



**INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE**

**REPORT OF
TWENTY FIFTH MEETING OF THE
COMMUNICATIONS/NAVIGATION AND SURVEILLANCE SUB-GROUP
(CNS SG/25) OF APANPIRG**

Video Tele-Conference (VTC)

18 - 22 October 2021

The views expressed in this Report should be taken as those of the Sub-group and not of the Organization. This Report will be submitted to the APANPIRG/32 Meeting and any formal action taken will be published in due course as a Supplement to the Report of the APANPIRG Meeting.

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1. Introduction

1.1 The Twenty Fifth Meeting of the Communications, Navigation and Surveillance Sub-group (CNS SG/25) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG), was held from *18 October to 22 October 2021* via Video Tele-Conference (VTC) using Microsoft Teams.

2. Attendance

2.1 The meeting was attended by **215** participants from **23** States/Administrations (Australia, Bhutan, China, Hong Kong China, Macao China, Fiji, India, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, USA, Viet Nam), and **4** International Organizations namely CANSO, IATA, IFALPA and IFATSEA, plus **28** participants from industry partners. The list of participants is placed at **Attachment 1** to this Report.

3. Opening of the Meeting

3.1 The meeting was inaugurated by Mr. Tao Ma, ICAO APAC Regional Director. In his opening remarks, Mr. Ma extended warm welcome to all delegates and shared special greeting to the former chairs of the CNS SG and chairpersons of various contributory bodies to the CNS SG. He highlighted some significant events, achievements and progresses in CNS area under the challenge of COVID-19 in the APAC Region since the last meeting of the Sub-group to provide an insight for the discussions to follow during the meeting. He extended his thanks and appreciation to the excellent leadership and significant contribution of Mr. Wu in steering the work of the CNS Sub-group since July 2017 and hoped that Mr. Wu will continue his commitment and support to this Sub-group in future.

3.2 Mr. Richard Wu, the Chair of CNS SG of APANPIRG, congratulated the new APAC Regional Director, Mr. Tao Ma, for taking up the leadership role and bringing in his rich experience in civil aviation to lead the APAC Regional Office. He also wished that with Mr. Ma's able leadership, the ICAO Regional Office would be brought to a new height while continuing to provide support to APAC members in expediting recovery in air transport. He informed that the IATA has lately forecasted that total air passenger numbers in 2021 would still be 52% lower than 2019 and in 2022, passenger numbers are expected to recover to 88% of pre-pandemic levels but with the pandemic variant and increasing rates of vaccination worldwide, the pace for recovery of international air traffic is still very fluid and unpredictable. He reviewed the achievements and tasks of the CNS SG since its last meeting, appreciated the hard work of the ICAO APAC Regional Office to organise a total of 12 online meetings and 4 webinars on CNS related matters, and the active participation from Member States in these meetings and webinars in the midst of pandemic, enabling this Group to make good progress on a number of major areas. Lastly, Mr. Wu expressed thankfulness to Mr. Arun Mishra, the former Regional Director, who has taken a new position in the ICAO Headquarters. He shared that Mr. Mishra's tremendous efforts in having served the APAC region for 7 years and significant contributions made in his capacity as Regional Director to provide exemplary leadership deserved the greatest respect and appreciation from all APAC members.

4. Officers and Secretariat

4.1 The meeting was chaired by Mr. Richard Wu, the Chair of the CNS Sub-group. Mr. Luo Yi, Regional Officer CNS and Ms. Soniya Nibhani, Regional Officer ANS (CNS) Implementation, ICAO Asia and Pacific Regional Office, acted as the secretaries of the meeting with the support of Mr. How Sze Lung, Associate CNS Officer, Ms. Zhong Wenhan, Associate CNS Officer, and Ms. Bhabhinan Sirapongkosit, the Programme Assistant of the same office. The meeting was also supported by Regional Officers, ATM, PBN of APAC-RO and RSO along with Technical Officers from ICAO HQ and NACC.

5. Organization, Working Arrangement, Language and Documentation

5.1 The working language was English inclusive of all documentation and this Report. The Sub-group met as a single body to deal with all the agenda items.

5.2 The meeting considered **33** Working Papers, **26** Information Papers, **5** Presentations, and **3** Flimsies. A list of Working Papers, Information Papers, Presentations, and Flimsies is provided in **Attachment 2** to the Report.

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, in accordance with the Sub-Group's Terms of Reference, require the attention of States or actions by ICAO in accordance with 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 internal working arrangement of the Sub-group only.

Note: *in accordance with APANPIRG Procedural Handbook, Sub-groups are empowered to adopt Conclusions and Decisions on technical matters (especially those concerning guidance to States in the implementation of ICAO SARPs, GANP, RANP, and Seamless ANS Plan).*

Reference	Subject	Page
Conclusion CNS SG/25/01 (ACSICG/08/01(CRV/08/01))	- CRV Implementation Plan amendment (<i>Version 2.1</i>)	4
Draft Conclusion CNS SG/25/02 (ACSICG/08/02 (CRV/08/02))	- Implementation of CRV for small Pacific Island and small ANSP in the region using CRV Solution, PCCWG SLA Package D.	5
Conclusion CNS SG/25/03 (SWIM TF/5/01)	- Asia/Pacific SWIM Implementation Plan and Status Survey	10
Decision CNS SG/25/04 (SWIMTF/05/02)	- Revised SWIM TF Terms of Reference	12
Conclusion CNS SG/25/05	- The Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers	24
Conclusion CNS/SG/25/06	- Update of Flight Inspection Guidance Material (FIGM) for APAC Region	25
Draft Conclusion CNS SG/25/07 (SURICG/6/1 (<i>Draft Conclusion DAPs WG/4/1, Draft Conclusion DAPs WG/4/2, Draft Conclusion DAPs WG/4/3</i>))	- Interrogator Code (IC) Planning and Coordination	27
Draft Conclusion CNS SG/25/08 (SURICG/6/2 (<i>DAPs WG/4/4</i>))	- Transition from II code to II and SI mixed code	28
Draft Conclusion CNS SG/25/09 (SURICG/6/3 (<i>DAPs WG/4/5</i>))	- The APAC Regional Roadmap for Mode S Implementation	29
Conclusion CNS SG/25/10 (SURICG/6/4 (<i>DAPs WG/4/6</i>))	- Mode S DAPs IGD 3.0	30
Conclusion CNS SG/25/11 (SURICG/6/5 (<i>Draft Conclusion DAPs WG/4/7 and Draft Decision DAPs WG/4/8</i>))	- Revision of the Regional Supplement to ASTERIX Interface Control Document (ICD)	30
Decision CNS SG/25/12 (SURICG/6/6)	- Revised ToR of Surveillance Study Group (SURSG)	31
Conclusion CNS SG/25/13 (SURICG/6/7)	- Integrity of ICAO Aircraft Address and Target Identification in ADS-B / MLAT / Mode S Data and Flight Plan	32
Decision CNS SG/25/14 (SURICG/6/8)	- Revised ToR of Surveillance Implementation Coordination Group (SURICG)	33
Conclusion CNS SG/25/15 (SURICG/6/9)	- Revised ADS-B Implementation and Operations Guidance Document (AIGD)	33
Decision CNS SG/25/16 (ATMAS TF/2/1 (<i>APA TF/7/1</i>))	- Dissolution of APA TF	37

Decision CNS SG/25/17 (<i>ATMAS TF/2/2</i>)	- Revised ATMAS TF Terms of Reference	37

Agenda Item 1: Adoption of agenda and Election of chair of the Sub-group**Adoption of Agenda (WP/01)**

- 1.1 The tentative agenda proposed in **WP/01** was adopted by the meeting.
- 1.2 To facilitate the election of the chair of Sub-group, the Secretariat presented *Rules of Procedure for the Conduct of Meetings of the Contributory Bodies of the APANPIRG* as per the APANPIRG Procedural Handbook and the considerations under current situation.
- 1.3 Proposed by China and seconded by Thailand and Singapore, Mr. Richard Wu, Deputy Director-General of Civil Aviation Department, Hong Kong China was unanimously elected as the Chair of the CNS Sub-group for the second term.
- 1.4 Mr. Richard Wu expressed great honour for the nomination and trust bestowed to him by the Member States. He emphasized CNS is the driving force behind many initiatives of ICAO and the need for ever stronger support from States to cope with the increasing challenges on aviation in the Region.

Agenda Item 2: Review outcomes of APANPIRG/RASG Chairpersons review, APANPIRG/31 meeting, ATM Sub-group and other major meetings relevant to CNS Sub-group**Outcomes of APANPIRG/31, APANPIRG/31 Midyear Review and 8th PIRG-RASG Coordination Meeting on CNS (WP/02)**

- 2.1 APANPIRG/31 was held from 14 to 16 December 2020 via video teleconference. The meeting discussed CNS related matters and took following actions on the report of CNS SG/24 meeting and other papers presented under AI 3.4. The APANPIRG/31 noted that CNS SG/24 meeting had adopted **8** Conclusions and **5** Decisions on technical and operational matters, and developed **4** Draft Conclusions which were adopted in APANPIRG/31 with only editorial amendment.
- 2.2 APANPIRG/31 Midyear Review and 8th Planning and Implementation Regional Group-Regional Aviation Safety Group (PIRG-RASG) Regional Coordination Meeting were held on 22 July 2021 via VTC. The APANPIRG/31 Midyear Review meeting discussed APAC key challenges in Air Navigation, key outcomes and achievements, updates on APANPIRG/31 Action Plan and outstanding APANPIRG Conclusions/Decisions Action Plan.
- 2.3 The meeting noted that the outstanding Conclusion C 28/19 **Amendment of the Management Service Agreement for CRV project (RAS14801)** is still open, which will be addressed by CRV OG/9 for a consolidated solution in January 2022.

Updates on CNS SG/24 and APANPIRG/31 Conclusions/Decisions, and Action Items (WP/22)

- 2.4 The paper presented the latest status and actions taken for various Conclusion/Decision adopted and recommended in the CNS SG/24 of APANPIRG, Conclusions/Decisions adopted by the APANPIRG/31 related to CNS along with latest status and action taken on various ACTION ITEMS formulated by the CNS SG/24 meeting for information and necessary follow-ups actions by CNS SG/25. The meeting noted the latest status and discussed the way forward for the conclusion/decisions as well as action items in process.
- 2.5 The meeting noted that with reference to the State Letter **Ref: T 8/8.6-AP058/21(CNS)** dated 9 April 2021 subject: *Simulation of VHF COM Frequency requirements for next 10 years*, sent in response to the **Conclusion** CNS SG/24/7, only **seven** Member States/Administrations have responded. The CNS SG Chair shared the concern that low responses to the State Letter may create an obstacle for the meaningful simulation of VHF COM Frequency requirements for next 10 years for APAC region

and there may be a delay in formulating regional requirements on this matter. The meeting urged delegates to take necessary action to respond to the State Letter as early as possible.

Air Traffic Management and Airspace Safety Monitoring Outcomes (WP/03)

2.6 This paper presented key outcomes from the technical working groups established under the oversight of the Air Traffic Management and Regional Airspace Safety Monitoring Advisory Sub-Groups of APANPIRG, and information relevant to CNS Sub-Group.

2.7 Regarding the query on the most appropriate Interface Control Document (ICD) for ATS Inter-Facility Data Communication (AIDC) in APAC, the ICAO Secretariat informed that the ***AIDC Implementation and Operations Guidance Document Edition 1.0 (July 2017)*** document would be the most appropriate to use.

2.8 The SAIOACG/10 and SEACG/27 presented the survey conducted to determine which ATC separation standards were being applied within the Asia/Pacific Region, in accordance with the provisions of the *Asia/Pacific Seamless ANS Plan*. The SAIOACG/10 and SEACG/27 meeting agreed to the following Draft Conclusion for consideration by ATM/SG/9 and CNS SG/25 was invited to discuss on the Draft Conclusion as follows:

Draft Conclusion SAIOACG/10 and SEACG/27-1: Implementation of Efficient ATS Horizontal Separations and Transfer of Control Aircraft Spacing

That, given the global priority to support airlines' recovery from the unprecedented negative economic consequences of the COVID-19 pandemic and the suitable low traffic environment:

- a) States/Administrations are strongly urged to review and update their National Air Navigation Plans (NANPs) to ensure that Air Navigation Service Providers (ANSPs) fully implement the horizontal separation and aircraft spacing elements in the Asia/Pacific Seamless ANS Plan V3.0; and
- b) ICAO considers the need for seminars, workshops and other educational material to support this implementation.

2.9 Australia expressed support to the proposed draft conclusion. CNS SG/25 meeting deliberated and supported the proposed draft conclusion and noted that the draft conclusion will be further endorsed by ATM/SG/9 and APANPIRG/32 meeting.

2.10 The meeting was reminded on the issue of missing Departure (DEP) messages. Data from an analysis of missing DEP messages conducted in 2019 indicated that, while there had been some improvement in the Asia/Pacific Region, there were still a number of States that needed to take further action to address the issue.

2.11 In accordance with ***Conclusion ATM/SG/6-3: Proposed Air Navigation Plan Volume II Amendment***, a Specific Regional Requirement was now included in the Air Navigation Plan (ANP) Volume II, reserving Secondary Surveillance Radar (SSR) Mode A Code 1000 for use as the Conspicuity code for Mode S-equipped aircraft operating in airspace under Mode S surveillance, where Aircraft Identification (Flight ID) was used for unambiguous ATC identification of aircraft, and to enable coupling of the ATS surveillance system information with the flight plan. Code A1000 had been removed from the Codes Allocation Plan of the Asia and Pacific Regions. In its 2019 update, the Asia/Pacific Seamless ANS Plan also included, in a note to element 7.27 (ATS Surveillance), the expectation that ATC units operating within controlled airspace wholly served by Mode S SSR and/or ADS-B surveillance should implement the use of the standard non-discrete Mode A code 1000 for Mode S transponder equipped aircraft to reduce the reliance on assignment of discrete Mode A SSR codes and hence reduce the incidence of code bin exhaustion and duplication of code assignment.

2.12 The Sixteenth Meeting of the Aeronautical Information Services (AIS) – Aeronautical Information Management (AIM) Implementation Task Force (AAITF/16) was informed that (at least) one State had delayed the necessary update to the AMHS, which was necessary to enable the processing of the new SNOWTAM format. Thus, the processing/handling of SNOWTAM, which will become mandatory from 04 November 2021, may be dependent on the configuration of AFS systems.

2.13 In discussing the outcomes from the Sixth Meeting of the Asia/Pacific Airport Collaborative Decision-Making Task Force (APA-CDM/TF/6, 28 to 30 April 2021) ATFM/SG/11 noted that APA-CDM/TF had agreed to develop a regional model for the integration of ATFM and A-CDM. Noting also **Draft Decision AOP/SG/5-4: Dissolution of the APA-CDM/TF**, ATFM/SG/11 agreed to **Draft Decision ATFM/SG/11-1: Revised ATFM/SG Terms of Reference**, which proposes that APANPIRG/32 agrees that ongoing APAC regional A-CDM work be conducted by ATFM/SG.

2.14 As per RASMAG/26, the lower number of data link Problem Reports (PRs) submitted to the Central Reporting Agency (CRA) in the 2020-2021 reporting period reflected the decrease in air traffic due to the impact of the COVID-19 pandemic. Regarding PRs relating to flights in areas of poor VHF coverage with subsequent reversion to SATCOM, or flights on the edge of VHF coverage experiencing media transitions, the FIT-Asia/11 meeting was reminded of the guidance for data link performance improvement for aircraft operators provided in FIT-Asia/9 WP/03 and subsequently approved by RASMAG for regional use under **Conclusion RASMAG/24-1: Guidance for Data Link Performance Improvement for Aircraft Operators**.

2.15 The CRA provided information to the FIT-Asia/11 meeting on causes of poor Performance-Based Communications and Surveillance (PBCS) performance in the South China Sea area, and potential resolutions. Removal of a specific VHF ground station had led to frequent media transitions to SATCOM. ARINC and SITA VHF ground station coverages in the South China Sea area, including the location of the removed ground station (Natuna Islands – NTX) were illustrated in the paper. Barring any network or avionics improvements, poor PBCS performance would continue and should be taken into account by affected ATC centres for aircraft flying those routes. Indonesia agreed to attempt to establish contact with the relevant authority to determine whether the NTX ground station could be re-activated.

2.16 The Monitoring Agency for the Asia Region (MAAR) provided the RASMAG/26 meeting with a combined summary of the safety analysis results for the Asia/Pacific Region, on behalf of the Asia/Pacific Regional Monitoring Agencies (RMAs) and En-route Monitoring Agencies (EMAs). CNS SG/25 was invited to note the importance of PBN and PBCS in collision risk outcomes and the achievement of TLS.

2.17 It was informed that MAAR had started a trial process to verify ICAO aircraft address and quality-check other parameters as a by-product of RVSM monitoring. For height monitoring purposes, the RVSM approval data contained ICAO aircraft addresses assigned to aircraft by State Civil Aviation Authorities. Errors detected included (i) mismatched aircraft address and the information in Item 18 of the flight plan, (ii) mismatched aircraft address due to incorrect address information in the RMA RVSM approval database, (iii) lag time in the provision of the combined snapshot when aircraft were transferred to a different State of Registry and assigned a new code, and (iv) mismatched aircraft type designators between the flight plan and the RMA database. ICAO informed the RASMAG/26 meeting that the ICAO Aircraft Address had a number of critical applications in Air Traffic Management systems. A paper on the MAAR activity in this regard should be submitted to SURICG, which reports to CNS SG.

2.18 The Unmanned Aircraft Systems (UAS) Advisory Group (UAS-AG) of the Remotely-Piloted Aircraft Systems (RPAS) Panel has developed the *ICAO UAS Toolkit*, which is a repository of information on UAS management that falls outside the scope of Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS) developed for RPAS operations. The toolkit is available at <https://www.icao.int/safety/UA/UASToolkit/Pages/default.aspx>.

Member States Support for CNS SG (WP/30)

2.19 The ICAO Secretariat summarised the issues being faced due to delay in submission of registration and Working Papers/Information Papers by Member States for the CNS meetings. The meeting agreed to request Member States to support the ICAO Secretariat by respecting various due dates specified in the meeting Invitation Package/State Letter to conduct the CNS SG and CNS contributory bodies meetings in a more effective manner.

Agenda Item 3: Aeronautical Fixed Service (AFS)

3.1 Under this agenda, the meeting reviewed meeting reports of a number of contributory bodies on the AFS matters.

Review the Report of the Eighth Meeting of the Aeronautical Communication Services Implementation Coordination Group (ACSICG/8) (WP/04)

3.2 The ICAO Secretariat presented the report of the ACSICG/8 held from 21 to 23 June 2021, which included the relevant outcomes of CRV OG/8 meeting.

CRV Implementation Plan Amendment

3.3 The meeting adopted following **Conclusion** based on the recommendation of CRV OG/8 through ACSICG/8 meeting. The proposed *CRV Implementation Plan amendment (Version 2.1)* adopted by the meeting is provided in **Appendix A** to this report.

Conclusion CNS SG/25/01 (ACSICG/08/01(CRV/08/01)) – CRV Implementation Plan amendment (Version 2.1)			
What: That, the CRV Implementation Plan be amended to include the following new text in paragraph 2.4.2 – IP Addressing		Expected impact:	
iii. In the development of the IPv4 plan, a flexible margin has been designated to allow future growth or change. Through draft Conclusion CRV OG/8/01, using 10.46.0.1 to 10.46.255.254, each third party Service Provider (e.g. AIREON LLC providing Automatic Dependent Surveillance - Broadcast data over CRV) is assigned 254, 510, 764 or 1022 usable Network addresses (depending on Service Providers’ technical requirements); and		☐ Political / Global	
		☐ Inter-regional	
		☐ Economic	
		☐ Environmental	
		☒ Ops/Technical	
Why: To allocate IP addresses to third party service providers for the delivery of services over CRV		Follow-up: ☐ Required from States	
When:	22-Oct-21	Status:	Adopted by Subgroup
Who: ACSICG		☒ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other:	

CRV Solution for Pacific Islands and small ANSPs

3.4 In CRV OG/8, Fiji presented the CRV solution for small Pacific Islands and small ANSPs in APAC region to implement CRV for voice & AMHS services. From the recent regional CRV implementation update submitted by PCCWG, it is noted that there has been slow implementation progress with the Pacific Island States and small ANSP in the region to date. With the target date for the implementation of CRV by 2022, the CRV OG must find ways to assist these Member States to implement CRV and ensure that No Country Left Behind (NCLB). The meeting adopted the following **Draft Conclusion** prepared by CRV OG/8 through ACSICG/8 meeting for consideration by APANPIRG/32.

Draft Conclusion CNS SG/25/02 (ACSICG/08/02 (CRV/08/02)) - Implementation of CRV for small Pacific Island and small ANSP in the region using CRV Solution, PCCWG SLA Package D.		
What:	That, the CRV OG should consider the following to assist small Pacific Islands & small ANSP in APAC in the implementation of CRV: a) Small Pacific Island and small ANSP in the region to consider using CRV SLA package D as the CRV solutions to implement CRV for the exchange of voice & AMHS services b) With target date to implement CRV by the end of 2021 by APANPIRG Conclusion C 31/12, it is recommended that the CRV OG to work closely with the small Pacific Islands, small ANSP in the region and PCCWG on a cost effective CRV solution to implement CRV.	Expected impact: ☐ Political / Global ☐ Inter-regional ☒ Economic ☐ Environmental ☒ Ops/Technical
Why: To facilitate the implementation of CRV for the small Pacific Island & small ANSP in the region	Follow-up:	☒ Required from States
When: 22-Oct-21	Status:	Draft to be adopted by PIRG
Who:	☒ Sub groups ☒ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: ACSICG	

CRV Landing Page

3.5 With reference to CNS SG/24 Decision CNS SG/24/5: *CRV Landing Page on the ICAO APAC Website*, New Zealand presented the content to provide information about CRV and how to join CRV and location of CRV landing page on the APAC ICAO website in CRV OG/8. The CRV landing page is implemented by the ICAO APAC Regional Office and informed Member States by State Letter Ref: T 8/2.10- AP107/21(CNS) dated 16 June 2021 and can be accessed by the link provided here: <https://www.icao.int/APAC/Pages/Join-CRV.aspx>

CRV Expert Groups

3.6 In CRV OG/8, New Zealand presented a proposal to implement expert groups within the CRV OG for the purposes of increasing member participation outside the OG meetings and to provide the ability to turn around decisions and changes quicker than waiting for the OG meeting. The Member States/Administrations volunteered for four expert groups are as follows:

SN	Expert Group Name	Volunteered Member	Group leader
1	Service Strategy	Singapore, USA, India	New Zealand/Fiji
2	Service Design	Singapore, USA, Hong Kong China	New Zealand/Fiji
3	Service Transition	China, Singapore	New Zealand/Fiji
4	Service Operations	Australia, China, Singapore, India	New Zealand/Fiji

3.7 The combined kick-off meeting of all four groups was held on 13 September 2021. The meeting discussed the objectives of the four expert groups, various tasks, and activities to be done by the expert groups, and working methodology to incorporate the outcomes in CRV Operations Manual.

ATN/AMHS/AIDC and CRV Implementation

3.8 The ATN/AMHS/AIDC implementation table and the CRV implementation table updated/reviewed by CRV OG/8, APA TF/7, and ACSICG/8 and noted by CNS SG/25 are provided in **Appendix B** and **Appendix C** to this report respectively.

Implementation updates in ACSICG/8 and CRV OG/8

3.9 The Philippines and USA presented the completed routing changes associated with the AMHS service between Civil Aviation Authority of the Philippines (CAAP) and USA Federal Aviation Administration (FAA). Meeting noted that ICAO Secretariat has already updated the AFTN routing directory related to the updates provided in this joint paper.

3.10 India presented a summary of status of ATN/AMHS/CRV implementation in India and urges BBIS and BIS States to resolve the bilateral issues on a priority basis for effective use of the AMHS/CRV network and the resources invested in by the states. India informed that the AMHS connectivity status among different pairs and shared difficulties in AMHS implementation with pending states. Additionally, India informed that regarding CRV implementation plan with BBIS and BIS states, India is expected to join the CRV by the end of year 2021.

3.11 Republic of Korea (ROK) presented the current CRV implementation status and the plan to convert direct circuits for voice between ROK and Japan to VOIP lines over CRV. In 2022, ROK and Japan are going to convert the existing networks to CRV. In 2023, there is a plan to make VOIP lines and to terminate current direct circuits for voice between two ACCs in ROK and Tokyo ACC in Japan.

3.12 China shared CRV implementation status between China and other States that have joined the CRV. Currently, China has a single connection with CRV network for data. China has completed the transition and creation of AMHS and ATFM connection with States/Administrations that have joined CRV namely Japan and Hong Kong China while AMHS data/message that support IWXXM format is being tested on CRV with other States/Administrations. The setting up of ATFM traffic over CRV is based on the planning requirement from operational departments responsible for traffic flow management.

3.13 FAA has been a user of the CRV since January 2018 with initial services to Australia, Fiji and New Zealand. As CRV services' performance has met FAA telecommunication requirements, the FAA has expanded its service to more ANSPs about which information was shared.

3.14 Philippines provided an update of AMHS, VOICE and AIDC implementation of the Philippines over CRV service.

3.15 PCCWG shared Latest CRV Updates and CRV Network Yearly Service Review. PCCWG informed that there are *38 circuits* in *26 cities* with different CRV packages, A, B+, C+, C and D. There are 2 service providers in the CRV network and 3 sites (B+, C) are under implementation. As of the day of updates, States/Administrations including Australia, Bhutan, China, Fiji, Japan, Malaysia, Nepal, New Zealand, Philippines, PNG, Hong Kong China, ROK, Singapore, and USA have joined CRV. It was further informed that 8 cities are planning to join CRV in 2021 which are *Mumbai (India)*, *Jakarta (Indonesia)*, *Makassar (Indonesia)*, *Bangkok (Thailand)*, *Moscow (Russia)*, *Khabarovsk (Russia)*, *New Caledonia*, and *French Polynesia*.

3.16 New Zealand presented an overview of the CRV Operations Manual covering the location, layout and content. The CRV OG Operations Manual (Edition 1.0) is accessible at this link under CNS section <https://www.icao.int/APAC/Pages/eDocs.aspx>

3.17 PNG informed about the implementation of Space-based ADS-B system in PNG and in particular that Space-based ADS-B is now operational and one path is already using CRV for operational surveillance data. Meeting concluded that the Space-based ADS-B data on CRV is an extremely important step for future usage of CRV for purposes other than initially planned.

CRV Pioneer State Contribution to the ICAO Managed Service Agreement (MSA) updates

3.18 The ICAO Secretariat informed CRV OG/2 about the fund balance as of 31 March 2017 of USD 104,596 and proposed a draft of revision of Annex 1b to the MSA. The APANPIRG/28 adopted the Conclusion APANPIRG/28/19: *Amendment of the Management Service Agreement for CRV project (RAS14801)* which remains as one of outstanding Conclusions/Decisions up to APANPIRG/31. The CRV OG/6 meeting adopted the recommendation of the WP/08 through the Decision CRV OG/6/3- *Using the Rest of CRV Pioneer State Contribution to the ICAO Managed Service Agreement (MSA)*. On 15 April 2021, the ICAO Secretariat held an online discussion among TCB, ICAO APAC and ICAO SAM on how to address the unspent funds from the completed CRV project (RAS14801) and the possibility for APAC to refer to the REDDIG II in SAM region. ACSICG/8 meeting agreed the importance to first prepare the safety and security assessment requirement to define scope of the work based on available funds and priorities of work to be done. The issue is planned to be discussed further in CRV OG/9 to be held from 25 - 27 January 2022.

MPLS/IP Based Inter-Regional Connection

3.19 The ACSICG/8 meeting noted that there are communications requirements between APAC ANSPs and SAM ANSPs, CRV and REDDIG II, in order to set up the AMHS P1 connection between AMHS COM Centers of Christchurch (New Zealand) and Santiago (Chile). Technically possible for two nodes of different networks (with different providers) to set up an IP connection was presented. Further discussion on the administrative and technical aspects to establish the required aeronautical communications between APAC and SAM ANSPs through MPLS NNI are in progress.

Updates from Member States for AMHS Readiness for IWXXM

3.20 The AMHS Readiness Table for Supporting IWXXM Traffic was updated in the ACSICG/8 meeting and is noted by CNS SG/25. The AMHS Readiness Table for Supporting IWXXM Traffic is provided in **Appendix D**. Different Member States including Australia, Fiji, ROK, Singapore, and USA updated about their IWXXM readiness by different papers. It was informed that Australia is ready to support IWXXM exchange via AMHS, however no end users in Australia have indicated to plan for system upgrades to receive IWXXM as yet.

3.21 Fiji and PCCWG presented PCCW IWXXM Translation and Exchange Services to ACSICG/8, which can serve as an alternative solution for Member States to fulfil the exchange of IWXXM messages as promulgated in Amendment 78 to ICAO Annex 3. It was informed that PCCWG has been developing the SWIM service on a private and scalable platform in partnering with one of leading aviation vendors – Frequentis. PCCWG also described the system architecture of PCCW SWIM service and its progress to build its Surveillance data-sharing platform with EMS and Service Registry.

AMHS readiness status for supporting IWXXM Traffic of the States/Administrations (WP/05)

3.22 The ICAO Secretariat supplemented information for AMHS readiness status for supporting IWXXM Traffic. The ICAO APAC Region has been discussing in APANPIRG and its contributory bodies on promoting the implementation of AMHS as a proper infrastructure identified for the Region to facilitate the exchange of IWXXM. The APAC **State Letter Ref.:** T 8/3.5 & T 8/2.11–AP160/20 (CNS) was sent to States/Administration in *August 2020* as a reminder to upgrade the AMHS with FTBP and deploy AMHS connect to achieve a synchronised AMHS distribution mechanism to support IWXXM exchange in the APAC Region. CNS SG/24 requested the MET SG and CNS SG to enhance mutual coordination and sharing outcomes of related survey and seminar/workshop, and the contributory body of MET SG (Meteorological Information Exchange Working Group (MET/IE WG))

to work collaboratively with ACSICG for a way forward in APAC region. As such, two papers were presented in ACSICG/8 on the requirements and latest developments on sharing information on IWXXM-exchange capabilities for APAC States.

3.23 In ACSICG/8, **12** States/Administrations provided their status on AMHS readiness and experience for supporting IWXXM Traffic, while **20** States/Administrations in APAC Region completed the AMHS implementation as per information from the ATS Messaging Management Centre (AMC) informed in ACSICG/7. Although there has been a significant increase in the AMHS readiness for supporting IWXXM Traffic, the reporting gap as well as the slow progress on the reporting were still identified, States/Administrations were urged to inform ICAO APAC Regional Office on their readiness and implementation progress/plan of AMHS with FTBP as soon as possible.

Review of Outcomes of APA TF/7 Meeting (WP/06)

3.24 The paper presented the report of the Seventh Meeting of the Asia/Pacific ATS Inter-Facility Data-Link Communication Implementation Task Force (APA TF/7), held from 07 to 09 June 2021.

AIDC Implementation

3.25 The APA TF/7 meeting updated the ATN/AMHS/AIDC implementation table and recommended to remove AIDC and ATM System Implementation columns from the table provided and format it into a separate Excel Sheet.

3.26 Singapore provided to APA TF/7 an updated Graphical Display on the AIDC implementation and planning status based on the inputs provided to the meeting via the updates by States to AIDC implementation, which is provided in **Appendix E**.

3.27 Singapore shared some of the implementation and operational issues which could be taken into consideration by other States in their implementation of AIDC. The first use of the APAC CRV for AIDC was introduced and it was informed that this is a step forward to address any existing latency issues associated with AFTN routing setups noted in some other connections.

3.28 Philippines presented updates on the AIDC trial implementation in Manila FIR. Philippines informed that it has done successful AIDC implementation with Singapore, Hong Kong China, Taipei and Ujung Pandang ACCs. Philippines shared the table with the results of AIDC tests and trial operations with six (6) adjacent centres.

3.29 China, India, Indonesia, Lao PDR, Malaysia, and Thailand shared their AIDC implementation plan by different WP/IPs. China informed about China and Laos AIDC Pre-Operational Trials, Hybrid Application of AIDC and OLDI, and application of Electronic Handover Technology between High Level and Low Level Sectors by IPs. India also shared Lessons Learnt From AIDC Implementation in India by WP/07.

Implementation Issues

3.30 The APA TF/7 Meeting reviewed and discussed the consolidated implementation issues collected and presented by Indonesia with supports from India and Singapore. Total 105 issues were consolidated. The meeting considered that the issue table would continue to serve as a reference for other States. A summary of the identified issues is shown in the table below.

Fault Categories	APA TF/7 (2021)		
	Issues Reported	Closed	Open
a. Communication Link	9	3	6
b. ATM System	61	29	32
c. AIDC Message	17	15	2
d. Airspace Design/Procedures	13	4	9
e. Other	5	2	3
Total	105	53	52

Future of APA Task Force

3.31 The meeting appreciated that significant achievements have been made in enhancing safety since the establishment of this task force in 2015, including the preparation of AIDC Planning Table in the Regional Air Navigation Plan, development of AIDC Implementation and Operations Guidance Document, maintenance of AIDC Issues Report, summary of AIDC focal points, the Implementation Status Chart as well as the sharing of the experience gained by States/Administration in the challenging process of AIDC implementation. The CNS SG/25 was informed that upon dissolution of APA TF, ATMAS TF would undertake AIDC implementation issues while ACSICG would handle communications-related issues. ToR of ATMAS TF will be reviewed as appropriate.

3.32 The APA TF/7 meeting updated the List of focal points for AIDC Implementation. The focal points should refer to ATMAS TF for sharing any issues or information related to AIDC Implementation.

3.33 Draft Decision (APA TF/7/1) - *Dissolution of APA TF* was proposed by the meeting for ATMAS TF/2 consideration. The ATMAS TF will design future meeting structure to accommodate the AIDC related functions and maintain the effectiveness in promoting AIDC implementation.

Review Report of SWIM TF/5 (WP/07)

3.34 The Co-Chair of SWIM TF presented the report of the Fifth Meeting of System Wide Information Management Task Force (SWIM TF/5) held from 9 to 11 August 2021.

3.35 SWIM TF/5 noted the relevant information and updates with the highlight on the reviewed outcomes of SWIM TF/4 and relevant discussions of other meetings of CNS SG/24 and APANPIRG/31 on AFS matters. The meeting also reviewed the outcomes of the First Meeting of the Surveillance Study Group (SURSG/1) and the ICAO APAC SWIM Workshop held from 6 to 7 July 2021.

3.36 Ms. Kristin Cropf, SWIM Program Manager, Federal Aviation Administration (FAA) nominated by Singapore and seconded by Australia and Japan was elected as Co-Chair of SWIM TF.

Expansion of SWIM Implementation Philosophy

3.37 In SWM TF/5, Singapore presented the expansion of the SWIM Implementation Philosophy which was discussed at the SWIM TF/3 through WP/19. SWIM Implementation Philosophy described a 'bottom up' approach to SWIM implementation where it starts with picking a particular operational use case that can be better supported by SWIM. Afterwards the SWIM services required to support the chosen use case are specified and developed and then deployed for technical and operational trials. Although these trials are largely focused on technical and operational aspects of SWIM implementation, their scopes should be expanded to include implementation of some governance concepts, especially the ones that have been developed by the task force. It was thus proposed that, when developing services and conducting the technical/operational trials following a bottom-up

approach aforementioned, the governance concepts, rules, and/or recommendations should also be identified, implemented, and tested in parallel. Importantly, lessons learnt from implementing these governance concepts should be then reported back to the task force for further refinement. The meeting agreed for the expansion of the SWIM Implementation Philosophy to include governance. The meeting noted that implementation of governance is an iterative process and it will be modified based on the lesson learnt throughout the implementation of SWIM.

Asia/Pacific SWIM Implementation Plan and Status Survey

3.38 In SWM TF/5, Singapore and Thailand presented a proposal for a survey to be conducted by Task 1 group of SWIM TF. Considering the high diversity among Member States in the Asia/Pacific region, it is challenging to devise a regional plan to achieve the region-wide harmonisation while not neglecting the constraints of each Member States. To create a baseline picture of SWIM implementation plan and status within the region, it was proposed to conduct a survey to obtain the current status and views towards SWIM implementation of the Asia/Pacific Member States.

3.39 Singapore and Thailand also proposed the scope of survey questions and that Task 1 group to be responsible for the conduct, collection, and analysis of this survey. Japan suggested that, in preparation of the survey questionnaire, the minimal usage of the term SWIM should be considered as the APAC Member States may have a limited or different understanding of SWIM. Additionally, the meeting discussed that the draft questionnaire should be supported by an attachment, which explained the technical terms used in the survey for easy reference of Member States. SWIM TF/5 endorsed a draft Conclusion which was then adopted by CNS SG/25 as follows:

Conclusion CNS SG/25/03 (SWIM TF/5/01) – Asia/Pacific SWIM Implementation Plan and Status Survey		
What:	To conduct a survey on SWIM implementation plan and status of Asia/Pacific Member States.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: To establish a baseline understanding of SWIM implementation plan and status within the Asia/Pacific region so as to aid the development of the regional SWIM implementation roadmap.	Follow-up:	☒ Required from States
When: 22-Oct-21	Status:	Adopted by Subgroup
Who: ☒ Sub groups ☒ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: SWIM TF		

3.40 ROK suggested that the views of MET, ATFM and other SWIM users should be included in the response of *Asia/Pacific SWIM Implementation Plan and Status Survey*. To ensure that, the SWIM TF/5 meeting agreed to add an introduction into the survey, mentioning that the *Member States should respond to the survey in consultation with MET, ATM, and other service providers*, who may be potential users of the SWIM.

Security services

3.41 In SWM TF/5, Japan, Thailand, and USA presented the technical implementation of security service on SWIM through a scenario-based validation and analysed some concerns and challenges to achieve end-to-end security through a SWIM-based trust framework. The meeting was reminded of the SWIM TI security capabilities as mentioned in the Manual on SWIM (Doc 10039). It was also informed that, in order to validate the PKI based trust framework concept and the implementation of SWIM TI security capabilities, the test platform has been developed by the team of

Multi-Regional Trajectory Based Operation (MR TBO) demonstration led by FAA. The high-level system architecture of MR TBO, the security service components as well as the approaches to implement SWIM TI security functional capabilities and non-functional qualities were discussed. The meeting was requested to provide the paper to Task 2, Task 3, Task 5 and Task 6 groups of SWIM TF along with CRV OG and ACSICG for deliberations.

FIXM version 4.2 Extension development

3.42 Thailand presented to SWIM TF/5 the update on FIXM version 4.2 Extension development to support the information exchange required for cross-border ATFM operations, ATFM/A-CDM integration, and FF-ICE/TBO in the Asia/Pacific Region along with a preliminary list of data attributes to be included in the FIXM version 4.2 Extension being developed. The meeting encouraged that other APANPIRG Working Groups and Task Forces, which are highly likely to have the operational requirements to use FIXM to support their related operations, should submit their consideration to SWIM TF in order to have Extension developed in due course if deemed necessary.

SWIM Discovery Service (SDS)

3.43 ROK and USA informed SWIM TF/5 about USA FAA and ROK Korea Airport Corporation (KAC) efforts to develop SWIM Discovery Service (SDS) to support transparent and replicable discovery of SWIM services in the APAC region. The paper described a brief summary of the SDS concept, the SDS demonstration environment and scenario, and shared the lessons learned from the SDS effort. The meeting congratulated ROK and USA for the successful demonstration of discovery services. Thailand also expressed their interest to join this work.

SWIM Service Level Agreement (SLA)

3.44 USA described the enabling technologies and practices for instituting a SWIM Service Level Agreement (SLA) in the context of APAC SWIM in SWIM TF/5. The SWIM TF/5 meeting discussed that use case-3 SLA management with participation of SLA manager may be appropriate reference for Asia/Pacific region. The next Task Leads coordination meeting may discuss in detail about the way forward for this proposal. It was also proposed that Task 5 group may provide a common SLA template, proposal on SLA management approach, and their validation methodologies.

SWIM Interoperability Assessment Matrix (SIAM)

3.45 USA introduced the SWIM Interoperability Assessment Matrix (SIAM) and how the SIAM can be used for interoperability assessments, articulation of requirements and supporting the planning and validation of SWIM components in international geo-organisational settings. The paper concluded that SIAM provides a structural and systematic approach for evaluating interoperability in the context of global SWIM initiatives. It is designed to be used as a tool for supporting interoperability analysis and articulating requirements as well as for planning and validating. Furthermore, it is designed in a manner that promotes extensibility and scalability which may be modified to meet business requirements that may emerge in the future.

SWIM Registries and their metadata

3.46 Australia and Hong Kong China presented to SWIM TF/5 a review of currently existing SWIM Registries and their metadata fields, and compared them to the proposed PANS-IM Service Overview fields. Recommendations were made with respect to additional APAC fields for initial version of APAC Service Overview Specification. The proposed additional Service Overview fields for the use in APAC and their advantages were presented. The meeting reviewed the proposed new APAC Service Overview fields and supported the draft version of APAC Service Overview Specification. With the possibility that the same information services may be offered by different service providers, in particular in the MET domain, as shared by Australia, the meeting thus suggested

Task 6 to consider the addition of Service Overview elements taking into account this matter. Australia informed that, in order to capture the feedback and suggestions from the APAC SWIM community on the extensions for SWIM Service Overviews, Australia has set up an “issues” list on GitHub, which can be accessed by the link: <https://github.com/icao-apac/service-overview/issues> and Australia will also publish the APAC SWIM Service Overview Extensions document at: <https://icao-apac.github.io/service-overview/>

Regional activities

3.47 IATA on behalf of SWIM TF provided a brief on key SWIM activities being undertaken in Asia & Pacific Region and primarily discussed at other ICAO APAC WG and TF meetings plus other industry meetings and webinars by WP/07 in SWIM TF/5. Mr. John Moore, IATA, informed that due to high workload, he would need to resign from the position of Task Lead of Task 10. However, he would continue to attend SWIM TF meetings, when available, and he will remain the point of contact between the SWIM TF and the airlines. He invited Member States for the nomination for Task Lead of Task 10 and for the contribution to SWIM TF. The meeting appreciated the contribution and consistent hard work of Mr. John Moore for SWIM TF in last five years. The ICAO Secretariat and Co-Chairs of SWIM Task Force extended their gratefulness to Mr. John Moore for very concise and relevant information provided at various meetings.

ICAO APAC-SWIM Secure Portal

3.48 The ICAO Secretariat updated SWIM TF/5 meeting that IMP is in the process of developing a draft SWIM Manual Vol. II Implementation Guidance (Doc 10039) to provide top-level guidance. The participants and concerned parties were encouraged to provide and share SWIM related videos, training materials and other useful information to SWIM TF and Secretariat for future compilation on **ICAO APAC-SWIM** Secure Portal. Dr. Amornrat Jirattigalachote added that APAC SWIM TF is not going to develop a new standard for Asia/Pacific region but SWIM TF need to streamline all outputs from various tasks and need to adopt technical specifications, regional exchange models, information services etc. from a regional perspective.

ToR and Work Plan

3.49 The SWIM TF/5 meeting reviewed the SWIM TF Work Plan and the Action List, and adopted the following Decision proposed by SWIM TF/5 for CNS SG/25 consideration.

Decision CNS SG/25/04 (SWIMTF/05/02) – Revised SWIM TF Terms of Reference	
What: That, the revised SWIM TF Terms of Reference (ToR) as shown in Appendix F to this report be adopted.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: To align with the progress made since the establishment of SWIM TF, the update of ICAO global and regional air navigation plans, and the revised task groups under SWIM TF adopted at SWIM TF/4.	Follow-up: ☐ Required from States
When: 22-Oct-21	Status: Adopted by Subgroup
Who: ☒ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: SWIM TF	

3.50 By Flimsy/02 of CNS SG/25, Australia proposed further amendments in draft ToR of SWIM TF adopted by the SWIM TF/5 meeting under consideration by CNS SG/25. The proposed amendments included deletion of “over CRV” word along with some other modifications. USA also shared its concern for using SWIM to transport time-critical information as detailed in WP/32. The SWIM TF Co-Chair, Dr. Amornrat Jirattigalachote advised the meeting that the draft ToR had been thoroughly discussed and agreed during the SWIM TF meeting. Taking into account views from CNS SG, Dr. Amornrat Jirattigalachote proposed to modify the term “over CRV” to “principally over CRV”. The proposal was supported by China, Hong Kong China, Japan, Singapore, Thailand, USA, and IATA. The CNS SG/25 meeting remarked that ToR is a living document which needs to be reviewed in a regular and timely manner. The meeting also reminded the SWIM TF to consider other IP-based network technologies in their forthcoming review on ToR. Therefore, with the aforementioned, the proposed ToR of SWIM TF was adopted by the meeting after the modification of the term “over CRV” to “principally over CRV” in section c of the proposed ToR. The meeting also advised SWIM TF to consider other modifications proposed by Australia in Flimsy/02 in coming task lead meetings and SWIM TF/6 and to present revised ToR, if any as the outcomes of discussion, in CNS SG/26. **ACTION ITEM 25-1.** The ToR adopted by CNS SG/25 is provided in **Appendix F** to this report. The meeting suggested and Australia agreed to nominate SWIM experts to participate in SWIM task leads and task force meetings.

Updates on SWIM

3.51 Australia informed SWIM TF/5 that a key aspect for regional (and global) interoperability for SWIM is to define the Technical Infrastructure Profile for the participating stakeholders. Australia informed that currently, there are a number of Profiles in use (or defined) for SWIM (globally) and the most famous SWIM Profile is the EUROCONTROL Yellow Profile. Task 2 lead, responsible for APAC SWIM technical infrastructure development, responded to the five questions raised in the paper regarding the need for APAC Technical Infrastructure Profile. At initial stage, SWIM TF needs to support the APAC Member States to evaluate and build their SWIM capabilities and once some experiences are gained, SWIM Profile for APAC region may be developed. The meeting noted that SWIM TF may get some references related to SWIM Profile in SWIM Manual Vol II being developed by IMP.

3.52 Hong Kong China summarised the updates on the development of IWXXM as discussed in ICAO METP/5 and associated works being carried out by the ICAO METP working groups and WMO Task Team on Aviation Data (TT-AvData) to SWIM TF/5.

3.53 Japan, Singapore, Thailand, and USA presented an overview of MR TBO Demo, a collaborative project undertaken by Japan, Singapore, Thailand, USA, and Canada to validate TBO concept as well as to showcase the TBO operational values and technical capabilities required to support TBO in SWIM TF/5 meeting.

3.54 Thailand presented SWIM TF/5 about an overview of Thailand’s SWIM implementation roadmap and lessons learnt during the planning process by WP/16. The meeting also considered utilising Thailand’s SWIM implementation roadmap and SWIM knowledge sharing outline as inputs for the tasks to be conducted by Task 1 and Task 11, respectively. It was added that the survey proposed by Singapore and Thailand may use Thailand’s SWIM implementation roadmap as a reference for preparation.

3.55 Hong Kong China proposed to SWIM TF/5 a proof-of-concept (POC) for surveillance data sharing on SWIM to be conducted in Hong Kong China for States’ reference. Meeting noted that hybrid model has been successfully demonstrated during the SWIM in ASEAN Demonstration in November 2019 and is considered as a suitable infrastructure for SWIM implementation in APAC. A high-level system block diagram of the POC was shared. Meeting was requested to provide support to the proof-of-concept of surveillance data sharing on SWIM and ongoing work of the SURCG.

3.56 India presented in SWIM TF/5 meeting about the plan and progress of the Proof of Concept (POC) undertaken by India to prepare a roadmap for the ground-to-ground SWIM implementation.

3.57 China presented in SWIM TF/5 meeting the validation and demonstration of FIXM ATMB ATFM Extension Model whose purpose was to validate the feasibility and availability of FIXM extension model in China. China also presented the research progress and plans of Air-Ground SWIM in China, proposed an air-ground information exchange model, and a new SWIM architecture.

3.58 ROK shared SWIM TF/5 about its experience on an experimental trial of surveillance data exchange in the SWIM environment and described motivation/requirements, system configuration/architecture, services, SWIM-enabled application, and lesson learned. Based on the experiences gained and the lessons learned by ROK, the meeting agreed to share the IP/05 with SURSG for further deliberations.

3.59 ROK presented the SWIM TF/5 meeting the status of SWIM as an ATM backbone network in the ROK and described the national roadmap to implement the local SWIM backbone network. ROK informed about its master plan of ATM and Navigational Aid systems and the master plan for the next five years to improve airport competitiveness, develop the aviation industry, strengthen interconnections, and prepare a systematic roadmap. ROK Roadmap for Transition to SWIM in two stages was explained and the drawing of its new aviation intra network including SWIM infrastructure deployment to exchange the real time information in a service-oriented architecture (SOA) for users was shared.

