jakarta ACC /Indonesia	Intraregional	AMHS	0	Main	9600	1		Planned	ICD V.3.0					
				Kuala Lumpur ACC /Malaysia	Intraregional	AMHS	7	Main	9600	1	Nov 2019	Operational	ICD V.3.0	EST,ACP,LAM,LRM	Voice	Automatic	yes	
				Kota Kinabalu ACC /Malaysia	Intraregional	AMHS	7	Main	9600	1	Jul 2021	Operational	ICD V.3.0	EST,ACP,LAM,LRM	Voice	Automatic	yes	
SOLOMON ISLANDS	non-implemented			Nadi ACC /Fiji	Intraregional													
				Port Moresby ACC/PNG	Intraregional													
				Brisbane ATSC /Australia	Intraregional													
SRI LANKA	Testing	Colombo ACC	INTELCAN	Male ACC /Maldives	Intraregional	AFTN			~~64000~~ 204800		SEP ~~2023~~ 2025	Testing	ICD V.3.0		Voice	Manual	yes	ABI message is not working during trials.
				Jakarta ACC / Indonesia	Intraregional	AMHS			2048000		SEP ~~2023~~ 2026	Planned	ICD V.3.0		Voice	Manual	yes	
				Melbourne ACC /Australia	Intraregional	AMHS			2048000		~~SEP 2023~~ Mar 2026	Planned	ICD V.3.0		Voice	Manual	yes	
				Chennai ACC /India	Intraregional	AMHS			2048000		SEP ~~2023~~ 2025	Testing	ICD V.3.0		Voice	Manual	yes	~~ABI message is not working during trials.~~
THAILAND	Implemented	Bangkok ACC	THALES	Kuala Lumpur ACC /Malaysia	Intraregional	AMHS	7	Main	1Mbps (CRV)	8	Mar 2020	Operational	~~ICD V.3.0~~ PAN AIDC ICD V.1.0	EST, ACP, LAM, LRM	Voice	Automatic	yes	CRV shared bandwidth
				Phnom Penh ACC /Cambodia	Intraregional	AMHS	7	Main	1Mbps (CRV)	6	Feb 2021	Operational	~~ICD V.3.0~~ PAN AIDC ICD V.1.0	ABI, EST, ACP, LAM, LRM	Voice	Automatic	yes	CRV shared bandwidth
				Vientiane ACC /Lao PDR	Intraregional	AMHS	7	Main	64000	7	Jul 2020	Operational	~~ICD V.3.0~~ PAN AIDC ICD V.1.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Yangon ACC /Myanmar	Intraregional	AMHS						Testing						Continuous operational use still not possible due to system limitation at Yangon ACC(Testing on August 2019)
TIMOR LESTE	non-implemented																	
TONGA	non-implemented																	
UNITED STATES	Implemented	Oakland ARTCC	Liedos, ATOP System	Anchorage ARTCC /United States	Intraregional	AMHS	7	Main	64,000	3	Oct 2005	Operational	ICD V.2.0	ABI, CPL, EST, MAC, CDN, ACP, REJ, EMG, MIS, LAM, LRM, PAC	CDN	Automatic	yes	
				Auckland OAC /New Zealand	Intraregional	AMHS	7	Main	64,000	4	Oct 2005	Operational	ICD V.2.0	ABI, CPL, MAC, CDN, ACP, REJ, LAM, LRM, PAC	CDN	Automatic	yes	
				Fukuoka ATMC /Japan	Intraregional	AMHS	7	Main	64,000	4	Oct 2005	Operational	ICD V.2.0	ABI, ACP, CDN, CPL, LAM, LRM, MAC	CDN	Automatic	yes	
				Nadi ATMC /Fiji	Intraregional	AMHS	7	Main	64,000	5	Oct 2005	Operational	ICD V.2.0	ABI, CPL, CDN, PAC, ACP, MAC, REJ, LAM, LRM	CDN	Automatic	yes	
				Brisbane ACC /Australia	Intraregional	AMHS	7	Main	64,000	1	Oct 2005	Operational	ICD V.2.0	ABI, EST, ACP, MAC, CDN, LAM, LRM	CDN	Automatic	yes	Full CDN functionality proposed 1-30-2023 via LOA.
				Tahiti ACC /French Polynesia	Intraregional	AMHS	7	Main	64,000	10	Dec 2014	Operational	ICD V 2.0	ABI, CPL, CDN, PAC, ACP, MAC, LAM, LRM	CDN	Automatic	yes	
				Port Moresby/PNG	Intraregional	AMHS	7	Main	64,000	6	Dec 2021	Operational	ICD V 2.0	ABI, EST, ACP, LAM, LRM	Voice	Automatic	yes	
				Manila /Philippines	Intraregional	AMHS	7	Main	64,000	5	Dec 2022	Planned	ICD V.2.0	ABI, EST, ACP, LAM, LRM	Voice	Automatic	yes	AIDC testing implemented via MOU with verbal verification for 30 days. Pending test results AIDC incorporation permanently via LOA.
				Mazatlan ACC	Interregional	AMHS	7	Main	64,000	4	Mar 2015	Operational	ICD V.2.0	ABI, ACP, EST, LAM, LRM	Voice	Automatic	yes	
				Ujung Padang/Indonesia	Intraregional	AMHS		Main	64,000		Mar 2023	Planned	ICD V 2.0	TBD-ABI, EST, ACP, LAM, LRM	Voice	Automatic	yes	Pending meeting to determine implementation dates in Jan 2023. Initial testing completed, propose additional live testing phase followed by revised LOA.
		Anchorage ARTCC	Liedos, ATOP System	Magadan ACC	Interregional	AMHS	7	Main	64,000	7	Jun 2018	Operational	ICD V.2.0	ABI, CPL, ACP, LAM, LRM	Voice	Automatic	yes	
				Fukuoka ATMC /Japan	Intraregional	AMHS	7	Main	64,000	4	Mar 2007	Operational	ICD V.2.0	ABI, ACP, CDN, CPL, LAM, LRM, MAC	CDN	Automatic	yes	
				Oakland ARTCC /United States	Intraregional	AMHS	7	Main	64,000	1	Mar 2007	Operational	ICD V.2.0	ABI, CPL, EST, MAC, CDN, ACP, REJ, EMG, MIS, LAM, LRM, PAC	CDN	Automatic	yes	
TUVALU	non-implemented																	
VANUATU	non-implemented																	
				Sanya ACC /China	Intraregional	AFTN						Testing	ICD V.1.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	

Table of AIDC Implementation Status in APAC

State/Administration	AIDC Implementation Status(Implemented or not)	Location of AIDC System ATSU1	ATM Automation System (Make/Model)	ATSU2 /Correspondent State – Administration	Intraregional/Interregional	Transmission Means	Frequency of Use(days in a week)	Main/Back up Circuit	Communication Signal Speed (bps)	Average Transimission Delay (One Trip Time in Seconds)	Implementation Date or Target Date as MON	Interface Status (Operational, Testing, Planned,	Interface Protocol / Version (OLDI or AIDC Version)	List of AIDC Messages Applicable between the Two ATSUs (ABI, EST, ACP, TOC, AOC, LAM, LRM, PAC, CDN, CPL, REJ, MAC; TRU, EMG,	Coordination by CDN or Voice	Automatic or Manual EST	A Warning Message to Controller in Case of AIDC Failure	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
VIET NAM	Implemented	Ho Chi Minh ACC	THALES	Phnom Penh ACC /Cambodia	Intraregional	AFTN						Testing	ICD V.1.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Vientiane ACC /Lao PDR	Intraregional	AFTN					3Q2025	Planned						
				Singapore ACC /Singapore	Intraregional	AFTN	7	Main	9600		Jul 2014	Operational	ICD V.1.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Manila /Philippines	Intraregional	AFTN						Testing	ICD V.1.0	EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Kuala Lumpur /Malaysia	Intraregional	AFTN					3Q2025	Planned						
		Ha Noi ACC	Selex	Vientiane ACC/Lao PDR	Intraregional	AFTN	7				JAN 2025	Operational	ICD V3.0	ABI, EST, ACP, TOC, AOC, LAM, LRM	Voice	Automatic	yes	
				Sanya ACC /China	Intraregional	AFTN	7	Main	9600		Dec 2023	Operational	ICD V3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	
				Naning ACC	Intraregional	AFTN	7	Main	9600		Dec 2023	Operational	ICD V.3.0	EST, ACP, LAM, LRM, TOC, AOC	Voice	Automatic	yes	

State/Administration	Last updated	Meeting	History
Afghanistan			
Australia	1/30/2023	AP135/22(CNS)	
Bangladesh	6/2/2025	ATMAS TF/6	
Brunei Darussalam			
Bhutan			
Cambodia	6/29/2023	ATMAS TF/4	
China	4/6/2025	ATMAS TF/6	12/6/2022 3/21/2024-ACSICG/11
Hong Kong, China	6/18/2024	ATMAS TF/5	1/30/2023
Macau China	3/25/2025	ACSICG/12	
Cook Islands			
Democratic People's Republic of Korea			
France (New Caledonia, French Polynesia, and Wallis & Futuna)			
Fiji			
India			
Indonesia	3/21/2024	ACSICG/11	
Lao PDR	3/27/2025	ACSICG/12	1/24/2023 6/6/2024 - ATMAS TF/5
Japan	3/29/2024	ACSICG/11	1/16/2023 8/25/2023
Kiribati			
Malaysia	3/26/2025	ACSICG/12	1/9/2023 4/3/2023 4/13/2023 6/29/2023 - ATMAS TF/4
Maldives	5/24/2023	AP135/22(CNS)	
Marshall Islands			
Micronesia (Federated States of)			
Mongolia	8/31/2023	CNS SG/27	
Myanmar			
Nauru			
Nepal			
New Zealand	8/25/2023	CNS SG/27	12/21/2022
Pakistan	3/25/2025	ACSICG/12	11/29/2022 - AP135/22(CNS)
Papua New Guinea			
Palau			
Philippines	4/6/2025	ATMAS TF/6	3/20/2025 - ACSICG/12
Republic of Korea	1/31/2023	AP135/22(CNS)	
Samoa			
Solomon Islands			
Singapore	3/27/2025	ACSICG/12	1/6/2023 6/6/2024 - ATMAS TF/5
Sri Lanka	4/6/2025	ATMAS TF/6	2/14/2023 - AP135/22 (CNS)
Tonga			
Thailand	4/6/2025	ATMAS TF/6	1/16/2023- AP135/22 (CNS)
Tuvalu			
Timor LESTE			
United States	12/21/2022	AP135/22(CNS)	
Vanuatu			
Viet Nam	4/6/2025	ATMAS TF/6	3/21/2024 - ACSICG/11

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE CNS FIELDS IN THE ASIA/PACIFIC REGION

Identification		Deficiencies			Corrective Action			
Requirement	**States/facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action**
Reliable ground to ground communication as specified in the regional Air Navigation Plan (Doc.9673) Tables CNS II-1; CNS II-2 & CNS II-3	Afghanistan and Pakistan	Unreliability of AFS communication between Afghanistan and Pakistan was brought to the notice of APANPIRG/21. Lack of reliability in the AFS including data communication between Kabul and Karachi and ATS voice communication between Lahore and Kabul was identified.	September 2010	A follow-up COM coordination meeting held in July 2019 discussed way forward	1. Site visits in Pakistan by expert from the VSAT service provider were made in February and March 2016. Remedial recommendations were provided to CAA. Pakistan. Pakistan requested ICAO to provide assistance in establishing VSAT link in 2022. 2. Both Afghanistan and Pakistan agreed to as first step to recover the VSAT connection by upgrading terminals in Lahore and Karachi. Afghanistan will provide assistance and does the Network Configuration settings; 3. A VPN link was established between Karachi and Kabul through UK. Now the VPN link between UK and Kabul is un-serviceable. 4. Both States also agreed to implement CRV as soon as practical to resolve the existing COM deficiencies. 5.Pakistan has joined CRV and is actively coordinating with Afghanistan to restore the communication link between Afghanistan and Pakistan. Pakistan expected to restore the connection by the end of 2024. 6. The AFS communication link between Pakistan and Afghanistan remains non-operational due to the	CAA. Afghanistan and CAA. Pakistan **For APANPIRG/36 from Pakistan-** Request that this deficiency be removed from Pakistan's side.	End of 2024 No dates can be shared from Pakistan – CNS SG/29 (16-20 June 2025)	A

Identification		Deficiencies			Corrective Action			
Requirement	**States/facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action**
					absence of a functioning AFS system on the Afghanistan side. Pakistan is fully prepared and available to activate the link as soon as Afghanistan establishes the required AFS infrastructure. Afghanistan had not given any tentative timelines. Therefore, it was requested that this deficiency be removed from Pakistan's side.			

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REGIONAL ATSEP HUMAN FACTORS GUIDANCE MATERIAL

Advanced Edition, Version 2.0 – June 2025

This page is intentionally left blank

AMENDMENTS

The issue of amendments is announced, when an amendment has been agreed by a meeting of the ICAO Asia/Pacific CNS/SG. The space below is provided to keep a record of such amendment.

RECORD OF AMENDMENTS

Amendment Number	Date	Amended by	Comments
0.0	20 June'2025	CNS SG/29 Meeting	Additional chapter on "Supervisory and Managerial Role of ATSEP"
0.1			

This page is intentionally left blank.

PREFACE

This publication is the most important deliverable of the Ad-hoc work group being established in April 2021 in response to the conclusion of "Thirty First Meeting of Asia/Pacific Air Navigation Planning and Implementation Regional Work Group (APANPIRG/31)" in December 2020 for the **Preparation of APAC Regional ATSEP Human Factors Guidance Material**. It aims at providing guidance to States, Air Navigation Service Providers, and their key taskforce 'ATSEP' on improving the human performance by addressing the key stress factors through effective countermeasures as proposed in the document.

With the extensive series of group discussions and deliberations, the Ad-hoc work group has prepared **Stress Factor Mapping Document (SFMD)** which focuses on grouping of the stress factors listed in IFATSEA study report- "**Factors adding stress and fatigue to ATSEP**" provided in **Appendix R** to the **CNS SG/24 Report** into key issues then mapping those key issues with the suitable countermeasures listed in the IFATSEA study report. This guidance material has been developed based on the SFMD and countermeasures to be taken.

A working team was established to formulate the structure and develop the contents of the guidance material, and IFATSEA has volunteered to take lead on coordinating and consolidating inputs from members of the working team. The team has successfully completed the task of drafting the regional guidance material within the targeted time and has presented the Regional ATSEP human factors guidance material in the "Twenty-Sixth Meeting of Communication, Navigation and Surveillance Sub-group of ICAO (CNS SG/26)" in September 2022 for review and adoption.

This guidance material has the clear description of all the guidelines for the actions to be taken and the self-evaluation checklists for the ATSEP/ANSPs to evaluate themselves. Also, the best practices that can be adopted and the long-term benefits to the ANSPs on addressing the human factors of ATSEP will be discussed in the document. Work group welcomes all ATSEP, ATSEP representatives and ANSPs for interactions and collaborations from all the regions not restricted to APAC region for their valuable feedback and review of the document for further improvement and adoption by the states. Images from IFATSEA are incorporated in this document.

Regional guidance material was adopted as v1.0 and published through ICAO state letter ref: T 8/2.15 – AP137/23 (CNS) dated 20th September 2023. In CNS SG/27, an additional chapter was proposed on **"Supervisory and Managerial Role of ATSEP"** who work for ANSP and coordinate with service providers and to ensure their performance within the scope of activities as defined in DOC 10057. Accordingly, the additional chapter was presented in CNS SG/28 and adopted by CNS SG/29 meeting. As such, the present document is being published as its Version 2.0.

The support from ICAO APAC Office and contributions from the following volunteer State/Administration and industry partner in preparing the guidance material is acknowledged and highly appreciated:

1. Air Traffic Management Bureau (ATMB), China
2. Airports Authority of India
3. Civil Aviation Authority of Singapore
4. Civil Aviation Authority of Thailand (CAAT) and Aeronautical Radio of Thailand Ltd (AEROTHAI)
5. Directorate General of Civil Aviation, Indonesia and Indonesian Aviation Electronics and Electrical Technician Association (IAEETA)
6. Hong Kong Civil Aviation Department, Hong Kong China
7. Japan Civil Aviation Bureau and Koukuu Hoan Shisetsu Shinraisei Center (KSC)
8. Korea Airport Corporation (KAC) and Incheon International Airport Corporation (IIAC)

This page is intentionally left blank

CONTENTS

ACRONYMS AND ABBREVIATIONS xvii
KEYWORDS xix
1. INTRODUCTION 5
1.1. Purpose 5
1.2. Background 5
1.3. Concept 7
1.3.1. Systems Approach 7
1.3.2. Mutual benefits for ANSP and ATSEP 8
1.3.3. Pareto rule 8
1.3.4. CANSO Standard of Excellence in Human Performance Management 9
1.3.5. Organizational Resilience 9
1.3.5.1. Preventative control: Defensive and Consistent 9
1.3.5.2. Mindful Action: Defensive and Flexible 10
1.3.5.3. Performance Optimization: Progressive and Consistent 10
1.3.5.4. Adaptive Innovation: Progressive and Flexible 11
1.3.6. Mapping of Resilience Levels and Process Maturity Levels 11
1.3.7. Evaluation method 11
1.4. Safety Roles of ATSEP 12
1.4.1. Activities. 15
1.4.1.1. Operational activities. 15
1.4.1.2. Maintenance activities. 15
1.4.1.3. Installation activities. 15
1.4.2. Unique characteristics of ATSEP working environment. 15
1.5. Outcomes and Endorsements 15
1.6. Arrangements of this document 16
1.7. Document History and Management 16
1.8. Copies 16
1.9. Changes to this document 16
1.10. Editing Conventions 17
1.11. ATSEP Human Factors Guidance Material - Request for Change Form. 17
1.12. Amendment Record. 17
2. REFERENCE DOCUMENTS 19
3. PEOPLE RESOURCING 23
3.1. Introduction 23
3.2. Benefits to ANSP 23
3.3. Benefits to ATSEP 23
3.4. Actions by ANSP 23

3.5. Actions by ATSEP 24
3.6. Most Influential Countermeasures 24
3.7. Human Factors Issues Addressed 24
3.7.1. Directly Addressed Factors 24
3.7.2. Indirectly Addressed Factors 25
3.7.3. Additional Factors Addressed 26
3.8. Self-Evaluation Checklist 26
3.8.1. Self-Evaluation Checklist for ANSP 26
3.8.2. Self-Evaluation Checklist for ATSEP 27
3.9. Resilience and Cost Benefits 28
4. JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING 31
4.1. Introduction 31
4.2. Benefits to ANSP 31
4.3. Benefits to ATSEP 31
4.4. Actions by ANSP 31
4.5. Actions by ATSEP 32
4.6. Most Influential Countermeasures 32
4.7. Human Factors Issues Addressed 32
4.7.1. Directly Addressed Factors 32
4.7.2. Indirectly Addressed Factors 33
4.8. Self-Evaluation Checklist 34
4.8.1. Self-Evaluation Checklist for ANSP 34
4.8.2. Self-Evaluation Checklist for ATSEP 35
4.9. Resilience and Cost Benefits 36
5. KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT 39
5.1. Introduction 39
5.2. Benefits to ANSP 39
5.3. Benefits to ATSEP 39
5.4. Actions by ANSP 40
5.5. Actions by ATSEP 40
5.6. Most Influential Countermeasures 41
5.7. Human Factors Issues Addressed 41
5.7.1. Directly Addressed Factors 41
5.7.2. Indirectly Addressed Factors 42
5.8. Self-Evaluation Checklist 43
5.8.1. Self-Evaluation Checklist for ANSP 43
5.8.2. Self-Evaluation Checklist for ATSEP 44

5.9. Resilience and Cost Benefits 45
5.10 Other Countermeasures 45
5.11. Relevant Appendix 45
6. INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY 49
6.1. Introduction 49
6.2. Benefits to ANSP 49
6.3. Benefits to ATSEP 49
6.4. Actions by ANSP 49
6.5. Actions by ATSEP 50
6.6. Most Influential Countermeasures 50
6.7. Human Factors Issues Addressed 51
6.7.1. Directly Addressed Factors 51
6.7.2. Indirectly Addressed Factors 51
6.8. Self-evaluation checklist 53
6.8.1. Self-evaluation checklist for ANSP 53
6.8.2. Self-evaluation checklist for ATSEP 54
6.9. Resilience and Cost Benefits 55
6.10. Other Countermeasures 55
7. WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD 59
7.1. Introduction 59
7.2. Benefits to ANSP 59
7.3. Benefits to ATSEP 59
7.4. Actions by ANSP 60
7.5. Actions by ATSEP 60
7.6. Most Influential Countermeasures 60
7.7. Human Factors Issues Addressed 60
7.7.1. Directly Addressed Factors 60
7.7.2. Indirectly Addressed Factors 62
7.8. Self-Evaluation Checklist 63
7.8.1. Self-Evaluation Checklist For ANSP 63
7.8.2. Self-Evaluation Checklist for ATSEP 64
7.9. Resilience And Cost Benefits 65
7.10. Relevant Appendix 65
8. MOTIVATION, COMMITMENT, AND ENGAGEMENT 69
8.1. Introduction 69
8.2. Benefits to ANSP 69
8.3. Benefits to ATSEP 69
8.4. Actions by ANSP 69

8.5. Actions by ATSEP 70
8.6. Most Influential Countermeasure 70
8.7. Human Factors Issues Addressed 70
8.7.1. Collectively Addressed Factors 70
8.8. Resilience and Cost Benefits 71
8.9. Other Countermeasures 71
9. BEHAVIOURAL AND ROLE SPECIFIC COMPETENCIES 75
9.1. Introduction 75
9.2. Benefits to ANSP 75
9.3. Benefits to ATSEP 75
9.4. Actions by ANSP 75
9.5. Actions by ATSEP 75
9.6. Most Influential Countermeasures 75
9.7. Human Factors Issues Addressed 75
9.7.1. Directly Addressed Factors. 75
9.7.2. Indirectly Addressed Factors. 76
9.8. Resilience And Cost Benefits 77
9.9. Other Countermeasures 77
10. SAFETY CULTURE PROMOTION 81
10.1. Introduction 81
10.2. Benefits to ANSP 81
10.3. Benefits to ATSEP 81
10.4. Actions by ANSP 81
10.5. Actions by ATSEP 82
10.6. Most Influential Countermeasure 82
10.7. Human Factors Issues Addressed 82
10.7.1. Directly addressed factors. 82
10.8. Resilience and Cost Benefits 83
10.9. Other Countermeasures 83
11. SUPERVISORY AND MANAGERIAL ROLE OF ATSEP 865
11.1. Introduction 87
11.2. Benefits to ANSP 90
11.3. Benefits to ATSEP 91
11.4. Actions by ANSP 91
11.5. Actions by ATSEP 91
11.6. Most Influential Counter-measures 911
11.7. Human Factors Issues Addressed 82
11.8. Resilience and Cost Benefits 92

APPENDIX 1 STRESS FACTOR MAPPING 944
1.1. Introduction 944
1.2. Description 988
APPENDIX 2 STRESS FACTORS 100
2.1. Introduction 100
2.1.1. Table 1 – Lack of Knowledge, Skills, and Competency. 100
2.1.2. Table 2 – Lack of proper workload distribution. 1011
2.1.3. Table 3 – Lack of proper procedures, information, tools, and practices. 1022
2.1.4. Table 4 – Duty duration, cycles of shifts and extended work hours. 1033
2.1.5. Table 5 – Continued stress, fatigue, and pressure. 1044
2.1.6. Table 6 – Lack of knowledge sharing, leadership, and teamwork. 1055
2.1.7. Table 7 – Human Resource Management policies. 1066
2.1.8. Table 8 – Lack of workplace facilities and environment. 1077
2.1.9. Most Significant Factors as per ATSEP 1088
APPENDIX 3 COUNTERMEASURES 110
3.1. Introduction 110
APPENDIX 4 ATSEP DUTY TIME LIMITATION 1122
4.1. Introduction 1122
4.2. Definitions 1122
4.3. Background 1122
4.4. Best Shift duty pattern 1144
4.5. Guidelines for best shift duty pattern 1177
4.5.1. Guideline 1 - Successive night shifts 1177
4.5.2. Guideline 2 - Rest period between night shifts 1188
4.5.3. Guideline 3 - Coherent blocked free time at the weekends 1188
4.5.4. Guideline 4 - Number of free days 1188
4.5.5. Guideline 5 - Shift rotation pattern 120
4.5.6. Guideline 6 - Early shift 120
4.5.7. Guideline 7 - Night shift length 120
4.5.8. Guideline 8 - Concentration of working hours restriction 120
4.5.9. Guideline 9 - Notification of rosters 12020
4.5.10. Guideline 10 - Rest in Night Shift / Single Shift 1211
4.5.11. Guideline 11 - Emergency Duty 1211
4.6. References 1211
APPENDIX 5 MEASURES DURING PANDEMIC 1222
5.1. Introduction 1222
5.2. Backdrop of the Paranoia: Fear psychosis behind Covid- 19 1222

5.3. The Mitigation measures to be taken during Pandemic. 1233
5.4. The future course of Action 1233
5.5. References 1244
APPENDIX 6 PROGRESSIVE TRAINING 1265
6.1. Introduction 1266
6.2. Background of ATSEP training 1266
6.3. The Roadblocks to complete adoption of the Docs 9868 & Doc 10057 1288
6.4. How can these roadblocks be addressed? 1288
6.5. References 1288
APPENDIX 7 STRESS MANAGEMENT 130
7.1. Introduction 130
7.1.1. Process of stress – Three stages 130
7.1.1.1. Alarm reaction 130
7.1.1.2. Resistance stage 130
7.1.1.3. Exhaustion stage 130
7.1.2. Causes of stress at working situations 13131
7.1.2.1. Stressors in the working environment 1311
7.1.3. Consequences of stress 1311
7.1.4. Symptoms of Stress 1322
7.2. Stress Management 1322
7.2.1. Human Nature and Individual Differences 1322
7.2.1.1. Human Nature 1333
7.2.1.1.1. Biological Models 1333
7.2.1.1.2. Goal-based models 1333
7.2.1.2. Individual Differences 1344
7.2.1.2.1. Extraversion 1344
7.2.1.2.2. Neuroticism 1344
7.2.1.2.3. Agreeableness 1344
7.2.1.2.4. Conscientiousness 1344
7.2.1.2.5. Openness to experience 1344
7.2.2. Relations Between Personality and Coping 1344
7.2.3. Benefits of active stress management 1355
7.2.4. Steps involved in the minimization of the stress. 1355
7.2.4.1. Identify the sources of stress in your life. 1355
7.2.4.2. Address the unhealthy coping strategies. 1355
7.2.4.3. Managing predictable stressors 1355
7.2.4.3.1. Avoid unnecessary stress. 1366

7.2.4.3.2. Alter the situation. 1366
7.2.4.3.3. Adapt the stressor. 1366
7.2.4.3.4. Accept the things you cannot change. 1366
7.2.4.4. Manage time and schedules. 1366
7.2.5. Assistance under stressful situation 1366
7.2.6. Effects of shocking and stressful situation 1377
7.3. References 1377
APPENDIX 8 SAFETY CULTURE 1388
8.1. Introduction 1388
8.1.1. Safety Importance in Aviation 1388
8.1.2. Safety: The Foremost Strategic Objective of ICAO 1388
8.1.3. Safety Work Culture 1388
8.1.4. Safety Culture and Safety Performance 1388
8.1.4.1. Quality safety culture entails considerate safety behaviour. 1399
8.1.4.2. ATSEP perform even when not under safety supervision. 1399
8.2. Safety Culture Development and Benefits. 14040
8.2.1. Developing A Positive Safety Culture. 14040
8.2.2. Safety Culture as Safety Enabler of Safety Management. 14040
8.2.3. Safety Work Culture benefits. 14040
8.2.3.1. Safety work culture benefits in case of adoption in ATSEP domain. 14040
8.2.4. Benefits of Safety Management. 1411
8.2.5. Safety Culture Enablers and Disablers 1411
8.3. Safety Reporting and Just Culture 1444
8.3.1. Safety Culture and its influence on Safety Reporting 1444
8.3.2. Safety Reporting 1455
8.3.2.1. Significance of Safety Reporting 1455
8.3.2.2. Dos and don'ts 1466
8.3.3. Just Culture 1466
8.3.3.1. Definition 1466
8.3.3.2. Just Culture conception 1466
8.3.3.3. Just Culture misconception 1466
8.3.4. Safety Culture and Cultural Diversity 1477
8.4. Challenges and Addressing the Roadblocks 1477
8.4.1. Loss of Upper Management Support 1477
8.4.2. Lack of Safety Accountability 1477
8.4.3. Lack of leadership commitment 1488

8.4.4. Lack of resources for safety success 1488
8.4.5. Ageing workforce 1488
8.4.6. Rise in the recruitment of young and less experienced ATSEP 1488
8.4.7. Loss of safety-related data 1499
8.4.8. Safety Feedback problems 1499
8.4.9. Safety culture and organizational change 1499
8.4.10. Economic unpredictability 1499
8.5. Monitoring and Measuring Safety Culture Effectiveness 1499
8.5.1. Safety Culture Assessment 1499
8.6. References 15050
APPENDIX-9: SELF EVALUATION CHECK LISTS 1522
COMPENDIUM 1622

LIST OF FIGURES

Figure 1: Timeline of ATSEP Human Factors Guidance Material 6
Figure 2: Interlinked Stress Factors and Human Performance 7
Figure 3: Typical Working Environment of ATSEP 13
Figure 4: Aviation Capsule 14
Figure 5: Scope of Activities (DOC 10057) 88
Figure 6: Supervisory and Management Role beyond Operations and Maintenance 89
Figure 7: ATSEP Duty Time Analysis - 1 114
Figure 8: ATSEP Duty Time Analysis - 2 114
Figure 9: ATSEP Duty Time Analysis - 3 115
Figure 10: Sleep / Wake Cycle 115
Figure 11: Shift Duties Effect on Health 116
Figure 12: Shift work with ATSEP Performance and Safety 120
Figure 13: Scope of ATSEP activities 127
Figure 14: ATSEP training phases 128
Figure 15: ATSEP training progression 128
Figure 16: Quantifying Safety Behaviour 140
Figure 17: Benefits of Safety Management 142
Figure 18: Understanding the evaluation check list process 153
Figure 19: Compendium Picture 1 162
Figure 20: Compendium Picture 2 163
Figure 21: Compendium Picture 3 164
Figure 22: Compendium Picture 4 165

LIST OF TABLES

Table 1: Mapping of Resilience Levels and Process Maturity Levels 11
Table 2: ATSEP Human Factors Guidance Material - RFC Form..... 17
Table 3: Reference Documents 19
Table 4: Supervisory roles and Managerial roles 89
Table 5: Activities and examples 90
Table 6: Specific Responsiblities.....90
Table 7: Consequences of Stress.....1312
Table 8: Symptoms of Stress 133
Table 9: Signs of Critical Incident Stress 138

ACRONYMS AND ABBREVIATIONS

ACC	Area Control Centre
AEROTHAI	Aeronautical Radio of Thailand Ltd.
AME	Aircraft Maintenance Engineer
ANSP	Air Navigation Service Provider
APAC	Asia Pacific Region
APANPIRG	Asia Pacific Air Navigation Planning and Implementation Regional Group
APP	Approach Control
ASBU	Aviation System Block Upgrades
ASO	Aeronautical Station Operator
ATC	Air Traffic Controller
ATCO	Air Traffic Control Officer
ATMB	Air Traffic Management Bureau
ATS	Air Traffic Services
ATSEP	Air Traffic Safety Electronics Personnel
BMC	Bone Marrow Cells
CAAT	Civil Aviation Authority of Thailand
CANSO	Civil Air Navigation Services Organization
CBTA	Competency Based Training and Assessment
CM	Corrective Maintenance
CNS	Central Nervous System
CNS/ATM	Communication, Navigation and Surveillance /Air Traffic Management
CNS SG	Communication, Navigation and Surveillance Sub-Group
EST	Eastern Time Zone
EU	European Union
FIR	Flight Information Region
FOCA	Federal Office of Civil Aviation
FPL	Flight Plan
HMI	Human-Machine Interface
HR	Human Resources
HRM	Human Resource Management
IAEETA	Indonesian Aviation Electronics and Electrical Technician Association
ICAO	International Civil Aviation Organisation
IFATCA	International Federation of Air Traffic Controllers' Association
IFATSEA	International Federation of Air Traffic Safety Electronics Association
IIAC	Incheon International Airport Corporation
ILS	Instrument Landing System
KAC	Korea Airport Corporation
KM	Knowledge Management
KS	Knowledge and Skill
KSA	Knowledge, Skill, and Attitude
KSC	Knowledge, Skill, and Competency
KSC	Koukuu Hoan Shisetsu Shinraisei Center
L1	Lowest One
L&D	Learning and Development
MET	Metrological Service
NOTAM	Notice to Airmen
OEM	Original Equipment Manufacturer
OFC	Optical Fibre Communication

OIC	Station-In-Charge
PANS- TRG	Procedures for Air Navigation Services-Training
PBN	Performance Based Navigation
PM	Preventative Maintenance
PPE	Personal Protective Equipment
QR	Qualitative Requirements
RADAR	Radio Detection and Ranging
RFC	Request for Change Form
RWY	Runway
SCN	Suprachiasmatic Nucleus
SFMD	Stress Factor Mapping Document
SMS	Safety Management System
SOP	Standard Operating Procedure
SSO	Shift Supervisory Officer
SSP	State Safety Plan
STSB	Swiss Transportation Safety Investigation Board
SWIM	System Wide Information Management
TM	Talent Management
UIC	Unit-In-Charge
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VVIP	Very Very Important Person
WSO	Watch Supervisory Officer

KEYWORDS

Approach and Avoidance Systems	This is a psychological construct that represents the conflict in motivation to move forward or to move away from an undesired result.
Behavioural and Functional Competencies	Behavioural requirements are specifications of user interactions with a system often represented as use cases. Functional requirements are business specifications such as calculations, business rules and process flow.
Circadian Rhythm	These are 24-hour cycles that are part of the body's internal clock, running in the background to carry out essential functions and processes.
Competency Modelling	Competency modelling is a systematic approach used in human resource management to identify and define the key competencies required for successful performance in specific roles within an organization. Competencies are a set of knowledge, skills, abilities (KSA) combined with behaviour, and other personal attributes that individuals need to effectively carry out their job responsibilities.
Computer-based Maintenance Data Analysis	Computer-based maintenance data analysis refers to the process of using computer systems and software to analyze and draw interpretation from maintenance data collected from various sources. It is a valuable tool for maintenance professionals to make informed decisions and optimize maintenance practices. It leads from reactive to proactive maintenance approach.
DIRTY DOZEN Model	The Dirty Dozen refers to twelve of the most common human error preconditions, or conditions that can act as precursors, to accidents or incidents. These twelve elements influence people to make mistakes. It covers the following dozen factors: 1.Fatigue 2.Stress 3.Complacency 4.Communication 5.Awareness 6.Distraction 7.Lack of knowledge 8.Teamwork 9.Lack of resources 10.Pressure 11.Lack of assertiveness 12.Norms
Double Bind Situation	A situation where opposing interests of safety and judiciary must be served and satisfied.
Extraversion	Extraversion has different emphases in different measures. Sometimes it is based in assertiveness, sometimes in spontaneity and energy. Sometimes it is based in dominance, confidence, and agency, sometimes in a tendency toward happiness.
Human Performance Management	As an ongoing process of identifying, measuring, assessing, and developing the performance of the employees in the organization.
Just Culture	A Culture where front-line operators or other personnel are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated.

Key Performance Indicators	Key Performance Indicators (KPIs) are the critical (key) indicators of progress toward an intended result. KPIs provides a focus for strategic and operational improvement, create an analytical basis for decision making and help focus attention on what matters most.
Maintenance Philosophies	It is the mix of strategies that ensure an item works as expected when needed.
Neuroticism	Concerns the ease and frequency with which a person becomes upset and distressed. Moodiness, anxiety, and depression reflect higher neuroticism
Organization Resilience	Refers to an organization's response to damage and it highlights the ability to recover and grow under uncertainty, crisis, and emergency. This includes following resilience levels – 1.Preventative control: defensive and consistent 2.Mindful action: defensive and flexible 3.Performance optimization: progressive and consistent 4.Adaptive innovation: progressive and flexible
Pareto Rule	The Pareto principle (also known as the 80/20 rule) is a phenomenon that states that roughly 80% of outcomes come from 20% of causes.
PEAR Model	The mnemonic PEAR is used to recall the four considerations for assessing and mitigating human factors in aviation maintenance: 1. People who do the job. 2. Environment in which they work. 3. Actions they perform; and 4. Resources necessary to complete the job.
Process Maturity Levels	Process maturity levels are different maturity states of a process/activity. The processes at higher levels also address the features of the lower levels.
Progressive Training	It defines the ATSEP training requirements in the event of Change within the system; Change of domain; Change of activities, and inclusion of any additional system
Psychological Contract	The term psychological contract refers to the often-unspoken set of expectations and assumptions that two parties (employees and the organisation, its leaders, and managers) have of each other about things like how they will behave and act.
Quality Management	Quality management ensures that an organization, product, or service consistently functions well. It has four main components: quality planning, quality assurance, quality control and quality improvement. Quality management is focused not only on product and service quality, but also on the means to achieve it.
Random Fault Simulation	A technique generally used in the field of electronics and digital systems design and testing to evaluate the performance and reliability of a circuit under fault conditions. In this method, faults are randomly introduced into the system, and the response is analysed to assess its behaviour. This type of test helps to ensure a robust response system.
REASON's Model	Classifies factors contributing to accidents into three domains: Organisational/systems, local workplace, and unsafe acts. The model promotes a focus on the conditions or situation in which the person is trying to perform, conditions which might be designed to create an incident or error.

Role Profile	It focuses on the following aspects of the ATSEP role: key result areas; knowledge, skills and abilities required; behavioural competencies
Safety and Service Strategy	An approach adopted by organizations to optimize a balance between the safety of their stakeholders and the quality of service being provided. It involves implementing measures and policies to ensure a safe environment and minimize risks while also delivering excellent and reliable services to meet customer needs and expectations.
Safety Management System	A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies, and procedures.
Safety Performance Indicator	A data-based safety parameter used for monitoring and assessing safety performance.
Scientific Knowledge Management	A systematic process of acquiring, organizing, validating, and disseminating scientific knowledge about human behaviour and capabilities. It involves conducting research and experiments to understand human interactions with systems, products, and environments. This knowledge is organized and stored for easy access, peer-reviewed for accuracy, and integrated into design and development processes to enhance efficiency, safety, and user satisfaction while minimizing errors and accidents.
Scientific Performance Evaluation System	Scientific performance evaluation refers to the systematic and objective process of assessing an individual's or a team's performance in a scientific or research-oriented setting. This evaluation is typically carried out using data-driven methods, standardized metrics, and well-defined criteria to measure and quantify the quality and impact of contributions
Shell Model	The SHELL Model is a conceptual tool used to analyse the interaction of multiple system components. The SHELL Model contains the following four components: a) Software (S) (procedures, training, support, etc.). b) Hardware (H) (machines and equipment). c) Environment (E) (the working environment in which the rest of the L-H-S system must function); and d) Liveware (L) (humans in the workplace).
State Safety Programme	An integrated set of regulations and activities aimed at improving safety.
Strategic People Resourcing	Strategic resourcing is a key part of strategic human resource management that aims on ensuring that organization has the people it needs to achieve the business goals. It is fundamentally related with matching human resources to the strategic and operational requirements of the organization and ensuring the full utilization of these resources.
Systems Approach	Systems approach is a management perspective which advocates that any business problem should be seen as system which is made up of a hierarchy of interrelated and interdependent sub-systems. Each part of the system derives inputs and information from other system to achieve the business goal. The system changes as per the environment and reacts to the changes in the environment. All departments and sub-systems of the overall large system need to product results.

System Wide Information Management	A global Air Traffic Management (ATM) industry initiative to harmonize the exchange of Aeronautical, Weather and Flight information for all Airspace Users and Stakeholders. SWIM is an integral part of the International Civil Aviation Organization (ICAO) Global Air Navigation Plan (GANP
Talent Management	Talent management is the strategic process of attracting, developing, and retaining skilled individuals within an organization. It involves identifying, nurturing high performing individuals, and aligning their abilities with the Organization mission and vision. Talent management encompasses various practices and activities aimed at optimizing human resources and maximizing their contributions to the organization's success.
Workforce Planning	This process identifies anticipated changes to the scope and nature of the organization's activities.

ATSEP HUMAN FACTORS GUIDANCE MATERIAL

This page is intentionally left blank.

ATSEP HUMAN FACTORS GUIDANCE MATERIAL

To cope with the new technologies and safety levels, Air navigation service providers (ANSPs) need to match modernization plans with human performance management of their key workforce i.e. ATSEP. To ensure the required level of human performance to assure safety, it is essential to understand the factors adding stress and fatigue in the present scenario.

THE OBJECTIVE

This guidance material introduces an important human performance management approach that may effectively address the variables by achieving various levels of maturity. Additionally provides the ANSP with self-evaluation tools to gauge the process maturity levels.

This guidance material focuses on

- The human factors that cause stress, fatigue, and have an impact on job performance
- Key human resource management processes
- Resilience and cost benefits that can be achieved through the process improvisation.

"Because ICAO SARPs drive states regulatory requirements, Human Performance (HP) considerations are essential to the development of those SARPs and their supporting guidance material."

DOC 10151 – MANUAL ON HUMAN PERFORMANCE

1. INTRODUCTION

1.1. Purpose

To cope with the new technologies and safety levels, Air navigation service providers (ANSPs) need to match modernization plans with human performance management of their key workforce i.e., ATSEP. To ensure the required level of human performance to assure safety, it is essential to understand the factors adding stress and fatigue in the present scenario.

On understanding the factors and their effective countermeasures, ANSPs can plan a human performance management system that can assure continued performance improvement w.r.t ATSEP.

The purpose of this guidance material is to list the factors that add stress, fatigue, and affect their job performance in their working environment (roles, responsibilities, deployment, duty pattern, requirement of knowledge, skills, attitude, competency, training, and resources) and address the factors through process improvement of human performance management system.

This guidance material introduces an important human performance management approach that may effectively address the variables by achieving various levels of maturity. Additionally, provides the ANSP with self-evaluation tools to gauge the process' maturity levels.

After the COVID-19 pandemic, it is important to get the organisation ready for higher levels of resilience so that it can recover and move forward. The advice material also makes a correlation between resilience levels and the maturity levels of the human performance management process.

Ergo, this guidance material focuses on

- the human factors that cause stress, fatigue, and have an impact on job performance.
- key human resource management processes that address them
- resilience and cost benefits that can be achieved through those process improvisation.

1.2. Background

Initially at the global level, the human factors issues were significant for flight crew operations, then considered to affect the performance of air traffic controllers, and later it was focused on the performance of aircraft maintenance personnel. In the present technology centric air-ground CNS/ATM systems, ATSEP role in the safety chain is crucial to seal all the holes in the last layer of defence. However, human factors of ATSEP are not being addressed or focused on the manner as it is done on the performance of Pilots, AME, ATCOs, MET, ASO and Flight Dispatchers.

The stressful working environment of ATSEP can lead to errors, lapses, latent or error causing conditions that brings the invisible windows of opportunity for unsafe acts, or even fatal accidents. Given the unique nature of the job performance with zero tolerance for error and with the requirements of elevated levels of technical skills, there was a need for defining uniform standards on the roles, responsibilities, deployment, duty pattern, requirement of knowledge, skills, attitude, competency, training, resources, and rewards with regards to ATSEP who are playing vital role in the safety chain.

The International Federation of Air Traffic Safety Electronics Association (IFATSEA) emphasized the importance to study the human factor issues of ATSEP on their working environment, abilities, limitations and on other characteristics for evaluating their job and safety

performance at CNS / SG 23 in Bangkok. The meeting considered that establishment of a small working group would be necessary to support such study.

Further, IFATSEA has conducted a global study on human factors of ATSEP to understand the abilities and limitations of Air Traffic Safety Electronics Personal (ATSEP) in their working environment. This global study assessed the present maturity levels of ANSPs in terms of human performance management pertaining to ATSEP. The study found that the human performance management maturity levels of ANSPs w.r.t ATSEP are in the exceedingly initial stages and there are scopes for improvement.

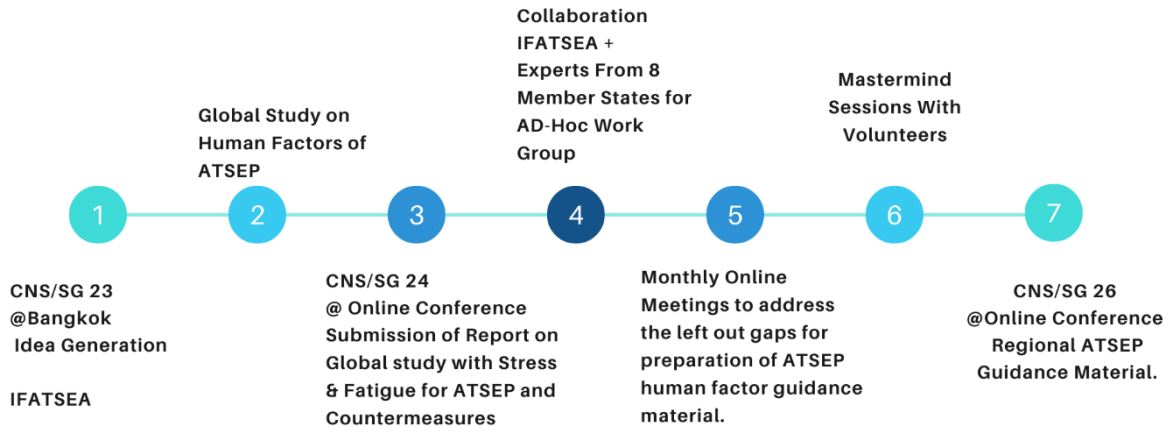


Figure 1: Timeline of ATSEP Human Factors Guidance Material

Based on the study, a report on human factors of ATSEP was presented in CNS SG/24 through web conference, and the meeting has forwarded the draft conclusion for adoption in APANPIRG/31. Consequent upon adoption in APANPIRG/31 and ICAO APAC has issued a state letter for the APAC states for encouraging them to consider the study recommendations for the implementation proactively and come forward to join the small work group for preparation of Regional ATSEP human factors guidance material.

The Ad-hoc work group of experts from Eight (8) member states (China, Hong Kong China, India, Indonesia, Japan, Republic of Korea, Singapore, and Thailand) and IFATSEA was established in April 2021 in response to the Conclusion APANPIRG/31/15-Addressing Human Factor Issues of ATSEP recommended by CNS SG/24 meeting for finding the left-out gaps and for preparing the regional ATSEP human factors guidance material.

Under the leadership of IFATSEA, the Ad-hoc work group has thoroughly discussed the factors that add Stress and Fatigue to ATSEP and deliberated on the effective countermeasures to address those human factors and ANSPs' resilience through countermeasures in the subsequent meetings. Based on this a Stress Factor Mapping Document (SFMD) was prepared.

Furthermore, the Ad-hoc group has deliberated on long term benefits to ANSP and ATSEP community on addressing the human factors, best practices to be adopted by the states to achieve highest level of resilience, and human performance process maturity levels. Deliberations on

priority actions to be taken by ATSEP and ANSP during pandemic like Covid-19 were also carried out. Consequently, the Ad-hoc group has worked on finalizing the structure and drafting of various modules of Regional ATSEP human factors guidance material.

Apart from the periodical meeting held by work group during June 2021 to June 2022, IFATSEA has conducted Global Webinar on Human Performance on 12th November 2021 to deliberate the ATSEP human performance and organizational resilience. IFATSEA has also arranged series of mastermind sessions involving volunteers from the work group on deliberating the issues that affect the human performance and solutions to ensure the highest level of performance.

Consequently, the Ad-hoc workgroup has presented and submitted the draft Regional ATSEP guidance material to the Twenty-Sixth Meeting of the Communications, Navigation and Surveillance Sub-group of APANPIRG CNS SG/26 scheduled during 5th-9th September 2022.

1.3. Concept

1.3.1. Systems Approach

Systems Approach was used to improve the current human resource management process and come up with solutions, which not only address the concerns outlined in this document but also potential future factors of a similar nature.

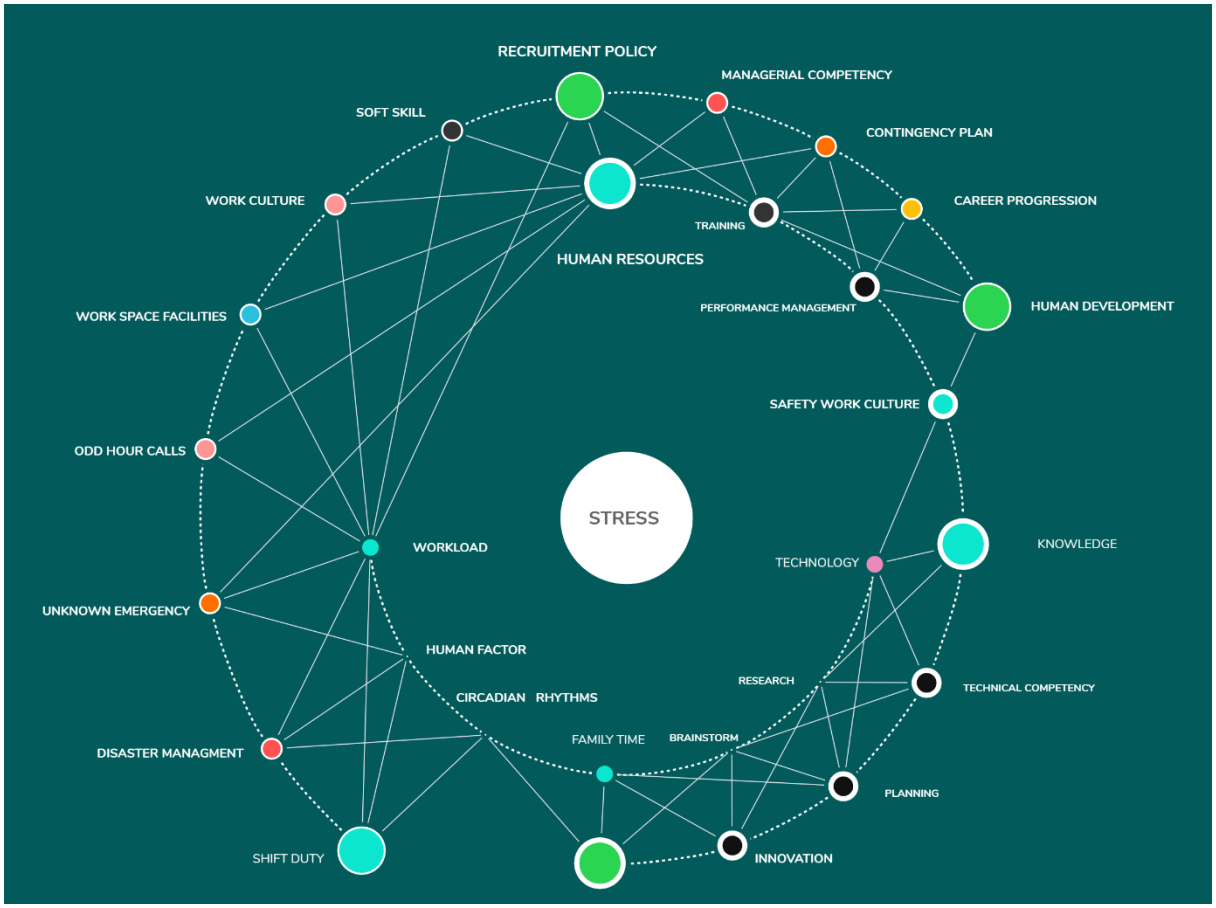


Figure 2: Interlinked Stress Factors and Human Performance

The figure 2 depicts the highly interconnected stress factors that affect job performance and the human performance management process that address these factors. By improving the human performance processes, we can reduce the stress levels of ATSEP, increase their performance

and achieve the safety and service commitment of ANSP even under challenging conditions in other words ANSP reaches elevated levels of resilience.

1.3.2. Mutual benefits for ANSP and ATSEP

The safety and service goals of any ANSP are realized through a key workforce who are strategically related to the mission and vision of the organization. There are several human performance management processes through which required competencies are identified, the right people are resourced, a conducive working environment is provided, people are developed continuously, and their motivation, commitment and engagement are enhanced for high performance.

The safety and service level results of any ANSP are correlated with human performance. If the human performance management procedure is premature or unavailable, they either introduce new stressors or exacerbate current ones. It has an impact on work performance and the favourable factors that produce the desired result in either scenario. So ANSPs cannot achieve the defined safety and service goals.

It is better to evaluate the outcome as well as the process maturity levels and take corrective measures to improve the process and thereby assuring the outcome. When the human performance management processes are at a higher level of maturity, it ensures that desired outcomes and resilience are achieved.

Stress factors can be reduced, and job performance boosted by trying to develop underdeveloped human performance management processes. With the increased job performance, the desired goals are achieved, and new goals can be set and assured.

The mutual benefits to ANSP and ATSEP are examined for each suggested measure. Resilience and financial advantages to ANSP are stated at the conclusion of each measure.

Along with their self-evaluation checklists, ANSP and ATSEP actions to be implemented to attain mutual advantages are listed. Self-evaluation checklists for ANSP are intended to assess both the organisational resilience level and the maturity levels of the human performance process. Based on the idea, self-evaluation checklists are suggested in five chapters for ANSP and ATSEP. The self-evaluation checklists are maintained straightforward to motivate the ANSPs to assess their performance and make improvements.

1.3.3. Pareto rule

The advice material has focused primarily on the countermeasures that are most effective and relevant to the process, which are necessary for any ANSP to increase organizational resilience.

This way by following Pareto rule, 20% of the most influential countermeasures that can address over 80% of the factors that affect the job performance and add stress and fatigue to ATSEP are highlighted as "**Most Influential Countermeasures**" in each chapter. However, the other relevant countermeasures also listed in the end of the chapter.

This guidance material scientifically addresses the challenges for human performance management and aims to provide best practices to be adopted by the states to build resilient ANSPs through ATSEP, those who ensure final defences in the safety chain.

However, the stress factor mapping document (SFMD), entire factors, countermeasures are given in the appendices 1, 2, & 3.

1.3.4. CANSO Standard of Excellence in Human Performance Management

This guidance material has adopted the *CANSO Standard of Excellence in Human Performance Management* model for evaluating the levels of maturities for the self-evaluation of ANSP. The maturity levels are given below for ready reference.

- **Level A – Informal Arrangements** - Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task.
- **Level B – Defined** - Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.
- **Level C – Managed** - Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied.
- **Level D – Assured** - Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.
- **Level E – Optimized** - Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria.

1.3.5. Organizational Resilience

This guidance material has adopted the organizational resilience concepts through human performance for evaluating the levels of resilience for the self-evaluation of ANSP. Brief information on different resilience levels is given below for ready reference.

1.3.5.1. Preventative control: Defensive and Consistent

The characteristic of this level is achieved by means of risk management, physical barriers, redundancy (spare capacity), systems back-ups and standardized procedures, which protect the organization from threats and allow it to '**bounce back'** from disruptions to restore a stable state. i.e., defensive + consistent.

Society expects organizations and critical infrastructures to be safe, secure, and dependable, and that industry, government, regulators, and service-deliverers have appropriate and continually improving capabilities to ensure this.

The goal of regulation is to produce fail-safe system designs. Defences, barriers, safeguards, and back-ups occupy a key position in this approach.

Systems have multiple defensive layers: some are engineered, others rely on people, and yet others depend on procedures and administrative controls.

Organization at it has have the following positive signs:

- Known problems are solved using proven techniques.
- Standard ways to do things are perfected by fine tuning.
- Redundancy through design and diversification has a stabilising effect.
- Disturbances are quickly counteracted by planned responses.

1.3.5.2. Mindful Action: Defensive and Flexible

The characteristic of this level is produced by people, who notice and react to threats and respond effectively to unfamiliar or challenging situations. i.e., Defensive + flexible.

To be resilient is to be prepared for adversity, which requires "improvement in overall capability, i.e., a generalized capacity to investigate, to learn, and to act, without knowing in advance what one will be called to act upon."

Rather than relying on static controls and reactive responses, Organizational Resilience also requires resources that can be activated, combined, and recombined in new situations, as challenges arise. An important contribution of this stream of work is that people are not regarded purely as sources of error but provide a positive contribution towards resilience.

Thus, the focus of resilience thinking shifted to the need for a culture that facilitates noticing and containing problems. Some organizations, despite operating in complex and dynamic environments and facing many opportunities for failure in their daily operations but almost never experience an operating failure or disruption.

Organization at its best has the following positive signs:

- People are wary about what could go wrong.
- Opportunities and problems are noticed, understood, and addressed quickly.
- People exercise judgement, discretion, and imagination when faced with challenges.
- People are empowered to act when they recognize a problem.

1.3.5.3. Performance Optimization: Progressive and Consistent

The characteristic of this level is formed by continually improving, refining, and extending existing competencies, enhancing ways of working and exploiting current technologies to serve present users and demands i.e., progressive + consistent.

Driven by globalization, the need for downward pressure on costs and the aim of improvements in shareholder value, many organizations have focused on the need to plan, organize for, and realize efficiency gain and increase productivity.

Performance optimization involves learning to do existing things better, delivering goals and meeting the needs of the public, the media, regulators, and the government, who all demand that products and services be delivered that 'work right this time, next time and every time.'

Typically, optimizing involves process enhancement, including the refinement, extension and exploitation of existing assets and competencies, technologies, and paradigms.

Organization at its best has the following positive signs:

- Performance improvement – 'do what we do better'
- Known solutions are implemented quickly – even by edict.
- A clear sense of direction, goals, roles, and responsibilities
- A strong individual leader who people can relate to

1.3.5.4. Adaptive Innovation: Progressive and Flexible

The characteristic of this level is created through creating, inventing, and exploring unknown opportunities and new technologies. Organizations can be the disruption in their environment i.e., progressive + flexible.

"It is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able to adapt to and to adjust best to the changing environment in which it finds itself."

In today's aviation business environment, the rapid production of knowledge and innovation is critical to organizational survival. Innovation involves creative problem-solving, innovation and learning, which have become critical to competitive advantage.

In response to these challenges, organizations can no longer engage in technical change by applying known solutions and current knowledge that can be implemented by experts, they need to engage in adaptive change that "requires going beyond any authoritative expertise to mobilize discovery, shedding certain entrenched ways, tolerating losses and generating the new capacity to thrive anew." This requires experiments, new discoveries, and invention from numerous places in the organization or community.

Organization at its best has the following positive signs:

- Productive tension disrupts existing patterns and generates a search for new possibilities.
- Creative thinking and problem solving by people drawing on multiple perspectives and taking risks in a safe environment.
- Collective strategic action with rich interactions coalition formation, negotiation, and compromise.
- Systems-wide changes across borders and boundaries; multidimensional and fundamental changes.

1.3.6. Mapping of Resilience Levels and Process Maturity Levels

For an easier comparison evaluation check lists for ANSP.

Table 1: Mapping of Resilience Levels and Process Maturity Levels

Process maturity levels		**Resilience levels**
Level A & B		Preventative control
Level C		Mindful action
Level D		Performance optimization
Level E		Adaptive innovation

1.3.7. Evaluation method

The guidance material is recommending the corresponding human resource management process improvement and their evaluation than evaluating factor by factor. By improving the process, ANSP will be able to address not only the listed factors but even beyond. At the same time without improvising the process, factors cannot be addressed effectively.

It is recommended to carry the self-evaluation at-least once in a year. When ANSP' s self-evaluation is in the level of D or E, then the same may be ascertained with the self-evaluation of ATSEP through a proportionate stratified random sampling. It is recommended to keep the sample size as 10% on each stratum of population and to select different samples each year.

1.4. Safety Roles of ATSEP

The term Air Traffic Safety Electronic Personnel (ATSEP) has been invented to describe those technical specialists working to provide and support the electronics and software, which enable ATS systems to function. ATSEP comprise engineers, technicians, and computer hardware and software specialists who are responsible for the specification, procurement, installation, calibration, maintenance, testing and certification of ground electronic systems used to help control aircraft movements. For that purpose, these people must be trained to have enough background knowledge about air navigation services adding to their own expertise in engineering, technology, hardware/software etc.

ATSEP may perform tasks on a wide variety of CNS/ATM systems and equipment requiring a wide range of competencies and expertise as well as knowledge and skills in electronics, computer sciences and network. In addition, ATSEP activities may be carried out from technician to high-level engineering. [DOC 10057].

The possible scope of ATSEP activities using engineering lifecycle as a basis, include system conception through design, operations and finally decommissioning. In addition to technical activities, others may be added related to management, teaching or assessment, safety management, security management and quality management.

A typical working environment on which ATSEP performs their tasks is depicted in the figure 3. The environment includes people, procedures, and equipment. ICAO SHELL model referred in DOC 9683 is well applicable and addresses the human factor issues of ATSEP.

Active participation and contribution of ATSEP are essential in all the stages of ANS ground facilities, right from the installation to operation. Addressing the human factor issues of ATSEP during these stages are very essential and issues related in the operation environment are incredibly significant, addressing of these issues directly contributes the safety, capacity, and efficiency of ANSP.

ATSEP are expected to perform duties with wide varying environment from high raised tower to cable trenches in the ground, extremely hot open place to temperature-controlled equipment room, remarkably busy cities to very remote places of the state.

The Aviation industry requires 24-hour activities to meet the operational demands. Global growth in the industry will continue to increase these round-the-clock requirements. Air Traffic Service must be available to support 24-hour a day operation to meet these industry demands. Pprograms for modernizing the air navigation infrastructure in both CNS and ATM are well underway around the globe. The implementation of modern technologies will bring significant benefits to

air navigation service providers and their users. At the same time, a new set of regulations are being established for the implementation and efficient operation of future CNS/ATM systems.

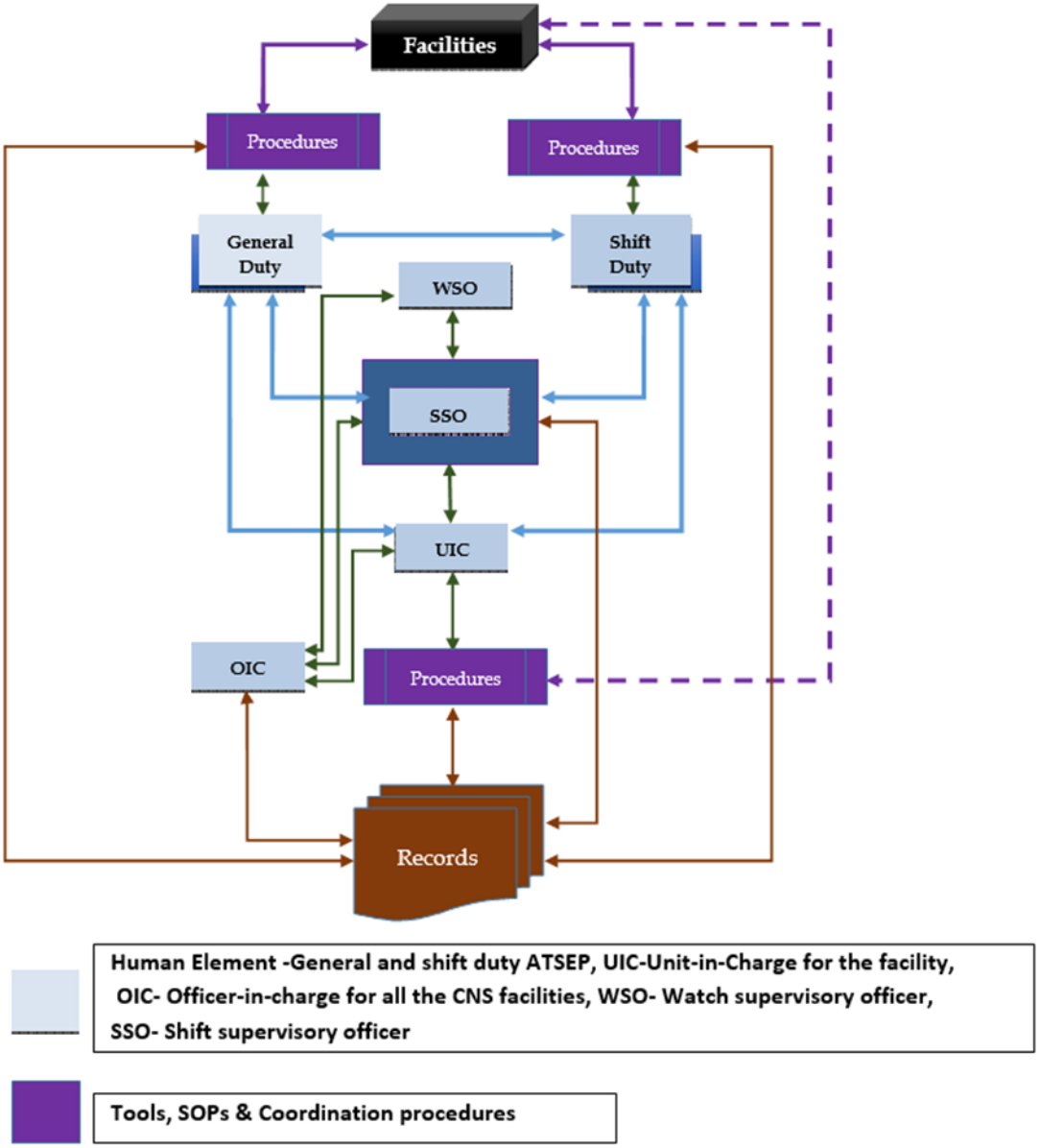


Figure 3: Typical Working Environment of ATSEP

Air Traffic Safety Electronics Personnel (ATSEP) are the authorized personnel who are proven competent to install, operate, maintain, release, and return into operations CNS/ATM equipment. It needs to ensure they have qualified and competent ATSEP to install maintain and operate, at optimum performance and resilience, these globally interconnected and complex CNS/ATM systems.

ATSEP are responsible for the provision of required communication, navigation, and surveillance performance, which are critical enablers to ensure Performance-Based Navigation (PBN) in any given airspace as stipulated by ICAO. High availability, accuracy, continuity, and resilience of these services are especially crucial factors in the aviation business. Unreliable CNS services lead to delays and increased pilot and controller workload.

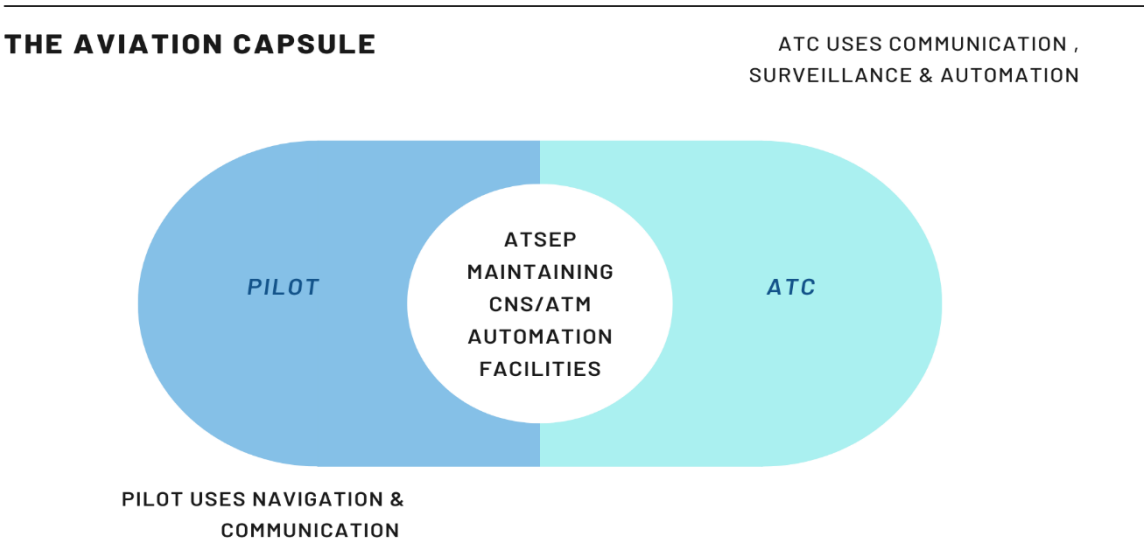


Figure 4: Aviation Capsule

Thus, the availability and continuity of ATM/CNS services impacts efficiency and increases user costs. Similarly, an ATM system failure can have major consequences. Traffic patterns of an entire flight information region can be affected with significant impact on flight schedules, increased fuel burn, and a more complex air traffic control environment.

Civil aviation is based on a worldwide interoperable system involving air and ground infrastructure, procedures, and regulations to ensure safe, efficient, and effective operations. These interconnected systems pose cybersecurity challenges in ATM. ATSEP are in the forefront of addressing cybersecurity issues as soon as they appear in these interconnected systems.

ATSEP are responsible for ensuring the integrity and availability of the information used by both pilots and ATCO. Services performed by ATSEP have been proven throughout the years as critical to ensuring safety and efficiency in the civil aviation.

ATSEP must ensure the resilience of the entire system in a standardized manner. New cybersecurity challenges in CNS/ATM (e.g., Remote Towers) ATSEP are in the forefront of addressing cybersecurity issues and threats equally in the networked ATM systems, at remote CNS facilities or for the 'signal in space.' These professionals need to be trusted, competent and responsible. Identifying a technical failure from a cybersecurity breach is a significant responsibility for ATSEP.

The ATM system is evolving towards a globally integrated and collaborative system. Air traffic safety electronics personnel (ATSEP) involved in the installation, operation and maintenance of the CNS/ATM system must have a shared understanding of what is expected of them in terms of performance wherever they may work to support a globally interoperable system and to achieve optimum capacity within acceptable safety limits. This shared understanding becomes critical when considering the increasing traffic and the growing complexity and interconnectedness of the systems involved.

1.4.1. Activities.

1.4.1.1. Operational activities.

Supervision, monitoring, control, and reporting in real time of technical services, supported by electronic systems and/or equipment for CNS/ATM.

1.4.1.2. Maintenance activities.

Preventive maintenance, corrective maintenance and/or modification and updates of supporting electronic systems and/or equipment for CNS/ATM.

1.4.1.3. Installation activities.

Project management, specification, conception, validation, integration, test and acceptance, safety assessment, calibration, certification, optimization, and upgrade of supporting electronic systems and/or equipment for CNS/ATM, engineering activities.

1.4.2. Unique characteristics of ATSEP working environment.

Operational environments, such as the flight deck or the ATC room, pilot or the controller will see the effects of the error before the aircraft completes its flight. It does not always apply to aircraft maintenance error. In contrast to the "real-time" nature of error in ATC and the flight deck, aircraft maintenance errors are often not identified at the time the error is made.

Whereas in case of ATSEP working environment, the error caused during the operation of the system will be known immediately to ATC as well as to ATSEP as they always work in the live system. At the same time any error caused during the installation, testing and commissioning stages will not be known immediately when the error is made.

ATSEP are expected to attend the degraded system live and always under pressure to make the system available in fullest capabilities. Unless otherwise there is a total breakdown, ATSEP carry their preventive and corrective maintenance works when the systems are working either in full capable mode or in degraded mode of operation. This makes their working environment unique among the safety chain stakeholders.

1.5. Outcomes and Endorsements

The International Federation of Air Traffic Safety Electronics Associations (IFATSEA) emphasized the importance to study the human factor issues of ATSEP on their working environment, abilities, limitations and on other characteristics for evaluating their job and safety performance at CNS / SG 23 in Bangkok. The meeting considered that establishment of a small working group would be necessary to support such study.

Based on the study, a report on human factors of ATSEP was presented in CNS SG/24 through web conference, and the meeting has forwarded the draft conclusion for adoption in APANPIRG/31. Consequent upon adoption in APANPIRG/31 and ICAO APAC has issued a state letter for the APAC states for encouraging them to consider the study recommendations for the implementation proactively and come forward to join the small work group for preparation of Regional ATSEP human factors guidance material.

The Ad-hoc work group of experts from Eight (8) member states (China, Hong Kong China, India, Indonesia, Japan, Republic of Korea, Singapore, and Thailand) and IFATSEA was established in April 2021 in response to the Conclusion APANPIRG/31/15-Addressing Human Factor Issues of ATSEP recommended by CNS SG/24 meeting for finding the left-out gaps and for preparing the regional ATSEP human factors guidance material.

1.6. Arrangements of this document

The regional ATSEP human factors guidance material has the following parts.

(1) Introduction,
(2) Reference Documents,
(3) People Resourcing,
(4) Job, Role and Skills Analysis and Competency Modelling,
(5) Knowledge Management, Talent Management, Learning and Development,
(6) Induction of New Systems and Maintenance Philosophy,
(7) Work Environment, Well-Being, Performance, And Reward,
(8) Motivation, Commitment, And Engagement,
(9) Behavioural and Role Specific Competencies,
(10) Safety Culture Promotion.

In addition to the above the guidance material has the following appendices

(1) Stress factor mapping (2) Stress factors, (3) Countermeasures, (4) ATSEP duty time limitation, (5) Measures during Pandemic, (6) Progressive Training, (7) Stress management, (8) Safety culture and (9) Consolidated Checklist Evaluation.

Appendix (1) Stress factor mapping document to be printed on A3 size if hard copy is preferred.

1.7. Document History and Management

This document was introduced in the CNS SG/26 meeting (5th September 2022 to 9th September 2022) for review and adoption.

1.8. Copies

Paper copies of this document are not distributed. Controlled and endorsed copies can be found at the following website: http://www.icao.int/APAC/Pages/edocs.aspx and may be freely downloaded from the website, or by emailing APANPIRG through the ICAO Asia and Pacific Regional Office who will send a copy by return email.

1.9. Changes to this document

Whenever a user identifies a need for a change to this document, a Request for Change (RFC) Form (see Section 1.11 below) should be completed and submitted to the ICAO Asia and Pacific Regional Office. The Regional Office will collate RFCs for consideration.

When an amendment has been adopted by the meeting of the CNS SG, then a latest version of the Regional ATSEP Human Factors Guidance Material will be prepared, with the changes marked by an "|" in the margin, and an endnote indicating the relevant RFC, so a reader can see the origin of the change. If the change is in a table cell, the outside edges of the table will be highlighted, e.g.:

Final approval for publication of an amendment to this will be the responsibility of APANPIRG.

1.10. Editing Conventions

(Intentionally blank).

1.11. ATSEP Human Factors Guidance Material - Request for Change Form.

Please use this form when requesting a change to any part of this **ATSEP human factors guidance material**. This form may be photocopied as required, emailed, faxed, or e-mailed to ICAO Asia and Pacific Regional Office +66 (2) 537-8199 or APAC@icao.int.

Table 2: ATSEP Human Factors Guidance Material - RFC Form

1. SUBJECT:			
2. REASON FOR CHANGE:			
3. DESCRIPTION OF PROPOSAL: [expand / attach additional pages if necessary]			
4. REFERENCE(S):			
5. PERSON INITIATING:		**DATE:**	
ORGANIZATION:			
TEL/FAX/E-MAIL:			
6. CONSULTATION	**RESPONSE DUE BY DATE:**		
Organization	**Name**	**Agree/Disagree**	**Date**
7. ACTION REQUIRED :			
8. DAPs IGD EDITOR		**DATE REC'D :**	
9. FEEDBACK PASSED		**DATE :**	

1.12. Amendment Record.

Amendment Number	Date	Amended by	Comments
0.1			

This page is intentionally left blank.

2. REFERENCE DOCUMENTS

Table 3: Reference Documents

Id	Name of the document	Edition	Date	Origin	Domain
1	Human Factors Training Manual Doc no.: 9683 - AN/950	1st Edition	1998	ICAO	
2	DOC 10057 Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment	Second Edition	2020	ICAO	
3	Doc 9868 - PROCEDURES FOR AIR NAVIGATION SERVICES – Training.	Third Edition	2020	ICAO	www.icao.int
4	Annex 19 – Safety management	Second Edition	2016	ICAO	
5	Doc 9859 - Safety Management Manual	Fourth Edition	2018	ICAO	
6	CANSO Standard of Excellence in Human Performance Management	-	2019	CANSO	
7	ATM Safety Framework Maturity Survey – Methodology for ANSPs	1st Edition	2009	Eurocontrol	
8	DAS/HUM, Fatigue and Sleep Management Personal strategies for decreasing the effects of fatigue in Air Traffic Control	-	15 Jan 2018	Eurocontrol	
9	APX. R - Factors adding stress and fatigue to ATSEP of WP 25 of CNS SG/24		04-12-2020	IFATSEA	www.icao.int
10	Concise study report of Human Factor Study of ATSEP		31-03-2021	IFATSEA	www.ifatsea.org
11	The circadian rhythm in balance				www.parans.com
12	Manipulating the sleep-wake cycle and circadian rhythms to improve clinical management of major depression			BMC Medicine	www.biomedcentral.com

Id	Name of the document	Edition	Date	Origin	Domain
13	Organizational Resilience: A summary of Academic evidence, Business insights and new thinking by BSI and Cranfield	1st Edition	2017	School of Management BSI and Cranfield University	
14	Just Culture Manual for ATCO, ANSE & ATSEP - Marc Baumgartner and Reto Schorer	1st Edition	2017	SwissATCA	
15	Benchmarking Best Practices in Maintenance, Reliability and Asset Management - Terry Wireman	Third Edition	2015	Industrial Press, Inc.	
16	Essential Guide to Knowledge Management - Shawn Marshall	First Edition	2017	Library Press	
17	Stress at Work - Management and Prevention - Jeremy Stranks	1st Edition	2005	Elsevier Butterworth-Heinemann	
18	Managing stress – Principles and Strategies for health and well-being – Brian Luke Seaward	Ninth Edition	2018	Jones & Bartlett Learning	
19	Human Resource Management - ROBERT L. MATHIS and JOHN H. JACKSON	13th Edition	2010	Cengage Learning.	
20	Fundamentals of Human Resource Management - DAVID A. DeCENZO, STEPHEN P. ROBBINS, SUSAN L. VERHULST	11th Edition	2013	John Wiley & Sons, Inc.	
21	Armstrong's Handbook of Human Resource Management Practice - MICHAEL ARMSTRONG and STEPHEN TAYLOR	13th Edition	2014	Koganpage	
22	People Resourcing and talent planning - STEPHEN PILBEAM and MARJORIE CORBRIDGE	Fourth Edition	2010	Pearson Education Limited	



CHAPTER 3
PEOPLE RESOURCING

This chapter discusses the importance of people resourcing in strategic human resource management for organizations, specifically in the context of Air Navigation Service Providers (ANSP) and Air Traffic Safety Electronics Personnel (ATSEP).

THE OBJECTIVE

The benefits of effective people resourcing for ANSPs and ATSEPs include optimal human resource requirements, competitive advantage, reduced tension and exhaustion, and positive psychological contracts.

The actions taken by ANSPs and ATSEPs to achieve strategic people resourcing include workforce planning, recruitment and selection, and talent management.

The most influential countermeasures for people resourcing include regular optimization of human resources and assessing optimal manpower requirements.

"It is people that control aircraft, it is people that maintain equipment and it is people that create safety."

- Human Performance Management - CANSO.

3. PEOPLE RESOURCING

3.1. Introduction

Through people resourcing, human resource management (HRM) objectives are strategically incorporated with organisational performance. Through effective people resourcing, an organisation may attract and retain the right number of individuals who are qualified, motivated, and engaged in adding value to the organisation and its stakeholders.

3.2. Benefits to ANSP

Optimum human resource requirements are worked out through workforce planning based on the projected changes in the types of activities carried out by the ANSP and the scale of those activities. Examples – New CNS/ATM projects, new airports, new runway, increased operational hours and additional facilities in the existing airport.

Ensures that ANSP achieves competitive advantage by recruiting, retaining, and developing more capable people and retains the talent by providing better opportunities, rewards, and conditions of employment. Even though all the systems are made human centric, the rapid growth and usage of technology impacts the air traffic to greater extent, leads to considerable monetary loss, damage to the reputations of ANSP and safety issues during technical snags. Examples – FIR / ACC closures, diversions, delays, and cancellations.

Matching human resources to the ANSP's culture, strategic goals, and operational needs ensures optimal use of those resources. When the recruiting and retention of talent are ensured throughout time, ANSP develops a brand value and draws talent from the market using the retained talents.

3.3. Benefits to ATSEP

Strategic people resourcing results in reduced tension and exhaustion owing to a sustainable workload and adequate breaks. ATSEP can share responsibilities more effectively with teammates who are equally competitive and efficient. Positive psychological contract results in greater commitment, trust, and engagement between parties. A healthier workplace environment also results in longer, more enjoyable family time.

3.4. Actions by ANSP

Strategic resourcing: It is concerned not only with obtaining and keeping the number and quality of staff required but also with selecting and promoting people who ‘fit’ the culture and the strategic requirements of the organization. It also deals with ensuring full utilization of those resources.

Workforce planning: This process identifies anticipated changes to the scope and nature of the organization's activities. It defines the essential skills and behaviours that the company needs to accomplish its objectives.

Recruitment and selection - it deals with finding and engaging the right people for the organization needs.

Talent Management - The process of ensuring that an organization has the talented people it requires to achieve its safety goals is known as talent management. It entails creating and maintaining a talent pipeline to strategically manage the flow of talent through an organization.

3.5. Actions by ATSEP

Understanding the culture and strategic requirements of the organisation aids ATSEP in increasing engagement and commitment to create mutual trust and the psychological contract. They add unique value to the organisation through their talent and skills.

3.6. Most Influential Countermeasures

The stress and fatigue levels of ATSEP can be reduced and safety goals can be met with regular optimum augmentation of human resources based on existing tasks, expected retirements, and expected additional facilities.

Assessing optimal manpower requirements, recruiting competent people, training, deploying, and promoting accordingly.

3.7. Human Factors Issues Addressed

3.7.1. Directly Addressed Factors

The following factors are addressed directly by the process of people resourcing i.e., by provisioning the optimum human resources all the time.

1	Approval of projects without looking into the resource's requirements like human, vehicles, and other support. Workload increases on coordinating for essential supporting resources and prevents the concentration on core project activities as well as to skip the maintenance activities of ongoing operational facilities.
2	Combined project and operational tasks.
3	Continuous works including weekends during the demanding situations for meeting the special maintenance and project works along with routine operational works.
4	Extra shift duties are forced due to shortage of manpower
5	Forced to carryout major maintenance works only during late night and need to return to duty next day by 0930AM.
6	Frequent changes in the team members or team lead prevents better teamwork and communications.
7	Improper and unbalanced work distribution with undue over burden and undue over leniency.
8	Inhibition of valuable suggestions and ideas due to the overload of works.
9	Innumerable, unspecified, and unpredicted works assigned to selected ATSEP preventing their attention from core maintenance tasks.
10	Irregular duty calls without any pattern due to shortage of manpower
11	Lack of competitive colleagues. People with substandard knowledge and skills are getting selected.
12	Lack of fresh recruitments, but more retirements and induction of new equipment.
13	Lack of job rotation and equal opportunities.
14	Lack of pride as not recognized as expert in particular field and transferred anywhere without considering the competencies acquired.

15	Lack of project management skills and competencies at the same time, simultaneous operation and projects tasks given with unrealistic timelines.
16	Lack of support on career development and career plan.
17	Lack of time to family
18	Leave requests not approved
19	Must report again by 0930AM even after late night breakdown calls and late-night project works.
20	No alternate/standby operational team to share the workload even at emergency.
21	No clear OFFs before shift pattern changes
22	No standardized duty pattern, duration, breaks and rest periods
23	Non-deployment of competent persons in right place after equipment training.
24	Permanent combined duties due to shortage of manpower increases workload and reduces the attention in all the combined units.
25	Selection criteria for inducting various levels of ATSEP for ensuring more competent people recruited in the higher levels.
26	Simultaneous project supervision and maintenance activities without additional manpower.
27	Single man shift.
28	Too many additional facilities added into ANSP like RADARS, CNS/ATM automation facilities, Nav-Aids at new airports and new RWYs in the last decade, without augmenting the human and other resources.

3.7.2. Indirectly Addressed Factors

The following factors are addressed indirectly by the process of people resourcing i.e., by provisioning the optimum human resources all the time.

1	Acceptance of inefficient manpower by management without any mitigation.
2	Additional tasks assigned by regional and or corporate head quarter in addition to local airport works. (QR preparation, tender evaluation, course development, etc..,)
3	Annual plan for ATSEP training and development in line with the operational and competency requirements.
4	Expected competencies in all domains of CNS/ATM systems.
5	Difference in stated corporate Mission/Vision and the ground reality.
6	Lack of equipment training even after years of deployment in the unit.
7	Lack of KS and Competency to manage complex modern equipment.
8	Lack of opportunity for developing and or retaining core competencies due to deployment in non-core areas for a prolonged period before and after equipment training.
9	Lack of opportunity to develop expertise on networking, operating systems, cyber security, project management etc. due to lack of in-house expertise instructors and training infrastructure.
10	No clear demarcation of competencies so spending more time on KSC update on all areas without even having the access to the equipment and facilities. (Too many make and models)
11	No clear demarcation of technical and managerial responsibilities among the junior ATSEP and senior ATSEP.
12	Sleep loss due to irregular shift pattern or fast rotating shift pattern

13	Too many unclassified additional works in smaller airports. Essential maintenance tasks skipped.
14	Uncertainty on future roles and responsibilities.

3.7.3. Additional Factors Addressed

The following additional factors that are addressed, which are aggravating stress and fatigue when the workload is more, and the human resources are less.

1	Different make and model for each facility / system.
2	Deployment in non-core activities for longer duration.
3	Compulsory movements within the nation during service life
4	Less human resources for core jobs but deployment in non-core areas like terminal management, security systems, airport systems, administration works, commercial, and general stores.
5	Manhours spent in Cargo, Customs clearance, without proper expertise or supporting staff instead of spending time on critical maintenance works and project works.
6	Multiple jobs of diversified nature in quick successions without notice or planning.
7	Often project deadlines are set without freezing the scopes and augmenting with necessary resources.
8	Where there is electronics, there shall be an ATSEP – Belief of airport in-charges.

3.8. Self-Evaluation Checklist

3.8.1. Self-Evaluation Checklist for ANSP

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – PEOPLE RESOURCING

##	Process	Maturity level	Description of the maturity level	Tick
1)	Strategic people resourcing for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to over workload and due to lack of human resources	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)		Level A		

	Strategic people resourcing for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to over workload and due to lack of human resources	Level B	
		Level C	
		Level D	
		Level E	
3)	Strategic people resourcing for addressing the factors that are **aggravating** stress and fatigue when the workload is more, and human resources are less	Level A	
		Level B	
		Level C	
		Level D	
		Level E	
4)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation	
5)	**If maturity level is D** w.r.t score of (1)		
	Do you have workforce planning based on projected changes?		Y/N
	Did you recruit people as per the workforce planning?		Y/N
	Did you provide better opportunities and better working conditions to your people?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.		
6)	**If maturity level is E** w.r.t score of (1)		
	Did you revise the workforce planning in the last two years?		Y/N
	Did you revise the recruitment process to suit the safety and service strategy?		Y/N
	Are you able to get more competitive people successively from the market?		Y/N
	Have you set the key performing indicators for measuring the above?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate		
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP			

3.8.2. Self-Evaluation Checklist for ATSEP

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – PEOPLE RESOURCING					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood the strategic requirements of my ANSP?			Y/N
	B	I have psychological contract with ANSP, that has built the mutual trust, increased commitment, and engagement.			Y/N
	C	I have improvised my unique talent and skills and adding values to my ANSP			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

3.9. Resilience and Cost Benefits

These actions incur negligible additional costs because only process improvement is required in the already established human resource management system.

In contrast, the organisation will save money overall for the following reasons: (1) optimum human resources are made available only in accordance with their safety and service strategy, and they are fully utilised on the core areas. (2) Ensures competitive advantage by developing and retaining safety-critical talent. (3) With increased employee commitment, the organisation transforms into a high-performing one.

In terms of organizational resilience, ANSP can reach the level of adaptive innovation.



CHAPTER 4
JOB,ROLE,SKILLS ANALYSIS & COMPETENCY MODELLING

This chapter discusses the importance of job, role, skill, and competency modelling in organizational and job design, recruitment and selection, performance management, learning and development, management development, career management, job evaluation, and the design of grade and pay structures. It also outlines the benefits of implementing a performance management system that includes clearly defined key result areas, accountability, and expected outcomes.

THE OBJECTIVE

The actions that ANSP and ATSEP can take to improve job performance and safety are discussed, including defining roles and responsibilities, understanding key result areas, and competency requirements, and developing the necessary knowledge and skills. The most influential countermeasures are identified as defining roles and responsibilities, limiting the stream of competency among CNS/ATM facilities, and restricting the deployment of ATSEP within the scope defined in DOC 10057.

"The ATM system is evolving towards a globally integrated and collaborative system. Air traffic safety electronics personnel (ATSEP) involved in the installation, operation and maintenance of the communication, navigation, surveillance/air traffic management (CNS/ATM) system must have a shared understanding of what is expected of them in terms of performance wherever they may work to support a globally interoperable system and to achieve optimum capacity within acceptable safety limits."

DOC 10057 -MANUAL ON ATSEP COMPETENCY BASED TRAINING & ASSESSMENT

4. JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING

4.1. Introduction

The analysis of job, role, skill, and competency modelling provides the information needed to create job descriptions, roles and learning requirements. They are critical in organisational and job design, recruitment and selection, performance management, learning and development, management development, career management, job evaluation, and the design of grade and pay structures.

4.2. Benefits to ANSP

A robust performance management system with clearly defined key result areas, accountability, and expected outcomes help in effectively grooming the key workforce with clearly defined learning specifications and personal specifications, which in turn results in lower costs as only necessary training investments are made.

Individuals and teams perform better because both behavioural and functional competencies are well defined. Job design, recruitment and selection, performance management, learning and development, management development, career management, job evaluation, and grade and pay structure design are all done in accordance with the organization's safety and service strategy.

4.3. Benefits to ATSEP

Reduced stress due to unambiguous job profile, clear communication on accountabilities and expected outcome.

Defined key result areas facilitate the motivation towards knowledge and skills update to achieve an acceptable level of performance. Defined behavioural competencies expectations facilitate the motivation in improving the behavioural competencies.

4.4. Actions by ANSP

Job descriptions based on job analysis - Job analysis gives the information on what the job holder is expected to contribute, to whom the job holder reports and who reports to the job holder, the nature and scope of the job in terms of the tasks and operations to be performed and the duties to be carried out. The job description includes the job title, the function in which the job is performed, and the job level within that function. Based on the job analysis, the job description also includes the main activities, tasks, or duties. Job descriptions are extremely specific, giving a clear indication of what must be done, what is done, and the purpose of the activity in terms of outcomes, outputs, or standards to be met.

Role analysis and role profile - identifying inputs – KSAs (knowledge, skill, and attitude), competency requirements (behavioural and functional) and required outcomes (key result areas or accountabilities). A role profile is initially set out under the same headings as a job description, i.e., role title, responsible to, responsible to role holder, and the purpose of the role, but it then focuses on the following aspects of the role: key result areas; knowledge, skills and abilities required; behavioural competencies.

Competency modelling based on skill analysis and job analysis - Skills analysis determines the skills required to achieve an acceptable standard of performance. It is primarily used for

technical, craft, manual, and office jobs as the foundation for developing learning and training programmes. Skills analysis begins with a broad job analysis and then delves into the specifics of not only what job holders must do, but also the abilities and skills required to do so. Individual-level competencies that are core or common for an occupational group, entire level of jobs (e.g., executive, management, supervisory, hourly), or the organisation are typically described by competency modelling approaches. Competency modelling is the basis for defining behavioural and technical competencies. Behavioural competencies are the behaviours that organisations expect their employees to exhibit in the course of their work.

4.5. Actions by ATSEP

Understanding the key result areas, and accountabilities for their roles. Understanding the knowledge, skill, and competency requirements for their roles. Developing the knowledge and skills needed to achieve an acceptable level of performance.