3.60 In SWIM TF/5 meeting, Australia shared a whitepaper discussing the role that Semantic Technologies will play in the future for the Aviation Industry and outlines a roadmap for SWIM services. Australia reviewed the current state of data standards in the aviation industry and looked at the pathway to a future of enhanced data capabilities, specifically, the use of Semantic Web technologies and the impact these will have on defining the strategic future for aeronautical, flight, and meteorological data services. It was presented in the paper that the roadmap to future needs wide industry consensus and planning and promises to deliver improved opportunities for data sharing, data automation, and data knowledge for safer skies. The meeting encouraged Member States to refer to the document titled Semantics in the Aviation Industry provided in Appendix to IP/07. Additionally, the meeting noted that <https://semantics.aero/> currently hosts several semantic artefacts developed for the aviation domain.

3.61 China presented to SWIM TF/5 meeting about a hybrid networking solution compatible with legacy systems under IP backbone network and realised compatible transition between legacy systems and SWIM-enabled systems through emulation technology at the transport layer and data protocol conversion technology at the application layer.

Proof of Concept for Exchanging Aeronautical, Flight and Weather Data through SWIM Platform (WP/29)

3.62 This paper presented the plan and progress of the Proof of Concept (POC) undertaken by India to prepare a roadmap for the ground-to-ground SWIM implementation. The main objective of this initiative was to globally exchange aviation related data with various stakeholders through SWIM. The project focuses on building SWIM Technical Infrastructure, generating digital datasets for Digital NOTAM, OPMET & Flight related ATS messages. The components to the SWIM architecture plan, timeline and deliverables of the project and supported dataset formats were discussed in the paper. The project proposed expected outcomes and requested States already engaged in developing SWIM to facilitate interface with India's SWIM for testing and validation of final outcomes. The meeting appreciated India's efforts for SWIM Implementation. The meeting encouraged India to share their SWIM implementation progress in CNS SG/26 and Member States to contact India for their request for testing and validation of final outcomes of SWIM.

AMHS Connections between APAC and EUR/NAT (IP/02)

3.63 The ICAO EUR/NAT Office initiated a coordination with ICAO APAC Office on interregional AMHS connection issues to support future AIRM data, such as IWXXM. Refer to the APAC Routine Directory for AFTN circuits, for the links between Europe and Asia, there are:

a. Bangkok-Rome	AFTN
b. Beijing-Khabarovsk	AFTN
c. Fukuoka-Moscow	AFTN
d. Singapore-London	AMHS

3.64 The meeting was informed that Singapore will continue to provide this bilateral link to maintain the interconnection between APAC and EUR/NAT region. The Rome-Bangkok AMHS connection is waiting for the readiness from the Rome side for the AMHS transition, and Thailand (AEROTHAI) commissioned one MPLS and tested the inter-operability between AMHS systems. China, Japan, and Russia are interested in switching to AMHS exchange between Beijing and Khabarovsk, and between Fukuoka and Moscow, the transition to AMHS of these two connections is expected as soon as possible, once Russia joins the CRV network.

Outcomes of ICAO Asia Pacific Implementation of CRV Webinar (IP/03)

3.65 The ICAO Asia Pacific Implementation of CRV Webinar was held on 20 July 2021 via VTC with 121 participants from 18 States/Administrations, 2 airlines industries and a telecommunication provider. Total Four (4) presentations were delivered by CRV experts from New Zealand, Fiji, USA, and Hong Kong China. During the Webinar, Questions and Answers (Q & A) sessions were held at end of each presentation through the Pigeonhole tool. Throughout the Webinar, a total of 40 questions were asked and *more than 15 feedbacks* for the Webinar were provided by Participants with 100% positive responses.

3.66 Based on Q&A sessions and submitted survey responses from Member States in the webinar, the need for potential discussion with PCCWG for extension of CRV Implementation deadline beyond the end of 2022 due to COVID-19 crisis as it is continued in 2021, the need for flexibilities in the package options selection by Member States, and the need for a platform for sharing lessons learnt and best practices based on experiences by Member States, which are using CRV, were felt. The ICAO Secretariat is taking necessary action about these potential discussion in CRV OG/9.

Outcomes of SWIM Workshop (IP/04)

3.67 The ICAO Secretariat presented the outcomes of the two days SWIM Workshop organised by ICAO APAC Office with support of SWIM TF key contributors and other volunteer members from 6 to 7 July 2021. The SWIM Workshop was attended by Two hundred and thirty one (231) participants from Twenty one (21) States/Administrations, one (1) International Organization, a group of airlines industries and an observer namely Frequentis. Dr. Amornrat Jirattigalachote, PhD, Policy and Strategy Management Bureau Aeronautical Radio of Thailand Ltd moderated the SWIM Workshop. Total Thirteen (13) presentations including one demonstration were delivered by Experts from different parts of the World in SWIM Workshop. Throughout the SWIM Workshop, 57 questions were asked and more than 60 feedbacks for the SWIM Workshop were provided by Participants with *100% positive responses*. The summary of all presentations was provided in the paper.

3.68 The meeting congratulated SWIM TF and other core contributors for organising SWIM workshop with high number of participations and suggested that SWIM TF may plan to conduct similar workshops in future.

CRV Post Implementation Issues in Bhutan (IP/10)

3.69 The paper summarised the issues faced by Bhutan related to CRV post implementation due to the non-readiness of peer States and the action taken by CRV OG and ACSICG for its resolution. During the CRV OG/8 meeting, Bhutan put forward some problems related to CRV post-implementation, as the follow-up action, an ad-hoc group with experts from six countries, including *Australia, Bhutan, India, New Zealand, Singapore, and Thailand* was established to discuss a way out for Bhutan to use its CRV service to some extent temporarily. After first meeting, the ad-hoc group agreed that Bhutan connects to AMHS through CRV tunnel directly to New Zealand, and New Zealand acts as a bridge between CRV and existing AMHS circuits for Bhutan. Bhutan also sent a State Letter to ICAO APAC Office to support on the issue. The second meeting of the Ad-hoc group discussed the AFTN Routing Directory changes and agreed that Bhutan and New Zealand will bilaterally coordinate to implement CRV connectivity and the next meeting will be based on the request from Bhutan and New Zealand.

SWIM Implementation in Japan (IP/18)

3.70 Japan informed that as the implementation of SWIM in Japan is a key enabler of the Collaborative Actions for Renovation of Air Traffic Systems (CARATS) which had been released in 2010, the Japan Civil Aviation Bureau (JCAB) has been consistently carrying out studies, research and development of SWIM. Japan shared the JCAB's activities on implementation of SWIM over the past 10 years through three phases, including the study phase, the Research and Development (R&D) phase, and the implementation phase. In addition, Japan also introduced the initial SWIM services, SWIM implementation strategy in Japan, and further advancement of SWIM initial services. The meeting was informed that the JCAB will start local SWIM operations in 2025, and intended to contribute to the expansion to Regional SWIM and Global SWIM with a strong sense of international collaboration. Japan also requested workshops and seminars at all levels of the aviation industry, for the application of PANS-IM to make a better understanding of SWIM. The meeting appreciated Japan for their various R&D work on SWIM and encouraged Japan to share updates in CNS SG/26 meeting.

Future plans for implementation of New ICAO SARPS compliant AMHS in India (IP/23)

3.71 India presented their plan to implement an ICAO SARPS-compliant PAN-INDIA AMHS thereby completely replacing the existing AMHS in Mumbai and the AFTN in elsewhere in India. The new AMHS is planned to provide both basic and extended AMHS services to support IWXXM/AIXM/FXXM traffic as per ICAO's SARPS requirements. The planned AMHS will be in a Data Centre and Disaster Recovery configuration to have a fail-safe operational redundancy achieved through geographical redundancy. Along with the AMHS, it is also planned to implement a Centralised Dynamic Database system supporting storage and retrieval of ATS, MET and NOTAM messages in addition to the Indian specific requirements. India has established a robust in-country TELCO network (FTI) with high availability to support the new AMHS, alongside its plan to implement CRV shortly. However, procurement of the new AMHS system was delayed due to the outbreak of COVID-19, and it is presently in tendering stage and expected to be implemented by Q1/Q2 of 2023. The meeting noted the development from India and would appreciate their further sharing in CNS SG/26 meeting.

Agenda Item 4: Aeronautical Mobile Communications Service and Aeronautical electromagnetic spectrum utilisation

Review Report of SRWG/5 (WP/08)

4.1 The paper presented the report of the Fifth Meeting of the Spectrum Review Working Group (SRWG/5) of APANPIRG, held via VTC from 15 to 17 March 2021.

Space-based VHF Communications

4.2 The ICAO Secretariat informed SRWG/5 that with reference to the ACTION ITEM 24-6 of CNS SG/24 on *Space-based VHF Communications* in 117.975-137 MHz frequency band, the Secretariat coordinated with SRWG chair, ACSICG chair and Singapore to see how to track and monitor the initiative, to take the concerns from States on a regional level. Singapore presented the latest updates to SRWG/5 on space-based VHF issue through Flimsy 02.

4.3 Singapore informed SRWG/5 that the space-based VHF frequency compatibility study has commenced in International Telecommunications Union (ITU) Working Party 5B (WP5B) meetings and the ICAO Frequency Spectrum Management Panel (FSMP) is the designated ICAO point of liaison with ITU WP 5B. At the FSMP Working Group 11 (FSMP WG/11) meeting held from 1 to 12 March 2021, it was noted that ITU WP5B had requested for technical information pertaining to aircraft VHF and the future space-based VHF system for the purpose of the compatibility study for space-based VHF (WRC-23 Agenda Item 1.7), and Singapore also presented the latest updates on space-based VHF to FSMP WG/11. The meeting discussed the point-of-contact of SRWG to track and monitor and to take the suggestions for improvement as well as concerns on the space-based VHF issue, and the ICAO Secretariat was requested to take this role whether the information be provided by Singapore on a voluntary basis, updates from an FSMP WG meeting, from States or from other appropriate sources.

Frequency Coordination Process and Tool

4.4 The ICAO Secretariat presented an overview of the frequency coordination process that is being used in the APAC Region. Some administrative measures have been implemented to improve the efficiency of the current process with the adoption of conclusion **CNS SG/24/8(SRWG/4/3)** *Establishment of a list of focal points responsible for the operation of Frequency Finder in States*. ICAO holds the view that frequency assignments that have been coordinated with ICAO have priority over those that have not been coordinated. For reported interference caused by frequency implemented by States/Administrations without coordination and registration with Regional Office, it may be considered as a discrepancy to the regional planning requirements, and be further identified as a deficiency upon harmful impact report on international operations.

4.5 The ICAO Secretariat informed that the current process for frequency coordination is based on a minimum bureaucracy when performing the frequency coordination and registration. A drafted POC list based on participant list of SRWG/4 was provided and it was suggested to nominate one main POC plus two associate POCs for one State/Administration which is capable to do so, to ensure the effective communication between Regional Office and the State/Administration, for normal frequency coordination and emergency coordination under unforeseeable harmful frequency interference to international operations. It was informed by the ICAO Secretariat that many States sent emails using yahoo or Gmail which are not organization email. In this case, private emails should be registered by POC with ICAO. In case of any changes, the revised information should be sent to ICAO by registered email of states with ICAO.

4.6 Indonesia reviewed updating process and coordination procedure for aeronautical facilities and services operating in the Frequency List No. 1 and Frequency List No. 2. The ICAO secretariat informed the meeting that ICAO has always encouraged States to update Frequency List 1, 2, and 3. States were urged to update their frequency list regularly and in a timely manner with the coordination with ICAO APAC Regional Office.

4.7 The ICAO Secretariat shared the latest updates brought to Frequency Finder. The module for the coordination of SSR Mode S Interrogator Identifier codes has been implemented and is in operation. The work on the development of module for VHF navigation systems (ILS, VOR, DME and GBAS) is near completion and is under evaluation. This module has incorporated the planning criteria for ILS, VOR and DME and GBAS based on Annex 10 - Aeronautical Telecommunications - Volume I - Radio Navigational Aids and the updates of the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (DOC 9718), Volume II, as recently agreed by NSP and FSMP. Several

other updates including an online course development related to frequency management for civil aviation were shared. The meeting was informed that the delivery and implementation of Frequency Finder NAV module (Frequency List 2) would follow a similar practice for COM module (Frequency List 3), and the installation management of Frequency Finder in a States would be based on the coordination between ICAO APAC Regional Office and the respective CAA.

4.8 Thailand proposed to explore the possibilities and benefits of using terrain data in Frequency Finder to increase the efficiency in frequency assignment planning for the frequency band 117.975 – 137 MHz based on the result of the analysis conducted by Thailand. The ICAO Secretariat reminded the meeting about the role of Frequency Finder. The meeting was informed that Frequency Finder can be considered as electronic version of Frequency List-3 managed by ICAO and a tool for frequency coordination. The need for different States may vary based on geographical location. Therefore, States may use additional tools for internal frequency requirements need and analysis. The ICAO Secretariat was requested to inform ICAO HQs to consider the feasibility incorporating terrain data into future versions of Frequency Finder.

4.9 Thailand also proposed to have in place a frequency assignment planning tool to support voice communication via satellite and emerging technologies. New technologies such as High-altitude platform station (HAPS) system are now emerging that could potentially be used as a communication relay platform to provide communication between aircraft and air traffic control centres in remote areas or oceanic areas. The meeting requested ICAO to take appropriate follow-up action to improve the awareness on the potential of emerging technologies and the necessity to consider the development of software tool like Frequency Finder to support the frequency assignment planning at regional office in future. The meeting also concluded to wait for the outcome of WRC-23 or relevant ICAO SARPs in place for further action on frequency assignment planning tool to support voice communication using satellite and emerging technologies.

Planning Requirements

4.10 India shared the experience in VOR frequency allocations and anticipated shortfall of new VOR channels. In India, around 164 VOR frequency assignments are already exist. Further, there are growing needs for an increased number of VOR channels. India is facing constraints to identify suitable candidate frequencies. India proposed consideration of some measures in APAC region to probably ease the shortfall of VOR channels.

4.11 The ICAO Secretariat presented material on the use of 50 kHz channels for the ILS/Localizer and VOR. To date, 50 kHz channel spacing has not been introduced in the APAC (as well as the AFI, CAR, MID and SAM Regions). For the introduction of 50 kHz channels for the Localizer and the VOR, the provisions in Annex 10 recognise two options: *General use of 50 kHz channels and restricted use of 50 kHz channels*. In both cases Annex 10, volume V requires a Regional Agreement. No such Regional Agreement has been established to date for any Region. The ICAO Secretariat proposed to have an ad-hoc group to be led by India to further explore the issue along with China, and IATA. This ad-hoc group is tasked to provide the inputs to SRWG/6. Mr. Robert Witzel and Thailand presented their interest to join the group. Japan is participating in the ad-hoc group.

4.12 SRWG/4 considered the development of a regional guidance material on aeronautical frequency spectrum management for APAC States. The current 26-page draft document was presented by China. The meeting thanked China for their effort in drafting the Asia Pacific Frequency Management Guidance Material. It was informed by the ICAO Secretariat that the guidance material started with VHF COM and the section on NAV will be drafted later. However, there will not be any surveillance part as these frequencies are universal.

4.13 The ICAO Secretariat presented a plan to simulate the VHF COM for APAC in 2030. CNS SG/24 adopted the **Conclusion CNS SG/24/7(SRWG/4/2) – Simulation of VHF COM Frequency requirements for next 10 years** to conduct a new round of simulation for VHF COM frequency assignment based on new operational requirements of States to 2030 as necessary. It was concluded

that the ICAO Secretariat will issue State Letter with clear actions and guidance for States to submit necessary data for VHF simulation, as a response to the Conclusion CNS SG/24/7.

4.14 India presented Indian VHF projections for 2030 based on future operational requirements and objective review to implement 8.33 kHz channel spacing in a limited manner in APAC region. India suggested that SRWG should deliberate and simulate a transition scenario for voice communication within APAC region from the current 25 kHz to 8.33 kHz channel spacing by taking into consideration the lead time for implementation and equipage. The meeting was further informed that in 2021 it is difficult to predict the surge in the usage of frequencies. It was decided by the meeting to review the outcome of the simulation before any further action is taken. IATA suggested to have a transition plan for future. If India predicts the need of 8.33 kHz spacing need in 2030, it should be done in a timeline approach to ensure a buffer window for operators, normally 5 years.

Spectrum Use and Interference

4.15 For the spectrum use, France presented Actions Taken to Mitigate Interference into The Radio Altimeters Systems from 5G/MFCN in the band 3.4-3.8 GHz, Boeing Australia presented Protection of interference to radio altimeters from 5G applications in the Asia-Pacific, Thailand presented a status report on the current interference situation in the band 117.975 – 137 MHz.

4.16 Hong Kong China shared their observations on potential impacts of departing aircraft on arriving aircraft under runway mixed-mode operation with respect to LOC signal fluctuations. States/Administrations are invited to note the importance of extending protection of ILS CA/SA from 2D (horizontal) context to 3D, especially for LOC. It has been presented in a WP/21 and discussed in the CNS SG/24 of APANPIRG. In view of the significance in the protection of ILS CA/SA in 3D, CNS SG/24 adopted the Conclusion CNS SG/24/11 Protection of ILS Critical and Sensitive Areas in Three Dimensional and ICAO APAC Regional Office forwarded the WP/21 and its presentation file to secretary of the ICAO NSP for consideration by Conventional Nav-aids and Testing Working Group (CNTWG).

4.17 China introduced a new initiative in detecting and positioning the source of GPS Radio Frequency Interferences based on QAR data. China introduced the operation of ILS/DMEs using the same frequency with different identifiers at Beijing Daxing International Airport in IP/07, as a possible way to improve frequency utilisation efficiency.

4.18 It was agreed that FF workshop will be conducted after new release of Frequency Finder by ICAO along with online course proposed by ICAO HQ for new release of Frequency Finder is available. The need was recognised to organise a face to face meeting in 2022 to review the outcome of simulations for States and progress the tasks listed in the Terms of Reference.

ICAO Position for ITU WRC-23 (WP/09)

4.19 The ICAO Secretariat reviewed the agenda for the International Telecommunication Union (ITU) World Radiocommunication Conference 2023 (WRC-23), discussed points of aeronautical interest and provided the ICAO Position for these agenda items in this paper. The ICAO State Letter E 3/5-21/37 *ICAO Position for the ITU WRC-23* was issued on 18 August 2021 informing Member States that the ICAO Council approved the ICAO Position for WRC-23 on issues of critical concern to aviation at its 223rd Session, which was held on 14 June 2021, and thus inviting Member States to consider the ICAO Position when developing your State's position for WRC-23 and to support the ICAO Position during WRC-23.

4.20 The ICAO Position is to be considered in conjunction with sections 7-II and 8 of the *Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I — ICAO spectrum strategy, policy statements and related information* (Doc 9718, Second Edition, 2018). The Position should be seen as being the guiding document wherever conflicts between the Position and the Handbook are observed. The aeronautical aspects on the Agenda for WRC-23 were summarised and the details were given in its attachment. States and international organizations were requested to make

use of the ICAO Position, to the maximum extent possible, in their preparatory activities for the WRC-23 at the national level, in the activities of the regional telecommunication organizations and in the relevant meetings of the ITU. The ICAO Position is to be presented to the ITU WRC-23, and the paper will be shared during the 3rd Meeting of the APT Conference Preparatory Group for WRC-23 (APG23-3), which is planned for 8- 13 November 2021, Virtual/Online Meeting. The meeting encouraged Member States to support ICAO position for ITU WRC-23.

Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718, Volume I and II) (IP/05)

4.21 The latest revision of the **Handbook on Radio Frequency Spectrum Requirement for Civil Aviation (DOC 9718), Volume I and Volume II**, will be published in *early 2022*. The meeting reviewed the background of discussion and highlights of changes to the document. The ICAO Secretariat initiated the revisions to the Handbook Volume II in 2018. The overall revisions were presented to APAC CNS SG/23 through IP/10 in 2019 and to APAC SRWG/4 through IP/02 in 2020, including a review to Chapter 1, new Chapters 3 - ILS, Chapter 4 - VOR, Chapter 5 – DME, Chapter 6 - GBAS/VDB and Appendix A with conversions and formulas relevant to frequency assignment planning. The “UNEDITED ADVANCE REVISION” of Doc 9718, Volume I and Volume II is uploaded at the Frequency Spectrum Management Panel (FSMP) website at <https://www.icao.int/safety/fsmp> on 30 July 2021. The Revision included all amendments resulting from FSMP WG/11 (1-12 March 2021, VTC). Doc 9718 Vol I included updates to Chapters 7 and 8 as well as Appendix F (ICAO Position). Doc 9718 Vol II included the new material as received from NSP/6 (2 - 13 November 2020, VTC). The planning requirements contained in the revision for compatibility assessment of frequency assignments to NAV systems (ILS, VOR, DME and GBAS/VDB) have been incorporated in the new release of **Frequency Finder** tool.

5G Implementation and Potential Impacts on Aircraft Radio Altimeters (IP/06)

4.22 The potential interference to radio altimeters due to pressures to implement 5G in the adjacent band was reported mainly in USA and Europe. The ICAO APAC Regional Office was informed through the ICAO FSMP secretary and presented to the ITU Regional Radiocommunication Seminar 2020 for Asia & Pacific in October 2020, while there has been zero reports to the ICAO APAC Regional Office from Member States or IATA.

4.23 France presented in SRWG/5 a WP/08 on *Actions Taken in France to Mitigate Interference into the Radio Altimeters Systems from 5G/MFCN in the band 3.4-3.8 GHz*, and Boeing Australia presented IP/03 *Protection of interference to radio altimeters from 5G applications in the Asia-Pacific*. As such, SRWG/5 developed ACTION ITEM 5-9: to take necessary follow up action at regional level, to support CAAs working with State’s spectrum regulators to avoid the future safety issues on radio altimeter due to 5G implementation.

4.24 On 25 March 2021, ICAO issued a state letter with the Subject: *Potential safety concerns regarding interference to radio altimeters (Ref.: SP 74/1-21/22)*, the Member States and Administrations are encouraged to consider as a priority, public and aviation safety when deciding how to enable cellular broadband/5G services in radio frequency bands near the bands used by radio altimeters. The meeting was invited to report to this Office in a timely manner once the interference to radio altimeters by these broadband technologies happens.

4.25 Hong Kong China shared their experience and the established mechanism in handling potential interference to radio altimeters caused by 5G implementation. They informed that in Hong Kong China, the frequency band from 3.3 – 3.6 GHz has been assigned for use of 5G mobile services. After noting the potential interference issue on radio altimeter by 5G mobile services operating in frequency band close to radio altimeter operating in 4.2-4.4 GHz, Hong Kong China has notified relevant aircraft operators through the issuance of “Flight Operations Notice” (FON) in April 2021 and has requested their vigilance on the possible interference on radio altimeter during any phase of flight, and report any relevant anomalies to the Civil Aviation Department (CAD) of Hong Kong China. Moreover, a working group, with members of CAD, Airport Authority Hong Kong (AAHK) and Office

of the Communications Authority (OFCA), has been established to keep in view of the situation as well as to coordinate the implementation of 5G at the Hong Kong International Airport (HKIA). As the issue is considered more appropriate to be followed up under RASG, Hong Kong China shared their plan to inform about this matter by a Working Paper in the upcoming RASG-APAC/11 from 25 to 26 November 2021.

4.26 The meeting agreed that Member States would keep an eye on monitoring the impact of 5G on radio altimeters in their States/Administration with reference to the safety and frequency spectrum issues. In parallel, it was advised that Member States CAA and airworthiness office may collect all relevant information and past issues reported, if any, and inform RASG-APAC in case of any significant concern. The issues related to frequency spectrum may be brought to the attention of CNS section of the ICAO Secretariat for their coordination with RASG-APAC and ICAO headquarter. The ICAO Secretariat will prepare a working paper to present in RASG-APAC/11 as an outcome of CNS SG/25 discussion for considering 5G potential interference with radio altimeter as a potential hazard.

ACTION ITEM 25-2

Status of 5G Implementation in Australia (IP/12)

4.27 Australia presented the status of activity in Australia to address the potential impact of deployment of wireless broadband services in the 3.4 to 4.0GHz band on Aviation safety. The meeting was informed that Australia through Australian Communications & Media Authority (ACMA) is consulting with stakeholders on the re-planning the use of Spectrum in the 3700MHz to 4000MHz bands for principally the deployment of wireless broadband (WBB) services including 5G. Australian aviation stakeholders with the representation of Civil Aviation Safety Authority, Airservices Australia, Department of Defence, NSW Police, Qantas Airways, Virgin Australia and Boeing Australia have made ACMA aware of potential impacts to the safety of operation of radio altimeter (RADALT) and associated aircraft systems with reference to international studies and mitigations.

Update of AeroMACS Application and Specification in China (IP/17)

4.28 Civil Aviation Administration of China (CAAC) shared the progress on the application of Aeronautical Mobile Airport Communications System (AeroMACS) technology in China. The meeting was informed that up to now, AeroMACS network has been deployed in 23 airports in China, and applications including D-TAXI based on AeroMACS and runway intrusion prevention were carried out. China shared the CAAC Roadmap of New Generation Aviation Broadband Communication Technology issued in April 2021 to promote the application of aviation broadband communication, build a civil aviation broadband network. Lastly, China provided two AeroMACS network implementation examples and its next step.

4.29 In response to a query from Singapore on section 3.1 of the paper, China further clarified the vehicles are equipped BDS receivers and are able to report positions to stakeholders while receiving traffic status from relevant systems over AeroMACS link, to build situational awareness.

Agenda Item 5: Navigation

Review Report of PBNICG/8(WP/10)

5.1 The Eighth Meeting of the Performance Based Navigation Implementation Coordination Group (PBNICG/8) was held through Video Teleconference (VTC), from 6 to 8 July 2021.

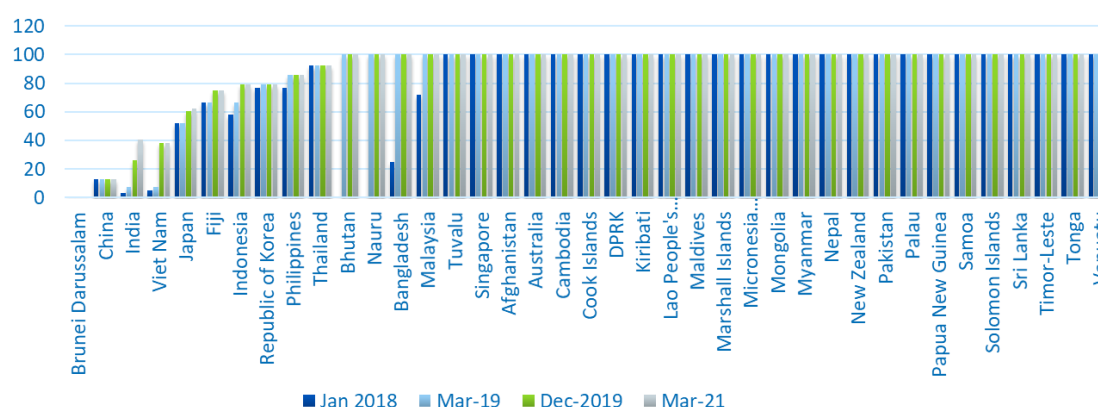
5.2 The ICAO Secretariat presented global PBN implementation status as available in ICAO iSTARS. ICAO informed that regarding key requirement of ICAO Assembly Resolution A37-11, which was the implementation of approach procedures with vertical guidance (APV) for all instrument runway ends by 2016, the APAC Region was behind global achievement. However,

implementation of PBN SID/STAR was above the global implementation status (Table 1). State-wise APV implementation progress is given in chart-1 below.

Table 1. ICAO Assembly Resolution A37-11 Implementation Status

March 2021	LNAV(including LNAV only)	APV		PBN SID	PBN STAR
		LNAV/VNAV	LPV		
Global (%)	71.4	59.4	34.4	49.4	44.8
Asia/Pacific (%)	57.5	47.1	0	71.6	68.8

Chart-1 PBN (Approach) Update, as of March 2021(as per iSTARS)



5.3 The Secretariat presented the implementation status of the regional transition plan for RNP APCH chart identification from RNAV to RNP, Asia/Pacific Regional Transition Plan for RNP APCH Chart Identification from RNAV to RNP as adopted by APANPIRG/30 vide Conclusion APANPIRG/30/14. The Secretariat reminded the States about the target date as November 2022 for RNP transition. The plan is available at the following link on ICAO APAC webpage: <https://www.icao.int/APAC/Documents/edocs/APX.%20B%20-%20Regional%20Transition%20Plan%20for%20RNP%20Chart%20Identification.pdf>

5.4 China, India, Indonesia, Myanmar, Nepal and Thailand presented their States PBN Implementation Progress. China informed that they had implemented RNP AR SIDs at some domestic airports. India presented a paper on the implementation of PBN approach procedures on non-instrument runways.

5.5 Bangladesh wanted some guidance on the PBN Ops approval from PBNICG/8, which is a key component of PBN implementation. ICAO explained that some PBN ops Approval activities have been conducted through the COSCAPs. Australia and Nepal shared their experience and provided the web link to their regulations. ICAO will contact COSCAPs and States to provide further information in the next meeting.

5.6 The ICAO Secretariat presented the list of action items agreed by the previous meetings. There were two action items left for discussion at the meeting. ICAO informed the meeting that the issue about the discrepancy in the list of international airports in iSTARS and APAC Air Navigation

Plan (ANP) was discussed with ICAO HQ and it was agreed that ANP to be used as a reference for a number of international airports. This issue was also discussed at AOP SG/4 and APANPIRG/31, States have been urged to update their list in ANP Vol-I & Vol-II. The ICAO Secretariat informed the meeting about the progress of each action item, and the meeting agreed to close both items after deliberations.

Review Report of GBAS/SBAS ITF/3 (WP/11)

5.7 The Third Meeting of the ICAO GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/3) was held by Video Teleconference (VTC) on 27-28 September 2021.

5.8 The Secretariat informed the meeting that a GBAS-SBAS Information Sharing Platform had been created on the APAC website for benefit of all States. This platform contains all those reference documents required for the implementation of GBAS/SBAS listed there with applicable links.

5.9 The USA and India presented about their SBAS program and potential extension to their neighbouring countries. Australia shared the journey for implementation of GBAS with detailed steps involved in each stage of implementation. Japan presented about status of MSAS, GBAS program at Tokyo International Airport (Haneda) and certification framework for GBAS and SBAS. Singapore presented a paper to highlight potential vulnerabilities to Global Navigation Satellite System (GNSS) disruptions, mitigations, and a resultant Concept of Operations (CONOPS) for the successful mitigation of a GNSS Outage in a State. Thailand presented an overview of the GBAS Proof-of-Concept (PoC) Project between Japan and Thailand to install GBAS PoC equipment at Suvarnabhumi International Airport and conduct an experiment for the deployment of GBAS at low geomagnetic latitude area, of which the performance is affected by ionospheric irregularities. The Republic of Korea presented the status of Korean SBAS called KASS (Korea Augmentation Satellite System).

5.10 The Secretariat presented a summary of Amendment to Annex 10 - Vol-I to include DFMC GNSS & SBASs, as well as Galileo & BDS Standards, to be applicable from 2 Nov 2023. This will help States to plan their GBAS/SBAS Implementation. This amendment will also allow some flexibility in the location of GBAS system in an airport.

5.11 The Co-Chairs presented a paper regarding the review of the GBAS safety assessment guidance document related to anomalous ionospheric conditions and identified items to be updated. States were requested to nominate members to constitute an expert group for updating this document and the following decision was taken:

Decision GBAS/SBAS ITF/3-1: Review and revise the GBAS and SBAS safety assessment guidance document related to anomalous ionospheric conditions.

5.12 Hong Kong China presented a paper to share their strategy and experience in VDB frequency assignment for GBAS as VDB frequency would use the same radio frequency band as other types of ground-based navigational systems. Hong Kong China presented about safety and risk assessment process, covering both engineering and operation aspect, applied for GBAS Trial at HKIA.

5.13 A framework of guidance reference for the implementation of GBAS/SBAS developed by the Co-Chairs was presented. The paper presented a high level framework of guidance reference document on the implementation process for GBAS/SBAS. The framework will be taken as a reference for the task force expert group to draft the guidance document for the Region. The following decision was taken:

Decision GBAS/SBAS ITF/3-2: Draft a Guidance Document on Implementation Process for GBAS/SBAS.

5.14 The Secretariat presented about GBAS/SBAS Flight Procedure Design Overview to describe the differences of these procedures vis-a-vis conventional procedures. The Action List of the task force was discussed, with description, relevance and priority being assessed by the meeting.

Update of Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers (WP/12)

5.15 The paper presented 11th edition of the updated Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers for meeting adoption. The Tenth edition of Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers was adopted by **CNS SG/22** by the **Conclusion CNS SG/22/11 – The catalogue of Asia and Pacific flight inspection and flight validation service providers**. CNS SG/24 noted that the new editions of the Catalogue should be published on a regular basis. ICAO APAC office issued the State Letter **AP098/20** dated **27 April 2020** subject *To update the catalogue of Asia and Pacific flight inspection and flight validation service providers* in this matter. In reply to the State Letter, limited responses were received due to emerging COVID-19 pandemic. In the year 2021, the reminders were sent to all Member States by giving reference to the above mentioned State Letter. Based on the response, the *Updated Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers* has been prepared. The latest edition of flight inspection guidance material adopted by CNS SG/25 will be appended to the catalogue for compilation of relevant documentation. The following Conclusion was adopted by the meeting:

Conclusion CNS SG/25/05 – The Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers	
What: That, <i>The Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers</i> (Eleventh Edition) in the Appendix G to this report is adopted and be published on the ICAO Regional Office website.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The information in <i>The Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers Tenth Edition, April 2018</i>) need to be updated as per the recommendation of CNS SG/24	Follow-up: ☐ Required from States
When: 22-Oct-21	Status: Adopted by Sub-group
Who: ☒ CNS Sub-group ☐ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☐ Other:	

5.16 The 11th edition of updated Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers will be uploaded on ICAO APAC e-doc portal soon and Member States will be informed by a State Letter.

The BDS Standardisation and Application in Civil Aviation (WP/23)

5.17 The paper presented the status of the BeiDou Navigation Satellite System (BDS) standardisation activities in ICAO and the BDS application practices in search and rescue in civil aviation. China informed that CAAC is promoting the BDS standardisation work in ICAO with the promotion of the BDS in civil aviation application including completing the BDS SARPs development and validation in ICAO Navigation Systems Panel (NSP), and participating in the DFMC GNSS standardisation work in civil aviation. China informed that the GBAS ground stations installed in Dongying Shengli Airport and Zhoushan Putuoshan Airport are being upgraded to be compatible with GPS, Galileo, and BDS and BDS has been put into practice in the field of civil aviation search and rescue. Furthermore, the meeting noted that CAAC had already retrofitted 20 aircrafts with BDS tracking and positioning devices to improve the capability in aircraft tracking and surveillance from 2019 to 2020, and all China's civil aviation fleet is planned to support BDS DFMC GNSS by 2025.

States/Administrations were encouraged to recognise the important role of BDS in aviation operation, search and rescue, and support BDS DFMC GNSS standardisation.

5.18 The meeting congratulated China for equipping aircrafts with BDS tracking and positioning devices and the plan for all China's civil aviation fleet equipped by 2025. The meeting encouraged China for promotion of the BDS in their civil aviation application.

Update of Flight Inspection Guidance Material (FIGM) for APAC Region (WP/26)

5.19 As the resolution of conflicting text in Doc8071 Vol III regarding flight inspections presented by Singapore through IP/09, China and Hong Kong China proposed to provide additional guidance in FIGM on the frequency for flight inspections of surveillance radar systems, by supplementing the frequency for flight inspections of Primary Surveillance Radar and Secondary Surveillance Radar (PSR/SSR) in the document. Some other minor amendments, including the latest guidelines on Flight Inspection periodicity considerations for radio navigation aids and the glossary of FIGM, are also proposed to be made. The following conclusion was formulated and endorsed by the meeting:

Conclusion CNS/SG/25/06 - Update of Flight Inspection Guidance Material (FIGM) for APAC Region	
What: That, the Edition 2.0 of the Flight Inspection Guidance Material (FIGM) provided in Appendix H to this Report be adopted.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The FIGM is subject to regular review and update, in the light of on-going development of flight inspection standards and recommended practices.	Follow-up: ☐ Required from States
When: 22-Oct-21	Status: Adopted by Subgroup
Who: ☒ Sub groups ☐ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☐ Other:	

Proposals for the Amendment of Annex 10, Volume I, on DFMC and GBAS (IP/07)

5.20 The ICAO Secretariat presented the main points of State Letter Ref.: AN 7/62.1.4-21/41 dated 6 July 2021 subject: *Proposals for the amendment of Annex 10, Volume I* and the action required by the letter regarding the Proposals for the amendment of Annex 10, Volume I to : a) support the introduction of dual-frequency, multi-constellation (DFMC) global navigation satellite system (GNSS) by adding provisions for additional frequencies of operation for the global positioning system (GPS), the global navigation satellite system (GLONASS) and the satellite-based augmentation system (SBAS), and by introducing provisions for the new BeiDou Navigation Satellite System (BDS) and Galileo system; and b) support ionospheric gradient mitigation for the ground-based augmentation system (GBAS). This proposed amendment to Annex 10, Volume I is envisaged for applicability on 2 November 2023.

Compatibility of Other GNSS Positioning Services with Aviation Services (IP/11)

5.21 Australia informed that Australian aviation authorities were challenged with the development of GNSS augmentation services for road tunnel users and shared the experience of the approval process of non-aviation augmentation systems with ensuring compatibility for aviation safety and regularity. In Australia, an operational need was identified to provide dynamic positioning services

for vehicles operating in road tunnels mainly for police and emergency services. The road tunnel operator has identified a European solution named translator. A trial is undertaken by the road tunnel operator to prove acceptable operation and monitored by the aviation authorities to ensure no interference to aviation services is experienced. Australia informed that if the trial is successful in meeting the operational needs to the road tunnel operator and is compatible with aviation safety and regularity, then it is expected that this technology will become a standard feature of road and rail tunnel systems in Australia.

Research on Operational Quality Analysis of Instrument Landing System (ILS) Based on Airborne DAR Data (IP/14)

5.22 The paper introduced a new method for analysing the operational quality of ILS based on flight airborne DAR (Digital ACMS Recorder) data. China informed about the ILS operation quality monitoring platform, which can monitor key parameters of LOC and GP in real time and discover hidden hazards in daily flights. Obtaining the accurate track position of the flight is difficult therefore this project used extracted airborne recorded data. China shared about methods for improved positioning accuracy, consistency of data analysis, correlation with flight inspection and facility difference inspection analysis. Lastly, China shared ILS operational problems and suggestions found by this research.

Concept of Operations for GNSS Event Reporting (IP/19)

5.23 Singapore highlighted potential vulnerabilities to GNSS disruptions, mitigations, and a resultant Concept of Operations (CONOPS) for the effective reporting of a GNSS outage in a State. It made recommendations on the GNSS Outage Responses and Reporting, based on ATC and airline operators' feedback. The paper focuses on detection of the GNSS outage events and a proposed response paradigm that addresses the need for the dissemination of critical information. Key objectives of this CONOPS paper were to describe how to identify and declare GNSS events, what information should be collected, and how to disseminate information and to whom it should be communicated.

Status of GBAS implementation in Japan (IP/20)

5.24 Japan introduced the status of operational trial of their CAT-I GBAS implementation at Tokyo Haneda from July 2020, and their research and development related to GBAS. Meeting noted that the information on the operational trial in Tokyo Haneda has been published as AIP supplement. Two Japanese airlines conducted GLS approaches in the trial and the pilots reported that the provided GLS approach was more stable as compared to that of ILS. On research and development, GAST-D experimental prototype has been developed and was installed at Ishigaki in Japan to evaluate the validity of the GAST-D standards under the ionospheric disturbances. Japan informed that he will continue to support refining the GAST-D standards from the results of study in collaboration with the ICAO NSP and will contribute to ICAO activities on DFMC GBAS standardisation.

SBAS Status Update in Japan (IP/21)

5.25 Japan provided information on the status update and the future plans of Japan Michibiki Satellite-based Augmentation Service (MSAS). MSAS started its operation with MTSAT GEO for Japan's FIR in 2007 and Michibiki Satellites Augmentation Service using Quasi-Zenith Satellite System (QZSS) GEO has taken over the operation since April 2020. With introduction of additional satellites to a seven-satellite configuration of QZSS, JCAB has been working on improving the performance of MSAS and aims to realise MSAS-LPV capability with the schedule and details of trial and full scale operation was provided in this paper.

Agenda Item 6: Surveillance

Review Report of the Sixth Meeting of the Surveillance Implementation Coordination Group (SURICG/6) (WP/13)

6.1 The paper reviewed the outcomes of SURICG/6, including the Fourth Meeting of Mode S Downlinked Aircraft Parameters Working Group (DAPs WG/4) and First Meeting of the Surveillance Study Group (SURSG/1).

Interrogator Code (IC) Planning

6.2 The SURICG/6 meeting reviewed the proposal to amend formerly adopted APANPIRG Conclusions related to II codes and extend the consideration to the use of SI codes. After discussion, the following Draft Conclusion was adopted by CNS SG/25 for consideration in APANPIRG/32:

Draft Conclusion CNS SG/25/07 (SURICG/6/1) (Draft Conclusion DAPs WG/4/1, Draft Conclusion DAPs WG/4/2, Draft Conclusion DAPs WG/4/3) - Interrogator Code (IC) Planning and Coordination	
What: That, With the need to extend the Use of Surveillance Identifier (SI) in Interrogator Code (IC) on top of Interrogator Identifier (II), the relevant APANPIRG Conclusions are updated as follows: <i>Coordination Process for SSR Mode S Interrogator Code (IC)</i> (formerly Conclusion 19/40) a) in view of the increasing density of SSR interrogator installations in the region, and that States have varying readiness to extend from Interrogator Identifier (II) to both Interrogator Identifier and Surveillance Identifiers (SI) codes, there will be a period whereby both II and SI will be used. b) while implementing SSR Mode S, States should take into account following issues while assigning IC for these installations: • for planning the implementation of SSR Mode S interrogators, administrations should ensure that the interrogators with overlapping coverage are not operating with the same IC. • where, the coverage of the interrogator extends beyond the boundaries of the State, The IC should be worked out in coordination with the ICAO Asia and Pacific Office and the neighbouring States concerned, and • administrations should inform the ICAO Asia and Pacific Office about the assigned IC for these installations. <i>Coordination Requirements for SSR Mode S Interrogator Codes (IC)</i> (formerly Conclusion 20/56) States be advised to provide the following information on SSR Mode S Interrogator Code to the ICAO Asia/Pacific Office for coordination and registration. a) Name of country/territory and location of facility; b) Antenna Coordinates (Latitude and Longitude); c) Elevation of antenna above the Mean Sea Level (MSL) in meters; d) Maximum Coverage of SSR Mode S Interrogator in nautical mile; e) II Code (1 to 15) or SI Code (1 to 63); and f) Remarks (special configuration such as radar clustering, lockout override, II/SI mode capability)	Expected impact: ☐ Political / Global ☒ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical

Planning Criteria for SSR Mode S Interrogator Code (IC) Assignment (formerly Conclusion 20/57)	
The planning criteria for SSR Mode S IC coordination and assignment as provided in Appendix J of Doc 9924 (Third Edition, 2020) be adopted for use in the Asia/Pacific Region.	
Why: Due to higher density of radars, some States are facing a shortage of II codes. It has to be solved by transiting from II to SI code. It is noted that state may use a mixture of II and SI codes before complete migration to SI code. The assignment of interrogator codes (IC), where necessary in areas of overlapping coverage, across international boundaries of flight information regions, shall be the subject of regional air navigation agreements. States still have to coordinate with ICAO APAC Regional Office on the allocation of II codes and SI codes.	Follow-up: ☒ Required from States
When: 02-Dec-2021	Status: Draft to be adopted by PIRG
Who: ☒ Sub groups ☒ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG	

*Note: This draft conclusion will supersede **APANPIRG Conclusions 19/40, 20/56 and 20/57** once adopted.*

6.3 In association, the *Table for SSR Mode S Interrogator Code Coordination* was reviewed as provided in the template in Appendix A to the paper. It was reported that Chairpersons of DAPs WG and the ICAO secretariat approached the Surveillance Panel about the addition of SI code allocation criteria into Doc 9924, and DAPs WG will work to reflect the required updates in Mode S DAPs IGD.

6.4 The Secretariat provided latest updates about Mode S II codes coordination in the APAC Region including a request from Eurocontrol for few new Mode S radars whose coverage overlaps several States in APAC, and another request for assignment of II Codes to 10+ planned Mode S Radars in a State near MID region and EUR region in 2021. An ongoing discussion on allocation of II codes 14 and 15 with matching SI codes was shared. States were encouraged to provide updates and coordination with ICAO APAC Regional Office for updating the SSR II code list through appropriate focal points to eliminate duplicated II code implementation in overlapped coverage at boundary areas.

6.5 As Doc 9924, Aeronautical Surveillance Manual does not contain sufficient information to help APAC region to plan the implementation of II and SI mixed code environment, a small working party comprising of representatives from China, Japan, Singapore, and the ICAO Secretariat were formed in DAPs WG/4 to amend the Doc 9924 to provide necessary guidance material. A proposal was submitted to the Surveillance Panel- Aeronautical Surveillance Working Group (SP-ASWG) to initiate the review. DAPs WG would continue work on this matter in parallel with the Surveillance Panel with the view to improve current guidance in Appendices H and J of Doc 9924.

Transition to II and SI Mixed Code Operation

6.6 The SURICG/6 meeting reviewed the strategy of transition from II code to II and SI mixed code and the following Draft Conclusion was adopted by the CNS SG/25 for consideration in APANPIRG/32:

Draft Conclusion CNS SG/25/08 (SURICG/6/2) (DAPs WG/4/4) - Transition from II code to II and SI mixed code	
What: States with Mode S radar capable of performing II/SI mode operations are encouraged to transit from II code to II and SI mixed	Expected impact: ☐ Political / Global

code, so as to ease the shortage of II codes. States planning to perform the transition shall coordinate with ICAO APAC Regional Office to obtain the SI codes.		☐ Inter-regional ☒ Economic ☐ Environmental ☒ Ops/Technical
Why: Due to higher density of radars, some States are facing a shortage of IC codes, which has to be solved by transiting from II to II and SI mixed code. It is noted that radars using II and SI codes can co-exist, hence there is no need for a big bang approach. However, States still have to coordinate with ICAO APAC Regional Office on the allocation of SI codes.	Follow-up: ☒ Required from States	
When: 02-Dec-2021	Status: Draft to be adopted by PIRG	
Who: ☒ Sub groups ☒ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG		

Roadmap for Mode S Implementation

6.7 The SURICG/6 meeting reviewed the revised Regional Roadmap proposed by DAPs WG/4 and submitted by following Draft Conclusion to CNS SG//25 for adoption, which was adopted in CNS SG/25 for the consideration of APANPIRG/32. The adopted APAC Regional Roadmap for Mode S Implementation is provided in **Appendix I**.

Draft Conclusion CNS SG/25/09 (SURICG/6/3) (DAPs WG/4/5) - The APAC Regional Roadmap for Mode S Implementation			
What: That, the APAC Regional Roadmap for Mode S Implementation provided in Appendix I to this report be adopted.			Expected impact: ☐ Political / Global ☐ Inter-regional ☒ Economic ☐ Environmental ☒ Ops/Technical
Why:	The revised Roadmap defined the scope and rational steps for the implementation of Mode S in APAC region.	Follow-up:	☒ Required from States
When:	02-Dec-2021	Status:	Draft To be adopted by PIRG
Who:	☒ Sub groups ☒ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG		

6.8 SURICG/6 noted the outcome a *Survey on Current use and Future planning of Mode S Enhanced Surveillance (EHS) Implementation* resulted from an Action Item from Mode S DAPs WG/4. The outcomes of the survey concluded that most of twelve States that responded to the survey are not facing any challenges in implementing APANPIRG/31/14 Conclusion. Additionally, the commercial fleet in APAC, North America, and MENA already possess Mode S ELS and EHS Mode S capability.

Mode S DAPs Implementation and Operations Guidance Document (IGD)

6.9 A proposal for revised draft Edition 3.0 of the Mode S DAPs Implementation and Operations Guidance Document (IGD) was discussed in SURICG/6. The main amendments include advice to mandating Mode S transponder, other protocols for DAPs extraction, use of parameters in the ATM automation system, Mode S DAPs application examples and identified issues, and Mode S radar parameter information. After review, CNS SG/25 adopted the following Conclusion. The *Mode S DAPs Implementation and Operation Guidance Document* Edition 3.0 adopted by the meeting is provided in **Appendix J**.

Conclusion CNS SG/25/10 (SURICG/6/4) (DAPs WG/4/6) - Mode S DAPs IGD 3.0		
What:	That, the <i>Mode S DAPs Implementation and Operation Guidance Document</i> Edition 3.0 provided in Appendix J to this report be adopted.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why:	Editorial correction and revision to reflect regional updates in implementation.	Follow-up: ☒ Required from States
When:	22-Oct-2021	Status: Adopted by Sub-Group
Who:	☒ Sub groups ☒ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG	

Regional Supplement to ASTERIX Interface Control Document (ICD)

6.10 EUROCONTROL published the System Area Codes (SAC) for the various regions except for APAC. The DAPs WG/4 meeting proposed the considerations to publish the APAC SAC at the EUROCONTROL website, which was adopted by SURICG/6 for consideration of CNS SG/25 by following draft Conclusion. Additionally, ICAO APAC also keeps track of the SIC allocation within the States through the Regional Supplement to ASTERIX Interface Control Document, provided in **Appendix K**, which States have their own control over the use of SIC and may change over time without the need for ICAO APAC to manage. The issue was discussed in SURICG/6 and SURICG/6 adopted by same draft conclusion to ICAO APAC Regional Office to coordinate the allocation of SAC within Asia Pacific and not the SIC for CNS SG/25 consideration. Subsequently, the following Conclusion was endorsed by CNS SG/25:

Conclusion CNS SG/25/11 (SURICG/6/5) (Draft Conclusion DAPs WG/4/7 and Draft Decision DAPs WG/4/8) - Revision of the Regional Supplement to ASTERIX Interface Control Document (ICD)		
What:	ICAO APAC Regional Office to: a) update EUROCONTROL with the latest SAC allocation within Asia Pacific; and b) coordinate the allocation of SAC within Asia Pacific and not the SIC.	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why:	a) EUROCONTROL published the SAC for all the regions except Asia Pacific. It is believed that the publication will be beneficial to the developers of future message protocol and surveillance related applications. b) SIC is managed by State and there is little value for ICAO APAC to manage the SIC. Considering the workload to manage the SIC and the negligible benefits, it is proposed that ICAO APAC not to manage SIC.	Follow-up: ☐ Required from States
When:	22-Oct-2021	Status: Adopted by Sub-Group
Who:	☒ Sub groups ☐ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG	

6.11 The Secretariat presented the recent updates to the Regional Supplement to ASTERIX ICD for APAC Region and introduced the planning criteria and current usage of SAC in APAC region. SURICG/6 noted that current allotments would be enough to cater the actual and planned increase of surveillance sensors and automation systems in the APAC Region.

ToR of Surveillance Study Group and Updates

6.12 Based on the recommendation of SURICG/6 proposed by SURSG/1, CNS SG/25 reviewed the revised ToR of SURSG and adopted the following Decision. The revised ToR of SURSG adopted by the meeting is provided in **Appendix L**.

Decision CNS SG/25/12 (SURICG/6/6): Revised ToR of Surveillance Study Group (SURSG)		
That, the Revised Terms of Reference of the Surveillance Study Group (SURSG) provided in Appendix L to this report be adopted.		Expected impact: ☐ Political /Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The SURSG/1 meeting reviewed the ToR and made amendments on adding chair role and function, frequency of the meeting of SURSG and the mode of the various task lead meetings for effective progress update, decision making, work assignments as they arise and the need to update the list of contributing States as necessary.	Follow-up: ☐ Required from States	
When: 22-Oct-2021	Status: Adopted by Sub-Group	
Who: ☒ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☐ APANPIRG ☒ Other: SURICG		

6.13 SURICG/6 reviewed a proof-of-concept (POC) for surveillance data sharing on SWIM to be conducted in Hong Kong China. The POC was explained by a high-level system block diagram in the paper. SURICG/6 expressed support to the POC and on-going work of the SURSG.

6.14 SURICG/6 discussed the proposed Concept of Operations (CONOPS) by Hong Kong China on behalf of SURSG for sharing of surveillance data among multiple parties using platform such as SWIM along with the objective of the CONOPS, so as to solicit suggestions/concerns from SURICG for consideration by SURSG in formulating the CONOPS.

ADS-B Implementation

6.15 SURICG/6 reviewed the ADS-B Implementation Status in the APAC Region. SURICG/6 reviewed other documents through ad-hoc working groups on *ADS-B Data Sharing Implementation Status in the APAC Region* and Reports on the Sub-regional ADS-B Implementation Plan/Projects presented by South East Asia (SEA) and Bay of Bengal (BOB) Ad Hoc Working Groups. The ADS-B Implementation Status in the APAC Region is provided in **Appendix M**. In addition, during the discussion in Ad Hoc Working Groups, some States had shared to the meeting that with the implementation of space-based ADS-B, the original ground-based ADS-B data sharing project would have to be re-evaluated.

6.16 FAA provided a description of two ADS-B avionics issues observed in the USA with DO-260B/ED-102A systems, its details and actions taken by FAA in the paper. SURICG/6 agreed to incorporate these issues in the paper into AIGD for easy reference in this region.

6.17 Aireon presented in SURICG/6 the status of space-based ADS-B as a service which has been operational for some time in various ANSPs. SURICG/6 noted that space-based ADS-B data was provided into APAC CRV network since 2020 and it is currently supporting Papua New Guinea (PNG) ATC operations. An example from NiuSky Pacific was explained to illustrate the benefits.

6.18 Boeing introduced their ADS-B implementation on their various models of different technology streams, which planned ahead for ADS-B Mandates in Europe and the United States. In addition, Boeing introduced the development of ADS-B solutions, including Airborne (AIRB) – Cockpit Display of Traffic Information (CDTI), Visual Separation on Approach (VSA) and In Trail Procedure (ITP).

Aircraft Address and Target Identification

6.19 Hong Kong China presented the observation on recurring inconsistencies of ICAO Aircraft Address and Target Identification between ADS-B / MLAT / Mode S data and flight plan for some aircraft flying within Hong Kong Flight Information Region despite repeated effort had been spent to follow up with concerned airlines. Such issues have not only caused safety implications to ATC operation but also induced additional workload to both ATC and to supporting staff for following up with the concerned airlines proactively. Hong Kong China was requested to share information of concerned airlines with relevant Civil Aviation Authorities (CAAs) to follow up. USA and IATA have been receiving such information from Hong Kong China since August 2021. Hong Kong China will contact other relevant CAAs to share the information as appropriate. Considering the potential safety implications to ATC operation and additional workload to controllers, Hong Kong China proposed the following Conclusion which was endorsed in SURICG/6 for CNS SG/25 consideration and was further endorsed by CNS SG/25:

Conclusion CNS SG/25/13 (SURICG/6/7) - Integrity of ICAO Aircraft Address and Target Identification in ADS-B / MLAT / Mode S Data and Flight Plan			
What:	To urge States/Administrations to proactively follow up with air operators to address discrepancies of ICAO Aircraft Address and Target Identification between ADS-B / MLAT / Mode S data and flight plan.	Expected impact:	
		☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical	
Why:	Such discrepancies will cause safety implications in ATC operation and induce additional workload to controllers and supporting staff in handling the cases.	Follow-up:	☒ Required from States
When:	22-Oct-2021	Status:	Adopted by Sub-group
Who:	☒ Sub groups ☒ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: SURICG		

Surveillance Performance Specifications

6.20 ROK presented in SURICG/6 on the issue that surveillance performance specifications in Eurocontrol Standard Document for Radar Surveillance “SUR.ET1.ST01.1000-STD-01-01” were quite old and could not include the recent innovation of surveillance technology. ROK tabulated the common misunderstanding about PSR & MSSR performance specifications with explanation and suggested the practical approach in a list of radar performance specifications. SURICG/6 discussed and suggested to form an Ad-hoc working group to discuss performance specifications and benchmarking of radar for APAC Region, and to prepare a working paper to make a recommendation on the way forward to SURICG/7. China, India, Indonesia, Republic of Korea, and Singapore volunteered to join the group.

6.21 SURICG/6 noted the outcomes of recent meetings of SP-ASWG/13 and SP-AIRBWG/11.

6.22 RTCA presented in SURICG/6 that the Combined Surveillance Committee, which made up of RTCA and EUROCAE committees working on ADS-B and Mode-S technologies, jointly published standards of surveillance technology, namely DO-260C/ED-102B (ADS-B), DO-361A

Change 1/ED-236A Change 1 (Flight-deck Interval Management (FIM) Change 1), DO-181F/ED-73F Mode-S Transponder in December 2020. It was informed that RTCA has undertaken an update of DO-282B Minimum Operational Performance Standards (MOPS) for Universal Access Transceiver (UAT) and ADS-B to align with DO-260C.

ToR and AIGD

6.23 SURICG ToR was reviewed in SURICG/6 in the view of integration of SEA/BOB ADS-B WG ToR and presented by draft Decision for consideration of CNS SG/25 which was further adopted in CNS SG/25. The revised SURICG ToR adopted by the meeting is provided in **Appendix N**.

Decision CNS SG/25/14 (SURICG/6/8): Revised ToR of Surveillance Implementation Coordination Group (SURICG)		
That, the Revised Terms of Reference of the Surveillance Implementation Coordination Group (SURICG) provided in Appendix N to this report be adopted.		Expected impact: ☐ Political /Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The ToR from dissolved SEA/BOB ADS-B WG was reviewed and necessary updates were identified.	Follow-up: ☐ Required from States	
When: 22-Oct-2021	Status: Adopted by Sub-Group	
Who: ☒ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☐ APANPIRG ☒ Other: SURICG		

6.24 SURICG/6 considered the avionics issue on Honeywell Primus II RCZ to be included in AIGD and subsequently the following Conclusion was formulated and endorsed in CNS SG/25. The revised ADS-B Implementation and Operations Guidance Document (AIGD) is provided in **Appendix O**.

Conclusion CNS SG/25/15 (SURICG/6/9) - Revised ADS-B Implementation and Operations Guidance Document (AIGD)		
What: That, the revised ADS-B Implementation and Operations Guidance Document (AIGD) provided in Appendix O to this report, which consolidated all change proposals during SURICG/6, is adopted as Version 14.		Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: Updates from SURICG/6	Follow-up: ☐ Required from States	
When: 22-Oct-2021	Status: Adopted by Subgroup	
Who: SURICG	☒ CNS Sub group ☐ APAC States	☒ ICAO APAC RO ☐ ICAO HQ ☒ Other:

6.25 The CNS SG Chair expressed appreciation to the significant efforts by the SURICG and its contributory bodies to take forward various initiatives with a view to enhancing and harmonising surveillance capability of member States/Administrations and the region. He looked forward to further contributions to be made by the SURICG and their reports in future CNS SG meetings

Outcomes of ICAO APAC Implementation of ADS-B Webinar (IP/08)

6.26 The ICAO APAC Webinar on Implementation of ADS-B was successfully conducted

on 1 September 2021 via Video Tele-Conference (VTC) using Microsoft Teams. The objectives of the Webinar were to review concepts, benefits of Automatic Dependent Surveillance – Broadcast (ADS-B), and share implementation experiences that include ADS-B mandate, ADS-B data sharing, implementation issues, and measures to support ADS-B operation. The latest ADS-B technologies including space-based ADS-B were also discussed during the Webinar. Total 298 participants attended the webinar and *four* presentations were delivered during the Webinar. The CNS SG Chair congratulated SURICG and ICAO for the good response from participants and encouraged ICAO Secretariat to organise similar webinars in future.

Resolution of Conflicting Text in DOC 8071 VOL III Regarding Flight Inspections (IP/09)

6.27 Singapore informed that although the Appendix A of Doc 8071 Vol III stated that flight check is required only during commissioning, unless there is specific problem investigation, or deemed necessary by the maintenance personnel, Appendix B of Doc 8071 Vol III implied that there must be flight inspections every 120 days. These two provisions are contradictory. The meeting was informed that it was discussed in Surveillance Panel members that most ANSPs perform flight checks based on Appendix A of Doc 8071 (i.e. during commissioning unless deemed necessary or for problem investigation) hence changes to Appendix B of Doc 8071 was suggested and discussed in the meeting, which is subject to acceptance by the SP-ASWG during its meeting on 1-5 Nov 2021, then the 4th Surveillance Panel Meeting (SP/4) on March/April 2022, and the submission of SRP report to the ANC in Q4 2022 for the amendment to be published in Q1 2023 after the review by ANC.

Mode S Activities Update in China (IP/13)

6.28 China presented a brief introduction of the Mode S related activities updated in China in recent years and the Mode S activity plans in the near future. Because of the benefits brought by Mode S, China has been committed to advance the Mode S implementation. China shared the related research and promotion activities on Mode S implementation by summarising the outcomes of Mode S implementation in avionic systems, surveillance systems, automation systems, spectrum analysis, ADS-B Implementation, and Mode S DAPs IGD with the reference papers presented in the previous meetings. China concluded the benefits achieved by the Mode S implementation and informed that China will continue to focus on Mode S research and implementation, new functions test and deployment, and system optimisation. The meeting appreciated the updates provided by China and invited China to provide updates next year.

Implementation of Space-based ADS-B Surveillance for the Oceanic Regions of Indian FIRs (IP/24)

6.29 India presented updates to the implementation of Space-based ADS-B (SADS-B) Surveillance. Airport Authority of India (AAI) signed a contract with Aireon on 25 July 2019 for the Space-based ADS-B. Three phases of SADS-B implementation were identified. First two phases related to establishment of required infrastructure and evaluation & testing of SADS-B have been completed successfully on 28 January 2021 and the third phase, the operational phase, has been commenced from 29 January 2021 for situational awareness of the aircraft flying over oceanic regions of Indian FIRs. The provision of processed SADS-B data was introduced, which Aireon delivers the data to AAI's Service Delivery Point (SDP) for further integrating into CNS/ATM automation systems of respective FIRs. A typical architecture of SADS-B system implemented in India and the five service volumes designated were explained in detail. India informed that India has issued ADS-B Avionic mandate that from **1 January 2020** with all aircrafts flying over Indian continental airspace at or above FL-290 to be equipped with on-board ADS-B equipment. The regulator is contemplating to provide priority in landing to the aircrafts equipped with ADS-B at airports where ADS-B based approach surveillance services are being provided.

Agenda Item 7: Automation**Review Report of the Second Meeting of ATM Automation Systems Task Force (WP/14)**

7.1 The paper summarised the main points of the Second Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (ATMAS TF/2).

Conspicuity Code

7.2 The ATMAS TF/2 meeting reviewed the report of SURICG/6 and discussed and agreed that the implementation of conspicuity code (Mode A code 1000) in ATM Automation Systems is necessary to support Mode S operations in the Region. China informed that the ATM Automation System Implementation and Operations Guidance Document (ATMAS IGD) had already provided the recommendation for the ATM Automation Systems on implementation of conspicuity code.

Repository of the ATM automation systems

7.3 To follow up ACTION ITEM 1-1 of ATMAS TF/1: *Develop a table to list the current ATMAS status for all states for this task force to establish a repository of the ATM automation systems implemented by States*, Indonesia proposed a draft Table of Current ATMAS Status for all States and invited States/Administrations to review and provide inputs to this regional repository. The meeting suggested that the table should make reference to the revised version of the ATMAS IGD and agreed to create an ad-hoc group led by Indonesia, including China, Hong Kong China, Republic of Korea, and Singapore with support of the ICAO Secretariat to consider the suggestions provided by the meeting and work out a revised version of the table before conduct a survey.

Problem Reporting Database

7.4 Hong Kong China informed that he has taken up the action item from ATMAS TF/1 on studying the feasibility of expanding the ADS-B Avionics Problem Reporting Database (APRD) to cover the report and sharing of ATMAS-related problems by States/Administrations in APAC region. Hong Kong China provided a detailed proposal to expand the existing APRD with pages, and concluded that it is technically feasible and cost-effective to implement ATMAS PRD by leveraging the framework and hardware resources of APRD with no additional hardware resource requirement. The ATMAS TF/2 meeting agreed that China, Hong Kong China, and Indonesia create an ad-hoc group with support of the ICAO Secretariat to further progress the development of ATMAS PRD and consider including AIDC implementation issue as well.

Updates from States

7.5 The ATMAS TF/2 meeting reviewed the relevant information and updates with the key outcomes of 4 webinars related to CNS, i.e. ICAO APAC Cybersecurity Webinar, Webinar on Implementation of CRV in APAC region, SWIM workshop, and Webinar on Implementation of ADS-B. The ICAO Secretariat agreed that it would be possible to hold a webinar about ATM Automation Systems in 2022.

7.6 China introduced the industry standards document MH/T 4029.3 "Civil Aviation Air Traffic Control Automation System - Part 3" to solve the problem of data synchronisation and interaction between ATM automation systems. The definition, application, and benefits of MH/T 4029.3 to exchange flight data in ATM Automation Systems were shared. The ATMAS TF/2 meeting agreed that information on the MH/T 4029.3 should be translated into English by China for better understanding by other Member States/Administrations before conducting a demand survey on such standards if needed.

7.7 China introduced a "One Code to the End" path used in China to maximally maintain the same SSR code for a flight and reduce the conflict of code, and pointed out it will reduce the

multiplex rate of the spatial dimensions. In order to solve the problems of code shortages, the spatial dimension distribution strategy suitable for China and the measures used to improve the utilisation rate of the SSR code in the spatial dimension including borrow SSR code, orientation distribution of SSR code, and SSR code sharing with experiences in Chengdu were introduced.

7.8 Singapore presented the likely trends in future ATM development - Open ATM. Singapore introduced the concept of Open ATM and explained the benefits of the Open ATM with comparing to the original ATM Automation Systems. The meeting was informed that Singapore and the industry are working on exploration of Open ATM together.

7.9 China introduced the research and practice of using Mode S downlink aircraft parameters (DAPs) which enhances the safety net of ATMAS based on trajectory prediction, detects air-ground inconsistency, and reduces the instruction deviation events caused by human factors. The existing problems of DAPs, such as BDS SWAP should be considered to avoid nuisance and false alerts were summarised.

7.10 China presented the analysis of operational requirements of the Tower ATM automation system, data interaction method between the ATM automation system and the Tower ATM automation system, and the data interaction method between main and backup Tower ATM automation systems. The technical solutions of data interaction to establish a flight plan synchronisation mechanism between the Tower ATM automation system and ATM automation system by using the data structure of the ATM automation system Flight Data Exchange Standard (MH/T 4029.3) were introduced. In addition, the application case was shared and the benefits of data interaction were analysed.

7.11 Hong Kong China informed that the Civil Aviation Department of Hong Kong China (HKCAD) has studied and identified the data diode technology which fulfilled HKCAD's needs to safely disseminate at sufficiently high data transmission rate from internal systems to external users while inhibiting malware and zero-day attacks that are originated from external sources. Hong Kong China shared the background, principle, and technical details of the data diode deployment which comprised of a transmitting host, an optocoupler, and a receiving host to protect critical ATC infrastructure against cyber threats. Hong Kong China encouraged the meeting to invite Member States/Administrations to consider adoption of proven and cost effective technologies to safeguard against cyber threats and enhance cyber resilience.

7.12 Hong Kong China informed that in connection with the implementation of enhanced Wake Turbulence Separation (eWTS) scheme for arrival traffic of Hong Kong International Airport (HKIA), an Approach Spacing Tool (AST) is being implemented at the HKIA to assist controllers in handling final approach operation under eWTS scheme while improving consistency in delivering the arrival traffic according to the intended runway capacity. Hong Kong China presented the considerations in the design and implementation of an Approach Spacing Tool to fit into an operational environment with track records of busy air traffic, and shared the installation of AST at HKIA has been completed and system acceptance tests are planned to commence in Q4 2021. The ATMAS TF/2 meeting reviewed and confirmed that the relevant design considerations of AST have been incorporated into the ATMAS IGD. Singapore shared that Singapore is implementing a similar AST system for the existing ATM system and has completed the training for controllers in August 2021 and would achieve operational status by Q1 2022.

7.13 China introduced the background of progress in the implementation of Performance-based Communication and Surveillance (PBCS) in China and the function evolution of ATM automation systems to match the research of PBCS.

ATM Automation System Implementation and Operations Guidance Document

7.14 Following the conclusion of ATMAS TF/1, the framework of Recommended Functions and Performances of ATM Automation System (RFAP ATM AS) Edition 0.0, which was led by China, Hong Kong China and Singapore in preparing, had been adopted. The completed draft guidance document was sent to Member States/Administrations on 6 August 2021 for review, China revised the

draft guidance document according to the comments and additional materials received. In order to align with the naming convention of other IGDs for APAC, Hong Kong China suggested to adopt "Air Traffic Management Automation System Implementation and Operations Guidance Document (ATMAS IGD)" instead of the original document name Recommended Functions and Performances of ATM Automation System (RFAP ATM AS) as the official name. Some suggestions to further improve the ATMAS IGD were discussed. The meeting agreed that the advance draft of ATMAS IGD to be taken forward to seek further comments and inputs from States and that the ICAO APAC Regional Office should issue a State Letter to circulate the advance draft of ATMAS IGD to States/Administrations, who should provide feedback within one month after receiving the State Letter.

Dissolution of APA TF

7.15 Based on the proposal by APA TF/7, which was reviewed by ACSICG/8, the ATMAS TF/2 meeting further reviewed and adopted the following Draft Decision for the consideration of CNS SG/25. The meeting adopted the following Decision:

Decision CNS SG/25/16 (ATMAS TF/2/1 (APA TF/7/1)) - Dissolution of APA TF		
What: Noting that most of the tasks outlined in the ToR have been achieved and the completion of residual part of action items will be undertaken by ATMAS TF. That, the APA TF be dissolved.		Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical
Why: The APA TF Terms of Reference have been completed and pending action items will be undertaken by ATMAS TF.	Follow-up: ☐ Required from States	
When: 22-Oct-2021	Status: Adopted by Sub-Group	
Who: ☒ Sub groups ☐ APAC States ☒ ICAO APAC RO ☐ ICAO HQ ☒ Other: ATMAS TF		

7.16 The ATMAS TF/2 meeting reviewed and updated the Action Item list for ATMAS TF, and also reviewed the Action Items arising from APA Task Force and agreed to consolidate APA TF work in ATMAS TF/3.

7.17 After dissolution of the APA TF, the ongoing APAC regional AIDC implementation work will be taken up by ATMAS TF while ACSICG would handle communications related issues. In order to integrate APA TF ToR into ATMAS TF ToR, the revised ATMAS TF ToR proposed by the ATMAS TF/2 was adopted by CNS SG/25 by following **Decision CNS SG/25/17**. The revised ATMAS TF Terms of Reference (ToR) adopted by the meeting is provided in **Appendix P**.

Decision CNS SG/25/17 (ATMAS TF/2/2) – Revised ATMAS TF Terms of Reference			
What: That, the revised ATMAS TF Terms of Reference (ToR) as shown in Appendix P to this Report be adopted.		Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☒ Ops/Technical	
Why: After dissolution of the APA TF, the ongoing APAC regional AIDC work will be conducted by ATMAS TF.		Follow-up:	☐ Required from States
When: 22-Oct-21		Status:	Adopted by Sub-Group
Who: ☒ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☒ Other: ATMAS TF			

Future Plan for ATM Automation System Implementation in India (IP/25)

7.18 India presented their future plan for ATM Automation system implementation in India. India informed that currently there are 44 ATM Automation Systems at major airports in India with most of them are on the verge of completing their usable operational life. Methodical planning of various processes involved in AAI for implementing CNS/ATM projects were discussed and the list of airports where procurement planning is already initiated and the classification of types of Automation System being procured or implemented were also provided in detail.

Implementation of the Weather Data Converter for a Legacy Automation System as an Interfacing to TDWR (IP/26)

7.19 Republic of Korea (ROK) presented the implementation of weather data converter for a legacy automation system as an interfacing to TDWR (Terminal Doppler Weather Radar) and benefit of it. A comparison of weather detection performance in PSR and TDWR was presented. It was informed that many ATC automation system does not understand weather radar file format directly. ATC system and weather radar (TDWR) are developed in the their own field and these two systems are advanced separately. Therefore, there were needs to make interactive connections between them. The legacy automation system with no ability to process SWIM API (Application programming interface) normally does not support TDWR interface. The alternative way to interface between TDWR and ATC automation system is to implement the weather data converter. The modules for implementation of weather data converter were described. It was concluded that the implementation of simple data conversion software could deliver cost-effective-benefit to a legacy automation system that does not have the SWIM capability and does not support RESTful API.

Approach Spacing Tool – Concept and Feature Overview (Presentation/02)

7.20 Thales introduced that in order to increase runway throughput, better ATC tools to provide decision support like an integrated Approach Spacing Tool (AST) are required. The Approach Spacing Tool with a sophisticated algorithm using 4D trajectory prediction can take advantage of new standards to provide the minimum safe separation on final approach and will become a key part of a wider range of tools, procedures, and practices to improve runway efficiency. Thales further explained features of the AST, including supporting separation values, offering guidance cues, and providing different spacing modes. Lastly, a range of warnings and implementation cases were shared.

7.21 Member States may wish to contact Thales by email to Mr. Duncan Kennedy at duncan.kennedy@thalesgroup.com.au for any other information.

Agenda Item 8: Review and updates

Review of Regional CNS Requirements in ICAO APAC e-ANP, Seamless ANS Plan and Updates on National Air Navigation Plan (NANP) (WP/15)

8.1 This paper presented the Regional CNS requirements specified in the three Volumes of ICAO APAC e-ANP, Seamless ANS Plan (Version 3.0, November 2019) and updates on National Air Navigation Plan (NANP). The meeting participants were invited to review all CNS-related information affecting their administration in the e-ANP and provide feedback to ICAO APAC Regional Office to update as necessary. States/Administrations are also invited to formulate their NANP to comply with commitments to Beijing Declaration by 2022.

8.2 The meeting noted that ICAO APAC Regional Office has been working to keep up-to-date and relevant information in the e-ANP. The Member States/Administrations were requested to provide updates in a timely manner for CNS requirements defined in section 2.1 of the paper.

8.3 The meeting was informed that the e-ANP Volume I Part II Table **AOP I-1 International Aerodromes Required In The Asia/Pacific Regions** and e-ANP Volume II Part II Table **AOP II-1 Requirements and Capacity Assessment in International Aerodromes in The Asia**

And Pacific Regions have been updated in 2021. Subsequently, the CNS provisions to **newly added aerodromes** should be updated in **e-ANP Volume II Part III Table CNS II-APAC 2** for relevant facilities. The Member States/Administrations were requested to review and submit the updates to ICAO APAC Regional Office for the updates on various facilities listed in **e-ANP Vol II Part III Table CNS II-APAC 2** for **new international aerodromes added in 2021** by filling the PfA template specified in section 2.4 and send it to ICAO APAC Regional Office. **ACTION ITEM 25-3**

8.4 Member States/Administrations were also invited to review **all CNS facilities listed and CNS requirements specified** in the e-ANP to verify that the information provided for their States/Administration is up-to-date and correct. In case of inconsistencies/incompleteness of any information, States should submit the updates to ICAO APAC Regional Office by following the procedure specified in section 2.4. Lastly, the Member States/Administrations should take into consideration to update e-ANP CNS relevant section defined in section 2.1 of the paper, when commissioning or decommissioning CNS systems in a timely manner and should inform to ICAO to add/delete new/obsolete CNS facilities.

8.5 In response to a question, the ICAO Secretariat informed that for e-ANP amendments, Member States are no longer constrained by update cycles as it was for former Doc 9673. At present, the ICAO Secretariat manage amendments through MS Word and PDF files submitted by Member States in PfA format. Amendments may be processed and incorporated in the e-ANP at any time in the year. There is no need for ICAO sections such as CNS, ATM, AGA, etc. to align submission date. If the part that CNS is amending has ATM elements, there would be automatic coordination between the sections internally before submitting a PfA by ICAO Secretariat. Therefore, CNS delegates from Member States are requested to inform the ICAO Secretariat about CNS related amendments in e-ANP relevant section by following procedure mentioned in the working paper. In addition, the Chair of CNS SG invited the ICAO Secretariat to carry out the same review on e-ANP volumes in ATM aspects. **ACTION ITEM 25-4**

Updates on Beijing Declaration Implementation Related to CNS (WP/16)

8.6 The ICAO Secretariat shared the information about current status of the Minister's commitment for implementation of technology (CNS) components under **Air Navigation Services** mentioned in 'Declaration on Asia/Pacific Ministerial Conference on Civil Aviation' also known as Beijing Declaration, which is to be implemented by 2022. The latest status of Ministerial Commitment for PBN implementation was reflected in graph-based on iSTARS tool updates as on March 2021, while current status of Common ground/ground telecommunication infrastructure to support ANS applications and Enhanced surveillance capability including ADS-B technology were informed to the meeting based on the information updated during CNS meetings in 2021.

Updates on ICAO Annex 10 VI RPAS C2 Link (WP/28)

8.7 The ICAO Secretariat presented the information about approval of Annex 10, Volume VI dedicated to the SARPs on the "C2 Link Procedures" and the "C2 Link Systems. Meeting was informed that the first edition of **Volume VI** to Annex 10 and **Amendment 90** to the ICAO SARPs, Annex 10- Aeronautical Telecommunications, **Volume V - Aeronautical Radio Frequency Spectrum Utilization** were adopted by the Council at the fifth meeting of its 222nd Session on **1 March 2021**. The Amendment 90 arise from the recommendations developed by the RPASP/13 which concerns the specifics of the frequency bands which can be used for the C2 Link. The corresponding State Letter was provided in Appendixes to the paper. The first edition of Volume VI becomes effective on 12 July 2021 and it will be applicable from 26 November 2026.

Seamless ANS Plan and Monitoring Update (WP/31)

8.8 The paper presented the status of the *Asia/Pacific Seamless Air Navigation Services (ANS) Plan* reporting, and the implementation progress of air navigation improvements in the Asia/Pacific Region. The paper introduced relevant APANPIRG Conclusions that shaped the current Seamless ANS Plan and the requirements to States/Administrations. The reporting status, points of

contact, regional picture as of March 2019 and future plans were provided in the paper as an overview to the overall status in APAC Region. Given the importance of Air Navigation Services planning on a higher-level whole-of-government approach through an effective National Air Navigation Plan, it is proposed that ATM/SG/9 to consider **Draft Conclusion ATM/SG/9-X: National Air Navigation Plan Reporting Form** and subsequent adoption of APANPIRG which reports the implementation progress on various Basic Plan Elements (BPEs) in the Form.

8.9 Hong Kong China questioned if as per abovementioned draft conclusion, Member States need to submit their NANP every year by 31 January. The ICAO Secretariat clarified that in line with other subsidiary plan, the ICAO Secretariat will request NANP reporting in designated format by Member States, if proposed draft conclusion would be adopted by ATM/SG/9. There is no need to submit NANP by Member States. The ICAO Secretariat added that ATM section of ICAO APAC Office is considering to modify deadlines of submission of subsidiary plans to ICAO Regional Office each year from April to 31 January of each year in order to align with NANP reporting form proposal.

8.10 In response to a question about deadlines to implement BPEs by Member States, the ICAO Secretariat informed that as per Beijing declaration, Ministers commit to implementation Air navigation in national planning frameworks such as National Development Plans (NDPs) supported by National Air Navigation Plans (NANP) by **2022**.

8.11 Nepal requested to consider modifications in deadlines of Beijing declaration commitments. The meeting considered that Member States may put up the proposal for modifications in deadlines set by Beijing declaration to APANPIRG/32.

The Long-Term Vision for the Future Air Traffic Systems of Japan (CARATS) (IP/22)

8.12 The paper presented the status of Collaborative Actions for Renovation of Air Traffic Systems (CARATS), the long-term vision for the future air traffic systems of Japan. It was informed that CARATS was introduced in 2010 to set various goals which aim for the skies of Japan in 2025. With the update of GANP editions, the roadmap of CARATS had been renovated. The paper introduced the KPIs in CARATS and there are environmental-related KPIs along with the actions to be taken to tackle the reduction of CO2 emissions due to increasing air traffic. In addition, the paper discussed their effort in implementing SWIM in 2024 and their effort to maximise SWIM's potential and bring benefits to every stakeholder even beyond aviation industry.

Agenda Item 9: Review status of CNS deficiencies (APANPIRG Deficiency List)

Review Status of CNS Deficiencies (WP/17)

9.1 The paper presented the list of Air Navigation Deficiencies in the CNS field which was reviewed in APANPIRG/31. The only outstanding issue was related to unreliability of AFS communication between Afghanistan and Pakistan. Poor performance of AFS including data communication between Kabul and Karachi and ATS voice communication between Lahore and Kabul had become issues of regional concerns. A COM coordination meeting (Afghanistan, China and Pakistan) held in July 2019 in ICAO APAC Regional Sub-Office agreed to restore the VSAT connection by upgrading the VSAT terminals and equipment in Lahore and Karachi. Both Afghanistan and Pakistan were also agreed to implement CRV as soon as practical. However, there was no further progress after last update in 2020. The current List of Air Navigation Deficiencies in the CNS field was reviewed in CNS SG/25 and endorsed as **Appendix Q** to this report.

9.2 Pakistan raised a few challenges they were facing, including lack of contact point of Afghanistan, challenges in restoring VSAT link, and waiting for pairwise CRV implementation with Afghanistan. The ICAO Secretariat informed they would update Pakistan with the latest contact point of Afghanistan in due course, and invited the meeting, particularly BBIS States including Thailand and India to implement CRV as soon as possible to provide convenient connections to BIS States.

Agenda Item 10: Human Factors and Air Traffic Safety Electronics Personnel (ATSEPs) related training**Review Outcomes of Small Working Group Study on Human Factor Issues of ATSEP (WP/18)**

10.1 The paper summarised the outcomes of the various Ad-hoc group meetings held from its establishment in April 2021 in response to APANPIRG Conclusion C 31/15 for finding the left-out gaps and for preparing the regional ATSEP human factor guidance material. In response to the abovementioned conclusion, the State Letter **Ref.: T 3/9.9- AP022/21 (CNS)** dated 26 January 2021 on subject *Addressing Human Factor Issues of ATSEP* was sent by ICAO APAC Office. In response, **Eight (8) States/Administrations (China, Hong Kong China, India, Indonesia, Japan, Republic of Korea, Singapore, and Thailand)** nominated the experts, and the ad-hoc group was formed with the participants from Eight (8) States/Administrations and one International Organization namely International Federation of Air Traffic Safety Electronics Associations (IFATSEA) in April 2021. The ad-hoc group is being led by IFATSEA.

10.2 In previous meetings, *a road map with timelines and monthly online meeting* were adopted by the ad-hoc group. The task completed and the summary of task to be completed were provided in Appendixes. Meeting was informed that the ad-hoc group immediate task of finding the gaps on the IFATSEA's report will be completed by 31st October 2021 and the ad-hoc group will start discussion on the best practices across the ANSPs and will prepare an SFMD (Stress Factors Mapping Document) by 30th November 2021. This SFMD will have mapping of key stress factors, effective counter measures, existing best practices, and long-term benefits to ANSPs on addressing the human factors of ATSEP. The planned tasks are to be completed by June 2022 as per the current timeline, and if done so without any hindrance or exceptional unavoidable situation, the ad-hoc group would present and submit the draft Regional ATSEP guidance material to CNS SG/26.

Agenda Item 11: Cybersecurity of CNS/ATM systems**Outcomes of ICAO Asia Pacific Regional Cybersecurity Webinar (WP/19)**

11.1 The paper presented the outcomes of ICAO Asia Pacific Regional Cybersecurity Webinar held on 14 June 2021 via VTC in response to ACTION ITEM 24-9 of CNS SG/24. The Webinar was attended by 317 participants from 26 States/Administrations, 6 International Organizations and 2 Technology/Solutions providers (Nokia and Thales) who sponsored the event. Total ten (10) presentations were delivered by Experts from different parts of the world under different domains related to cybersecurity. During the Webinar, Questions and Answers (Q & A) sessions were held at end of each presentation through the Pigeonhole tool. Throughout the Webinar, a total of 69 questions were asked and *more than 100 feedbacks* for the Webinar were provided by participants with 100% positive responses.

11.2 The meeting commented that CANSO has been active on the cybersecurity topic for ANSPs. The meeting invited and CANSO expressed their continued commitment to share more experience and the latest development, such as their cybersecurity guidance publications, in future ICAO APAC meetings.

Implications of Cybersecurity and Associated Requirements for CRV Operations (WP/32)

11.3 USA addressed the implications for existing services and the CRV resulting from the Cybersecurity Webinar (WP/19 refers) and future support of SWIM and other proposed services for the Region. FAA recalled SWIM “*shifts the ATM information architecture paradigm from point-to-point data exchanges to system-wide interoperability.*” The Meeting was informed that Cyber Security Webinar organised by ICAO APAC RO on 14 June 2021 presented the International Aviation Trust Framework (IATF) initiative composed of *Digital Identity* and *Network Information Security* elements,

which were further elaborated. It was explained that a user's client applications would access the hosted SWIM Information Exchange Services over the CRV that would interact with other SWIM deployments and information sources and could provide information consolidation and mediation services, e.g. translation from Traditional Alphanumeric Code (TAC) to ICAO Weather Information Exchange Model (IWXXM). The Meeting was requested to comment and discuss suggested implications of ICAO Requirements for IPv6 dedicated address block, Name Space and field DNS, Trust Framework for Digital Identities, CRV Network Requirements, Service Provider Options, CRV user requirements. In addition, the meeting was requested to review the various challenges in addressing cybersecurity and SWIM.

11.4 Regarding the challenges, Dr. Amornrat Jirattigalachote, the Co-Chair of SWIM TF, advised that the issue on setting service level agreement has already been discussed at SWIM TF/5 meeting as presented in WP/07, and SWIM TF will take back and explore the resolution to these challenges.

11.5 Mr. Hoang Tran, Co-Chair of ACSICG, commented that there are some issues, which are not be assigned to any groups in ICAO APAC, for example, who would be responsible for the DNS and cybersecurity. He suggested that formation of independent bodies be recommended to APANPIRG to look into cybersecurity across various domains from-end-to-end.

11.6 Mr. Kelepi Dainaki, Co-chair of CRV OG (Pacific), informed that the cybersecurity requirements for CRV are under discussion in CRV OG.

11.7 The meeting noted that certain basic cybersecurity building blocks e.g. IPv6 dedicated address blocks and DNS service for APAC Region have yet been addressed.

11.8 Australia commented that other regions of ICAO have more experience in certain cybersecurity aspects and relevant Panels (such as IMP) will be of good reference. The meeting was reminded that the Region should avoid implementing unique solutions not aligned to other Regions that could cause interfacing issues at boundaries with other Regions.

11.9 The ICAO Secretariat informed the meeting that initial coordination with other ICAO Regional Offices on regional network cybersecurity requirements has been initiated. The Chair of CNS SG invited ICAO APAC Regional Office to follow up with ICAO Headquarter on the issue. **ACTION ITEM 25-5**

Cybersecurity in Air Navigation Activities (WP/33)

11.10 The paper provided information of cyber threat, one relevant and emergent challenge that must be taken into account as an integral part of air navigation activities, as well as a summary about experience and activities development by ICAO NACC Regional Office to address and support Caribbean States in their air navigation cybersecurity approach. The paper recalled Resolution *A40-10 Addressing Cybersecurity in Civil Aviation* and introduced the seven important pillars for the implementation of cybersecurity, which requires a holistic approach and the interfaces between aviation security components deserve special attention. The paper introduced the projects by ICAO NACC Regional Office developed in collaboration with CANSO and AIRBUS for the CAR region that aims to support the States in the establishment of their first *Cybersecurity Policy Manual*. The paper pointed out that Cybersecurity challenges require joint work by all areas of the Civil Aviation system and encouraged States to consider adopting multidisciplinary approaches to cybersecurity for all air navigation operations.

Cybersecurity in ATM System of Systems Approach - Patch Management (Presentation/03)

11.11 Thales presented on the topic *Cybersecurity in ATM System of Systems approach* focused on patch management. The agenda included Security Patching relevant to ATM system and Recommended security patching process flow. Firstly, the patching considerations were elaborated, including software assurance level, performance and business continuity, vulnerability management, and system development life cycle, etc. Furthermore, Thales shared the recommended security patching process flow which takes into account different architecture components, threat modelling, and critical and non-critical aspects based on priority. It was concluded that the security patching requires deliberate planning, system of systems approach, and sub-systems / components integrated approach. Member States may contact Mr. Binny Sarien at binny.sarien@thalesgroup.com.au for any relevant questions.

Information Security Requirements for Exchange of Information over IP (Presentation/04)

11.12 The presentation introduced the information security requirements for exchange of information over IP from PANS-IM and information security framework aspect. The meeting was informed about the ICAO provision on draft PANS-IM, information service, and guidance material. The requirements of the information security framework were shared including scalable, minimum requirements to ensure trust, common practices based on NIST and ISO, etc. Furthermore, the scope and layered approach of information security framework were elaborated with emphasising on the IPv6 dedicated block of addresses and the impact of the loss of information security on safety.

11.13 The meeting requested ICAO to consider organising another webinar on this subject on how Information Security Requirements for Exchange of Information over IP can be implemented by Member States in a pragmatic manner. **ACTION ITEM 25-6**

Agenda Item 12: Discuss and share experience and application of new technologies, including big data analysis, artificial intelligence, Digital-Tower counter UAS detection and identification system, UTM, etc.

12.1 Under this agenda item, in response to APANPIRG's call on enhancing engagement with the industry, CNS SG invited various industry partners to share and update the latest progress in relevant areas.

UAS-Based PAPI Inspection Technology in China (WP/24)

12.2 China informed that the Unmanned Aerial System (UAS) application research team in China has been developing a leading and practical PAPI flight inspection technology and explained the prototype of the UAS-Based PAPI Flight Inspection System. China informed that thirteen trial flights had been carried out to test the UAS plus the payload's functions and performance, evaluate the technology concept, verify the mission module, and integrated system at both plain and plateau airports. The latest trial flight in Nyingchi Mainling airport validated the technology further and demonstrated the advantages particularly at the airport like Mainling counting on RNAV RNP operation. Furthermore, China presented the limits of the prototype and informed that despite there is room for improvement, the UAS-based PAPI inspection technology has great potential to benefit both the flight inspection service provider and the airports when applied, and encouraged to provide feedback on the methodology. The meeting was further informed that while there could be natural limitations such as distance to runway and wind speeds that restricted the type of flying objects, China envisaged a greater applicability in the future in calibration of equipment in addition to current ILS, VOR, DME, NDB, ADS-B and PAPI through working with various parties such as regulatory bodies. The meeting noted the application of UAS technology in China and would welcome further sharing of the progress in CNS SG/26 meeting.

Trial Inspection on CNS Outstations by Drone to Enhance Maintenance Work in Hong Kong China (WP/25)

12.3 The paper provided information about a trial conducted by Hong Kong China to explore potential applications and benefits of using the drone to support maintenance work for CNS facilities at remote outstations. A trial in Cheung Chau, an outstation on an outlying island, was shared through comparison of inspection by maintenance personnel and by drone with the conclusion that the benefits of drone inspection in savings in cost and labour, as well as reduction in occupational safety and health risks, are significant. The meeting was informed that more sophisticated building / structural inspection is feasible with relevant technologies equipped onboard, including thermographic building diagnostics and Building Information Modelling (BIM) for On-site Buildings and Structures. The site-specific factors which might affect the applicability, scope and regularity of the drone inspection were also introduced. It was informed that Hong Kong China will further explore other potential use cases of drone to enhance the overall robustness and efficiency in CNS maintenance work and encouraged States/Administrations to consider cost effective and proven technologies to enhance CNS maintenance work. The meeting noted that application of Artificial Intelligence and BIM for drone-based inspection would be major development areas in the future.

Development of an Integrated Safeguarding Surface to Uphold Flight Safety While Facilitating Infrastructure/Building Developments in Hong Kong China (WP/27)

12.4 Hong Kong China shared the successful experience in making use of advanced computer modelling to proactively develop integrated safeguarding surfaces for CNS equipment, aerodrome and flight procedures, and publish them under a regulatory framework to uphold flight safety while minimising constraints to infrastructure/building developments to cope with the pressing needs for lands for developments in the Hong Kong territories. Hong Kong China has revamped the existing CNS safeguarding surfaces based on comprehensive computer modelling for each CNS equipment against the environment in which the equipment operates by means of a state-of-the-art 3-dimensional computer modelling solution. States/Administrations were encouraged to be fully aware of the potential risks induced by the protrusion of safeguarding surfaces and take proactive steps to engage advanced computer modelling to enhance protection of their CNS equipment operation while facilitating infrastructure/building developments.

Standard Establishment of Data Link for UAS-Based Flight Inspection in China (IP/15)

12.5 China informed that the joint research and developing team in China is drafting a minimum operational performance standard (MOPS) for special-purpose air-ground data link used in UAS-based flight inspection missions. The special data link is expected to transmit flight inspection raw data, mission payload status information, mission payload remote command, etc. via radio communication, but not UAS command and control data which are specified in RTCA DO-362. The being drafted standard focuses on establishing featured requirements for the data link designed for UAS-based flight inspection scenario. The meeting noted that in China the frequency used for datalinks would depend on local governmental regulations.

Implementation of A-SMGCS Level IV Operation in Beijing Daxing International Airport (IP/16)

12.6 China informed that the Daxing A-SMGCS system was put into operation in September 2019, which can meet the level IV operation standard in DOC 9830 and provide surveillance, alert, routing, and guidance functions for ground targets in airport and added that the A-SMGCS level IV operation function will be promoted in other airports in China. Regarding a question on how to resolve the situation for false targets triggering the automatic routing function, China explained that with the multilateration system deployed, the effect of false targets to routings has barely happened.

Standard Establishment of UAS-based Flight Inspection System in China (Flimsy/03)

12.7 CAAC published the first technical specification of fixed-wing/hybrid-wing UAS-based civil aviation flight inspection system in September 2020, as a big move of the standard establishment plan for UAS-based flight inspection technology and application. The issued standard specifies essential functions, performance requirements, system components, antennas, and requirements of the core units, including inspection receiver, signal acquisition unit, evaluation and processing unit, etc. as well as requirements for tag, documentation, transportation, and storage. The meeting was invited to provide feedback on the technical specification attached to this flimsy.

Uniting the Things That Fly - How to Integrate ATM and UTM for a Safer APAC Sky (Presentation/01)

12.8 The presentation put the spotlight on challenges in the emerging Unmanned Aerial Vehicles (UAVs) market and reflected the broad areas of Frequentis expertise in supplying ATM infrastructure solutions for CNS. Frequentis introduced the insights gained on projects in the USA, very large scale demonstrations in the Gulf of Finland (GOF 2.0), and real live UTM operations for Norwegian air navigation services, AVINOR. Furthermore, Frequentis shared the experience of supporting APAC legislators, regulators and ANSPs to safely manage airspace in Asian Megacities, high-security zones, and across national borders. Member States may wish to contact Frequentis by email to Thomas Lutz at thomas.lutz@frequentis.com for any other information.

Application of Knowledge Graph in Air Traffic Management (Presentation/05)

12.9 The China State Key Laboratory of ATM System and Technology shared the applications of knowledge graph in air traffic management. The meeting was informed that the knowledge graph represents a collection of interlinked descriptions of entities. To establish the knowledge graph in air traffic management, the methods for ontology construction in ATM field, knowledge extraction, and knowledge fusion were shared. Furthermore, the China State Key Laboratory of ATM System and Technology elaborated the applications of the knowledge graph in air traffic management, including relationship analysis, flow control message analysis and delay prediction, and weather message analysis. It was concluded that knowledge graph will enhance the ability of air traffic management system in data integration, search, and reasoning and decision making.

Agenda Item 13: CNS related work/projects impacted by COVID-19

Impact of COVID-19 to CNS Works in 2021 (WP/20)

13.1 The ICAO Secretariat summarised the impact of COVID-19 on CNS works in 2021. It included the CNS meetings scheduled for 2021 by VTC, the organisation of a series of webinars for easier access to ICAO events, and increase in the number of participants than face to face meeting. The meeting noted that due to the decline of implementation of CNS/ATM projects by the Member States, the planned programme has been postponed or has broken into phases and the harmonisation of implementing activities between neighbouring States and among stakeholders became more difficult. The ICAO Secretariat informed about alleviations to the Standards of the Annexes and its associated system named COVID-19 Contingency Related Differences (CCRD) and [Roadmap to OPS Normal \(icao.int\)](https://www.icao.int/safety/OPS/OPS-Normal/Pages/AN-Services.aspx). It was added that Flight inspection periodicity considerations for radio navigation aids is provided under Air Navigation Services section at <https://www.icao.int/safety/OPS/OPS-Normal/Pages/AN-Services.aspx>, which covers two parts: i) Flight inspection practices during the pandemic, ii) Restoration to service after temporary removal from service. States/Administrations were encouraged to send representatives to join meetings taking advantage of virtual platform, and contribute Subject Matter Experts to support webinars on various topics.