4.6. Most Influential Countermeasures

By defining the roles and responsibilities clearly along with accountabilities, individual job performance of ATSEP will increase and in-turn over all safety performance of ANSP will also increase.

Improving the safety job performance of ATSEP by restricting their deployment within the scope defined in DOC 10057.

By limiting their stream of competency among CNS/ATM facilities, higher levels of expertise and competencies can be developed and retained.

4.7. Human Factors Issues Addressed

4.7.1. Directly Addressed Factors

1	Acceptance of inefficient manpower by management without any mitigation.
2	Annual plan for ATSEP training and development in line with the operational and competency requirements.
3	ATSEP desire for recognition on all the facilities (CNS/ATM Automation) and on different makes and models.
4	Combined project and operational tasks.
5	Deployment in non-core activities for longer duration.
6	Diversified tasks during duty.
7	Expected competencies in all domains of CNS/ATM systems.
8	Forced to do tasks even without qualification (attending power lines of UPS and working at heights etc..,)
9	Gender bias and equal field works not assigned to women ATSEP.
10	Improper and unbalanced work distribution with undue over burden and undue over leniency.
11	Innumerable, unspecified, and unpredicted works assigned to selected ATSEP preventing their attention from core maintenance tasks.
12	Lack of delegation or poor overlapping delegation and preferences towards frontline tasks not on managerial or leadership tasks.
13	Lack of leadership in communicating the priorities to sub-ordinates.
14	Lack of mutual performance assessment as per the roles and responsibilities assigned.

15	Lack of opportunity for developing and or retaining core competencies due to deployment in non-core areas for a prolonged period before and after equipment training.
16	Lack of opportunity to develop expertise on networking, operating systems, cyber security, project management etc. due to lack of in-house expertise instructors and training infrastructure.
17	Lack of pride as not recognized as expert in particular field and transferred anywhere without considering the competencies acquired.
18	Lack of regulatory requirements for complying standardized trainings and licencing to ATSEP
19	Lack of scientific annual performance assessment and rewarding scheme considering the unique working environment and expected level of performance of ATSEP.
20	Lack of teamwork, more dependency on individuals and collective inputs not taken by team lead for decision.
21	Less human resources for core jobs but deployment in non-core areas like terminal management, security systems, airport systems, administration works, commercial, and general stores.
22	Manhours spent in Cargo, Customs clearance, without proper expertise or supporting staff instead of spending time on critical maintenance works and project works.
23	Multiple jobs of diversified nature in quick successions without notice or planning.
24	No clear demarcation of competencies so spending more time on KSC update on all areas without even having the access to the equipment and facilities. (Too many make and models)
25	No clear demarcation of technical and managerial responsibilities among the junior ATSEP and senior ATSEP.
26	No clear job description, roles and responsibilities are varying after each movement, deployed at non-core areas.
27	Non deployment of competent persons in right place after equipment training.
28	Poor workload distribution makes few carries stress, pressure, fatigue, and timeline pressure throughout without any relief.
29	Uncertainty on future roles and responsibilities.
30	Where there is electronics, there shall be an ATSEP – Belief of airport in-charges.

4.7.2. Indirectly Addressed Factors

1	Always under pressure to give back the facilities within the EST of NOTAM
2	Compromising qualities, essential OEM documentations, training and after acquisition supports on new systems against the cost (L1).
3	Compulsory movements within the nation during service life
4	Constant mind switchover between old and modern technologies, procedures, tools etc.., within the same service facilities. Different aged, make and model of equipment within a single service facility like VHF, Nav-Aids, and surveillance.
5	Delayed annual and other planned preventive and corrective maintenance due to non-availability of time for maintenance actions.
6	Delayed flight calibration due to poor preparation and planning.
7	Difference in stated corporate Mission/Vision and the ground reality.
8	Different make and model for each facility / system.
9	Expectations on making quick decision, in less reactive time with zero error tolerance and on fixing the system immediately.

10	Extraordinary file work delays in getting approvals for proceeding to next stages.
11	Lack of equipment training even after years of deployment in the unit.
12	Lack of fresh recruitments, but more retirements and induction of new equipment.
13	Lack of job rotation.
14	Lack of knowledge and expert support while trying to fix an unfamiliar technical glitch.
15	Lack of knowledge in handling emergencies and disastrous situations.
16	Lack of KS and Competency to manage complex modern equipment.
17	Lack of support on career development and career plan.
18	Little or no-hands on training
19	Managing the procurement tasks and maintenance tasks of multiple airports in addition to the local.
20	Single man shift.

4.8. Self-Evaluation Checklist

4.8.1. Self-Evaluation Checklist for ANSP

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING

##	Process	Maturity level	Description of the maturity level	Tick
1)	Job, role and skills analysis and competency modelling for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to ambiguities on accountabilities and responsibilities.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria.	
2)	Job, role and skills analysis and competency modelling for **indirectly**	Level A		
		Level B		
		Level C		

	addressing the factors that are adding stress and fatigue to ATSEP due to ambiguities on accountabilities and responsibilities.	Level D	
		Level E	
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation	
4)	**If maturity level is D** w.r.t score of (1)		
	Do you have clear job description?		Y/N
	Did you have clear role profile?		Y/N
	Do you have competency modelling of both behavioural and functional competencies?		Y/N
	Do you have annual training plan prepared based on the role profiles of ATSEP?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.		
5)	**If maturity level is E** w.r.t score of (1)		
	Have you done the job evaluation of your ATSEP job role profiles in the last two years?		Y/N
	Have you recruited new ATSEP based on the outcome of this process?		Y/N
	Is ATSEP performance management system designed as per the outcome of this process?		Y/N
	Have you set the key performing indicators for measuring the above?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate		
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP			

4.8.2. Self-Evaluation Checklist for ATSEP

Human performance management processes maturity level
Self-Evaluation Check list for ATSEP – JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING

##		Process	Maturity level	Description of the maturity level	Tick
1)	A	I have understood the key result areas and accountabilities of my role			Y/N
	B	I have understood the knowledge, skill, and competency requirements for my role			Y/N
	C	I have developed the knowledge and skills needed to achieve an acceptable level of performance			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

4.9. Resilience and Cost Benefits

These actions incur negligible additional costs because only process improvement is required in the already established human resource management system.

However, the organisation will save money on training investments and developing key personnel in accordance with learning specifications and personal specifications. Evaluations of the outcome in key areas for which recruitment was done are made using efficient performance management systems. Organizations transform into high-performing organisations by developing the key workforce's behavioural and functional competencies.



CHAPTER 5
KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT

This chapter discusses the benefits of knowledge management, talent management, and learning and development for an organization, particularly an Air Navigation Service Provider (ANSP), as well as the actions that ANSP and Air Traffic Safety Electronics Personnel (ATSEP) can take to improve their knowledge and skills.

THE OBJECTIVE

ANSP can establish a knowledge management system, create talent planning and resourcing plans, integrate learning and development programs with safety and service strategy, and design performance-related learning programs.

Meanwhile, ATSEP can invest time in knowledge update, organize and share unique knowledge, engage in self-directed learning, develop leadership and management skills, and prepare to assume higher responsibilities.

The most effective countermeasures for ATSEP are thought to be the provision of only verified and validated SOPs as well as ANSP level scientific knowledge management on operations, maintenance, projects, and emergencies.

"Human factors (HF) encompass knowledge from a range of scientific disciplines that support human performance (HP) through the design and evaluation of equipment, environments and work, in order to improve system performance."

DOC 10151 -MANUAL ON HUMAN PERFORMANCE

5. KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT

5.1. Introduction

Knowledge management - Knowledge management is concerned with storing and sharing the wisdom, understanding and expertise accumulated in an enterprise about its processes, techniques, and operations. It treats knowledge as a key resource. Knowledge management is about getting knowledge from those who have it to those who need it to improve organizational effectiveness. Knowledge management identifies relevant information and then disseminates it so that learning can take place. It promotes the sharing of knowledge by linking people with people and by linking them to information so that they learn from recorded experiences.

Talent management - Talent management contains strategies and protocols for the systematic attraction, identification, development, retention, and deployment of individuals with high potential who are of value to an organization. Talent management is the process of ensuring that an organization has the talented people it requires to achieve its safety and service objectives.

Leaning and Development - Learning and development strategies and practices, aim to ensure that people in the organization acquire and develop the knowledge, skills, and competencies they need to carry out their work effectively and advance their careers to their own benefit and that of the organization. Individuals are given the opportunity to learn, frequently on their own, with guidance and support.

5.2. Benefits to ANSP

Cost benefits due to early completion of the task, even problematic tasks are solved early. Efficient utilization of man-hours and environment for innovation and organizational learning. Managed intellectual capitals in the organization. Increased organization performance due to established shared understanding.

Cost benefits on hiring and developing. Provides means for developing the organization from within by using job experience, coaching, and mentoring to cultivate the potential in managers. Ensures the availability of talents it needs to attain its safety and service goals. Provides the organization a long-term recruiting strategy and valuable human capital. Strategically implemented talent management ensures systematic attraction of talent, identification, development, retention, and deployment of individuals with high potential who are of value to an organization.

Organization can deliver the safety and service objective cost effectively due to the availability of human resource having the required competencies. Overall improved performance due to the mechanism that ensures the improvement of individuals as well as teams. Effective utilization of resources in learning and development through self-managed learnings.

5.3. Benefits to ATSEP

Reduced stress and frustration due to readily available knowledge and expertise. Reduced stress and increased self-efficacy, optimism, hope, and resiliency.

Reduces stress caused by a lack of knowledge, skills, and competencies by ensuring continuous improvement in skills and competencies through various trainings to distinct levels of executives.

It reduces the ambiguity among ATSEP on their career and motivates them to progress in developing the competencies and qualities that are required for the career progression. Talented people remain engaged and be committed members of the organization as they are aware of the opportunities for career development and growth.

Feeling of accomplishment for educated graduate recruits who are given education and training for core technical or professional roles.

Gaps in the knowledge, skills and competencies is addressed through systematic workplace learning and planned experience. Reduced stress due to lack of knowledge, skills, and competencies, through various means of L & D, the gaps can be filled through self-directed learning. Motivated to improve their leadership and management skills toward the career progression. Motivated to assume higher responsibilities as they are developed with appropriate workplace learning and planned experience.

5.4. Actions by ANSP

Establishing ANSP level knowledge management system.

Talent planning - the process of determining how many and what types of talented individuals are required now and in the future. It employs workforce planning techniques.

Talent resourcing plans - the outcomes of talent planning are programmes for obtaining people from within and outside the organization (internal and external resourcing). Internally they involve the identification of talent, and their development and career management. Externally, they refer to the implementation of policies aimed at attracting high-quality workers.

Talent development - learning and development policies and programmes are key components of talent management. They aim to ensure that people acquire and enhance the skills and competencies they need. Policies should be formulated by reference to 'employee success profiles,' which are described in terms of competencies and define the qualities that need to be developed.

The talent pipeline – the processes of resourcing, talent development and career planning that maintain the flow of talent needed to create the talent pool required by the organization.

Integrate learning and development plans and programs with the safety and service strategy and human resource strategy. Designing the learning and development programs as performance related, to achieve specified improvements in corporate, functional, team and individual performance and make a major contribution to bottom-line results. Framework for individual learning through self-managed learning and are supported by coaching, mentoring and formal training. Ensuring the blend of learning through workplace learning and planned experience so that required knowledge, skills and competencies are addressed without gaps.

5.5. Actions by ATSEP

Making use of the opportunities given for learning and developing the skills and competencies. Investing time on knowledge update in the required areas. Discussing with the senior colleagues and clarifying the doubts.

Organizing the unique knowledge gathered. Sharing the unique knowledge to others. Contributing for the knowledge management.

Self-directed learning to improve performance in their present job or to develop their potential and satisfy their career aspirations. Develop leadership skills as well as management skills to progress in the career. Prepare to assume higher responsibilities through workplace learning and planned experience.

5.6. Most Influential Countermeasures

By providing only optimum number of verified and validated SOPs without redundancy, the stress of restoring facilities in brief time, will reduce significantly.

ANSP level scientific knowledge management on operations, maintenance, projects, and emergencies will reduce the stress significantly as ATSEP are continuously learning the latest problems and solutions and be ready with the proven techniques.

5.7. Human Factors Issues Addressed

5.7.1. Directly Addressed Factors

1	Different make and model for each facility / system.
2	Frequent failures of OFC and leased lines connectivity. Non-availability of near perfect cable or line diagrams for optical fibre cable and power lines in the operational area.
3	Impact of changes not communicated, and individuals are reluctant to adopt.
4	Improper Complaint reporting mechanism by user, which do not convey the key information required for the early rectification of the equipment.
5	Improper training (Training, assessing and evaluation) for the required competencies. There is a gap in the training provided and the practical work environment.
6	In compatible interfaces and data formats among different makes and models for integration and extending the data and voice to other ACC or APP airports.
7	Inaccurate procedures, lack of tested and validated SOPs leads to corrective maintenance delays.
8	Lack of brainstorming on handling unfamiliar situation and regular interactions for knowledge sharing.
9	Lack of document control and missing acknowledgement on new update on regulations and operational procedures.
10	Lack of effective annual spare and capital procurement plan and related budget provisions.
11	Lack of effective coordination procedures for men material movements inside the operational areas of private operator owned airports.
12	Lack of external training, workshops, and seminars to keeping up-to-date knowledge on modern technology and systems well before the systems getting inducted.
13	Lack of knowledge and expert support while trying to fix an unfamiliar technical glitch.
14	Lack of knowledge in handling emergencies and disastrous situations.
15	Lack of knowledge on critical maintenance aspects of the equipment outsourced.
16	Lack of knowledge sharing on latest developments in local airport level and in ANSP level to frontline ATSEP.
17	Lack of KS and Competency to manage complex modern equipment.
18	Lack of operational training to develop competency on the old generation equipment even after service life expansion program in place.
19	Lack of opportunity to develop expertise on networking, operating systems, cyber security, project management etc. due to lack of in-house expertise instructors and training infrastructure.

20	Lack of self-learning tools
21	Lack of teamwork, more dependency on individuals and collective inputs not taken by team lead for decision.
22	Lack of training and documentation increases workload and time.
23	Lack of update in the maintenance procedures, operating procedures, and maintenance philosophies in line with the technologies.
24	Mismatching in course development that does not make the ATSEP competent enough to address the practical field issues.
25	No clear demarcation of competencies so spending more time on KSC update on all areas without even having the access to the equipment and facilities. (Too many make and models)
26	Poor OEM documentation on system, diagnostic procedures, site adaptable parameters and on HMI.
27	Procedural delays and extended file works on spare procurements.
28	Requirement of diversified expertise (Cyber security, Information technology, interface devices, data convertors, communication lines and links) other than core equipment for maintaining the service level.
29	Short of ideas; being alone.
30	Sudden failures of the systems due to natural calamities and power supply issues.
31	Unable to resolve external interference problems and other typical problems not covered in the training.

5.7.2. Indirectly Addressed Factors

1	Additional tasks assigned by regional and or corporate head quarter in addition to local airport works. (QR preparation, tender evaluation, course development, etc..,)
2	Always under pressure to give back the facilities within the EST of NOTAM
3	Project management.
4	Contract management.
5	Fear on consequences of failure while trouble shooting in live system.
6	Inadequate first-hand information given by user.
7	Constant mind switchover between old and modern technologies, procedures, tools etc.., within the same service facilities. Different aged, make and model of equipment within a single service facility like VHF, Nav-Aids, and surveillance.
8	Expectations on making quick decision, in less reactive time with zero error tolerance and on fixing the system immediately.
9	Extraordinary file work delays in getting approvals for proceeding to next stages.
10	Forced to do tasks even without qualification (attending power lines of UPS and working at heights etc..,)
11	Frequent failures and outages of out-lived equipment and facilities.
12	Lack of guidelines and provisions of PPE to ATSEP for protecting them while working at highly polluted with noise and dust, heights, closer to high power radiating radars, X-rays, etc..,
13	Lack of opportunity for developing and or retaining core competencies due to deployment in non-core areas for a prolonged period before and after equipment training.
14	Lack of project management skills and competencies at the same time, simultaneous operation and projects tasks given with unrealistic timelines.
15	Lack of protection and guidelines while attending equipment during heavy lightning and abnormal weather conditions.

16	Little or no-hands on training
17	Manhours spent in Cargo, Customs clearance, without proper expertise or supporting staff instead of spending time on critical maintenance works and project works.
18	Repairing critical modules of the facilities that are under NOTAM
19	Sense of expectation on out-lived equipment failures even while conducting preventive maintenance.
20	Trouble shooting in busy working environment on live interconnected systems.
21	Unrealistic timelines due to poor planning and coordination with ATCOs before making maintenance activities.
22	User requirements defined not met with the supplied system.

5.8. Self-Evaluation Checklist

5.8.1. Self-Evaluation Checklist for ANSP

Human performance management processes maturity level Self-Evaluation Check list for ANSP – KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT				
##	**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	Knowledge management, talent management, learning and development for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria.	

2)	**Knowledge management, talent management, learning and development for indirectly addressing the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.**	**Level A**	
		Level B	
		Level C	
		Level D	
		Level E	
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation	
4)	**If maturity level is D** w.r.t score of (1)		
	Have you established organizational knowledge management?		Y/N
	Have you managed talent management to match with the strategic people resourcing?		Y/N
	Have you established learning and development system for individuals as well as teams?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.		
5)	**If maturity level is E** w.r.t score of (1)		
	Did you bring new knowledges in the knowledge management in the last year?		Y/N
	Did you bring any changes in the talent planning to suit the safety and service strategy in last two years?		Y/N
	Did you evaluate the effectiveness of the learning and development process in last year?		Y/N
	Have you set the key performing indicators for measuring the above?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate		
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP			

5.8.2. Self-Evaluation Checklist for ATSEP

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood the opportunities for my career development and growth.			Y/N
	B	I know the provisions for developing myself to core technical or professional roles			Y/N
	C	I have developed the leadership and management skills toward the career progression			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

5.9. Resilience and Cost Benefits

These actions have a negligible budgetary impact on the ANSP, which has well-established information technology and training infrastructure. Initial man-hours spent designing systems with available infrastructure will yield exceptionally good long-term results. These efforts will reduce the costs of corrective maintenance and lost opportunities during breakdowns. It also reduces the time required for all tasks, saving money in terms of man-hours. Long-term strategies and valuable human capital benefit ANSP.

5.10. Other Countermeasures

By ensuring necessary OEM documentation and support on spare that suits the maintenance philosophies of the ANSP, overall effectiveness of corrective maintenance will improve.

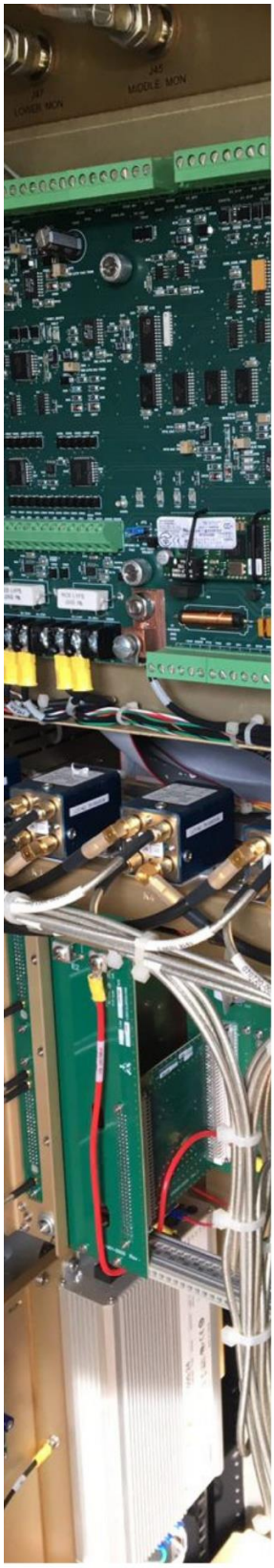
Provisioning online based self-learning tools.

Conducting seminar on best practices adopted at different airports within ANSP.

5.11. Relevant Appendix

To understand the available ICAO framework, adoption hurdles, and how to overcome those roadblocks, please refer to Appendix 6 - Progressive Training.

This page is intentionally left blank



CHAPTER 6
INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY

This chapter emphasizes how strategic maintenance of CNS/ATM facilities can help ANSPs to generate more revenue through adaptive innovation and optimal usage of resources.

THE OBJECTIVE

Benefits include improved stakeholder relations, reduced reactive maintenance costs, and predictive maintenance capabilities.

ANSPs should implement an integrated best practice maintenance strategy that includes preventive, predictive, and reliability-centred maintenance, among other practices.

ATSEP should plan and undertake maintenance tasks, maintain records, and propose new procedures. The most influential countermeasures are reviewing maintenance philosophies, utilizing technologies, and implementing proactive procurement and replacement policies.

"Within a complex system, it is the human contribution that often provides the important safety barriers and source of recovery."

DOC 10151 -MANUAL ON HUMAN PERFORMANCE

6. INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY

6.1. Introduction

Strategic maintenance increases profits of ANSP by increasing the availability of all the CNS/ATM facilities in fullest functional capabilities for which they are designed. Maintenance strategies with adaptive innovation also contributes to overall reduction of costs through optimum usage of men, materials, contracts, and energy.

6.2. Benefits to ANSP

Ensures trust relations with all the stakeholders, especially outside ANSP. Effective preventive maintenance reduces the costs due to reactive maintenance even reducing their occurrences. Strategic maintenance reduces costs due to optimum spares on inventory. ANSP has data for financial optimization decisions like whether to repair in-house or repair or replace. ANSP has the significant capability of increasing the service life of the equipment which directly adds to the cost benefits of ANSP. ANSP will be able to establish the system for predictive maintenance to prevent reactive maintenance.

6.3. Benefits to ATSEP

Feel recognized as key role player in the organization and motivated to develop knowledge, skills, and competencies to meet the performance requirements. Reduced stress due to availability of documentation from original equipment manufacturers for additional references and improvisation. Get better coordination results from the stakeholders on carrying planned maintenance.

6.4. Actions by ANSP

The maintenance strategy shall drive the ANSP for an integrated best practice that includes preventive maintenance, inventory and procurement, workflow and controls, computerized maintenance management system usage, stakeholders' involvement, predictive maintenance, reliability centred maintenance and total productive maintenance.

The preventive maintenance (PM) program is the key to any attempt to improve the maintenance process. This program reduces the amount of reactive maintenance to a level that allows the other practices in the maintenance process to be effective. Effective preventive maintenance reduces the costs due to reactive maintenances even reducing their occurrences.

Proactive measures before the induction of new systems to ensure the resources and competencies are made available before the installation of new systems. Involving the filed level experts in the major system procurements from the preparations of the specifications preparations till commissioning including factory acceptance, site acceptance, and OEM document verifications.

Ensuring the OEM documentation on recommended maintenance procedures and detailed technical and operation manuals in line with the maintenance philosophies of the ANSP. Before the ANSP progress to next level of process improvisation, the initial preventive maintenance begins only with the OEM documentation. Any gap in this will severely impact the fundamental resilience of the ANSP that is preventative control. Most important resilience level is to keep all

the stakeholders outside the ANSP trust. Also, ANSP will fail to meet the regulatory requirements.

Ensuring required tools, knowledge, skills, and competencies are available with the field level ATSEP for carrying out the maintenance effectively.

All the maintenance activities should be documented for traceability from initiation to completion. This documentation helps in the effective planning and scheduling of future proactive maintenance schedules. Computerization of these data flow will help the ANSP for processing and analysing for process improvisation. Computerized data analysis that includes downtime, maintenance cost, duration of the degraded mode of operations, etc., will guide to financial optimization to decide whether to repair or replace the system. This will also give ANSP the key data for the service life expansion program.

Established stakeholders' agreement on owning the maintenance activities as a common task and all planned activities are carried out in time to save cost on reactive maintenance tasks. The entire stakeholders should be aware of the system capability, performance, and the importance of maintenance activities.

Carrying the flight calibration as required in time to ensure the safety certification as well as to prevent the increased man-hours on additional ground checks.

Innovated means of observations and data logging through technologies for automated investigation of equipment without disturbing the operation, reduces man-hours spent on traveling to remote sites, carrying out routine activities, and gives data for predictive maintenance.

Continuous improvement on maintenance philosophies, as well as training and development of the ATSEP in accordance with the reviewed maintenance philosophies, must be done on a regular basis to ensure safety and cost savings. Internal or external benchmarking with key performance indicators will propel the organisation to higher levels of maturity.

6.5. Actions by ATSEP

Planning and undertaking scheduled maintenance tasks. Responding to breakdowns, diagnosing faults, repairing, and restoring the facilities. Maintain all the records of maintenance including the cost involved. Initiate root cause analysis on repeated faults to understand the primary and secondary failures. Planning for the annual spare and other maintenance material required, provision the budget needed, and stock the optimum spares. Propose new and improvised maintenance procedures for approval. Ensuring the health and safety regulatory requirements. Adhering to standard operating procedures and all coordination procedures.

6.6. Most Influential Countermeasures

Reviewing maintenance philosophies, utilizing technologies, and bringing innovation to supervise CNS/ATM systems for reducing paper works, physical visits and saving manhours.

Pro-active procurement and replacement policies in managing the out-lived equipment will reduce the stress among the key stake holders of ANSP due to their safety commitment.

6.7. Human Factors Issues Addressed

6.7.1. Directly Addressed Factors

1	Being helpless in rectifying the unit after knowing inherent flaws in the design of the equipment and its unreliability
2	Compromising qualities, essential OEM documentations, training and after acquisition supports on new systems against the cost (L1).
3	Continuous changes in the scope and requirements on complex projects from the user point of view, without proper consideration from the maintenance point of view.
4	Delayed annual and other planned preventive and corrective maintenance due to non-availability of time for maintenance actions.
5	Delayed flight calibration due to poor preparation and planning.
6	Faulty equipment design and or faulty alert mechanism. Mis-leading front panel indications and irrelevant documentations. Unknown bug and or hidden deficiencies cropping up after the warranty and service agreement.
7	Frequent failures and outages of out-lived equipment and facilities.
8	Improper Complaint reporting mechanism by user, which do not convey the key information required for the early rectification of the equipment.
9	Lack of effective annual spare and capital procurement plan and related budget provisions.
10	Lack of readily available spare parts and poor supply chain management makes the recovery delays after emergencies and disasters.
11	Lack of update in the maintenance procedures, operating procedures, and maintenance philosophies in line with the technologies.
12	Non-availability of calibrated working test equipment as required for the preventive as well as for the corrective maintenance.
13	Non-availability of vehicle to reach the remote site.
14	Non-utilization of technologies and machines for the installation and maintenance works and planning.
15	Often project deadlines are set without freezing the scopes and augmenting with necessary resources.
16	Planning (for replacement of obsolete system) and procurement.
17	Poor OEM documentation on system, diagnostic procedures, site adaptable parameters and on HMI.
18	There is a long wait and no provision of comfortable and appropriate mode of commute to approach remote sites even though during scorching summer days.
19	Too much of file works for a low-cost but immediate and essential spare procurement.
20	User requirements defined not met with the supplied system.
21	Too many additional facilities added into ANSP like RADARS, CNS/ATM automation facilities, Nav-Aids at new airports and new RWYs in the last decade, without augmenting the human and other resources.

6.7.2. Indirectly Addressed Factors

1	Approval of projects without looking into the resource's requirements like human, vehicles, and other support. Workload increases on coordinating for essential supporting resources and prevents the concentration on core project activities as well as to skip the maintenance activities of ongoing operational facilities.

2	Constant mind switchover between old and modern technologies, procedures, tools etc.., within the same service facilities. Different aged, make and model of equipment within a single service facility like VHF, Nav-Aids, and surveillance.
3	Frequent (change of) exposure to too low temperature in the server or equipment room and too high outside temperature.
4	Frequent exposure of high outside remote site temperature and less inside equipment room temperature in a shift.
5	Frequent failures of OFC and leased lines connectivity. Non-availability of near perfect cable or line diagrams for OFCs and power lines in the operational area.
6	Installations at very remote places, and high mountains preventing regular visits due to resources.
7	Lack of guidelines and provisions of PPE to ATSEP for protecting them while working at highly polluted with noise and dust, heights, closer to high power radiating radars, X-rays, etc.,
8	Lack of protection and guidelines while attending equipment during heavy lightning and abnormal weather conditions.
9	Managing the procurement tasks and maintenance tasks of multiple airports in addition to the local.
10	Procedural delays and extended file works on spare procurements.
11	Age and condition of supporting equipment like generators, electrical installations, air conditioners etc…,
12	Annual plan for ATSEP training and development in line with the operational and competency requirements.
13	Different make and model for each facility / system.
14	Difficulties in trouble shooting behind the ATC consoles in general and at late night hours due to poor lighting at the behind the console.
15	Extraordinary file work delays in getting approvals for proceeding to next stages.
16	Fear on consequences of failure while trouble shooting in live system.
17	Frequent movement to and from in between ATC complex and different operational sites especially in case of A-SMGCS, ILS sites and multiple RADAR sites for daily checks and maintenance work.
18	In compatible interfaces and data formats among different makes and models for integration and extending the data and voice to other ACC or APP airports.
19	Inadequate first-hand information given by user.
20	Insufficient logistics support and communication infrastructure to support ATSEP works, those at remote site/area.
21	Mismatching in course development that does not make the ATSEP competent enough to address the practical field issues.
22	Narrow space around equipment racks filled with too many wires and connections, making difficulties in accessing and replacing the modules.
23	No access of fresh air and sunlight for long duration.
24	Permanent combined duties due to shortage of manpower increases workload and reduces the attention in all the combined units.
25	Repairing critical modules of the facilities that are under NOTAM
26	Sense of expectation on out-lived equipment failures even while conducting preventive maintenance.
27	Single man shift.
28	Trouble shooting in busy working environment on live interconnected systems.

6.8. Self-evaluation checklist

6.8.1. Self-evaluation checklist for ANSP

Human performance management processes maturity level Self-Evaluation Check list for ANSP – INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY				
##	**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	Induction of new systems and maintenance philosophy for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)	Induction of new systems and maintenance philosophy for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation		
4)	**If maturity level is D** w.r.t score of (1)			
	Maintenance strategy includes all the process in addition to preventive maintenance			Y/N
	All the maintenance activities are documented for easy traceability			Y/N
	Annual reactive maintenance duration is only 20% or less than the total maintenance duration?			Y/N
	Required competencies and resources made available prior to the installation of new systems.			Y/N
	All OEM documents required to meet the maintenance strategies were ensured before SAT			Y/N
	Computer-based maintenance data analysis established for financial optimization			Y/N
	Root cause analysis is being practiced on safety sensitive facilities for finding primary failures			Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.			

5)	**If maturity level is E w.r.t score of (1)**	
	Innovated means of observations and data logging done for automated investigation	Y/N
	Continuous improvement on maintenance process including training done as per new systems	Y/N
	Annual reactive maintenance cost is reduced when compared to last year	Y/N
	Computer based maintenance data analysis helped in carrying out predictive maintenance	Y/N
	Repeated failures were analysed through root cause failure and identified primary failures	Y/N
	Trained and developed ATSEP on FAT, SAT, and document verification to ensure OEM documents and system delivered as per the user requirements.	Y/N
	Have you set the key performing indicators for measuring the above?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate	
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP		

6.8.2. Self-evaluation checklist for ATSEP

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood all the process involved in the maintenance strategy of my ANSP			Y/N
	B	I have well documented all the activities of maintenance for easy traceability			Y/N
	C	I have acquired all the skills and competencies required for maintaining new systems			Y/N
	D	I have acquired the skills for carrying root cause failure analysis			Y/N
	E	I have made the annual plan for the spares and other materials including budgeting			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				
	D				
	E				

6.9. Resilience and Cost Benefits

These actions are very essential for any ANSP as this is the lowest level of resilience any organizations to possess to retain the trust of the stakeholders and to meet the regulatory requirements. With effective preventive or proactive maintenances, reactive maintenance and its cost will come down to a greater extent. With innovation in carrying out the routine maintenance activities ANSP can reduce the costs of maintenance activities. With the systematic capture and analysis of the maintenance data ANSP can take financially optimized decisions like service life expansion instead of replacement.

6.10. Other Countermeasures

Pre-planning the pre-monsoon, annual and other major preventive maintenance tasks well in advance and carrying out the tasks as planned. So that sudden or total failures and long corrective maintenance works prevented.

Roadblocks on procurement process can be reduced by training selected ATSEP on government compliance requirements by experts having background on the financial regulation. ATSEP those who participate in the major or repeated procurement process can be permitted to have consultants on these areas.

Adopting procurement policies that facilitates buying quality systems.

This page is intentionally left blank



CHAPTER 7
WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD

This chapter discusses the importance of creating a positive work environment that promotes well-being and high performance in the aviation industry

THE OBJECTIVE

It emphasizes the value of reward and performance management in attaining these objectives as well as the advantages for both ANSPs (air navigation service providers) and ATSEPs (air traffic safety electronics employees).

It makes suggestions for steps ANSP and ATSEP can do to establish a great working environment, including developing incentive policies and practices, delivering assistance and direction for performance development, and implementing non-monetary benefits.

"People's ability to adapt means that the system is more likely to recover from unexpected disturbances, resulting in increased resilience."

DOC 10151 -MANUAL ON HUMAN PERFORMANCE

7. WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD

7.1. Introduction

The work environment consists of the system of work, the design of jobs, working conditions and the ways in which people are treated at work by their managers and co-workers. Working conditions need to meet health and safety requirements. The way people are treated is affected by managerial behaviour, achieving work-life balance and how issues such as stress, harassment and bullying are dealt with.

Well-being at work exists when people are happy with what they do, how they are treated, how they get on with others. The well-being of employees depends on the quality of working life provided by their employers the feelings of satisfaction and happiness arising from the work itself and the work environment.

Performance management and reward management are strongly associated topics that play an important part in achieving one of the key goals of HRM – to contribute to the development of a high-performance culture.

Performance management is a means of getting better results by providing the means for individuals to perform well within an agreed framework of planned goals, standards, and competency requirements It entails developing a shared understanding of what is to be accomplished and how it is to be accomplished.

Performance management, if carried out properly, can reward people by recognition through feedback, the provision of opportunities to achieve, the scope to develop skills, and guidance on career paths. All these are non-financial rewards that can encourage job and organizational engagement and make a longer-lasting and more powerful impact than financial rewards such as performance-related pay.

Reward strategy defines what how an organization wants intends to do about to reward their employees. It leads to the development of a reward system that consists of interrelated processes and practices that combine to ensure that reward management is carried out to the benefit of the organization and its employees.

7.2. Benefits to ANSP

Increased job satisfaction and happiness among the workforces. Development towards a high-performance culture. Getting better results from all. Increased level of engagement among the workforces. Talented people are attracted and retained.

7.3. Benefits to ATSEP

A set of properties of the work environment, perceived directly or indirectly by the employees, which is assumed to be a major force in influencing employee behaviour. Engagement and commitment strategies may be more about taking action that affects employees collectively such as improvements in the work environment.

A satisfactory work environment leads to reduced stress, improves work-life balance, eliminates sexual harassment and bullying problems, providing services for individuals including employee assistance programmes, and provides individual.

services such as employee assistance programmes and provides group services such as restaurants and social/sporting facilities.

They include non-monetary recognition of accomplishments, the creation of fulfilling jobs, providing opportunities for people to advance their skills and careers, and providing a work environment that promotes a high quality of life at work and an appropriate balance of work and personal life (work-life balance).

7.4. Actions by ANSP

Employers are responsible for creating an excellent work environment, not only because it is their duty to do so but also as part of the total reward system. Total reward approaches that emphasize the importance of enhancing the work environment.

ANSP need to create a work environment that is conducive to high performance and can introduce policies and practices that encourage people to do everything expected of them.

Performance management provides the basis for self-development but, importantly, it is also about ensuring that the support and guidance people need to develop and improve are readily available. Performance management can play a significant role in rewarding employees by providing them with positive feedback and the recognition of their accomplishments.

Developing reward policies and practices that support the achievement of safety and service goals. Rewarding people according to their contribution. Recognizing the value of everyone who is making an effective contribution, not just the exceptional performers. Providing incentives that attract and retain employees and contribute to the development of a high-performance culture.

Creating non-monetary rewards focuses on the varying degrees of recognition, achievement, personal growth, and acceptable working conditions that people have. Non-monetary rewards can be extrinsic, such as praise or recognition, or intrinsic, such as job challenge and interest, as well as feelings that one's work is worthwhile.

7.5. Actions by ATSEP

Perform well in an excellent work environment. Develop on the required area based on the performance management feedback by utilizing readily available support and guidance.

7.6. Most Influential Countermeasures

Providing a working environment, with consideration to human factor issues of ATSEP.

Following HR policies that encourage recognition, appreciation, and suitable compensations.

7.7. Human Factors Issues Addressed

7.7.1. Directly Addressed Factors

1	ATSEP desire for recognition on all the facilities (CNS/ATM Automation) and on different makes and models.
2	Behind the curtain profession
3	Below par and uncomfortable residential facilities at faraway places instead of provisions of comfortable nearby quarters with reasonable rent.

4	Congested or no desk / table. Too many items placed in the control and monitoring room. No space for keeping important manuals, procedures, SOPs in most visible and accessible manner.
5	Continuous works including weekends during the demanding situations for meeting the special maintenance and project works along with routine operational works.
6	Difficulties in trouble shooting behind the ATC consoles in general and at late night hours due to poor lighting at the behind the console.
7	Frontline ATSEP views ignored, and not recognized as experts.
8	Gender bias and equal field works not assigned to women ATSEP.
9	Insufficient logistics support and communication infrastructure to support ATSEP works, those at remote site/area.
10	Lack of attractive compensation for extra shift works performed
11	Lack of basic workplace facilities like parking, canteen, fixtures, rest rooms, vending machines, common transport for pickup and drop from employee quarters to workplace, etc..,
12	Lack of guidelines and provisions of PPE to ATSEP for protecting them while working at highly polluted with noise and dust, heights, closer to high power radiating radars, X-rays, etc..,
13	Lack of motivating compensations for extra manhours spent in general maintenance, VVIP movements, project works, additional works, and additional shifts.
14	Lack of opportunity and fund provisions for innovation and carry station level smaller projects.
15	Lack of pride as not recognized as expert in particular field and transferred anywhere without considering the competencies acquired.
16	Lack of protection and guidelines while attending equipment during heavy lightning and abnormal weather conditions.
17	Lack of scientific annual performance assessment and rewarding scheme considering the unique working environment and expected level of performance of ATSEP.
18	Lack of specific workplace facilities for women like identified rest rooms in the operational areas, Creche, childcare leave, etc…,
19	Lack of time to family
20	Lack policies and practices towards the human factors of ATSEP.
21	Narrow space around equipment racks filled with too many wires and connections, making difficulties in accessing and replacing the modules.
22	No access of fresh air and sunlight for long duration.
23	No refreshment breaks
24	No say of ATSEP in HR policies being set for them.
25	No standardized duty pattern, duration, breaks and rest periods
26	Odd hours and on field shift duties for women ATSEP without basic rest room facilities in the operational sites.
27	Payment delays.
28	Salary and allowances not at par with the industry standards for the level of stress and workload.
29	Sense of being unheard by management
30	Sleep loss due to irregular shift pattern or fast rotating shift pattern
31	Stress and fatigue management.
32	Stressful 12 hours night shift without breaks and rests

33	There is a long wait and no provision of comfortable and appropriate mode of commute to approach remote sites even though during scorching summer days.
34	Working in lower temperature in equipment room.
35	Working under noise pollution in the airfield.
36	Working under severe dust pollution during the project work.
37	Acceptance of inefficient manpower by management without any mitigation.
38	Improper and unbalanced work distribution with undue over burden and undue over leniency.
39	Lack of support on career development and career plan.
40	No clear OFFs before shift pattern changes

7.7.2. Indirectly Addressed Factors

1	Compulsory movements within the nation during service life
2	Lack of involvements in the discussion sessions and feedback sessions on major policy decisions.
3	Lack of involvements of frontline experts in policies designed for improving the performance of frontline experts.
4	Annual plan for ATSEP training and development in line with the operational and competency requirements.
5	Approval of projects without looking into the resource's requirements like human, vehicles, and other support. Workload increases on coordinating for essential supporting resources and prevents the concentration on core project activities as well as to skip the maintenance activities of ongoing operational facilities.
6	Difference in stated corporate Mission/Vision and the ground reality.
7	Extra shift duties are forced due to shortage of manpower
8	Forced to carryout major maintenance works only during late night and need to return to duty next day by 0930AM.
9	Frequent (change of) exposure to too low temperature in the server or equipment room and too high outside temperature.
10	Frequent exposure of high outside remote site temperature and less inside equipment room temperature in a shift.
11	Frequent movement to and from in between ATC complex and different operational sites especially in case of A-SMGCS, ILS sites and multiple RADAR sites for daily checks and maintenance work.
12	Inhibition of valuable suggestions and ideas due to the overload of works.
13	Innumerable, unspecified, and unpredicted works assigned to selected ATSEP preventing their attention from core maintenance tasks.
14	Installations at very remote places, and high mountains preventing regular visits due to resources.
15	Irregular duty calls without any pattern due to shortage of manpower
16	Lack of effective coordination procedures for men material movements inside the operational areas of private operator owned airports.
17	Lack of knowledge in handling emergencies and disastrous situations.
18	Late hour calls and frequent calls after duty hours even during weekly OFFs
19	Leave requests not approved
20	Mandatory transfers
21	Monotonous monitoring for a long time.

22	Mostly corrective maintenance work conducted at night.
23	Multiple jobs of diversified nature in quick successions without notice or planning.
24	Must report again by 0930AM even after late night breakdown calls and late-night project works.
25	Non-availability of calibrated working test equipment as required for the preventive as well as for the corrective maintenance.
26	Non-availability of vehicle to reach the remote site.
27	Permanent combined duties due to shortage of manpower increases workload and reduces the attention in all the combined units.
28	Short of ideas; being alone.
29	Simultaneous project supervision and maintenance activities without additional manpower.
30	Single man shift.
31	Too many unclassified additional works in smaller airports. Essential maintenance tasks skipped.
32	Travelling long distance from home to workplace as green field airports are situated at outer part of the cities and no provision of common transportation facility.
33	Uncertainty on future roles and responsibilities.
34	Where there is electronics, there shall be an ATSEP – Belief of airport in-charges.

7.8. Self-Evaluation Checklist

7.8.1. Self-Evaluation Checklist For ANSP

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD

##	Process	Maturity level	Description of the maturity level	Tick
1)	Work environment, well-being, performance, and reward for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria.	

2)	Induction of new systems and maintenance philosophy for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	Level A	
		Level B	
		Level C	
		Level D	
		Level E	
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation	
4)	**If maturity level is D** w.r.t score of (1)		
	Total reward system approaches in practice that emphasize the enhanced work environment.		Y/N
	Work environment is conducive to high performance.		Y/N
	Performance management system in practice ensures the support and guidance people need to develop and improve are readily available.		Y/N
	Reward system includes non-financial rewards like recognition, achievement, personal growth		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.		
5)	**If maturity level is E** w.r.t score of (1)		
	Work environment is periodically reviewed for enhancement		Y/N
	Increased level of job satisfaction and happiness found after enhancing work environment		Y/N
	Unique values added by all the employees were recognized and rewarded		Y/N
	Increased level of engagement among the workforces were observed		Y/N
	Have you set the key performing indicators for measuring the above?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate		
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP			

7.8.2. Self-Evaluation Checklist for ATSEP

Human performance management processes maturity level
Self-Evaluation Check list for ATSEP – WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD

##		Process	Maturity level	Description of the maturity level	Tick
1)	A	Work environment enabled me towards more engagement and commitment.			Y/N
	B	Work environment has reduced my stress and improved my work-life balance			Y/N
	C	I have not experienced or heard of any sexual harassment and bullying problems.			Y/N
	D	I am benefited by the individual as well as group services provide by my ANSP			Y/N
	E	I am highly motivated due to the non-financial reward systems in place.			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				

	C	
	D	

7.9. Resilience and Cost Benefits

ANSP incurs minimal costs in improving the work environment and incurs no additional costs in implementing non-monetary rewards. Organizations progress toward high performance by increasing employee job satisfaction and happiness. Talent management objectives are met when talented people are attracted and retained, and employee behaviour and organisational culture are improved.

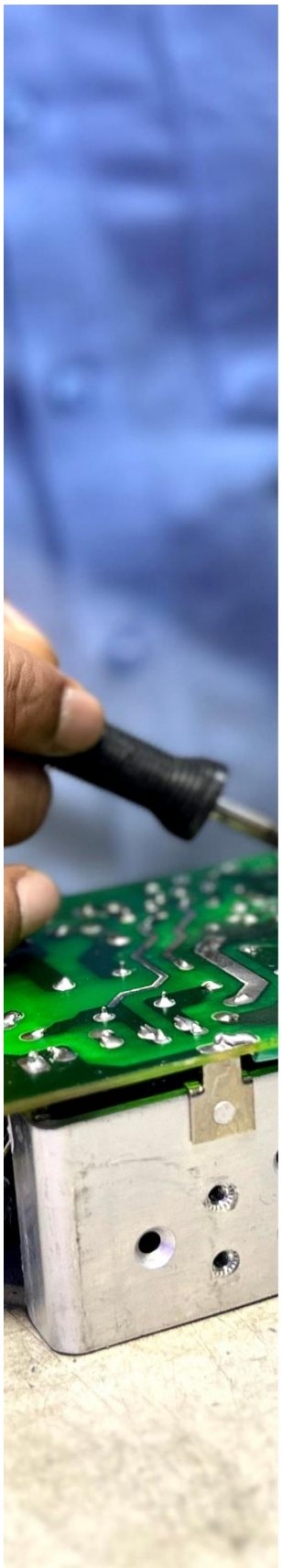
7.10. Relevant Appendix

Refer to Appendix 4 on ATSEP Duty Time Limitation for further information on the current system of watch hours, shift duty cycles, duty hours in a day, number of duties per week, number of hours of duty per week, impact, and advice for better management of duty cycles and duty hours.