Agenda Item 14: Dates of next meeting and any other business**CNS Points of Contact (WP/21)**

14.1 The ICAO Secretariat informed that the need for points of contact from States/Administrations who would respond in a timely, effective, and efficient manner was important in addressing CNS-related operational deficiencies notified to the Regional Office, including but not limited to: cyber-attack to CNS/ATM systems, frequency interference, duplicated II code/matching SI code used at overlapping area, contingency planning due to unexpected disaster. The ICAO Secretariat explained the layer concept of putting this CNS Points of Contact list as a higher but more general list for handling issues that are not able to be dealt with in the Focal Points from each of contributory bodies. The meeting endorsed the concept and Member States/Administrations would be invited to review and update their existing nominated CNS Points of Contact to the APAC Regional Office, and each State/Administration was requested to provide points of contact of CNS contingency planning and administrative support for effective and efficient coordination in CNS aspect.

CNS Meeting Planning for 2022 (Flimsy/01)

14.2 The ICAO Secretariat presented the tentative meeting plan for CNS SG and its contributory bodies for 2022 through Flimsy/01.

14.3 The meeting was informed that the unprecedented situation of the COVID-19 pandemic hindered CNS Meeting plan in 2020 and 2021. As the situation is improving and there is high hope for resumption of travel from 2022, The ICAO Secretariat prepared a tentative meeting plan for 2022 based on assumption of possibilities of Face-to-Face (F2F) meeting from Q2 of 2022. Meeting noted that ICAO Secretariat will conduct future F2F meeting with additional option for Member States to join the meeting by VTC as much as practical, which is termed as Hybrid Mode (HM) meeting. The tentative meeting plan for 2022 is as follows:

No.	Meeting Name	Tentative Dates	Mode
1	CRV OG/9	25-27 January	VTC
2	SRWG/6	01-03 March	VTC
3	SURSG/2	15-17 March	VTC
4	DAPS WG/5	23-25 March	VTC
5	PBNICG/9	March	VTC
6	ACSICG/9	19-21 April	HM
7	SWIM TF/6	17-20 May	HM
8	SURICG/7	24-27 May	HM
9	SBAS/GBAS, ITF/4	May	HM
10	ATMAS TF /3	14-17 June	HM
11	CNS SG/26	04-08 July	HM
12	Frequency Finder Workshop	Q4	F2F

14.4 The ICAO Secretariat will inform Member States about the exact dates, mode and venue of the meeting while issuing invitation letters in due course.

The CNS SG/25 Meeting Action Items

14.5 The meeting summarised the six action items resulted from the CNS SG/25 meeting, its target date, and action parties. The summary of action items is provided in **Appendix R**.

Note of appreciation

14.6 On behalf of the CNS SG, Mr. Richard Wu, Chairperson of CNS Sub-group, expressed thankfulness to ICAO Secretariats for their excellent support and dedication in ensuring smooth running of the CNS SG/25 meeting within the tight timeframe.

14.7 Mr. Richard Wu expressed his appreciation to all participants from Member States/Administrations, International Organizations namely IATA, CANSO, IFALPA, and IFATSEA along with industries namely PCCW Global (ICAO CRV service provider), SITA, and sponsoring industries namely CASRI, China State Key Laboratory of ATM System and Technology, Chinney Alliance Engineering, Frequentis, Nokia, Rohde and Schwarz, Thales, SAAB, and Searidge, for their significant contributions and active participation in making the meeting a successful and fruitful one. Mr. Wu gave a brief summary on the achievements by the CNS Sub-group in this meeting while highlighting the key issues discussed and addressed. He believed that with the strong dedication and unfailing support from all the Subject Matter Experts, the CNS Sub-group would upkeep our professional work and momentum to ride on the pandemic storm while gearing up ourselves for traffic recovery. He envisaged the CNS Sub-group would continue taking a significant role in shaping the future direction of CNS development for this region.

14.8 ICAO Secretariat shared its appreciation to Mr. Richard Wu, Chairperson of CNS Sub-group for operating CNS SG/25 meeting in a timely and efficient manner. Lastly, ICAO Secretariat expressed its gratitude for contribution and support from APAC Member States, international organisations, and industries partners.

INTERNATIONAL CIVIL AVIATION ORGANIZATION



COMMON AERONAUTICAL VPN (CRV) IMPLEMENTATION PLAN

Version 2.1

17 May 2021

COMMON AERONAUTICAL VPN (CRV)
IMPLEMENTATION PLAN – V1.0

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ABBREVIATIONS

ABBREVIATION	DESCRIPTION
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATS Inter-facility Data Exchange
AMHS	Air Traffic Service Message Handling System
ANSP	Air Navigation Service Provider
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APAC	Asia/Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
BBIS	Backbone Boundary Intermediate System
BIS	Boundary Intermediate System
CAA	Civil Aviation Authority
CAR	Caribbean Region
CBA	Cost Benefit Analysis
CNS	Communications, Navigation and Surveillance
ConOps	Concept of Operations
CRV	Common aeRonautical Virtual Private Network
DSCP	Differentiated Services Code Point
EUR	European Region
FIXM	Flight Information Exchange Model
FPL	Flight Plan
ICAO	International Civil Aviation Organization
IP	Internet Protocol
IPS	Internet Protocol Suite
IWXXM	ICAO Weather Information Exchange Model
MET	Meteorological
MPLS	Multi-Protocol Label Switching
NAT	Network Address Translation
NID	Network Interface Device
OH	Operational Hazard
OG	Operation Group
OSI	Open Systems Interconnections
PoC	Point of Contact
QoS	Quality of Service
RFI	Request for Information
RFP	Request for Proposal
SARP	Standards and Recommended Practices
SAT	Site Acceptance Test
SIP	Session Initiation Protocol
SME	Subject Matter Expert
SOP	Standard Operating Procedures
ST	Sealed Tender
SWIM	System-Wide Information Management

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ABBREVIATION	DESCRIPTION
TF	Task Force
WXXM	Weather Information Exchange Model (based on XML)
UC	Use Case
VoIP	Voice Over Internet Protocol
VPN	Virtual Private Network
XML	Extensible Markup Language

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Implementation Plan is to provide guidance for all States/ Administrations on the operation requirements for the upcoming Common aeronautical Virtual Private Network (CRV) used in Asia/ Pacific (APAC) Region.

The details include in Table 1, Table 2 , a list of all States/ Administrations concerned, and for each State/ Administration include the:

- i. National Points of Contact; and
- ii. Local Points of Contact.

The information contained in this document was first adopted by the 1st Meeting of CRV Operations Group (CRV OG/1). It is intended that this Implementation Plan shall be used as the means to:

- i. identify all actions required to implement CRV;
- ii. ensure a harmonized approach for the APAC Region;
- iii. monitor and report on progress; and
- iv. identify any issues, risks or problems which may arise.

1.2 Overview of the CRV

Currently, aeronautical ground-ground communications in the ICAO Asia/Pacific Region, and in particular Aeronautical Fixed Telecommunication Network (AFTN) and AMHS services, operate over point-to-point international leased circuits. However, this network configuration exhibits a number of limitations such as the inability to switch to new protocols like Voice over IP (VoIP) or System Wide Information Management (SWIM) efficiently, high cost for every connection and limited flexibility for increase in bandwidth.

A CRV Task Force (TF) was formally established in accordance with APANPIRG Decision (24/32), (Bangkok, Thailand, 24-26 June 2013). The concept of CRV was taken from other common network that has already implemented in other regions such as Pan-European Network Services (PENS) and FAA Telecommunication Infrastructure (FTI).

The CRV is a dedicated multiprotocol label switching (MPLS) Internet Protocol (IP) based Virtual Private Network (VPN) communication network provided by a common network service provider and support all Aeronautical Fixed Service (AFS) in the APAC region. Telecommunication costs are reduced as States/ Administrations will only require minimal connections to a far reaching network instead of individual connections to each neighboring State/ Administration. The CRV service provider provides the service to allow CRV members to exchange voice and data information with each other.

Each CRV member should determine the amount of bandwidth require for each Quality of Service (QoS) sub queue. In addition, each CRV member should also determine the total access bandwidth that they need to subscribe.

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2.0 IMPLEMENTATION OVERVIEW AND PROCESSES

2.1 General Description of Implementation

States/ Administrations should refer to the CRV implementation roadmap to take note of the estimated CRV implementation date provided by other States/ Administrations that they wish to exchange data/ voice via the CRV.

The implementation date, type of data, voice, bandwidth and QoS between the two States/ Administrations shall be negotiated and agreed bilaterally and supported by the CRV service provider.

CRV service provider is to put up individual service contracts for the two connecting States/ Administrations.

The work processes and CRV implementation roadmap in Para. 2.2 provides a breakdown of the estimated schedule and serve as a guide.

2.2 Implementation Schedule/ Roadmap

The planned project timeline for each States/ Administrations to implement CRV could be based on the estimated work processes schedule and roadmap for CRV.

2.2.1 Work Processes

The projected activities and schedule to implement the services includes the following:

S/No.	Subject	Projected Activities	Projected Schedule
1	Technical requirements and SOW	1. Respective ANSPs develop their associated requirements and Statement of Work (SOW) that specify performance, interface, conversion, operational procedure, acceptance test procedure 2. Present to Vendor for comment and response 3. To seek CRV-OG concurrence on deviation from CRV common package 4. Finalize requirements	6 to 9 months
2	Negotiation and agreement between two connecting States/ Administrations	1. To decide the type of data or voice to be exchanged via CRC, QoS for each type of applications and the required bandwidth 2. CRV Contractor to comment and response to the agreed requirements 3. Agree to implementation schedule	6 to 9 months
3	CRV Contractor proposes Contract to ANSP	4. Contractual and Legal review 5. Technical and operational review 6. Finalize contract 7. Establish contract and payment system	6 to 9 months
4	Site preparation	Site preparation and implementation of the service	1 to 3 months

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S/No.	Subject	Projected Activities	Projected Schedule
5	Test and evaluation	1. Perform acceptance test with associated applications 2. Perform acceptance test with respective ANSPs	3 to 6 months
6	Service acceptance	Service acceptance	1 week

2.2.2 Roadmap for CRV

The roadmap for CRV implementation in the APAC Region will be updated by the CRV Operations Group.

2.3 Application Transition Schemes

This paragraph provides States/ Administrations the recommended transition scheme for each application (e.g. AMHS, ATFM, ADS-B, Voice, etc.) targeted to be implemented or migrated from the existing communication link/ network.

2.3.1 AMHS

Being IP, it should be possible to reroute the existing connection at the IP layer either by an address translation or by pointing the LA at a new IP address in the AMHS system. However, the recommended approach will be to setup a parallel connection using the CRV that can be thoroughly tested to the satisfaction of both ANSP's. Once the stability of the CRV has been verified, the cutover would be conducted by the respective com-centers at the AMHS system level. The actual approach taken will require a negotiation between each pair of ANSP's.

2.3.2 AFTN

Depending on the existing AFTN connection there are a number of migration strategies available.

Option 1. Migration to AMHS

Setting up a new AMHS link over the CRV as per ICAO grand master plan xyz.123 would be the preferred option for migration of AFTN. It would allow the new connection to be setup and tested independently.

Option 2. Migrate from native X.25 to XoT

Where the existing connection is a native X.25 connection end to end, and migration to AMHS is not possible, then XoT is the next preferred option. It is recommended that a new LA be setup that uses the XoT over CRV path. Once the XoT connection has been verified and tested by each ANSP then actual migration of AFTN would be performed by the respective com centers similar to AMHS in 2.3.1 above. If PCCW are not able to provide serial interfaces on their CE routers then it would be incumbent on the ANSP to deliver the AFTN traffic as a XoT connection.

Option 3. Migrate from XoT to XoT

Where the AFTN connection between two ANSP's is already using XoT, and if the trust in the performance of the CRV is high, then the cutover from the legacy link to the CRV could be as simple as an X25 route change on each ANSP's respective XoT routers. Alternatively, a new LA could be setup and tested before being cutover at the system level by the respective ANSP's com-centers.

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2.3.3 ADS-B

To deliver their stream to the PCCW gateway, likewise at the other end it would be up to the partner ANSP to ensure that there is a multicast path available from the CRV egress to their flight data management system. Being multicast, it is possible for the same information to traverse the same two endpoints via multiple network paths simultaneously, however some ANSPs may decide to setup new multicast groups via the CRV so that the performance of the CRV can be measured against the legacy link. Alternatively, ANSPs may decide to replace the multicast stream with unicast data flows that operate via an ADS-B filter.

PCCW could implement Generic Routing Encapsulation (GRE) tunnel solution (NID to NID) between States/ Administrations who are agreeable to have direct connection for routing control over the any to any MPLS layer 3 backbone.

2.3.4 Voice

The specific strategy used to migrate the voice services will vary depending on the existing setup, the proposed voice interface between the ANSP and PCCW (E&M / ISDN / VoIP), how the partner ANSP is setup and their intended connection to PCCW. Despite this there are two main options.

Option 1 – New buttons on the operator consoles - Preferred

This option involves setting up new buttons on the operator consoles at each end. The new buttons are configured from the outset to route via the CRV. This strategy allows the new service to be configured and tested with minimal disruption to operators and also allows for an almost seamless cutover (pressing a different button). Another great advantage of this strategy is to ability to do a practical test of the voice quality by allowing the same pair of controllers test both paths within a few seconds of each other.

Option 2 – Reconfigure existing connections to use the CRV

Where Option 1 is not possible, the only other alternative is to reconfigure the existing connection. This will involve increased coordination between the two ANSP's and PCCW as well as potentially multiple technical groups within an ANSP as it is likely that multiple systems will need to be reconfigured at the same time. E.g. Voice switches, networking devices etc. This option would also involve a lengthy outage and interruption to operational staff.

2.4 Technical Specifications of CRV (for applications reference)

CRV envisaged in the ICAO CNS/ ATM concept via through two backbones (one Multiprotocol Label Switching (MPLS), based on a terrestrial, satellite, or both networks, and one based on a secured Virtual Private Network over the public internet.

- i. It will be a homogeneous and generalized application of the IP protocol in the transport network for voice and data aeronautical communications;
- ii. It will established an appropriate Quality of Service (QoS) quality requirements;
- iii. It will have a centralized and common network management;
- iv. It will have a homogeneous and standardized interface, consisting Network Interface Device(s) (NID(s)) linked to the existing local switches, satellite and/or terrestrial links based on the Multiprotocol Label Switching (MPLS) technology, as well as ground services, based on a Virtual Private Network (VPN) over the public internet;

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- v. It will have voice and data gateway service by the Service Provider; and
- vi. For IT security, individual ANSPs may implement an authentication service based on a cooperative public key infrastructure (PKI) including IPsec for IPv4 and IPv6 and digital certificates management for public IP links between ANSPs.

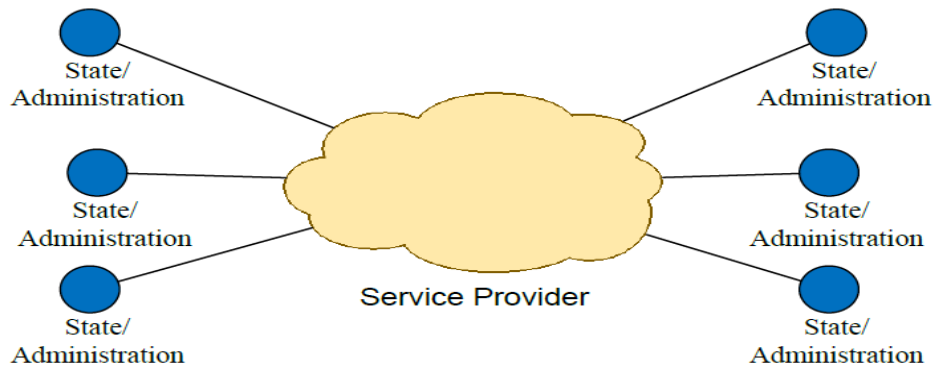


Figure 1: High level system overview of CRV

2.4.1 Service Level Agreement & Quality of Service

- i. QoS are implemented using guidance from IETF RFC 4594 Configuration Guidelines for Different Service Classes. The routing protocol, voice, voice signaling, real-time interactive and standard data types shall all be given separate QoS bandwidth;
- ii. Differentiated Services Code Point (DSCP) QoS markings to traffic will be used before it enters the network; and
- iii. SLAs are based on States/ Administrations' requirements (i.e. Packages A, B, B+, C, C+ and D offered by CRV contractor).

2.4.2 IP Addressing

- i. CRV supports IPv4 and IPv6 addressing. The overall IP addressing plan will be centrally managed by the CRV contractor and will be known as the CRV IP address plan;
- ii. An IPv4 plan, appended as Appendix A, was agreed in the APAC region and was concluded through Conclusion 21/22 - Asia/Pacific ATN Interim Addressing Plan;
- iii. In the development of the IPv4 plan, a flexible margin has been designated to allow future growth or change. Through draft Conclusion CRV OG/8/01, using one vacant /19 IP address block "10.46.0.1 to 10.46.255.254", each third party Service Provider (e.g. AIREON LLC providing Automatic Dependent Surveillance - Broadcast data over CRV) is assigned 254, 510, 764 or 1022 usable Network addresses (depending on Service Providers' technical requirements); and
- iv. The Middle East Regional (MID) region IPv4 plan is appended as Appendix B of this document.

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2.4.3 Interface

- i. The interface type provided by the NID to the CRV User is the Ethernet IEEE 802.3ab (1000 Base-T).

2.4.4 Routing Restrictions

- i. Route advertisements will be restricted so that each CRV User which interacts with the CRV routing protocol can only advertise subnets which are allowed in the CRV IP Address Plan.
- ii. When peering with the CRV Contractors network, it is permissible to use the CRV User's own Public IP addressing and ASN, and the CRV Contractor will use a Public AS.

2.4.5 Packet Loss Rate:

- i. Packet loss rate of less than 0.1% for all the SLA-Voice; and
- ii. Packet loss rate of less than 0.5% for all the SLA-Data.

2.4.6 For VoIP Transport (ED-137)

- i. The VoIP Transport shall provide a maximum jitter of 40ms;
- ii. The VoIP Transport shall provide a maximum packet loss of 0.1%;
- iii. The VoIP Transport shall provide an availability greater than 99.9%; and
- iv. The CRV shall use the high priority tags in the VPN packet headers to ensure that VoIP traffic is given high priority and minimal delay. An appropriate level of priority will be given to ED-137 SIP signaling.

2.4.7 Standards used

- i. SNMP and MIB-II management protocols, implemented in accordance with RFC 1157 and RFC 1213;
- ii. Implementation of the RTP/RTCP and RTP "header compression" protocols, in accordance with RFC 2508;
- iii. The multiservice IP network permit the creation of VPNs using MPLS, in accordance with RFC 2547 and RFC 3031, and QoS configuration over MPLS/VPN, in accordance with RFC 3270 and RFC 2983;
- iv. QoS is implemented using guidance from IETF RFC 4594. (Covered under QoS); and
- v. The CRV provide transport for the ED-137 VoIP.

*Note: If at the time of the publication of this document the specific rules and standards mentioned in any of the other Sections have been revoked, superseded or updated, the new rules or standards shall be deemed as applicable.

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2.5 Use Cases

Use Case 1 – ANSPs Interconnect AMHS

Summary of Situation

ANSP ‘A’ and ANSP ‘B’ wish to have a direct connection between their AMHS. Both ANSPs decide that the AMHS application shall be built upon the Aeronautical Telecommunication Network (ATN). The ATN will in turn use the CRV.

User Response

Each ANSP already has a connection to the CRV. Each ANSP:

1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access speed is sufficient. If it is not the ANSP will arrange with the CRV Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what IT security arrangements are required. In this User Case they decide to implement an IPSec VPN.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.
5. Notify CRV-OG on completion of the implementation to update records.

Operational Needs

UC1.1 The CRV link must meet the reliability and availability needs of AMHS.

UC1.2 The CRV link must provide IP version 4 transport for the ATN.

UC1.3 The CRV link must provide IP version 6 transport for the ATN.

UC1.4 The CRV link must allow the ANSPs to implement IPSec VPN tunnels.

UC1.5 The CRV link must allow for bandwidth changes.

Use Case 2 – ANSPs Implement ATC Voice over Internet Protocol Circuits

Summary of Situation

ANSPs ‘A’ and ‘B’ wish to build upon the success of their AMHS implementation and have identified four Voice over Internet Protocol (VoIP) voice circuits which should be moved to the CRV.

User Response

Each ANSP already has a connection to the CRV. Each ANSP:

1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what IT security arrangements are required. In this Case they decide to implement an IPSec VPN to provide secure end-to-end transport between ANSPs.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.
5. Tags the VPN traffic containing the Voice over Internet Protocol (VoIP) Real-time Transport Protocol (RTP) and Session Initiation Protocol (SIP) data with appropriate priority markings to allow the CRV Service Provider to identify the voice traffic.

Operational Needs

UC2.1 The CRV link must meet the reliability and availability needs of ATC voice.

UC2.2 The CRV link must provide an IP version 4 VPN tunnel to transport IP version 4 VoIP and SIP signaling.

UC2.3 The CRV link must provide an IP version 6 VPN tunnel to transport IP version 6 VoIP and SIP signaling.

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UC2.4 The CRV link will use the high priority tags in the VPN packet headers to ensure that VoIP traffic is given high priority and minimal delay.

Use Case 3 – ANSPs Implement Automatic Ring-down Circuits

Summary of Situation

ANSPs 'A' and 'B' wish to build upon the success of their AMHS implementation and have identified an Automatic Ring-down (ARD) analog voice circuit which should be moved to the CRV.

User Response

Each ANSP already has a connection to the CRV. Each ANSP:

1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what voice quality Mean Opinion Score (MOS) is required. Perceptual Evaluation of Speech Quality (PESQ) ITU-T Rec. P.862 may be used to measure the effects of distortions (e.g. errors, packet loss, delay, etc.) to provide the MOS score.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.

UC3.1 The CRV link must meet the reliability and availability needs of ATC voice.

UC3.2 The CRV link must provide conversion from analog voice to VoIP.

UC3.3 The CRV link must provide appropriate SIP signaling to support the ARD functionality.

UC3.4 The CRV link must provide IP version 4 transport for the VoIP.

UC3.5 The CRV link must provide IP version 6 transport for the VoIP.

UC3.6 The CRV link will use the high priority tags in the packet headers to ensure that VoIP traffic is given high priority and minimal delay. The CRV must give an appropriate level of priority to SIP.

UC3.7 The CRV link must deliver voice so that it is clearly understood with minimal delay.

Use Case 4 – ANSPs Implement Analog Voice Circuits

Summary of Situation

ANSPs 'A' and 'B' wish to build upon the success of their AMHS implementation and have identified four analog voice circuits which should be moved to the CRV.

User Response

Each ANSP already has a connection to the CRV. Each ANSP:

1. Notifies the CRV-OG Coordinator of their intention to establish the new facility.
2. Determines if their existing access bandwidth is sufficient. If it is not, the ANSP will arrange with the Service Provider to increase their bandwidth.
3. Negotiates bi-laterally with the other ANSP to determine what voice quality Mean Opinion Score (MOS) is required. In this Case they decide a MOS of 4.0 is required so they select a CRV service level that provides the required voice quality.
4. Negotiates bi-laterally with the other ANSP to determine what testing, acceptance and commissioning procedures are required.

Operational Needs

UC4.1 The CRV link must meet the reliability and availability needs of ATC voice.

UC4.2 The CRV link must provide conversion from analog voice to VoIP.

UC4.3 The CRV link must detect analog signaling and provide appropriate SIP signaling and vice versa.

UC4.4 The CRV link must provide IP version 4 transport for the VoIP.

UC4.5 The CRV link must provide IP version 6 transport for the VoIP.

UC4.6 The CRV link will use the high priority tags in the packet headers to ensure that VoIP traffic is given high priority and minimal delay. The CRV must give an appropriate level of priority to SIP.

UC4.7 The CRV link must deliver voice so that it is clearly understood with minimal delay.

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3.0 IMPLEMENTATION SUPPORT

3.1 Introduction

The aim of the transition is to be interruption less. But as the services must migrate from the current network infrastructure to the CRV, an interruption time due to disconnection and reconnection, is mandatory and the team involved (CRV-OG, CRV Members and Contractor) will be of utmost importance to the overall process.

This chapter comprises the basic teams involved in the implementation of the CRV infrastructure, the roles of each professional and the main coordination steps and stakeholders including the CRV-OG.

These responsibilities come in addition to those stated in the Terms and Conditions and Terms of Reference.

Figure 3 describes the relevant entities for the CRV implementation.

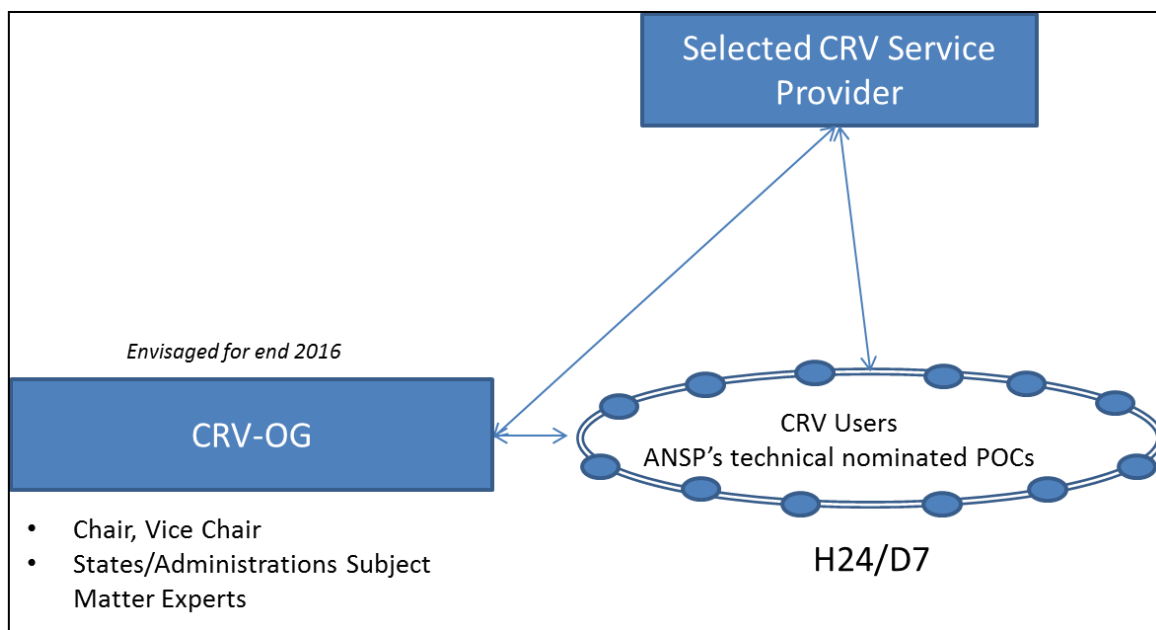


Figure 3: Relevant Entities to this Project.
(Source: CRV Tender doc - Att II - Terms of Reference_v3)

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3.2 Implementation Team

The implementation team will be composed of the CRV-OG representatives, the National Points of Contact (NPOC), Local Points of Contact (LPOC) and the CRV Contractor Team, as described in the following sections.

3.2.1 CRV-OG

The CRV Operations Group (OG) will provide oversight of the function and performance of the network after the CRV is completely installed. Besides, it will be involved in the oversight of the implementation of the CRV post Contract Award.

The main activities and roles applied to the CRV-OG during the implementation of the CRV infrastructure are:

- i. Develop close coordination with the National CRV POC and Contractor for the complete implementation of the CRV node;
- ii. Provide the CRV IP Addressing Scheme (Plan) to the Contractor, in close coordination with the National CRV POC; and
- iii. Provide the classification and marking scheme for the prioritization of traffic for the QoS to be used by the aeronautical applications in the CRV network.

Note: When applying QoS, the end-to-end configuration needs to be observed (LAN- layer 2 switches and WAN- Layer 3 routers devices). So, this activity will involve close coordination with the National CRV POC and Contractor, taking into consideration the tender document Att II - Annex b - Matrix of Flows for CRV services_v2), SLA, and the tender document Att II - Annex c - Mapping of services for quality management_v2.

3.2.2 National CRV Points of Contact

Table 1 contains the National CRV Points of Contact that will be in charge of the whole process in each CRV Member, independently if the State involved has more than one node.

The main activities and roles of the National CRV Points of Contact are:

- i. Develop close coordination with the CRV-OG representatives, Contractor and Local CRV POC for the complete implementation of the CRV node;
- ii. Receive the requests for site surveys from the Contractor, coordinating the actions with the Local CRV POC;
- iii. Participate and/or Coordinate the participation of the Local CRV POC and Local Staff in the implementation meetings with the Contractor;
- iv. Participate and/or Coordinate the participation of the Local CRV POC and Local Staff in the training package (online, on site, initial and refresh) as defined in the Section 3.12 (Training) of the Terms of Reference (TOR) document;
- v. Coordinate the actions and instruct the Local CRV Points of Contact regarding all activities

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involved in the implementation phase;

- vi. Review and approve the System Design Document (SDD), System Engineering plan (SEP) and other documents, part of the tender package, prepared by the Contractor upon the contract award and signature;
- vii. Review and approve the Validation Plan, including the Site Acceptance Test (SAT), prepared by the Contractor;
- viii. Oversee if the Contractor is following the national laws and procedures concerning the assignment of frequencies with the radio regulator authorities in each country (case of microwave and satellite equipment);
- ix. Update the ICAO CNS Regional Officer (ICAO Asia and Pacific Regional Office) with regard to the timeframe, situation, difficulties and other topics deemed necessary for the implementation of the CRV node(s);
- x. Provide the local CRV IP Addressing Scheme - Plan to the Contractor in close coordination with the CRV-OG representatives.
- xi. Provide the current numbering plan for the ATS Switched Voice Circuits to the Contractor;
- xii. Provide the current direct hotline Voice Circuits configuration to the Contractor;
- xiii. Provide the classification and marking scheme for the prioritization of traffic for the QoS to be used by the aeronautical applications in the CRV network (See note in the paragraph 3.2.1.3);
- xiv. Receive the requests for site surveys from the Contractor and coordinate the activities with the Local CRV POC; and
- xv. Approve the implementation planning.

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Table 1: National CRV Points of Contact

Asia Pacific Region:

State/ Administrati on	ANSP/ CAA	National CRV Point of Contact (POC)	Job Title	E-mail	Telephone/FAX	Address
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV						

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MID Region (CRV) Focal Points (updated in December 2017 at CRV OG/3 meeting):

<u>State</u>	<u>Name/Title</u>	<u>Contact Details (Tel./Fax/Mobile/Email)</u>
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV		

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3.2.3 Local CRV Points of Contact

Table 2 contains the Local Points of Contact. In fact, the professionals nominated and listed in the referred tables will really take part in the installation, on behalf of the States, and will be in charge of the oversight of the Contractor's team in each site. They will report directly to the National Points of Contact of each CRV Member. The main activities and roles for the Local CRV Points of Contact are:

- i. Instruct and coordinate the actions with all the local staff involved in the CRV implementation;
- ii. Develop close coordination with the National CRV POC and the Contractor's site staff for the complete implementation of the CRV node;
- iii. Coordinate the actions for the site surveys with the National CRV POC;
- iv. Participate in the implementation meetings with the Contractor (if decided by the National Point of Contact);
- v. Participate to the elaboration of the implementation planning;
- vi. Participate in the Training Package and nominate, to the National CRV POC, the Local staff there will participate in the referred events;
- vii. Report, give feedback and update the National CRV POC regarding all aspects concerning the implementation of the CRV node;
- viii. Assist the National POC in the revision and approval of the SDD, SEP and other implementation documents, prepared by the Contractor;
- ix. Assist the National POC in the revision and approval of the Validation Plan including the SAT, prepared by the Contractor;
- x. Oversee the installation in order to ensure that the Contractor team is keeping the working area clean and free from fire hazards and if after installation, all excess material is duly removed;
- xi. Make sure that the local safety rules are observed by the Contractor in terms of intervention on operational systems;
- xii. Oversee the installation in order to ensure that the Contractor is following what is described in the TOR, item 3.3.2.9, concerning the Electromagnetic compatibility/ grounding;
- xiii. Oversee if the QoS configuration is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;
- xiv. Oversee if the CRV IP Addressing Scheme (Plan) is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;
- xv. Oversee if the configuration of current numbering plan for the ATS Switched Voice is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;

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- xvi. Oversee if the configuration of the current Direct Circuits (DIR) is duly performed by the Contractor, as defined by the CRV-OG representatives and the National CRV POC;
- xvii. Coordinate the actions for the site surveys and assist the Contractor's personnel during the visits;
 and
- xviii. Hold meetings with the Contractor as deemed necessary and report to National POC.

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Local CRV Points of Contact (installation and oversight of the Contractor's team on each site)

State	State/ANSP	Site	Local CRV Points of Contact	Email	Telephone / Fax	Service installation
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV						

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3.2.4 CRV Contractor

The Contractor shall nominate all the staff involved in the implementation of the CRV node, mainly the Program Manager for the CRV program. The Contractor will follow all the steps described in the tender documentation, specially the TOR and Instructions to Tenderers, for the implementation of the CRV node. The main activities to be carried out by the Contractor during the implementation are:

- i. Submit the updated SDD and the SEP to the CRV-OG, to the CNS Officer for the Asia/Pacific Regional Office and to the National CRV POC;
- ii. Submit the requests for site surveys to the National CRV POC following the procedures described in the paragraph 4.1.2.2;
- iii. Update and submit the Installation Transition Plan to the CRV-OG, to the CNS Officer for the Asia/Pacific Regional Office and to the National CRV POC;
- iv. Be responsible for the supply, transport, installation, start-up and operation of all CRV equipment especially designed for a given CRV node;
- v. Be dealing with customs and transport company about shipping and introducing the equipment in the Country;
- vi. The interconnection (to be provided by CRV users) of the Network Interface Device (NID) to the Local Area Network (LAN) switches and other local equipment, including Voice Communication System (VCS), will be confirmed during the site survey;
- vii. Demonstrate before the final validation of the SDD and through a test bed that the main characteristics of the intended design of the network will meet the performance requirements, SLA, safety, security and contingency requirements;
- viii. Implement the CRV IP Addressing Scheme (Plan), following the information provided by the CRV-OG and/or the National CRV POC;
- ix. Implement the classification and marking scheme for the prioritization of the traffic and Quality of Services (QoS), as described in the document Att II - Annex c - Mapping of services for quality management_v2 and in coordination with the CRV-OG and the National and Local CRV POCs (See note in the paragraph 3.2.1.3);
- x. The Contractor shall measure the established parameters during circuit implementation (in accordance with ITU-T), and shall also monitor them for 24 hours to show compliance with the established specifications;
- xi. Implement the configuration of current numbering plan for the ATS Switched Voice, as defined by the CRV-OG representatives and the National CRV POC, and taking into account the tender document Att II - Annex b - Matrix of Flows for CRV services_v2;
- xii. Implement the configuration of the current Direct Circuits (DIR), as defined by the CRV-OG representatives and the National CRV POC and taking into account the tender document Att II - Annex b - Matrix of Flows for CRV services_v2;

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- xiii. Submit, in details, the escalation process to be followed for the implementation in each CRV node;
- xiv. Submit, to the CRV National POC, the documentation for the training of the CRV technicians;
- xv. Contractor Representative shall record the minutes of the meeting and distribute the minutes within three (3) Business Days of the meeting date;
- xvi. The Contractor shall propose a planning chart that includes all the actions, steps, milestones, meetings, after negotiations with CRV Local and National POC and respect it once approved by the CRV User Representative or amend it in coordination with CRV User representatives; and
- xvii. The Contractor shall help the CRV User in the uptake of responsibility before commissioning the equipment by accompanying the CRV User technicians in charge of the equipment.

4.0 BASIC SITE IMPLEMENTATION REQUIREMENTS

Chapter 4 describes the site and facilities requirements envisaged in the implementation phased for the CRV infrastructure, divided into CRV User's and Contractor's responsibilities, and also the main hardware and software for the proof of concept and implementation of the WAN links, LAN protocols, applications and main equipment.

These responsibilities come in addition to those stated in the Terms and Conditions and Terms of Reference.

4.1 Site/ Facilities Requirements

4.1.1 CRV User Responsibility

- i. The CRV User shall provide the physical space for the installation of cabinets and equipment;
- ii. The CRV User shall deliver to the premises the electric power required to feed the equipment to be provided by the Contractor;
- iii. The CRV User shall provide access to the equipment to be connected to the CRV NID and to analog/ digital voice gateway;
- iv. The CRV User shall accompany and assist the Contractor during the whole operation;
- v. The CRV User shall provide room for storing the equipment, received before its installation; and
- vi. The CRV User shall inform the Contractor about the local safety rules and procedures and produce suited documents as deemed necessary.

4.1.2 Contractor Responsibility

- i. The Project Manager, on behalf of the Contractor, shall nominate and introduce all the staff involved in the site surveys and in the implementation of a CRV node. The list with the staff nominated will be submitted to the National and Local CRV POCs with the formal requests for the site survey and beginning of the very implementation of the CRV equipment and following the

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procedures described in the paragraph 4.1.2.4;

- ii. The Contractor shall identify the exact locations of the equipment during the site survey;
- iii. The Contractor will be responsible for providing the accessories, switches, cables, connections between the main distribution panel and the NID;
- iv. The Contractor shall be responsible for the installation of the CRV network equipment, accessories and the provision of the tools, testing equipment and software for the Site Acceptance Tests (SAT);
- v. The procedures to the Contractor for the site surveys aiming the installation of the equipment are as follows:
 - a) Send a formal request to the national CRV POC, with an anticipation of 20 days for the required coordination with the local CRV POC, sending the names of the staff to be involved with the visit;
 - b) If authorized, the Contractor shall proceed to the site survey in the date and time indicated by the national CRV POC;
 - c) If the Contractor fails to comply with the survey in the exact date, the national POC will cancel the visit and the Contractor will have to restart the whole site survey process; and
 - d) The Contractor will provide all of the instruments and tools deemed necessary for the site survey.
- vi. The Contractor shall be held liable for any damage to existing property in each CRV User facilities caused to the facilities by its staff and/or its sub-contractors’;
- vii. The Contractor shall comply with the site safety rules especially during critical phases such as commissioning or interferences with operational systems by following CRV User staff indications in charge of technical safety and not take personal initiatives that could have an impact on operational systems;
- viii. The Contractor shall be responsible for storing the equipment before its installation;
- ix. The Contractor may be asked to sign additional documents in order to follow local safety rules;
- x. The Contractor shall keep the working area clean and free from fire hazards. After installation, all excess material shall be removed;
- xi. The Contractor shall identify the exact locations for the installation of cabinets and equipment during the site survey;
- xii. The Contractor shall provide the CRV equipment grounding in each node;
- xiii. If necessary, the Contractor shall install protection against atmospheric discharges for all the equipment to be implemented for the provision of the CRV infrastructure in each node;

Note: The Contractor will be responsible for reviewing the characteristics of any existing devices that might be available as long as it is allowed the usage by the CRV representative;
- xiv. The Contractor shall be responsible for the connection to the power supply in the installation site, including electrical wiring between the power outlet and the equipment rack of the Contractor, including the respective circuit breakers and devices to protect against surges and atmospheric

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discharges;

- xv. The Contractor shall be running simulations over a period that has to be determined before commissioning the equipment. CRV User representatives shall be involved in the setting and execution of these simulations; and
- xvi. The Contractor shall procure the results of the tests.

4.2 Hardware and Software Requirements

4.2.1 General Topics

- i. For the installation of the equipment to be provided, the Contractor shall follow and consider all the tender documents, especially the TOR, the Att II - Annex e - CRV IRS_v2 and the Att II - Annex f - Additional Voice and Data Gateway Service_v3.
- ii. Although the Contractor operates MPLS data transport solutions, it is fully committed to the perfect operations of the applications and shall follow the initial end-to-end applications trials.

4.2.2 Hardware Requirements

- i. For the satellite equipment, the Contractor shall install the indoor and outdoor units.
- ii. Where Applicable, the basic satellite equipment to be provided and checked is: Block Up Converters (BUC), Low Noise Block (LNB) down converters and Satellite Modems and VSAT Network management sub-system.
- iii. Where Applicable, the basic ground/terrestrial equipment to be provided will comprise: routing system of the IP VPN Internet (with the needed interfaces), the basic ground voice and data gateway (with the needed interfaces), the NID (with the needed interfaces), switches (with the needed interfaces), A/B baseband switch (with the needed interfaces), Multiprotocol Label Switching (MPLS) for the Wide Area Network (WAN) (optical and/or microwave) links equipment.
- iv. Before connecting the NID and the analog/digital, if needed, the contractor's team shall install the new racks and prepare the transition cables, such as junction coaxial cables, junction sub-d cables or RJ based cables.
- v. All the test and measurement tools shall be provided by the Contractor. No testing and measurement equipment will be provided by the CRV User representatives.
- vi. All the needed equipment must be shipped and acknowledge by the CRV-User before the installation phase with sufficient delay. The Provider have to take the customs procedure delay into account.
- vii. All the received items must be inventoried and tested before the beginning of installation in order to avoid dispute.

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4.2.3 Software Requirements

Where applicable, the basic software to be provided and/or used in each site is: Network Management Systems (NMS) software, if the SDD indicates that one or more CRV nodes will be selected to manage the CRV network in parallel with the Contractor's Network Operations Center (NOC), software for BUC, Satellite Modems, NID, Voice/Data Gateway and switches.

4.2.3.1 Documentation Requirements

The needed documentation for the uptake of the equipment shall be provided to CRV User on its demand as deemed necessary.

5.0 TESTING AND EVALUATION.

The tests for the acceptance of the implemented equipment in each CRV node will be performed using simulations of the applications and, eventually, the real application tests that will follow the operational requirements as described in the tender documents, mainly, but not restricted to:

- i. Att II - Annex a - CRV CONOPS_v2;
- ii. Att II - Annex b - Matrix of Flows for CRV services_v2;
- iii. CRV Implementation plan (Chapter 5); and
- iv. Validation Plan including the Site Acceptance Test (SAT) protocols (prepared by the Contractor).

The main testing and measurement equipment and tools that shall be used by the Contractor are:

- i. Spectrum Analyzer;
- ii. cable analyzer;
- iii. audio analyzer/generator;
- iv. Multi-meters;
- v. LAN/Network protocol analyzer; and
- vi. Telephones.

Note: This paragraph doesn't exhaust all the testing and measurement equipment to be used during the implementation phase, and the Contractor shall describe all of them in the documentation to be provided after the contract signature.

The Contractor shall test its backbone (end-to-end) and the connection to its Network Operating Center (NOC). The links will be tested using computers for asynchronous and IP flows for example, and analogical phones.

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An example of asynchronous test is opening a HyperTerminal session and send characters and a Bit Error Rate Test using a software such as WinSSD.

The requirements for the test procedures will be reflected in the Chapter 5 (Testing and Evaluation). Notwithstanding this fact, the tests procedures will need some software for the applications as reflected in the following paragraphs.

Note: The following paragraphs don't exhaust all the software and the Contractor shall describe all of them in the documentation to be provided after the contract signature.

For AFTN simulation: The simulation will consist of connecting a PC to the AFTN port at the back of the rack (with the right rate described in the document Att II - Annex b - Matrix of Flows for CRV services_v2) and close the serial interface at the other end of the circuit (loop). With the PC launch the *winssd* program (or other similar) and start the Bit Error Rate (BER) test. Run the test for 5 minutes and check that there are only a few errors.

For AMHS simulation: AMHS service is over IP (see the document Att II - Annex b - Matrix of Flows for CRV services_v2). To simulate it:

- i. ping any remote equipment in the network according to the following cross matrix; and
- ii. Verify that the end user is exchanging information correctly.

IP based RADAR and Asterix: The simulation will consist in selecting two sites, configuring sufficient bandwidth and multicast an IP flow.

ATS/DS Circuits: All ATS/DS calls are auto-dialed. The communication is established after the user picks up the phone. The simulation will consist of connecting a telephone on the desired line at the back of the rack, pick-up the phone make the call to the other end of the circuit. For E1 based circuits, to be connected to a VCS, this cannot be simulated.

ATS Switched Circuits: ATS switched calls are dialed. The communication is established after the user picks up the phone and dials the remote dial number. The simulation will consist of connecting a telephone on the desired line at the back of the rack, pick-up the phone and dial a remote number in order to call the other end of the circuit. For E1 based circuits, connected to a VCS, this cannot be simulated.

6.0 CONTINGENCY PLAN/ BACK-OFF PLAN

6.1 Purpose

States/ Administrations are to establish contingency plan, with the CRV contractor in case of the following scenario:

- i. CRV total failure;
- ii. CRV partial failure (e.g. voice channel failure);
- iii. Provider Edge (PE) to Customer Edge (CE) link failure (e.g. ANSP1 lose connectivity to CRV); and

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- iv. PE to PE failure (e.g. ANSP1 and ANSP2 unable to exchange data/ or voice).

6.2 Harmonized Contingency Plan

States/ Administrations could also bilaterally/ multilaterally setup additional IPLC(s) as a contingency. This contingency plan could be harmonized in the APAC region to reduce costs.

7.0 MIXED OPERATING ENVIRONMENT

7.1 Routing of AFTN/ AMHS messages to non-CRV States/ Administrations

During the initial phase of the CRV implementation, States/ Administrations who have joined CRV are to ensure the routing of AFTN/ AMHS messages to States/ Administrations who have not joined CRV.

7.2 Inter-Region common network connectivity

It is envisaged for common networks (e.g. PEN, FTI and CRV) in different Regions to be inter-connected.

Appendix A – APAC IPv4 Address Plan

Appendix A

1 Introduction

1.1 Objective

This document is meant to describe the addressing plan for IPv4 addresses throughout the Asia/Pacific Region. This document defines the recommended address format for IPv4 addresses. The IPv4 network is to be used within region.

1.2 References

[1]	ICAO Doc 9705-AN/956	Manual of Technical Provisions for the ATN
[2]	ICAO Doc 9896	Manual for the ATN using IPS Standards and Protocols
[3]	ICAO Doc 7910	ICAO Location Indicators
[4]	RFC 1518	An Architecture for IP Address Allocation with CIDR
[5]	RFC 1918	Address Allocation for Private Internets
[6]	RFC 2050	BGP-4 Internet Registry IP Allocation Guidelines
[7]	RFC 3330	Special-Use IPv4 Addresses
[8]	RFC 4271	BGP-4 Specification

1.3 Terms Used

<i>Administrative Domain</i>	–	An administrative entity in the ATN/IPS. An Administrative Domain can be an individual State, a group of States, an Aeronautical Industry Organization (e.g., an Air-Ground Service Provider), or an Air Navigation Service Provider (ANSP) that manages ATN/IPS network resources and services. From a routing perspective, an Administrative Domain includes one or more Autonomous Systems.
<i>Autonomous System</i>	–	A connected group of one or more IP prefixes, run by one or more network operators, which has a single, clearly defined routing policy.

<i>Intra-domain (interior gateway) routing protocol</i>	–	Protocols for exchanging routing information between routers within an AS.
<i>Inter-domain (exterior gateway) routing protocol</i>	–	Protocols for exchanging routing information between Autonomous Systems. They may in some cases be used between routers within an AS, but they primarily deal with exchanging information between Autonomous Systems.
<i>Local Internet Registry</i>	–	A Local Internet Registry (LIR) is an IR that primarily assigns address space to users of the network services it provides. LIRs are generally ISPs, whose customers are primarily end users and possibly other ISPs. [LACNIC]

1.4 Acronyms

AMHS	–	ATN Message Handling System
ARP	–	Address Resolution Protocol
ATN	–	Aeronautical Telecommunications Network
BGP	–	Border Gateway Protocol
DNS	–	Domain Name Service
IANA	–	Internet Assigned Numbers Authority
ICS	–	ATN Internet Communication Service
IP	–	Internet Protocol
IPv4	–	Internet Protocol Version 4
IPv6	–	Internet Protocol Version 6
IPS	–	Internet Protocol suite
LACNIC	–	Latin American and Caribbean Internet Address Registry
LIR	–	Local Internet Registry
OSPF	–	Open Shortest Path First
RIR	–	Regional Internet Registry

1.5 Overview of Addressing Issues

The following subsections present issues that affect the completion of the addressing plan for operating the IPS-based AMHS network.

1.5.1 Public or Private Address

An important decision for the region is whether to use private or public addresses. Private addresses can be used if coordinated by all participating States and Organization; however, it is possible that existing networks already use addresses in the private block ranges. Public addresses must be obtained from a Regional Internet Registry (RIR). The Internet Assigned Numbers Authority (IANA) has delegated responsibility for administration of Internet numbering to the Latin American and Caribbean Internet Address Registry (LACNIC).

1.5.2 Address of Systems in External Regions

Systems in external regions could be assigned an address from the APAC address space rather than use an address in their regional address block. Note however that this must be coordinated with private addresses so as to avoid collisions.