To comprehend the dread psychosis behind Covid-19, mitigation measures, and future action in similar circumstances, please refer to Appendix - 5 Measures During Pandemic.

To understand the three stages of stress, stressors in the workplace, the effects of stress, and the concepts of stress management, please refer to Appendix 7: Stress Management.

This page is intentionally left blank



CHAPTER 8
MOTIVATION, COMMITMENT & ENGAGEMENT

This chapter discusses the importance of motivation, commitment, and engagement which are the factors that influence performance.

THE OBJECTIVE

Intrinsic motivation is when people find their work important, interesting, and challenging, and have autonomy, opportunities to achieve and advance, and opportunities to use and develop their skills and abilities.

Extrinsic motivation involves rewards or punishments to motivate people. Commitment and engagement are linked and influenced by factors such as training, career opportunities, performance appraisal systems, autonomy, and rewards and recognition.

High performance is achieved through motivated, committed, and engaged employees. ANSP and ATSEP can benefit from increased motivation, commitment, and engagement.

"The overall goal of Aviation Maintenance human factors research is to identify and optimize the factors that affect human performance in maintenance and inspection."

- FAA on Human Factors in Aviation Maintenance

8. MOTIVATION, COMMITMENT, AND ENGAGEMENT

8.1. Introduction

Motivation, commitment, and engagement are all factors that influence behaviour and thus performance. Motivation is the driving force that propels, directs, and sustains behaviour. Well-motivated people who are willing to exert discretionary effort, i.e., do more than is expected of them, achieve high performance.

Intrinsic motivation occurs when people believe that their work is important, interesting, and challenging, and that it gives them a reasonable degree of autonomy (freedom to act), opportunities to achieve and advance, and opportunities to use and develop their skills and abilities. It can be described as work-motivation. Job design can help to boost intrinsic motivation.

Extrinsic motivation occurs when things are done to or for people to motivate them. These include rewards such as incentives, increased pay, praise, or promotion; and punishments such as disciplinary action, withholding pay, or criticism. Extrinsic motivators can have an immediate and powerful effect, but it will not necessarily last long.

The intrinsic motivators, which are concerned with the 'quality of working life,' are likely to have a deeper and longer-term effect because they are inherent in individuals.

Commitment represents the strength of an individual's identification with, and involvement in, an organization. Commitment refers to attachment and loyalty.

Engagement takes place when people are committed to their work and the organization and are motivated to achieve elevated levels of performance.

Both commitment and engagement are inextricably linked. Some of the factors that influence commitment and engagement are training, career opportunities, performance appraisal systems, autonomy, and rewards and recognition.

8.2. Benefits to ANSP

High performance is achieved through highly motivated, committed, and engaged employees. All the benefits discussed in previous chapters where high performance is discussed apply here as well.

8.3. Benefits to ATSEP

Motivated to contribute more through increased commitment and engagement. All the benefits discussed in previous chapters where high performance is discussed apply here as well.

8.4. Actions by ANSP

Keeping the motivation level high through both intrinsic as well extrinsic measures. Provide additional training to the people in their areas of interest. Provide career opportunities based on their performance which is evaluated through a scientific performance evaluation system. Provide autonomy to the workforce according to their position in the organization.

8.5. Actions by ATSEP

Making use of the training opportunities to add the knowledge in the areas of interest or where there is a need or where there is a gap. Efficient and contributing ATSEP are recognized through intrinsic measures and at the same time all contributions are taken care by extrinsic means.

8.6. Most Influential Countermeasure

All the countermeasures discussed in the earlier topics will also enhance the motivation, commitment, and engagement. However, additional countermeasures to consider are given in the end of this chapter.

8.7. Human Factors Issues Addressed

8.7.1. Collectively Addressed Factors

Considering all the influential countermeasures discussed so far, collectively the following factors are addressed that add stress and fatigue.

1	Acceptance of inefficient manpower by management without any mitigation.
2	ATSEP desire for recognition on all the facilities (CNS/ATM Automation) and on different makes and models.
3	Continuous changes in the scope and requirements on complex projects from the user point of view, without proper consideration from the maintenance point of view.
4	Frontline ATSEP views ignored, and not recognized as experts.
5	In compatible interfaces and data formats among different makes and models for integration and extending the data and voice to other ACC or APP airports.
6	Inhibition of valuable suggestions and ideas due to the overload of works.
7	Lack of attractive compensation for extra shift works performed
8	Lack of brainstorming on handling unfamiliar situation and regular interactions for knowledge sharing.
9	Lack of corrective measure in addressing the commitment levels and contributions of ATSEP.
10	Lack of effective annual spare and capital procurement plan and related budget provisions.
11	Lack of guidance, information exchange, and non-participation in the discussion make the freshers isolated.
12	Lack of involvements in the discussion sessions and feedback sessions on major policy decisions.
13	Lack of involvements of frontline experts in policies designed for improving the performance of frontline experts.
14	Lack of knowledge and expert support while trying to fix an unfamiliar technical glitch.
15	Lack of knowledge in handling emergencies and disaster situations.
16	Lack of motivating compensations for extra manhours spent in general maintenance, VVIP movements, project works, additional works, and additional shifts.
17	Lack of mutual respect and mentorship for knowledge and experience sharing among the generations.
18	Lack of opportunity and fund provisions for innovation and carry station level smaller projects.

19	Lack of pride as not recognized as expert in particular field and transferred anywhere without considering the competencies acquired.
20	Lack of scientific annual performance assessment and rewarding scheme considering the unique working environment and expected level of performance of ATSEP.
21	Lack of skills and competencies in managing the CNS/ATM automation systems (Configuration, adaptation, replacement and upgrading the network devices, operating systems, shared storage devices, firewalls, and device drivers etc..,) due to lack of OEM documentations.
22	Lack of support on career development and career plan.
23	Lack of teamwork, more dependency on individuals and collective inputs not taken by team lead for decision.
24	Mismatching in course development that does not make the ATSEP competent enough to address the practical field issues.
25	Monotonous monitoring for a long time.
26	No clear job description, roles and responsibilities are varying after each movement, deployed at non-core areas.
27	No say of ATSEP in HR policies being set for them.
28	Non-utilization of technologies and machines for the installation and maintenance works and planning.
29	Peer pressure due to evaluation and comments from colleagues who are not accountable
30	Poor workload distribution makes few carries stress, pressure, fatigue, and timeline pressure throughout without any relief.
31	Salary and allowances not at par with the industry standards for the level of stress and workload.
32	Short of ideas; being alone.
33	Unable to resolve external interference problems and other typical problems not covered in the training.
34	Unrealistic timelines due to poor planning and coordination with ATCOs before making maintenance activities.

8.8. Resilience and Cost Benefits

Every cost and resilience benefit that we have previously addressed whenever high performance is mentioned also applies here.

8.9. Other Countermeasures

Encourage innovation on routine tasks.

Promote research groups within the ANSP.

Rewards and promotion based on contribution and effort.

Assign dedicated small assignments based on the specific talents and skills.

Innovative ideas should be welcomed through brainstorming sessions with the frontline experts before making major policies and procurements of new systems.

By limiting their stream of competency and developing higher level expertise and competencies, forming ANSP level backup team for emergency, disaster, and pandemic situation.



CHAPTER 9
BEHAVIOURAL AND ROLE SPECIFIC COMPETENCIES

This chapter discusses the importance of behavioural competencies (soft skills) and technical competencies (hard skills

THE OBJECTIVE

Behavioural competencies relate to the desired behaviours needed for successful performance in areas such as teamwork, communication, leadership, and decision-making.

Technical competencies relate to the specific knowledge and skills required for job performance. The benefits and actions for ANSP and ATSEP regarding knowledge management, talent management, and learning and development are applicable to both.

The most influential countermeasure for ATSEP is to train them in human factors as per DOC 10057.

"Operator error is very rarely the root cause of an occurrence. Usually, some underlying systemic issue is hiding behind it."

DOC 10151 -MANUAL ON HUMAN PERFORMANCE

9. BEHAVIOURAL AND ROLE SPECIFIC COMPETENCIES

9.1. Introduction

Behavioural competencies, also referred to as soft skills, specify behavioural expectations, i.e., the kind of behaviour needed to produce results under such topics as teamwork, communication, leadership, and decision-making. The focus on providing services to airlines and managing air traffic, awareness of developments in civil aviation, team orientation, results orientation, communication effectiveness, leadership, conflict resolution, innovation, adaptability, self-confidence and assertiveness, people management, planning and organising, technical skills, and decisiveness are a few examples of behavioural competencies.

Technical competencies—also referred to as "hard skills"—define what people must know and be able to accomplish (knowledge and skills) to carry out and satisfy performance objectives. They might relate to generic roles (sets of related roles) or to specific roles (referred to as "role-specific competences"). Typically, they are not included in a behavioural-based competency framework, even though they are connected when analysing and evaluating position needs and requirements.

9.2. Benefits to ANSP

All the benefits come out of knowledge management, talent management and learning and development are applicable here as well.

9.3. Benefits to ATSEP

All the benefits come out of knowledge management, talent management and learning and development are applicable here as well.

9.4. Actions by ANSP

All the actions discussed on knowledge management, talent management and learning and development are applicable here as well.

9.5. Actions by ATSEP

All the actions discussed on knowledge management, talent management and learning and development are applicable here as well.

9.6. Most Influential Countermeasures

Train ATSEP in human factors as per DOC 10057 in various levels that suits their technical and managerial accountabilities.

9.7. Human Factors Issues Addressed

9.7.1. Directly Addressed Factors.

1	24H operations with stringent regulatory compliance.

2	Expectations on making quick decision, in less reactive time with zero error tolerance and on fixing the system immediately.
3	Frequent changes in the team members or team lead prevents better teamwork and communications.
4	Lack of guidance, information exchange, and non-participation in the discussion make the freshers isolated.
5	Lack of involvements of frontline experts in policies designed for improving the performance of frontline experts.
6	Lack of knowledge and expert support while trying to fix an unfamiliar technical glitch.
7	Lack of knowledge in managing the available scarce human resources for maximum performance due to lack of soft skills.
8	Lack of leadership in building relationships and establishing communication or coordination frameworks with internal as well as external stakeholders.
9	Lack of leadership in communicating the priorities to sub-ordinates.
10	Lack of leadership in ensuring the safety conscious among sub-ordinate, instead of being reactive and blaming.
11	Lack of leadership in handling professional disagreement with internal and external stakeholders and pass it to frontline ATSEP.
12	Lack of leadership in managing conflicts and ensuring team goals and safety objectives over individuals interests and goals.
13	Lack of mutual respect and common values among internal stakeholders. (ATCOs, ATSEP, Engineers)
14	Lack of mutual respect and mentorship for knowledge and experience sharing among the generations.
15	Lack of teamwork, more dependency on individuals and collective inputs not taken by team lead for decision.
16	Managerial or higher responsibilities without proper training.
17	Peer pressure due to evaluation and comments from colleagues who are not accountable
18	Safety consciousness in keeping the facilities available all the time.
19	Sense of expectation on out-lived equipment failures even while conducting preventive maintenance.
20	Stress and fatigue management.
21	Timeline pressure from boss, management, ATCOs, and other stakeholders.

9.7.2. Indirectly Addressed Factors.

1	Always under pressure to give back the facilities within the EST of NOTAM
2	ATSEP desire for recognition on all the facilities (CNS/ATM Automation) and on different makes and models.
3	Being helpless in rectifying the unit after knowing inherent flaws in the design of the equipment and its unreliability
4	Constant mind switchover between old and modern technologies, procedures, tools etc.., within the same service facilities. Different aged, make and model of equipment within a single service facility like VHF, Nav-Aids, and surveillance.
5	Improper and unbalanced work distribution with undue over burden and undue over leniency.
6	Improper training (Training, assessing and evaluation) for the required competencies. There is a gap in the training provided and the practical work environment.

7	Inhibition of valuable suggestions and ideas due to the overload of works.
8	Lack of effective coordination procedures for men material movements inside the operational areas of private operator owned airports.
9	Lack of knowledge in handling emergencies and disastrous situations.
10	Lack policies and practices towards the ATSEP of ATSEP.
11	Mostly corrective maintenance work conducted at night.
12	Poor workload distribution makes few carries stress, pressure, fatigue, and timeline pressure throughout without any relief.
13	Repairing critical modules of the facilities that are under NOTAM
14	Sudden failures of the systems due to natural calamities and power supply issues.
15	Unrealistic timelines due to poor planning and coordination with ATCOs before making maintenance activities.

9.8. Resilience and Cost Benefits

The knowledge management, people management, and learning and development benefits that increase resilience and lower costs are all applicable in this situation.

9.9. Other Countermeasures

Train ATSEP on the Engineering module as per DOC 10057 that suits the ANSP roles on projects and procurements.

Training on infrastructure as per DOC 10057.

Training on factory and site acceptance tests of major systems for verifying the performance of the system compliance of user requirements and tender terms and conditions.

Training on handling emergency and disaster situations.

Developing competency for preparing upcoming complex CNS/ATM systems specifications.

Developing Communication skills for effective communications with internal and external stakeholders.

Developing skills for preparing detailed project reports and technical reports.

Developing skills for analysing the external interference, external interfaces, data formats, communication protocol and communication links associated with CNS/ATM facilities.

Soft skill development to increase the productivity.

This page is intentionally left blank



CHAPTER 10
SAFETY CULTURE PROMOTION

In order to understand Safety culture promotion, we need to understand 'What culture means to different groups and sub-groups of people'. The culture of a group of people refers to their shared knowledge, experience, beliefs, values, attitudes, and meanings.

THE OBJECTIVE

Safety Culture is the way safety is perceived, valued, and prioritized in an organization.

ANSP and ATSEP both benefit from an optimum Safety Culture as it promotes mutual trust, enhances productivity, and leads to a clearer and more comprehensive picture of operational risk.

ANSP can take various actions to promote a positive Safety Culture, such as establishing better information flow, promoting strong safety values, and implementing Voluntary Safety Reporting Programs.

ATSEP should consider the potential effect of their decisions on safety and report any concerns voluntarily. The most influential countermeasure is to sensitize all stakeholders on the role of ATSEP in ATM service delivery and their contributions to air safety.

"Error is intimately bound up with the notion of intention. The term 'error' can only be meaningfully applied to planned actions that fail to achieve their desired consequences."

- James Reason

10. SAFETY CULTURE PROMOTION

10.1. Introduction

Culture refers to the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, acquired by a group of people during generations through individual and group striving.

Safety Culture is the way safety is perceived, valued, and prioritised in an organisation. It reflects the real commitment to safety at all levels in the organisation. It is something an organisation acquires over period as a product of the combined effects of organisational culture, and professional culture.

Safety Culture's essence is in what people believe about the importance of safety, including what they think that their peers, superiors, and leaders really believe about safety as a priority.

10.2. Benefits to ANSP

Safety Culture have a direct impact on safe performance. With the safety culture, top management of ANSP show that safety is their priority, and the entire organization gives priority on safety.

An optimum Safety Culture will deliver a clearer and more comprehensive picture of operational risk, one that takes in all aspects of the activities of the organisation.

This enhancement of mutual trust with management gives a positive impact on productivity.

In an organization with a strong safety culture, individuals and groups take responsibility for safety by communicating safety concerns and striving to learn, adapt, and modify individual and organizational behaviour based on lessons learned.

10.3. Benefits to ATSEP

Safety Culture is seen as a key safety and service target so that the people at the 'sharp end' feel empowered to act in the interests of safety in the knowledge that the management will support them. This increases the mutual trust and motivation to play the safety role.

A strong safety culture helps ensure that personnel are trained and competent to perform their duties and that continual training and updates on safety progress are provided.

10.4. Actions by ANSP

Establishing better information flow and the maintenance of an effective dialogue within the organisation about safety performance as priority.

Promoting strong safety values means that all ANSP employees share lessons learned from investigations and experiences, both internally and from other organizations.

The tenets of Safety Promotion are used to foster a positive safety culture in which ANSP employees understand why safety is important and how they affect it, providing a sense of purpose to safety efforts.

Open communication is critical to a positive safety culture. ANSP communicates safety objectives to all operational personnel to improve the way safety is perceived, valued, and prioritized.

One of the initiatives that ANSP makes for maintaining positive safety culture is Voluntary Safety Reporting Programs. It is a confidential system for controllers and other employees to voluntarily identify and report safety and operational concerns.

Promoting the safety aspects of the roles played by ATSEP to the other stakeholders in ANSP so that they are not assigned with non-core activities, get the necessary information, infrastructural and other support for the operation and maintenance of CNS/ATM systems.

10.5. Actions by ATSEP

Each employee must consider the potential effect their decisions may have on safety and is responsible for understanding the significance of his or her job as it relates to safety. voluntarily identify and report safety and operational concerns.

10.6. Most Influential Countermeasure

Sensitizing all the stakeholders on the role of ATSEP in ATM service delivery and contributions to air safety.

10.7. Human Factors Issues Addressed

10.7.1. Directly addressed factors.

1	Age and condition of supporting equipment like generators, electrical installations, air conditioners etc.,
2	Diversified tasks during duty.
3	Inadequate first-hand information given by user.
4	Behind the curtain profession
5	Delayed annual and other planned preventive and corrective maintenance due to non-availability of time for maintenance actions.
6	Difference in stated corporate Mission/Vision and the ground reality.
7	Improper and unbalanced work distribution with undue over burden and undue over leniency.
8	Improper Complaint reporting mechanism by user, which do not convey the key information required for the early rectification of the equipment.
9	Innumerable, unspecified, and unpredicted works assigned to selected ATSEP preventing their attention from core maintenance tasks.
10	Insufficient logistics support and communication infrastructure to support ATSEP works, those at remote site/area.
11	Lack of effective coordination procedures for men material movements inside the operational areas of private operator owned airports.
12	Lack of mutual performance assessment as per the roles and responsibilities assigned.
13	Lack of mutual respect and common values among internal stakeholders. (ATCOs, ATSEP, Engineers)
14	Lack of planning before maintenance works. Not adhering to the schedules if planned.
15	Lack of professional communication or poor communication on technical terms to approving authority, who is mostly a non-ATSEP.

16	Lack policies and practices towards the human factors of ATSEP.
17	Multiple jobs of diversified nature in quick successions without notice or planning.
18	No say of ATSEP in HR policies being set for them.
19	Poor workload distribution makes few carries stress, pressure, fatigue, and timeline pressure throughout without any relief.
20	Timeline pressure from boss, management, ATCOs, and other stakeholders.
21	Too many unclassified additional works in smaller airports. Essential maintenance tasks skipped.
22	Where there is electronics, there shall be an ATSEP – Belief of airport in-charges.

10.8. Resilience and Cost Benefits

All ANSP have already established the SMS systems and they will have to promote safety work culture in the organization through leadership. It may add negligible additional costs but ensures ANSP to ensure safety and maintain reputation. This will also improve the commitment and productivity of internal stakeholders.

10.9. Other Countermeasures

Imparting human factors training to ATSEP and explaining the safety impacts from the perspective of human factors.

Rewarding the safety performance.

Encouraging them to voluntarily disclose the errors committed if any before major shutdown to find the root causes.

This page is intentionally left blank



CHAPTER 11

SUPERVISORY AND MANAGERIAL ROLE OF ATSEP

ATSEP must not only demonstrate technical proficiency but also possess behavioural competencies critical to supervisory and managerial responsibilities, particularly when overseeing contractors, suppliers, and service providers**.** These roles directly impact safety, service quality, and regulatory compliance – core pillars in air traffic management.

THE OBJECTIVE

The accountabilities of an ATSEP require distinct competencies associated with supervisory and managerial roles. Key competencies include hiring the right people and services, evaluating preliminary and detailed designs, training and developing team members, and building strong relationships with stakeholders.

"ICAO's guidance on safety, standards, communication, and performance-based management directly informs the supervisory and managerial responsibilities of an engineering manager in the aviation industry"

11. SUPERVISORY AND MANAGERIAL ROLE OF ATSEP

11.1 Introduction

In addition to the technical activities, ATSEP play supervisory and managerial roles towards contractors, suppliers, and service providers. Based on the degree of responsibility given to ATSEP and the model through which ANSP ensures the service and regulatory compliance, in addition to technical competencies, behavioral competencies to play supervisory and managerial roles towards the contractors, suppliers and service providers also needed and these competencies play crucial part in the safety chain.

The following figure illustrates the possible scope of ATSEP activities from system conception through design, operation and, lastly, decommissioning. [Doc 10057].

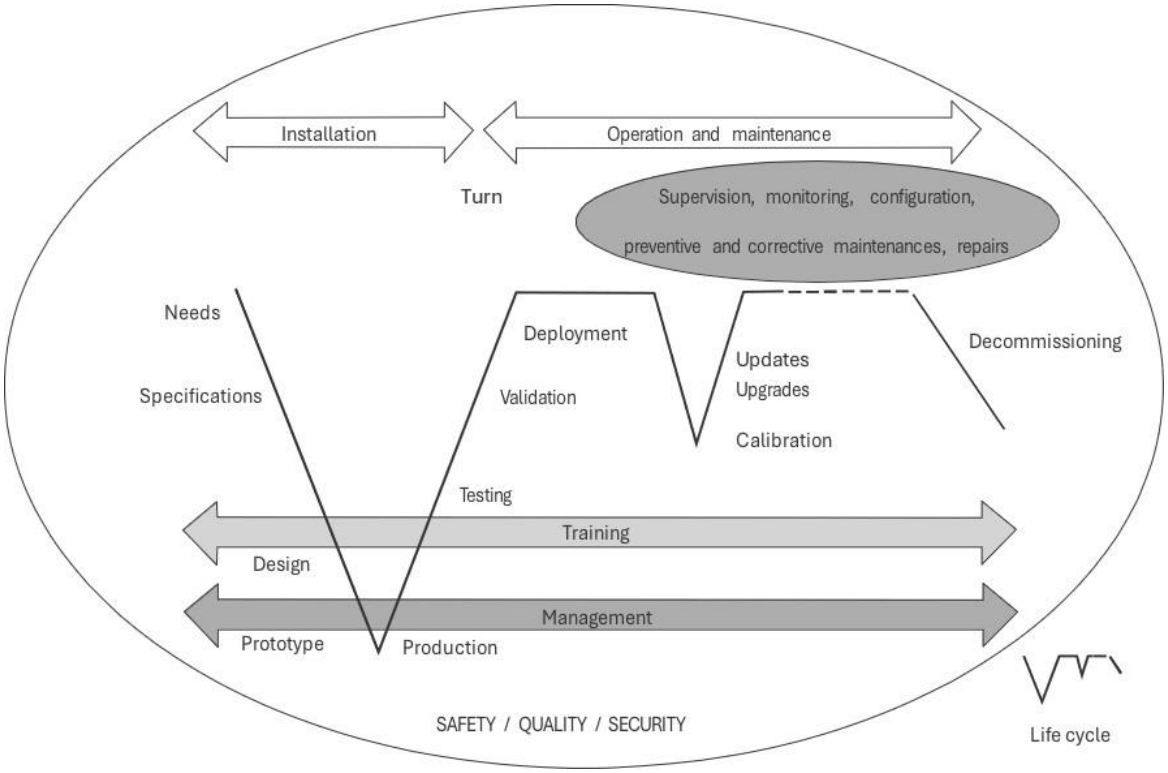


Figure 5: Scope of activities [DOC 10057]

Prior to operations and maintenance, there are additional crucial tasks including system and service implementation, provisioning, and installation. Tasks related to augmentation, adaptation, and upgrading are carried out while the system and services are in operation. At the final stage of a system's life, planning, phasing out, and introducing new systems and services are done.

All these activities are centered around operations and maintenance and on closed loops as shown in the figure 2.

All these activities are directly contributing the safety assurance and regulatory compliance for any given ANSP. These accountabilities necessitate the different competencies of supervisory and managerial role. Hiring right people and services, preliminary and detailed design evaluation, training and developing team, and building relationship with stakeholders are some of the competencies that are essential for the supervisory and managerial roles.

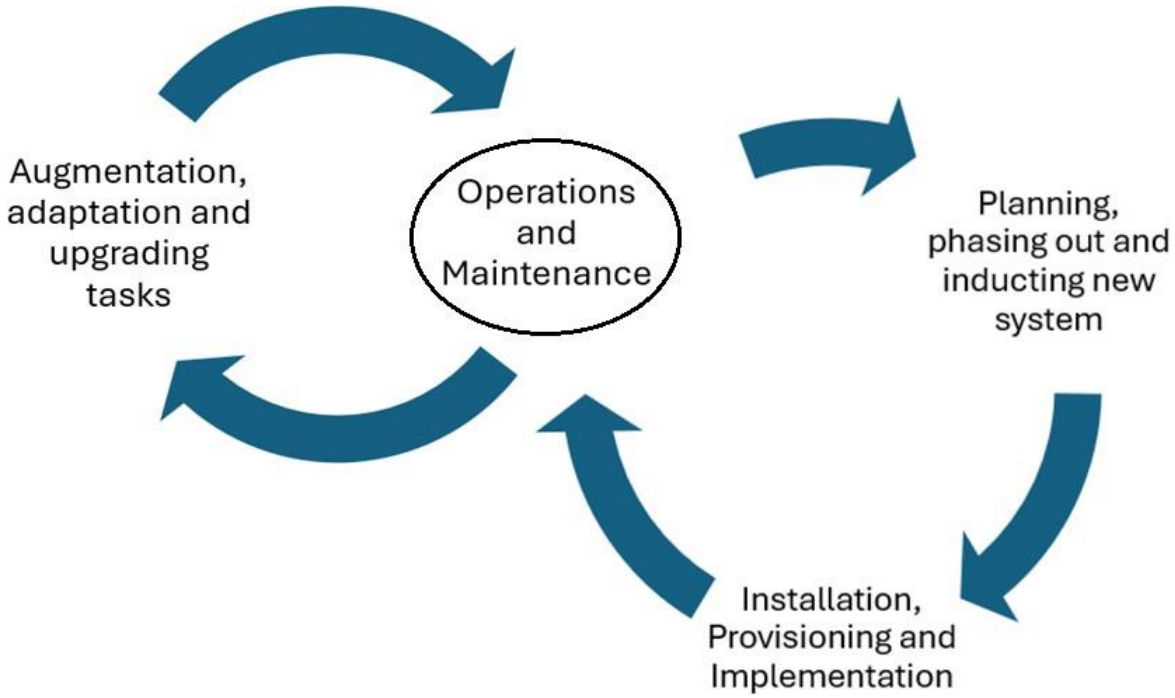


Figure 6: Supervisory and Managerial role beyond operations and maintenance

Thus, the varied and crucial functions that ATSEP plays in administrative and supervisory roles are essential to the effective deployment of systems and services as well as the successful completion of projects. They guarantee that projects are finished on schedule, within budget, and to the greatest possible levels of quality by managing contractors, suppliers, and service providers skillfully.

11.1.1 Roles and responsibilities

The tables 1, 2, & 3 are depicting the key differences among supervisory and managerial roles played by ATSEP, key activities under both the roles with examples, and specific responsibilities towards the contractor, suppliers, and service providers, respectively.

Table 4: Supervisory roles and managerial roles

Supervisory roles	Managerial Roles
overseeing the daily activities. Immediate Problem-Solving. close and direct interactions. monitor individual performance. assign specific tasks. ensure that the team adheres.	Strategic Oversight. high-level decisions. Risk Management. focus on the big picture. evaluate the overall performance. develop the project plan. allocate resources.

communicate daily instructions. facilitate communication within the team. Tactical Decisions Quality Control.	communicate with stakeholders. prepare detailed reports. Strategic Decisions Innovation.

Table 4: Activities and examples

Role	Activities	Examples
Supervisory roles	Technical supervision -Compliance -Quality control Project Coordination -Ensuring milestones -Liaison Resource management -Material availability -human resources for assigned tasks	Oversee the installation and testing. Function as a liaison between different parties. Monitor and manage inventory levels.
Managerial roles	Strategic Planning -Project plan -Risk management Contract Management -Cost estimation and fund provision -Procurement of services and goods -Cost negotiation -Contract performance compliance -Fund management Relationship Building -Stakeholders relationship Training and Development -Team development - knowledge and skill update	Define the scope of projects. Engage with stakeholders in project planning. Identify and mitigate project risks. Manage the procurement process. Select contractors and suppliers. Prepare detailed cost estimates for the project. Track and monitor project expenses. Build and maintain strong relationships with stakeholders. Organizing and conducting workshops or seminars. Implementing on-the-job training programs

Table 3: Specific responsibilities

Stakeholder	Specific responsibilities
Contractor	Selection and awarding Contract performance compliance. Regulatory compliance
Suppliers	Selection and awarding

	Timely delivery of right material Adherence to the specifications
Service providers	Service level agreements. Performance Compliance Regulatory compliance

The tables mentioned above provide a more comprehensive view of the diverse and important tasks that ATSEP plays inside a given ANSP. According to their strategic objectives, ANSPs will differ in the same way. Different extra tasks will be assigned to ATSEP by ANSPs with research, design, and development activities than by ANSPs without those activities. Similar to this, the tasks that an ANSP that outsources some services to assign to ATSEP will differ from those that another ANSP handles internally.

However, irrespective of the model of the ANSP, with reference to the scope of activities described in DOC 10057, whoever play the roles to carry or manage those activities partially or entirely are ATSEP proven competent to carry those tasks. On the other hand, ANSPs those who assign different tasks to ATSEP are expected to ensure their competency and address any human factor issues that affect their safety performances.

11.1.2 Human factor issues

The chapters of the guidance material that have relevance to this topic are listed here.

(3) People Resourcing, (4) Job, Role and Skills Analysis and Competency Modelling, (5) Knowledge Management, Talent Management, Learning and Development, (6) Induction of New Systems and Maintenance Philosophy, and (9) Behavioral and Role Specific Competencies.

Key issues are listed briefly for ready reference:

11.1.2.1 Effective people resourcing to add value to the organization and to meet strategic goals.
11.1.2.2 The analysis of job, role, skill, and competency modelling to match the roles requirements.
11.1.2.3 Knowledge management, Talent management, and Leaning and Development for sharing the knowledge, availability of talent, and to ensure that people in the organization acquire and develop the knowledge, skills, and competencies.
11.1.2.4 Development of behavioural competencies along with the technical competencies.

11.2 Benefits to ANSP

Some of the benefits discussed on the chapters 3, 4, 5, 6, & 9 are applicable here as well. Key benefits are listed below.

1. Optimum human resource requirements are worked out through workforce planning based on the projected changes in the types of activities conducted by the ANSP and the scale of those activities.
2. ANSP achieves competitive advantage by recruiting, retaining, and developing more capable people and retains the talent.

3. Matching human resources to the ANSP's culture, strategic goals, and operational needs ANSP ensures optimal use of those resources.
4. Individuals and teams perform better because both behavioural and functional competencies are well defined.

11.3 Benefits to ATSEP

Some of the benefits discussed on the chapters 3, 4, 5, 6, & 9 are applicable here as well. Key benefits are listed below.

1. Reduced stress due to unambiguous job profile, clear communication on accountabilities and expected outcome.
2. Defined key result areas facilitate the motivation towards knowledge and skills update to achieve an acceptable level of performance.
3. Reduced stress and annoyance due to readily available knowledge and expertise.

11.4 Actions by ANSP

The actions discussed on the chapters 3, 4, 5, 6, & 9 will themselves address all the human factor issues arises on this topic.

11.5 Actions by ATSEP

The actions discussed on the chapters 3, 4, 5, 6, & 9 will themselves address all the human factor issues arises on this topic.

11.6 Most Influential Counter-measures

The stress and fatigue levels of ATSEP can be reduced and safety goals can be met with regular optimum augmentation of human resources based on existing tasks, expected retirements, and expected additional facilities.

Assessing optimal manpower requirements, recruiting competent people, training, deploying, and promoting accordingly.

ANSP level scientific knowledge management on operations, maintenance, projects, and emergencies will reduce the stress significantly as ATSEP are continuously learning the latest problems and solutions and be ready with the proven techniques.

Pro-active procurement and replacement policies in managing the out-lived equipment will reduce the stress among the key stake holders of ANSP due to their safety commitment.

Roadblocks on procurement process can be reduced by training selected ATSEP on government compliance requirements by experts having background on the financial regulation.

Adopting procurement policies that facilitates buying quality systems.

Train ATSEP on the Engineering module as per DOC 10057 that suits the ANSP roles on projects and procurements.

Training on planning and procurement, project, and contract management.

Training on factory and site acceptance tests of major systems for verifying the performance of the system compliance of user requirements and tender terms and conditions.

Developing competency for preparing upcoming complex CNS/ATM systems specifications.

Developing Communication skills for effective communications with internal and external stakeholders.

Developing skills for preparing detailed project reports and technical reports.

11.7 Human Factors Issues Addressed

11.7.1 Directly Addressed Factors

1	Preparing technical specification for a new system without knowing the local government guidelines and latest technology available.
2	No clear demarcation of technical and managerial responsibilities among the junior ATSEP and senior ATSEP.
3	Compromising qualities, essential OEM documentations, training and after acquisition supports on new systems against the cost (Lowest quote).
4	Lack of project management skills and competencies at the same time, simultaneous operation and projects tasks given with unrealistic timelines.
5	Lack of knowledge in managing the available scarce human resources for maximum performance due to lack of soft skills.
6	Simultaneous project supervision and maintenance activities without additional manpower.
7	Non-utilization of technologies and machines for the installation and maintenance works and planning.
8	Approval of projects without looking into the resource's requirements like human, vehicles, and other support. Workload increases on coordinating for essential supporting resources and prevents the concentration on core project activities as well as to skip the maintenance activities of ongoing operational facilities.
9	User requirements defined not met with the supplied system.
10	Continuous works including weekends during the demanding situations for meeting the special maintenance and project works along with routine operational works.
11	Timeline pressure from boss, management, ATCOs, and other stakeholders.
12	Sense of expectation on out-lived equipment failures even while conducting preventive maintenance.
13	Often project deadlines are set without freezing the scopes and augmenting with necessary resources.
14	Lack of leadership in building relationships and establishing communication or coordination frameworks with internal as well as external stakeholders

11.8 Resilience and Cost Benefits

Some of the benefits discussed on the chapters 3, 4, 5, 6 & 9 are applicable here as well. Key benefits are listed below:

1. Optimum human resources are made available only in accordance with their safety and service strategy, and they are fully used on the core areas.

2. Ensures competitive advantage by developing and retaining safety-critical talent.
3. With increased employee commitment, the organization transforms into a high- performing one.
4. In terms of organizational resilience, ANSP can reach the level of adaptive innovation.
5. Organizations transform into high-performing organizations by developing the key workforce's behavioural and functional competencies.

****

APPENDIX 1 STRESS FACTOR MAPPING

1.1. Introduction

The excel sheet given below indicates the mapping of stress factors and countermeasures.

##	Table	Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	Top 10%	Top 20%	Top 30%	Top 40%
1	1	1				1																									1	1			1					0	0	1	1
2	1	3		1							1														1															0	1	1	1
3	1	4		1				1		1			1													1														1	1	1	1
4	1	5		1						1			1													1														1	1	1	1
5	1	6		1				1	1	1			1									1				1			1											1	1	1	1
6	1	7									1		1													1														1	1	1	1
7	1	8				1		1	1													1							1		1	1	1	1		1	1			1	1	1	1
8	1	10										1													1				1			1	1			1				0	0	1	1
9	1	11						1	1	1	1											1							1								1			1	1	1	1
10	1	12				1	1				1																1				1	1					1			0	1	1	1
11	1	13				1	1		1																		1		1		1	1	1							1	1	1	1
12	1	14		1						1			1													1														1	1	1	1
13	1	15											1													1														1	1	1	1
14	1	16						1	1		1					1	1			1		1			1				1	1	1							1		1	1	1	1
15	1	17						1														1							1			1				1				0	1	1	1
16	1	18				1		1	1				1													1						1	1		1				1	1	1	1	1
17	1	19						1	1													1			1											1				1	1	1	1
18	1	20																													1	1	1	1	1			1			0	1	1	1
19	1	21														1															1			1					1	0	1	1	1
20	1	22						1	1													1																		1	1	1	1
21	1	23		1				1		1			1									1				1			1											1	1	1	1
22	1	24						1	1													1							1											1	1	1	1
23	1	25																						1						1	1									0	1	1	1
24	1	26								1					1			1	1	1	1									1	1									0	1	1	1
25	2	1		1							1		1													1														1	1	1	1
26	2	2	1				1						1													1														1	1	1	1
27	2	3											1													1														1	1	1	1
28	2	4	1								1		1													1		1		1										1	1	1	1
29	2	5											1													1				1		1							1	1	1	1	1
30	2	6		1		1		1	1				1									1				1			1											1	1	1	1
31	2	7									1		1	1												1		1												1	1	1	1
32	2	8	1										1				1									1		1												1	1	1	1
33	2	9											1	1	1	1	1									1		1		1										1	1	1	1
34	2	10		1									1	1	1											1		1		1										1	1	1	1
35	2	11									1		1	1	1	1							1			1		1		1	1									1	1	1	1
36	2	12				1		1	1				1													1					1	1			1					1	1	1	1
37	2	13									1					1				1			1			1				1										1	1	1	1

##	Table	Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	Top 10%	Top 20%	Top 30%	Top 40%
38	2	14										1															1					1	1			1		1			0	0	1	1
39	2	15	1															1	1		1																				0	1	1	1
40	2	16				1	1				1																1					1	1			1					0	1	1	1
41	2	17								1			1	1												1		1													1	1	1	1
42	2	18		1				1		1	1		1									1				1			1											1	1	1	1
43	2	19	1				1	1	1																															1	1	1	1
44	2	20						1	1								1												1		1					1		1		1	1	1	1
45	2	21						1	1			1										1							1											1	1	1	1
46	2	22					1						1													1		1				1							1	1	1	1
47	3	1	1				1	1				1															1					1	1			1		1			0	1	1	1
48	3	2				1	1																				1													0	0	0	1
49	3	3			1									1																										0	0	0	1
50	3	4	1			1	1																				1													0	1	1	1
51	3	5	1											1														1													1	1	1	1
52	3	6						1	1			1					1												1												1	1	1	1
53	3	7						1	1			1																	1												1	1	1	1
54	3	8	1				1							1																								1			0	1	1	1
55	3	9	1		1						1																														0	1	1	1
56	3	10	1		1						1			1																											0	1	1	1
57	3	11	1		1																						1													1	1	1	1
58	3	12				1	1																	1			1					1	1			1		1		1	0	0	1	1
59	3	13					1	1	1			1						1	1		1											1	1		1	1		1			1	1	1	1
60	3	14		1				1	1	1																		1												1	1	1	1
61	3	15	1				1					1														1						1	1			1		1			0	1	1	1
62	3	16	1					1														1										1			1	1					0	1	1	1
63	3	17	1						1					1	1																			1							1	1	1	1
64	3	18	1	1						1			1													1			1	1											1	1	1	1
65	3	19			1			1	1					1														1			1			1						1	1	1	1
66	3	20	1			1	1		1																1		1														1	1	1	1
67	3	21	1					1	1			1																	1												1	1	1	1
68	3	22	1			1	1	1				1															1					1	1			1		1			0	1	1	1
69	3	23	1					1	1																1				1							1					1	1	1	1
70	4	1											1													1		1													1	1	1	1
71	4	2		1									1													1		1													1	1	1	1
72	4	3											1													1		1													1	1	1	1
73	4	4											1													1		1													1	1	1	1
74	4	5														1												1		1											1	1	1	1
75	4	6											1													1		1													1	1	1	1
76	4	7											1			1										1		1		1											1	1	1	1
77	4	10											1													1		1		1											1	1	1	1
78	4	11											1													1		1													1	1	1	1
79	4	12											1			1										1		1													1	1	1	1
80	4	13																										1													1	1	1	1

##	Table	Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	Top 10%	Top 20%	Top 30%	Top 40%
81	4	14														1				1								1		1											1	1	1	1
82	4	15																										1													1	1	1	1
83	4	16																										1													1	1	1	1
84	4	17											1													1		1													1	1	1	1
85	5	1																													1										0	1	1	1
86	5	2			1												1											1			1										1	1	1	1
87	5	3	1		1	1	1		1																						1										1	1	1	1
88	5	4			1									1	1																1										0	1	1	1
89	5	5												1	1																1			1							0	1	1	1
90	5	6	1				1		1																						1										1	1	1	1
91	5	7	1			1	1		1		1																														1	1	1	1
92	5	9	1																									1													1	1	1	1
93	5	11													1			1	1	1	1										1										0	1	1	1
94	5	12									1			1		1				1											1										0	1	1	1
95	5	13	1				1					1															1				1										0	1	1	1
96	5	14					1						1													1	1					1								1	1	1	1	1
97	5	15	1					1	1								1																								1	1	1	1
98	5	16						1	1		1																				1										1	1	1	1
99	5	17						1	1		1						1														1										1	1	1	1
100	5	18					1	1	1	1							1														1										1	1	1	1
101	5	19			1				1															1							1			1							1	1	1	1
102	5	20						1	1	1	1											1			1			1			1										1	1	1	1
103	6	1									1			1																										0	1	1	1
104	6	2																													1			1							0	1	1	1
105	6	3																1	1		1			1						1											0	0	1	1
106	6	4												1																				1	1						0	0	0	1
107	6	5												1																	1			1							0	1	1	1
108	6	6															1														1											0	1	1	1
109	6	7						1	1						1														1												1	1	1	1
110	6	8											1													1					1											1	1	1	1
111	6	9															1														1											0	1	1	1
112	6	10						1	1									1	1					1					1													1	1	1	1
113	6	11																													1			1							0	1	1	1
114	6	12						1													1							1													0	1	1	1
115	6	13									1																															0	1	1	1
116	6	14																1	1	1	1										1											0	1	1	1
117	6	15						1	1													1						1													1	1	1	1
118	6	16													1	1				1																						0	0	0	0
119	6	17																1	1		1			1							1											0	1	1	1
120	6	18						1	1			1																				1	1				1	1			1	1	1	1
121	6	19						1	1		1							1	1		1										1											1	1	1	1
122	6	20									1																				1											0	1	1	1
123	6	21											1			1				1						1				1	1											1	1	1	1

##	Table	Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	Top 10%	Top 20%	Top 30%	Top 40%
124	7	1		1						1	1		1			1				1						1				1											1	1	1	1
125	7	2																										1		1											1	1	1	1
126	7	4									1		1													1															1	1	1	1
127	7	5		1						1	1		1													1				1											1	1	1	1
128	7	6																												1											0	0	1	1
129	7	7																					1			1															1	1	1	1
130	7	9														1				1								1		1											1	1	1	1
131	7	10																1	1		1									1											0	0	1	1
132	7	11																								1															1	1	1	1
133	7	12		1						1																															0	0	1	1
134	7	13		1						1	1		1							1					1		1		1											1	1	1	1
135	7	14														1				1								1		1											1	1	1	1
136	7	15		1												1				1			1					1		1											1	1	1	1
137	7	16		1									1													1															1	1	1	1
138	7	17																1	1					1						1											0	0	1	1
139	7	18																												1											0	0	1	1
140	7	19												1														1		1	1										1	1	1	1
141	7	20												1														1		1											1	1	1	1
142	7	21									1																	1		1											1	1	1	1
143	7	22												1										1						1											0	0	1	1
144	7	23		1						1	1		1	1												1				1											1	1	1	1
145	8	1																										1													1	1	1	1
146	8	2																										1													1	1	1	1
147	8	3	1		1				1																			1									1				1	1	1	1
148	8	4																										1													1	1	1	1
149	8	5																										1													1	1	1	1
150	8	6	1						1																			1									1				1	1	1	1
151	8	7	1		1																							1													1	1	1	1
152	8	8	1																									1													1	1	1	1
153	8	9	1														1											1				1									1	1	1	1
154	8	10																										1													1	1	1	1
155	8	11	1		1																							1													1	1	1	1
156	8	12	1														1											1													1	1	1	1
157	B7	1	1																									1													1	1	1	1
158	B7	2	1																									1													1	1	1	1
159	B7	3																										1													1	1	1	1
160	B7	4																										1													1	1	1	1
161	B8	1		1							1			1																											0	1	1	1
162	B8	2																1	1		1		1					1													1	1	1	1
163	B8	3								1	1		1													1					1										1	1	1	1
164	B8	4																										1													1	1	1	1
165	B9	1					1	1	1													1							1												1	1	1	1
166	B9	2	1						1					1	1																					1					1	1	1	1

##	Table	Factor	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	Top 10%	Top 20%	Top 30%	Top 40%
167	B9	3	1																									1													1	1	1	1
168	B9	4						1	1													1			1			1													1	1	1	1
169	B10	1	1				1																				1				1	1		1		1	1			0	1	1	1
170	B10	2																										1		1										1	1	1	1
171	B10	3				1		1	1													1							1			1	1		1	1	1	1			1	1	1	1
172	B10	4						1	1													1							1			1	1			1	1	1		1	1	1	1	1
173	B11	1		1						1	1		1													1														1	1	1	1
174	B11	2		1			1	1	1	1			1									1				1	1		1											1	1	1	1
175	B11	3		1						1	1		1													1														1	1	1	1
176	B11	4		1						1																1		1													1	1	1	1
			C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12.1	C12.2	C12.3	C12.4	C13.1	C13.2	C13.3	C13.4	C13.5	C13.6	C13.7	C13.8	C14.1	C14.2	C14.3	C14.4	C14.5	C15.1	C15.2	C15.3	C15.4	C15.5	C15.6	C15.7	C15.8	C15.9	C15.10	125	161	172	175
			38	25	12	16	24	43	45	23	33	12	47	22	10	16	13	12	12	14	10	21	5	10	6	51	15	58	28	32	36	26	19	13	7	18	10	11	2	6				
Top 10%			38	25	12	16	24	43	45	23	33	12	47	22	10	16	13	12	12	14	10	21	5	10	6	51	15	58	28	32	36	26	19	13	7	18	10	11	2	6	71%			
Top 20%			38	25	12	16	24	43	45	23	33	12	47	22	10	16	13	12	12	14	10	21	5	10	6	51	15	58	28	32	36	26	19	13	7	18	10	11	2	6		91%		
Top 30%			38	25	12	16	24	43	45	23	33	12	47	22	10	16	13	12	12	14	10	21	5	10	6	51	15	58	28	32	36	26	19	13	7	18	10	11	2	6			98%	
Top 40%			38	25	12	16	24	43	45	23	33	12	47	22	10	16	13	12	12	14	10	21	5	10	6	51	15	58	28	32	36	26	19	13	7	18	10	11	2	6				99%

1.2. Description

All the green cells with “1” indicates the mapping of factor with the countermeasure. Coloured cells in Top 10%, 20%, 30%, and 40% rows indicate the most influential countermeasures.

Cell value “1” in Top 10%, 20% 30%, and 40% columns indicates that the factor is addressed either directly or indirectly by the most influential countermeasures in respective %age.

.

This page is intentionally left blank

APPENDIX 2 STRESS FACTORS

2.1. Introduction

2.1.1. Table 1 – Lack of Knowledge, Skills, and Competency.

Table 1: Factors that affect the job performance due to the lack of KSA, Competency in coping with the successive induction of modern technologies	
1	Preparing technical specification for a new system without knowing the local government guidelines and latest technology available.
2	No clear job description, roles and responsibilities are varying after each movement, deployed at non-core areas.
3	Lack of opportunity for developing and or retaining core competencies due to deployment in non-core areas for a prolonged period before and after equipment training.
4	Lack of equipment training even after years of deployment in the unit.
5	Lack of KSA and Competency to manage complex modern equipment.
6	No clear demarcation of technical and managerial responsibilities among the junior ATSEP and senior ATSEP.
7	Improper training (Training, assessing and evaluation) for the required competencies. There is a gap in the training provided and the practical work environment.
8	Lack of skills and competencies in managing the CNS/ATM automation systems (Configuration, adaptation, replacement and upgrading the network devices, operating systems, shared storage devices, firewalls, and device drivers etc..,) due to lack of OEM documentations.
9	Forced to do tasks even without qualification (attending power lines of UPS and working at heights etc..,)
10	Compromising qualities, essential OEM documentations, training and after acquisition supports on new systems against the cost (L1).
11	Procedural delays and extended file works on spare procurements.
12	Deployment of competent persons in right place after equipment training.
13	Lack of job rotation and equal opportunities.
14	Lack of knowledge in handling emergencies and disastrous situations.
15	Requirement of diversified expertise (Cyber security, Information technology, interface devices, data convertors, communication lines and links) other than core equipment for maintaining the service level.
16	Lack of project management skills and competencies at the same time, simultaneous operation and projects tasks given with unrealistic timelines.
17	Unable to resolve external interference problems and other typical problems not covered in the training.
18	Managerial or higher responsibilities without proper training.
19	Lack of knowledge in managing the available scarce human resources for maximum performance due to lack of soft skills.
20	Lack of operational training to develop competency on the old generation equipment even after service life expansion program in place.

21	Lack of opportunity to develop expertise on networking, operating systems, cyber security, project management etc. due to lack of in-house expertise instructors and training infrastructure.
22	Lack of external training, workshops, and seminars to keeping up-to-date knowledge on modern technology and systems well before the systems getting inducted.
23	Lack of involvements of frontline experts in policies designed for improving the performance of frontline experts.
24	ATSEP desire for recognition on all the facilities (CNS/ATM Automation) and on different makes and models.

2.1.2. Table 2 – Lack of proper workload distribution.

Table 2: Factors that affect the job performance due to improper workload management within the available scarce competent human resources.	
1	Less human resources for core jobs but deployment in non-core areas like terminal management, security systems, airport systems, administration works, commercial, and general stores.
2	Too many additional facilities added into ANSP like RADARS, CNS/ATM automation facilities, Nav-Aids at new airports and new RWYs in the last decade, without augmenting the human and other resources.
3	No alternate/standby operational team to share the workload even at emergency.
4	Single man shift.
5	Simultaneous project supervision and maintenance activities without additional manpower.
6	Manhours spent in Cargo, Customs clearance, without proper expertise or supporting staff instead of spending time on critical maintenance works and project works.
7	Innumerable, unspecified, and unpredicted works assigned to selected ATSEP preventing their attention from core maintenance tasks.
8	Permanent combined duties due to shortage of manpower increases workload and reduces the attention in all the combined units.
9	Too many unclassified additional works in smaller airports. Essential maintenance tasks skipped.
10	Where there is electronics, there shall be an ATSEP – Belief of airport in-charges.
11	Improper and unbalanced work distribution with undue over burden and undue over leniency.
12	Additional tasks assigned by regional and or corporate head quarter in addition to local airport works. (QR preparation, tender evaluation, course development, etc..,)
13	Acceptance of inefficient manpower by management without any mitigation.
14	Lack of OEM documentation increases the workload in preparing the maintenance procedures in-house.
15	Non-utilization of technologies and machines for the installation and maintenance works and planning.
16	Managing the procurement tasks and maintenance tasks of multiple airports in addition to the local.
17	Multiple jobs of diversified nature in quick successions without notice or planning.
18	No clear demarcation of competencies so spending more time on KSC update on all areas without even having the access to the equipment and facilities. (Too many make and models)

19	Frequent failures and outages of out-lived equipment and facilities.
20	Sudden failures of the systems due to natural calamities and power supply issues.
21	Lack of training and documentation increases workload and time.
22	Approval of projects without looking into the resource's requirements like human, vehicles, and other support. Workload increases on coordinating for essential supporting resources and prevents the concentration on core project activities as well as to skip the maintenance activities of ongoing operational facilities.

2.1.3. Table 3 – Lack of proper procedures, information, tools, and practices.

Table 3: Factors that affect the job performance due to improper procedures, information, tools, and practices.	
1	Poor OEM documentation on system, diagnostic procedures, site adaptable parameters and on HMI.
2	Lack of readily available spare parts and poor supply chain management makes the recovery delays after emergencies and disasters.
3	Lack of planning before maintenance works. Not adhering to the schedules if planned.
4	Too much of file works for a low-cost but immediate and essential spare procurement.
5	Insufficient logistics support and communication infrastructure to support ATSEP works, those at remote site/area.
6	Inaccurate procedures, lack of tested and validated SOPs leads to corrective maintenance delays.
7	Lack of document control and missing acknowledgement on new update on regulations and operational procedures.
8	Age and condition of supporting equipment like generators, electrical installations, air conditioners etc…,
9	Delayed flight calibration due to poor preparation and planning.
10	Delayed annual and other planned preventive and corrective maintenance due to non-availability of time for maintenance actions.
11	Non availability of calibrated working test equipment as required for the preventive as well as for the corrective maintenance.
12	Continuous changes in the scope and requirements on complex projects from the user point of view, without proper consideration from the maintenance point of view.
13	In compatible interfaces and data formats among different makes and models for integration and extending the data and voice to other ACC or APP airports.
14	Little or no-hands on training
15	Faulty equipment design and or faulty alert mechanism. Mis-leading front panel indications and irrelevant documentations. Unknown bug and or hidden deficiencies cropping up after the warranty and service agreement.
16	Frequent failures of OFC and leased lines connectivity. Non availability of near perfect cable or line diagrams for OFCs and power lines in the operational area.
17	Improper Complaint reporting mechanism by user, which do not convey the key information required for the early rectification of the equipment.
18	Annual plan for ATSEP training and development in line with the operational and competency requirements.
19	Lack of effective coordination procedures for men material movements inside the operational areas of private operator owned airports.

20	Lack of effective annual spare and capital procurement plan and related budget provisions.
21	Lack of update in the maintenance procedures, operating procedures, and maintenance philosophies in line with the technologies.
22	User requirements defined not met with the supplied system.
23	Mismatching in course development that does not make the ATSEP competent enough to address the practical field issues.

2.1.4. Table 4 – Duty duration, cycles of shifts and extended work hours.

Table 4: Factors that affect the job performance due to duty duration, cycles of shifts, late night calls and other late hour maintenance works without breaks and rests.	
1	No standardized duty pattern, duration, breaks and rest periods
2	Extra shift duties are forced due to shortage of manpower
3	Sleep loss due to irregular shift pattern or fast rotating shift pattern
4	Lack of time to family
5	Late hour calls and frequent calls after duty hours even during weekly OFFs
6	Irregular duty calls without any pattern due to shortage of manpower
7	Must report again by 0930AM even after late night breakdown calls and late-night project works.
8	No clear OFFs before shift pattern changes
9	Leave requests not approved
10	Forced to carryout major maintenance works only during late night and need to return to duty next day by 0930AM.
11	No refreshment breaks
12	Lack of attractive compensation for extra shift works performed
13	Odd hours and on field shift duties for women ATSEP without basic rest room facilities in the operational sites.
14	Stressful 12 hours night shift without breaks and rests
15	Continuous works including weekends during the demanding situations for meeting the special maintenance and project works along with routine operational works.

2.1.5. Table 5 – Continued stress, fatigue, and pressure.

Table 5: Factors that affect the job performance due to continued stress, fatigue, pressure, time pressure and deadlines on multiple tasks.	
1	24H operations with stringent regulatory compliance.
2	Mostly corrective maintenance work conducted at night.
3	Repairing critical modules of the facilities that are under NOTAM
4	Safety consciousness in keeping the facilities available all the time.
5	Timeline pressure from boss, management, ATCOs, and other stakeholders.
6	Sense of expectation on out-lived equipment failures even while conducting preventive maintenance.
7	Extraordinary file work delays in getting approvals for proceeding to next stages.
8	Frequent movement to and from in between ATC complex and different operational sites especially in case of A-SMGCS, ILS sites and multiple RADAR sites for daily checks and maintenance work.
9	Peer pressure due to evaluation and comments from colleagues who are not accountable
10	Poor workload distribution makes few carries stress, pressure, fatigue, and timeline pressure throughout without any relief.
11	Being helpless in rectifying the unit after knowing inherent flaws in the design of the equipment and its unreliability
12	Often project deadlines are set without freezing the scopes and augmenting with necessary resources.
13	Trouble shooting in busy working environment on live interconnected systems.
14	Always under pressure to give back the facilities within the EST of NOTAM
15	Expectations on making quick decision, in less reactive time with zero error tolerance and on fixing the system immediately.
16	Constant mind switchover between old and modern technologies, procedures, tools etc.., within the same service facilities. Different aged, make and model of equipment within a single service facility like VHF, Nav-Aids, and surveillance.
17	Unrealistic timelines due to poor planning and coordination with ATCOs before making maintenance activities.
18	Lack of knowledge and expert support while trying to fix an unfamiliar technical glitch.

2.1.6. Table 6 – Lack of knowledge sharing, leadership, and teamwork.

Table 6: Factors that affect the job performance due to poor leadership, lack of knowledge sharing, lack of communication, and lack of teamwork.	
1	Lack of mutual performance assessment as per the roles and responsibilities assigned.
2	Lack of leadership in building relationships and establishing communication or coordination frameworks with internal as well as external stakeholders.
3	Frontline ATSEP views ignored, and not recognized as experts.
4	Lack of professional communication or poor communication on technical terms to approving authority, who is mostly a non-ATSEP.
5	Lack of mutual respect and common values among internal stakeholders. (ATCOs, ATSEP, Engineers)
6	Lack of leadership in ensuring the safety conscious among sub-ordinate, instead of being reactive and blaming.
7	Impact of changes not communicated, and individuals are reluctant to adopt.
8	Frequent changes in the team members or team lead prevents better teamwork and communications.
9	Lack of leadership in managing conflicts and ensuring team goals and safety objectives over individuals interests and goals.
10	Lack of brainstorming on handling unfamiliar situation and regular interactions for knowledge sharing.
11	Lack of leadership in handling professional disagreement with internal and external stakeholders and pass it to frontline ATSEP.
12	Lack of knowledge sharing on latest developments in local airport level and in ANSP level to frontline ATSEP.
13	Lack of delegation or poor overlapping delegation and preferences towards frontline tasks not on managerial or leadership tasks.
14	Lack of mutual respect and mentorship for knowledge and experience sharing among the generations.
15	Lack of self-learning tools
16	Lack of corrective measure in addressing the commitment levels and contributions of ATSEP.
17	Lack of guidance, information exchange, and non-participation in the discussion make the freshers isolated.
18	Lack of knowledge on critical maintenance aspects of the equipment outsourced.
19	Lack of teamwork, more dependency on individuals and collective inputs not taken by team lead for decision.
20	Lack of leadership in communicating the priorities to sub-ordinates.
21	Inhibition of valuable suggestions and ideas due to the overload of works.

2.1.7. Table 7 – Human Resource Management policies.

Table 7: Factors that affect the job performance due to poor selection, human resource management policies and other organizational policies affect the motivation levels.	
1	Lack of support on career development and career plan.
2	Payment delays.
3	Lack of fresh recruitments, but more retirements and induction of new equipment.
4	Uncertainty on future roles and responsibilities.
5	Sense of being unheard by management
6	Lack of competitive colleagues. People with substandard knowledge and skills are getting selected.
7	Lack of motivating compensations for extra manhours spent in general maintenance, VVIP movements, project works, additional works, and additional shifts.
8	Lack of opportunity and fund provisions for innovation and carry station level smaller projects.
9	Selection criteria for inducting various levels of ATSEP for ensuring more competent people recruited in the higher levels.
10	Lack of regulatory requirements for complying standardized trainings and licencing to ATSEP
11	Lack of pride as not recognized as expert in particular field and transferred anywhere without considering the competencies acquired.
12	Salary and allowances not at par with the industry standards for the level of stress and workload.
13	Lack of scientific annual performance assessment and rewarding scheme considering the unique working environment and expected level of performance of ATSEP.
14	Lack of job rotation.
15	Lack of involvements in the discussion sessions and feedback sessions on major policy decisions.
16	Mandatory transfers
17	Lack policies and practices towards the human factors of ATSEP.
18	Behind the curtain profession
19	Gender bias and equal field works not assigned to women ATSEP.
20	No say of ATSEP in HR policies being set for them.
21	Difference in stated corporate Mission/Vision and the ground reality.

2.1.8. Table 8 – Lack of workplace facilities and environment.

Table 8: Factors that affect the job performance due to lack of workplace facilities and environment.	
1	Lack of basic workplace facilities like parking, canteen, fixtures, rest rooms, vending machines, common transport for pickup and drop from employee quarters to workplace, etc..,
2	Lack of specific workplace facilities for women like identified rest rooms in the operational areas, Creche, childcare leave, etc…,
3	Lack of protection and guidelines while attending equipment during heavy lightning and abnormal weather conditions.
4	Below par and uncomfortable residential facilities at faraway places instead of provisions of comfortable nearby quarters with reasonable rent.
5	Travelling long distance from home to workplace as green field airports are situated at outer part of the cities and no provision of common transportation facility.
6	Lack of guidelines and provisions of PPE to ATSEP for protecting them while working at highly polluted with noise and dust, heights, closer to high power radiating radars, X-rays, etc..,
7	There is a long wait and no provision of comfortable and appropriate mode of commute to approach remote sites even though during scorching summer days.
8	Frequent exposure of high outside remote site temperature and less inside equipment room temperature in a shift.
9	Narrow space around equipment racks filled with too many wires and connections, making difficulties in accessing and replacing the modules.
10	Congested or no desk / table. Too many items placed in the control and monitoring room. No space for keeping important manuals, procedures, SOPs in most visible and accessible manner.
11	Installations at very remote places, and high mountains preventing regular visits due to resources.
12	Difficulties in trouble shooting behind the ATC consoles in general and at late night hours due to poor lighting at the behind the console.

2.1.9. Most Significant Factors as per ATSEP

Factors that affect the health
B.7.1. Frequent (change of) exposure to too low temperature in the server or equipment room and too high outside temperature.
B.7.2. No access of fresh air and sunlight for long duration.
B.7.3. Working under severe dust pollution during the project work.
B.7.4. Working under noise pollution in the airfield.
Factors that affect the attention
B.8.1. Diversified tasks during duty.
B.8.2. Monotonous monitoring for a long time.
B.8.3. Combined project and operational tasks.
B.8.4. Working in lower temperature in equipment room.
Factors that affect the response time
B.9.1. Fear on consequences of failure while trouble shooting in live system.
B.9.2. Inadequate first-hand information given by user.
B.9.3. Non availability of vehicle to reach the remote site.
B.9.4. Short of ideas; being alone.
The training that are most preferred by manager level ATSEP
B.10.1. Planning (for replacement of obsolete system) and procurement.
B.10.2. Stress and fatigue management.
B.10.3. Project management.
B.10.4. Contract management.
Most significant roadblock that prevents ATSEP in developing their competencies and expertise
B.11.1. Expected competencies in all domains of CNS/ATM systems.
B.11.2. Different make and model for each facility / system.
B.11.3. Deployment in non-core activities for longer duration.
B.11.4. Compulsory movements within the nation during service life

This page is intentionally left blank

APPENDIX 3 COUNTERMEASURES

3.1. Introduction

C.1. Reviewing maintenance philosophies, utilizing technologies, and bringing innovation to supervise CNS/ATM systems for reducing paper works, physical visits and saving manhours.
C.2. Improving the safety job performance of ATSEP by restricting their deployment within the scope defined in DOC 10057
C.3. Pre-planning the pre-monsoon, annual and other major preventive maintenance tasks well in advance and carrying out the tasks as planned. So that sudden or total failures and long corrective maintenance works prevented
C.4. Roadblocks on procurement process can be reduced by training selected ATSEP on government compliance requirements by experts having background on the financial regulation. ATSEP those who participate in the major or repeated procurement process can be permitted to have consultants on these areas
C.5. Pro-active procurement and replacement policies in managing the out-lived equipment will reduce the stress among the key stake holders of ANSP due to their safety commitment
C.6. ANSP level scientific knowledge management on operations, maintenance, projects, and emergencies will reduce the stress significantly as ATSEP are continuously learning the latest problems and solutions and be ready with the proven techniques
C.7. By providing only optimum number of verified and validated SOPs without redundancy, the stress of restoring facilities in brief time, will reduce significantly
C.8. By limiting their stream of competency among CNS/ATM facilities, higher levels of expertise and competencies can be developed and retained.
C.9. By defining the roles and responsibilities clearly along with accountabilities, individual job performance of ATSEP will increase and in-turn over all safety performance of ANSP will also increase.
C.10. By ensuring necessary OEM documentation and support on spare that suits the maintenance philosophies of the ANSP, overall effectiveness of corrective maintenance will improve.
C.11. With regular optimum augmentation of human resource based on the existing tasks, expected retirements, and expected additional facilities, the stress and fatigue levels of ATSEP can be brought to a minimum and safety goals can be assured.
C.12. To ensure the fullest commitment of all the ATSEP on safety tasks, ANSPs must encourage the safety work culture in the working environment of ATSEP to make sure that no ATSEP is left out. ANSPs can improve safety work culture by taking the following measures:
C.12.1. Sensitizing all the stakeholders on the role of ATSEP in ATM service delivery and contributions to air safety
C.12.2. Imparting human factors training to ATSEP and explaining the safety impacts from the perspective of human factors
C.12.3. Rewarding the safety performance
C.12.4. Encouraging them to voluntarily disclose the errors committed before major shutdown to find the root causes.
C.13. To prevent the ATSEP to be complacent and getting bored on repeated tasks, ANSPs must try to engage them during shift duties constructively so that they remain engaged and remain alert to handle the unexpected. ANSPs can improve the engagement of duty ATSEP by taking the following measures.

C.13.1. Encourage innovation on routine tasks.
C.13.2. Promote research groups within the ANSP
C.13.3. Rewards and promotion based on contribution and effort
C.13.4. Assign dedicated small assignments based on the specific talents and skills.
C.13.5. Provisioning online based self-learning tools
C 13.6. Random Fault Simulation (Mock drills) and performance assessment of ATSEP based on this exercise.
C 13.7. Innovative ideas should be welcomed through brainstorming sessions with the frontline experts before making major policies and procurements of new systems.
C 13.8. By limiting their stream of competency and developing higher level expertise and competencies, national level backup team can be formed for emergency, disaster, and pandemic situation.
C.14. To keep the motivation level of ATSEP to progress continuously upward, ANSPs need to adopt the best practices in their work environment. It is a human nature to benchmark their organization and work environment with that of others. So, ANSPs need to keep adopting the best practices into the working environment. Some of the best practices that can be adopted are
C.14.1. Assessing optimum manpower requirement, recruit competent people, train, deploy and promote accordingly.
C.14.2. Following procurement policies that facilitates buying quality systems.
C.14.3. Providing working environment, with consideration to human factor issues of ATSEP
C.14.4. Conducting seminar on best practices adopted at different airports within ANSP.
C.14.5. Following HR policies that encourages recognition, appreciation, and suitable compensations.
C.15. Knowledge, skills, attitude, and competencies of ATSEP are very essential for their safety job performance. ATSEP job performance is essential for meeting the safety goals of any ANSPs. The following are among the essential competency developments on which ANSPs can focus in developing on their ATSEP.
C.15.1. Train ATSEP in human factors as per DOC 10057 in various levels that suits their technical and managerial accountabilities
C.15.2. Train ATSEP on Engineering module as per DOC 10057 that suits the ANSP roles on projects and procurements
C.15.3. Developing competency for preparing upcoming complex CNS/ATM systems' specifications.
C.15.4. Developing Communication skills for effective communications with internal and external stakeholders.
C.15.5. Developing skills for preparing detailed project reports and technical reports
C.15.6. Developing skills for analysing the external interference, external interfaces, data formats, communication protocol and communication links associated with CNS/ATM facilities.
C.15.7. Training on infrastructure as per DOC 10057.
C.15.8. Training on factory and site acceptance tests of major systems for verifying the performance of the system compliance of user requirement and tender terms and conditions.
C.15.9. Training on handling emergency and disaster situations.
C 15.10 Soft skill development to increase the productivity – project management, contract management, Teambuilding, and other relevant skills.

APPENDIX 4 ATSEP DUTY TIME LIMITATION

4.1. Introduction

As humans, we each have a unique living, breathing set of capabilities. We also have an innate set of fears: at the workplace, this can translate to fear of criticism, fear of uncertainty, and fear of harming one's career. Organizations that prioritize and strengthen employee development not only enable their workers to realize their full career potential but also foster an organizational culture of innovation.

It is no longer a surprise that people seek more from their employers than just a paycheck and a safe place to work. A preponderance of evidence suggests that "good work" also means satisfying employees' psychological needs. (Meet the psychological needs of your people--all your people | McKinsey).

"Duty working hours" means the period during which an employee is available for employment. "Duty working Hour" is an integral part of the workspace environment and a crucial factor in determining the psychological needs of an ATSEP.

There have been incidents of traffic diversions, partial or full closure of airport operations due to non-availability of safety critical Air Navigation Facilities. Accidents cannot be ruled out if the stress and fatigue issues of ATSEP are not addressed. Better workspace environments are key factors in reducing their stress and fatigue.

4.2. Definitions

- Period of Duty - The period during which the ATSEP is required to carry out any task associated with the CNS/ATM service provider, includes breaks and any extension of duty.
- Operational duty - the period that an ATSEP is really using their knowledge of equipment for providing CNS/ATM service to end users.
- Night duty - A period of duty of not less than four hours between 2200 hours and 0700 hours next following in local time.

4.3. Background

Throughout the operation and maintenance work profile, an ATSEP must be vigilant and effective, prepared to handle any unanticipated circumstances that may arise, such as the effects of degradation of equipment, equipment failure due severe weather or visit to a remote place without any support. Ergo, Extreme anxiety and stress arise.

A Survey was conducted across various ANSP to analyse prevailing working hours and shift pattern which may assist us in defining the best policies and practices around the globe to make ATSEP work environment better and efficient.

From the following three graphs, ATSEP worldwide work under difficult working environments due to a lack of duty time guidelines, which results in poor job performance due to duty duration, shift cycles, late-night calls, and other late-hour maintenance work without breaks and rests.

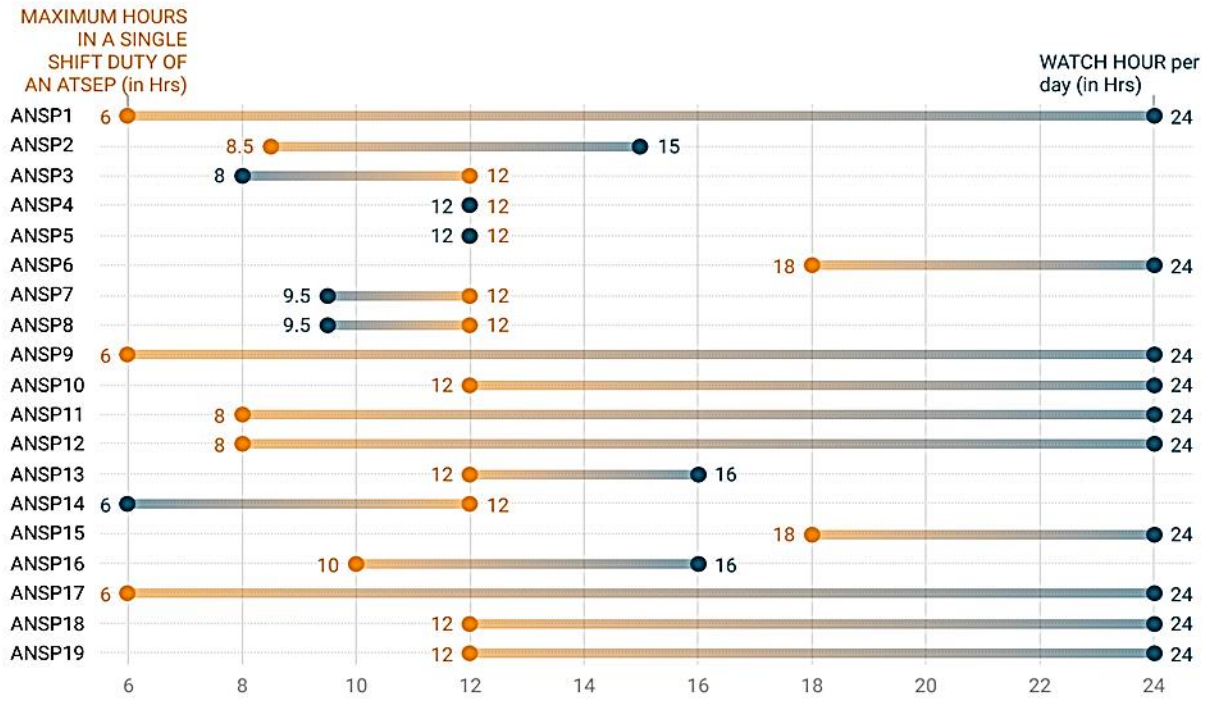


Figure 7: ATSEP Duty Time Analysis - 1

Plot Between "Watch Hour per Day (In Hrs)" vs "Maximum Hour in a Single Shift"

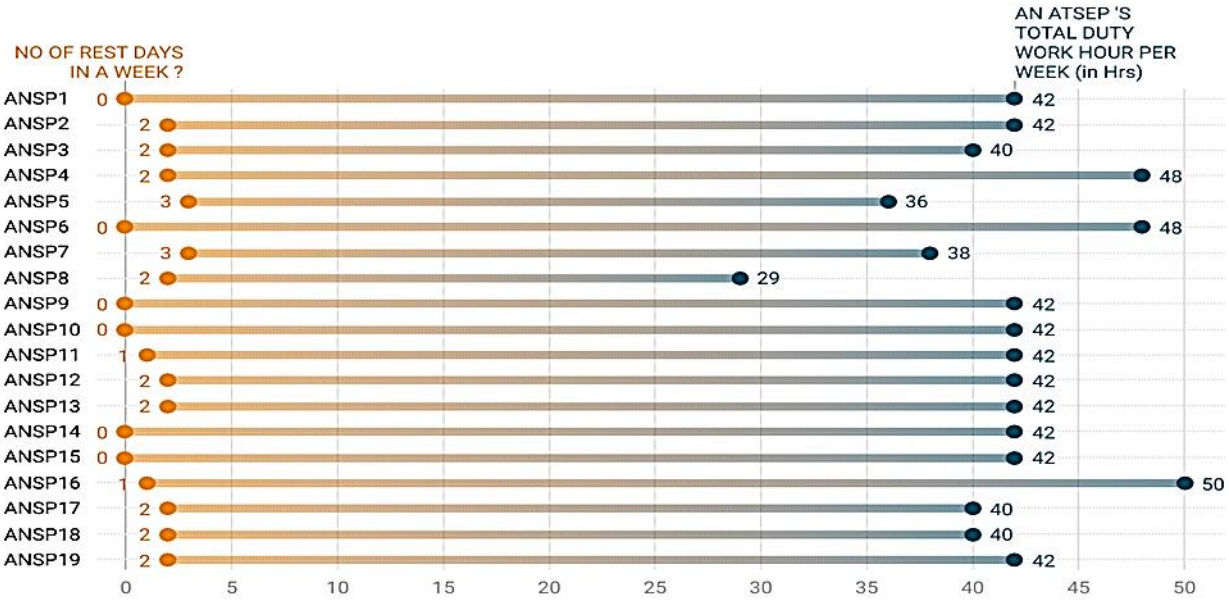


Figure 8: ATSEP Duty Time Analysis - 2

Plot Between "Total Duty Hours per week" vs "Number of Rest Days in week"

Plot Between "Any Break During the break (in Hrs)" vs "Maximum Hour in a Single Shift (In Hrs)"

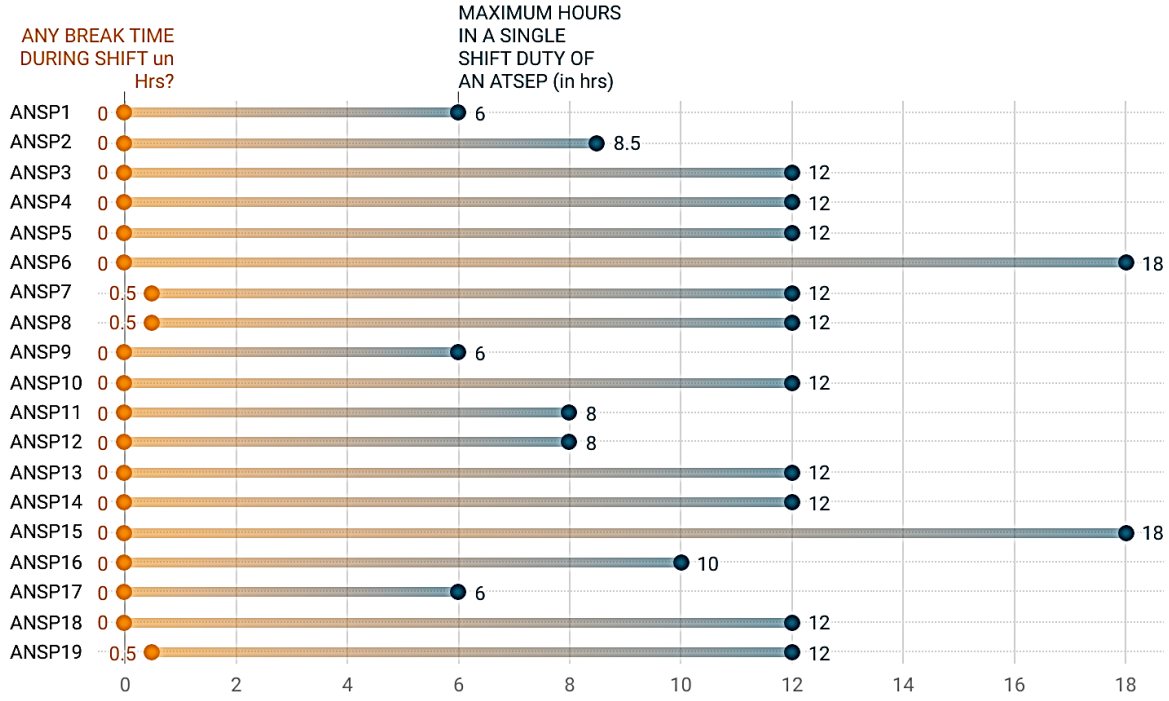


Figure 9: ATSEP Duty Time Analysis - 3

4.4. Best Shift duty pattern

Circadian systems need to be considered in relation to three differing levels of organization of information and operation. First is the way in which the physical environment communicates (or 'Inputs') key information, particularly related to differentiation of night from day to the internal 'master' clock (located in the brain's suprachiasmatic nucleus (SCN)). Second are the 'Intrinsic' brain factors, consisting of the master clock and its linked regulatory systems (notably secretion of melatonin from the pineal gland). These contribute to sleep onset, sleep architecture, sleep-wake cycles, and other central nervous system (CNS)-dependent behavioural changes. Third is the way in which the circadian system coordinates all other hormonal, metabolic, immune, thermoregulatory, autonomic nervous and other physiological processes to optimize the relationships between behaviour and body functions (that is, the 'Outputs') (reference: Manipulating the sleep-wake cycle and circadian rhythms to improve clinical management of major depression).

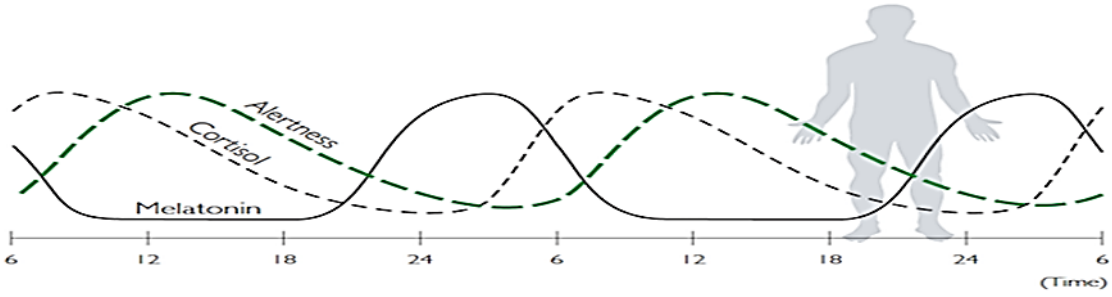


Figure 5: Sleep / Wake Cycle

The human organs are orchestrated to work in harmony with each other, generating a body rhythm that is set everyday by daylight. This rhythm is called the circadian rhythm and includes production and secretion of hormones to regulate functions such as body temperature, awareness, and immune system activity.

Because of the reduced traffic volume or no traffic, maintenance of CNS facilities is frequently performed at night. We are aware of this reality, but we also need to consider factors like human factor, safety concerns.

The most common maintenance systems/practices in use are planned, predictive, scheduled, corrective and emergency.

- Planned maintenance - Planned maintenance refers to any strategy where you plan and perform maintenance tasks before a fault occurs. Preventive maintenance is more specific.
- Predictive maintenance - Predictive maintenance is a strategy that tracks equipment's performance while it is in use using condition-monitoring technologies and methods.
- Corrective maintenance - Corrective maintenance (CM) involves the replacement or repair of equipment after it fails.
- Emergency maintenance - Emergency maintenance, also known as breakdown maintenance, is maintenance required when an asset or piece of equipment suffers an unexpected breakdown.



Figure 6: Shift Duties Effect on Health

4.4.1. Shift work with ATSEP performance and Aviation safety

Number of successive night shifts

- The chance of errors and accidents rises with the number of subsequent night shifts; the risk is 13% greater on the second night, 25% higher on the third, and 45% higher on the fourth.

- Up to a shift cycle of seven consecutive shifts, the risk for each shift block increases with the length of the blocks and is dependent on the number of consecutive nights.

- The results agree with findings about performance reduction due to fatigue.

Shift length

- Vernon (1921, 1940) was the first to note that working twelve instead of eight hours raised the chance of an accident by a factor of 1.5 to 2

- Studies have shown that in extended shifts:

  1) Fatigue and the risk of incidents is increased

  2) Productivity is decreased

  3) Employees are longer exposed to higher stress levels

- However, Twelve-hour shifts are highly preferred by employees since they allow them more spare time by reducing the number of trips to the workplace.

Night shift

- The ability of employees to work at night is fundamentally constrained by their biological clocks and levels of activation during the day, respectively.

- Significantly decreased productivity and performance from 7 p.m. to 7 a.m.

- Human Performance found to be lower, especially between midnight and six in the morning. (2003's Folkard and Tucker).

- However, alternative, and occasionally less dangerous duties are regularly carried out at night.

Shift work and productivity

- Productivity in the field of economics is defined as the ratio of the quantity and quality of units produced to the labour per unit of time

- In CNS/ATM, productivity is usually seen in safety, low amount of delays due a smaller number of missed approaches, communication failure, equipment failure.

- Productivity is not only dependent on the right amount of arousal, but also on the number of hours worked, night work, allocation of breaks and type of roster.

Shift work and efficiency

- The term efficiency means an ability to perform well or achieve a result without wasted energy, resources, effort, time, or money.

- The following are the main shift work impacts on efficiency:

a. Shift length-varied, contained, or extended,

b. Shift starting time-staggered or rigid, matched, or circadian rhythm or not,

c. Overlapping shifts-single shifts overlap each other

d. Break times-fixed or varied according to traffic demand,

e. Break facilities-exercise, relaxation, meals,

f. Roster cycle-short or long,

g. Roster organization-individual or team,

h. Advance notice of duty-short or long,

i. Management of time leakage

j. Management of overtime

4.4.2. Shift work design

1. Shift system design calls for an elevated level of expertise, knowledge, and experience on the part of the designer.

2. The design of shift systems aims to create a working-time organization that considers the company's interests (safety, productivity, and efficiency), health-affecting factors, social impairments, as well as individual preferences.

3. The specific circumstances of the work situation, the workload, its spatial and temporal distribution, the individual conditions, such as age, attitude, and social support, as well as the organizational frame, play a crucial role in the design of shift systems.

4.5. Guidelines for best shift duty pattern

4.5.1. Guideline 1 - Successive night shifts

The number of successive night shifts should be as low as possible; it should not exceed three-night shifts in a row.

Explanation

1) Many shift workers having a schedule of five or more successive night shifts feel that their body has adapted, there is genuine adaptation of the body functions to working at night.

2) Working successive night shifts causes an accumulation of sleep deficiency with reduced sleep quality. To health damages the risk of accidents is increased due to the increasing fatigue.

3) The number of night shifts does not only affect health, but also social relations.

4) Working at night means working against the body clock. Therefore, the night shift period should be as short as possible.

5) The number of the successive night shifts should be as low as possible to avoid an accumulation of sleep deficiency and negative social consequences, respectively.

4.5.2. Guideline 2 - Rest period between night shifts

After a night shift, the rest period should be if possible. The resting time should not be less than 24 hours.

Explanation

1) Scientific research has shown that working night shifts carries an additional risk on top of the tasks involved in the profession. Considering this, workers ought to be given additional downtime following their night shift.

2) The ideal recovery period is 48 hours. Unfortunately, it is difficult to always keep this advice in mind when putting it into reality.

3) Night shift work is regarded as an added risk. As a result, the time spent relaxing following a night shift needs to be increased. It is important to consider the features of cohesive leisure time.

4.5.3. Guideline 3 - Coherent blocked free time at the weekends

Coherent, 'blocked' free time at the weekend is to be preferred to single days off during the weekend),

Explanation

1) Even though the structure of the workweek is diversifying, the weekend still occupies a prominent position.

2) Most workers place a much higher value on free time on the weekends than they do during the workweek.

3) Coherent weekend free time is defined as two consecutive weekends with at least one Saturday and one Sunday being completely free. For instance, Friday and Saturday, Saturday and Sunday, or Sunday and Monday are all combinations.

4.5.4. Guideline 4 - Number of free days

Shift workers should have more free days per year than employees on day duty.

Explanation

1) Working on the weekends and on holidays should be compensated with leisure time even with a continuous production method.

2) Additionally, compensating for the added stress brought on by working night shifts.

3) The payment should be made in the form of free time. Additional free days are to be offered based on the number of night shifts.

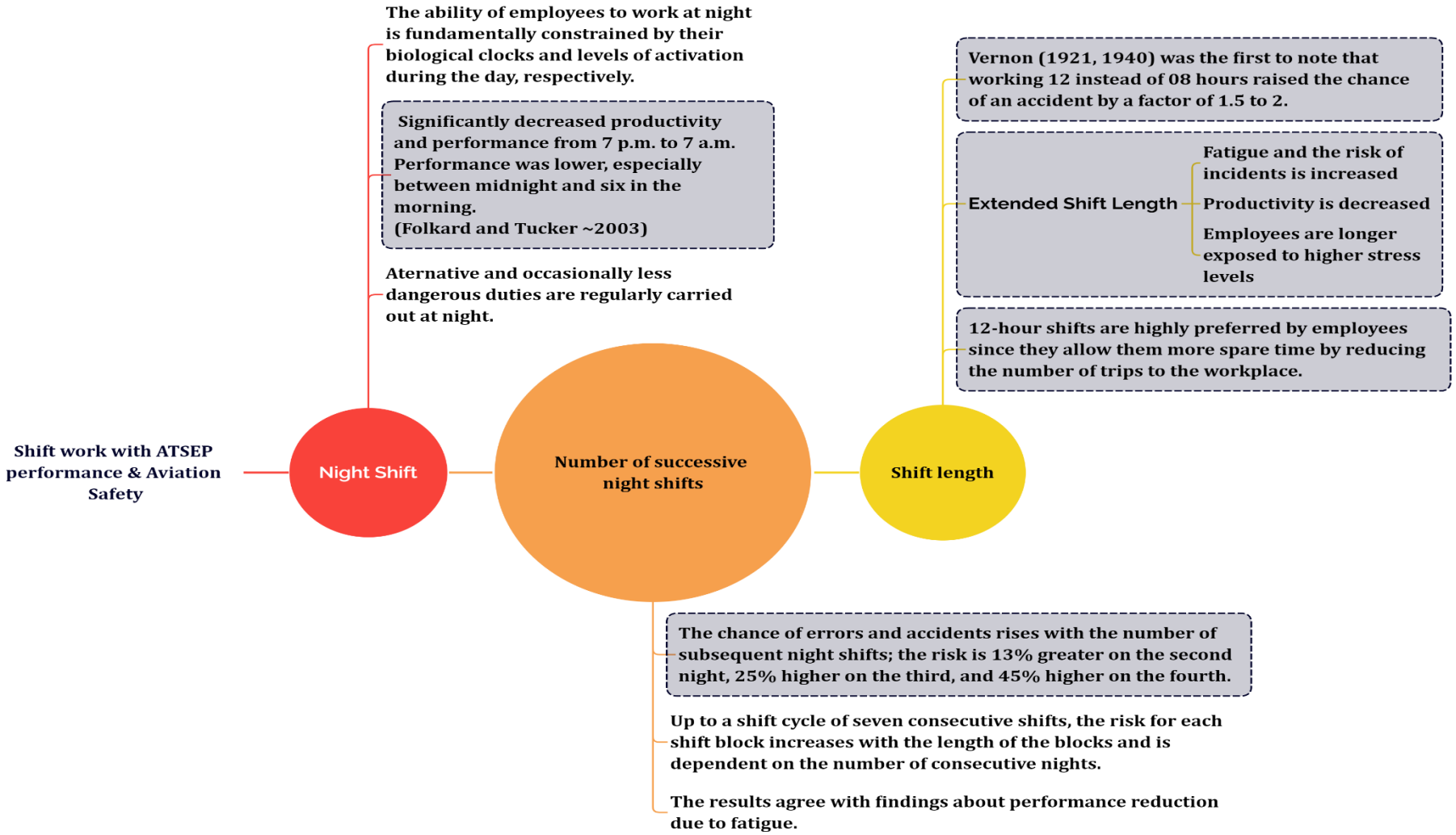


Figure 7: Shift work with ATSEP Performance and Safety

4.5.5. Guideline 5 - Shift rotation pattern

Unfavourable shift sequences are supposed to be avoided. Forward rotation is preferable.

Explanation

1) According to ergonomic research, workers who rotate their shifts forward (early, late, and night shifts) experience less health problems than those who cycle their shifts backward (night, late, early, shift).

2) In systems with a forward rotation, the rest periods between shifts are typically longer.

4.5.6. Guideline 6 - Early shift

The early shift is not supposed to start too early.

Explanation

1) The early shift is not intended to be only a portion of the night shift. They must wake up at 3:30 in the morning to begin their shift at 5:30 in the morning because many employees today frequently have long commutes to work.

2) It has been observed that workers who work the early shift do not often retire much earlier. Many people also worry about not waking up on time.

3) This causes a significant sleep deficit, particularly in long-rotated systems.

4.5.7. Guideline 7 - Night shift length

Night shifts should finish as early as possible.

Explanation

1) This advice is based on the discovery that the times of daytime sleep are related to the time of sleep onset.

2) The likelihood of sleeping for a longer period increases with earlier sleep onset.

3) Due to their body clocks, most employees awake around midday after night shift.

4) The length of their sleep varies depending on when they first fell asleep.

4.5.8. Guideline 8 - Concentration of working hours restriction

The concentration of working days or working hours on one day is supposed to be restricted.

Explanation

1) Experience has shown that shift arrangements with a significant amount of free time are quite appealing to the workers.

2) The concentration required during work hours must be sacrificed to have extended periods of free time.

3) Many shifts must be completed without a break on days off to obtain extensive free leisure periods.

4.5.9. Guideline 9 - Notification of rosters

1) Employers must provide the roster at least seven days' advance.

2) Prior to the start of a shift, an employer must give employees at least 48 hours' notice of the start time due change in roster.

3) Employees should receive financial compensation if prior notice is not possible with at least 48 hours' notice.

4.5.10. Guideline 10 - Rest in Night Shift / Single Shift

1) An employee shall be allowed periods of rest from operational duties in accordance with occupational health and safety principles (fatigue risk management assessment and screen-based work).

2) The ANSP shall monitor the occupational health and safety element of shift lengths and operational duty requirements for the provision of breaks on safety and risk assessments in circumstances when only single-person staffing is offered or on night shifts

4.5.11. Guideline 11 - Emergency Duty

1) Emergency Duty: employees may be required to work emergency duty, that is, work in circumstances where they are recalled working to meet an emergency at a time when the employee would not ordinarily have been on duty and notice of which was not given prior to an employee's ceasing duty on the previous shift. Proper rest should be given to the employee.

4.6. References

1) The circadian rhythm in balance (parans.com).

2) Manipulating the sleep-wake cycle and circadian rhythms to improve clinical management of major depression | BMC Medicine | Full Text (biomedcentral.com).

3) Human Factor of ATSEP.

4) IFATSEA Mastermind group discussion.