2 IPv4 Addressing Overview and Fundamentals

In the Internet Protocol a distinction is made between names, addresses, and routes. A name indicates what we seek. An address indicates where it is. A route indicates how to get there. The Internet protocol deals primarily with addresses. Its main task is to forward data to a particular destination address. It is the task of higher-level protocols to make the mapping from names to addresses, for example using a domain name service (DNS). The Internet protocol forwards packet data units (PDU) to a destination address using routing tables maintained by a routing protocol. The routing tables contain the address of the next hop along the route to the destination. There are in general two classes of routing protocols: inter-domain or exterior routing protocols such as the Border Gateway Protocol (BGP) and intra-domain or interior routing protocols such as the Open Shortest Path First (OSPF) protocol. In order to forward PDUs to the next hop address, there must be a mapping from this address to the link level address, for example, an Ethernet address. This mapping is maintained by an address discovery protocol such as the Address Resolution Protocol (ARP).

An IPv4 address consists of four bytes (32 bits). These bytes are also known as octets. For readability purposes, humans typically work with IP addresses in a notation called dotted decimal. This notation places periods between each of the four numbers (octets) that comprise an IP address. For example, an IP address that a computer sees as

00001010 00000000 00000000 00000001

is written in dotted decimal as

10.0.0.1

Because each byte contains 8 bits, each octet in an IP address ranges in value from a minimum of 0 to a maximum of 255. Therefore, the full range of IP addresses is from 0.0.0.0 through 255.255.255.255. That represents a total of 4,294,967,296 possible IP addresses.

A network may be set up with IP addresses to form a private or public network. On a private network a single organization controls address assignment for all nodes. On a public network there must be some conventions to assure that organizations do not use overlapping addresses. In the Internet this function is performed by the Internet Assigned Numbers Authority (IANA), which delegates authority to Regional Internet Registries (RIR). For the CAR/SAM Region the RIR is the Latin American and Caribbean Internet Address Registry (LACNIC).

IPv4 Addresses are a fixed length of four octets (32 bits). An address begins with a Network ID, followed by a Host ID as depicted in Figure 2-1.

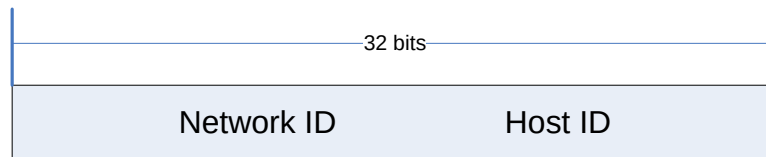


Figure 2-1. IPv4 Address Format

The original IP addressing scheme divided the Network ID from the Host ID in several octet boundaries. In this scheme the main classes of addresses were differentiated based on how many octets were used for the Network ID. This method is called classful addressing. Classful addressing was by convention further modified so that the Host ID could be split into subnet ID and sub host ID. This is typically accomplished using a subnet mask and is called classful addressing with subnetting. This eventually evolved into classless addressing where the division between the Network ID and Host ID can occur at an arbitrary point, not just on octet boundaries. With classless addressing the dividing point is indicated by a slash (/) followed by the number of bits used for the Network ID. This value is called the prefix length of the address and the address value up to that point is called the network prefix.

Private Addressing is defined in RFC 1918. IANA has reserved the following three blocks of the IP address space for private Internets:

- 10.0.0.0 - 10.255.255.255 (10/8 prefix)
- 172.16.0.0 - 172.31.255.255 (172.16/12 prefix)
- 192.168.0.0 - 192.168.255.255 (192.168/16 prefix)

Because of the number of bits available to users, these blocks are referred to as a "24-bit block", a "20-bit block", and a "16-bit" block. An enterprise that decides to use IP addresses out of the private address space defined by RFC 1918, can do so without any

coordination with IANA or an Internet registry. Addresses within this private address space will only be unique within an enterprise or a group of enterprises (e.g., an ICAO region), which chose to cooperate over this space so they may communicate with each other in their own private Internet.

3 IPv4 Addressing

3.1 Overview CAR/SAM

3.1.1 During the fourth meeting of ATN/TF4 (Santo Domingo, Dominican Republic, 27 to 28 June 2008) the group analyzed different alternatives for the implementation of the TCP/IP in the CAR/SAM Regions identifying the available options that would facilitate this implementation in the AMHS Service and future applications. This was reviewed in accordance with Document 9880 Part IIB of the ICAO. In this respect the Meeting decided two viable options for the implantation the TCP/IP:

- a) AMHS using the RFC1006 on Guiders TCP/IP (IPv4) to allow AMHS to directly interface with IPv4 Guiders for the intra-regional connections.
- b) Configuring AMHS, as specified in a) with capacity for IPv4 conversion to IPv6 through the implementation of a function of IP router as gateway for the interregional connections.

3.1.2 The Sixth Meeting of Committee ATM/CNS (ATM/CNS/6) (Santo Domingo, Dominican Republic, 30 June to the 04 July 2008) analyzed this Plan of IP Addressing for CAR/SAM Regions and considered that such a plan would be sent to the ICAO for revision.

3.1.3 During the ACP/WG/I/8 (Montreal, Canada, 25 to 29 August 2008) it was concluded that it is possible to consider a regional scheme of IPv4 addressing. Taking into consideration that the private sector would be using the propose addressing scheme in other applications, the Meeting considered nonviable to apply the IP addressing scheme at a global level.

3.1.4 The Third Meeting of the Group of Regional Implementation SAM/IG/3 (Lima, Peru, 20 to 24 April 2009) considered that, taking into account specified in Table CNS 1Bb from the FASID, the AMHS system to be installed in the SAM Region will use IP protocol and will initially use the IPv4 version. The block of used IPv4 addresses will follow the format established during the ATM/CNS/SG/6 Meeting.

3.2 IP Addressing Plan

When we began to work on the plan of IP addressing, we once again reviewed the scheme that was originally proposed, analyzed the amount of States/Territories by

Region, the amount of addressing that each State/Territory could use and the amount of addressing reserved for the interconnection between States/Territories. The result of this study concluded that:

3.2.1 1 bit would be reduced to State/Territory level. This means the transfer of 256 States to 128 States by region. In the EUR/NAT Region, which is most numerous, has 53 States/Territories, means that there are many vacant numbers.

3.2.2 1 bit at Host's level would be added. This would allow the transfer from 4096 to 8190 hosts per State/Territory. This was considered due to the amount of future applications that would be implemented, mainly in the more developed States, and could cause the amount of directions not to be sufficient. The structure is shown below:

IPv4 Address																																
10								Region				State / Territory								Host's												
0	0	0	0	1	0	1	0	.	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
1st. Byte								.	2nd. Byte								.	3rd. Byte								.	4th. Byte					

3.2.3 It should be noted the networks assigned to each State are private networks (RFC 1918). The first Bytes that integrate the assigned address will always maintain a decimal value of 10. Whereas the other three Bytes are used to distribute, in hierarchic form, the blocks of directions corresponding to each State.

3.2.4 The first four bits of the second Byte (4 bits) will be used to identify the regions in around which the States/Territories of the world are grouped:

- 0000 => SAM: South American Office.
- 0001 =>. NACC: North American, American Power station and Caribbean Office.
- **0010** => **APAC: Asia and Pacific Office.**
- 0011 => MID: Middle East Office.
- 0100 => WACAF: Western and Central African Office.
- 0101 => ESAF: Eastern and Southern African Office.
- 0110 => EUR/NAT: European and North Atlantic Office.

3.2.5 On the other hand, the last four bits of the second Byte, and the first three bits of the third Byte (7 bits) will be used to identify the States/Territories of each region.

3.2.6 Whereas the last five bits of the third Byte and the eight bits that compose the fourth Byte (13 bits) will be used by each one of the States/Territories to assign addressing to their terminals/servers

3.2.7 The IPv4 address allocation scheme will be able to cover:

- 16 Regions.

- 128 States/Territories by each Region.
- 8190 Host' s for each State/Territory

3.2.8 The IPv4 addressing plan would allow each State/Territory to be able to make use of the block of directions assigned as needed.

- a) Each State has been assigned 8190 usable Network addresses, which seem to be sufficient to cover existing needs.
- b) In the development of the mentioned scheme, a flexible margin has been designated so that it will allow the future growth or change in the network in the future. For example, if a region were subdivided in two or more regions, or the emerging of a new State/Territory.
- c) Argentina has already implemented its ATN network with a scheme of addresses different from the proposed one, prior to the publication of this document, has placed a border devise with the intention that this devise will make the address translation between the outer directions.

3.3.1 Network Assignment for ASIA/PACIFIC

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV								

3.3.2 Network Assignment for USA

Ref	State/Administration	Network	Direction used	Decimal notation	Binary Notation	Region	State/Territory	Host's
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV								

3.4 Using IPv4-Compatible Address Formats

In many instances, you can represent a 32-bit IPv4 address as a 128-bit IPv6 address. The transition mechanism defines the following two formats.

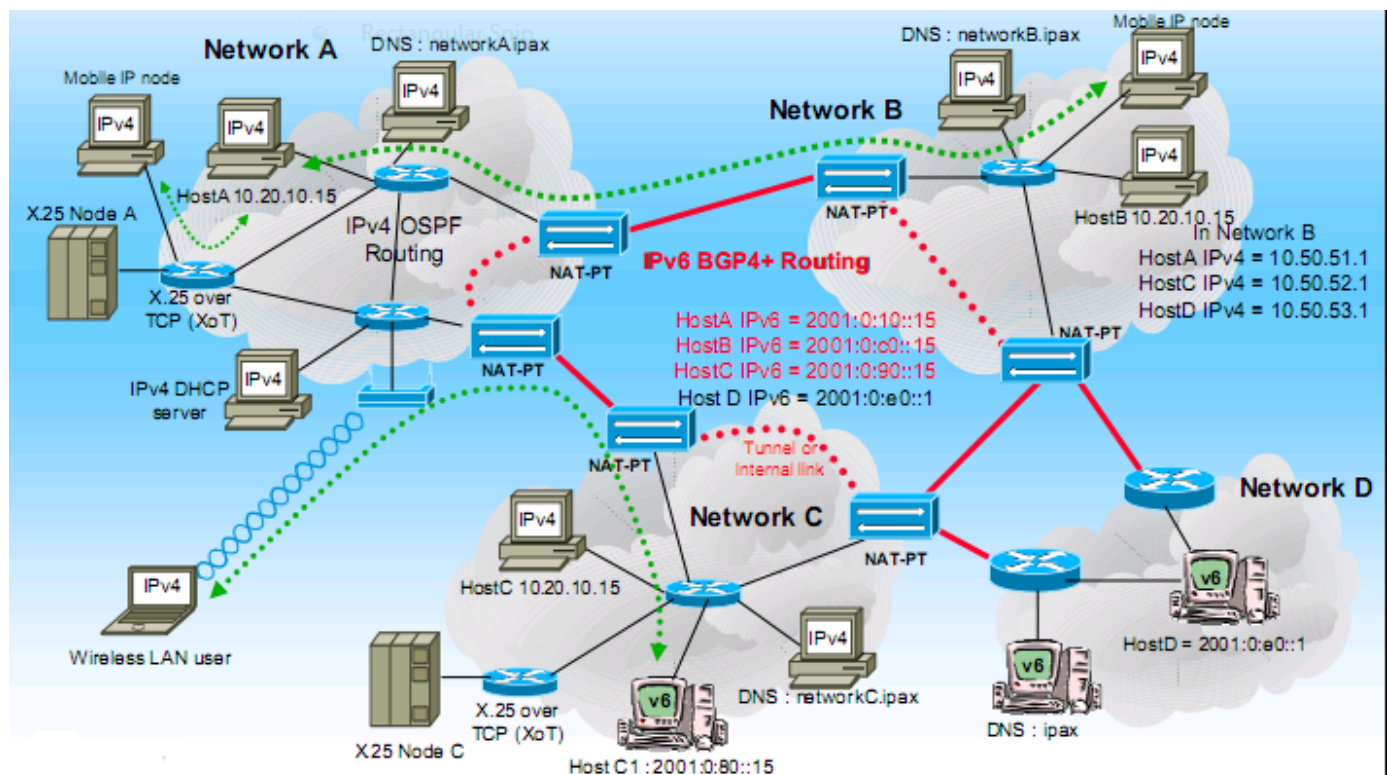
IPv4-compatible address

000 ... 000	IPv4 Address

IPv4-mapped address

000 ... 000	0xffff	IPv4 Address

The mapped address format is used to represent an IPv4 node. The only currently defined use of this address format is part of the socket API. An application can have a common address format for both IPv6 addresses and IPv4 addresses. The common address format can represent an IPv4 address as a 128-bit mapped address. However, IPv4-to-IPv6 protocol translators also allow these addresses to be used.



Appendix B – MID IPv4 Address Plan

Appendix B

No.	State	Network IP Address	Hosts IP addresses			
			Decimal Notation	Binary Notation		
				1 st Byte	Region	State
The information is restricted and can be accessed by New Zealand hosted CRV portal at https://airwayscorporation.sharepoint.com/teams/APAC-CRV/SitePages/Home.aspx or ICAO APAC CRV Secure Portal. If you are an ANSP wishing to connect to another ANSP or consume a service, please email the APAC CRV Portal administrator at vaughan.hickford@airways.co.nz. to get access to New Zealand hosted CRV portal If you are proposing the provision of a service be added to the CRV, please liaise through your sponsoring ANSP. To get access to ICAO Secure portal, please use group Name: CRV						

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
AFGHANISTAN					
AUSTRALIA	ATN tests were conducted. BIS Router and Backbone BIS Router and AMHS implemented. CRV operational since May 2019. AMHS over CRV with: Singapore, New Zealand, Fiji and USA AMHS over leased line with: South Africa Planning to migrate existing AFTN connections over leased line with Indonesia and PNG to AFTN over CRV (2021) prior to upgrading to AMHS over CRV (TBC) Extended AMHS with FTBP in support of IWXXM exchange in operation since Nov. 2020.	Frequentis Comsoft	AFTN/AMHS based AIDC Implemented between Brisbane and Melbourne. For neighbouring ANSP of <u>Brisbane</u>, AIDC implemented with Auckland, Nadi, Oakland, Port Moresby, Ujung Pandang For neighbouring ANSP of <u>Melbourne</u>, AIDC implemented with Johannesburg and Mauritius.		CPL and CDN exchange limited
BANGLADESH	In Q1/2013, Bangladesh installed ATN/AMHS and BIS Router at Dhaka (VGHS) with User Agents at Chittagong (VGEG) and Sylhet (VGSY).	COMSOFT	Tentative date of implementation of AIDC is Q4 of 2023 with Kolkata and Yangon.		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.
BHUTAN	ATN/AMHS circuits, using IP over VPN, with Thailand (Bangkok) and India (Mumbai) commissioned in June and July 2017 respectively.	AEROTHAI’S AMHS System	Currently not applicable. If required in the future, will decide after CRV implementation.		

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	IOT and POT with Mumbai completed on 27 th June 2017. IOT and POT with Thailand completed on 2 nd May 2017. TMC signing with both countries signed.				
BRUNEI DARUSSALAM	ATN BIS Router planned for 2015 and AMHS planned for 2015				
CAMBODIA	BIS Router and AMHS installed. Cambodia (CATS) AMHS connected with Bangkok via VSAT IP link since 10 December 2013	AVITECH	AIDC function and capability made available. Ready for testing with neighbors ATS Facilities starting from 2017 and target date of implementation with Bangkok in 4Q2019	THALES which supports AIDC ICD Version 1.	
CHINA	ATN Router and AMHS including NCC deployed in 2008 which is being upgraded to support ATN/IPS with target date of completion in December 2013. The Beijing-Hong Kong AMHS link was put into operation in 2018; With Thailand was put into operation in Q12020	IN-HOUSE (Aero-Info Technologies Co., Ltd)	AIDC between some of ACCs within China has been implemented. AIDC between several other ACCs are being implemented. AIDC between Sanya and Hong Kong China put into operational use since 8 Feb 2007.	ATN Router and AMHS including NCC deployed in 2008 which is being upgraded to support ATN/IPS with target date of completion in December 2013. The Beijing-Hong Kong AMHS link was put into operation in 2018; With Thailand is completed POT, after sign the TMC circuit and was put into operation in Q12020	IN-HOUSE (Aero-Info Technologies Co., Ltd)

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	AMHS/ATN technical tests with Macau completed in 2009. Plan for ATN/AMHS implementation with Macao China is TBD. ATN/AMHS circuit with ROK has been put into operation since June 2011. ATN/AMHS tests with India has been put into operation since 2016. ATN and AMHS IOT with Mongolia is completed in May 2018. Plan for commissioning after POT completion in 2021 Connection tests with Nepal is TBD. AMHS testing with Japan was completed in March 2021.It will put into operation after TMC is signed. AMHS testing with Russia in 2021.		AIDC between Dalian and Incheon implemented in Nov. 2016; AIDC between Sanya and Hong Kong China put into operational use since Februarv 2007. (duplicate) AIDC between Shanghai/Guangzhou and Tapei China put in to operational use since 2013. AIDC between Dalian and Incheon put into operational use since October 2016. AIDC between Guangzhou and Hong Kong China put into operational use since May 2018. OLDI between Shenyang and Khabarovsk put into operational use since Oct.2019.	AMHS/ATN technical tests with Macau completed in 2009. Plan for ATN/AMHS implementation with Macao China in 2019. ATN/AMHS circuit with ROK has been put into operation since June 2011. ATN/AMHS tests with India has been put into operation since 2016. ATN and AMHS IOT with Mongolia is completed in May 2018. Plan for commissioning after POT completion in 2021 Connection tests with Nepal is TBD. with the Beijing - Japan AMHS link was put into operation in 2020. AMHS testing with Russia in 2021	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			AIDC between Kunming and Vientiane put into pre-operational trails since January 2021. AIDC technical test between Beijing ACC and Ulaanbaatar ACC conducted since 2018. Kunming/Yangon under test and progress since May 2017 AIDC technical test between Sanya ACC and Hanoi ACC conducted since 2019.		
HONG KONG, CHINA	Manila / Philippines CRV/AMHS circuit was put into operation in May 2019. Beijing / China CRV/AMHS circuit was put into operation in April 2021 Macao / China ATN/AMHS circuit was put into operation in December 2009. Wait for Macao to join CRV. Bangkok / Thailand ATN/AMHS circuit was put into operation use in 2014. Wait for Thailand to join CRV. Fukuoka / Japan CRV/AMHS circuit was put into operation in September 2020. HoChiMinh / Vietnam Currently on AFTN. Simple AMHS IOT was conducted in Dec 2019. Wait for Vietnam to join CRV. Taipei CRV/AMHS circuit was put into operation in June 2020.	COMSOFT	AFTN-based AIDC with Sanya put into operational use in Feb 2007. AIDC with Taipei put into operational use in Nov 2012. AIDC with Guangzhou put into operational use in May 2018. AIDC with Manila put in operational use in May 2019.	Raytheon ATM system Support AIDC ICD Version 3 commissioned in November 2016.	Already support exchange of IWXXM messages based on FTBP. Support of IHE is planned since November 2020.

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
MACAO, CHINA	ATN/AMHS interoperability test with Beijing commenced in March 2009. ATN/AMHS circuit with Hong Kong put into operational use in end Dec 2009. Upgrade of ATN/AMHS to support IPS and IWXXM planned with tentative target date of Q3 2021.	COMSOFT	[Not applicable for using AIDC, looking into the possible application between TWR and ACC/APP]		
COOK ISLANDS					
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA	The ATN BIS Router and AMHS planned for in 2011.		With neighboring ACCs to be implemented		
FIJI ISLANDS	ATN BBIS IPS router and AMHS implemented over CRV for connection to USA in April, 2019 with Australia planned for June, 2019. . For connections with sub-regional centers: For New Caledonia using AMHS since 2017; For connection with Kiribati using UA/AMHS implemented in 2015.	COMSOFT	AFTN based AIDC implemented between Nadi/ Brisbane, Auckland and Oakland.	- Support and implemented AIDC messaging: ABI, EST, CPL, CDN, ACP, TOC, AOC with all three centers - AIDC ICD version 2.0 implemented with Auckland and Oakland. - AIDC ICD Version 1.0 implemented with Brisbane	B2B connection between Nadi AMHS and Brisbane AMHS planned for Q3, 2021 as backup for CRV.
FRANCE (French Polynesia Tahiti)	Planned for implementation of AMHS in 2022 (T1). Using IP with New Zealand since 2017.		Implementation of AIDC (based on Version 3) with adjacent centers (Oakland and Auckland) since 2009.	THALES EUROCAT for AIDC	Alternate routing for backup between Tahiti and Christchurch via Tahiti/New Caledonia IP link
INDIA	Dual stack ATN/IP router and AMHS implemented at Mumbai in 2011.	COMSOFT	Initially-15-May-2017, AIDC implemented between Chennai and Kuala Lumpur with ABI and EST messages. India is currently using APAC AIDC ICD version 3.	Mumbai: Raytheon Auto track-III Chennai- Raytheon Auto track-III +	INDIA

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	Operational AMHS connections with Bangkok, Dhaka, Singapore, Kathmandu, Karachi implemented. With Beijing implemented in 2016; With Colombo implemented in May2017; With Bhutan implemented in July 2017; (IOT/POT) between Mumbai – Muscat is scheduled with mutual agreement between India & Oman between 0600-0900 UTC from 21.06.2021 onwards. IOT with Nairobi in September 2020 failed due to compatibility issues noticed at Nairobi, which has Thales system, Messages from Mumbai did not go out of the transmit queue. System software level compatibility problems need to be resolved by Nairobi taking the OEMs on board.		A. Implementation within India: Testing & trials: I. At Delhi with: Ahmedabad, Varanasi, Nagpur II. At Chennai with: Mumbai, Kolkata, Trivandrum, Mangalore, Trichy, Hyderabad, Bengaluru III. At Kolkata with: Chennai, Nagpur, Varanasi, Guwahati IV. At Mumbai with: Chennai, Ahmedabad, Nagpur Operational: Chennai- Mumbai; Delhi-Nagpur; Delhi-Ahmedabad, Functional: Delhi-Varanasi, LOA to be signed shortly.	Delhi: INDRA Aircon Kolkata: INDRA Aircon Bengaluru: SELEX Hyderabad: SELEX Ahmedabad: INDRA Aircon 2100 Nagpur: INDRA Aircon 2100 Varanasi: INDRA Aircon 2100 Guwahati: INDRA Aircon 2100 Trivandrum: INDRA Aircon 2100 Mangalore: INDRA Aircon 2100 Trichy: INDRA Aircon 2100 All these systems follow APAC AIDC ICD Ver 3.0 of 2007	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			B: Implementation with Neighboring States: The status on AIDC implementation with following ATSUs of neighboring FIRs is as under: I. Chennai & Kuala Lumpur (Malaysia) – ABI, EST successful. CDN is done with voice confirmation. TOC/AOC is implemented w.e.f. 1st Jan 2021. LOA signed on 26th May 2021 effective from 1st June 2021. II. Chennai & Male (Maldives) – Trails have been successful. LOA in process. Safety Assessment conducted on 9th April 2021 for implementation III. Chennai & Colombo (Sri Lanka) - Colombo in process to address the syntax errors in ABI. Thereafter, trails will be conducted. LOA in progress. IV. Chennai & Yangon (Myanmar) – Trials commenced in January 2018. Issues of incorrect reference number in Counter CDN from Yangon persists. Yangon has intimated that, they will inform Chennai for conducting the Test, as soon as they are ready V. Mumbai & Male (Maldives) – Safety Assessment conducted on 9th April 2021 for implementation. Final LOA to be signed shortly. VI. Mumbai & Mogadishu - Successful trials conducted in March 2021. Minor adaptation system issues with Mogadishu automation system identified. Resolution awaited from Mogadishu.		

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			VII. Mumbai & Muscat - Successful trials conducted in March 2021. System issues with Muscat's automation system identified. Resolution awaited from Muscat ATCAS vendor VIII. Ahmedabad & Karachi (Pakistan) – Automatic message exchange (e.g. ABI, EST) happens for most of the East bound flights between Karachi & Ahmedabad. Karachi Automation system not generating auto ACP message in response of EST messages. Pakistan is currently doing technical trials between Lahore and Delhi ACCs in first phase. Pakistan will take up test trials between Karachi and Mumbai & Karachi and Ahmedabad in second and third phase respectively. IX. Delhi & Lahore (Pakistan)- Under test trails. During the first test trials during the March'2021 it was identified that Lahore Automation system not generating automatic ACP messages. Also Delhi system is rejecting the AIDC messages because of the extra space in messages from Lahore. X. Kolkata & Yangon (Myanmar) – Initial trials were conducted in Q4 of 2018 in which some ABI and message reference errors were encountered. Vendor at both ends modified the software and issues were mitigated. In the next trials in Q1 of 2020 most message exchanges were successful. LOA to be negotiated and signed. C. Under Planning		

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			I. To conduct operational trials between Kolkata-Dhaka, Mumbai-Karachi (Pakistan), Chennai-Jakarta and Varanasi-Kathmandu subject to readiness from the concerned states. D. Seychelles and Sana ATSU do not have a compatible ATM Automation system in place for AIDC coordination with Mumbai ATSU E. Delhi – Karachi: AIDC between Delhi & Karachi will not be required due to re-structuring of FIRs		
INDONESIA	ATN BIS Router and AMHS with Singapore implemented since February 2018; AMHS Trial (IOT) with Brisbane pending for CRV implementation.	IDS	AIDC implementation in Ujung Pandang ACC conducted as follows: 1) Ujung Pandang ACC –Brisbane ACC: Implemented since July 2017. 2) Ujung Pandang ACC – Manila ACC: Implemented since 4Q 2020; 3) Ujung Pandang ACC – Kota Kinabalu ACC: - Successfully tested and target date for operational trial in 4Q2020; - Target date for implementation 4Q2021. 4) Ujung Pandang ACC – Oakland ARTCC:	Thales TopSky in Makassar able to support ICD version 3 since December 2015.	For CRV, target of contract in 3Q2021 and implementation in 4Q2021.

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			- Successfully tested and target date for implementation in 4Q2021. 5) Ujung Pandang ACC – Port Moresby ACC; - Successfully tested on 7 July 2020; - Target date for operational trial in 3Q2020. - Target date for implementation 2Q2021. 6) Ujung Pandang ACC – Jakarta ACC; - Target date for operational trial in 3Q2021. - Target date for implementation 4Q2021; AIDC implementation in Jakarta ACC will be carried out with the following priorities: 1) Jakarta – Ujung Pandang (4Q2021); 2) Jakarta – Chennai (2Q2022); 3) Jakarta – Melbourne (3Q2022); 4) Jakarta – Colombo (4Q2022); 5) Jakarta – Singapore (2Q2023); 6) Jakarta - Kuala Lumpur (3Q2023); 7) Jakarta – Kota Kinabalu (4Q2023).		Priority is in accordance with Hot Spot identified by RASMAG/23
JAPAN	ATN BBIS router and AMHS installed at USA in 2000. Connection tests with USA in 2000 - 2004 and put into operational use in 2005. ATN BBIS router (to apply to Dual Stack) and AMHS (to upgrade in 2015. The connection test with each country which is not currently connecting is started after update.	NEC	AIDC implemented between Fukuoka ATMC and Oakland ARTCC in 1998. AIDC implemented between Fukuoka ATMC and Anchorage ARTCC in 2005.		Japan and USA conducting testing AIDC over AMHS and cutover date is 5 May 2017.

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	Hong-Kong AMHS/FTBP over CRV was put into operation in September 2020. Singapore AMHS/FTBP over CRV was put into operation in December 2020. Beijing/China AMHS/FTBP over CRV test was all completed in March 2021. It will put into operation after TMC is signed Taipei Plan for AMHS/FTBP over CRV IOT in July 2021 POT in 1Q 2022 Incheon/Korea Plan for AMHS/FTBP over CRV IOT in 4Q 2021		AIDC implemented between Tokyo ACC/Fukuoka ACC and Incheon ACC in 2010. Implemented between Fukuoka and Incheon since June 2009. AIDC implemented between Fukuoka ACC/Naha ACC and Taipei ACC implemented. AIDC between Fukuoka ACC and Shanghai ACC under negotiation.		
KIRIBATI	Connection with Nadi using UA/AMHS implemented in 2015.				

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
LAO PDR	- ATN BIS Router and AMHS Implemented with Bangkok and Phnom Penh. - AFTN used with Hanoi and Kunming. - For Yangon we have no direct link the connection is used via Bangkok.	THALES	- Vientiane ACC AIDC used for coordination between Bangkok and Phnom Penh ACCs since 2020. - Operation trials are on going with Kunming, Hanoi and Yangon ACCs.	THALES which is able to support ICD Version 2	
MALAYSIA	ATN BIS Router completed 2007. AMHS for Malaysia – Singapore implemented in March 2020. AMHS for Malaysia – Thailand implemented in Dec 2019.	FREQUENTIS	<u>Kuala Lumpur ACC and Bangkok ACC</u> AIDC technical test between Kuala Lumpur ACC and Bangkok ACC conducted since November 2016 (ABI/EST/ACP/LAM/LRM/CDN/REJ/TOC/AOC). The operational trial commenced in August 2019 (EST/ACP/LAM/ LRM). The operational implementation commenced on 14th March 2020 (EST/ ACP/LAM/LRM). <u>Kuala Lumpur ACC and Chennai OCC</u> AIDC technical test between Kuala Lumpur ACC and Chennai OCC conducted since 31st July 2013. The operational trial implemented in phases from September 2016 (ABI/EST/MAC/LAM/LRM/ACP). Review on the CDN message implementation conducted in August 2017. SOP signed 26 April, 2017. The MOU signed on March 2020. The operational implementation commenced on 1st April 2020 (ABI/EST/ ACP/LAM/LRM/CDN/REJ/MAC).	SELEX which is able to support ICD Version 3.	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			The operational trial for TOC/AOC started on 1st July until 1st August 2020. The operational implementation for TOC/AOC commenced on 1st January 2021. The updated LOA signed on 26th May 2021. <u>Kuala Lumpur ACC and Singapore ACC</u> AIDC technical test between Kuala Lumpur ACC and Singapore ACC conducted since April 2015 (ABI/EST/ACP/LAM/LRM/CDN/REJ). The operational trial started on September 2018 (EST/ACP/LAM/ LRM). The operational implementation commenced on 1st November 2019 (EST/ACP/LAM/LRM). <u>Kuala Lumpur ACC and Ho Chi Minh ACC</u> AIDC technical test between Kuala Lumpur ACC and Ho Chi Minh ACC To Be Discussed (TBD). <u>Kuala Lumpur ACC and Jakarta ACC</u> AIDC technical test between Kuala Lumpur ACC and Jakarta ACC TBD. <u>Kota Kinabalu ACC and Manila ACC</u> AIDC Technical Test 1 between Kota Kinabalu ACC and Manila ACC started on 21 – 22nd May 2019 (ABI / EST / ACP / LAM / LRM / TOC / AOC / MAC). Technical Test 2 was conducted on 21 – 22nd October 2019 (ABI / EST / ACP / LAM / LRM / TOC / AOC / MAC). Upcoming AIDC Technical Test between Kota Kinabalu ACC and Manila ACC to be conducted in Q32021 <u>Kota Kinabalu ACC and Ujung Pandang ACC</u>		

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			AIDC Technical Test 1 between Kota Kinabalu ACC and Ujung Pandang ACC started on 7 – 8th August 2019 (ABI / EST / ACP / CDN / LAM / LRM / REJ / MAC). Technical Test 2 was conducted on 23 – 24th October 2019 (ABI / EST / ACP / LAM / LRM / TOC / AOC / MAC). Technical Test 3 was conducted on 11th March 2020 (EST / ACP / LAM / LRM). Upcoming AIDC Technical Test between Kota Kinabalu ACC and Ujung Pandang ACC to be conducted in Q32021 <u>Kota Kinabalu ACC and Jakarta ACC</u> AIDC Technical Test between Kota Kinabalu ACC with Jakarta ACC is to be discussed. <u>Kota Kinabalu ACC and Singapore ACC</u> AIDC Technical Test between Kota Kinabalu ACC and Singapore ACC started on 22nd September 2015 (ABI / EST / ACP / CDN / LAM / LRM / REJ / MAC). AIDC Technical Test 1 was conducted on 18 – 19th November 2019 (ABI / EST / ACP / CDN / LAM / LRM / REJ / MAC). Technical Test 2 was conducted on 16th January 2020 (EST / ACP / LAM / LRM). AIDC Operational Trial started since 16th November 2020 and to be extended until 30th June 2021. Agreement on Operational Implementation has been materialized on 3rd June 2021. Operational Implementation is agreed to be conducted on 1st July 2021 (EST / ACP / LAM / LRM) <u>Kuching ACC and Singapore ACC</u>		

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			AIDC Technical Test (First and Second) between Kuching ACC and Singapore ACC was conducted both on 11 November 2015 and 24-25 November 2015 (ABI, EST, LAM, CDN, ACP, REJ, and LRM). However, it was discontinued until November 2019 The AIDC Technical Test (Third and Fourth) was conducted both on 20-21 November 2019 and 14 January 2020 (ABI, EST, LAM, CDN, ACP, REJ, and LRM) AIDC Operational Trial was started on 20 July until 18 October 2020. Then it was continuing until 31 January 2021. Agreement on Operational Implementation has been materialized on 12 January 2021 via videoconference. The operational implementation was on 1 February 2021. The AIDC messages included for exchange are EST, LAM, LRM and ACP. <u>Kuching ACC and Jakarta ACC</u> AIDC between Kuching ACC and Jakarta ACC TBD.		
MALDIVES	In the process of replacing the existing operational AFTN system by AMHS. It is expected to complete the installation before the end of 2019. With the new AMHS, it is planned to establish a new IP connection between an additional neighboring ATSU as the current link is an X.25 connection between Colombo.		Connection established with all the adjacent ATSUs. Interoperability tests successfully completed in 2017.	SELEX which is able to support ICD Version 3.	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	Also will look for the possibility of implementing the CRV network to use with AMHS and AIDC during the same phase.		LOA signed for operational trials between Mumbai, Chennai, and Trivandrum. Operational trials were also successful with these ATSUs, while several issues were resolved from both ends. Ready to sign LOA with Melbourne and is expected during the 2nd quarter of 2019. Trials with Colombo had few issues, which Colombo is working to resolve it on their end with the automation system supplier. Connections between all 5 ATSUs are turned ON in the ATS automation system to conduct pre-notified operational trials.		
MARSHALL ISLANDS					
MICRONESIA (EDERATED STATES OF)					
Chuuk Kosrae Pohnpei Yap					
MONGOLIA	AMHS/AFTN gateway implemented 2012. ATNBIS router implemented in 2014. ATN and AMHS IOT with China was completed in May 2018. Plan for commissioning after POT completion in 2019.	COMSOFT	ATM automation system supports both AIDC and OLDI. Coordinating with Russia on OLDI connection in target date 2016. Coordinating with China on AIDC connection between Beijing/Ulaanbaatar technical trials in progress.	INDRA Aircon 2100 supporting AIDC ICD Version 2.	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
			Planned date of testing in 2019.		
MYANMAR	AMHS including AFTN/AMHS gateway implemented in Nov 2011. Connection with Thailand implemented in 4Q2016. Planned for AMHS connection with Beijing. Target date TBC.	THALES	AIDC connection pre- operation test with Thailand conducted in 4Q2017 and Target date of implementation 4Q2020; AIDC testing with Chennai, Kolkata and Vientiane conducted in 2020. Myanmar improved ATS Surveillance Coverage at coordination point with China and will start AIDC test again with Kunming ACC in 2020.	THALES Automation system (Topsky ATC) supports APAC AIDC ICD Ver. 2.	AMHS including AFTN/AMHS gateway implemented in Nov 2011. Connection with Thailand implemented in 4Q2016. Planned for AMHS connection with Beijing. Target date TBC.
NAURU					
NEPAL	AFTN/AMHS Gateway implemented in 2012. AMHS implemented with India since June 2014. AFTN connection with China. Plan to test AMHS connection soon.	COMSOFT	Nepal uses custom built ATM system from NEC. Some issues regarding ICD need to be resolved in order to proceed ahead with AIDC testing with India and China.		
NEW CALEDONIA	New router and AMHS commissioned December 2016	COMSOFT			
NEW ZEALAND	AMHS connection with the USA over CRV was implemented in April 2019. AMHS connection to Australia over CRV is scheduled for June 2019.	COMSOFT	AIDC implemented between New Zealand, Australia, Fiji, Tahiti, Chile and USA.	Supported the Basic 5 message set. ATM systems are LEIDOS and ADACEL	
PAKISTAN	ATN/AMHS connections with Mumbai and Kuwait since 2015 and 2018 respectively.	Existing COMSOFT	Implemented between Karachi and Lahore ACCs. Lahore/Delhi ACC AIDC trials are being carried out which started in March 2021 (Phase-1), Karachi/Mumbai & Karachi/Ahmedabad are planned in Phase-2.	ATM system from Indra AIRCON 2100 version-2 in Lahore and Karachi ACC, Si-ATM version-3 in Islamabad ACC	Existing ATM system are likely to be upgraded in Lahore and Karachi ACC.

State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	AMHS connection with Beijing, Kabul, Tehran and Muscat will be provided after up gradation of existing AMHS at Karachi which is already in progress.	After up gradation ISD	After modification of Lahore/Karachi FIRs boundaries, trials between Karachi/Delhi ACC are not required.		
PAPUA NEW GUINEA	Currently AFTN over IP. AMHS implementation is planned for after successful implementation of CRV this year. AMHS implementation planned for 2020.	COMSOFT is the supplier of PNG AFTN/AMHS system	AIDC using AFTN operational with Australia, testing/trial with Oakland (USA) started late last year and in progress. AIDC implementation with Indonesia to happen after CRV implementation this year.	New ATM System from Thales (TopSky-ATC) implemented and operational now supports AIDC V3.	
PHILIPPINES	ATN/AMHS Boundary Intermediate System was installed at the new Manila CNS/ATM Center; - Site Acceptance, Oct. 2015 - Commissioned & operational, March 2018 AMHS implementation over CRV with; HONG KONG - May 2019 TAIPEI - Sept. 2019	Frequentis - Comsoft	AIDC implementation status/update over AMHS with the following FIR's; HONG KONG – Implemented, May 2019 SINGAPORE – Implemented, December 2020 TAIPEI – Implemented, December 2019	THALES which is able to support ICD Version 2.	The New ATN/AMHS of Manila CNS/ATM center has been in domestic operations since March 2018. And with the implementation of CRV, AMHS connection has been implemented with the following adjacent FIR's; -HONG KONG -TAIPEI -SINGAPORE

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	SINGAPORE - Dec. 2020 OAKLAND - April 2021		UJUNG PANDANG – Implemented, December 2020 via BBIS HO CHI MINH – Awaiting OPS trial. Technical Test conducted on June 15-16, 2021. KOTA KINABALU – Next progress AIDC test to be scheduled, target 3Q2021 OAKLAND – 1st test to be scheduled, target 3Q2021		-OAKLAND
REPUBLIC OF KOREA	Plan to upgrade AMHS support IWXXM from 2023 over CRV Frequentice 1) AMHS/CRV IOT with China and Japan in 4Q of 2021 2) AMHS/CRV POT with China and Japan in 4Q 2022 3) Cutover to AMHS/CRV with Chi na and Japan in Q1 2023 after POT 4) Implementation of AMHS/CRV with Japan Q1 2023	FREQUENTIS	AIDC implemented between ACC and Fukuoka ATMC in 2010 AIDC between Incheon and Dalian implemented in Nov. 2016.	Rockheed Martin System	
SINGAPORE	AMHS implemented with: 1) AMHS circuit with India put into operational use in Mar 2011.	FREQUENTIS COMSOFT	1) Operational with Ho Chi Minh implemented Jul 2014. 2) Kuala Lumpur operational trial started since Sep 2018 and is implemented Nov 2019.	THALES supports ICD Version 3 since December 2018	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	2) AMHS circuit with UK put into operational use in Mar 2012. 3) AMHS circuit with Thailand put into operational use in Dec 2014. 4) AMHS circuit with Australia put into operational use in Oct 2016. 5) AMHS circuit with Indonesia put into operational use in Feb 2018. 6) AMHS circuit with Malaysia put into operational in Mar 2020. 7) AMHS circuit with Japan put into operational in Dec 2020. 8) AMHS circuit with Philippines put into operational in Dec 2020. Inter-Operability Test (IOT) with Vietnam started in 2019. IOT with Sri Lanka, Bahrain and Brunei to be confirmed.		3) Implemented with Kuching ATCC in Feb 2021. 4) Operational trial ongoing with Kota Kinabalu ATCC since Nov 2020 and implementation date on 1st July 2021. 5) Manila operational trial started in Feb 2019. Implementation Nov 2019. 6) Technical trials with Jakarta ACC will be initiated once the Jakarta ACC ATMS renewal is completed.		
SRI LANKA	ATN BIS Router Planned for 2013. IP based AMHS implemented by Oct. 2017. - Mumbai tested May 2017 operational planned for Q4 2017;	IDS	Trials with Male planned for in 3Q2019.	INTELCAN which is able to support ICD Version 3.	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	- Singapore testing in Q4 2017 operational for 2018; - Male testing and operational date TBD.		Trial with Chennai on-going. Plan for implementation in 2018 and with Melbourne plan for 1Q2018.		
THAILAND	BBIS/BIS Routers already implemented. Connection with Bangladesh, Bhutan, Cambodia, China, India, Lao PDR, Myanmar, Singapore, Hong Kong China, and Malaysia implemented. Bangkok -Viet Nam Circuit ☐ IOT Test: Done ☐ POT Test: Planned for end of 3Q2021 Bangkok - Rome Circuit ☐ IOT Test: Planned for 3Q2021 Connection with SITA (SITA AMHS Gateway inter-connections) implemented. ☐ POT Test: Planned for end of 4Q2021	AEROTHAI's AMHS System	The implementation with ☐ Lao PDR has done since 14th July 2020 ☐ Cambodia has done on 22nd feb 2021 In addition, it is planned to implement AIDC with Myanmar.	THALES which supports AIDC feature APAC AIDC ICD V.3	
TONGA	AMHS planned for 2008. The provider is linked to the New Zealand AFTN				CPDLC and ADS-C is not considered for lower airspace
UNITED STATES	- Australia - Fiji - New Zealand	IN-HOUSE	- Fiji, Japan, New Zealand - Tahiti (via New Zealand),	IN-HOUSE which is able to support APAC and NAT ICDs currently Version 2.	

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State/Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AMHS Vendors Selected	AIDC	ATM System selected to support AIDC and Associated ICD (Implementation Status of the Basic 5 message set supported)	Remarks
	- Japan - Philippines - Papua New Guinea (2021) - Indonesia (2022) - Russia (Planned)		- Papua New Guinea via Australia (Direct planned for 2021) - Philippines (2021) - Indonesia via Australia (Direct planned for 2022) - Russian Federation (pending joining CRV)		
VANUATU					
VIET NAM	AMHS (basic) implemented from 4Q/2018. Plan AMHS extended from Q4 2022 IOT with Singapore from 10/2019 to 8/2020 IOT with Hong Kong 12/2019 IOT with Thailand 6/2020, POT 8/2020.	IN-HOUSE	Operational between Ho Chi Minh and Singapore since July 2014. Operational trial for additional messages sets on-going. Technical testing between Ho Chi Minh with Philippines on going Technical testing with Cambodia already done; Technical testing between Hanoi and Vientiane, Lao. PDR-already done with Malaysia TBC For operation trial TBC. Operation trial between Ho Chi Minh and Hanoi ongoing.	Support ICD Version 1.0 with THALES at Ho Chi Minh ATM system. Support ICD Version 3.0 with Selex at Hanoi ATM System.	
Wallis and Futuna (FRANCE)	AMHS implementation planned for end of 2017			COMSOFT	

CRV IMPLEMENTATION TABLE

State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
Australia	Contract in May2018 and service readiness in 3Q 2018	AFTN, ADS-B, AMHS, Voice With: Australia February,2019(AMHS/AIDC), March,2019(Voice) Fiji March,2019 (AMHS June 2019/AIDC, Voice completed April) New Zealand , February, 2019 (AMHS June 2019, AFTN May 2019/AIDC), March, 2019 (Voice April 2019 completed) Indonesia 4Q2019 (TBC) (AMHS/AIDC, Voice, ADS-B); PNG 4Q2019(TBC), (AMHS/AIDC, Voice) Singapore 2Q2019 TBC (AMHS/AIDC, Voice); South Africa TBC 3Q2019 TBC (AMHS/AIDC, Voice); Japan would be end of 2019.	staged approach	Termination of current COM contract
Bhutan	Contract signed on Oct 2019. CRV installed successfully in Dec 2021. CRV P2P Test between Paro-Mumbai & Paro- Bangkok to be done once India and Thailand join CRV	AMHS first and Voice & ADS-B will follow up after AMHS.		Dependent on India and Thailand for utilization of CRV network.

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
Cambodia	As early as convenient, dependent on neighboring countries			Internal decision making
China	Contract signed on 21 June 2020.	Applications targeted: Data(AMHS) With: Hong Kong 3Q2020; Japan 4Q2020; Thailand TBD; India TBD. Republic of Korea 4Q2020 ATFM test with Japan and ROK at Sep 2020 over CRV	staged approach	
Democratic People's Republic of Korea	Contract in 3Q2018 and service readiness in 4Q2018	AFTN and VoIP		
Hong Kong, China	Contract signed on 6 April 2018. Connection was installed successfully in June 2018.	With Manila CRV-Voice put into operation in August 2018 CRV-AMHS put into operation in May 2019 With Taipei CRV-AMHS put into operation in May 2020 With Fukuoka CRV-AMHS put into operation in September 2020 With Beijing CRV - AMHS POT in March and operation in April 2021	staged approach	Need to coordinate with relevant CAAs/ANSPs in joining CRV in a harmonized manner, etc.

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
		Bangkok and Hochiminh Subject to their readiness		
Macao, China	Service readiness in Q4 2021	To be confirmed	Staged approach	Migration from X.25 to IPS
Fiji	Contract in May 2018 and service readiness in 3Q 2018.	Data (AMHS) and VoIP With: Australia ATS voice April 2019 completed, AMHS completed in July 2019, NZ ATS voice completed April 2019 and USA ATS voice completed in March 2019 and AMHS completed in April 2019.	Staged approach	CBA, safety case
France (New Caledonia and French Polynesia)	2023 is target for DNSA to sign contract subject to internal security assessment (done).	ATS Voice, AMHS with Fiji & AIDC, AMHS with USA, AIDC/AMHS with NZ.		CBA, cost must be affordable <i>Wallis and Futuna: no dedicated connection to CRV</i>
India	Contract for CRV implementation with M/s PCCW in India will be signed in 3Q of 2021 and CRV Service will be ready in 4Q of 2021.	AFTN/AMHS, ADS-B, AIDC, ATS Voice	staged approach	Internal Administrative approvals & safety case

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
Indonesia	Contract in 3Q2021 and service readiness in 4Q2021.	AFTN, AMHS, ADS-B and voice		CBA completed
Japan	Contract signed in Nov.2017 and service readiness in 1Q 2018 for Fukuoka	Data first with: Hong Kong completed 3Q2020 USA completed 1Q2019 Singapore completed 4Q2020 China completed 1Q2021 Voice Plan with: USA 2Q2021 Daegu and Incheon (R.O.K) started in 1Q2021	staged approach	
Malaysia	Contract to be signed 4Q 2020 and service readiness in 1Q 2021	AFTN, AMHS, ADS-B and ATS voice	staged approach	New ATC centre operational in 2021 Contract issue with the new ATC main contractor. COM Project is part of the main contract.
Myanmar	Contract will be signed 4Q2020.	AFTN/AMHS, AIDC, ADS-B and voice	staged approach	One of counterparts join in
Nepal	Nepal intends to join CRV on staged approach with AMHS data connectivity as first priority and intends to sign the contract with PCCW within 2020.			