5) ICAO Asia Pacific meeting for preparation of human factors guidance material for ATSEP.

APPENDIX 5 MEASURES DURING PANDEMIC

5.1. Introduction

Coronavirus disease, often known as Covid-19, is an infectious & contagious disease, which took the world in its grip like a wildfire. The virus (Corona Virus) was initially discovered in in 2019. Covid-19 was declared a global pandemic by the World Health Organization in March 2020. True to the nature of Pandemics, Covid-19 swept the Civil aviation off its feet and in turn threatened to destroy the world economy by sheer disruptive impact. No doubt that, it was a devastating year for the aviation industry. Since then, the International Civil Aviation has been trying to limp back to normalcy. Considering the current dependence of world economy on aviation, it can be safely said that the sooner Civil Aviation acquires normalcy the better it will be for Global economy. However, seeing the crisis from only Economic perspective and ignoring the Human angle may generate a wrong perception. Such erroneous perception may lead to mitigation methods that are bereft of Human factors.

The Civil aviation is supported by the Pilots, ATCOs, AMEs and the common binding force connecting all of them: the ATSEP. That there should be measures taken to preserve this workforce to enable it to operate at full efficiency and in turn ensure Safe, Timely and Efficient Civil Aviation. We must also consider the fact that Covid-19 may not be the last pandemic to hit mankind. That means that we must be on a lookout for the minute symptoms and remain in a state of preparedness to ensure that the Covid- induced glitch remains an isolated phenomenon.

5.2. Backdrop of the Paranoia: Fear psychosis behind Covid- 19

In the case of COVID-19, it has been a suffering on the part of ANSPs and the ATSEP as well. Whereas for ANSPs the pandemic has meant considerable loss on the economic front as well as on the Personnel front. So many precious lives have been lost and many others have been scarred for life.

1. Fear of Contracting the Disease while performing Operational duties. To cover the Medical, Cargo, Repatriation flights ATSEP had to be on active duty, however the atmosphere of fear was always there.

2. Airline staff/ Traffic hands coming with Physical FPL, NOTAM Broadcast messages etc. This is an interaction which has been unavoidable due to the existing methods of operation. But at the same times, such methods mean that the Covid-19 protocols were to be ignored at times.

3. Being alone on duty- No one to share load/ feelings etc, giving rise Negative Emotions & thoughts. ANSPs resorted to Single person duty to ensure maximum Physical separation. However, this move resulted in personnel performing duties alone and hence battling negative emotions.

4. Worry about risk to family members. Every operational duty person was worried about the possible risk to family members especially when the Office atmosphere was not totally risk free.

5. Reduction in Opportunity for knowledge/ skill enhancement- especially in Classroom environment. Technical personnel are more used to classroom trainings and physical interaction with Instructors/ Mentors.

6. Reduction in Salary and continuous fear of Layoffs. ANSPs in general opted for reducing the salary of the staff to cut the losses in view of the economic slowdown arising out of State enforced lockdown and Pandemic situation.

7. Delay in Arrangement of Sanitization, Arrangement of Vaccines despite being Frontline workers. ATSEP functioned as frontline workers during Pandemic. But when vaccinations were being arranged, the frontline worker tag was conveniently taken away.

5.3. The Mitigation measures to be taken during Pandemic.

1. Provision of Adequate and quality preventive measures at Offices (Sanitizers, masks, PPE etc). A happy and confident worker is an efficient worker. Immediate address of safety concerns of ATSEP with respect to contracting disease on duty can be mitigated and services be utilised in efficient manner.

2. Technical strive to reduce handling of physical papers, this will ensure suitable follow of Covid-19 protocol which very clearly mentions maintaining Physical distancing.

3. Raising Awareness among ATSEP by displaying Posters with messages, Dos/ Don'ts etc. By suitable display of Placards/ posters, the ATSEP can be educated about the methods to keep oneself safe and free from the disease.

4. Ensure Clean & hygienic Office Environment. A clean and hygienic office atmosphere can go a long way in ensuring mitigation of any pandemic be it Covid or any other in future.

5. Pre-order sufficient Sanitizers, masks etc. By ensuring proper and sufficient supply of preventive supplies, fear psychosis can be dealt with.

6. Regular and mandatory Counselling Sessions for ATSEP. Though posters and placards help to educate the personnel, it is required to carry out regular counselling of ATSEP regarding the preventive methods.

7. Active engagement of Non-Operational staff in monitoring the situation & liaison with state/ medical organizations. Coordination with the National level Medical Organizations

8. Consider whether a Face-to-Face meeting is must or Teleconference could be sufficient.

5.4. The future course of Action

The pandemic struck and wreaked havoc all around. Now what?? We need to embark on a continuous process to mitigate and to remain prepared for any such Pandemic- like situation that may occur in future.

1. Assessing the priorities within the aviation sector. The ANSPs need to set the priorities right. In the event of any future Pandemic, the ANSP must prioritize the Physical and Mental health of the ATSEP. This will be a win-win situation for both- ATSEP and ANSP. As the ANSP would be able to sustain the critical operations by ensuring Physical and Mental well-being of the ATSEP. Since the maintenance of CNS-ATM systems is the prime responsibility of ATSEP, effort should be made to minimize the exposure of ATSEP to risky environment in Pandemic situation.

2. Identifying human factors and human performance related risks. Pandemic like situations tend to leave permanent scars in the mind of the survivors. It may also result in loss of confidence of the personnel who have gone through these situations. It is important to address such issues by carrying out confidence building methods.

3. Identifying potential indicators for monitoring the COVID-19 situation and Monitoring of occurrences and trends. Proactive monitoring may be a domain of the State health agencies, but by suitable liaising with the State agencies, the preparedness condition can be enhanced.

4. Reporting systems and documenting lessons learned. Once the effect of Pandemic has been dealt with, it becomes especially important to prepare for any such eventuality in future. The pandemic has taught many humane values and critical lessons. These must be incorporated in Human factor considerations.

5. Planning for the restart of operations. This step involves many sub-plots that work towards ensuring a proper restart of aviation after the ill effects of the pandemic:

- Design a restart/ relaunch framework.
- Take steps to build confidence among the end users and the technical experts (ATSEP).
- Safeguarding the health of personnel.
- Review of the demand-supply chain. How much to start full-fledged and how much to operate at a degraded level.
- Handling the restart with a Human touch.
- Sustaining the values learnt from pandemic crisis and planned investing in recovery.

5.5. References

1. Human factors of ATSEP: Factors & Countermeasures.

2. https://www.icao.int/covid/cart/Pages/CART-Take-off.aspx

3. Brainstorming sessions of Mastermind group.

4. Brainstorming sessions of APAC workgroup of HF guidance material preparation.

This page is intentionally left blank

6.1. Introduction

ATSEP (Air Traffic Safety Electronics Personnel) is the recognized terminology used for personnel competent in the installation, operation, and maintenance of a CNS/ATM system. ATSEP are those technical specialists working to provide and support the electronics and software which enable ATS systems to function. ATSEP comprise engineers, technicians, and computer hardware and software specialists who are responsible for the specification, procurement, installation, calibration, maintenance, testing and certification of ground electronic systems used to help control aircraft movements. ANSP has the responsibility to define the scope of ATSEP activities and it must be approved by appropriate authority. A competency-based training and assessment program for ATSEP has already been established which is recommended for the training of ATSEP by ANSPs. Lately Aviation fraternity has taken cognizance of the role played by ATSEP in delivering safety and of their role in the safety chain. At a time of increasing complexity of the air traffic system, it is important to minimise the risk arising from technical and engineered systems, and to ensure their correct functioning.

In this context, ICAO has specific documents recommended for preparation of CBTA training material for ATSEP namely Doc 9868 (PANS- TRG) and Doc 10057 (Manual of ATSEP CBTA). ANSPs are expected to design ATSEP training programs based on the above referenced Docs.

6.2. Background of ATSEP training

1. The scope of activities performed by ATSEP is of a wide variety: knowledge skills and aptitude required in fields of Electronics, Computers, and network, however not limited to these. At the same time level varying from Technician to maintenance engineer and going up to High level engineering. Working in such varied CNS/ATM systems requires a wide Range of competencies and expertise.

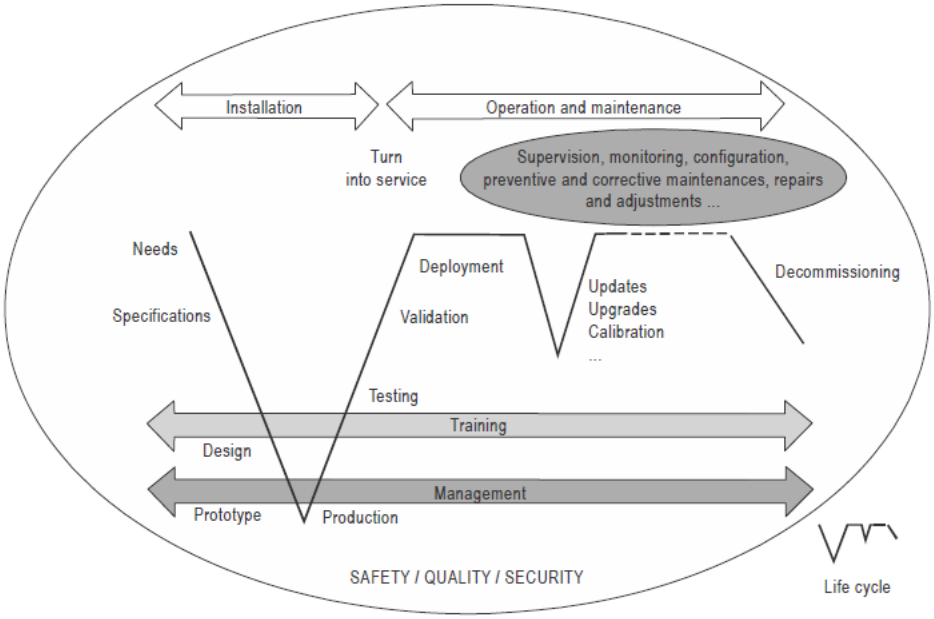


Figure 13: Scope of ATSEP activities

2. The Training Phases of ATSEP can be organized into five phases namely: Selection, Initial Training, Unit Training, Continuation training, and Development training.

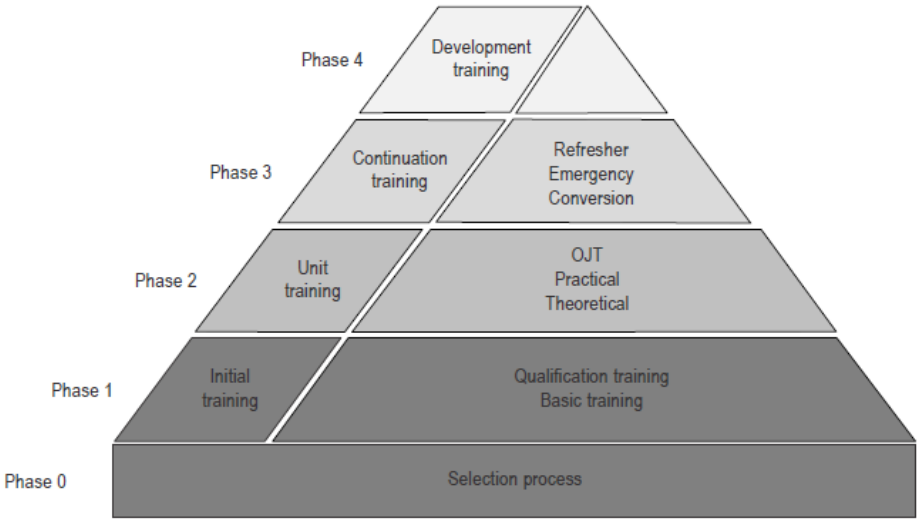


Figure 14: ATSEP training phases

3. The ATSEP training path and its progression is also well taken care of by the Doc 10057. It defines the training requirements in the event of Change within the system; Change of domain; Change of activities, and inclusion of any additional system. The ATSEP training progression can be depicted through the appended figure.

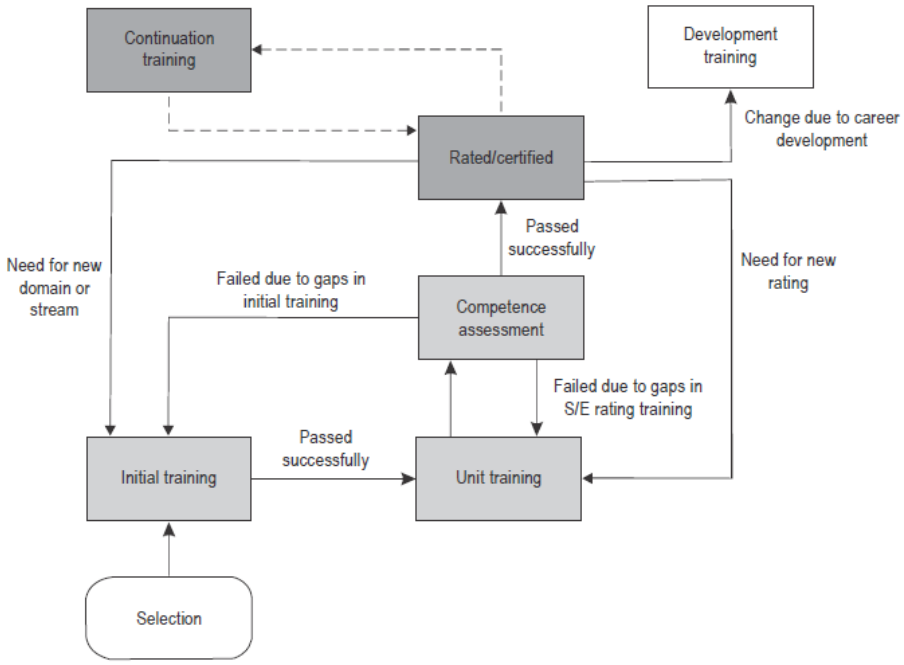


Figure 15: ATSEP training progression

6.3. The Roadblocks to complete adoption of the Docs 9868 & Doc 10057

1. Trainee is required to be taken out from normal duties for imparting training.
2. Exorbitant Training Cost in terms of infrastructure and training Man-hours as well.
3. Maintenance perils of Training on live equipment (at centres other than Dedicated training Centres).
4. Communication gap between ATSEP, ATCO and Pilot in terms of facilities being available for Operation or withdrawn for training purposes.
5. Lack of awareness regarding Airborne equipment and its functions.
6. Maintain the competency by continuous assessment and measurement of the performance criteria

6.4. How can these roadblocks be addressed?

1. Simulation and real-life based experiments with the live systems.
2. Build a repository of questionnaire and update frequently to have a training infrastructure which is not system- dependent.
3. Maintaining centralized general log and fault logs.
4. System wide information management- Access to all kinds of information from OEM to all levels of ATSEP i.e., CNS/ATM system issues from installation to commissioning, operational and maintenance issues, faults, and their solutions. Seamless access to procedures, standards, and recommendations of CNS/ATM related information.
5. ATSEP should have a knowledge of ATM operational environment and the exact application of facilities being provided.
6. Unit level training on operational equipment and on a backup system.
7. Collection and analysis of the system logs from time to time.
8. Refresher courses and proficiency checks.

6.5. References

1. DOC 10057 Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment.
2. Doc 9868 - PROCEDURES FOR AIR NAVIGATION SERVICES – Training
3. Brainstorming sessions of APAC workgroup of HF guidance material preparation
3. Brainstorming sessions of Mastermind group.

This page is intentionally left blank

APPENDIX 7 STRESS MANAGEMENT

7.1. Introduction

Stress is the psychological and physical state that results when the resources of the individual are not sufficient to cope with the demands and pressures of the situation. Thus, stress is more likely in some situations than others and in some individuals than others. Stress can undermine the achievement of goals, both for individuals and for organizations.

Stress at workplace, changes in the work environment has led to a change in the balance between physical and mental activity. Technological developments have reduced the amount of heavy physical work. Mental and emotional strain have increased in new working environments that are characterized by lack of time, more uncontrollable factors, background distractions, lack of space, general uncertainty, and more administrative work.

Stressors are the agents which trigger the various stress reactions. Today's environment provides physical, emotional, and mental stressors that set off the initial alarm reaction. Physical stressors in factories are usually linked to noise and physical and chemical hazards. Emotional or mental stressors can be unpleasant or pleasant. A promotion can be just as stressful as the loss of a position. Stressors are additive and can build up. The way in which people are affected depends on their values, experience, and adaptability. A single stressor can become compounded if elements of the established support system fail-for example, if a car breaks down on the way to an important meeting.

7.1.1. Process of stress – Three stages

7.1.1.1. Alarm reaction

This is the immediate response to a challenge or threat. Mobilisation of the autonomic nervous system triggers the stress response ("fight or flight" response). The various body systems involved coordinate the readiness for action, influencing mood (limbic system), the regulation of the cardiovascular system, breathing, muscle tension, and fine motor activities.

7.1.1.2. Resistance stage

The alarm reaction cannot be maintained indefinitely, and longer exposure to stressors causes people to reach the resistance stage. In this phase people develop a "survival" strategy and a way of fighting against the response the stressor has initiated. Coping mechanisms may be adequate or inadequate. People tend to prefer short term relief to long term solutions and try to escape uncomfortable situations with a quick remedy. Unfortunately, most easy, short-term measures are inadequate because they usually lead to secondary problems such as long-term reduction in performance. People need help to identify measures that can lead to long term benefit.

7.1.1.3. Exhaustion stage

The stress response is healthy in origin and is necessary to keep a person motivated and adaptable. It is when the demands on body and mind are too high or cannot be met in an appropriate way that the person becomes "distressed." Prolonged stress can lead to chronic problems, an exhaustion of all reserves and energies and even frank depression.

7.1.2. Causes of stress at working situations

Stress is often related directly to the job specifications and working environment or to relationships with people at work, or a combination of both. Conflicts with managers, subordinates, or colleagues may increase as work becomes more pressured. Smaller workforces are expected to do the same or more work, and there is a widespread lack of training in communication and interpersonal skills. Some of the stress also relates to the identification of a person's role.

7.1.2.1. Stressors in the working environment

- Uncertainty and lack of control (low job discretion)
- Lack of support from others including co-workers
- Extreme demands of working environment-long hours, high responsibility, commitment
- Extremely low demands leading to boredom, lack of meaning in work.
- Workstation-noise, poor lighting, lack of space, extreme temperatures poor ergonomics
- Chemical hazards, fumes, passive smoking
- Repetitive tasks

7.1.3. Consequences of stress

Table 7: Consequences of Stress

Physical disorders	Emotional disorders	Mental dysfunction
Tension headaches, migraines irritable bowel syndrome Impaired resistance-Colds and other "viral" illnesses Potentiation of asthma, dermatitis, psoriasis, backache "Gastritis" High blood pressure	Depression Suicidal ideation Anxiety syndrome	Accidents or near accidents Loss of clarity of thought Reduced performance Difficulty in concentrating- "Small" but important things are forgotten or misled. Increase in mistakes and excuses. Increase in misunderstandings at work and at home. Sudden loss of short-term memory

7.1.4. Symptoms of Stress

Table 8: Symptoms of Stress

Frequent headaches, jaw clenching or pain	Excess anxiety, worry, guilt, nervousness
Gritting, grinding teeth.	Increased anger, frustration, hostility
Stuttering or stammering	Depression, frequent or wild mood swings
Tremors, trembling of lips, hands.	Increased or decreased appetite
Neck ache, back pain, muscle spasms	Insomnia, nightmares, disturbing dreams
Light headedness, faintness, dizziness	Difficulty concentrating, racing thoughts.
Ringing, buzzing or "popping sounds.	Trouble learning added information.
Cold or sweaty hands, feet	Forgetfulness, disorganization, confusion
Dry mouth, problems swallowing	Difficulty in making decisions.
Frequent colds, infections, herpes sores	Feeling overloaded or overwhelmed
Rashes, itching, hives, "goose bumps".	Frequent crying spells or suicidal thoughts
Unexplained or frequent "allergy" attacks	Feelings of loneliness or worthlessness
Heartburn, stomach pain, nausea	Little interest in appearance, punctuality
Constipation, diarrhoea, loss of control	Nervous habits, fidgeting, feet tapping.
Difficulty breathing, frequent sighing.	Increased frustration, irritability, edginess
Sudden attacks of life-threatening panic	Overreaction to petty annoyances
Chest pain, palpitations, rapid pulse	Increased number of minor accidents
Frequent urination	Obsessive or compulsive behaviour
Social withdrawal and isolation	Reduced work efficiency or productivity
Constant tiredness, weakness, fatigue	Lies or excuses to cover up poor work.
Frequent use of over-the-counter drugs	Rapid or mumbled speech
Weight gain or loss without diet	Excessive defensiveness or suspiciousness
Increased smoking, alcohol, or drug use	Problems in communication, sharing
Excessive gambling or impulse buying	

7.2. Stress Management

There are known effective ways how the stress can be managed. However, everyone cannot handle the stress in the same manner as their personality differs from that of the others. Let us discuss these points and the benefits of the active stress management further.

7.2.1. Human Nature and Individual Differences

Personality psychology is partly about what makes everyone the same and partly about what makes people differ from each other. That is, personality theories are partly statements about human nature. Of the great many viewpoints that have been taken on human nature, two appear particularly relevant to stress and coping i.e., biological models and goal-based models.

Personality also concerns individual differences. Individual differences can be found on any dimension imaginable, but the five-factors widely adopted as a consensual framework. The five factors are most labelled extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience.

It will also be useful to have a sense of some of the ways in which people differ and expectations of how those differences may play a role in coping.

7.2.1.1. Human Nature

7.2.1.1.1. Biological Models

An increasingly influential perspective, not just in personality but in all of psychology, treats humans as biological entities. From this view, it is desirable to develop a clear understanding of the basic properties of animal self-regulation and of how those properties are manifested in human behaviour. We focus here on three properties: the tendency to approach desirable objects and situations (e.g., food), the tendency to avoid dangerous objects and situations (e.g., predators), and the capacity to regulate the approach and avoidance tendencies.

Biological models assuming approach and avoidance temperaments have acquired a good deal of influence over the past decade. They hold that approach and avoidance systems are supported partly by distinct brain areas, and that the sensitivity of each system (which varies among persons) influences behaviour in response to environmental reward and threat cues.

Effortful control can override impulses stemming from the approach and avoidance systems. It acts as a supervisory system, provided sufficient mental resources are available. This confers many advantages, including constraining emotions and permitting the organism to plan and take situational complexities into account in behavioural decisions. Effortful control is a construct from developmental psychology, but its features closely resemble those of adult self-control: the ability to override impulses to act and the ability to make oneself undertake or persist in difficult, uninteresting, or unpleasant tasks.

Approach and avoidance systems, together with a supervisory system able to reorder the priorities they pursue, form the core of a biological model of human nature. They also form the core of a conceptually distinct but complementary view of human nature.

7.2.1.1.2. Goal-based models

From this perspective, knowing a person means knowing the person's goals and values and the relations among them. In goal-based theories, it is important to distinguish between motivational processes aimed at moving toward goals and those aimed at staying away from threats.

A desired goal has a positive incentive value that pulls behaviour to it. Looming harm or pain has a negative incentive value that pushes behaviour away from it. Sometimes only approach or avoidance is engaged. Sometimes they conflict, as when moving toward a goal also increases possibility of harm. Sometimes they work together, as when attaining a desired goal simultaneously forestalls something the person wants to avoid. Goal-based models also typically incorporate an expectancy construct: a sense of confidence or doubt that a given outcome will be attained successfully.

People sometimes give up or scale back on goals they have been pursuing. It is sometimes important to relinquish goals, though the process of doing so involves feelings of sadness and despair. An alternative to giving up is scaling back. This is disengagement in the sense that the initial goal is no longer operative. It avoids complete disengagement, however, by substituting the more restricted goal. This accommodation thus keeps the person involved in that area of life, at a level that holds the potential for successful outcomes.

Issues of goals and threats are important to understanding the structure of stressors. Issues of goal engagement and disengagement are important to understanding the structure of coping, as are issues of positive and negative expectancies for the future.

7.2.1.2. Individual Differences

7.2.1.2.1. Extraversion

As is true of several traits, extraversion has different emphases in different measures. Sometimes it is based in assertiveness, sometimes in spontaneity and energy. Sometimes it is based in dominance, confidence, and agency, sometimes in a tendency toward happiness. Extraversion is often thought of as implying sociability.

7.2.1.2.2. Neuroticism

The second factor, neuroticism, concerns the ease and frequency with which a person becomes upset and distressed. Moodiness, anxiety, and depression reflect higher neuroticism. Measures often include items or facets pertaining to hostility and other negative feelings, but they are dominated by vulnerability to experiences of anxiety and general distress. Neuroticism has been linked to the avoidance temperament discussed above, suggesting that anxiety and sensitivity to threat is indeed its emotional core.

7.2.1.2.3. Agreeableness

Agreeable people are friendly and helpful, empathic, and able to inhibit their negative feelings. Agreeable people get less angry over others. At the opposite pole is an oppositional or antagonistic quality. People low in agreeableness use displays of power to deal with social conflict. Agreeableness as a dimension is often characterized as being broadly concerned with the maintaining of relationships.

7.2.1.2.4. Conscientiousness

Agreeableness and conscientiousness share an important property. Both suggest breadth of perspective. Many manifestations of conscientiousness imply broad time perspective: taking future contingencies into account. Agreeableness implies a broad social perspective: taking the needs of others into account.

7.2.1.2.5. Openness to experience

It involves curiosity, flexibility, imaginativeness, and willingness to immerse oneself in a typical experience.

7.2.2. Relations Between Personality and Coping

People respond to perceptions of threat, harm, and loss in diverse ways. Coping is often defined as efforts to prevent or diminish threat, harm, and loss, or to reduce associated distress.

Extraversion, grounded in an approach temperament, involves sensitivity to reward, positive emotions, sociability, assertiveness, and high energy. Strong approach tendencies and assertiveness should provide the energy required to initiate and persist in problem; positive affect should facilitate cognitive restructuring; and an orientation toward others and access to a social network should facilitate social support coping.

Neuroticism, grounded in an avoidance temperament, reflects tendencies to experience fear, sadness, distress, and physiological arousal. Given this vulnerability to distress, neuroticism should lead to emotion-focused coping and disengagement from threat. Disengagement may be reinforced through short-term relief of distress this relief may reduce motivation to return to the stressor, thus minimizing engagement coping. Furthermore, the mere presence of intense emotional arousal can interfere with the use of engagement strategies that require careful planning. Negative affect should also make positive thinking and cognitive restructuring difficult.

Agreeableness involves elevated levels of trust and concern for others. Because those high in agreeableness tend to have strong social networks, agreeableness may predict social support coping. Openness to experience involves the tendency to be imaginative, creative, curious, flexible, attuned to feelings, and inclined toward new activities and ideas. These tendencies may facilitate engagement coping strategies that require considering new perspectives, such as cognitive restructuring and problem solving, but may also facilitate use of disengagement strategies such as dreaming.

Optimism involves the expectation of good outcomes and an engaged approach to life, reflecting the belief that good outcomes require some effort. These characteristics suggest that optimism will relate positively to engagement types of coping, such as problem solving and cognitive restructuring, and inversely to avoidance or disengagement coping. Pessimism involves the expectation of bad outcomes, which should promote distress and disengagement coping.

7.2.3. Benefits of active stress management

If you are living with elevated levels of stress, you are putting your entire well-being at risk. Stress wreaks havoc on your emotional equilibrium, as well as your physical health. It narrows your ability to think clearly, function effectively, and enjoy life.

Effective stress management, on the other hand, helps you break the hold stress has on your life, so you can be happier, healthier, and more productive. The goal is a balanced life, with time for work, relationships, relaxation, and fun—and the resilience to hold up under pressure and meet challenges head on.

7.2.4. Steps involved in the minimization of the stress.

7.2.4.1. Identify the sources of stress in your life.

Stress management starts with identifying the sources of stress in your life. This is not as straightforward as it sounds. While it is easy to identify major stressors such as changing jobs, moving, or a going through a divorce, pinpointing the sources of chronic stress can be more complicated. It is all too easy to overlook how your own thoughts, feelings, and behaviours contribute to your everyday stress levels. Sure, you may know that you are constantly worried about work deadlines, but it is your procrastination, rather than the actual job demands, that is causing the stress. A stress journal can help you identify the regular stressors in your life and the way you deal with them. Each time you feel stressed; keep track of it in your journal. As you keep a daily log, you will begin to see patterns and common themes.

7.2.4.2. Address the unhealthy coping strategies.

Think about the ways you currently manage and cope with stress in your life. Your stress journal can help you identify them. Ensure your coping strategies healthy and helpful. If any of the following is a stress coping strategy of yours, then it is neither healthy nor helpful. Smoking, using pills or drugs to relax, drinking too much, withdrawing from friends, family, and activities, Procrastinating, sleeping too much and taking out your stress on others. If your methods of coping with stress are not contributing to your greater emotional and physical health, it is time to find healthier ones. No single method works for everyone or in every situation, so experiment with different techniques and strategies. Focus on what makes you feel calm and in control.

7.2.4.3. Managing predictable stressors

While stress is an automatic response from your nervous system, some stressors arise at predictable times your commute to work, a meeting with your boss, or family gatherings, for example. When handling such predictable stressors, you can either change the situation or change your reaction. When deciding which option to choose in any given scenario, it is helpful to think of the avoid, alter, adapt, or accept.

7.2.4.3.1. Avoid unnecessary stress.

It is not healthy to avoid a stressful situation that needs to be addressed, but you may be surprised by the number of stressors in your life that you can eliminate. Know your limits and stick to them. Distinguish between the "should" and the "musts". Drop tasks that are not necessary to the bottom of the list or eliminate them entirely. Avoid people who stress you out. Take control of your environment.

7.2.4.3.2. Alter the situation.

If you cannot avoid a stressful situation, try to alter it. Often, this involves changing the way you communicate and operate in your daily life. Express your feelings instead of bottling them up. Be willing to compromise. Try to find a balance between work and family life, social activities and solitary pursuits, daily responsibilities, and downtime.

7.2.4.3.3. Adapt the stressor.

If you cannot change the stressor, change yourself. You can adapt to stressful situations and regain your sense of control by changing your expectations and attitude. Try to view stressful situations from a more positive perspective. Take perspective of the stressful situation. Set reasonable standards for yourself and others.

7.2.4.3.4. Accept the things you cannot change.

Some sources of stress are unavoidable. You cannot prevent or change stressors such as the death of a loved one, a serious illness, or a national recession. In such cases, the best way to cope with stress is to accept things as they are. Acceptance may be difficult, but overall, it is easier than railing against a situation you cannot. Do not try to control the uncontrollable instead focus on the things you can control. When facing major challenges, try to look at them as opportunities for personal growth. Learn to forgive. Talk to a trusted friend or make an appointment with a therapist.

7.2.4.4. Manage time and schedules.

Poor time management can cause a lot of stress. When you are stretched too thin and running behind, it is hard to stay calm and focused. Do not over-commit yourself. Prioritize tasks. Break projects into small steps. Delegate responsibility. Maintain balance with a healthy lifestyle. Eat a healthy diet. Reduce caffeine and sugar. By reducing the amount of coffee, soft drinks, chocolate, and sugar snacks in your diet, you will feel more relaxed, and you will sleep better. Avoid alcohol, cigarettes, and drugs. Self-medicating with alcohol or drugs may provide an easy escape from stress, but the relief is only temporary. Do not avoid or mask the issue at hand, deal with problems head on and with a clear mind. Get enough sleep. Adequate sleep fuels your mind, as well as your body. Feeling tired will increase your stress because it may cause you to think irrationally.

7.2.5. Assistance under stressful situation

The best way to get assistance from others under stressful situations is to have better connection with others. There is nothing more calming than spending quality time with another human being who makes you feel safe and understood. In fact, face-to-face interaction triggers a cascade of hormones that counteracts the body’s defensive “fight-or-flight” response. Its nature’s natural stress reliever, it also helps stave off depression and anxiety. So, make it a point to connect regularly and in person with family and friends.

Keep in mind that the people you talk to do not have to be able to fix your stress. They simply need to be good listeners. And try not to let worries about looking weak or being a burden keeps you from opening. The people who care about you will be flattered by your trust. It will only strengthen your bond. Of course, it is not always realistic to have a friend close by to lean on when you feel overwhelmed by stress, but by building and

maintaining a network of close friends you can improve your resiliency to life's stressors.

Some of the tips for building relations through which the assistance can be obtained or offered during the stressful situation. Reach out to a colleague at work, help someone else by volunteering, have lunch or coffee with a friend, ask a loved one to check in with you regularly, accompany someone to the movies or a concert, Call or email an old friend, go for a walk with a workout buddy, Schedule a weekly dinner date, meet new people by taking a class or joining a club, Confide in a clergy member, teacher, or sports coach.

7.2.6. Effects of shocking and stressful situation

A critical incident is any situation that causes a person to experience unusually strong stress reactions that the person perceives as disturbing or disabling.

Few examples of such traumatic events are, earth quacks, tsunami, aviation accidents, terrorism, major air traffic collision, failed rescue attempts, hostages type events.

Critical incidents produce characteristic sets of psychological and physiological reactions or symptoms (thus the term syndrome) in all people, including emergency service personnel. Typical symptoms of Critical Incident Stress include Restlessness, Irritability, Excessive Fatigue, Sleep Disturbances, Anxiety, Startle Reactions, Depression, Moodiness, Muscle Tremors, Difficulties, Concentrating, Nightmares, Vomiting, Diarrhoea and Suspiciousness.

The physical and emotional symptoms, which develop as part of a stress response, are normal but have the potential to become dangerous to the responder if symptoms become prolonged.

Signs of Critical Incident Stress as per Centre for Disease Control of USA are given below.

Table 9: Signs of Critical Incident Stress

Physical	Cognitive	Emotional	Behavioral
Fatigue	Uncertainty	Grief	Inability to rest
Chills	Confusion	Fear	Withdrawal
Unusual thirst	Nightmares	Guilt	Antisocial behavior
Chest pain	Poor attention	Intense anger	Increased alcohol
Headaches	Poor concentration	Apprehension	consumption
Dizziness	Poor memory	Depression	Change in communications
	Poor problem solving	Irritability	Loss/increase in appetite
	Poor decision-making ability	Chronic anxiety	

7.3. References

DOC 10057 (Second edition) - Recommended training objectives for a basic training course, Subject 15 – Human Factors, Topic – 7 – Stress.

8.1. Introduction

8.1.1. Safety Importance in Aviation

Safety and security are of paramount importance in aviation. A safe aviation system contributes to the economic development of states and their industries. For all ANSPs regardless of whether they are operated by a state or by a commercial organisation, safety must come first when delivering Communications, Navigation, Surveillance/Air Traffic Management (CNS/ATM) services. In the present technology centric air-ground CNS/ATM systems, ATSEP role in the safety chain is crucial to seal all the holes in the last layer of defence.

8.1.2. Safety: The Foremost Strategic Objective of ICAO

Aviation safety is the fundamental objective of International Civil Aviation Organisation (ICAO). This strategic objective aims to enhance global civil aviation safety and focuses primarily on a state's effective safety oversight and its capabilities in the management of safety.

Aviation industries and service providers operate in an open system that remain exposed to many external variables which requires highly vigilant and constant monitoring to ensure that the higher levels of aviation safety can be realized. To offer this safety assurance, ICAO has mandated in November 2006 that all member states shall implement a formal Aviation Safety Management Systems (SMS).

Annex 19 of ICAO requires that both the states and service providers promote a positive safety culture with the aim of fostering effective safety management implementation through the SSP/SMS.

8.1.3. Safety Work Culture

Aviation safety work culture is the set of enduring values, behaviours, and attitudes regarding safety, shared by every individual at every level of an organization. It has been described as "how people behave in relation to safety and risk when no one is watching". Attitude, awareness, behaviour, commitment – these are the primary tenets of safety culture as these ensure safety success which-

- reflects the **attitudes** in an organization.
- needs safety **awareness** to be successful.
- is exemplified by **behaviour** of employees at all levels of an organization; and
- indicates future **commitment** and safety performance.

A safety culture is the natural consequence of having humans involved in the aviation system. It is an expression of how safety is perceived, valued, and prioritized by management and employees in an organization, and is reflected in the extent to which individuals and groups are:

- aware of the risks and known hazards faced by the organization and its activities.
- continuously behaving to preserve and enhance safety.
- able to access the resources required for safe operations.
- willing and able to adapt when facing safety issues.
- willing to communicate safety issues; and
- consistently assessing the safety related behaviours throughout the organization

8.1.4. Safety Culture and Safety Performance

Safety Culture has a direct impact on safety performance. Here are some ways to show how aviation safety culture leads directly to safety performance.

8.1.4.1. Quality safety culture entails considerate safety behaviour.

A safety culture is something that happens on an organizational level and as well as individual level. A successful and a quality aviation safety culture demonstrates a commitment to the aviation SMS.

What is difficult about safety behaviour is how to measure it. Consider the following as quantifiable and trackable ways of measuring safety behaviour, where each point requires specific action on the part of ATSEP and management to achieve safety success.

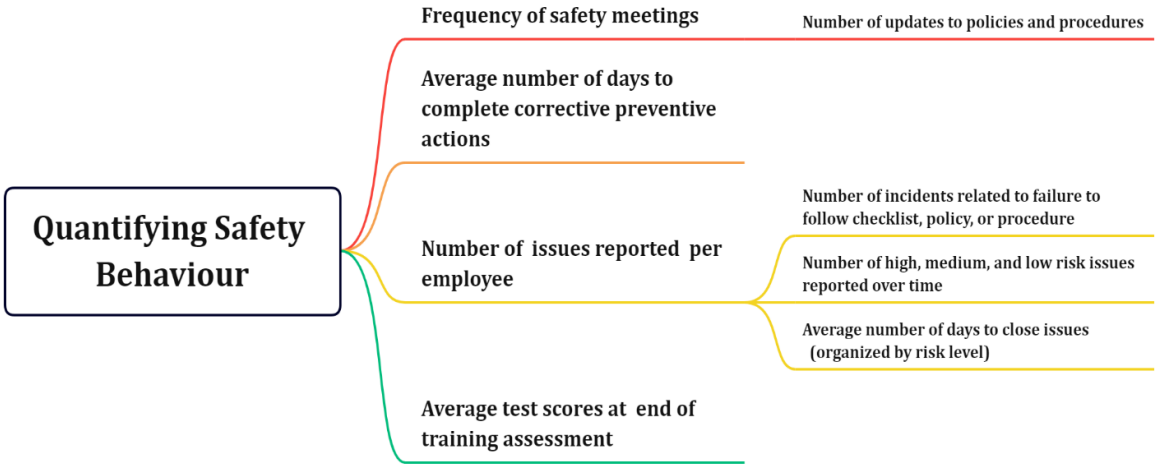


Figure 16: Quantifying Safety Behaviour

8.1.4.2. ATSEP perform even when not under safety supervision.

There can be two possibilities to check if management is not supervising the safety behaviours of ATSEP-

- The actions of the managerial authority when ATSEP are not under safety supervision of management? Or,
- The response of ATSEP when management is not watching.

In most organizations, individuals only loosely follow policies and procedures when management is not around. This is especially true when management does not take an active role in its relationship with front-line ATSEP.

One of the financial incentives in building a safety culture and thereby supervising the safety behaviour, besides saving money due to workplace injuries, is that ATSEP become more productive because their work is consistent. This productivity does not come at the cost of safety. Rather, ATSEP:

- are set back by safety issues less often.
- maintain working standards and adhere to organisation policy most of the time; and
- are better at monitoring and responding quickly to their work environment.

On the management side, managers can devote more time to important safety tasks, and less time for micromanaging employees and other managers. Good safety culture removes the burden of "authority" inherent in the top-down structure of aviation SMS implementations. Employees better manage themselves, and the top-down structure remains important for guidance rather than discipline.

8.2. Safety Culture Development and Benefits.

8.2.1. Developing A Positive Safety Culture.

A positive safety culture has the following features:

- managers and frontline ATSEP, individually and collectively, want to make decisions and take actions that promote safety.
- individuals and groups continually critique their behaviours, processes and welcome the critique of others searching for opportunities to change and improve as their environment changes.
- management and individuals share a common awareness of the hazards and risks faced by the organization and its activities, and the need to manage risks.
- individuals act and make decisions according to a common belief that safety is part of the way they do service and ensures safety.
- individuals value being informed, and informing others, about safety.
- individuals trust their colleagues and managers with information about their experiences, and the reporting of errors and mistakes is encouraged to improve how things are done in the future.

8.2.2. Safety Culture as Safety Enabler of Safety Management.

Safety values are incorporated into practices by management and personnel who directly affects how key elements of the State Safety Plan (SSP), and Safety Management System (SMS) are established and maintained. Therefore, safety culture has a direct impact on safety performance.

If someone believes that safety is not that important then workarounds, cutting corners, or making unsafe decisions or judgements may be the result, especially when the risk is perceived as low and there is no apparent consequence or danger.

The safety culture of an organization therefore significantly influences how their SSP, or SMS develops and how effective it becomes. If an organization has instituted all the safety management requirements but does not have a positive safety culture, it is likely to underperform.

When the organization has a positive safety culture, and this is visibly supported by upper and middle management, front-line ATSEP tend to feel a sense of shared responsibilities towards achieving the organization's safety objectives. Effective safety management also supports efforts to drive towards an increasingly positive safety culture by increasing the visibility of management's support and improving active involvement of personnel in managing safety risk.

8.2.3. Safety Work Culture benefits.

When leadership actively endorses safe practices, it becomes the normal way of doing things. The ideal situation is a fully implemented and effective SSP/SMS and a positive safety work culture. Hence, an organization's safety culture is often seen as a reflection of the maturity of its SSP/SMS. Effective safety management empowers a positive safety culture, and a positive safety culture empowers effective safety management.

8.2.3.1. Safety work culture benefits in case of adoption in ATSEP domain.

- Safe, efficient, effective, and economic provision of Air Navigation Services
- Reduced incidents/injuries
- Increased productivity
- Reduced costs
- Supports safe environment and workplace ergonomics.

8.2.4. Benefits of Safety Management.

The advantage of having a positive safety work culture will invariably results in the benefits derived from implementation of the effective safety management system in any ANSP.

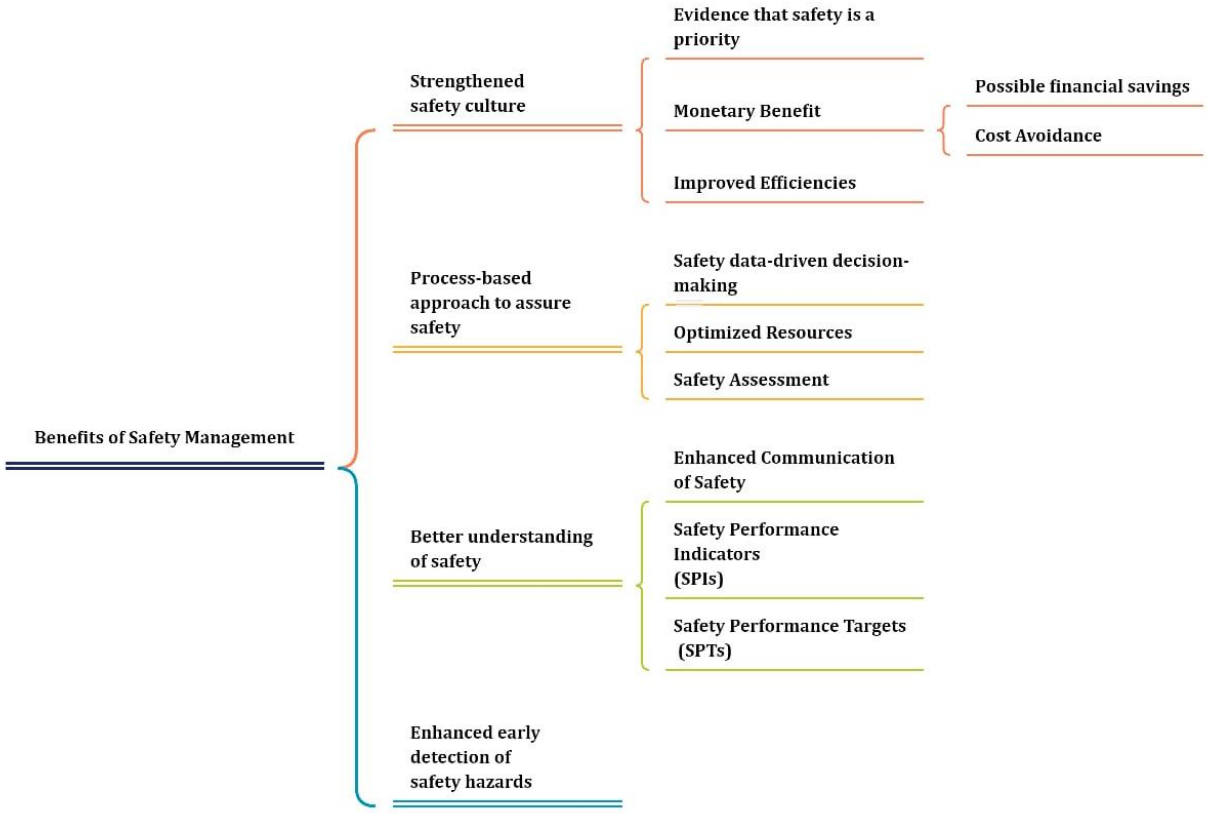


Figure 17: Benefits of Safety Management

8.2.5. Safety Culture Enablers and Disablers

Actions by management and employees can help drive their safety culture to be more positive. The following table provides examples of the actions of management and employee that will enable or disable a positive safety culture in an organization. Organizations should focus on providing enablers and removing any disablers to promote and achieve a positive safety culture.

Element and its General Description	Enablers	Disablers
Commitment to safety This reflects the extent to which senior management within the organization have a positive attitude towards safety and recognizes its importance. Senior management should be genuinely committed to achieve and maintain an elevated level of safety and give employees motivation and the means to do so also.	• Management leads safety culture and is actively motivating its employees to care for safety, not only by talking but by acting as role models • Management provides resources for a range of safety related tasks (e.g. training) • Continuous safety management oversight and governance is established	• Management is actively demonstrating that profit, cost reduction and efficiency come first. • Investments to improve safety are often made when required by regulations or after accidents • Neither oversight nor governance regarding safety management is established

Element and its General Description	Enablers	Disablers
Adaptability Adaptability reflects the extent to which employees and management are willing to learn from past experiences and can act necessary to enhance the level of safety within the organization.	• Employee input is actively encouraged when addressing safety issues • All incidents and audit findings are investigated and acted upon • Organizational processes and procedures are questioned for their safety impact (high extent of self-criticism) •A clear proactive approach to safety is demonstrated and followed.	• Employee input on safety issues is are not sought from all levels of the employees • Actions are often taken only after accidents or when required by regulations. Even when an accident occurs the organization is unwilling to question itself. • Organizational processes and procedures are considered adequate if no accident occurs (complacency or lack of self-criticism) • A reactive approach to safety is demonstrated and followed.
Awareness Awareness reflects the extent to which employees and management are aware of the aviation risks faced by the organization and its activities. From a state perspective, personnel are aware of both the safety risks induced by their own activities and the organizations they oversee. Employees and management should be constantly maintaining a high degree of vigilance with respect to safety issues.	• An effective way of hazard identification has been established • Investigations seek to establish the root cause. • The organization stays abreast of important safety improvements, and adapts itself accordingly as necessary • The organization systematically evaluates if safety improvements are implemented and working as intended. • Where appropriate, members of the organization are well aware of the safety risks induced by their individual actions and company operations / activities	• No effort is spent on hazard identification • Investigations stop at the first viable cause rather than seek the root cause • The organization does not stay abreast of important safety improvements • The organization does not evaluate if safety improvements are implemented properly. • Where appropriate, members of the organization are not aware of the safety risks induced by their individual actions and company operations • Safety data is gathered but not analysed and acted upon

Element and its General Description	Enablers	Disablers
Behaviour with respect to safety Behaviour with respect to safety reflects the extent to which every level of the organization behaves such as to maintain and improve the level of safety. The importance of safety should be recognized, and processes and procedures needed to maintain it should be put in place.	• The employees motivate themselves to act safely and by acting as role models • Continuous monitoring of safe behaviour is practised. • Intentional unsafe behaviour is not tolerated by management and colleagues • The working conditions support aviation safety at all times.	• No monitoring of aviation safety within the organization's products or services is practised. • Employees are not punished for intentional unsafe behaviour to the benefits of their own or other interests • The working conditions provoke behaviour and workarounds that are detrimental to aviation safety • It is not acceptable to offer constructive feedback that can improve aircraft safety.
Information Information reflects the extent to which information is distributed to all necessary people within the organization. Employees should be enabled and encouraged to report. aviation safety concerns and receive feedback on their reports. Work information related to aviation safety must be communicated meaningfully to the right people to avoid miscommunication that could lead to hazardous aviation system situations and consequences. The State is open to share aviation safety related information to all service providers.	• An open and just safety reporting environment exists. • Employees are provided with safety-relevant information in a timely manner to allow for safe operations or decisions to be made. •Management and supervisors regularly check whether safety relevant information is understood and acted upon • Knowledge transfer and training about aviation safety is actively practiced (e.g., sharing of lessons learned)	• A blaming safety reporting environment is evident. • Safety-relevant information is withheld. • Safety communication is not monitored for its effectiveness • No knowledge transfer or training is provided.

Element and its General Description	Enablers	Disablers
Trust Employee contribution to safety thrives in a reporting environment that fosters trust – trust that their actions or omissions, commensurate with their training and experience, will not be punished. Such an environment is fundamental to effective and efficient safety reporting. Effective safety reporting systems help to ensure that people are willing to report their errors and experiences, so that States and service providers have access to relevant data and information that is necessary to address existing and potential safety deficiencies and hazards. These systems create an environment in which people can be confident that safety data and safety information will be used exclusively for improving safety.	• There is a distinction between acceptable and unacceptable behaviour, which is known to all the employees. • Occurrences (including accidents and incidents) investigations consider individual as well as organizational factors. • Good aviation safety performance is recognized and rewarded on a regular basis. • There is willingness among employees and operational personnel to report events in which they have been involved.	• There is no identifiable distinction between acceptable and unacceptable behaviour. • Employees are systematically and rigorously punished for human errors. • Accident and occurrence investigations focus on individual factors only. • Good safety performance and safe behaviour is taken for granted.

8.3. Safety Reporting and Just Culture

8.3.1. Safety Culture and its influence on Safety Reporting

SSPs and SMSs are sustained by safety data and safety information that is necessary to address existing and potential safety deficiencies and hazards, including safety issues identified by ATSEP. The success of a reporting system depends entirely on the continuous flow of information from, and feedback to, organizations and individuals. The protection of safety data, safety information and related sources is essential to ensure continued availability of information.

For example, in voluntary safety reporting systems, this may be realized through a system that is confidential, and not used for purposes other than maintaining or improving safety. The benefits are twofold. Often frontline ATSEP who are the closest to safety hazards, so a voluntary reporting system enables them to actively identify these hazards and suggest workable solutions. At the same time, the regulator or management can gather important safety information and build trust with the organizations or frontline ATSEP who are reporting the information.

States are expected to adopt laws to adhere to the provisions outlined in Annex 19 for the protection of safety data, safety information and related sources. In the case of a voluntary reporting system, confidentiality should be ensured, and the reporting system operated in accordance with safety protection laws.

Further, organizations need to have an appropriate disciplinary policy, which is accessible to all and widely understood. A disciplinary policy should clearly indicate what behaviours are considered unacceptable and how the organization will respond in such cases. The disciplinary policy needs to be applied fairly and consistently.

Finally, if organizations and individuals who report safety issues are protected and treated in a consistent manner, are more likely to report their experiences and errors in an environment where they will not be judged or treated unfairly by their peers or their employer.

Overall, organizations and individuals must believe they will be supported when reporting in the interest of safety. This includes organizational and personal errors and mistakes. An increase in confidential reports and a decrease in anonymous reports is usually indication of the organization's progress towards a positive safety culture.

8.3.2. Safety Reporting

8.3.2.1. Significance of Safety Reporting

Writing a report after having been involved in an incident often seems to be and feels like an inconvenient, time-consuming, and worthless action. However, it is way more than that – and important and helpful in diverse ways.

- Safety

Reporting enables the organization and the personnel to understand what happened, to learn from past events and to make things safer in future. This means, it is about procedures, rules and standardisation and the potential difference between 'work as done' and 'work as imagined' (which is shaped by 'work as prescribed' in rules and procedures).

- Law

Reporting is compliant with applicable law and hence enables the organization to support its individuals. By law, any incident with a safety-relevant aspect must be reported. In other words, failing to report will lead to the breach of the law and a committed offence. It will not be regarded as a mistake and, in case of detection, the concerned will be prosecuted regardless of the actual event/ incident, as it is a breach of criminal law – and will be treating as such.

- Double bind situation

All the states and service providers are highly interested in a continuously improved and safer working environment, which is why they fully supports the established reporting processes and expect to keep on reporting any safety-relevant event. Furthermore, no one wants to be confronted with any legal issues based on non-compliance with law.

On the other hand, it is obvious that reporting may raise questions about accountability and possible legal proceedings, but none of these issues may be solved by non-reporting.

There is no way out of this so called "double bind" situation, where opposing interests of safety and judiciary must be served and satisfied.

Overall safety reporting is;

- **not about convenience**. Reporting is not only important for safety but also a legal requirement and therefore should be compliant with applicable law. Reporting shall be a normal routine after having been involved in an incident.
- **not about time**. Reporting is about your very own, your colleagues' and your organization's safety and reputation.
- **not worthless**. Reporting enables the whole ATM system to get safer.
- **about content**. Reporting can be done in many ways, from a noticeably short, factual, and static report to a very descriptive and safety-wise helpful, but not a self-incriminating report of the occurrence.

8.3.2.2. Dos and don'ts

This is a crucial point. It should be emphasized, while writing safety reports that

- the language used in filing a report shall be neutral,
- no names shall be stated (neither first/last names nor initials),
- the information provided shall be kept short and factual to protect yourself, especially from unintentional and unconscious self-incrimination,
- the information provided shall be fact-bound, non-emotional and refrain from finger pointing,
- judgments, assumptions and/or interpretations shall not be part of a report,
- wording such as e.g. – "I forgot…" – "I assumed…" – "I was not aware…" – "I was sure the equipment…." – "I thought it might…" –etc. shall be avoided.
- from a safety point of view, it is best to provide as much information as possible but from a legal point of view, it is best to keep the information as short and factual as possible.

8.3.3. Just Culture

8.3.3.1. Definition

A Culture where front-line operators or other personnel are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated. Just culture policies that distinguish wilful acts of misconduct from inadvertent errors, providing for an appropriate punitive or non-punitive response (a disciplinary policy), are essential to ensure the effective reporting of systemic safety deficiencies. [European Commission, Eurocontrol & IFATCA].

8.3.3.2. Just Culture conception

Just Culture is about safety. It is a question of mind-set, about fostering a constructive environment by which individuals can share their accounts to add to our knowledge of how the CNS/ATM system works. In doing so, just culture is a mechanism that allows to uncover pertinent aspects of the operation that are traditionally hidden.

The concept of Just culture represents the fundamental recognition that both aviation safety and the administration of justice would benefit from a carefully established equilibrium, moving away from fears of criminalisation, balancing, and satisfying the interests of two unique and not compatible worlds: The world of safety and the world of justice.

8.3.3.3. Just Culture misconception

Nothing quick or unambiguous

Just Culture is not about quick fixes, clear rules, strict guidelines, or a set of given norms. It is about a constant interaction

- between Safety and Judiciary to satisfy both needs,
- with internal, organisational justice processes.

No absolution, no "no blame culture"

Just culture does not mean complete protection of front-line ATSEP in the event of aviation incidents and accidents. Particularly, it does not offer protection in case of gross negligence, wilful misconduct and/or destructive acts, severe and serious disregard of an obvious risk and/or profound failure of professional responsibility. E.g.: Just Culture covers a reported incident – but not the omission of reporting!

No valid term in the legal world

FOCA, STSB, the Swiss Legislator and the EU have all acknowledged the importance of Just Culture, even though implementation of its principles is still lagging, especially in the criminal law. As Judiciary is bound to the law – with little to no scope to deviate from it for the benefit of Just Culture and/or the accused – it is subject to a case-by-case appreciation by the competent judicial authority.

8.3.4. Safety Culture and Cultural Diversity

From a safety management perspective, national culture influences organizational culture and plays a large part in determining the nature and scope of regulatory enforcement policies, including the relationship between regulatory authority personnel and industry personnel, and the extent to which safety information is protected. These, in turn, impact on peoples' willingness to report safety issues.

When implementing safety management, managers should be capable of moulding their culturally diverse workforce into effective teams. Eliminating differences in safety risk perceptions that may derive from diverse cultural interpretations and enhancing other safety-related aspects, such as communication, leadership styles and interaction between supervisors and subordinates is key. The degree of success will depend on management's ability to promote a mutual understanding of safety and everyone's role in its effectiveness. Regardless of an individual's cultural background, effective safety management relies on a shared safety culture, with everyone in the organization understanding how they are expected to behave in relation to safety and risk "even when no one is watching."

8.4. Challenges and Addressing the Roadblocks

8.4.1. Loss of Upper Management Support

- Without having the top management support, we can never think of an aviation SMS. Loss of top or upper management support can be attributed to:
    - Change in top-level leadership.
    - Changing attitudes toward the Aviation SMS due to other prevailing strategic opportunities/challenges; or
    - Safety management team not performing their jobs regarding regular communications with upper management.
- To regain top/upper management support, the safety manager (accountable for safety) will need to start at the very top and open a dialog with the accountable executive. Topics to enforce include:
    - Requirements of the aviation safety work culture and SMS.
    - Benefits of the aviation safety work culture and SMS.
    - Importance of top/upper management support.
    - Methods to demonstrate top-level support of the aviation safety program.

8.4.2. Lack of Safety Accountability

The second most significant reason for aviation safety work culture implementation failure is the loss of the sole safety manager. Safety managers are the key personnel and if the corporate knowledge leaves the organisation, the safety program will collapse.

- Strategies to minimize this risk include:
    - Having another "part-time" safety manager who understands how the safety program functions.
    - Requiring 30-days prior notice before key personnel leave the organisation to be "eligible" for rearrangement.
    - Training department should head in safety program activities.

- An excellent alternative to role of safety manager is to actively involve department heads in the workings of the SMS. There will be additional benefits, including:
    - Increased involvement and buy-in to the safety program.
    - Improved responsiveness toward risk management activities.

8.4.3. Lack of leadership commitment

A positive safety culture relies on a high degree of trust and respect between personnel and management. Time and effort are needed to build a positive safety culture, which can be easily damaged by management decisions and actions, or inactions. Continuous effort and reinforcement are needed.

Visible demonstrations of leadership support towards safety program are paramount to the success of service provider's safety program. Common displays commitment of top-level support include:

- Newsletter articles from the accountable executive detailing the importance of the Safety.
- Offering regular (weekly or bi-weekly) meetings with the safety manager; and
- Occasionally walking through the area of operations with the safety manager to demonstrate that the safety team has upper management's support.

8.4.4. Lack of resources for safety success

The situations where there is a lack of

- improved tool and workplace architecture to match the fast pace of change of technological development.
- or adequate safety training and well equipped ATSEP,

may lead to inability of the ATSEP to fulfil the safety objectives as set by the ANSPs.

Safety Training /Education programs to improve the knowledge and skill of ATSEP to handle the safety challenges should be included in SMS/SSP and necessary resources and guidance should be provided to ATSEP to adapt to changing work environment. Also, the provision of environmental and equipment safety skills to ATSEP regarding equipment and material storage and disposal or maintaining general office hygiene or handling equipment with high radiation.

8.4.5. Ageing workforce

ATSEP with more years of services may sometimes feel reluctant to adapt to changing work environment and fast pace of technological developments and in turn may not follow the safety work culture demands. Aged and senior executives may also avoid knowledge sharing to lower subordinates due to some superiority complex.

Sensitizing the ageing workforce about safety aspects and knowledge sharing with lower subordinates to improve the positive safety culture among all levels of workforce is important.

8.4.6. Rise in the recruitment of young and less experienced ATSEP

It is no secret that newly joined ATSEP by far may pose the greatest risk to safety in the aviation industry and beyond if not guided properly. as they are:

- unfamiliar with the work environment.
- impressionable to existing norms in the work environment; and
- unfamiliar with existing policies/procedures.

This considerable amount of risk involved with new ATSEP can be mitigated by a strong safety culture which:

- requires teamwork that acts as a natural monitor and guide for new ATSEP.
- exhibits truly little negative norms that could potentially lead a new ATSEP into dangerous action.
- always has a strong precedent of safety training (induction and recurring); and
- will surely has strong leaders to keep new ATSEP "on track" in terms of behaving safely.

8.4.7. Loss of safety-related data

Safety-related data like databases, spreadsheets, safety reporting documents are critical to the organisation. During any Safety breaches like Cyber security attacks, leakage of such critical information may pose serious threat to the aviation industry.

Mitigation strategies for loss of safety-related data include:

- Utilizing in-house centralized databases and file systems.
- Using cloud-based, professionally designed aviation safety management system solutions; and
- Enforce regular backup strategies for all safety-related data.
- Imparting Cyber security.

8.4.8. Safety Feedback problems

This problem may arise due to-

- Not collecting feedback
- Doing nothing with collected feedback

Proper way of collecting safety data and safety feedback builds up trust between the ATSEP and the management ensuring positive safety and just culture in the organisation.

8.4.9. Safety culture and organizational change

Safety management requires that organizations manage the safety risks associated with organizational and operational changes. Staff concerns about workload, job security and access to training are associated with meaningful change in organizations and can have a negative impact on safety culture. The degree to which staff feel involved in the development of change and understand their role in the process will also influence the safety culture.

8.4.10. Economic unpredictability

This situation may arise due to any unprecedented situation like COVID-19. This can be addressed if SMS/SSP includes preparedness during emergency situations.

8.5. Monitoring and Measuring Safety Culture Effectiveness

8.5.1. Safety Culture Assessment

Safety culture is subject to many influences and organizations may choose to assess their safety culture to:

- understand how people feel about the organization and how importantly safety is perceived.
- identify strengths and weaknesses.
- identify differences between various groups (subcultures) within an organization; and
- examine changes over time (e.g., in response to significant organizational changes such as following an accident, a change in senior management or altered industrial relations arrangement).

There are several ways which can be used to assess safety culture maturity, usually in combination of:

- questionnaires.
- interviews and focus groups.
- observations; and
- document reviews.

Measuring of the effectiveness of safety work culture can be done by:

- reviewing the programs and procedures in place for upgradation to suit the requirement.
- establishing communication between management and ATSEP for active culture assessment to be handled with care and empathy.
- assessing the safety training which gives the clue about the organisation's commitment to safety.

Assessing safety culture maturity can provide valuable insight, leading to actions by management that will encourage the desired safety behaviours. It should be noted that there is a degree of subjectivity with such assessments, and they may reflect the views and perceptions of the people involved at a particular moment only. Also, scoring safety culture maturity can have unintended consequences by inadvertently encouraging the organization to strive to achieve the "right" score, rather than working together to understand and improve the safety culture.

8.6. References

- ICAO-ANNEX 19 Safety Management
- DOC-9859 Safety Management Manual Fourth Edition 2018
- APAC Seamless ANS Plan (V3.0) Safety Culture Survey
- EURO CONTROL ATM Safety Framework Maturity Survey Methodology
- for ANSPs ESP-2009-78
- CANSO Standard of Excellence in Safety Management System.
- SWISS ATCA Just Culture Manual for ATCO, ANSE & ATSEP Behaviour after an incident and further proceedings

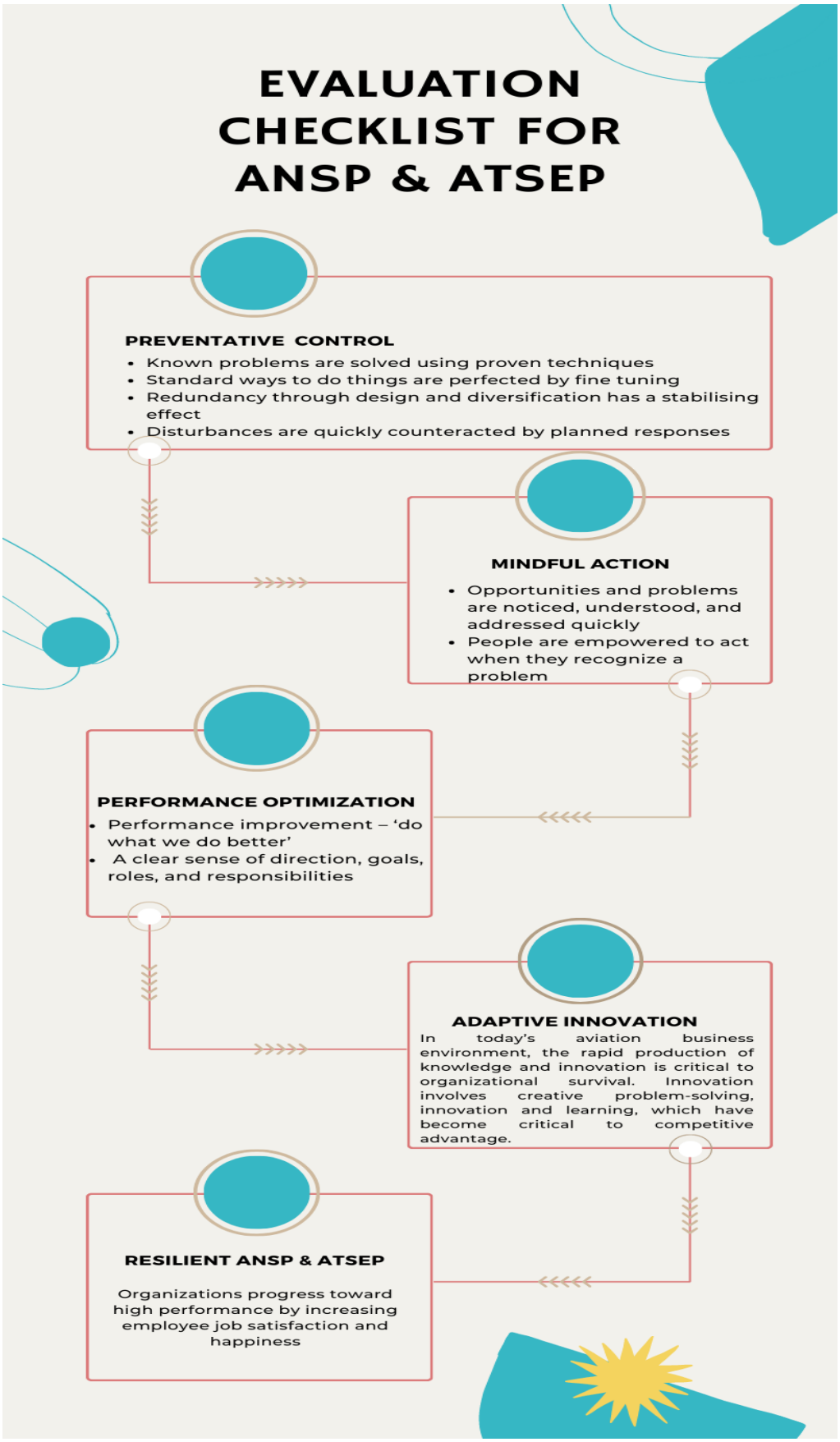


Figure 18: Understanding the evaluation check list process.

Self-Evaluation Check list for ANSP

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – PEOPLE RESOURCING

##	Process	Maturity level	Description of the maturity level	Tick
1)	Strategic people resourcing for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to over workload and due to lack of human resources	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)	Strategic people resourcing for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to over workload and due to lack of human resources	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
3)	Strategic people resourcing for addressing the factors that are **aggravating** stress and fatigue when the workload is more, and human resources are less	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
4)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation		
5)	**If maturity level is D** w.r.t score of (1)			
	Do you have workforce planning based on projected changes?			Y/N
	Did you recruit people as per the workforce planning?			Y/N
	Did you provide better opportunities and better working conditions to your people?			Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.			

6)	**If maturity level is E** w.r.t score of (1)	
	Did you revise the workforce planning in the last two years?	Y/N
	Did you revise the recruitment process to suit the safety and service strategy?	Y/N
	Are you able to get more competitive people successively from the market?	Y/N
	Have you set the key performing indicators for measuring the above?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate	
	If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP	

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING

##	Process	Maturity level	Description of the maturity level	Tick
1)	Job, role and skills analysis and competency modelling for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to ambiguities on accountabilities and responsibilities.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)	Job, role and skills analysis and competency modelling for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to ambiguities on accountabilities and responsibilities.	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation		
4)	**If maturity level is D** w.r.t score of (1)			
	Do you have clear job description?			Y/N
	Did you have clear role profile?			Y/N
	Do you have competency modelling of both behavioural and functional competencies?			Y/N
	Do you have annual training plan prepared based on the role profiles of ATSEP?			Y/N

	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.	
5)	**If maturity level is E** w.r.t score of (1)	
	Have you done the job evaluation of your ATSEP job role profiles in the last two years?	Y/N
	Have you recruited new ATSEP based on the outcome of this process?	Y/N
	Is ATSEP performance management system designed as per the outcome of this process?	Y/N
	Have you set the key performing indicators for measuring the above?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate	
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP		

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT

##	Process	Maturity level	Description of the maturity level	Tick
1)	Knowledge management, talent management, learning and development for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)	Knowledge management, talent management, learning and development for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation		

4)	**If maturity level is D** w.r.t score of (1)	
	Have you established organizational knowledge management?	Y/N
	Have you managed talent management to match with the strategic people resourcing?	Y/N
	Have you established learning and development system for individuals as well as teams?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.	
5)	**If maturity level is E** w.r.t score of (1)	
	Did you bring new knowledges in the knowledge management in the last year?	Y/N
	Did you bring any changes in the talent planning to suit the safety and service strategy in last two years?	Y/N
	Did you evaluate the effectiveness of the learning and development process in last year?	Y/N
	Have you set the key performing indicators for measuring the above?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate	
	If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP	

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY

##	Process	Maturity level	Description of the maturity level	Tick
1)	Induction of new systems and maintenance philosophy for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria	
2)	Induction of new systems and maintenance philosophy for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	Level A		
		Level B		
		Level C		
		Level D		
		Level E		
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation		

4)	**If maturity level is D** w.r.t score of (1)	
	Maintenance strategy includes all the process in addition to preventive maintenance	Y/N
	All the maintenance activities are documented for easy traceability	Y/N
	Annual reactive maintenance duration is only 20% or less than the total maintenance duration?	Y/N
	Required competencies and resources made available prior to the installation of new systems.	Y/N
	All OEM documents required to meet the maintenance strategies were ensured before SAT	Y/N
	Computer-based maintenance data analysis established for financial optimization	Y/N
	Root cause analysis is being practiced on safety sensitive facilities for finding primary failures	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.	
5)	**If maturity level is E** w.r.t score of (1)	
	Innovated means of observations and data logging done for automated investigation	Y/N
	Continuous improvement on maintenance process including training done as per new systems	Y/N
	Annual reactive maintenance cost is reduced when compared to last year	Y/N
	Computer based maintenance data analysis helped in carrying out predictive maintenance	Y/N
	Repeated failures were analysed through root cause failure and identified primary failures	Y/N
	Trained and developed ATSEP on FAT, SAT, and document verification to ensure OEM documents and system delivered as per the user requirements.	Y/N
	Have you set the key performing indicators for measuring the above?	Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate	
	If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP	

Human performance management processes maturity level
Self-Evaluation Check list for ANSP – WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD

##	Process	Maturity level	Description of the maturity level	Tick
1)	Work environment, well-being, performance, and reward for **directly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	**Level A**	Human performance management processes and/or requirements have not been agreed at the organization level – they are either not routinely undertaken or depend on the individual assigned the task	
		Level B	Human performance management processes and/or requirements are defined but not yet fully implemented, documented, or consistently applied.	
		Level C	Human performance management processes and/or requirements meet the required regulatory standards and comply with relevant ICAO Annexes. Human performance management processes and/or requirements are formally documented and consistently applied	
		Level D	Evidence is available to provide confidence that human performance management processes and/or requirements are being applied appropriately and are delivering positive, measured results.	
		Level E	Human performance management processes and/or requirements set international best practice, focusing on innovation and improvement. The effectiveness of the human performance management improvement actions is measured and evaluated against defined improvement criteria.	

2)	Induction of new systems and maintenance philosophy for **indirectly addressing** the factors that are adding stress and fatigue to ATSEP due to improper tools, procedures and shared knowledge and practices.	Level A	
		Level B	
		Level C	
		Level D	
		Level E	
3)	**Resilience Level** w.r.t score of (1)	A & B – Preventative Control, C- Mindful action, D-Performance optimization, E – Adaptive innovation	
4)	**If maturity level is D** w.r.t score of (1)		
	Total reward system approaches in practice that emphasize the enhanced work environment.		Y/N
	Work environment is conducive to high performance.		Y/N
	Performance management system in practice ensures the support and guidance people need to develop and improve are readily available.		Y/N
	Reward system includes non-financial rewards like recognition, achievement, personal growth		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and take necessary measures to reach the next level.		
5)	**If maturity level is E** w.r.t score of (1)		
	Work environment is periodically reviewed for enhancement		Y/N
	Increased level of job satisfaction and happiness found after enhancing work environment		Y/N
	Unique values added by all the employees were recognized and rewarded		Y/N
	Increased level of engagement among the workforces were observed		Y/N
	Have you set the key performing indicators for measuring the above?		Y/N
	If your score is one or more "N," please assume the immediate lower level of maturity and evaluate		
If your final level of maturity is D or E, please ascertain with the self-evaluation of ATSEP			

Self-Evaluation Check list for ATSEP

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – PEOPLE RESOURCING					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood the strategic requirements of my ANSP?			Y/N
	B	I have psychological contract with ANSP, that has built the mutual trust, increased commitment, and engagement.			Y/N
	C	I have improvised my unique talent and skills and adding values to my ANSP			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – JOB, ROLE AND SKILLS ANALYSIS AND COMPETENCY MODELLING					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood the key result areas and accountabilities of my role			Y/N
	B	I have understood the knowledge, skill, and competency requirements for my role			Y/N
	C	I have developed the knowledge and skills needed to achieve an acceptable level of performance			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – KNOWLEDGE MANAGEMENT, TALENT MANAGEMENT, LEARNING AND DEVELOPMENT					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood the opportunities for my career development and growth.			Y/N
	B	I know the provisions for developing myself to core technical or professional roles			Y/N
	C	I have developed the leadership and management skills toward the career progression			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – INDUCTION OF NEW SYSTEMS AND MAINTENANCE PHILOSOPHY					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	I have understood all the process involved in the maintenance strategy of my ANSP			Y/N
	B	I have well documented all the activities of maintenance for easy traceability			Y/N
	C	I have acquired all the skills and competencies required for maintaining new systems			Y/N
	D	I have acquired the skills for carrying root cause failure analysis			Y/N
	E	I have made the annual plan for the spares and other materials including budgeting			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				

Human performance management processes maturity level Self-Evaluation Check list for ATSEP – WORK ENVIRONMENT, WELL-BEING, PERFORMANCE, AND REWARD					
##		**Process**	**Maturity level**	**Description of the maturity level**	**Tick**
1)	A	Work environment enabled me towards more engagement and commitment.			Y/N
	B	Work environment has reduced my stress and improved my work-life balance			Y/N
	C	I have not experienced or heard of any sexual harassment and bullying problems.			Y/N
	D	I am benefited by the individual as well as group services provide by my ANSP			Y/N
	E	I am highly motivated due to the non-financial reward systems in place.			Y/N
2)	*If your choice for one or more questions is "N," please state the specific reasons*				
	A				
	B				
	C				
	D				

COMPENDIUM



Figure 19: Compendium Picture 1



Figure 20: Compendium Picture 2



Figure 21: Compendium Picture 3



Figure 22: Compendium Picture 4

5.2 Report of the APANPIRG Contributory Bodies Review Task Force Meeting

……

5.2.5 APANPIRG/26 noted that following the reorganization of APANPIRG structure and the revised Terms of Terms of the Sub Groups, it is necessary for the Sub group to review the structure of its Working Groups and Task Forces and their Terms of Reference. APANPIRG adopted the following Decision.

Decision APANPIRG/26/66 — Review Terms of Reference of Contributory Bodies under the APANPIRG Sub Groups

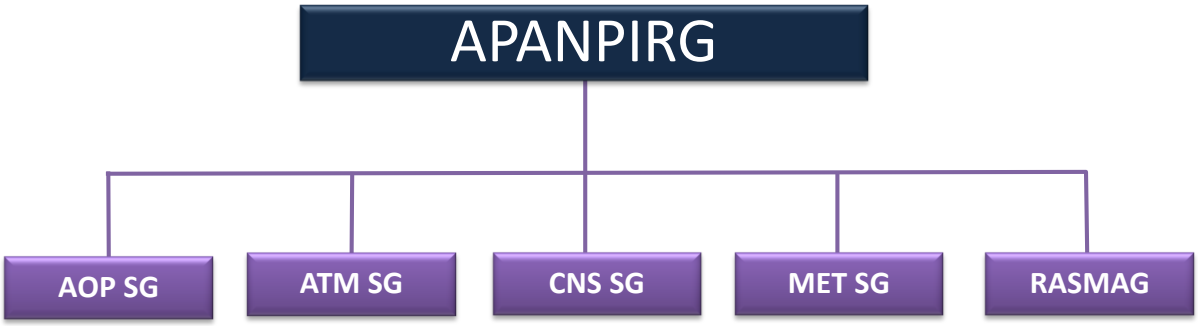
That, the Secretariat, in consultation with Chairs of the existing Task Forces and Working Groups under the APANPIRG Sub Groups, reviews the TOR as necessary, and submits to the respective Sub Groups and APANPIRG/27 for further review and adoption.

.....

— — — — — — —

APPENDIX B

PROPOSED NEW STRUCTURE OF APANPIRG



- AOP SG: Aerodrome Operations and Planning Sub Group
- ATM SG: Air Traffic Management Sub Group
- CNS SG: Communications, Navigation and Surveillance Sub Group
- MET SG: Meteorology Sub Group
- RASMAG: Regional Airspace Safety Monitoring Advisory Group

Note: The scope of the ABSRTF is limited to APANPIRG Sub Groups

APPENDIX C to the Report on Agenda Item 5

APPENDIX C

Terms of Reference for APANPIRG Communications, Navigation and Surveillance/Sub Group (CNS/SG)

The Objectives of the CNS/SG are to:

1) *ensure continuous and coherent development of the CNS parts of the Asia/Pacific Regional Air Navigation Plan (APAC ANP) in a manner that is harmonized with adjacent regions, consistent with ICAO SARPs, the Global Air Navigation Plan and the Global Aviation Safety Plan;*

2) *facilitate the implementation of CNS systems and services identified in the APAC ANP, Aviation System Block Upgrade (ASBU) priority modules and Asia/Pacific Seamless ATM Plan elements using the project management principles where appropriate;*

3) *review, identify and address deficiencies that impede the implementation or provision of efficient CNS services in the Asia & Pacific Regions.*

Deliverables to meet the Objectives:

1) *Progress report to be **submitted** to APANPIRG addressing the CNS SG deliverables (listed in 2 to 9 below);*

2) *CNS parts of the APAC ANP to be **reviewed** and, as necessary, amendment proposals **prepared** to update the APAC ANP to reflect changes in the operational and global requirements;*

3) *Level of implementation of CNS systems and services to be **monitored** and, as necessary, **facilitated** to support the effective implementation of ASBU priority modules and the Asia/Pacific Seamless ATM Plan elements;*

4) *Air navigation deficiencies in the field of CNS to be `**identified** (which may require any necessary systems performance monitoring to be **facilitated**) and, where necessary, appropriate corrective action **proposed** and the development and implementation of action plans by States to resolve identified deficiencies **facilitated**;*

5) *Air navigation deficiencies in the field of CNS (as listed in the APANPIRG database) to be **reviewed** and, as necessary, **updated** to reflect the current situation;*

6) *Research and development, trials and demonstrations in the field of CNS and other relevant areas to be **monitored** and, as necessary, the transfer of this information and expertise between States **facilitated**;*

7) *Specific recommendations to be **made,** and guidance materials **developed,** aimed at improving CNS services by the use of existing and/or new procedures, facilities and technologies;*

8) *Inter-regional and intra-regional co-ordination issues in the field of CNS to be **reviewed** and **identified** and, as necessary, actions **recommended** addressing those issues*;

9) *CNS environmental initiatives are consistently identified and progressed; and report outcomes from CNS environmental initiatives*;

10) *Draft Conclusions and Decisions to be **formulated** relating to matters in the field of CNS that come within the scope of the APANPIRG work plan.*

APPENDIX D to the APANPIRG/26 Report on Agenda Item 5

APPENDIX D

Project Management Principles

1 In the context of a project management approach, projects will be identified primarily from ASBU Modules adopted by APANPIRG, agreed regional targets and objectives and existing initiatives. Any ANS operational improvement is conducted through a project[1]. The Seamless ATM implementation guidance published and maintained by the ICAO Regional Office would apply for structuring the project and providing the necessary technical guidance (standards etc). However the level of documentation required would be commensurate with the project objectives and scale (see below).

2 Where it is not the case, a project team will be nominated by States and concerned international organizations in coordination with SG. The Task Force Chair and/or the ICAO Secretariat will act as Project Managers.

3 In this regard it is proposed that the ToR of the Sub Groups should be reviewed to better support the ICAO performance framework, in particular implementation activities to align with ASBUs and regional priorities. It is also proposed to empower the Sub Groups/Task Forces to make decisions on internal matters and take corrective actions. The Sub Groups would have the ability to agree, without further APANPIRG endorsement, any Conclusion or Decision (especially those concerning guidance to States in the implementation of ICAO SARPs) that does not have significant additional economic, environmental or political effects, which should be considered at a higher level at APANPIRG.

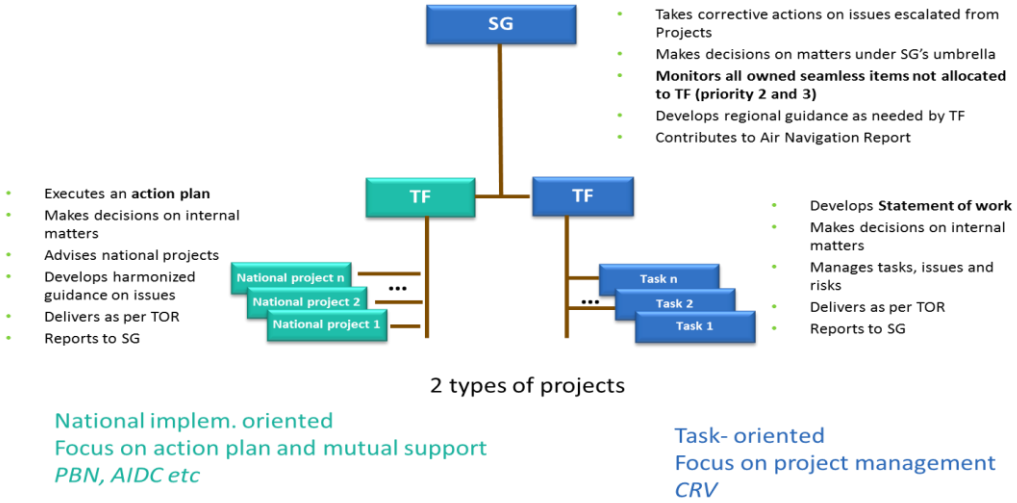
Scale of projects

4 The scale of the project will be defined as experience shows that coordination and control activities vary accordingly:

- interregional (example: definition of an interregional AIDC standard)
- regional (examples: CRV, ATFM projects)
- sub-regional (example: Implementation of new PBN routes between States in a sub region)
- a collection of national projects driven by a State/Administration

Types of project

5 Depending on the objective of the project, 2 types of projects could be defined:



1 Project: according to ISO 10006, unique process consisting of a set of co-ordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including constraints of time, cost and resources.

Documents and tools

6 TORs of the Project should define timelines from start to completion. These timelines should be consistent with eANP Volume III main planning table, stating all deadlines for ASBU and regional objectives and related ANRF.

7 TORs will record also the project manager(s), the project team, the reporting lines (SG and APANPIRG) and scale (interregional, regional, sub-regional, or national) of the project.

8 Projects should be conducted using standardised and simple documents for which templates would be proposed on ICAO APAC RO website:

- Statements of work for the definition of tasks inside a project
- Action list for the allocation and follow-up of actions inside the project and outside the project (dependencies)
- Basic Risk table for the identification and mitigation of risks inside a project
- Project report (1 slide) to report to the SG(s)
- Summary of discussions of the meeting

9 At the creation of the project, the set of applicable documents would be proposed by the Project Manager according to the scale and type of project, endorsed by the SG, and recorded in the TOR.

10 The use of ICAO portal and teleconferences should be generalized to control and coordinate the activities conducted under a project.

Safety management

11 For inter-regional, regional and sub-regional projects undertaking major changes to the air navigation system in Asia Pacific Region, a safety analysis may have to be conducted[2] in the framework of the project. For national projects, the analysis would more probably be conducted inside the State/organizations involved. Such analyses have to comply with ICAO Doc 9859, Safety Management Manual, particularly the Safety risk probability table and the Safety risk severity table.

12 If no other process is available or preferred, the analysis could be based on:

- A Concept of Operations (CONOPS) and/or OSED identifying the new operational services/environments being envisaged;
- Operational Hazard Analysis (OHA) identifying hazards brought by the new operational services;
- Preliminary System Safety Assessment (PSSA) as per ARP 4761 identifying and mitigating the causes of hazards (people, equipment, procedures)
- System Safety Assessment (SSA) as per ARP 4761 establishing that the risk is acceptable according to ICAO Doc 9859.

2 A criterion could be that if an initial Hazard Analysis identifies hazards with severity being major or more severe (significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency, Serious incident, Injury to persons) then an extensive process would have to be conducted. Otherwise a lighter process would be conducted.

Checking/Reporting

13 It is proposed that interregional, regional and sub-regional projects report to their SG through a one page slide on their progress, issues and top risks. National projects would be tracked through the seamless ATM plan on-line reporting process.

14 In order to track the progress of implementation, data collection will be done through the seamless ATM plan on-line reporting process using the metrics defined.

15 A regional picture could be developed to graphically illustrate the progress by seamless ATM plan implementation item. The project was started but is frozen. ICAO's resources would need to be mobilized to support the regional picture.

Acting/correcting

16 A SG would have an overview of all its projects: objectives, achievements, issues, top risks. It will take action on issues escalated by any project supervised or identified between projects supervised. APANPIRG would have an overview of all the projects and will take corrective actions on issues escalated from SGs or identified between SGs.

17 SGs would monitor dependencies between projects. APANPIRG would monitor dependencies between projects supervised by different SG. APANPIRG could review periodically the top 10 risks. A table of projects for the region could be maintained by APANPIRG.

Change management

18 The project management principles presented in this Attachment and considered beneficial by ABSRTF should be refined and recorded in the APANPIRG Procedural Handbook**.**

19 All principles would need a certain time to be properly and homogeneously applied throughout the region. Selection and briefing of project managers would be necessary. Certain principles may be regarded as guidance/good practice first and later on become recommendations.