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
New Zealand	Contract signed in July 2018 and service implemented December 2018	Australia Voice Completed March 2019 and AMHS June 2019 Completed USA Voice Completed March 2019 and AMHS March 2019 Completed Fiji Voice Completed April 2019 French Polynesia AMHS and Voice Chile AMHS (SAM regional network REDDIG)	Awaiting French Polynesia joining. Awaiting outcome of inter-regional network connectivity discussion. For Chile	CBA attractive if all counterparts join in.
Philippines	Contract signed in March 2018 and service readiness in 2Q2018	Completed: with HONG KONG AIDC - 2Q2019; AMHS - 2Q2019; Voice - 3Q2018. with TAIPEI AIDC 4Q2019; AMHS 3Q2019; Voice 1Q 2019. with SINGAPORE AIDC – 4Q2019; AMHS –4Q2020; Voice – 1Q2020. with USA AMHS – 2Q2021; Voice – 4Q2019;	staged approach	Success transition to the New ATM centre in 4Q2018

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
		with INDONESIA AIDC – 4Q2020.		
Republic of Korea	Contract in 3Q 2019 and service readiness in 4Q 2019	Completed: with Japan Voice –March 2021 Planned; With Japan Voice additional lines-from 2022 to 2023 AMHS-4Q 2022 With China Data(AMHS)-4Q 2022	staged approach	
Singapore	Contract signed in May 2019 and service readiness in Dec 2019	Data (AMHS over IP) with: Australia Dec 2020 (completed); Japan Nov 2020 (completed); and Philippines Dec 2020 (completed);and Malaysia Q3 2021. Voice with: Philippines Mar 2020 (completed).	Staged approach	Singapore
Sri Lanka	As soon as CRV is available	AMHS connectivity with Mumbai, Singapore and Male. Direct Speech facilities with Chennai, Trivendrum, Mumbai, Male, Jakarta, Melbourne, Singapore	Phased approach with the implementation of CRV	CBA

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State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
Thailand	Contract in 3Q2021 and service readiness in 1Q2022	Data first Then voice, subject to safety case: China 1Q2022 Hong Kong 1Q2022; Singapore 1Q2022; India 2022.	Staged approach	
United States	Contract in January 2018	1) AMHS with Australia Fiji Japan Philippines New Zealand Papua New Guinea (2021) Indonesia (2022) 2) AIDC with Fiji Japan New Zealand Papua New Guinea (Direct planned 2021) Tahiti (via New Zealand) Indonesia (Direct planned 2022) Russia (when join CRV) 3) VoIP with Fiji Japan Philippines New Zealand Papua New Guinea (direct planned 2021) Indonesia (2022) Russia (when join CRV)	Staged approach	

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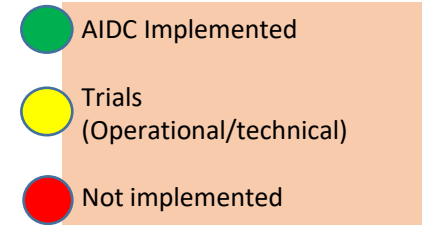
State/ Administration	Intended date for CRV cut-over	Applications targeted	Migration scheme	Prerequisites/ dependencies
Viet Nam	To be confirmed later (After discussed with PCCW Global)			

AMHS Readiness Report for Supporting IWXXM Traffic					
No.	States/Administration	Name of State (Administration)/name of BBIS/BIS location where AMHS is installed:	AFTN/AMHS transition date/schedule	Readiness Status of AMHS for supporting File Transfer Body Part (FTBP), the Interpersonal Message (IPM) Heading Extension (IHE) to support for exchanging IWXXM reports of a maximum size of 4MB and FTBP of maximum 2MB:	Capacity status of the operational AFS links to support the exchange of the required meteorological information in both IWXXM GML form and TAC form:
1	Australia	Airservices - Brisbane	Completed. AMHS exchange in place with USA, Fiji, New Zealand, Singapore and South Africa. AFTN still in place with Indonesia and PNG, migration to AMHS based on pending readiness both partners Several Pacific island nations connecting via FCO CADAS ATS Terminal, currently over AFTN. Airservices plans to migrate to AMHS P3 CADAS but will need to provide user training. All domestic users and data originators still on AFTN, no desire by external partners to migrate to AMHS, awaiting SWIM instead.	Full compliance and support since Nov 2020	Airservices has contracted a 2.0Mbps bandwidth using CRV Package C+ for Voice & AMHS services. Bandwidth on the leased line with South Africa / Johannesburg is also 2Mbps.
2	China	Beijing	AMHS deployed in 2008 which was upgraded to support ATN/IPS in 2013 and upgraded to support exchanging IWXXM in 2020.	support	CRV bandwidth is 3M. Minimally 64kbps for each AMHS connection..
3	Hong Kong China	Hong Kong China	December 2009	Support	2MB for CRV and 64kbps for IPLCs
4	Fiji	Fiji Airport/Air Traffic Management Centre	Completed. In June 2019, Fiji completed the transition of ATN BBIS to IPS for the AMHS service from Nadi to Salt Lake, USA & Brisbane, Australia over the CRV network. The local end User still operates on AFTN terminal and is converted to AMHS over the AFTN/AMHS Gateway.	The Comsoft AMHS System supports File Transfer Body Part (FTBP). Our system has the capability of exchanging IWXXM reports of a maximum size of 4MB and FTBP of maximum.	Nadi has contracted a 1.0Mbps bandwidth using CRV Package C+ for Voice & AMHS services. The total bandwidth usage for voice and data is 768K from the total 1.0Mbps. The bandwidth for AMHS is 64Kbps each to Brisbane & Salt Lake Center. It is noted in the ACSICG/7 WP04 presented by USA that 64Kbps is the minimum recommended required bandwidth for AMHS to exchange FTBP for IWXXM.
5	India	AAI/Mumbai Airport	AMHS is in operation since 2011. India is in the process of tendering for replacement of existing AMHS system . The Tender action stands delayed due to COVID pandemic.	Presently India is not able to exchange the required 4 MB messages and 2 MB FTBP attachments.	Indian Meteorological Department is in the process of upgradation of HPC & DB to support IWXXM.

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No.	States/Administration	Name of State (Administration)/name of BBIS/BIS location where AMHS is installed:	AFTN/AMHS transition date/schedule	Readiness Status of AMHS for supporting File Transfer Body Part (FTBP), the Interpersonal Message (IPM) Heading Extension (IHE) to support for exchanging IWXXM reports of a maximum size of 4MB and FTBP of maximum 2MB:	Capacity status of the operational AFS links to support the exchange of the required meteorological information in both IWXXM GML form and TAC form:
6	Japan	Japan/Fukuoka	ATN BBIS router and AMHS installed at 2000. Connection tests with USA 2000 - 2004 and put into operational use in 2005 and over CRV in February 2019. Put into AMHS operation with Hong- Kong and Singapore in 2021. AMHS implementation with China in 2021 , Korea and Taipei in 2022.	Already support exchange of IWXXM messages based on FTBP in August 2015. It is possible to send , receive and transfer up to 2GB for the contents such as FTBP,IPM and IHE in AMHS,and the size of IWXXM suported system by Japan Meteorological Agency is 2MB	AFS links over CRV is a Package A, Bandwidth 2M.
7	Macao China	Macao China	Q4/2009	Q3/2021	To be determined
8	Philippines	Philippines/ATMC Manila	Completed March 2018	Can support IHE and FTBP maximum 1MB (tested with Taipei on 13-May-20)	1MB Philippines has contracted 2Mbps bandwidth using CRV package "A" voice and data services.
9	Republic of Korea	Gimpo international airport	ATN/AMHS with China put into operational use in June, 2011. AMHS implementation with China and Japan over CRV will be in 4Q, 2022.	AMHS implementation for supporting FTBP and IHE will be in 4Q, 2022.	AFS links over CRV is a Package A, Bandwidth 2M.
10	Singapore	Singapore	March 2011	Yes	2MB for CRV and minimally 64kbps for IPLCs
11	Thailand	Thailand	BBIS/BIS Routers already implemented. AMHS has been implemented since July 2011. Connection with Bangladesh, Bhutan, Cambodia, China, India, Lao PDR, Myanmar, Singapore, Hong Kong China, and Malaysia implemented. Connection with SITA (SITA AMHS Gateway inter-connections) implemented. Bangkok - Vietnam Circuit IOT Test : Done POT Test: Planned for end of 3Q2021 Bangkok - Rome Circuit IOT Test: Planned for 3Q2021 POT Test: Planned for 4Q2021	Completed, the IWXXM exchange has been implemented since November 2020.	The capacity of links readied to support in both form.

No.	States/Administration	Name of State (Administration)/name of BBIS/BIS location where AMHS is installed:	AFTN/AMHS transition date/schedule	Readiness Status of AMHS for supporting File Transfer Body Part (FTBP), the Interpersonal Message (IPM) Heading Extension (IHE) to support for exchanging IWXXM reports of a maximum size of 4MB and FTBP of maximum 2MB:	Capacity status of the operational AFS links to support the exchange of the required meteorological information in both IWXXM GML form and TAC form:
12	USA	Federal Aviation Administration	Q4, 2020	Yes. FAA AMHS has FTBP capability. National Weather Service (NWS) projected to implement IWXXM by Q3, 2021	Yes. 2MB bandwidth over CRV



Hotspots with AIDC or AIDC implementation by 2022

Hotspots with no plans for AIDC implementation

APX. E - 1

Presentation of the initial proposal:

1. The *Background* and *Comments* are provided in *italic text*.
2. The text of the proposed amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

a) ~~Text to be deleted is shown with a line through it.~~	text to be deleted
b) New text to be inserted is highlighted with grey shading.	new text to be inserted
c) ~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

TERMS OF REFERENCE

SWIM Task Force

Objectives: In order to achieve ~~B1-SWIM~~ the SWIM thread as specified in the Aviation System Block Upgrade (ASBU) of the Global Air Navigation Plan (GANP) ~~and, the Asia/Pacific Seamless ATM ANS Plan objectives, and the ATM and AIM air navigation systems –that are in compliance with ICAO global standards for the conceptualisation and exchange of aeronautical, flight and meteorological information– should be implemented in the high density FIRs and high density international aerodromes by November 2022 (PASL Phase III) and in all FIRs and international aerodromes by November 2025 (PASL Phase IV).~~ ~~To that end,~~ the SWIM Task Force will:

- a) Benchmark the various successful implementations of SWIM in States and regions to ~~adopt~~ promote best practices;
- b) Develop and maintain ~~a the Asia/Pacific regional roadmap for SWIM services (ATM, AIM, MET, other), dependencies and enablers~~ implementation, including SWIM technical infrastructure, SWIM governance, SWIM information services;
- c) ~~Liaise with relevant regional contributory bodies to refine operational and communications requirements (example: ATFM/SG, AATF, MET IE/WG, ACSIGG, CRV/OG, etc.)~~ Define a high-level Asia/Pacific regional SWIM architecture, the corresponding SWIM technical infrastructure requirements, and the implementation approach to construct such architecture principally over CRV to ensure interoperability among regional SWIM participants and to support transition for non-SWIM capable entities;
- d) ~~Complement global SWIM governance with regional procedures as needed and define how it can be implemented in APAC, with a particular focus on version management of concept and exchange models, architecture models, cyber security, data quality management and maintenance of a trusted environment~~ Develop the Asia/Pacific regional SWIM cyber security architecture framework and SWIM security strategy in line with ICAO International Aviation Trust Framework (IATF);

- e) ~~Provide guidance and training to APAC member States and APANPIRG contributory bodies involved in SWIM-related work~~ Support APANPIRG WGs/TFs regarding information exchange models and examine if any extension to the existing information exchange models, i.e. AIXM, FIXM, and IWXXM, and/or the new information exchange model(s) are required to support the Asia/Pacific regional operational requirements;
- f) ~~Develop guidance/requirements for publishers/service providers and subscribers/service consumers~~ Establish a robust and sustainable governance model to ensure that a common set of policies, rules, and standards for identifying, designing, implementing, discovering, and operating SWIM-enabling components, including SWIM registries, is consistently applied and enforced throughout the Asia/Pacific region;
- g) ~~Promote enablement of ATM services as SWIM Application Services (SAS)~~ Develop and define the Asia/Pacific version of the SWIM information service overview specifications and the Asia/Pacific version of data catalogue for information services based on the regional operational needs;
- h) ~~Define how SWIM Registry/Registries and services will be implemented in the APAC region and what the minimum level of information a service needs to provide to the Registry/Registries~~ Track and observe SWIM demonstrations and trials within the Asia/Pacific region as well as provide, if required, support for regional SWIM demonstrations;
- i) ~~Support APANPIRG WG/TF regarding data exchange models of AIXM, FIXM, and IWXXM and examine if any extension is required for the operational use in APAC~~ Construct a platform for SWIM services and applications validation and support the implementation of SWIM services and applications;
- j) Monitor developments by the IMP and escalate the regional issues as required;
- k) ~~Implement the APAC Regional SWIM~~ Identify, communicate, and liaise with relevant APANPIRG WGs/TFs in regard to SWIM-related activities, including providing support to refine SWIM operational and communications requirements; ~~and~~
- l) ~~Undertake any other tasks related to SWIM implementation that may arise in the future~~ Develop an educational and promotional materials required to support the regional SWIM implementation to ensure cohesiveness among regional SWIM participants;
- m) Implement the Asia/Pacific regional SWIM; and
- n) Undertake any other tasks related to SWIM implementation that may arise in the future.

~~Considering the cross-disciplinary nature of SWIM, the Task Force will ensure proper coordination with relevant regional contributory bodies under APANPIRG.~~

Composition:

The SWIM TF will consist of experts from ATM, AIM, MET, and CNS from Asia/Pacific States (ANS Providers), and international organizations such as from IATA and ICCAIA.

Conduct of the work:

The task force will conduct its work through Web-Conferences web conferences, teleconferences, other electronic means of communications, and Face-to-Face meetings.

Reporting:

The group will report to CNS SG.

TERMS OF REFERENCE

SWIM Task Force

Objectives: In order to achieve the SWIM thread as specified in the Aviation System Block Upgrade (ASBU) of the Global Air Navigation Plan (GANP), the Asia/Pacific Seamless ANS Plan objectives, and the air navigation systems that are in compliance with ICAO global standards for the conceptualisation and exchange of aeronautical, flight and meteorological information, the SWIM Task Force will:

- a) Benchmark the various successful implementations of SWIM in States and regions to promote best practices;
- b) Develop and maintain the Asia/Pacific regional roadmap for SWIM implementation, including SWIM technical infrastructure, SWIM governance, SWIM information services;
- c) Define a high-level Asia/Pacific regional SWIM architecture, the corresponding SWIM technical infrastructure requirements, and the implementation approach to construct such architecture principally over CRV to ensure interoperability among regional SWIM participants and to support transition for non-SWIM capable entities;
- d) Develop the Asia/Pacific regional SWIM cyber security architecture framework and SWIM security strategy in line with ICAO International Aviation Trust Framework (IATF);
- e) Support APANPIRG WGs/TFs regarding information exchange models and examine if any extension to the existing information exchange models, i.e. AIXM, FIXM, and IWXXM, and/or the new information exchange model(s) are required to support the Asia/Pacific regional operational requirements;
- f) Establish a robust and sustainable governance model to ensure that a common set of policies, rules, and standards for identifying, designing, implementing, discovering, and operating SWIM-enabling components, including SWIM registries, is consistently applied and enforced throughout the Asia/Pacific region;
- g) Develop and define the Asia/Pacific version of the SWIM information service overview specifications and the Asia/Pacific version of data catalogue for information services based on the regional operational needs;
- h) Track and observe SWIM demonstrations and trials within the Asia/Pacific region as well as provide, if required, support for regional SWIM demonstrations;
- i) Construct a platform for SWIM services and applications validation and support the implementation of SWIM services and applications;
- j) Monitor developments by the IMP and escalate the regional issues as required;
- k) Identify, communicate, and liaise with relevant APANPIRG WGs/TFs in regard to SWIM-related activities, including providing support to refine SWIM operational and communications requirements ;
- l) Develop an educational and promotional materials required to support the regional SWIM implementation to ensure cohesiveness among regional SWIM participants;
- m) Implement the Asia/Pacific regional SWIM; and

- n) Undertake any other tasks related to SWIM implementation that may arise in the future.

Composition:

The SWIM TF will consist of experts from ATM, AIM, MET, and CNS from Asia/Pacific States and international organizations such as IATA and ICCAIA.

Conduct of the work:

The task force will conduct its work through web conferences, teleconferences, other electronic means of communications, and Face-to-Face meetings.

Reporting:

The group will report to CNS SG.



INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC REGIONAL OFFICE

www.icao.int/APAC/Pages/eDocs.aspx

CATALOGUE OF ASIA AND PACIFIC FLIGHT INSPECTION AND FLIGHT VALIDATION SERVICE PROVIDERS

**Eleventh Edition
October 2021**



FOREWORD

The Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers contains information on Service Providers that are currently operating in the Asia and Pacific region. The purpose of this catalogue is to disseminate information to States, which do not have their own Flight Inspection and Flight Validation Service Providers and are interested in making use of Service Providers that have capacity available to conduct flight tests of their radio navigation aids and Flight Validations for instrument flight procedures designed based on Performance Based Navigation (PBN) Concept.

DISCLAIMER

The designations employed and the presentation of material in this publication do not imply the expression of any opinion, recommendations or approval whatsoever on the part of ICAO concerning the service providers, legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

INTRODUCTION

ICAO APAC office publishes updated *Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers* more regularly to reflect the latest information that would benefit potential new customers seeking flight inspection/validation services within the APAC Region or beyond.

The Catalogue is published based on the information received from various Service Providers, ANSPs, or CAA of different States. Various Service Providers of a State are grouped together under the name of a State in order to easily access of information and good information presentation. ICAO take no responsibilities of the approval/ accreditation of any Service Provider's legal status or adopted practices by respective States or any other entities.

We are happy to publish 11th edition of *Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers*. The document can be accessed by the link <https://www.icao.int/APAC/Pages/eDocs.aspx> under CNS section.

The experiences gained in Flight Inspection and Procedure Validation (FIPV) practices, while recognizing different local geographical considerations, resulted in development of a Regional Guidance material on implementation of ICAO requirements and provisions for FIPV while keeping abreast of the latest developments of associated emerging technologies.

First edition of Flight Inspection Guidance Material (FIGM) for APAC Region to provide additional guidance on planning, execution and delivery of flight inspection for the States/Administrations in APAC Region was adopted by CNS SG/24 of APANPIRG/31 by *Conclusion CNS SG/24/10* on 04 December 2020. The State Letter **Ref:** T 8/9.1 – P262/20 (CNS) dated 22 December 2020 Subject “*To note the various regional guidance materials available on the ICAO APAC website and take into consideration for their implementation*” was sent to States to inform about this document. The First Edition of Asia Pacific Flight Inspection Guidance Material is being appended to this Regional Catalogue.

States are encouraged to use the information provided in the document. This catalogue and guidance material can hopefully facilitate and be useful to States/Administrations, especially for those without a national Flight Inspection Service Provider (FISP) and with difficulties when conducting flight inspection.

ABBREVIATIONS AND ACRONYMS

AFIS	Automatic Flight Inspection System
ANSPs	Air Navigation Service Providers
CAA	Civil Aviation Authority
DF	Direction Finder / Direction Finding
DME	Distance Measuring Equipment
FMS	Flight Management System
GBAS	Ground Based Augmentation System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ILS	Instrument Landing System
LNAV/VNAV	Lateral Navigation / Vertical Navigation
LOC	Localizer
LPV	Localizer Performance with Vertical Guidance
MLS	Microwave Landing System
NDB	Non Directional Beacon
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
RF	Radio Frequency
RFI	Radio Frequency Interference
RNP APCH	Required Navigation Performance Approach
SAR	Surveillance Approach Radar
SBAS	Satellite Based Augmentation System
SID	Standard Instrument Departure
SP	Service Providers
SRE	Surveillance Radar Element
STAR	Standard Instrument Arrival
VASIS	Visual Approach Slope Indicator System
VOR	VHF Omni Directional Radio Range

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ATTACHMENT A

[ASIA PACIFIC FLIGHT INSPECTION GUIDANCE MATERIAL, FIRST EDITION](#)

Capabilities of Flight Validation/Flight Inspection Service Provider

1. Name, Country and Address of the service provider: *AUSTRALIA*

Flight Inspection

AeroPearl Pty

Ltd

Address: 3 Melaleuca St, Brisbane Airport, QLD, 4008

Tel: +61 7 3860 0600

Fax: +61 7 3860 0664

E-mail: admin@aeroparl.com.au

Flight Validation

Civil Aviation Safety Authority

E-mail: CNS.atm@casa.gov.au

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Beach 350</i>	<i>3</i>	<i>As negotiated.</i>	<i>As negotiated.</i>		<i>V & I</i>
<i>Learjet 35A</i>	<i>1</i>	<i>As negotiated.</i>	<i>As negotiated.</i>		<i>I (SSR/ADS-B only)</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>1 to 4</i>	<i>2 to 10</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>1 to 4</i>	<i>4 to 8</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>NA</i>	<i>NA</i>	
<i>ILS CAT I</i>	<i>Y</i>	<i>2 to 6</i>	<i>4 to 15</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>2 to 6</i>	<i>4 to 15</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>2 to 6</i>	<i>4 to 15</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>1 to 2, depending on requirements</i>	<i>1 to 4, depending on requirements</i>	<i>Automatic</i>
<i>SRA</i>	<i>Y</i>	<i>1, depending on requirements</i>	<i>1 to 2, depending on requirements</i>	<i>Automatic</i>

<i>SRE</i>	<i>Y</i>	<i>1, depending on requirements</i>	<i>1 to 2, depending on requirements</i>	<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>0.5 to 2</i>	<i>2 to 8</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>0.5</i>	<i>0.5 to 2</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>0.5</i>	<i>0.5 to 2</i>	<i>Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>0.5</i>	<i>0.5 to 2</i>	<i>Automatic</i>
<i>RF Interference</i>	<i>Y</i>	<i>varies, depending on requirements and location</i>	<i>varies, depending on requirements and location</i>	<i>Automatic</i>
<i>GNSS interference</i>	<i>Y</i>	<i>varies, depending on requirements and location</i>	<i>varies, depending on requirements and location</i>	<i>Manual (in relation to item 8.)</i>
<i>GBAS</i>	<i>Y</i>	<i>0.5</i>	<i>4 to 12</i>	<i>Automatic</i>
<i>SSR/ADSB</i>	<i>Y</i>	<i>0.5 to 15, depending on requirements</i>	<i>2 to 20, depending on requirements</i>	<i>Automatic</i>
<i>PSR</i>	<i>Y</i>	<i>1 to 2, depending on requirements</i>	<i>2 to 20, depending on requirements</i>	<i>Automatic</i>
<i>TACAN</i>	<i>Y</i>	<i>2 to 4</i>	<i>4 to 12</i>	<i>Automatic</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>.5</i>	<i>.5</i>	<i>Aircraft</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>.75</i>	<i>.5</i>	<i>Aircraft + Level D Simulator</i>
<i>RNP APCH (LPV)</i>	<i>NA</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SBAS CAT I</i>	<i>NA</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>GBAS CAT I</i>	<i>Y</i>	<i>.5</i>	<i>.5</i>	<i>Aircraft</i>
<i>GBAS CAT II/III</i>	<i>NA</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>.75</i>	<i>.5</i>	<i>Aircraft+ Level D Simulator</i>

<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>.75</i>	<i>.5</i>	<i>Aircraft+ Level D Simulator</i>
<i>ILS/LOC</i>	<i>Y</i>	<i>.5</i>	<i>.5</i>	<i>Aircraft</i>
<i>VOR/NDB</i>	<i>Y</i>	<i>.5</i>	<i>.5</i>	<i>Aircraft</i>

5. Type of Flight Management System which is used for flight data coding:
 - *CASA comment for flight validation: GE FMC using Jeppesen custom database*
6. Location and Type of flight simulators which is used for flyability check, if available:
 - *CASA: Brisbane, B737 Level D Simulator but others on request*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
 - *CASA and AeroPearl comments: On request*
8. GPS interference detection capability, if equipped:
 - *AeroPearl comment - GPS Receiver and Spectrum Analyser combined with downward-facing GPS antenna. Data from GPS receiver is monitored/analysed and Spectrum Analyser continuously scanning looking for interference.*
9. Languages possibly used by flight testing team:
 - *English*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
 - *Variable, on request.*
11. Advance notice expected before delivery of the service:
 - *Variable, on request.*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
 - *Airservices Australia Flight Inspection Requirements*
 - *ICAO Doc 8071*
 - *ICAO Annex 10*
13. State Regulation(s) commonly complied with when delivering flight validation services:
 - *CASR 173 and MOS*

14. Provide a link for further information, if any:

- www.aeropearl.com.au
- <https://www.legislation.gov.au/Details/F2017C00201>

15. Other information:

AeroPearl comment

- *Utilizes Aerodata Fully Automatic Flight Inspection System*
- *Able to provide Flight Validation Service on Request outside of Australia*
- *Able to provide Jeppesen database organization for Flight Validation procedures*

Capabilities of Flight Validation/Flight Inspection Service Provider

1. Name, Country and Address of the service provider: *CHINA*

The name of flight validation/flight inspection service

provider Flight Inspection Center of CAAC

Address: No 18 North Huoyun Road, Beijing Capital International Airport, Beijing, China. 100621

Tel: +86106454329

8

Fax: +8610645432

93

E-mail: cuij@chinacfi.net

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordination s	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Citation 560XLS</i>	<i>5</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>V/I</i>
<i>Citation 560XLS+</i>	<i>4</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>V/I</i>
<i>Citation 680</i>	<i>3</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>V/I</i>
<i>Gulfstream 450</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>V</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>4-5hr</i>	<i>6-7hr</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>In relation to VOR</i>	<i>In relation to VOR</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>			<i>Automatic</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>5hr</i>	<i>7hr</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>5hr</i>	<i>7hr</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>5hr</i>	<i>7hr</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>As required</i>	<i>3-4hr</i>	<i>Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>As required</i>	<i>3-4hr</i>	<i>Automatic</i>
<i>SRE</i>	<i>N</i>			
<i>NDB/LOC</i>	<i>Y</i>	<i>3hr</i>	<i>4hr</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>In relation to ILS</i>	<i>In relation to ILS</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>40min</i>	<i>1hr</i>	<i>Manual</i>
<i>VASIS</i>	<i>Y</i>			<i>Manual</i>

<i>RF Interference</i>	<i>Y</i>	<i>As required</i>	<i>As required</i>	<i>Automatic</i>
<i>GNSS interference</i>	<i>SNR for each satellite is available</i>	<i>As required</i>	<i>As required</i>	

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>10min</i>	<i>As required</i>	<i>Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>10min</i>	<i>As required</i>	<i>Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>10min</i>	<i>As required</i>	<i>Automatic</i>
<i>SBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT I</i>	<i>Y</i>	<i>6-10hr</i>	<i>As required</i>	<i>Automatic</i>
<i>GBAS CAT II/III</i>	<i>Y</i>	<i>6-10hr</i>	<i>As required</i>	<i>Automatic</i>
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>15-20min</i>	<i>As required</i>	<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>15-20min</i>	<i>As required</i>	<i>Automatic</i>

5. Type of Flight Management System which is used for flight data coding:

- Honeywell NZ 7.0(G450&CE680)*
- Honeywell NZ6.0(CE560XLS)*
- Collins FMC-3000V4.0(CE560XLS+)*

6. Location and Type of flight simulators which is used for flyability check, if available:

- Type D, Shanghai, China*

7. Charges per hour (USD, tax excluded) for simulation, including flight crew:

- 4700USD*

8. GPS interference detection capability, if equipped:

- Not available*

9. Languages possibly used by flight testing team:

- Chinese English*

10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:

- *300hours (Negotiable)*

11. Advance notice expected before delivery of the service:

- *3 months*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *ICAO Doc.8071 & Annex 10, CCAR85, CCAR86*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *ICAO Doc.9906*

14. Provide a link for further information, if any:

- *www.chinacfi.net*

15. Other information:

- *All flight inspection systems are certified by ISO/IEC 17025.*
- *For prior coordination, please contact Ms Jie Cui, with email:cuij@chinacfi.net.*

Capabilities of Flight Validation/Flight Inspection Service Provider

1. Name of the service provider: *FRANCE, DGAC/DSNA/DTI/CEV*

*Address: 1, Avenue du Dr. Maurice Grynfolgel - CS 53584 F –
31 035 TOULOUSE CEDEX 1 - FRANCE*

Contact: Mr. Joel Faucon Tel:

+33 (0) 562 145 143

Fax: +33 (0) 562 145 401

E-mail: joel.faucon@aviation-civile.gouv.fr

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>PA31-350 located in French Polynesia (NTAA) – range: South Pacific islands</i>	<i>1</i>	<i>on demand-rates depend on location</i>	<i>On demand</i>	<i>Portable GNSS FIS for helicopter FV or GNSS RFI detection</i>	<i>V/ I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours)		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>1-2h</i>	<i>3-4h dependent upon number of routes</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>0.5h-1h or along with VOR/ILS</i>	<i>1h or along with VOR/ILS</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>			
<i>ILS CAT I</i>	<i>Y</i>	<i>3h</i>	<i>6-9h</i>	<i>Automatic – RTK DGPS</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>4h</i>	<i>6-10h</i>	<i>Automatic – RTK DGPS</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>4h</i>	<i>6-10h</i>	<i>Automatic – RTK DGPS</i>

PAR	N			
SAR	N			
SRE	N			
NDB/LOC	N			
Marker Beacon	Y	0.2h or along with ILS	0.4h or along with ILS	Automatic – RTK DGPS
PAPI	Y	0.3h or along with ILS	0.5h	Automatic
VASIS	Y	0.3h or along with ILS	0.5h	Automatic
RF Interference	Y	Dependent upon RFI/ spectrum monitoring can be performed during navaid flight check		Automatic
GNSS interference	Y	Dependent upon RFI/ spectrum monitoring can be performed during PBN procedure flight validation		Automatic (See item 8.)

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
RNP APCH (LNAV)	Y	From 1h to 2h Dependent on nb of legs and on nb of minima on the chart		Automatic, procedure can be precoded in Garmin GTN (extra fees)
RNP APCH (LNAV/VNAV)	Y			
RNP APCH (LPV)	Y			
SBAS CAT I	Y			
GBAS CAT I	N			
GBAS CAT II/III	N			
RNAV/RNP SID	Y	Dependent on nb of legs		Automatic, procedure can be precoded in Garmin GTN (extra fees)

<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>Dependent on nb of legs</i>		<i>Automatic, procedure can be precoded in Garmin GTN (extra fees)</i>

5. Type of Flight Management System which is used for flight data coding:
 - *Garmin GTN 750/650*
6. Location and Type of flight simulators which is used for flyability check, if available:
 - *None*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
 - *N/A*
8. GPS interference detection capability, if equipped:
 - *Rohde &Schwarz EM100 or EB200 receiver connected to GPS +LNA antenna, driven by a specialized RFI detection software (CGX AiRFInDeR) and GPS measurements impact assessment*
9. Languages possibly used by flight testing team:
 - *French or English.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
 - *50h, could be increased.*
11. Advance notice expected before delivery of the service:
 - *3 months.*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
 - *ICAO doc 8071 vol 1 and 2,*
 - *French regulation : Arrêté du 10 avril 2015 relatif à la mise en service et au suivi des aides radio à la navigation NOR: DEVA1507970A.*
13. State Regulation(s) commonly complied with when delivering flight validation services:
 - *ICAO doc 9906 vol5.*
 - *French regulation : Arrêté du 4 octobre 2017 relatif à l'établissement des procédures de vol aux instruments au bénéfice des aéronefs évoluant selon les règles applicables à la circulation aérienne générale NOR: TRAA1721722A*

14. Provide a link for further information, if any:

- <https://www.ecologique-solidaire.gouv.fr/en/performance-based-navigation-0>

15. Other information:

- *Type of Flight inspection System: SAFRAN Carnac30.*
- *DGAC/DSNA/DTI/CEV is the Flight Inspection Service Provider for France mainland and its oversea territories with 2 aircraft based in French Polynesia and French Caribbean. Holds also annual contracts since several years in Belgium, Tunisia, Lebanon. Performed more than 250 RNP APCH flight inspection and validation since 10 years in France among which more than 200 LPVs, and 2 RNP AR.*
- *DGAC/DSNA/DTI/CEV can provide support to APAC states to perform PBN procedure ground and flight validation including onboard interferences detection (with possible FIS portable system lease)*

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *INDIA, Airports Authority of India*

*Address: Executive Director,
Flight Inspection Unit
Airport Authority of India,
Safdarjung Airport, New Delhi 110003*

Tel: +91 (11) 24611077

Fax: +91 (11) 24697211

E-mail: edfiu@aai.aero

Or

*Address: General Manager,
Business Development
C-Block, Rajiv Gandhi Bhawan, New Delhi 110003*

Tel: +91 (11) 24629347

Fax: +91 (11) 24610841

E-mail: bd@aai.aero

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Beach 350</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Dornier DO-228</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>2.5</i>	<i>5.0</i>	<i>Automatic,</i>
<i>DME</i>	<i>Note 1</i>			
<i>MLS</i>	<i>N</i>			
<i>ILS CAT I</i>	<i>Y</i>	<i>3.5</i>	<i>5.5</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>3.5</i>	<i>5.5</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>3.5</i>	<i>5.5</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>Note 2</i>		
<i>SAR</i>	<i>Y</i>			
<i>SRE</i>	<i>Y</i>			
<i>NDB/LOC</i>	<i>Y</i>	<i>1.5</i>	<i>3.0</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Note 3</i>			

<i>PAPI</i>	<i>Y</i>	<i>0.5</i>	<i>1.5</i>	<i>Manual</i>
<i>VASIS</i>	<i>Y</i>	<i>0.5</i>	<i>1.5</i>	<i>Manual</i>
<i>RF Interference</i>	<i>Y</i>			<i>Manual</i>
<i>GNSS interference</i>	<i>Y</i>			<i>See item 8</i>
<i>Note 1: The estimated flight check time is included in the DVOR of other co-located facilities with DME support.</i> <i>Note 2: The estimate for flight check of PAR/SSR/SSE/SRE will depend on the user requirement.</i> <i>Note 3: The requirement of the flight check time of Marker Beacon is included in flight check time of ILS.</i>				

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
RNP APCH (LNAV)	Y	Note		Automatic
RNP APCH (LNAV/VNAV)	Y			Automatic
RNP APCH (LPV)	Y			Automatic
SBAS CAT I	Y			Automatic
GBAS CAT I	Y	1.5	0.5	Automatic
GBAS CAT II/III	---	---	---	---
RNAV/RNP SID	Y	Note		Automatic
RNAV/RNP STAR	Y			Automatic
Note: Estimated flight validation tine depends upon the user Requirement				

5. Type of Flight Management System which is used for flight data coding:
- FMS DATA TYPE 7 DATABASE “L7 EURASPAC”*
6. Location and Type of flight simulators which is used for flyability check, if available:
- N/A*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- N/A*
8. GPS interference detection capability, if equipped:
- RD 460 (By Aerodata Germany)/Homing Method*

9. Languages possibly used by flight testing team:

- *English.*

10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:

- *As Per Agreement*

11. Advance notice expected before delivery of the service:

- *As Per Agreement*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *ICAO Documents.*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *ICAO Documents*

14. Provide a link for further information, if any:

- www.aai.aero/en/services/consultancy-services-offered-aai

15. Other information:

- *Point of Contact for prior co-ordination:
Executive Director,
Flight Inspection Unit,
Airports Authority of India,
Safdarjung Airport,
New Delhi-110003.
Tel: +91(11) 24611077
Fax: +91(11) 24697211
E-mail: edfiu@aai.aero*

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name of Service Provider: *Indonesian Flight Inspection Service Provider (BALAI BESAR KALIBRASI FASILITAS PENERBANGAN)*

*Address: Jln. Raya STPI – Curug, Legok, Tangerang, Banten,
Indonesia, 15820 Tel : +62-21 5473086, 5472943, 5472942
Fax : +62-21 5473086*

*E-mail: info@flightcalibration.co.id
bbkfp-ubud@dephub.go.id*

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validation / Inspection (V/I)
		Positionin g Flights	Check Flights		
<i>Kingair B350i</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Kingair B200</i>	<i>4</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Hawker 900XP</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V</i>
<i>Bell 429</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours) *		Type of Flight Check System
		Routine	Commissionin g	
<i>VOR</i>	<i>Y</i>	<i>2.5</i>	<i>7 to 10</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>2</i>	<i>2 to 4</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>-</i>	<i>-</i>	
<i>ILS CAT I</i>	<i>Y</i>	<i>4 to 8</i>	<i>15 to 20</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>4 to 8</i>	<i>15 to 20</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>4 to 8</i>	<i>15 to 20</i>	<i>Automatic</i>
<i>PAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	
<i>SAR</i>	<i>Y</i>	<i>-</i>	<i>15 to 25*</i>	<i>Automatic</i>
<i>SRE</i>	<i>N</i>	<i>-</i>	<i>-</i>	
<i>NDB/LOC</i>	<i>Y</i>	<i>1</i>	<i>2 to 4</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>0.5</i>	<i>0.5</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>1</i>	<i>1 to 2</i>	<i>Automatic</i>

VASIS	Y	1	1 to 2	Automatic
RF Interference	Y	0.5	-	Automatic
GNSS interference				(See item 8.)

* Estimated time depends on requirements

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
RNP APCH (LNAV)	Y	Depend on the design of Instrument Flight Procedure		Automatic
RNP APCH (LNAV/VNAV)	N			
RNP APCH (LPV)	Y			Automatic
SBAS CAT I	N			
GBAS CAT I	Y			Automatic
GBAS CAT II/III	N			
RNAV/RNP SID	Y			Automatic
RNAV/RNP STAR	Y			Automatic

5. Type of Flight Management System which is used for flight data coding:
- Rockwell Collins ProLine 21 (FMS-3000)
6. Location and Type of flight simulators which is used for flyability check, if available:
- Full Flight Simulator King Air B200GT/350i for flyability check, location in base office
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- Negotiable
8. GPS interference detection capability, if equipped:
- Not equipped

9. Languages possibly used by flight testing team:
- *Flight Validation/Inspection: Bahasa Indonesia, English*
 - *Report: English*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
- *On Request/Negotiable*
11. Advance notice expected before delivery of the service:
- *Time for prior coordination required, 60 days*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
- *ICAO Annex 10*
 - *ICAO Doc 8071*
 - *Advisory Circular CASR Part 171-5 from DGCA Indonesia applied to the flight inspection*
13. State Regulation(s) commonly complied with when delivering flight validation services:
- *ICAO Doc 9906*
 - *Advisory Circular CASR Part 171-5 from DGCA Indonesia applied to the flight validation*
14. Provide a link for further information, if any:
- *www.flightcalibration.co.id*
15. Other information:
- *CASR 171 certification/approval type of flight inspection/validation system from DGCA Indonesia*

Capabilities of Flight Validation/Flight Inspection Service Provider

1. Name of the Service Provider: *JAPAN*

Ministry of Land, Infrastructure, Transport, and Tourism

Japan Civil Aviation Bureau

Address: 2-1-3 Kasumigaseki Chiyoda-ku, Japan, zip code 100-8918

Tel: +81(3)5253 8111

Fax: +81(3)5253 1664

E-mail:

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour(USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Flights Check		
<i>CJ4</i>	<i>5</i>	<i>Negotiable</i>			<i>V/I</i>
<i>DHC-8-315</i>	<i>1</i>				<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours)*		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>1.5</i>	<i>4.0+ Procedure radial</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>1.0 or along with VOR/ILS</i>	<i>2.0 or along with VOR/ILS</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>2.0</i>	<i>depends on requirements of ground equipment</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>3.0</i>		<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>3.0</i>		<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>1.5</i>	<i>2.0</i>	<i>Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>As required</i>		<i>Automatic</i>

<i>SRE</i>	<i>Y</i>	<i>As required</i>	<i>depends on requirements of ground equipment</i>	<i>Automatic</i>
<i>NDB</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>0.5 or Along with ILS</i>	<i>0.5 or Along with ILS</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>1.0</i>	<i>1.5</i>	<i>Automatic</i>
<i>VASIS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RF Interference</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>GNSS interference</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>TACAN</i>	<i>Y</i>	<i>1.5</i>	<i>4.0+ Procedure radial</i>	<i>Automatic</i>
<i>* The Flight Inspection time change by various elements. For example, used Regulations, a number of air-routes, air traffic density, and so on.</i>				

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification:

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>Depend on the design of Instrument Flight procedures</i>		<i>Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>			<i>Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>			<i>Automatic</i>
<i>SBAS CAT I</i>	<i>N</i>			<i>Automatic</i>
<i>GBAS CAT I</i>	<i>Y</i>			<i>Automatic</i>
<i>GBAS CAT II/III</i>	<i>N</i>			<i>-</i>

<i>RNAV/RNP SID</i>	<i>Y</i>	<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>Automatic</i>

5. Type of Flight Management System which is used for flight data coding:
CJ4: FMS-3000 (Rockwell Collins)
DHC-8-315: UNS-1Ew (Universal)
6. Location and Type of flight simulators which is used for flyability check, if available:
Flight Training Device for B737NG 400XR (CAE)
Flight Inspection Center at CHUBU CENTRAIR International Airport
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
Negotiable
8. GPS interference detection capability, if equipped:
Not equipped
9. Languages possibly used by flight testing team:
Japanese
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
Negotiable.
11. Advance notice expected before delivery of the service:
4 months
12. State Regulation(s) commonly complied with when delivering flight inspection services:
Japan Civil Aviation Bureau Rule, ICAO DOC 8071, FAA Order 8200.1
13. State Regulation(s) commonly complied with when delivering flight validation services:
Japan Civil Aviation Bureau Rule, ICAO DOC 9906, FAA Order 8200.1
14. Provide a link for further information, if any:
No WEB site
15. Other information:

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *MALAYSIA*

*Flight Calibration Division,
Civil Aviation Authority of
Malaysia, CAAM Hangar,
LTSAAS, 47200 Subang, Selangor,
MALAYSIA.*

*Telephone: 603-7831 3005
Fax: 603-7846 9510
Email: fcu@caam.gov.my*

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other coordination ns	Used for Validation/ Inspection (V/I)
		Positionin g Flights	Chec k Flight s		
<i>Learjet 60</i>	<i>2</i>	<i>Negotiable</i>	<i>3900.00</i>	<i>-</i>	<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigatio n Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routin e	Commissionin g	
<i>VOR</i>	<i>Y</i>	<i>1h 30m</i>	<i>4h</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>1h 30m</i>	<i>2h</i>	<i>Automatic</i>
<i>ILS CAT 1</i>	<i>Y</i>	<i>1h 30m</i>	<i>10h</i>	<i>Automatic</i>
<i>ILS CAT 2</i>	<i>Y</i>	<i>1h 30m</i>	<i>10h</i>	<i>Automatic</i>
<i>ILS CAT 3</i>	<i>Y</i>	<i>1h 30m</i>	<i>10h</i>	<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>1h</i>	<i>2h</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>1h</i>	<i>2h</i>	<i>Automatic</i>
<i>PAPI/VASI</i>	<i>Y</i>	<i>2h</i>	<i>4h</i>	<i>Automatic</i>
<i>TACAN</i>	<i>Y</i>	<i>1h 30m</i>	<i>4h</i>	<i>Automatic</i>
<i>PSR/SSR/MLAT</i>	<i>Y</i>	<i>2h</i>	<i>3h</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>2h</i>	<i>6h</i>	<i>Automatic</i>
<i>AGL</i>	<i>Y</i>	<i>1h</i>	<i>2h</i>	<i>Automatic</i>

4. Flight validation capability for instrument flight procedures including PBN
Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RNP APCH (LPV)</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SBAS CAT I</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>

<i>GBAS CAT I</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>GBAS CAT II/III</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RNAV/RNP SID</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RNAV/RNP STAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>

5. Type of Flight Management System which is used for flight data coding:
 - *(Provide the type of FMS system) Not available*
6. Location and Type of flight simulators which is used for flyability check, if available:
 - *(Provide the type of simulator and its location) Not available*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
 - *(Provide overall cost for using simulator) Not applicable*
8. GPS interference detection capability, if equipped:
 - *(Provide the type of detection equipment and detection method) Not applicable*
9. Languages possibly used by flight testing team:
 - *English / Bahasa Melayu (if applicable)*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
 - *100 hours / Negotiable*
11. Advance notice expected before delivery of the service:
 - *Provide the time for prior coordination required notice of 2 months in advanced.*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
 - *(Provide State regulation(s) applied to the flight inspection and if available, referenced ICAO documents or criteria.) ICAO Doc 8071 Vol. I & III, Annex 10 and Annex 14*
13. State Regulation(s) commonly complied with when delivering flight validation services:
 - *(Provide State regulation(s) applied to the flight inspection and if available, referenced ICAO documents or criteria.) ICAO Doc 8071 Vol. II*
14. Provide a link for further information, if any:
 - *(Website information, if available) None*
15. Other information:
 - *Flight Calibration Division under Civil Aviation Authority of Malaysia established since 1975. Responsible on periodic and commissioning flight check to all nav aids, visual aids and radars in Malaysian airports, military base and for DCA Brunei Darussalam airport.*
 - *(AFIS) Automatic Flight Inspection System Airfield Technology AT-950*
 - *Flight Inspector certify to operate AFIS AT-950 (Certificate form Airfield Technology, US)*

- *May provide a point of contact for prior coordination.*

Captain Jamaluddin bin Tambychik
Director
Flight Calibration Division,
Civil Aviation Authority of
Malaysia,
CAAM Hangar, LTSAAS,
47200 Subang, Selangor, MALAYSIA.