— — — — — — —

ACTION ITEMS OF CNS SG/29					
Action Item	**Subject**	**Status / Target Date**	**Action Party**	**Status**	**Remarks / follow-up**
.29-1	ICAO Secretariat would share the decision made by CRV OG/14 with delegates of member States/Administrations participating in ACSICG/12 and CNS SG/29 to seek their endorsement on the decision, and feedback/comments, if any, by email	Nov-25	ICAO Secretariat, ACSICG/12, CNS SG/29	Open	
.29-2	The CNS SG/29 Meeting agreed to defer to the SRWG to study the need for a group under CNS SG to assess and analyze the incidents shared by APAC Member States/Administrations and GNSS and Data Link Disruption Ad-Hoc Group to develop mitigation strategies, considering the global development in this domain	CNS SG/30	ICAO Secretariat, SRWG	Open	
.29-3	. The Meeting requested that APAC States/Administrations that have not responded to the SELCAL survey share their readiness with the ICAO APAC Office	CNS SG/30	APAC States/Administrations	Open	
.29-4	A question about the need for deployment of 8.33 KHz channel spacing in the APAC region in the near future, when space-based VHF will be implemented, was raised. It was also shared that there is a need to assess the effect of the deployment of space-based VHF on terrestrial VHF systems in the APAC region. The Meeting agreed that SRWG should discuss the proposed needs and share updates with CNS SG at the next meeting	CNS SG/30	ICAO Secretariat, SRWG	Open	
.29-5	Considering the significance of the list of recommendations for GNSS RFI mitigations presented to the Meeting, the Meeting suggested that ICAO consider publishing them at the global level and sharing them with all States/Administrations officially	CNS SG/30	ICAO HQ	Open	
.29-6	The Meeting found the information of IP/13 of CNS SG/29 very useful and encouraged China to present this information at the GBAS/SBAS ITF meetings	CNS SG/30	China	Open	
.29-7	The Meeting shared the significance of the information shared in the ADS-B Quality Performance Monitoring – Japan (WP/24) and suggested that Japan present this information in future SURICG Meetings	CNS SG/30	Japan	Open	

ACTION ITEMS OF CNS SG/29					
Action Item	**Subject**	**Status / Target Date**	**Action Party**	**Status**	**Remarks / follow-up**
.29-8	It was informed that the ICAO APAC office manages the ADS-B avionics problem reporting database. In addition, the Surveillance Panel (SP) maintains the FAA No Services Aircraft List (NASL), which is the list indicating all aircraft that do not comply with minimum ADS-B requirements. The SURICG Co-Chair informed that SURICG is discussing the need to maintain the proposed databases, and the outcomes will be shared at the CNS SG meeting	CNS SG/30	SURICG	Open	
.29-9	A question was asked about the expectation to submit reporting by States/Administrations once a year or twice, as in the ANS Reporting Tool currently, the report period is the first half of a year and the second half of a year. It was informed that ICAO expects States to submit updates up to the end of last year “at least once annually”, preferably before 28 February of the year. It was added that the report period column would be modified so that States/Administrations could submit updates at least once annually	CNS SG/30	ICAO Secretariat (ATM Section)	Open	
.29-10	As only a few States/Administrations have submitted their information on the reporting tool, it was suggested that all remaining States/Administrations submit their information about 2024 so that the ICAO Secretariat can make further analysis of the ‘as-is’ status before the ATM SG/13 meeting planned in August 2025	CNS SG/30	APAC States/Administrations	Open	
.29-11	It was informed that the ICAO Secretariat will issue a State Letter to all States/Administrations for necessary action after the CNS SG/29 meeting. States/Administrations are requested to update the required information in ICAO APAC e-ANP Vol II	CNS SG/30	ICAO Secretariat	Open	
.29-12	Hong Kong China shared inconsistencies it observed in the ANS Reporting Tool in the “Seamless Plan or ASBU Reference” column and the corresponding column in “Seamless Plan Explanation.” It was requested that while updating the reporting tool for Seamless ANS Plan 4.0, the ICAO Secretariat consider a comprehensive review of all ASBUs and associated descriptions/definitions for States/Administrations to refrain from adding wrong interpretations	CNS SG/30	ICAO Secretariat (ATM Section)	Open	

ACTION ITEMS OF CNS SG/29					
Action Item	**Subject**	**Status / Target Date**	**Action Party**	**Status**	**Remarks / follow-up**
.29-13	Pakistan informed that the AFS communication link between Pakistan and Afghanistan remains non-operational due to the absence of a functioning AFS system on the Afghanistan side. Pakistan is fully prepared and available to activate the link as soon as Afghanistan establishes the required AFS infrastructure. Afghanistan had not given any tentative timelines. Therefore, it was requested that this deficiency be removed from Pakistan's side.	CNS SG/30	ICAO Secretariat, Pakistan	Open	
.29-14	Australia, China, Japan (TBC), Malaysia, New Zealand, Singapore, Thailand and the USA volunteered to join the group. It was agreed that the ANSIA TF would prepare the draft Terms of Reference (ToR), its key deliverables, and plan in close coordination with CRV OG, ACSICG, SWIM TF, TFP Secretary and Information Management Panel Secretary	CNS SG/30	ANSIA TF	Open	
.29-15	It was also agreed that the first meeting of ANSIA TF would be conducted in Q1-2026	CNS SG/30	ANSIA TF	Open	
.29-16	It was agreed to form an ad-hoc group composed of members from China, Hong Kong China, Thailand and the USA. In reviewing the ToR, the ad-hoc group was advised to refer to the CNS ToR of other regions. The revised ToR will be presented by the ad-hoc group at the next CNS SG meeting.	CNS SG/30	ICAO Secretarait, China, Hong Kong China, Thailand and the USA	Open	

CNS POINTS OF CONTACT

(Key: **ADM** – Administration; **URG** –Urgent Matters)

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
	AFGHANISTAN				
ADM / URG	Eng. Mohammad Shaker Popal	CNS Acting Director Afghanistan Civil Aviation Authority	+93(0)799601095 (Mobile)	engpopal@gmail.com;	* Suggested to include Mr. Toryalai Himat, Head of AIS and training, httoryal@gmail.com in emails with Afghanistan POC
	AUSTRALIA				
ADM	Airservices Australia – International Engagement team	Airservices Australia		International@AirservicesAustralia.com;	
URG	Airservices Australia – Service Desk Airways (H24)	Airservices Australia	+61262685555 option 1	TOCBNATM@AirservicesAustralia.com; TOCMLATM@AirservicesAustralia.com; International@AirservicesAustralia.com;	
	BANGLADESH				
ADM	Md. Mahabubur Rahman	Director (CNS) Civil Aviation Authority of Bangladesh	Tel: +88 02 41091032 Fax: +88 02 8901411 Mobile: +88 0189 490 8400	dcnshq@caab.gov.bd;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG	Md. Mahabubur Rahman	Director (CNS) Civil Aviation Authority of Bangladesh	Tel: +88 02 41091032 Fax: +88 02 8901411 Mobile: +88 0189 490 8400	dcnshq@caab.gov.bd;	Please copy Fax: +88 02 8901411 Mobile: +88 0189 490 0000 E-mail: chairman@caab.gov.bd
	BHUTAN				
ADM	Karma Gayley	CNS officer/Bhutan civil Aviation Authority		kgayley@bcaa.gov.bt;	
URG	Devi Maya Adhikari	Dy. Exe. CNS Engineer /Department of Air Transport		dmadhikari@doat.gov.bt;	
	BRUNEI DARUSSALAM				
ADM/URG	Haji Azrol Haji Saruji/Seruji	Chief Aeronautical Telecommunication Officer (CATO) Aeronautical Telecommunication Services, Department of Civil Aviation Brunei		azrol.saruji@dca.gov.bn	
	CAMBODIA				
ADM	Mr. Neang To	Chief of CNS Bureau State Secretariat of Civil Aviation Cambodia (SSCA)	Tel: +855 12820811	Neangto.ans@gmail.com;	
URG	Mr. Heng Mengkong	Deputy Chief of CNS Bureau State Secretariat of Civil Aviation Cambodia (SSCA)	Tel: (+855) 16 398 599	hengmengkong@gmail.com;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
	CHINA				
ADM	Pan Jie	Division Rank Official Air Traffic Regulation Office, CAAC	Tel: +86 010-64092578 Fax: +86 010-64091944	panjie@caac.gov.cn;	
URG	Wang Pengyu	Assistant Air Traffic Management Bureau, CAAC	Tel: +86 18511663906 Fax: +86 010-87786964	wangpengyu.caac@foxmail.com;	
	HONG KONG, CHINA				
ADM	Derek HOW	Electronics Engineer Civil Aviation Department	Tel: +852 2910 6586 Fax: +852 2845 7160	cns_icao@cad.gov.hk;	
URG	Hui Man Ho	Assistant Director-General of Civil Aviation (Air Traffic Management) Civil Aviation Department	Tel: +852 2910 6501 Fax: +852 2845 7160	cns_icao@cad.gov.hk;	
	MACAO, CHINA				
ADM	Mr. LO Veng Tong	Senior Safety Officer Civil Aviation Authority of Macao. China	Tel: +853-87964132 Fax: +853-28338089	freemanlo@aacm.gov.mo;	
URG	Mr. LO Veng Tong	Senior Safety Officer Civil Aviation Authority of Macao. China	Tel: +853-87964132 Fax: +853-28338089	freemanlo@aacm.gov.mo;	
	COOK ISLANDS				
ADM					
URG					
	DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA				
ADM					
URG					

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
	FIJI				
ADM	Sereima Bolanavatu	ANS Inspector (CNS) Civil Aviation Authority of Fiji (CAAF)	Tel: +679 999 5217 Fax: +679 672 1500	sereima.bolanavatu@caaf.org.fj;	
ADM	Mr. Sakiusa Dovibula Vakacautadra Junior	Air Navigation Services Inspector – CNS Civil Aviation Authority of Fiji	Tel: +679 998 8107 Fax: +679 672 1500	sakiusa.vakacautadra@caaf.org.fj;	
URG	Sereima Bolanavatu	ANS Inspector (CNS) Civil Aviation Authority of Fiji (CAAF)	Tel: +679 999 5217 Fax: +679 672 1500	sereima.bolanavatu@caaf.org.fj;	
URG	Mr. Sakiusa Dovibula Vakacautadra Junior	Air Navigation Services Inspector – CNS Civil Aviation Authority of Fiji	Tel: +679 998 8107 Fax: +679 672 1500	sakiusa.vakacautadra@caaf.org.fj;	
	FRANCE				
	FRENCH POLYNESIA				
ADM	Mrs Chloe BERNACKI	Chief of Technical Division / Direction Générale de l'Aviation Civile (DGAC) / France	Tel: +689 89 77 92 59 Fax: +689 40 86 10 09	chloe.bernacki@aviation-civile.gouv.fr;	
URG	Operations Coordination (24h)	Operations Coordination (24h) Direction Générale de l'Aviation Civile (DGAC) / France	Tel: +689 89 77 10 38 Fax: +689 40 86 10 09	seac-pf-sna-rpo-bf@aviation-civile.gouv.fr;	
	FRANCE (NEW CALEDONIA				

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM	Mr. Florent CHAHINIAN	Chief of Technical Division Direction Générale de l'Aviation Civile (DGAC) Direction de l'Aviation Civile en Nouvelle-Calédonie, France	+687 79 60 83	florent.chahinian@aviation-civile.gouv.fr	
URG	Operations coordination	Operations Coordination (24h) Direction Générale de l'Aviation Civile (DGAC) / Direction de l'Aviation Civile en Nouvelle-Calédonie, France	+687 74 23 39	noumea-permanence-ipo@aviation-civile.gouv.fr	
	WALLIS AND FUTUNA ISLANDS				
ADM					
URG					
	INDIA				
ADM	S K Mallik	ED (CNS-OM)/ Airports Authority of India	Tel: +91 (11) 2081 8210 Fax: +91 (11) 2465 4142	edcnsom@AAI.AERO;	
URG	S K Mallik	ED (CNS-OM)/ Airports Authority of India	Tel: +91 (11) 2081 8210 Fax: +91 (11) 2465 4142	edcnsom@AAI.AERO;	
	INDONESIA				
ADM	Budi Fathoni	Air Navigation Inspector of CNSA/ DGCA of Indonesia	Tel: +628563356444	bfathoni@yahoo.com;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM	Muhammad Ryan	Meteorological Information Dissemination Officer, BMKG/ Indonesian Meteorology, Climatology, and Geophysical Agency.	Tel: +6281343160168	muhammad.ryan@bmkg.go.id;	
ADM	Subhan Bin Awad Syawie	Junior Manager of Communication Facility Readiness/ Airnav Indonesia	Tel: +6285240490004	Subhan2902@gmail.com;	
URG	Arian Nurahman	Air Navigation Inspector of CNS/ DGCA of Indonesia	Tel: +6285695414428	ariannurahman@gmail.com ;	
URG	Ardhian Riansyah Cono	Meteorological Public Operation Management Officer, BMKG/ Indonesian Meteorology, Climatology, and Geophysical Agency	Tel: +6285215039595	ardhian1595@gmail.com;	
URG	Dedy lskandar	Junior Manager of Surveillance and Automation Facility Readiness/ Airnav Indonesia	Tel: +6285219917747	dedy.nav7@gmail.com;	
	JAPAN				
ADM	Mr. Masahiro NAKAKUBO	Air Navigation Services Department JCAB		nakakubo-m44ij@mlit.go.jp;	
URG	CNS Operations Coordination(24H)	Air Traffic Management Center(24H) JCAB	Tel: +81-92-608-8888 （092-608-8888）	cab-cnsunyou@mlit.go.jp;	
	KIRIBATI				
ADM					
URG					

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
	LAO PDR				
ADM	Mr. Soudalath	CNS Officer, Air Navigation Standards Division Department of Civil Aviation, Lao	Tel: +856 (21) 513 163 Mobile: +856 (20) 55995009 Fax: +856 (21) 513 177	S.khamsoy@gmail.com;	
ADM	Mr. Somphavanh KINGSADA	Director, CNS Office Lao Air Navigation Service	Mobile: +856 (20) 55675292	somphavanhking@gmail.com;	
URG	Mr. Moukphamay THAMMVONGSA	Deputy Director, Air Navigation Standards Division Department of Civil Aviation, Lao	Tel: +856 (21) 513 163 Mobile: +856 (20) 99649159 Fax: +856 (21) 513 177	moukth@msn.com;	
URG	Mr. Kongsavanh CHANTHAVONG	Deputy Director, CNS Office Lao Air Navigation Service	Mobile: +856 (20) 55817599	kongsavanh.lans@gmail.com;	
	MALAYSIA				
ADM/ URG	Mr. Azman bin Hitam	Senior Assistant Director Quality & Standards Division Civil Aviation Authority of Malaysia (CAAM)	Tel: +60388934175	azman.hitam@caam.gov.my;	
URG	Mr. Sharudin Hashim	Principal Assistant Director (CNS) ANS Technical Division Civil Aviation Authority of Malaysia (CAAM)	Tel: +60385291208	sharudin@caam.ov.my;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG	Mr. Shairyzal Bin Mohamad @ Azizan	Assistant Director ANS & Aerodrome Standard Division Civil Aviation Authority of Malaysia (CAAM)	Tel: +60388714387 Fax: +60388714135	shairyzal.azizan@caam.gov.my;	
	MALDIVES				
ADM	Ms. Fathimath Ahmed	Manager, Engineering Maldives National Air Traffic Service	Mobile: +9609660646	fathimath.ahmed@mnats.aero	
	Mr. Ishag Abdulla	Chief Technical Officer Maldives National Air Traffic Service	Mobile: +9607957235	ishag@mnats.aero	
URG	Mr. Ibrahim Imran	Manager, Air Traffic Engineering Maldives National Air Traffic Service	Mobile: +9607784344	imran@mnats.aero	
	Mr. Ishag Abdulla	Chief Technical Officer Maldives National Air Traffic Service	Mobile: +9607957235	ishag@mnats.aero	
	MALSHALL ISLANDS				
ADM					
URG					
	MICRONESIA (FEDERATED STATES OF)				
ADM					
URG					
	MONGOLIA				

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM	Mr. Odgerel Chagnaadorj	Director Air Navigation and Airports Policy Regulation Department, Civil Aviation Authority of Mongolia	Tel: +976 71 282003 Fax: +976 70046562	odgerel.ch@mcaa.gov.mn;	
URG	Mr. Ganbaatar Puntsag	Senior inspector Air navigations Oversight Division, Civil Aviation Authority of Mongolia	Tel: +976 71 282215 Fax: +976 70046562	ganbaatar@mcaa.gov.mn;	
URG	Mr. Zolboo Batuskh	Inspector Air navigations Oversight Division, Civil Aviation Authority of Mongolia	Tel: +976 71 282075 Fax: +976 70046562	zolboo.ba@mcaa.gov.mn	
URG	Mr. Enkhmunkh.E	Officer Air Navigation and Airports Policy Regulation Department, Civil Aviation Authority of Mongolia	Tel: +976 88016763 Fax: +976 70046562	enkhbold.e@mcaa.gov.mn	
	MYANMAR				
ADM	MR. ZAW MIN OO	DEPUTY GENERAL MANAGER (CNS) DEPARTMENT OF CIVIL AVIATION MYANMAR	Tel: +951-7533020, +959-425324449 Fax: +9517-533016	zawminoo76@gmail.com; zawminoo.cns@dcamyanmar.aero;	
URG	MR. AUNG MYO	ASSISTANT GENERAL MANAGER (CNS) DEPARTMENT OF CIVIL AVIATION MYANMAR	Tel: +951-7533052, +959-5414430 Fax: +9517-533016	aungmyo.ms@gmail.com; aungmyo@dcamyanmar.aero;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG	MR. HTET ARKAR	EXECUTIVE ENGINEER (CNS) DEPARTMENT OF CIVIL AVIATION MYANMAR	Tel: +951-7533024, +959-5213154 Fax: +9517-533016	kohtetarkar@gmail.com; htetarkar@dcamyanmar.aero;	
	NAURU				
ADM					
URG					
	NEPAL				
ADM					
URG					
	NEW ZEALAND				
ADM	Xavier Ruch	National Continuous Monitoring Coordinator /ICAO Liaison Civil Aviation Authority of New Zealand	+64 4 560 9400	Policyand.InternationalRelationsUnit@caa.govt.nz;	
URG	Sean Rogers	Head of Aeronautical Services Civil Aviation Authority of New Zealand	Tel: +64 27 807 4875	aeronautical.services@caa.govt.nz;	
URG	Edmund Heng	Senior Technical Specialist Aeronautical Services Civil Aviation Authority of New Zealand	+64 4 460 6968	edmund.heng@caa.govt.nz;	
URG	Mark Blanchard *(back-up for No. 1 point of contact)*	Regulatory Assurance Manager Airways New Zealand	+64 27 597 5604	regulatoryassurance@airways.co.nz;	
URG	Jennifer Nepton	Manager Air Traffic Services Development Airways New Zealand	+64 3 358 1567	jennifer.nepton@airways.co.nz;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG	Tim Yearsley	Manager National Engineering Airways New Zealand	+64 27 252 2580	Timothy.Yearsley@airways.co.nz;	
URG	David Wills	Technology Safety and Regulatory Compliance Specialist Airways New Zealand	+64 (3) 3576897	david.j.wills@airways.co.nz ;	
	PAKISTAN				
ADM	Saeed Ahmed Butt	Director CNS Engineering Pakistan AirportAuthority	Tel: +92 21 9907 2200 Fax: +92 21 9924 2121	Director.CNS@caapakistan.com.pk;	
ADM	Engr. Muhammad Ali Qasim	Deputy Director AAR Pakistan Civil Aviation Authority	Tel : +92 21 99072622	Ali.Qasim@caapakistan.com.pk	
URG	Engr. Muhammad Asad Khan Niazi	Senior Joint Director Radar (Maint/ Plans) Pakistan Civil Aviation Authority	Tel: +92 21 99242194 Fax: +92 21 34604329	mak.niazi@caapakistan.com.pk;	
	PALAU				
ADM					
URG					
	PAPUA NEW GUINEA				
ADM	Mr. Phil Irvine (Primary Contact)	Executive Manager Air Traffic Services NiuSky Pacific Limited Jacksons International Airport Port Moresby PAPUA NEW GUINEA	Tel: +675 7895 3027	pirvine@niuskypacific.com.pg;	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM	Mr. Leonard Robert (Associate Contact)	Manager Training and Standards NiuSky Pacific Limited Jacksons International Airport Port Moresby PAPUA NEW GUINEA	Tel: +675 3121580	lrobert@niuskypacific.com.pg;	
URG	Mr. Kalogo Gulaga	Acting Executive Manager Engineering NiuSky Pacific Limited Jacksons International Airport Port Moresby PAPUA NEW GUINEA	Tel: +675 7837 0158	kgulaga@niuskypacific.com.pg;	
	PHILIPPINES				
ADM	Gary M. Jadie	Department Manager III Air Navigation Service Civil Aviation Authority of the Philippines	Tel: +63 (2) 8246 4988 loc 2189 +63 910 740 2150 (Mobile)	garymjadie@caap.gov.ph;	
URG	Leandro R. Varquez	Department Manager III Air Navigation Service Civil Aviation Authority of the Philippines	Tel: +632 8246 4988 loc 2182 / +63 908 862 0722 (Mobile)	elbotvarquze@caap.gov.ph	
URG	Florian S. Atienza	Division Chief III Air Navigation Service Civil Aviation Authority of the Philippines	Tel: +632 8246 4988 loc 2198 +63 917 108 9351 (Mobile)	anod_chief@caap.gov.ph	

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
	REPUBLIC OF KOREA				
ADM	Kyung-Joon Jang	Deputy Director Ministry of Land, Infrastructure and Transport (MOLIT)	Tel: +82 44-201-4350 Fax: +82 44-201-5637	skyjan@korea.kr;	
ADM	Yu-Jin Kim	Assistant Director Ministry of Land, Infrastructure and Transport (MOLIT)	Tel: +82 44-201-4364 Fax: +82 44-201-5637	kyjin22@korea.kr;	
URG	Kyung-Joon Jang	Deputy Director Ministry of Land, Infrastructure and Transport (MOLIT)	Tel: +82 44-201-4350 Fax: +82 44-201-5637	skyjan@korea.kr;	
URG	Yu-Jin Kim	Assistant Director Ministry of Land, Infrastructure and Transport (MOLIT)	Tel: +82 44-201-4364 Fax: +82 44-201-5637	kyjin22@korea.kr;	
	SAMOA				
ADM					
URG					
	SINGAPORE				
ADM/URG	Augustine Lau	Head(Communications Systems)/Civil Aviation Authority of Singapore		augustine_lau@caas.gov.sg;	
ADM/URG	Lee Suk Leng	Head (Surveillance Systems) Civil Aviation Authority of Singapore		Lee_Suk_Leng@caas.gov.sg;	
	SOLOMON ISLANDS				
ADM					

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG					
	SRI LANKA				
ADM	Mrs. N.S.Casseer	Deputy Director General-Airspace Regulations Civil Aviation Authority Sri Lanka	Tel: +94112358821/+94112253496	ddgasr@caa.lk;	
ADM	Mr. M.A.K.Prasanna	Director Air Navigation Services Civil Aviation Authority Sri Lanka	Tel: +94112358849/+94112253863	dans@caa.lk;	
ADM	Eng. Jananath Konara Rathninda	Head of Electronics & Air Navigation Engineering, Airport & Aviation Services Sri Lanka (PVT) limited	Tel : +94773834032/+94112263600 Fax: +94112252400	head.eane@airport.lk;	
URG	Eng. Mihiri Kumari	Senior Electronics Engineer Airport & Aviation Services Sri Lanka (PVT) limited	Tel : +94768242736, Fax: +94112633488,	mihiri.eane@airport.lk;	
URG	Eng. Asanga Bandara Senarath	Senior Electronics Engineer Airport & Aviation Services Sri Lanka (PVT) limited	Tel: +94768242654, Fax: +94112252400,	asanga.eane@airport.lk;	
URG	Eng. Vidura Thammitage	Senior Electronics Engineer Airport & Aviation Services Sri Lanka (PVT) limited	Tel : +94768242735, Fax: +94112633488,	vidura.eane@airport.lk;	
URG	Eng. Prasanna Wijeratna	Electronics Engineer Airport & Aviation Services Sri Lanka (PVT) limited	Tel : +94779975589, Fax: +94112633488,	prasannaw.eane@airport.lk;	
	THAILAND				

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM	Mr. Sarawoot Rungruengwajiake	Head of Communications, Navigation and Surveillance Standards Division Air Navigation Services Standards Department Civil Aviation Authority of Thailand (CAAT)	Tel: +66 (2)568 8800 ext. 0808 +66 (89) 066 1313 (mobile) Fax: +66 (2) 568 8847	sarawoot.r@caat.or.th;	
ADM	Dr. Amornrat Jirattigalachote	Strategic Planning Manager (Engineering) Aeronautical Radio of Thailand Ltd. (AEROTHAI)	Tel: +66 (2) 287 8262 (Office) +66 (81) 887 2535 (Mobile)	amornrat.ji@aerothai.co.th;	
URG	Lt. JG. Chalor Uthai, RTN	Navigation Aids Section, Base Operations Division, Naval Air Station, Royal Thai Naval Air Division U-Tapao Airport Authority	Tel: 089 989-6726	lor_uthai@hotmail.com;	
URG	Mr. Chanyoot Janprasong	Vice President Air Traffic Services Engineering Aeronautical Radio of Thailand Ltd. (AEROTHAI)	Tel: +66 (2) 287 8830 (Office) +66 (85) 481 1746 (Mobile)	chanyoot.ja@aerothai.co.th;	
	TIMOR LESTE				
ADM					
URG					
	TONGA				

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
ADM					
URG					
	TUVALU				
ADM					
URG					
	USA				
ADM	Mr Shayne Campbell	Senior Air Traffic Representative, Asia Pacific Federal Aviation Administration Air Traffic Organization, Mission Support (AJV-I2) American Embassy, Singapore	Tel: +65 6476 9413 Mobile: +65 8909-1136	shayne.a.campbell@faa.gov ;	
URG	Mr Shayne Campbell	Senior Air Traffic Representative, Asia Pacific Federal Aviation Administration Air Traffic Organization, Mission Support (AJV-I2) American Embassy, Singapore	Tel: +65 6476 9413 Mobile: +65 8909-1136	shayne.a.campbell@faa.gov ;	
	TUVALU				
ADM					
URG					
	VANUATU				
ADM					

CAT	STATE/ NAME OF CONTACT	TITLE/ORGANIZATION	TEL/FAX	E-MAIL	REMARK
URG					
	VIET NAM				
ADM	Mr. Nguyen The Hung	Director/Air Navigation Department, CAAV	Tel: 84 24 38723600	hungand@caa.gov.vn;	
	Mr. Vu Ngoc Tuan	CNS Official/Air Navigation Department, CAAV	Tel: 84 24 38720199	vungoctuan@caa.gov.vn;	
URG	Mr. Ho Sy Tung	Deputy Director General/ Viet Nam Air Traffic Management Corporation	Tel: 84 913222564	tunghosy@vatm.vn;	
	Mr. Be Nhat Hoan	Director/CNS Department, Viet Nam Air Traffic Management Corporation	Tel: 84 913003737	benhathoan@caa.gov.vn;	

List of Participants

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
1.	**AUSTRALIA (2)**				
	1.	Mr. Long Nguyen	CNS Senior Engineering Specialist | Business Manager Lifecycle Planning CNS, Airservices Australia	long.nguyen@airservicesaustralia.com;	
	2.	Mr. Brad Parker	Manager CNS/ATM, CASA	brad.parker@casa.gov.au;	
2.	**BHUTAN (1)**				
	3.	Mr. Sonam Dorji	Communication/Navigation Engineer, Department of Air Transport	sonamdorji@doat.gov.bt;	
3.	**BRUNEI DARUSSALAM (2)**				
	4.	Mr. Muhammad Rafiee Bin Haji Mohd Efenddy	Senior Technical Assistant Aeronautical Telecommunication Services, Department of Civil Aviation	rafiee.effendy@dca.gov.bn;	Attend only on 18, 19, 20 June
	5.	Mr. Muhammad Shamrin bin Abdullah Bundol	Aeronautical Telecommunication Officer, Aeronautical Telecommunication, Department of Civil Aviation Brunei.	shamrin.bundol@dca.gov.bn;	Attend only on 18, 19, 20 June
4.	**CHINA (7)**				
	6.	Mr. Li Li	Director, CNS Division of ATRO, CAAC		
	7.	Ms. JING CAI	Deputy director, ATMB.CAAC	caijing_atmb@qq.com;	
	8.	Ms. Jingjing Zhao	Associate Professor, Beihang University		

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	9.	Mr. Qingchao Li	Associate Professor, Beihang University	qingchaoli@buaa.edu.cn;	
	10.	Mr. Chen Weiqing	Senior Engineer of Equipment Maintenance Center, East China Regional Air Traffic Management Bureau Of CAAC	cwq3545@163.com;	
	11.	Mr. Wenyan An	Senior Engineer, SWATMB of CAAC	skywalkeran@163.com;	
	12.	Mr. PENG LI	Senior Engineer, Technical Centre of Air Traffic Management Bureau of CAAC	lipeng@atmb.net.cn;	
5.	**HONG KONG CHINA (6)**				
	13.	Mr. M H HUI	Assistant Director-General of Civil Aviation (Air Traffic Management), Civil Aviation Department of Hong Kong China	mhhui@cad.gov.hk;	
	14.	Mr. Richard WU	Senior Consultant (Civil Aviation), Civil Aviation Department of Hong Kong China	rckwu@cad.gov.hk;	
	15.	Ms. Olivia CHAN	Senior Operations Officer (Technical), Civil Aviation Department of Hong Kong China	osmchan@cad.gov.hk;	
	16.	Ms. Silvia MAK	Senior Aeronautical Communications Supervisor, Civil Aviation Department of Hong Kong China	wymak@cad.gov.hk;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	17.	Mr. Derek HOW	Acting Senior Electronics Engineer (Projects), Civil Aviation Department of Hong Kong China	dslhow@cad.gov.hk;	
	18.	Ms. Yumi TUNG	Electronics Engineer, Civil Aviation Department of Hong Kong China	yymtung@cad.gov.hk;	
6.	**MACAO CHINA (3)**				
	19.	Ms. Un Kei Leong	Assistant Safety Officer, Civil Aviation Authority of Macao S.A.R.	lillianleong@aacm.gov.mo;	
	20.	Mr. Veng Tong Lo	Senior Safety Officer (CNS), Civil Aviation Authority of Macao SAR	freemanlo@aacm.gov.mo;	
	21.	Mr. Keng Chong Sun	Head of IT and CNS Division, CAM - Macau International Airport Co. Ltd.	sonnysun@macau-airport.com;	
7.	**FIJI (2)**				
	22.	Mr. Sakiusa Dovibula Vakacautadra Junior	ANS Inspector - CNS, Civil Aviation Authority of Fiji	Sakiusa.Vakacautadra@caaf.org.fj;	
	23.	Mr. William Reece	Manager Air Navigation Engineering Services, Fiji Airports Ltd	williamr@fijiairports.com.fj;	
8.	**FRANCE (NEW CALEDONIA) (1)**				
	24.	Mr. Florent Chahinian	Head of Air Navigation Service Technical Department, DGAC/ DAC-NC	florent.chahinian@aviation-civile.gouv.fr;	
9.	**INDIA (4)**				

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	25.	Ms. Lakshmi Chandala	Joint General Manager, National Institute of Aviation Management & Research, Airports Authority of India	lakshmica@aai.aero;	
	26.	Mr. Anil Kumar S.	General Manager (CNS), CHQ		
	27.	Mr. Nitin Agarkar	Jt. General Manager (CNS), RHQ-WR, Mumbai		
	28.	Mr. Upal Debnath	Asst. General Manager (CNS), RHQ-ER, Kolkata		
10.	**INDONESIA (4)**				
	29.	Mr. Rachmat Hidayat	FACILITY READINESS-HEAD OFFICE, AirNav Indonesia	rachmathidayat2704@gmail.com;	
	30.	Mr. Rahmad Abadi Hutama	Data Processing Engineer, Perum LPPNPI (AirNav Indonesia)	rahmad.abadi@airnavindonesia.co.id;	
	31.	Ms. Rizki Amelia	Assistant Vice President Navigation Facility Planning, Perum LPPNPI (AirNav Indonesia)	rizki.amelia@airnavindonesia.co.id;	
	32.	Ms. Sara Dhelviana	Communication Engineer, Perum LPPNPI (AirNav Indonesia)	sara.dhelviana@airnavindonesia.co.id;	
11.	**JAPAN (6)**				
	33.	Mr. Masahiro Nakakubo	Special Assistant to the Director, Japan Civil Aviation Bureau	nakakubo-m44ij@mlit.go.jp;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	34.	Mr. Ryuichi Nagai	CNS Expert, Japan Radio Air Navigation Systems Association (JRANSA)	nagai-r194@jransa.or.jp;	
	35.	Mr. Shinji Hara	Senior Advisor, Japanese International Cooperation Agency (JICA)	Hara.Shinji@jica.go.jp;	
	36.	Mr. Masashi Kotatsu	Chief, JCAB/JAPAN	kotatsu-m46wv@mlit.go.jp;	
	37.	Mr. Hajime Yoshimura	Director, CNS Planning Office, Air Navigation Services Department, Civil Aviation Bureau, MLIT, Ministry of Land, Infrastructure, Transport and Tourism of Japan	yoshimura-h2v2@mlit.go.jp;	
	38.	Mr. Susumu Saito	Principal Researcher, National Institute of Maritime, Port, and Aviation Technology	susaito@enri.go.jp;	
12.	**LAO PDR (4)**				
	39.	Mr. Moukphamay Thammavongsa	Deputy Director of Air Navigation Standard Division, Department of Civil Aviation of Lao PDR	moukth@msn.com;	
	40.	Mr. Xayyalath Vonglatsmy	Officer, Department of Civil Aviation of Lao PDR	xayyalath03@outlook.com;	
	41.	Mr. Xaysavanh Kittanouvong	Deputy General Director of Lao Air Navigation Services	Xays.kitta@gmail.com;	
	42.	Mr. Chanthaveth Souphatta	Deputy Director of CNS Technical Officer	Souphattac@gmail.com;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
13.	**MALAYSIA (3)**				
	43.	Mr. Mohd Hafiz Hamzah	CNS Officer, Civil Aviation Authority Malaysia	mhafiz@caam.gov.my;	
	44.	Mr. Khairul Nazmi Zainol Ariffin	PRINCIPAL ASSISTANT DIRECTOR, Civil Aviation Authority of Malaysia	k.nazmi@caam.gov.my;	
	45.	Ms. Nurul Ain Zhafarina Muhamad	Air Traffic Control Officer, Civil Aviation Authority of Malaysia	zhafarina@caam.gov.my;	
14.	**MALDIVES (2)**				
	46.	Mr. Ishag Abdulla	Chief Technical Officer, Maldives National Air Traffic Service	ishag@mnats.aero;	
	47.	Mr. Ibrahim Imran	Manager Air Traffic Engineering, Maldives National Air Traffic Service	imran@mnats.aero;	
15.	**MONGOLIA (1)**				
	48.	Mr. Zolboo Batsukh	CNS inspector, Civil Aviation Authority of Mongolia (CAAM)	zolboo.ba11@gmail.com;	
16.	**NEW ZEALAND (1)**				
	49.	Mr. Edmund Heng	Senior Technical Specialist Aeronautical Services, Civil Aviation Authority of New Zealand	edmund.heng@caa.govt.nz;	
17.	**PAKISTAN (2)**				
	50.	Mr. Sohail Ahmed	Deputy Director / CNS Inspector, PAKISTAN Civil Aviation Authority - AAR Directorate	sohail_ahmed@caapakistan.com.pk;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	51.	Mr. Muhammad Ali Qasim	Deputy Director, PAKISTAN Civil Aviation Authority – DAAR	m.aliqasim27@gmail.com;	
18.	**PHILIPPINES (2)**				
	52.	Mr. Gary Jadie	Dept. Manager III, Civil Aviation Authority of the Philippines	garymjadie@caap.gov.ph;	
	53.	Mr. Leandro Varquez	Department Manager III, Civil Aviation Authority of the Philippines (CAAP)	elbotvarquez@gmail.com;	
19.	**REPUBLIC OF KOREA (3)**				
	54.	Mr. Jeyoung Lee	Deputy General Manager, Korea Airport Corporation	no1ress@hanmail.net;	
	55.	Mr. Jihoon Jang	Assistant Manager, Korea Airport Corporation	wkdwlwl0410@airport.co.kr;	
	56.	Mr. Kyungwon LEE	Assistant Director, Republic of Korea, Ministry of Land, Infrastructure and Transport	junag333@korea.kr;	
20.	**SINGAPORE (6)**				
	57.	Mr. Aaron Ng	Senior Air Traffic Control Manager, Civil Aviation Authority of Singapore	aaron_ng@caas.gov.sg;	
	58.	Mr. Augustine Lau	Head (Communications Systems), Civil Aviation Authority of Singapore	Augustine_lau@caas.gov.sg;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	59.	Mr. Mohamed Ruzaini Bin Mohamed Ismail	Senior Air Traffic Control Manager (Operations Technology), Civil Aviation Authority of Singapore	mohamed_ruzaini_ismail@caas.gov.sg;	
	60.	Mr. Wee Sin Ho	Deputy Director, Civil Aviation Authority of Singapore	Ho_wee_sin@caas.gov.sg;	
	61.	Mr. Aloysius Ang	Head (Ops Tech Planning, Civil Aviation Authority of Singapore (CAAS)	Aloysius_ang@caas.gov.sg;	
	62.	Mr. Victor Lee	Principal Manager (CNS Regulation), Civil Aviation Authority of Singapore (CAAS)	victor_lee@caas.gov.sg;	
21.	**THAILAND (18)**				
	63.	Mr. Chainan Chaisompong	Air Traffic Engineering Manager, Aeronautical Radio of Thailand Limited (AEROTHAI)	chainan.ch@aerothai.co.th;	
	64.	Ms. Amornrat Jirattigalachote	Expert (Director Level), Aeronautical Radio of Thailand Ltd. (AEROTHAI)	amornrat.ji@aerothai.co.th;	
	65.	Mr. Chonlawit Banphawatthanarak	Senior Director, Internal Audit Bureau, AEROTHAI	chonlawit.ba@aerothai.co.th;	
	66.	Mr. Dhivatbodi Sivajdhanachoti	Strategic Planning Manager (Engineering), AEROTHAI	dhivatbodi.si@aerothai.co.th;	
	67.	Mr. Guntarith Lertutsahakul	Senior Director, Air Traffic Services Engineering Support Bureau, AEROTHAI	guntarith.le@aerothai.co.th;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	68.	Mr. Kom Promsuttikul	Strategic Planning Manager (Engineering), AEROTHAI, Aeronautical Radio of Thailand Ltd.	kom.pr@aerothai.co.th;	
	69.	Mr. Narupon Montree	Senior Air traffic system engineering, AEROTHAI, Aeronautical Radio of Thailand Ltd.	narupon.mo@aerothai.co.th;	
	70.	Mr. Pakkawin Watcharakhajonwong	Executive Strategic Planning Officer (Engineering), AEROTHAI, Aeronautical Radio of Thailand Ltd.	pakkawin.wa@aerothai.co.th;	
	71.	Mr. Punyawee Phatthanakitworarak	Air Traffic Systems Engineer, AEROTHAI, Aeronautical Radio of Thailand Ltd.	punyawee.bu@aerothai.co.th;	
	72.	Mr. Chanyut Phrukkumwong	Director, Air Traffic Services Engineering, Research and Development Department, AEROTHAI, Aeronautical Radio of Thailand Ltd.		
	73.	Mr. Supparerk Sirimoung	Acting Director, Air Traffic Surveillance, Systems Engineering Department, AEROTHAI, Aeronautical Radio of Thailand Ltd.		
	74.	Mr. Chavalit Ithiapa	Air Navigation Services Standards Senior Officer, The Civil Aviation Authority of Thailand	chavalit.i@caat.or.th;	

	STATE/NAME	TITLE/ORGANIZATION	E-MAIL	REMARKS
	75. Mr. Phichpawis Plengsiriwat	Air Navigation Operation Officer, The Civil Aviation Authority of Thailand	phichpawis.p@caat.or.th;	
	76. Mr. Thamawoot Pocathikorn	Senior ANS Officer, The Civil Aviation Authority of Thailand	thamawoot.p@caat.or.th;	
	77. Mr. Jeerapat Chotsaengthong	Air Navigation Operations Management Officer, The Civil Aviation Authority of Thailand (CAAT)	jeerapat.c@caat.or.th;	
	78. Mr. Sarawoot Rungruengwajiake	Head of CNS Standards Division, The Civil Aviation Authority of Thailand (CAAT)	sarawoot.r@caat.or.th;	
	79. Captain Supanit Kandhavivorn	Pilot Management Department Operations Department, Thai Airways International PCL		
	80. Co-Pilot Piya Kaewsorn	Pilot Management Department Operations Department, Thai Airways International PCL		
22.	**UNITED STATES (2)**			
	81. Mr. Shayne Campbell	Senior International Air Traffic Representative Asia Pacific, United States Federal Aviation Administration (FAA)	shayne.a.campbell@faa.gov;	
	82. Ms. Diana Liang*	Engineer Manager, FAA	diana.liang@faa.gov;	
23.	**VIETNAM (4)**			

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	83.	Mr. Nguyen Manh Thang	Deputy Director – CNS	thangnm@vatm.vn;	
	84.	Mr. Nguyen Dinh Quang Dang	Officer – Safety and Quality Department	gnadnguyen@gmail.com;	
	85.	Mr. Chau Van Tu	Deputy Head of Technical Centre – Middle Regional Air Traffic Service	Chautu1987@gmail.com;	
	86.	Mr. Do Quang Vu	CNS Engineer, VATM – ATTECH	vudq@attech.com.vn;	
24.	**IFATSEA (1)**				
	87.	Mr. Umesh Kumar*	Regional Director APAC region	umeshkc@aai.aero;	
25.	**AEROVISION TECHNOLOGY LIMITED (1)**				
	88.	Ir. Dr. Angus Cheung	Chief Executive Officer, Aerovision Technology Limited	angus.cheung@aerovision.com.hk;	Attend only on 19, 20 June
26.	**AIREON (2)**				
	89.	Mr. Joe Holewa	Manager, APAC Sales, Aireon	joe.holewa@aireon.com;	
	90.	Mr. Diego Albert	Director, APAC Sales, Aireon	diego.albert@aireon.com;	Attend only on 16, 17 June
27.	**HARMONY TECH INNOVATION LIMITED (1)**				
	91.	Mr. Pavel Lau	Executive Director, Harmony Tech Innovation Limited	pavellau@harmonytech.hk;	Attend only on 17, 18, 19 June
28.	**ICAO (9)**				
	92.	Dr. Soniya Nibhani	Regional Officer ANS (CNS) Implementation International Civil Aviation Organization Asia and Pacific Office	snibhani@icao.int;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	93.	Mr. De Zhang	Regional Officer, Communications, Navigation and Surveillance, Asia and Pacific Office, International Civil Aviation Organization, Asia and Pacific Office	dzhang@icao.int;	
	94.	Mr. Peter Dunda	Regional Officer MET/ENV International Civil Aviation Organization Asia and Pacific Office	pdunda@icao.int;	Attend only on 16 June
	95.	Mr. Takata Hiroyuki	Regional Officer ATM International Civil Aviation Organization Asia and Pacific Office	htakata@icao.int;	Attend only on 16 June
	96.	Mr. Mior Sallehhuddin	Regional Officer ATM International Civil Aviation Organization Asia and Pacific Office	msallehhuddin@icao.int;	Attend only on 18 June
	97.	Ms. Muna Alnadaf*	Technical Officer, Communications, Navigation and Surveillance, ANB/ANS/CNSS, ICAO	malnadaf@icao.int;	
	98.	Mr. Michael Goodfellow*	Technical Officer, Global Interoperable Systems, ANB/ANS/GIS, ICAO	mgoodfellow@icao.int;	

	STATE/NAME		TITLE/ORGANIZATION	E-MAIL	REMARKS
	99.	Ms. Jian Xu	Associate Programme Officer, Air Navigation Systems (CNS) Implementation, International Civil Aviation Organization, Asia and Pacific Office	jixu@icao.int;	
	100	Ms. Varapan Meefuengsart	Programme Assistant International Civil Aviation Organization Asia and Pacific Office	vmeefuengsart@icao.int;	

* Virtual Attendance

LIST OF INFORMATION AND WORKING PAPERS

WP/IP/SP Number	Agenda	Subject	Presented by
		WORKING PAPERS	
WP/01	1	Provisional Agenda	Secretariat
WP/02	3	Review of Relevant Meetings	Secretariat
WP/03	3	Outcomes of the Twelfth Meeting of the Air Traffic Management Sub-Group (ATM/SG/12) of APANPIRG and Other Relevant Outcomes	Secretariat
WP/04	3	Relevant Outcomes from MET SG and other relevant meetings	Secretariat
WP/05	4.1	Outcomes of The Twelfth Meeting of The Aeronautical Communication Services Implementation Coordination Group (ACSICG/12)	Secretariat
WP/06	5.1	Review Report of Tenth Meeting of System Wide Information Management Task Force (SWIM TF/10)	Secretariat
WP/07	5.2	Review Report of the First and Second Working Sessions of the SWIM Implementation Pioneer Ad-Hoc Group (SIPG WS/1 and SIPG WS/2)	Secretariat
WP/08	5.3	Outcomes of the SWIM Seminar	Secretariat
WP/09	6.1	Outcomes of WRC-27 Workshop	Secretariat
WP/10	6.2	Review the Report of the Ninth Meeting of the Spectrum Review Working Group (SRWG/9)	Secretariat
WP/11	7.1	Review Report of the Seventh Meeting of GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/7)	GBAS/SBAS ITF Co-Chairs
WP/12	7.2	Outcomes of Radio Navigation Symposium	Secretariat
WP/13	7.3	Outcomes of Flight Inspection and Procedure Validation Seminar	Secretariat
WP/14	8.1	Review Report of Tenth Meeting of the Surveillance Implementation Coordination Group (SURICG/10)	Secretariat
WP/15	9.1	Review Report of the Sixth Meeting of the ATM Automation Systems Task Force (ATMAS TF/6)	Secretariat
WP/16	10.1	APAC Seamless ANS Plan V4.0 and ANS Reporting Tool Update	Secretariat
WP/17	10.1	Updates in e-ANP Vol II	Secretariat

WP/IP/SP Number	Agenda	Subject	Presented by
WP/18	13.1	Need for the creation of an APAC contributory body for the management and implementation of ICAO ANS Cybersecurity provisions	CRV OG and SWIM TF
WP/19	10.2	Delhi Declaration implementation status related to CNS	Secretariat
WP/20	12	Supervisory and Managerial Roles of ATSEP – Proposed	IFATSEA
WP/21	11	Review the status of CNS deficiencies	Secretariat
WP/22	16	CNS Point of Contact	Secretariat
WP/23	15	Review of ToR and action items	Secretariat
WP/24	8.2	ADS-B Quality Performance Monitoring	Japan
WP/25	10.3	Building a Disaster-Resilient Network	Japan
WP/26	12	Support for the Build Sustainable Capacity	Japan
WP/27	6	Outcomes of Survey for assessment of readiness for Amendment 91 to Annex 10, Volume III on Selective Calling (SELCAL) Codes Implementation	Secretariat
WP/28	7.2	Recommendations of the Radio Navigation Symposium	Secretariat
WP/29	14	Trials of using two-phase immersion cooling to enhance the ANS Systems' performance and energy efficiency Trials of Using Two-phase Immersion Cooling to Enhance Air Navigation Services Systems Performance and Energy Efficiency	Hong Kong China
WP/30	14	Real-time Tracking of Outdoor Activities to Improve Safety and Emergency Response	Hong Kong China
WP/31	4	Future Bandwidth Requirements for CRV basedBased on Outcomes of a Demonstration Event Hosted by Hong Kong China HK	Hong Kong China
WP/32	16	Implementation of a new CNS&ATM Workshop and Training program	China
WP/33	6	Accelerating the LDACS Technique Development for Civil Aviation Application	China
WP/34	6.4	AeroMACS 2.0 Project Progress in China	China
WP/35	12	Hong Kong China's initiatives in supporting the ICAO Next Generation Aviation Professionals Programme	Hong Kong China

WP/IP/SP Number	Agenda	Subject	Presented by
WP/32	16	Implementation of a new CNS&ATM Workshop and Training program	China
WP/33	6	Accelerating the LDACS Technique Development for Civil Aviation Application	China
WP/34	6.4	AeroMACS 2.0 Project Progress in China	China
WP/35	12	Hong Kong China Initiatives in Supporting the ICAO Next Generation Aviation Professionals Programme	Hong Kong China
		INFORMATION PAPERS	
IP/01	-	Meeting Bulletin	Secretariat
IP/02	5	APAC TBO Pathfinder - FF-ICE/R1 Laboratory Demonstration	Thailand
IP/03	6.4	Space-based VHF Update	Australia
IP/04	7.4	Establishment and Validation of Australia's Backup Navigation Network	Australia
IP/05	8.2	ADS-B GNSS Performance Issues in Australia	Australia
IP/06	14	AIRNAV Maintenance Facility	Indonesia
IP/07	16	Invitation to the 60th Conference of Directors General of Civil Aviation, Asia and Pacific Region in Sendai, Japan from 28 July to 1 August 2025	Japan
IP/08	17	CNS Meeting Plan for 2026	Secretariat
IP/09	16	Shaping Thethe Future of Airspace – Airspace Asia Pacific 2025	Hong Kong China
IP/10	6.3	Research and Application of Air-Ground Data Link-Based Landing Information Interaction Technology for Inbound Flights	China
IP/11	6.3	Research and Application of Airport Surface Safety Technology based on AeroMACS	China
IP/12	6.4	Research Progress and Implementation Plans for VoIP Air-Ground Communications in China	China
IP/13	7.4	Application of LDACS in Aviation Navigation Network	China
IP/14	7.4	GBAS Status Update in CHINA	China

PRESENTATIONS

SP/01	13.1	Update on Trust Framework Activities	Secretariat
SP/02	3	Global Developments Related to CNSS & GIS	Secretariat
SP/03	10.1	ANS Reporting tool updates	Secretariat
SP/04	14	Connected Aircraft and the Hyperconnected ATM	USA
SP/05	6.4	WP/34: AeroMACS 2.0 Project Progress in China	China
SP/06	14	Intelligent Baggage Thermal Detection and GNSS Interference Monitoring System	Aerovision Technology Ltd.
SP/07	14	Low-altitude Economy Status & Characteristics and Air Traffic Management	Harmony Tech Innovation Ltd.

– – – – – – – – – – – –