Telephone : 603-7831 3005
Fax : 603-7846 9510
Email : jamal@caam.gov.my

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *MONGOLIA*

Flight Inspection and Procedure Design Services of National Civil Aviation Center of Mongolia

Address: Mongolia, Ulaanbaatar-34, Buyant-Ukhaa

17120 Tel: +976-71-285080; +976-71-285506

Fax: +976-71285506

E-mail: fipds@mcaa.gov.mn

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Beach C90</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Tomas Air LLC</i>	<i>V/I</i>
<i>C208B</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Geosan LLC</i>	<i>V/I</i>
<i>C208B</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Sky Horse New LLC</i>	<i>V/I</i>
<i>PC-6</i>	<i>-</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Customer airlines</i>	<i>V/I</i>
<i>EMB145LR</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Aeromongolia LLC</i>	<i>V/I</i>
<i>ATR72-212A</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Khunnu Air LLC</i>	<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>3</i>	<i>6</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>Combined with VOR or ILS</i>		<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>6</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>6</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>8</i>	<i>14</i>	<i>Automatic</i>
<i>PAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SAR</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>

<i>SRE</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>3</i>	<i>4</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>Combined with ILS</i>		<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>2</i>	<i>3</i>	<i>Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>3</i>	<i>4</i>	<i>Automatic</i>

<i>RF Interference</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>GNSS interference</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Manual</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>SBAS CAT I</i>	<i>N</i>	-	-	-
<i>GBAS CAT I</i>	<i>N</i>	-	-	-
<i>GBAS CAT II/III</i>	<i>N</i>	-	-	-
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>Dependent upon nature and extent of checks required</i>		<i>Automatic</i>

5. Type of Flight Management System which is used for flight data coding:
- Airfield Technology Inc. AT-940 system.*
6. Location and Type of flight simulators which is used for flyability check, if available:
- Customer's responsibility.*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- Customer's responsibility.*

8. GPS interference detection capability, if equipped:
 - *Comparison of GTN635 (dual) and Novatel 638 GPS receiver's data technique is applied.*
 - *In LOS condition, GNSS correction can also be used.*
9. Languages possibly used by flight testing team:
 - *English, Russian, Mongolian.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
 - *Negotiable.*
11. Advance notice expected before delivery of the service:
 - *45 days for periodic flight inspection and 2 months for commissioning flight inspection and flight validation.*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
 - *Mongolian Civil Aviation Rule Part 171 and Requirements for Flight Inspection.*
13. State Regulation(s) commonly complied with when delivering flight validation services:
 - *Mongolian Civil Aviation Rule Part 173.*
14. Provide a link for further information, if any:
 - *Website: <https://ncac.mcaa.gov.mn/>*
 - *Facebook: <http://www.facebook.com/fipdsmgl/>*
15. Other information:
 - *Type of flight inspection/validation system: Airfield Technology Inc. AT-940 dual system.*
 - *We have experience in conducting flight inspection services at some airports in the Islamic Republic of Iran..*
 - *For prior coordination, please contact with Mr. Gansukh Khurelsukh (e-mail: gansukh@mcaa.gov.mn; telephone number: +976-71-285506).*
 - *The flight procedure design service is available based on Customer demand.*
 - *If the Customer has accepted it, the planes of local airlines may be usable for flight inspection and flight validation on the basis of the independent contract.*

Capabilities of Flight Validation/Flight Inspection Service Provider

1. Name, Country and Address of the service provider: *MYANMAAR*

*Department of Civil Aviation, Myanmar
Mr. Yan Aung Oo
Acting Director (Flight Standards Division)
Department of Civil Aviation
DCA H/Q Building,
Yangon Int'l Airport Mingaladon 11021, Yangon, Myanmar
Tel: +95 (017) 533004
Fax: +95 (017) 533016
Email: dfsd@dca.gov.mm*

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validation/ Inspection(V/I)
		Positioning Flights	Check Flights		
<i>Beechcraft 1900D</i>	<i>1</i>	<i>Negotiation</i>		<i>Myanmar National Airlines</i>	<i>Inspection</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours)		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>4</i>	<i>Depend on condition of facility under inspection</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>Combined with VOR or ILS</i>		<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>5</i>	<i>Depend on condition of facility under inspection</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>5</i>		
<i>ILS CAT III</i>	<i>Y</i>	<i>5</i>		
<i>PAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SRE</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>3</i>	<i>Depend on condition</i>	

<i>Marker Beacon</i>	<i>Y</i>	<i>Combined with ILS</i>	<i>of facility under inspection</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>2</i>		<i>Semi-automatic and Manual</i>
<i>VASIS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RF Interference</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>GNSS Interference</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification:

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>N</i>			
<i>RNP APCH (LNAV/VNAV)</i>	<i>N</i>			
<i>RNP APCH (LPV)</i>	<i>N</i>			
<i>SBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT II/III</i>	<i>N</i>			
<i>RNA V/RNP SID</i>	<i>N</i>			
<i>RNA V/RNP STAR</i>	<i>N</i>			

5. Type of Flight Management System which is used for flight data coding:
- *None*
6. Location and Type of flight simulators which is used for flyability check, if available:
- *None*
7. Charges per hours (USD, tax excluded) for simulation, including flight crew:
- *N/A*
8. GPS interference detection capability, if equipped:
- *None*
9. Languages possibly used by flight testing team:

- *Myanmar and English*

10. Estimated annual flight time available to assist other Administrations for testing radionavigation aids:

- *None.*

11. Advance notice expected before delivery of the service:

- *N/A*

-

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *MCAR Part-5 Section-9 Vol I.*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *N/A*

14. Provide a link for further information, if any: <http://www.dca.gov.mm>

15. Other information:

- *Beechcraft 1900D is equipped with Norwegian Special Mission (NSM) Automatic Flight Inspection System (UNIFIS-3000).*

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *NEW ZEALAND*

AIRWAYS CORPORATION OF NEW ZEALAND LTD

Address: Main Airport Hanger, 60 Toru Road, Paraparaumu, Wellington

Tel: +64 4 460 0703

Fax: +64 4 471 0395

E-mail: Philip.pinkney@airways.co.nz

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Piper Cheyenne IV</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Nil</i>	<i>V and I</i>
<i>Piper Seneca</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Third Party Operator</i>	<i>V and I</i>
<i>BK117 Helicopter</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>Third Party Operator</i>	<i>V and I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>*</i>	<i>**</i>	
<i>ILS CAT I</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Semi- Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Semi- Automatic</i>
<i>SRE</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Semi- Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Semi- Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Semi- Automatic</i>

<i>RF Interference</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Manual</i>
<i>GNSS interference</i>	<i>Y</i>	<i>*</i>	<i>**</i>	<i>Manual</i>

- (*) Subject to certification requirements, contractual requirements, environment, aircraft performance and ATC holding. Call to discuss any requirements.
- (**) Subject to items stated in (*) however may vary depending on the standard of facility installation. Call to discuss any requirements.
4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi-Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi-Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi-Automatic</i>
<i>SBAS CAT I</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi - Automatic</i>
<i>GBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT II/III</i>	<i>N</i>			
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi - Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>*</i>	<i>*</i>	<i>Semi - Automatic</i>

- (*) *Subject to certification, contractual requirements, environment, aircraft performance and ATC restrictions. Airways typically only flight validates procedures vetted by Airways under our PART 173 procedure design authorization.*

5. Type of Flight Management System which is used for flight data coding:
- Garmin and AFIS system*
6. Location and Type of flight simulators which is used for flyability check, if available:
- Typically provided by our National Carrier when required.*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- N/A*
8. GPS interference detection capability, if equipped:

- *Spectrum analyzer, R&S PR100*
9. Languages possibly used by flight testing team:
- *English.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
- *Negotiable and depends on requirement. If we are required to use our dedicated flight check.*
11. Advance notice expected before delivery of the service:
- *Negotiable depending on Contract and location.*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
- *Airways are currently certified under CAA rule Parts 171,172,173 and operate in accordance with most applicable part numbers such as 12,39,43,61,91,100.*
13. State Regulation(s) commonly complied with when delivering flight validation services:
- *Airways are currently certified under CAA rule Parts 171,172,173 and operate in accordance with most applicable part numbers such as 12,39,43,61,91,100.*
14. Provide a link for further information, if any:
- *www.airways.co.nz*
15. Other information:
- *Airways Corporation is a Government State Owned Enterprise tasked with providing Air Navigational Services to New Zealand.*
-

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *NEW ZEALAND*

Radiola Limited

Address: L1, Unit 2, 15 Marina View, Paremata 5026

Tel: +64 (0)21 270 9780

E-mail: richardt@radiola.co.nz

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co-ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>DA42</i>	<i>6</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Cessna 208B</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>MU2</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Piper Aztec</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>King Air 200</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>TBM 900</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>2</i>	<i>4</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>1</i>	<i>2</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>			
<i>ILS CAT I</i>	<i>Y</i>	<i>3</i>	<i>6</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>3</i>	<i>6</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>3</i>	<i>6</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>1</i>	<i>3</i>	<i>Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>1</i>	<i>3</i>	<i>Automatic</i>
<i>SRE</i>	<i>Y</i>	<i>1</i>	<i>3</i>	<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>2</i>	<i>3</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>0</i>	<i>1</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>1</i>	<i>1</i>	<i>Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>1</i>	<i>1</i>	<i>Automatic</i>
<i>RF Interference</i>	<i>Y</i>	<i>2</i>	<i>5</i>	<i>Manual</i>
<i>GNSS interference</i>	<i>N</i>			<i>(in relation to</i>

				<i>item 8.)</i>
<i>TACAN</i>	<i>Y</i>	<i>2</i>	<i>4</i>	<i>Automatic</i>
<i>RADAR</i>	<i>Y</i>	<i>10</i>	<i>16</i>	<i>Manual</i>
<i>All times are estimates, these can vary due to traffic density, safety risk analysis, airspace restrictions, operational limits, weather conditions and the flight inspection aircraft used.</i>				

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification
5. Type of Flight Management System which is used for flight data coding:
 - *Provide the type of FMS system*
6. Location and Type of flight simulators which is used for flyability check, if available:
 - *Provide the type of simulator and its location*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
 - *Provide overall cost for using simulator*
8. GPS interference detection capability, if equipped:
 - *Provide the type of detection equipment and detection method.*
9. Languages possibly used by flight testing team:
 - *Provide available language for flight validation/inspection and report. If they are different, state separately.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
 - *Provide available time that can be used for other Administrations, e.g. 100 hours / Negotiable / etc.*
11. Advance notice expected before delivery of the service:
12. *Provide the time for prior coordination required, e.g. 15 days, 3 months, etc.*
13. State Regulation(s) commonly complied with when delivering flight inspection services:

ICAO Doc 8071
ICAO Annex 10 UK CAP670 PNG Part 171 FAA on request
14. State Regulation(s) commonly complied with when delivering flight validation services:

ICAO Doc 9906 (Vol. 5)

15. Provide a link for further information, if any:

www.radiola.co.nz

16. Other information:

Approved by the UKCAA to provide Flight Inspection in the United Kingdom (CAP670 approval).

Approved by Air Safety Support International (ASSI) for flight inspection of British Overseas Territories.

Forward operating base in

Singapore Richard Thompson

Tel: +64 (0)21 270 9780

E-mail: richardt@radiola.co.nz

Capabilities of Flight Validation / Flight Inspection Service Provider

1. Name, Country & address of Service provider: *ISLAMIC REPUBLIC OF PAKISTAN*

*Flight Inspection Unit of Pakistan CAA
Headquarters Civil Aviation Authority
Jinnah Int'l Airport, Terminal-1, Karachi, Pakistan
Tele: +9221 99242762
Fax: +9921 99242695
E-mail: riaz.chishti@caapakistan.com.pk*

2. Type(s) and number of flight testing aircraft available associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (US\$)		Other Co- ordinations	Used for Validation / Inspection (V/I)
		Positioning Flights	Checks Flights		
<i>Beechcraft B 200</i>	<i>02</i>	<i>Flight Inspection Unit of Pakistan CAA will provide a Financial Quote in response to any request.</i>		<i>-</i>	<i>V & I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Time		Type of Flight Check System
		Routine	Commissioning	
VOR	Y	2.0 hr.	6.0 hr.	Aero-Data Automatic Flight Inspection System
DME	Y	1.0 hr.	2.0 hr.	
MLS	Y	*Note		
ILS CAT I	Y	3.5 hr.	10.0-12.0 hr.	
ILS CAT II	Y	4.5 hr.	12.0-15.0 hr.	
ILS CAT III	Y	4.5 hr.	12.0-15.0 hr.	
PAR	Y	3.0 hr.	6.0 hr.	
SAR	Y	*Note		
SRE	Y			
NDB/LOC	Y	1.5 hr.	6.0 hr.	
Marker Beacon	Y	1.5 hr.	2.0-3.0 hr.	
PAPI	Y	1.5 hr.	2.0-3.0 hr.	
VASI	Y	1.5 hr.	2.0-3.0 hr.	
RF Interference	Y	*Note		
GNSS Interference	Y			
				(In relation to item-8)

Note: Depending upon Scope and Requirement.

4. Flight Validation capability for instrument flight procedures including PBN Navigation Specification.

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
RNP APCH (LNAV)	Y	5.0 - 6.0 Hours	5.0 - 6.0 Hours	Aero-Data Automatic Flight Inspection System
RNP APCH (LNAV/VNAV)	Y	5.0 - 6.0 Hours	5.0 - 6.0 Hours	
RNP APCH (LPV)	N	-	-	
SBAS CAT I	Y	5.0 - 6.0 Hours	5.0 - 6.0 Hours	
GBAS CAT I	Y	5.0 - 6.0 Hours	5.0 - 6.0 Hours	
GBAS CAT II/II	Y	5.0 - 6.0 Hours	5.0 - 6.0 Hours	
RNAV/RNP SID	Y	Actual Flight Time Blocks Off to Blocks On will be charged		
RNAV/RNP STAR	Y			

5. Type of Flight Management System which is used for flight data coding.
Rockwell Collins/ Collins United FMS 3000.
6. Location and Type of flight simulators which is used for fly ability check if available.
None
7. Charges per hour (USD), tax excluded for simulator, including flight crew.
N/A
8. GPS interference detection capability, if equipped.
AeroData AD-120 Automatic Flight Inspection System
9. Languages possibly used by flight testing team.
English
10. Estimate annual flight time available to assist other Administrations for testing radio navigation aids is *300-400 Hours approx*
11. Advance notice expected before delivery of the service: *03/04 Weeks.*
12. State Regulation commonly complied with when delivering flight inspection services
ANO-002-ARTS-2.0 & ICAO Doc 8071
13. Regulation(s) commonly complied with when delivering flight validation services.
ICAO DOC 9906 (Vol.-5)
14. Provide a link for further information, if any:
www.caapakistan.com.pk

15. Other information:

i) *Flight Inspection Unit of Pakistan CAA has been providing flight Inspection & Validation services in the Asia Pacific & Middle East region to various countries such as Bangladesh, Sri Lanka, Nepal, Maldives, Vietnam, Cambodia, Iran, Bahrain, UAE, Kingdom of Saudi Arabia, Qatar, Oman, & Eretria.*

ii) *Long term Flight Inspection contracts are offered at Special rates, depending upon length of contract & quantum of work. All local taxes landing, housing, ground handling charges to be borne by the host State/ Authority.*

Capabilities of Flight Validation / Flight Inspection Service Provider

THE PHILIPPINES

1. Name of the Service Provider:

Flight Inspection & Calibration Group, Civil Aviation Authority of the

*Philippines Address: FICG. CAAP Hangar, Andrews Avenue, Pasay City,
Metro Manila*

Tel: 0632 994 2334

Fax: 0632 851 3914

E-mail: ficg@caap.gov.ph

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validation/ Inspection (V/I)
		Positionin g Flights	Check Flights		
<i>Learjet 31A</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>
<i>Pilatus PC12</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours)		Type of Flight Check System
		Routine	Commissionin g	
<i>VOR</i>	<i>Y</i>	<i>2</i>	<i>6</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>Along with VOR or ILS</i>	<i>Along with VOR or ILS</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>			
<i>ILS CAT I</i>	<i>Y</i>	<i>4</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>4</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>N</i>			
<i>PAR</i>	<i>N</i>			
<i>SAR</i>	<i>Y</i>	<i>4</i>	<i>12</i>	
<i>SRE</i>	<i>Y</i>	<i>4</i>	<i>12</i>	
<i>NDB/LOC</i>	<i>Y</i>	<i>1</i>	<i>5</i>	

<i>Marker Beacon</i>	<i>Y</i>	<i>Along with ILS</i>	<i>Along with ILS</i>	
<i>PAPI</i>	<i>Y</i>	<i>1</i>	<i>2</i>	
<i>VASIS</i>	<i>Y</i>	<i>1</i>	<i>2</i>	
<i>RF Interference</i>	<i>Y</i>			
<i>GNSS interference</i>	<i>Y</i>			<i>(See item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>2</i>	<i>1</i>	<i>Manual</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>3</i>	<i>1</i>	<i>Manual</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>3</i>	<i>1</i>	<i>Manual</i>
<i>SBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT II/III</i>	<i>N</i>			
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>2</i>	<i>1</i>	<i>Manual</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>2</i>	<i>1</i>	<i>Manual</i>

5. Type of Flight Management System which is used for flight data coding:
- Apex Primus/ UNS – 1E*
6. Location and Type of flight simulators which is used for flyability check, if available:
- Not Available*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- Not Applicable*
8. GPS interference detection capability, if equipped:

- *Rhode & Schwarz RFI / DF*
9. Languages possibly used by flight testing team:
- *English.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
- *Negotiable*
11. Advance notice expected before delivery of the service:
- *3 months*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
- *Philippine Civil Aviation Regulations for Air Navigation Services Part 6, 9, 10*
13. State Regulation(s) commonly complied with when delivering flight validation services:
- *Philippine Civil Aviation Regulations for Air Navigation Services Part 16*
14. Provide a link for further information, if any:
- *www.caap.gov.ph*
15. Other information:
- *ficg@caap.gov.ph*
-

Capabilities of Flight Validation / Flight Inspection Service Provider

REPUBLIC OF KOREA

1. Name of the Service Provider:

Flight Inspection Center, Ministry of Land, Infrastructure and Transport

*Address: Gimpo International Airport, 84 Haneul-Gil, Gangseo-Gu, Seoul
07505, Republic of Korea*

Tel: +82 (2) 2660 2162, 2167

Fax: +82(2) 2662 0881

E-mail: airjeong@korea.kr or fic99@korea.kr

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available	Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validatio n/ Inspectio n (V/I)
	Positionin g Flights	Chec k Flight s		
<i>CL 601-3R</i>	<i>Negotiable</i>	<i>2,787</i>		<i>V/I</i>
<i>Hawker 750</i>	<i>Negotiable</i>	<i>2,787</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigatio n Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time (Hours)		Type of Flight Check System
		Routine	Commissionin g	
<i>VOR</i>	<i>Y</i>	<i>2</i>	<i>4</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>1</i>	<i>2</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>	<i>N/A</i>	<i>N/A</i>	<i>N/A</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>2</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>2</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>2</i>	<i>12</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>1</i>	<i>4</i>	<i>Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>1</i>	<i>4</i>	<i>Automatic</i>
<i>SRE</i>	<i>Y</i>	<i>1</i>	<i>4</i>	<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>0.5</i>	<i>2</i>	<i>Automatic</i>

<i>Marker Beacon</i>	<i>Y</i>	<i>-</i>	<i>-</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>0.5</i>	<i>4</i>	<i>Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>0.5</i>	<i>4</i>	<i>Automatic</i>
<i>RF Interference</i>	<i>Y</i>	<i>-</i>	<i>-</i>	<i>Automatic</i>
<i>GNSS interference</i>	<i>Y</i>	<i>-</i>	<i>-</i>	<i>(See item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time (Hours)		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>2</i>	<i>0.5</i>	<i>Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>	<i>2</i>	<i>0.5</i>	<i>Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>2</i>	<i>1</i>	<i>Automatic</i>
<i>SBAS CAT I</i>	<i>Y</i>	<i>2</i>	<i>1</i>	<i>Automatic</i>
<i>GBAS CAT I</i>	<i>Y</i>	<i>10</i>	<i>1</i>	<i>Automatic</i>
<i>GBAS CAT II/III</i>	<i>Y</i>	<i>10</i>	<i>1</i>	<i>Automatic</i>
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>2</i>	<i>0.5</i>	<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>2</i>	<i>0.5</i>	<i>Automatic</i>

5. Type of Flight Management System which is used for flight data coding:
- CL601-3R: UNS-1*
 - Hawker 750: FMS-6000*
6. Location and Type of flight simulators which is used for flyability check, if available:
- N/A*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- N/A*
8. GPS interference detection capability, if equipped:

- *Rohde & Schwarz FSV7, Cubic 4400 with Aerodata package.*
9. Languages possibly used by flight testing team:
- *Korea, English.*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
- *100 hours / Negotiable*
11. Advance notice expected before delivery of the service:
- *2-3 months*
12. State Regulation(s) commonly complied with when delivering flight inspection services:
- *Korea Act, ICAO DOC 8071, FAA Order 8200.1*
13. State Regulation(s) commonly complied with when delivering flight validation services:
- *ICAO and FAA related Documents.*
14. Provide a link for further information, if any:
- *Under construction*
15. Other information:

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider: *Thailand*

Aeronautical Radio of Thailand Ltd.

Address: 102 Ngamduplee Rama IV Tung mahamek Bangkok 10120, Thailand

Tel: (662) 2878571, (668) 1734 9242

Fax: (662) 285-9565

E-mail: bs@aerothai.co.th tirachai.su@aerothai.co.th

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordinations	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>Beechcraft B300</i>	<i>2</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>-</i>	<i>V/I</i>
<i>Beechcraft B200</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>	<i>-</i>	<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>2-4</i>	<i>12</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>Combined with DVOR/ILS</i>	<i>Combined with DVOR/ILS</i>	<i>Automatic</i>
<i>MLS</i>	<i>N</i>			<i>Automatic</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>6</i>	<i>12</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>6</i>	<i>14</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>6</i>	<i>14</i>	<i>Automatic</i>
<i>PAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SAR</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>SRE</i>	<i>Y</i>	<i>4</i>	<i>8</i>	<i>Automatic</i>
<i>NDB/LOC</i>	<i>Y</i>	<i>2</i>	<i>4</i>	<i>Automatic</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>Combined with ILS</i>	<i>Combined with ILS</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>2</i>	<i>4</i>	<i>Automatic</i>
<i>VASIS</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>-</i>
<i>RF Interference</i>	<i>Y</i>	<i>Depend on the interference case</i>		
<i>GNSS interference</i>	<i>N</i>	<i>-</i>	<i>-</i>	<i>(in relation to item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>Depend on number of legs and waypoints</i>		<i>Automatic</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>			
<i>RNP APCH (LPV)</i>	<i>N</i>			-
<i>SBAS CAT I</i>	<i>N</i>			-
<i>GBAS CAT I</i>	<i>Y</i>	<i>Depend on number of legs and waypoints</i>		<i>Automatic</i>
<i>GBAS CAT II/III</i>	<i>N</i>			-
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>Depend on number of legs and waypoints</i>		<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>			

5. Type of Flight Management System which is used for flight data coding:

- *Rockwell Collins FMS*

6. Location and Type of flight simulators which is used for flyability check, if available:

- *N/A*

7. Charges per hour (USD, tax excluded) for simulation, including flight crew:

- *N/A*

8. GPS interference detection capability, if equipped:

- *Spectrum Analyzer, ROHDE & SCHWARZ FSV30*

9. Languages possibly used by flight testing team:

- *English and Thai*

10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:

- *200 hours*

11. Advance notice expected before delivery of the service:

- *30 – 60 days*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *Civil Aviation Authority of Thailand (CAAT) and/or ICAO standards and/or FAA standards.*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *Civil Aviation Authority of Thailand and/or ICAO standards and/or FAA standards.*

14. Provide a link for further information, if any:

- www.aerothai.co.th

15. Other information:

Capabilities of Flight Inspection /Flight Validation Service Provider

UNITED STATES OF AMERICA

1. Name, Country and Address of the service provider:

The name of flight validation/flight inspection service provider: Federal Aviation Administration, AJF-1

*Address: 6500 S. MacArthur
Bld. Oklahoma City,
OK 73169*

*Tel: 405-954-
9780 Fax: 888-
286-2739*

E-mail: Bradley.W.Elliott@faa.gov

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordination s	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flight s		
<i>Challenger 6XX</i>	<i>6</i>	<i>4,132</i>	<i>4,132</i>		<i>V/I</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capabil ity (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>Y</i>	<i>2 + 0.2/SIAP</i>	<i>8</i>	<i>Automatic</i>
<i>DME</i>	<i>Y</i>	<i>0.5</i>	<i>3</i>	<i>Automatic</i>
<i>MLS</i>	<i>Y</i>	<i>2</i>	<i>6</i>	<i>Automatic</i>
<i>ILS CAT I</i>	<i>Y</i>	<i>1.5</i>	<i>7</i>	<i>Automatic</i>
<i>ILS CAT II</i>	<i>Y</i>	<i>1.5</i>	<i>13</i>	<i>Automatic</i>
<i>ILS CAT III</i>	<i>Y</i>	<i>1.5</i>	<i>13</i>	<i>Automatic</i>
<i>PAR</i>	<i>Y</i>	<i>1.5</i>	<i>5</i>	<i>Automatic</i>
<i>SAR</i>	<i>Y</i>	<i>1</i>	<i>6</i>	<i>Automatic</i>
<i>SRE</i>	<i>Y</i>	<i>-</i>	<i>11</i>	<i>Automatic</i>
<i>NDB</i>	<i>Y</i>	<i>0.7</i>	<i>2</i>	<i>Manual</i>
<i>Marker Beacon</i>	<i>Y</i>	<i>0.1</i>	<i>0.3</i>	<i>Automatic</i>
<i>PAPI</i>	<i>Y</i>	<i>0.5</i>	<i>1.5</i>	<i>Automatic</i>
<i>VASIS</i>	<i>Y</i>	<i>0.5</i>	<i>1.5</i>	<i>Automatic</i>

<i>RF Interference</i>	<i>N</i>			
<i>GNSS interference</i>	<i>Y</i>	<i>-</i>	<i>-</i>	<i>Manual (See item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>	<i>1.5</i>	<i>0.5</i>	<i>Automatic/Manual</i>
<i>RNP APC H (LNAV/VNAV)</i>	<i>Y</i>	<i>1.5</i>	<i>0.5</i>	<i>Automatic/Manual</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>	<i>1.5</i>	<i>0.5</i>	<i>Automatic</i>
<i>SBAS CAT I</i>	<i>Y</i>	<i>1.5</i>	<i>0.5</i>	<i>Automatic</i>
<i>GBAS CAT I</i>	<i>Y</i>	<i>7</i>	<i>2 + 0.2/SIAP</i>	<i>Automatic</i>
<i>GBAS CAT II/III</i>	<i>N</i>			
<i>RNAV/RNP SID</i>	<i>Y</i>	<i>1</i>	<i>-</i>	<i>Automatic/Manual</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>	<i>1</i>	<i>-</i>	<i>Automatic/Manual</i>

5. Type of Flight Management System which is used for flight data coding:
- Universal UNS-1Fw, Collins FMS-6000 and Collins FMS-6200*
6. Location and Type of flight simulators which is used for flyability check, if available:
- Oklahoma City, OK, Boeing 737-800 and Airbus A300*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- No additional cost, if FAA is inspecting the procedure.*
8. GPS interference detection capability, if equipped:
- Cubic DF-4400*
9. Languages possibly used by flight testing team:

- *English*

10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:

- *Negotiable*

11. Advance notice expected before delivery of the service:

- *60 days*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *FAA Order 8200.1 and ICAO Doc 8071*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *FAA Order 8200.1 and ICAO Doc 9906*

14. Provide a link for further information, if any:

- https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/flight_program_operations/

15. Other information:

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name of the service provider: **Flight Tech Engineering, LLC**

Address: P.O. Box 3596

Englewood, CO 80155

Tel:(1) 720-465-6170

E-mail: IFP@flight-tech.aero

2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other co- ordination s	Used for Validation/ Inspection (V/I)
		Positionin g Flights	Check Flights		
<i>Cirrus SR20</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capabilit y (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>	<i>N</i>			
<i>DME</i>	<i>N</i>			
<i>MLS</i>	<i>N</i>			
<i>ILS CAT I</i>	<i>N</i>			
<i>ILS CAT II</i>	<i>N</i>			
<i>ILS CAT III</i>	<i>N</i>			
<i>PAR</i>	<i>N</i>			
<i>SAR</i>	<i>N</i>			
<i>SRE</i>	<i>N</i>			
<i>NDB/LOC</i>	<i>N</i>			
<i>Marker Beacon</i>	<i>N</i>			
<i>PAPI</i>	<i>N</i>			
<i>VASIS</i>	<i>N</i>			
<i>RF Interference</i>	<i>N</i>			
<i>GNSS interference</i>	<i>N</i>			<i>(in relation to item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>			<i>Manual</i>
<i>RNP APCH (LNAV/VNAV)</i>	<i>Y</i>			<i>Manual</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>			<i>Manual</i>
<i>SBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT I</i>	<i>N</i>			
<i>GBAS CAT II/III</i>	<i>N</i>			
<i>RNAV/RNP SID</i>	<i>Y</i>			<i>Manual</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>			<i>Manual</i>

5. Type of Flight Management System which is used for flight data coding:
- Garmin GNS 480, Garmin GTN 750, Garmin G1000*
6. Location and Type of flight simulators which is used for flyability check, if available:
- N/A*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- Negotiable*
8. GPS interference detection capability, if equipped:
- N/A*
9. Languages possibly used by flight testing team:
- English*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:

- *N/A*

11. Advance notice expected before delivery of the service:

- *30 days*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *FAA Order 8200.1 and ICAO Doc 8071*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *FAA Order 8200.1 and ICAO Doc 9906*

14. Provide a link for further information, if any:

- www.flight-tech.aero / www.performancenav.com

15. Other information:

- *Flight Tech Engineering (FTE) is an FAA approved IFP Service Provider specializing in Fixed Wing and Helicopter Instrument Procedure Design and Validation services. IFP Design capabilities include FAA and ICAO criteria standards. FTE can support both civilian and military operations and employs the same IFP design systems as the FAA and United States Air Force (USAF). On-Demand (time sensitive) ARINC/FMS coding, charting, and validation services available.*
- *FAA Approvals: Flight Validation, Simulator Validation, Airborne Obstacle Assessment, Ground Obstacle Validation.*
- *Points of Contact: Fixed Wing: Alec Seybold (aseybold@flight-tech.aero), Rotorcraft: Richard Scott (rscott@flight-tech.aero)*

Capabilities of Flight Inspection /Flight Validation Service Provider

1. Name, Country and Address of the service provider:
HUGHES Aerospace Corporation
1790 Hughes Landing Blvd, Suite 400, The Woodlands Texas 77380 USA
+1.281.655.3330
Fax: +1.281.360.1761
E-mail: info@hughesaerospace.com
2. Type(s) and number of flight testing aircraft available, associated charges and conditions:

Type of Aircraft & Aircraft Available		Flight Time Charges per hour (USD)		Other coordination s	Used for Validation/ Inspection (V/I)
		Positioning Flights	Check Flights		
<i>PA46T</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V</i>
<i>R66</i>	<i>1</i>	<i>Negotiable</i>	<i>Negotiable</i>		<i>V</i>
<i>UAS</i>	<i>3</i>			<i>Obstacle</i>	<i>V</i>

3. Flight testing capability and estimated flight time:

Radio Navigation Aids	Flight Check Capability (Y/N)	Estimated Flight Check Time		Type of Flight Check System
		Routine	Commissioning	
<i>VOR</i>				
<i>DME</i>				
<i>MLS</i>				
<i>ILS CAT I</i>				
<i>ILS CAT II</i>				
<i>ILS CAT III</i>				
<i>PAR</i>				
<i>SAR</i>				
<i>SRE</i>				
<i>NDB/LOC</i>				
<i>Marker Beacon</i>				
<i>PAPI</i>	<i>Y</i>			
<i>VASIS</i>	<i>Y</i>			
<i>RF Interference</i>				
<i>GNSS interference</i>				<i>(in relation to item 8.)</i>

4. Flight validation capability for instrument flight procedures including PBN Navigation Specification

Type of Procedures	Flight Validation Capability (Y/N)	Estimated Flight Validation Time		Type of Flight Validation System
		Initial	Periodic Review	
<i>RNP APCH (LNAV)</i>	<i>Y</i>			<i>Automatic</i>
<i>RNP APC H (LNAV/VNAV)</i>	<i>Y</i>			<i>Automatic</i>
<i>RNP APCH (LPV)</i>	<i>Y</i>			<i>Automatic</i>
<i>SBAS CAT I</i>	<i>Y</i>			<i>Automatic</i>
<i>GBAS CAT I</i>				
<i>GBAS CAT II/III</i>				
<i>RNAV/RNP SID</i>	<i>Y</i>			<i>Automatic</i>
<i>RNAV/RNP STAR</i>	<i>Y</i>			<i>Automatic</i>
<i>COPTER RN P APCH</i>	<i>Y</i>			<i>Automatic</i>
<i>COPTER SBAS</i>	<i>Y</i>			<i>Automatic</i>

5. Type of Flight Management System which is used for flight data coding:
- Primarily GTN650 Hughes works directly with GARMIN or Honeywell to create Flight Inspection databases.*
6. Location and Type of flight simulators which is used for flyability check, if available:
- Hughes can source various simulators worldwide for Validation activities*
7. Charges per hour (USD, tax excluded) for simulation, including flight crew:
- TBD – Contact Hughes for a quote.*
8. GPS interference detection capability, if equipped:
- Provide the type of detection equipment and detection method.*
9. Languages possibly used by flight testing team:
- English*
10. Estimated annual flight time available to assist other Administrations for testing radio navigation aids:
- TBD*

11. Advance notice expected before delivery of the service:

- *30 Days*

12. State Regulation(s) commonly complied with when delivering flight inspection services:

- *NA*

13. State Regulation(s) commonly complied with when delivering flight validation services:

- *FAA, ICAO, Host Regulator*

14. Provide a link for further information, if any:

- www.hughesaerospace.com *Hughes App – iOS, Android*

15. Other information:

- *Hughes is certificated ANSP by the FAA, ICAO and other member states. Hughes provides procedure design, charting, flight inspection and procedure maintenance for both airports & heliports. Hughes can also source aircraft & simulators locally for validation activities.*
- *Contact Alyce Shingler at alyce.shingler@hughesaerospace.com +1.281.665.3330.*



Asia and Pacific Office

ASIA PACIFIC FLIGHT INSPECTION GUIDANCE MATERIAL

Second Edition

(ii)

AMENDMENTS

Amendments are announced in the supplements to the *Publications Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS, CORRIGENDA AND ADDENDA

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PREFACE

This publication was prepared in response to a recommendation from the “Seminar on Flight Inspection and Procedure Validation (FIPV)” held in the ICAO Asia and Pacific (APAC) Regional Office, Bangkok, Thailand from 24 to 27 September 2019 with content contribution from volunteer States / Administrations and industry partners. It is decided to complement existing Standards and Recommended Practices (SARPs) to provide guidance on flight inspection and to serve as a reference upon which States / Administrations can develop their own specific practices and procedures.

The guidance material is developed with the experiences and knowledge among APAC States / Administrations and industry partners and includes recommendations of key activities and milestones in planning, execution, and delivery of a flight inspection. Useful materials, including sample flight inspection reports are also included for reference. This guidance material can hopefully facilitate and be useful to States / Administrations, especially for those without a national Flight Inspection Service Provider (FISP) and with difficulties when conducting flight inspection.

This guidance material is not intended to and shall not replace the relevant flight inspection requirements stipulated in Annex 10 and Doc 8071. In the event of any inconsistency or conflict between this document and Annex 10 and Doc 8071, Annex 10 and Doc 8071 shall take precedence.

The support from ICAO APAC Office and contributions from the following volunteer State/Administration and industry partner (in alphabetical order) in preparing the guidance material are acknowledged and highly appreciated: -

- AeroPearl, Australia
- Airways, New Zealand
- Civil Aviation Authority of Singapore
- FCS Flight Calibration Services GmbH, Germany
- Flight Inspection Center, Civil Aviation Administration of China, China
- Hong Kong Civil Aviation Department, China

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GLOSSARY

SYMBOLS AND UNITS

DDM	Difference in the depth of modulation
Ft	Feet
Kg	Kilogram
Km/h	Kilometers per hour
Kw	Kilowatt
M	Meter
NM	Nautical mile
QNH	Atmospheric pressure adjusted to mean sea level

ABBREVIATIONS

ADS-B	Automatic Dependent Surveillance – Broadcast
AI	Artificial Intelligence
AIP	Aeronautical Information Publication
ANSP	Air Navigation Service Provider
AOC	Air Operator's Certificate
APAC	Asia and Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
CCC	Crew Coordination Concept
CNS	Communication, Navigation and Surveillance
COVID-19	Coronavirus Disease 2019
CRM	Crew Resource Management
DME	Distance Measuring Equipment
DVOR	Doppler VHF Omni-Directional Range
EASA	European Union Aviation Safety Agency
EFB	Electronic Flight Bag
FAA	Federal Aviation Administration of the United States of America
FIPV	Flight Inspection and Procedure Validation
FISP	Flight Inspection Service Provider
FL	Flight Level
FTL	Flight Time Limitation
GBAS	Ground Based Augmentation System
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
GP	Glidepath
ICAO	The International Civil Aviation Organization
ICASC	The International Committee for Airspace Standards and Calibration
IFR	Instrument Flight Rules
ILS	Instrument Landing System
LOC	Localizer
LSALT	Lowest Safe Altitude
MSA	Minimum Sector Altitude
MRVA	Minimum Radar Vectoring Altitude
NAVAID	Navigation Aid
NDB	Non Directional Beacon
NOTAM	Notice to Airmen
PANS-Ops	Procedures for Air Navigation Services – Aircraft Operations
PAPI	Precision Approach Path Indicator
PSR	Primary Surveillance Radar
RNAV	Area Navigation
RNP	Required Navigation Performance
RPAS	Remotely Piloted Aircraft Systems
SARPs	Standards And Recommended Practices
SMS	Safety Management System
SOPs	Standard Operating Procedures
SORA	Specific Operations Risk Assessment

SSR	Secondary Surveillance Radar
TAR	Test Accuracy Ratios
TERPs	Terminal Instrument Procedures
TRM	Team Resource Management
TSO	Technical Standard Orders
UAV	Unmanned Aerial Vehicle
VASI	Visual Approach Slope Indicator
VHF	Very High Frequency
VMC	Visual Meteorological Conditions

Chapter 1

INTRODUCTION

This material was developed in response to the recommendation from the Seminar on Flight Inspection and Procedure Validation (FIPV) held in the ICAO APAC Regional Office, Bangkok, Thailand from 24 to 27 September 2019, considering the typical need of States / Administrations without a national FIS provider and some recommended measures necessary for conducting flight inspection at night.

1.1 OBJECTIVE

1.1.1 In accordance with the ICAO Annex 10 Volume I and Document 8071 requirements, flight inspection has to be conducted periodically to ensure accuracy, reliability and integrity of the signals-in-space from the air navigation facilities, and that the radio navigation systems meet the SARPs in Annex 10.

1.1.2 While flight inspection could also be conducted for surveillance facilities and/or other purposes such as flight procedure validation, VHF coverage checking, etc., this guidance material focuses on flight inspection for air navigation and surveillance facilities and is a sharing and representation of common practices existing in a number of States with considerable experiences in flight inspection.

1.1.3 This guidance material introduces and describes different stages in flight inspection for air navigation facilities, including planning, conducting and accepting the report that all tolerances are met. It is not intended to recommend specific FISP(s) or equipment to be used, but rather to provide general details and guidelines in the arrangement of flight inspection for States' own consideration.

1.2 SCOPE

1.2.1 This guidance material describes general reference in conducting flight inspection, including resources planning, roles and responsibilities of involving parties and identification of stakeholders. It also provides guideline in communication with stakeholders and criteria on planning and scheduling flight inspection.

1.2.2 This document introduces example flight inspection procedures for Instrument Landing System (ILS) including visual aids, Doppler Very High Frequency Omni-Directional Range (DVOR), Distance Measuring Equipment (DME), Primary Surveillance Radar and Secondary Surveillance Radar (PSR / SSR) and discusses about the arrangement for flight inspection at night and also emergency flight inspections.

1.2.3 Reference is also given on the example flight inspection system performance specifications and associated Test Accuracy Ratios (TAR) and the workflow on reporting of flight inspection results. Sample flight inspection records and reports are also shared in this document for States to make reference with.

Chapter 2

PLANNING FOR FLIGHT INSPECTION

2.1 GENERAL

2.1.1 General Setup and Resources Planning

- 2.1.1.1 General setup – there are 2 typical scenarios of flight inspection arrangements:
- (a) State has its own flight inspection unit; or
 - (b) Engagement of external FISP.
- 2.1.1.2 State's own flight inspection unit will be:
- (a) Able to activate within a short period of time during emergency (high flexibility);
 - (b) Particularly useful when State has large number of facilities / aerodromes to be flight inspected; and
 - (c) Likely regulated by State.
- 2.1.1.3 Engagement of external FISP will be:
- (a) More cost effective when State has small number of facilities to be flight inspected;
 - (b) More feasible when the State may not have the necessary expertise;
 - (c) More flexible to change FISP to meet the required service performance; and
 - (d) Little or no control when an emergency flight inspection is required.
- 2.1.1.4 General planning before flight inspection typically includes the following:
- (a) Determine types of flight inspection required (commissioning or routine) and periodicity for routine ones;
 - (b) Identify facilities to be flight inspected;
 - (c) Determine type of aircraft used for flight inspection, for example using jet aircraft for high level (i.e. FL350 and above) radar coverage check;
 - (d) Check with apron operations on where the inspection aircraft can park and identify any traffic/timing restrictions for its taking off and landing;
 - (e) Plan the time of flight inspection, after consulting operations;
 - (f) Develop draft flight inspection schedule and flight inspection profiles as well as proposed date for brief and debrief;
 - (g) Notify parties involved/affected by draft flight inspection schedule and flight inspection profiles. Parties involved/affected could be ATC, runway maintenance team, military, ground handlers, Nav aids & Surveillance facilities managers, Nav aids & Surveillance maintenance staff, airfield lighting / Precision Approach Path Indicator (PAPI) maintenance team;
 - (h) Conduct flight inspection briefing with involved / affected parties;

- (i) Issue Notices to Airmen (NOTAMs) for any change / cancellation of runway maintenance works; and
- (j) Develop list of contact details of parties involved in the flight inspection.

2.1.2 Roles and Responsibilities of the Flight Inspection Service Provider (FISP) Including Crew Resources Management

FISP is the main party to provide safe and reliable flight inspection services. Selection of an appropriate FISP is a key successful factor for flight inspection.

2.1.2.1 Roles

- (a) Assist Air Navigation Service Provider (ANSP) in planning, scheduling and conducting the flight inspection;
- (b) Be familiar with the airspace / airport to conduct safe and efficient flight inspection with minimum impact to normal traffic; and
- (c) Provide routine, commissioning or ad-hoc (special or urgent) flight inspection services.

2.1.2.2 Responsibilities

- (a) Assist ANSP to ensure no equipment (e.g. navigation aids) would expire the validity period as recommended by ICAO or State's regulatory requirement, or any validity period as confirmed by the ANSP, with proper planning and scheduling of flight inspection tasks;
- (b) Survey or assist to survey the reference point(s) for Global Navigation Satellite System (GNSS) for precision flight inspection on ILS;
- (c) Obtain all the necessary permits to fly over areas for its flight inspection;
- (d) Closely coordinate with ATC and ground technical personnel to prepare and conduct flight inspection including the provision of flight profiles for ATC assessment;
- (e) Implement Safety Management System (SMS) as appropriate to deliver safe flight inspection services;
- (f) Keep good archived records of flight inspection results of the equipment / system being inspected and provide advice if there was any anomaly trend or result observed;
- (g) Feedback to the ANSP on overall flight inspection arrangement, discuss and assist to resolve problems encountered; and
- (h) Desirable to have Crew Resource Management (CRM) to clearly define the roles and responsibilities of each crew member and to establish close collaboration among the crew members.

2.1.2.3 Crew Resource Management (CRM) System

Crew Resource Management (CRM) and Crew Coordination Concept (CCC) define how crews are to work together and the roles and responsibilities of each crew member. It clearly describes the communications involved in executing tasks and should be reinforced by Standard Operating Procedures (SOPs) and checklists. The CRM system, however, does not only define the cooperation among cockpit members, but also should encompass procedures and communication between cockpit and cabin, and it should define the interface between the flight crew and the rest of the organisation, like tasking / scheduling, management, maintenance, etc. This holistic approach in CRM is of great importance to create a working environment that takes into account all requirements to accomplish the organization's mission profile safely and reliably. It effectively translates into a Team Resource Management (TRM).

2.1.3 Roles and Responsibilities of the Flight Inspector

A flight inspector is the person who performs checking on equipment / system status. He / she must be proficient and have a good understanding on the characteristics of various equipment / systems to be flight inspected as well as familiarise himself / herself with relevant procedures to perform flight inspection on that equipment / system.

2.1.3.1 Roles

- (a) Contribute in early planning of the flight inspection;
- (b) Coordinator between ANSP and the flight inspection service provider;
- (c) Perform equipment checking in flight inspection and alert ANSP in real time of any out-of-tolerance conditions or anomaly observed during the flight inspection;
- (d) Assist ANSP to identify and analyse any anomaly / adverse trends observed; and
- (e) Prepare flight inspection records and reports.

2.1.3.2 Responsibilities

- (a) Provide advice to ANSP in planning the flight inspection tasks;
- (b) Assist in preparing flight inspection procedures for checking a specific equipment / system;
- (c) Coordinate with the rest of flight inspection team (e.g. pilots) for ad-hoc and flexible arrangement of flight inspection procedures (e.g. re-check on a specific run);
- (d) Observe the measured results of flight inspection and checks against the relevant tolerance limits;
- (e) Keep records of the measurement results and notifies ANSP for any trend/anomaly observed;
- (f) Assist ANSP from the flight inspection perspective for the rectification on any anomaly observed; and
- (g) Coordinate any real time changes to the flight inspection schedule due to unforeseen circumstances such as inclement weather, aircraft or aircrew problem.

2.1.4 Roles and Responsibilities of ANSP

The ANSP is ultimately responsible for management of the flight inspection. It is therefore vital that ANSP takes an active role throughout the flight inspection.

2.1.4.1 Roles

- (a) Types of ANSP Personnel
 - (i) Ground technical personnel maintaining navigational and landing aids, surveillance radars, airfield lighting and PAPIs, etc.; and
 - (ii) Air Traffic Controllers – En-route, Approach and Tower.

2.1.4.2 Responsibilities

- (a) Ensure that all systems and facilities to be flight inspected are operational and in a condition suitable for flight inspection on the scheduled dates;
- (b) Ensure all systems and facilities are regularly flight inspected, complying with the State's regulatory requirement on the periodicity of flight inspection;

- (c) Provide an annual draft schedule of systems and facilities to be flight inspected to the flight inspection service provider to facilitate early planning;
- (d) Assist in obtaining security clearance for flight inspection crew to access aircraft;
- (e) Provide necessary geographical information of systems & facilities under flight inspection, for example latitude and longitude co-ordinates of all navigation facilities;
- (f) Provide authorization for flight inspection aircraft to fly below established minimum altitudes, together with all other necessary air traffic authorizations to accomplish the flight inspection;
- (g) Provide qualified staff to be present during flight inspection;
- (h) Coordinate flight inspection briefing and debriefing;
- (i) Review flight inspection profiles with ATC and arrange discussion with FISP for any clarification, if required;
- (j) Ensure FISP obtain necessary permits to fly over areas for the planned flight inspection;
- (k) Issue necessary NOTAMs for flight inspection;
- (l) Review flight inspection reports;
- (m) Publish addition or / and amendments to AIP regarding systems / facilities after flight inspection;
- (n) Make arrangement for flight inspection crew to call ATC before the start of each sortie for co-ordination purposes;
- (o) ATC to facilitate flight inspection and accord it some priority, whenever possible; and
- (p) ATC to be conversant with flight inspection profiles.

2.2 FLIGHT INSPECTION COORDINATION AND PREPARATION

2.2.1 Identification of Stakeholders

The smooth conduct of flight inspection requires concerted efforts from all key stakeholders. Subject to the organization structure in the States, an example list of stakeholders related to flight inspection is provided below for reference:

2.2.1.1 Flight Inspection Service Provider (FISP)

- (a) FISP plays a vital role in flight inspection and is expected to be conversant with the relevant ICAO and local standards and requirements for flight inspection of various CNS equipment. FISP is also expected to be familiar with the flight profiles to be conducted and local airport / airspace environment in order to perform flight inspection in an efficient and effective manner. FISP should also be familiar with details of permits / approvals required for flying in airspace to ensure a successful and effective flight inspection.
- (b) The flight inspection team deployed by the FISP normally consists of three types of staff, namely pilots, flight inspectors and aircraft engineers.
 - (i) Pilots – mainly communicate with air traffic controllers to perform flight inspection profiles
 - (ii) Flight Inspector – mainly coordinate with ground maintenance personnel or systems supplier engineer to take, report and calibrate measurement reading to ensure the equipment under inspection performs within the relevant tolerance limits.

- (iii) Aircraft Engineer – support staff to deal with daily maintenance and problems encountered on the flight inspection aircraft, which would normally have been deployed at a far distance from the FISP's main base.

2.2.1.2 ANSP - Air Traffic Controller

- (a) States may consider, as far as practicable, to assign dedicated air traffic controller(s) in handling the flight inspection aircraft, in which the flight path might cross multiple sectors and affect normal traffic patterns. Experienced air traffic controllers could efficiently reduce the lead time to conduct flight inspection, while keeping the impact to normal traffic to a minimum.
- (b) Subject to different airport and airspace, temporary holding of ground and / or air traffic might be required to allow the flight inspection aircraft to conduct dedicated profiles unaffected.
- (c) Air traffic controller handling flight inspection aircraft has to work closely with the flight inspection pilot and keep a very close eye on the aircraft position to keep it clear from normal traffic.

2.2.1.3 Aerodrome Operator

- (a) Local aerodrome operator plays an important role in providing necessary logistics support to the flight inspection team, for example in the facilitation of access to airport restricted area, facilitate the conduct of flight profiles on ground or assist in handling the shipment of spare parts to address technical faults encountered by the flight inspection aircraft.

2.2.1.4 ANSP - Ground Maintenance Personnel

- (a) The ground maintenance personnel are responsible for equipment maintenance and adjustment during the flight inspection. They have to work closely with the flight inspector to ensure the measured reading is within tolerance limit and ensure the equipment is safe for operational use. Prior to the flight inspection, the ground maintenance personnel shall also ensure the equipment is operational and in a condition suitable for flight inspection.

2.2.1.5 Other Supporting Personnel

- (a) To facilitate daily flight inspection mission, there might be logistics support required for the flight and ground crews of the flight inspection team to travel between airport and their accommodation place. Immigration, Customs and Exercise clearance support might also be required to facilitate smooth operation of flight inspection activities.

2.2.1.6 Military, if applicable

- (a) The military shall be informed of the civilian flight inspection schedule to ensure military flights and civilian flight inspection aircraft routes are de-conflicted. The civilian flight inspection aircraft should take note of the military no fly zones.

2.2.2 Communication with Stakeholders

2.2.2.1 A thorough understanding of the details of flight inspection arrangements is crucial to the successful completion of a flight inspection. All stakeholders should know their roles and duties to render the best support to the flight inspection activities.

2.2.2.2 To facilitate clear communication among stakeholders, ANSP could consider preparing a comprehensive but concise daily programme for sharing among all stakeholders. The daily programme would typically include information on equipment / facility to be inspected, estimated start and end time, parties involved and their roles, useful contacts, etc. (see sample at Attachment A to this chapter).

2.2.2.3 In addition, the ANSP could also consider preparing a detailed flight inspection check sheet for each equipment / facility to document the planned flight inspection profiles to be conducted (preferably with diagrams for easy visualisation) and estimated duration for each run. This check sheet could greatly facilitate air traffic controllers and airport stakeholders to assess any potential impact to airport / airspace operations and to aid

communication during the flight inspection (see sample at Attachment B to this chapter). Appropriate NOTAM should also be issued to ensure airlines and pilots are kept informed of the flight inspection schedule and time.

2.2.2.4 Before the commencement of each round of flight inspection, an in-briefing involving all key stakeholders is recommended to ensure all are familiar with their roles and responsibilities in supporting the daily flight inspection as well as any issues requiring special attention. This also allows all stakeholders to exchange comments about the daily arrangement, for instance the flight profiles sequence, and helps to spot early issues that would potentially hinder normal ATC operations and flight inspection.

2.2.2.5 Contingency plan, including 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 during the in-briefing.

2.2.2.6 During the flight inspection, it is essential that the ground maintenance personnel maintains direct communication with the on-board flight inspector so that any required adjustment of ground facilities or any recheck can be done expeditiously.

2.2.2.7 During the flight inspection period, daily de-briefing among flight inspection crews, ANSP, ATC and ground maintenance personnel would allow quick feedback on any issues encountered during the flight inspection so as to make timely fine-tuning when necessary for the subsequent flight inspection. This allows individual stakeholder to make adjustment / enhancement arrangement promptly such as issuance / cancellation of NOTAM, co-ordination / cancellation of runway closures, etc.

2.2.2.8 After the completion of each round of flight inspection, a de-briefing involving all stakeholders would help all to strive for continuous improvements on overall flight inspection arrangement, with parties sharing their views and suggestions as well as to share results and resulting actions of the flight inspection.

2.2.3 Consideration in the Planning and Scheduling of Flight Inspection

Flight inspection, depending on the exact flight profiles to be conducted, often causes some degrees of disruption to normal airport and airspace operations, especially at busy international airports during peak traffic hours. When planning and scheduling flight inspections, a number of key factors have to be considered so as to minimise potential interruptions to normal operations, for example:-

2.2.3.1 Traffic Volume

- (a) During day time when normal traffic is usually at its peak, the coordination of flight inspection by air traffic controllers will be complex and with great challenges which often results in undesirable disruption to normal air traffic. Hence, for busy airports, there is a trend to advance the flight inspection time to dawn or even earlier so as to avoid the busy day time traffic.
- (b) Some flight inspection profiles may require day-light conditions to perform. When scheduling the flight inspection, one possible way to take advantage of less busy early hours would be to perform those flight profiles that do not require day-light condition first, followed by those requiring day-light conditions. As the time of flight inspection is dependent on time of peak traffic volume, close co-ordination and early inputs from ATC and slot planner from the airport operator in the planning would be beneficial.

2.2.3.2 Holiday and Peak Travel Season

- (a) Long holidays and travel peak seasons would significantly increase the air traffic volume. In some ANSPs, there may also be a period of time in which equipment configuration or change is not allowed as this supports the heavy traffic in long holiday and peak season. Therefore, when planning and scheduling flight inspection programs, such long holiday and travelling peak seasons should be avoided as far as practicable.

2.2.3.3 Seasonal Weather Condition

- (a) In some States, there might be seasonal strong winds, typhoons or severe weather conditions in some parts of the year. Heavy rainfall, lightning and other severe weather conditions may impact or delay flight inspection activities. As such, the flight inspection program should be scheduled to avoid bad weather seasons as far as practicable.

2.2.3.4 Major Military Flying Exercises

- (a) Planning of flight inspection should avoid disruption with a period of major military flying exercises. This is because during the latter, many forbidden flying areas / zones may be activated and such activations could affect the normal flight inspection.

2.2.3.5 Types of Flight Inspections

- (a) Depending on type of flight inspections, some of them, such as some ILS commissioning checks, procedure validation, etc., may have to be carried out in the daytime with suitable visual conditions.

2.2.3.6 Contingency Arrangement

- (a) Back-up/contingency dates should be planned to cater for any unplanned cancellation or effect on flight inspection activities.
- (b) The back-up/contingency flight inspection date(s) could be inserted as buffer date(s) in between the planned flight inspection activities, or after all the planned flight inspection activities as an extended arrangement.

2.3 FLIGHT INSPECTION AT NIGHT

Flight inspection operations at night are becoming more popular and may inevitably be required at large and high traffic density airports so as to minimize potential impact to the normal air traffic flow. The possibility of reduced traffic flow densities at night may allow the necessary inspection profiles to be flown with minimal disruption to ATC. However, the potential risks for the FISP crews for performing such tasks at night need to be properly managed.

To reduce the risk in flight inspection at night, FISP crews should be familiar with the airspace and airport environment including the height of terrain and structures along and close to the flight inspection path. Air traffic controllers have to pay special attention to the altitude and flight path of the flight inspection aircraft to avoid any deviation from the planned safe flight path.

Night operations should be considered as any flight inspection being performed 30 minutes after sunset until 30 minutes before sunrise.

2.3.1 Flight Inspection Aircraft Type

2.3.1.1 The aircraft should be a multi-engine type capable of safe flight within the intended operational envelope with one engine inoperative, fully equipped and instrumented for night and instrument flight operations.

2.3.2 Crew Resource Management (CRM)

2.3.2.1 Flight inspection operations at night present additional risks that must be identified, assessed with necessary mitigations and documented. Night flying operations should only be conducted by experienced pilots that are current and proficient at night flying and who understand well the risks associated with night-time flight inspection.

2.3.2.2 A dual pilot operation should be considered for a normal night flight inspection operation to mitigate against the higher risks involved for night operations.

2.3.3 Night Duty Periods

2.3.3.1 FISPs operate under their own Air Operator's Certificate (AOC) and Flight Time Limitation (FTL) which would normally include duty periods for their specific night operations. Consideration should be given to the preceding duty period prior to any planned night duty to ensure the crew, including the flight inspector, have enough rest periods before and after the night duties.

2.3.3.2 Limitations should be provided for night duties worked in immediate succession, for example two consecutive nights, with a maximum duty period of 11 hours each.

2.3.3.3 Upon the conduction of a single night duty, or two consecutive night duties, there should be a minimum interval of rest time for the FISP crews before the commencement of the next duty time.

2.3.4 Operational Requirements

2.3.4.1 Where a requirement exists for flight inspection of ILS or other NAVAID installations at night, the following operational requirements should be met.

2.3.4.2 Aircraft Related - In addition to the normal equipment required for a night operation, the following equipment should be functioning normally:

- (a) Both aircraft altimeters;
- (b) Radar altitude indicators;
- (c) Auto-Pilot;
- (d) All flight instrument displays;
- (e) Up-to-date database for flight inspection equipment map display (If applicable);
- (f) Electronic Flight Bag (EFB), if applicable; and
- (g) Approach plate holders with adequate lighting.

2.3.4.3 ANSP Related – The following is recommended to be provided by the ANSP prior to any night flight inspection operation:

- (a) ATC are able to provide an Instrument Flight Rules (IFR) service;
- (b) ANSP should provide a full radar service within the area of operation;
- (c) Runway edge, centreline, approach lighting and PAPI's shall be serviceable and operating normally;
- (d) Any obstacle lighting shall be operational within the designated area of operation;
- (e) The weather conditions for the night inspection must be Visual Meteorological Conditions (VMC) below the 25/10 NM Minimum Sector Altitude (MSA) or Minimum Radar Vectoring Altitude (MRVA) / Radar Lower Safe Altitude (LSALT); and
- (f) ATC to provide any aerodrome QNH changes expeditiously.

2.3.4.4 Pilot Related - Prior to the commencement of any night inspection operation, a skyline plot of the obstructions in the approach path must be obtained from the aerodrome operating authority. The pilot should compare the intended inspection runs and adjustments made to the minimum operating altitude as necessary.

2.3.4.5 Where flight crews have not conducted a daylight operation into an aerodrome, then prior to conducting a night inspection task, the crew should first fly the approach in daylight conditions to assess the obstacle clearance within the approach area.

2.3.4.6 Areas surrounding the inspection runs shall be predominantly level, clear of terrain and obstacles.

2.3.4.7 For operations in certain States it may be compulsory for the crew to provide an alternate Aerodrome for recovery, these requirements must be determined prior to commencement of night operations. In addition, holding and alternate requirements always need to be borne in mind.

2.3.4.8 To raise the flight crew situational awareness and to reduce fatigue, the autopilot should be used whenever possible.

2.3.4.9 Flights should be conducted under the IFR.

2.3.4.10 Flight Inspection Profiles - Flight inspection at night should be conducted using the following minimum altitudes:

- (a) Level runs, Orbits and Part Orbits should not be conducted below the sector 25NM/10NM MSA or radar LSALT.
- (b) Not below SECTOR 25/10 NM MSA or radar LSALT until established on a flight inspection approach run, when established within full-scale deflection of the localiser descent may occur.

2.3.4.11 Localiser (LOC) offset approaches that involve flights more than half scale (5 Dots) indications should be flown during daylight.

2.3.4.12 Where a LOC part orbit altitude needs to be increased for a night operation, a range change may be required to ensure that the localiser coverage area correlates with the published GlidePath (GP) angle.

2.3.4.13 Cat III ILS approaches that include a fly through at 50ft along the runway to ILS Point 'E' should only be flown at night providing the following are met:

- (a) Runway centreline lights are serviceable; and
- (b) Pilots have conducted the relevant simulator training for such an operation.

An alternate method would be for the aircraft to perform a run along the runway centreline prior or post the inspection.

2.3.4.14 GP approach profiles that involve flight with more than half scale "FLY UP" indications should be flown during daylight e.g. GP lower edge (5 dots Fly Up) runs.

2.3.4.15 GP level runs need to encompass coverage and clearance at a minimum angle of 0.45° , however, increasing the height to be at MSA for this measurement will inevitably mean an increase in the start range to achieve this, with the possibility that the GP coverage tolerance may not be met beyond 10NM. As an alternate solution, the GP level run profile could be flown with the addition of the night profile run during daylight and the measurements used as a reference transfer standard between the two profiles.

2.4 EMERGENCY FLIGHT INSPECTION ARRANGEMENT

2.4.1 Types of Flight Inspection

2.4.1.1 The various types and priorities of flight inspection are published within ICAO DOC 8071, Chapter 1 (Para.1.5). The following paragraphs discuss the requirements surrounding special inspections.

2.4.2 Priorities of Flight Inspection

2.4.2.1 If there are multiple flight inspection requests, the use of inspection priorities will determine the tasks to be supported first and make the most effective use of the resources in FISP. The following is an order of priorities that should be considered:

Priority	Type	Description
1	Accident/Incident	Accident or incident investigation requiring immediate response.
2	Restoration	Restore a commissioned facility after an unscheduled outage.
3	Periodic	A regularly scheduled inspection of a commissioned facility.
4	Commissioning	A comprehensive inspection of a newly installed facility.
5	Site Evaluation	An inspection to determine the environmental effects on the performance of a planned navigational aid.

Table 2-1. Flight Inspection Priority

2.4.3 Post-Accident Investigation

2.4.3.1 A flight inspection may be requested following an accident or incident by the investigating authority to verify the NAVAID system performance is satisfactory and able to continue to support the published instrument approach procedures and ANSP operations.

2.4.3.2 For a FISP, this type of inspection should be accorded highest priority and an appropriate response time should be contractually agreed between the ANSP and the service provider.

2.4.3.3 Pre-Flight Requirements – The flight inspector will be required to obtain the following information:

- (a) Equipment configuration at the time of the accident i.e. transmitter in operation;
- (b) Instrument approach procedures used; and
- (c) Any additional information required to support the investigation.

2.4.3.4 The flight inspector will need to coordinate the system configuration with the maintenance personnel and perform as a minimum, an inspection of the facility which may include the instrument procedure used if applicable. It is important to note that no equipment adjustments should be made during this inspection and if required, should be performed in a separate special inspection to facilitate investigation.

2.4.3.5 In the event of an accident or incident, ANSP should do all that is reasonably practicable to ascertain that a NAVAID is operating correctly. For this reason, ANSP should have equipment suitable for making field measurements available.

2.4.4 Post-Incident Investigation

2.4.4.1 Where a runway excursion by an aircraft has occurred and damage has been sustained to a NAVAID, the maintenance authority will determine the repairs required to the facility and whether a ground or flight inspection is required to return the facility back into service. However, the following considerations should be given when determining the need for a flight inspection:

- (a) Antenna array replacements that will affect the radiated pattern;
- (b) Cable replacements that affect transmission line lengths;
- (c) Replacement or re-positioning of an ILS near field monitor if the system does not contain integral course monitoring;
- (d) Major repair work to the LOC antenna distribution unit or when the center line phasor has been adjusted;
- (e) Adjustment or corrective maintenance on phasing or width controls that results in figures outside the monitor site acceptance figures;
- (f) Any work performed on the GP antenna distribution unit;
- (g) Adjusts to GP integral monitor probes, cables or monitor combiner unit; or
- (h) Damage to ILS critical areas ground in the beam forming areas that need re-grading.

2.4.4.2 In the event of an accident or incident, ANSP should do all that is reasonably practicable to ascertain that the facility is operating correctly. For this reason, all aerodromes should have equipment suitable for making field measurements available.

2.4.5 Flight Inspection Service Providers (FISP)

2.4.5.1 Information regarding FISP may be obtained from the appropriate ICAO Regional Office or online from the International Committee for Airspace Standards and Calibration (ICASC) at <http://www.icasc.co>¹

¹ ICAO DOC 8071 Fifth Edition, 2018

2.4.6 Navigational Aid Performance Reports

2.4.6.1 The reporting of aviation safety occurrences is vital to the prevention of aircraft accidents and contributes to the understanding of where safety risks lie within the aviation system. This information provides an understanding of the safety related issues thus allowing these to be addressed and relevant measures adopted. Safety occurrence reporting by aviation professionals contributes to the prevention of accidents and fundamentally promotes the safety of aviation activities within the organisations that employs them or uses their services.

2.4.6.2 Persons involved in aviation activities should be encouraged to report any safety issue they encountered. State regulations should differentiate between the cases which would require mandatory reporting and those that may be reported after judging it relevant.

2.4.6.3 The obligation of these reporting occurrences would be included within the normal operation of an organisation's SMS. ANSP or airline operator should, through a mandatory reporting system, inform the relevant authority of a particular occurrence and with defined categories that represent a significant risk to aviation safety.

2.4.6.4 Safety management systems are reliant on the collection and analysis of safety related information. Therefore, anything that is perceived by the individuals as having the potential to impact safety should be reported within reasonable time, for example, 72 hours to raise awareness of the occurrence.

2.4.6.5 Organisations SMS may define the format of the occurrence reports to be used by relevant aviation professional. It should include areas to report NAVAID performance or RNAV procedure where relevant. In general, reporting forms need to be user friendly and will not discourage potential reporters to report the occurrences. The aim should be to facilitate the collection of occurrence information as much as practicable from the front-line individuals and allow the appropriate authorities to understand and address the issues from the information provided.

2.4.6.6 The following reporting information requirements should be considered as a minimum, but not limited to, in the determination of NAVAID's performance from both an ATC and Pilots perspective.

- (a) Date/Time UTC
- (b) Aircraft Call Sign
- (c) Airline Operator
- (d) Pilot Name
- (e) SSR Code
- (f) Aircraft Type
- (g) Aircraft Flight Phase (Climb, Descent, Level, Approach), IFR/VFR, Radar Vectored, Navigational Aid in use (ILS/VOR/DME/NDB/RNAV)
- (h) Description of Occurrence

2.4.6.7 ANSP's and Airline Operators are likely to have their own organisations occurrence report forms to cover the mandated reporting requirements within their SMS. These may not contain the aforementioned information relevant for a pilot reporting an unreliable NAVAID performance. Therefore, additional information may be required for investigation purposes depending on the seriousness of the occurrence. Consultation with the ground technicians will greatly assist an immediate investigation on a system status and possible actions required.

2.4.6.8 For precision approach landing aid systems such as an ILS/DME or GNSS Landing System (GLS), once an occurrence report related to the system is received from a pilot, an ANSP would have to follow up by investigation and discussion with ground technicians and may require the issue of a NOTAM on that facility once it is identified to be faulty and requires maintenance. The ANSP has to ensure a continued safe operation or provide alternative services and procedures resulting from the occurrence.

2.5 CONSIDERATIONS ON FLIGHT INSPECTION PERIODICITY DURING PANDEMIC

2.5.1 There might be occasion that the flight inspection could be affected by external factor with global impact, such as the COVID-19 pandemic. With such a huge global impact, cross-country deployment of flight inspection aircraft might become difficult, especially for those States who do not have their own FISP. As such,

States should assess and consider the flight inspection periodicity on radio navigation aids to secure continuous service or keep minimum impact to service.

2.5.2 ICAO has published a reference note on the considerations of radio navigation aids flight inspection practices during the pandemic and restoration to service after temporary removal from service, details please refer to the following link:

<https://www.icao.int/safety/OPS/OPS-Normal/Pages/Flight-inspection-for-radio-aids.aspx>

Attachment A

Example Flight Inspection Programme

Example Routine Flight Inspection Program

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Remarks
In-briefing at (time)						In-briefing with flight inspection team
	XX VOR OFF (time)	XX VOR F/I (start time)				XX VOR – periodic F/I after annual maintenance
			XX ILS maintenance (off time)	XX Tx 1 F/I (start time) XX Tx 2 F/I (start time)		XX ILS - periodic F/I after annual maintenance
					De-briefing	De-briefing with flight inspection team

Notes for ATC and/or Aerodrome Operator:

- Expected period and end time for VOR and ILS flight inspection
- Runway closure and maintenance requirements

Attachment B

Example Flight Inspection Profiles

VOR/DME Routine Inspection

EXAMPLE VOR/DME INSPECTION PROCEDURES LIST					Profile Version
Facility ID			[Facility ID]	Routine Inspection	
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		Radial xxx°	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1	e.g. Reference Radial/Alignment Check
		Radial xxx°	xxNM-xxNM, QNH xxxxFT	VOR/DME No.2	e.g. Reference Radial/Alignment Check
		Radial xxx°	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1 Only	e.g. VOR Monitor Alarm Check
		Radial xxx°	xxNM-xxNM, QNH xxxxFT		
		Radial xxx°	xxNM-xxNM, QNH xxxxFT	VOR/DME No.1	e.g. VOR Monitor Alarm Normal
		Orbiting (C.C.W. / C.W.)	Radius: xxNM, QNH xxxxFT	VOR/DME No.1	Mean Alignment Error, Bends, Roughness, DME Range Error
		Orbiting (C.C.W. / C.W.)	Radius: xxNM, QNH xxxxFT	VOR/DME No.2	Mean Alignment Error, Bends, Roughness, DME Range Error

Routine Inspection (ILS Tx1)

EXAMPLE ILS INSPECTION PROCEDURES LIST					Profile Version
Runway		ILS Name	ID	ILS Identification	Routine Inspection
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		e.g. Threshold Parking	Runway	LOC No.1&2	e.g. Monitor Alarm Check
xxxx-xxxx		e.g. Level Run	xxNM-xxNM QNH xxxxFT	GP No.1	e.g. Width (including alarm), Symmetry SBP, etc.
xxxx-xxxx		e.g. Level Arc	xxNM, +xx°/-xx°, QNH xxxxFT	LOC No.1	e.g. Width (including alarm), Symmetry, Clearance, etc.
xxxx-xxxx		e.g. Approach with low pass	Initial From xxNM and QNH xxxxFT	DME No.1; LOC/GP No.1	e.g. DME and Runway Lighting, Path Angle, Datum, Mod Sum, Structure, etc.

Routine Inspection (ILS Tx2)

EXAMPLE ILS INSPECTION PROCEDURES LIST					Profile Version
Runway		ILS Name	ID	ILS Identification	Routine Inspection
Target Completion Time (LT)	Run No.	Flight Procedure	Procedure Description	Facility Transmitter Number	Items To Be Inspected
xxxx-xxxx		e.g. Level Run	xxNM-xxNM QNH xxxxFT	GP No.2	e.g. Width (including alarm), Symmetry SBP, etc.
xxxx-xxxx		e.g. Level Arc	xxNM, +xx°/-xx°, QNH xxxxFT	LOC No.2	e.g. Width (including alarm), Symmetry, Clearance, etc.
xxxx-xxxx		e.g. Approach with low pass	Initial From xxNM and QNH xxxxFT	DME No.2; LOC/GP No.2	e.g. DME and Runway Lighting, Path Angle, Datum, Mod Sum, Structure, etc.

Remarks:

- Any protection to ILS sensitive area should be applied

Chapter 3

Conducting Flight Inspection

3.1 TYPICAL FLIGHT INSPECTION PROCEDURES

3.1.1 Flight Inspection Procedures Manual

3.1.1.1 Each FISP should provide evidence of operating to a Flight Inspection Procedure Manual. This manual provides assurance to the customer that the necessary compliance checks are being carried out as intended by Doc 8071 and can help with demonstrating compliance. These may vary State to State depending on the regulatory oversight. Some investigation into other areas of aviation within your State can aid with what could be acceptable criteria such as:

- (a) Procedure Development (Procedures for Air Navigation Services – Aircraft Operations (PANS-Ops) or Terminal Instrument Procedures (TERPs)); and
- (b) Aircraft Recognized Approval Documentation (FAA/EASA, etc.).

3.1.1.2 Doc 8071 provides guidance on typical check methods intended for both Ground and Air for each facility type. The operator should ensure that each listed item is applicable to the inspection type (Commissioning or Categorization, Site, Periodic). The operator or owner of the facility should verify the FISP is adequate to satisfy the required parameter check. For comparison, flight test procedures have been also included in Doc 8071 for guidance.

3.1.1.3 Some flight profiles have been included in this document to assist with comparisons. In some situations, flight validation of the procedure is considered a separate inspection, and therefore it is important to check if the intended procedure covers flying the approach procedure. This may be of benefit in satisfying the procedure revalidation criteria.

3.1.1.4 Clear procedures should be provided to cover any navigational, surveillance or communication equipment that is subject to flight inspections. Inspections should be undertaken with equipment that has calibration traceability and where the FISP can provide clear evidence of the suitability for individual parameter assessment. A Test Accuracy Ratio (TAR) of minimum three or better for each parameter measured can provide a good picture of uncertainties and if the system is fit for purpose.

3.1.1.5 As a provider of service such as DVOR, ILS or other navigational equipment, it is important that the ANSP can demonstrate the facilities are operating to the respective ICAO standard. For this reason, the closer the inspecting receivers represents the level of avionics needed in large aircraft, the less risk of finding inconsistencies between airline approaches and ground check measurements. Hence it is sometimes advantageous if the equipment has international accreditation such as TSO conformance and other relevant aircraft software development standards. This is more important for systems that are directly used for the purpose of Air Navigation verification. The degree of compliance is less for items used as a surveillance tool.

3.1.2 Instrument Landing System (ILS)

3.1.2.1 Key requirements:

- (a) Antenna should be calibrated for field strength through the frequency range and different orientations. This should also include frequency response and polar patterns. This data should be available for verification.
- (b) The antenna should have TSO compliance for IFR and comply with the local airworthy certification. Location and installation of the antenna should be in accordance with the following:
 - (i) Recordings should show minimum propeller modulation.
 - (ii) Aircraft should be fitted with airworthy ILS/DME/Markers equipment approved for IFR flight.

- (iii) Kit should be capable of recording the required parameters against the reference system, typically at a rate greater than 5 samples per second.
- (iv) The antenna should also have the appropriate TSO rating as required by IFR flight.
- (v) The kit should be capable of recording the parameters as outlined in Doc 8071 within the accuracy specified.

3.1.2.2 Typical Flight Profiles for ILS flight checks:

- (a) Alignment runs normally commencing as required by the published procedure or 10NM for periodic Inspections.
- (b) 6-10NM arc profiles, forty degrees either side of the runway centre-line.

3.1.2.3 Typical parameters to be recorded as applicable for the items being checked:

- (a) Receiver course deviation for all systems include Localizer/Glidepath/markers/DME
- (b) Aircraft position fixing system deviation
- (c) The difference (a) minus (b)
- (d) Receiver input signal level
- (e) Modulation levels
- (f) Frequency spectrum (optional)

3.1.2.4 Careful consideration should be made with regard to the procedures used and the purpose of the check.

3.1.2.5 Depending on the methods employed to ensure monitor integrity, instead of inspecting both the transmitting and monitoring systems of the ILS in every check, some locations may choose to flight inspect the transmitting system once in every two inspections.

3.1.2.6 FISP should be able to provide a table of parameters to assist with comparisons against Doc 8071.

3.1.2.7 An example checklist of commissioning and periodic flight inspection items for ILS is tabulated below for reference.

Check Item	Commission	Periodic
Identification	X	X
Modulation Balance	X	R
Modulation Depth	X	X
Polarisation	X	R
Front Course Alignment	X	X
Course Structure	X	X
Course Sector Width and Symmetry	X	R
Off-course DDM Clearance	X	-
Coverage or Usable Distance	X	-
Monitor Alarm – Front Course Alignment (Position Alarm)	X	X
Monitor Alarm - Course Sector Width (Width Alarms)	X	X
Monitor Alarm - Off-Course DDM Clearance	X ⁽¹⁾	X
Monitor Alarm – Coverage	X	-
Dual Equipment	X	X ⁽³⁾
Flyability	X	X
Associated Navigation Aids (Navaids)	X	X ⁽²⁾

LEGEND: R = To action on request
X = To action

- = Not required
- (1) = Capture/Clearance Wide Alarm applies only for a dual frequency localizer
- (2) = Includes runway visual aids
- (3) = Alignment, Modulation Depth and Identification Only

3.1.3 Doppler Very High Frequency Omni-Directional Range (DVOR)

3.1.3.1 Key requirements:

- (a) Antenna should be calibrated for field strength, and data should be available for verification. The antenna should have TSO compliance for IFR and comply with the local airworthy certification.
- (b) Recordings should show minimum propeller modulation.
- (c) Aircraft should be fitted with airworthy DVOR equipment approved for IFR flight.
- (d) Kit should be capable of recording the required parameters against the reference system, typically at a rate greater than 5 samples per second.
- (e) The antenna should also have the appropriate TSO rating as required by IFR flight.
- (f) The kit should be capable of recording the parameters as outlined in Doc 8071, within the accuracy specified.

3.1.3.2 Typical parameters to be recorded as applicable for the items being checked:

- (a) Receiver course deviation
- (b) Aircraft position fixing system deviation
- (c) The difference (a) minus (b)
- (d) Receiver input signal level
- (e) Modulation levels
- (f) Modulation index

3.1.3.3 An example checklist of commissioning and periodic flight inspection items for DVOR is tabulated below for reference.

Check	Commission	Periodic
Identification	X	X
Voice	X	X
9960 Hz/30 Hz Levels	X	X
Vertical Polarisation	X	-
Orbit	X	X
En route Radials	X	R
Terminal Radials and Procedures	X	X ⁽²⁾
Radial Plan	X	-
Intersections and Changeover Points	X	-
Off-track Coverage	X	-
VOR/DME Sector Altitude Coverage	X	R
High Angle Coverage	X	R
Receiver Checkpoint	X	X
VOR Monitor Checks	X	X
Dual Equipment	X	X
Transmitter Differential	X	-
Standby Power	X	-
Associated Navigation Aids (Navaids)	X	X ⁽¹⁾

LEGEND: R = To action on request
X = To action

- = Not required
- (1) = An appearance inspection of the VASI/PAPI is to be included if not otherwise subject to a routine inspection
- (2) = Final approach radial(s) only, profile as published

3.1.3.4 Some typical Flight Profiles for DVOR flight inspections:

- (a) Arcs at published minimum safe altitude.
- (b) Published approach radials at advisory altitudes.

3.1.4 Distance Measuring Equipment (DME)

3.1.4.1 Key requirements:

- (a) Antenna should be calibrated for field strength and data should be available for verification. This should consider cables and connectors.

3.1.4.2 A summary of flight test requirements is listed in ICAO Doc 8071. These form a comparison against the FISP's procedure manual. If there are missing parameters, further clarification should be made where in some cases, with acceptable technical and statistical validation, these parameters could be moved to a ground inspection. This is more common on DME facilities. However, this may not be acceptable by your State's regulatory authority and may need to be endorsed by them.

3.1.4.3 Often the DME equipment would be included as part of the ILS or DVOR flight inspections where it is considered an associated facility.

3.1.4.4 Typically, published DME arcs with the appropriate altitude restrictions would be flown, and in accordance with any associated procedures.

3.1.4.5 Doc 8071 provides a list of parameters for reference. It is important to consider both ground check requirements and flight inspection requirements for DME.

3.1.4.6 An example checklist of commissioning and periodic flight inspection items for DME is tabulated below for reference.

Check	Commission	Periodic
Identification	X	X
DME System Distance Accuracy	X	X
Coverage - Terminal Procedures	X	X
Coverage – En-route Radials	X	-
Coverage - Off-track	X ⁽¹⁾	-
Coverage - Steps, Intersections and Changeover Points	X	-
Sector Coverage	X ⁽¹⁾	-
Dual Equipment	X	X ⁽²⁾
Standby Power	X	-
Associated Navigation Aids (Nav aids)	X	X

LEGEND: X = To action
 - = Not required
 (1) = As specified by Navigation Services
 (2) = Identification only for second transponder

3.1.5 Primary Surveillance Radar and Secondary Surveillance Radar (PSR/SSR)

3.1.5.1 The requirements are very dependent on the engineering assessment requirements and expected coverage volume.

3.1.5.2 Some typical considerations are:

- (a) Altitude;
- (b) Range;

- (c) Delay to alert; and
- (d) Minimum radar coverage elevation.

3.1.5.3 According to Doc 8071, Civil ATC PSR and SSR facilities, after being commissioned and set into operational service, do not require a periodic flight inspection.

3.1.5.4 Special flight inspections may be conducted as part of a measurement campaign after major equipment modifications, or for specific problem investigation.

3.2 OTHER TYPES OF FLIGHT INSPECTION

3.2.1 Procedure Validation

3.2.1.1 This is detailed in ICAO Doc 9906, Quality Assurance Manual for Flight Procedure Design. Volume 5 – Validation of Instrument Flight Procedures. The ANSP, FISP and Procedure Design Company need to work closely to ensure this aspect is covered off adequately.

3.2.2 VHF equipment, ADS-B, GBAS

3.2.2.1 Flight inspection is typically carried out under request from an appropriately trained Communications/ADS-B or GBAS engineer. The specifics such as location, type of check and flight profiles are determined by a collaborative approach between all involved disciplines. In some cases, flight inspection is used to assist in the validation of models for determining coverage.

3.2.3 Performance-based Navigation – RNAV and RNP

3.2.3.1 At a minimum, the aircraft should have the capability to undertake the desired procedure validation. RNP procedures' validation requirements would normally be specified within the Procedure Design Company specifications. The Aeronautical Design and Development organization should analyze the results to determine containment within the specified criteria. Technical assessment perspective is as follows;

- (a) Validation of obstacle survey data is recommended during the flight validation process.
- (b) Verification of survey data can be performed by setting ground stations at certain survey points. The ground survey team can check and compare the DGPS signal to the TSO avionics aircraft receiver position.
- (c) The survey data may be affected by waypoint, track and bearing error.
- (d) The effect of terrain shielding should be taken into consideration.
- (e) Verification is often done slightly lower than the published profile to remove altimeter error as often it is advantageous to verify in the worst-case position.

3.3 TYPICAL FLIGHT INSPECTION SYSTEM PERFORMANCE SPECIFICATIONS AND ASSOCIATED TEST ACCURACY RATIOS (TAR)

3.3.1 Test Accuracy Ratios

3.3.1.1 As the results obtained by the flight inspection system could potentially be used to defend a service provider in the event of an incident or accident, the State should clearly specify the standards adopted in the maintenance and calibration of the systems used for flight inspection purposes. To effectively perform calibration of a system, the calibration equipment should be typically five (minimum three) times more accurate than the system equipment. Some considerations should be as follows:

- (a) Temperature stability and compensation.

- (b) Electromagnetic interference.
- (c) Polar Pattern considerations.
- (d) Absolute measurements.
- (e) Relative measurements.
- (f) Aircraft receiver and calibration equipment duplication.

3.3.1.2 The calibration equipment should also undergo regular periodic checking as part of verification against traceable international standards that support the TAR required.

3.3.1.3 A dedicated calibration facility operated by the ANSP or ISO/IEC 17025 approved facility is the preferred means by which to achieve this to ensure a good consistency of standards.

3.3.2 Duplication

3.3.2.1 System duplication is important throughout the calibration process of both the flight inspection equipment and calibration laboratory used to calibrate the systems. Duplication of equipment can very quickly identify system drift and prevent unknowingly using a bad receiver to adjust an air critical system incorrectly.

Chapter 4

Reporting of Flight Inspection Results

4.1 TYPICAL FLIGHT INSPECTION REPORTS

4.1.1 After each daily flight inspection, the flight inspector should prepare the flight inspection report. The formal flight inspection report signed by the responsible captain and flight inspector should be provided after the flight inspection. The contents of flight inspection report typically include the following items:

- (a) Location
- (b) Identification
- (c) Flight inspection date(s)
- (d) Facility inspected
- (e) Type of inspection
- (f) Inspected items
- (g) Results
- (h) NOTAM
- (i) Facility status
- (j) Remarks
- (k) Aircraft registration number

4.1.2 A sample flight inspection report is provided in Attachment A to this Chapter for reference.

4.2 TYPICAL FLIGHT INSPECTION RECORDS

4.2.1 Flight inspection records and flight inspection data sheet should be provided by flight inspector. The contents of flight inspection record typically comprise of the following items:-

- (a) Airport name
- (b) Aircraft registration number
- (c) Date of inspection
- (d) Inspector's name
- (e) Flight hours
- (f) Facility type and identification
- (g) Run numbers
- (h) Transmitter number
- (i) Flight inspection results of each run

4.2.2 A sample Flight Inspection Report is provided in Attachment B to this Chapter for reference.

Attachment A

Sample Flight Inspection Reports

Sample Flight Inspection Report for ILS/DME

1.LOCATION:				2.RUNWAY NO:	
3.DATE(S) OF INSPECTION:				4.IDENTIFICATION:	
5.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC	
		COMMISSIONING		SURVEILLANCE	
6.FACILITY INSPECTED		LOCALIZER		GLIDE SLOPE	
		LIGHTING SYSTEM		7. AIRCRAFT NO:	
8.CATELOGY:			9.FREQUENCY:		
10.COMMISSIONED COURSE WIDTH:			11.COMMISSIONED PATH ANGLE:		
12.LOCALIZER					
FLIGHT INSPECTION ITEMS	TX1		TX2		
	INITIAL	FINAL	INITIAL	FINAL	
IDENTIFICATION					
MODULATION					
ALIGNMENT					
COURSE STRUCTURE—Z1/RNG					
COURSE STRUCTURE—Z2/RNG					
COURSE STRUCTURE—Z3/RNG					
COURSE STRUCTURE—Z4/RNG					
COURSE STRUCTURE—Z5/RNG					
VERTICAL POLARIZATION/RNG					
WIDTH/SYMMETRY					
MEAN WIDTH(HALF)/SYMMETRY					
CLEARANCE 90/DEG					
CLEARANCE 150/DEG					
MOD.BALANCE(COS/CLR)					
Z5 ROLL OUT RESULT:					

USABLE DISTANCE				
MONITOR				
WIDTH ALARM(NARROW)/SYM				
WIDTH ALARM(WIDE)/SYM				
CLEARANCE 90 (WIDE ALARM)				
CLEARANCE 150(WIDE ALARM)				
ALIGNMENT ALARM(+)				
ALIGNMENT ALARM(-)				
13.GLIDE SLOPE				
FLIGHT INSPECTION ITEMS	TX1		TX2	
	INITIAL	FINAL	INITIAL	FINAL
ANGLE /REFERENCE DATUM HEIGHT				
MODULATION				
PILOT IN CHARGE:	FLIGHT INSPECTOR:		AIRCRAFT NUMBER:	

Sample Flight Inspection Report for Runway Approach Lights and PAPI

1.LOCATION:				2.RUNWAY NO:			
3.DATE/DATES OF INSPECTION:							
4.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC		SPECIAL	
		COMMISSIONING		SURVEILLANCE		INCOMPLETE	
5.FACILITY INSPECTED		PAPI		RUNWAY LIGHTS		APPROACH LIGHTS	
6.COMMISSIONED PAPI ANGLES		NO.1	NO.2	NO.3	NO.4	PATH ANGLE	
	LEFT						
	RIGHT						
7.PAPI INSPECTION RESULTS							
ACTUAL PAPI ANGLES		NO.1	NO.2	NO.3	NO.4	PATH ANGLE	
	LEFT						
	RIGHT						
ITEMS CHECKED		SAT	UNSAT	ITEMS CHECKED		SAT	UNSAT
COVERAGE ANGLE				VISIBLE DISTANCE			
INTENSITY LEVEL				INTENSITY COINCIDENCE			
NO. OF INOPERATIVE LIGHTS				COINCIDENCE WITH ILS			
8.APPROACH LIGHTS RESULTS INSPECTION RESULTS							
ITEMS CHECKED		SAT	UNSAT	ITEMS CHECKED		SAT	UNSAT
LAMP ALINMENT				VISIBLE DISTANCE			
INTENSITY LEVEL				INTENSITY COINCIDENCE			
NO. OF INOPERATIVE LIGHTS				LIGHTS CATEGORY			
9.RUNWAY LIGHTS INSPECTION RESULTS							
ITEMS CHECKED		SAT	UNSAT	ITEMS CHECKED		SAT	UNSAT
LAMP ALINMENT				VISIBLE DISTANCE			
INTENSITY LEVEL				NO. OF INOPERATIVE LIGHTS			
RUNWAY END LIGHTS				LANDING ZONE LIGHTS			

10.FACILITY STATUS	PAPI	RUNWAY LIGHTS	APPROACH LIGHTS	11.NOTAM's:
UNRESTRICTED				
RESTRICTED				
UNUSABLE				
12.REMARKS:				
PILOT IN CHARGE'S SIGNATURE:			FLIGHT INSPECTOR'S SIGNATURE:	AIRCRAFT NO:

Sample Flight Inspection Report for DVOR/DME

1.LOCATION:					2.IDENTIFICATION:			
3.FLIGHT INSPECTION DATE(S):			4.FACILITY INSPECTED			VOR		DME
5.TYPE OF INSPECTION		SITE EVALUATION		PERIODIC		SPECIAL		
		COMMISSIONING		SURVEILLANCE		INCOMPLETE		
6. ORBIT RESULTS								
NO.	TX NO.	FLIGHT LEVEL(MSL)	ORBIT RADIUS(NM)	MEAN BEARING ERROR		MEAN RANGE ERROR		
1	1							
2	2							
7. RADIAL RESULTS								
RADIAL USE								
AZIMUTH								
TX NO.								
MSL ALTITUDE								
DISTANCE FROM								
DISTANCE TO								
ALIGNMENT ERROR								
MAX BEND/RANGE								
ROUGHNESS/RANGE								
POLARIZATION								
TRANSMITTER DIFF								
MOD30HZ AM								
MOD30HZ FM								
MOD9960HZ								
MINIMUM SS								

DME RANGE ERROR								
INTERFERENCE								
8.MONITORS								
TX NO.	REFERENCE RADIAL	MSL	RANGE	ALIGNMENT	ALARM+	ALARM-		
9. ORBIT BEARING ERROR (TX NO.1)								
9. ORBIT BEARING ERROR (TX NO.2)								
10. GROUND RECEIVER CHECK POINT								
GROUND CHECK POINT	TX NO.		BEARING READING		RANGE READING			
11. GENERAL		TX1		TX2				
		SAT	UNSAT	SAT	UNSAT			
STANDBY POWER								
VOICE								
VOR IDENTIFICATION								
DME IDENTIFICATION								

DME ACCURACY						
DME COVERAGE						
12.FACILITY STATUS			13.NOTAM's:			
STATUS	VOR	DME				
UNRESTRICTED						
RESTRICTED						
UNUSABLE						
14.REMARKS:						
PILOT IN CHARGE'S SIGNATURE:			FLIGHT INSPECTOR'S SIGNATURE:		AIRCRAFT NO:	

Attachment B

Sample Flight Inspection Records

Sample Flight Inspection Record

[illegible]

Appendix 1

1. USEFUL REFERENCE

- ICASC - Document on Standards and Recommended Practises for Flight Inspection & Flight Validation Organisations
http://www.icasc.co/sites/faa/uploads/documents/Library/ICASC/ICASC_SARPs_FI_FV_v14_11102018_final101.pdf
- ICASC Recommended Flight Inspection & Flight Validation Contract Annex
http://www.icasc.co/sites/faa/uploads/documents/Library/ICASC/ICASC_FIS_Contract_Annex_v0_2_26_05_2016_final101.pdf
- Reference note from ICAO on the considerations of radio navigation aids flight inspection periodicity
<https://www.icao.int/safety/OPS/OPS-Normal/Pages/Flight-inspection-for-radio-aids.aspx>

Appendix 2

1. Use of Emerging Technology to Supplement Flight Inspection

1.1. Flight navigation systems are essential in the world where global air traffic grows continuously. These systems enable Air Navigation Service Providers (ANSPs) to ensure that aircraft can reach their destination in due time safely, despite the continuous increase in air traffic density. Indeed, Air Traffic Management (ATM) companies strongly rely on advanced, unfailing and efficient navigation aid equipment in order to accomplish their mission in the best conditions.

1.2. Among the numerous requirements from the International Civil Aviation Organization (ICAO), flight navigation systems must be regularly calibrated, inspected and maintained to ensure that all essential navigation aids for pilots are always working properly. This means that these systems must be tuned and maintained to radiate the correct signals in the airspace, at any time. To achieve this, a combination of ground and air inspections is necessary, like the localizer measurements for CAT III ILS (Instrument Landing System).

1.3. ILS is an essential navigation aid to help pilots land their aircraft in low visibility conditions during IFR (Instrument Flight Rules) flights. In order to maintain the ICAO ILS certification, dynamic measurements need to be performed by the airport operators / ANSPs, their subcontracted flight inspection organizations or government agencies. These companies are always looking to improve and streamline inspection processes to mitigate impacts on airport operations. The regular ILS signal inspection is made in flight, using a manned aircraft. It requires prior coordination and preparation with various stakeholders, together with ground measurements in order to optimize the manned flight inspection.

1.4. Both of the above flight and ground operations have their limitations: the manned aircraft is costly, noisy and environmental unfriendly with large fuel consumption by flight inspection aircraft, while the ground one is limited in terms of reachable distance and height for the measurement antenna. The ground ILS inspections are indeed restrained to the runway threshold, since they are performed using masts that generally don't go higher than around 25 meters, from the ground. This is where the initiative for developing drones or Unmanned Aerial Vehicle (UAV) inspection solution. With improved lifting power, efficiency and reliability, the drone / UAV could perform inspections in the ILS far field as well as ILS elevation profiles and mini approaches with inspection to analyze the ILS signals (course alignment, slope angle, alarms, displacement sensitivity, etc.) and to supplement the ground and manned flight measurements in a more comprehensive mean.

1.5. With the technology of UAV being widely and rapidly developing, more and more flight inspection institutes came into the research on how to utilize UAVs for flight inspection and many practices have been made. The UAVs are normally classified in two groups, the drones, which are smaller, normally with multiple rotors; and Remotely Piloted Aircraft System (RPAS), which are heavier and with fixed wings. Some institutes concentrate on the development of RPAS flight inspection, which is quite similar to the performance of normal flight inspection aircrafts, but cheaper on cost.

1.6. It should be noted that the technology of UAV/RPAS is still emerging. Major issues that still need to be addressed including the integration of UAV/RPAS with other manned civil aviation traffic in unsegregated airspace, while maintaining a similar high level of integrity and reliability that have been developed and matured over the past decades. These integrity requirements, especially those apply to the operations beyond line of sight, would be even more significant when operating in Terminal Airspace, with a mixture of UAV/RPAS operations and regular traffic in densely used airspace. Major challenges in mastering UAV/RPAS autonomous operations (traffic sensing and avoidance), improving system integrity and reliability, as well as establishing a suitable certification framework and process, still need to be addressed. Nowadays, UAV/RPAS are already well positioned to assist Ground and Flight Inspection under a clearly defined and restrained operational environment.

2. Flight Inspection with Drones

2.1. Application of drone inspection allows improvements on ILS inspection operations by dramatically reducing the manned aircraft flight inspection frequency and thus decreasing the overall operational cost for airport operators. Highlights of advantages that could be brought by applying drone in ILS flight inspections are listed below:

- (a) Supplement to ILS ground measurements
- (b) Excellent repeatability
- (c) Cost & time saving

- (d) Flexible inspection time
- (e) Reducing operational disturbances
- (f) Reducing CO₂ and noise emissions

2.2. This major step in ILS maintenance domain for preventive and corrective maintenance is only a beginning. Thanks to the technology advancement, research institutes are going further in developing the next generation ATM systems. In addition to ILS flight inspections, new horizon also arise for drone / UAV inspection on other systems like VOR, DF, PAPI, radars, etc.

2.3. With user-friendly interface, preparing the drone operation could take less than 1 minute. The operator just has to select the airport and the runway from database and then choose the type of the required inspection. Once this is done, all the required data (missions, waypoints, distances, altitudes, etc.) is generated automatically. There is no need to read the procedures to figure out which measurements that are to be made and where to be made. The operation could be created in platform with simple access from the tablet to view and download the details. This database of airports, runways and navigation aids can be expanded and updated with an easy-to-use web interface.

2.4. Once the corresponding operation has been downloaded to the inspection program / application, the operator could launch the mission and monitor the automated procedures. The operator is guided throughout the mission. Each mission takes only a few minutes of flight and could be repeated as many times as needed. Measurements are available and could be viewed in real-time.

2.5. Reports are viewable on-site through the program / application. There is no need to download the measured data to compile the reports. Reports contain all the relevant measurements and parameters same as any report generated from generic flight inspection aircraft, in the form of tables and images. Reports, along with all the measurements, images or videos, are uploaded into a platform for centralized recording, future reference or additional processing.

3. Worldwide Development of Drones to Assist Flight Inspection / Testing

3.1. As in 2019, flight inspection organizations or institutes in Belgium, China, Germany, Italy, Russia, Spain have used drones to assist and provide supplementary tests in flight inspection works. The drones are normally be used to assist testing of navigation equipment signals, since they are not competent for all flight inspection missions with limited performance in speed, service ceiling, endurance, crosswind resistance, payload, etc.

3.2. Belgium

- (a) The development of the UAV / drone solution for ILS inspection was started in 2015 and in operation since January 2018 in Belgium and has extended the usage to Geneva (GVA – LSGG) and Zurich (ZRH – LSZH) airports.

3.3. Germany

- (a) In early November 2018, a drone specially developed for carrying out ILS measurements was employed at Hannover International Airport in Germany during the commissioning of a new ILS. This entailed generating DDM (Difference of Depth of Modulation) measurement curves above and below the 3° approach path of the new 09R ILS at 1 km distance from the threshold. The measurement flights were monitored not only in the control tower of the Hannover airport, but also at the DFS headquarters in Langen via a drone tracking system. The flights were very successful and form an important impulse for the rapid operational introduction of measurement drones for ground measurements of the numerous Instrument Landing Systems installed at German airports.

4. Flight Inspection with RPAS

4.1. Balancing the factors of performance, cost, operation, maintenance, management, safety, the fixed-wing RPAS with 8-11 meters wing span is better for flight inspection due to its stability in flying, with following example performance for reference.

4.2. Typical performance of RPAS for flight inspection

- (a) Wingspan: 8-11 meters

- (b) Cruising speed: 100-180 km/h
- (c) Max speed: 200-240km/h
- (d) Ceiling: 6000m or higher
- (e) Runway length for take-off and landing: 300m or longer
- (f) Payload for inspection equipment: 50kg or more
- (g) Electrical power supply: 2kw or more
- (h) Endurance: 5 hours or more after inspection system installed
- (i) Communication: C2 or 5G or Data link with bandwidth more than 2M
- (j) Flight control: fully pre-programmable

4.3. Typical RPAS flight inspection system configuration

- (a) RPAS aircraft
- (b) Airborne inspection system including all the receivers, transceivers, camera, position-fixing, communication equipment and antennas, etc.
- (c) Vehicle-borne system including control console, communication equipment, differential station, etc.
- (d) Container and transportation truck
- (e) Control car
- (f) Auxiliary equipment and mobile

4.4. Operation considerations of RPAS flight inspection

- (a) Fully pre-programmed flight for all inspection profiles including take-off and landing
- (b) Signal collection in the air and processing on the ground
- (c) Internet Big Data system and Artificial Intelligence (AI) analysis
- (d) On-site co-operation with NAVAID maintenance and ATC
- (e) Ground transportation from airport to airport
- (f) Crew members: 1 or 2 inspectors, 3 or 4 maintenances/operators

4.5. Safety management of RPAS flight inspection

- (a) Organizations or institutes operating RPAS flight inspection should establish a safety management system (SMS) to ensure flight safety of RPAS. A good experience is to evaluate with the tool named SORA (Specific Operations Risk Assessment).

5. Profiles and Items for RPAS Flight Inspection

5.1. ILS

- (a) All the ILS inspection profiles could be flown by RPAS.

- (b) All the inspection items including LOC alignment, GP angles, modulations, structures, clearance, width, coverage and all the alarms could be checked by RPAS.
 - (c) Alignment alarm of LOC should be checked closer to the antenna on the runway or using the approach since it would be difficult to get a stable result on the ground of runway threshold.
- 5.2. VOR/DME and NDB
 - (a) RPAS could implement almost all the profiles required for VOR/DME and NDB flight inspection. The only insufficiency is the high flight level en-route signal check limited by RPAS performance.
- 5.3. PAPI
 - (a) Many institutes and organizations have attempted to check PAPI with camera-equipped drones. RPAS could do this work better since it could simulate a real approach and get more realistic results. However, camera stability and the ability to zoom during high speed approach would be a challenge to RPAS flight inspection researchers.
- 5.4. Flyability
 - (a) The lack of human sensing and judgment in actual cockpit and without assistance from on-board flight instruments, it is difficult to rate the fly-ability for a specific procedure / equipment by RPAS flight inspection. . It is suggested that fly-ability should be assessed by manned aircrafts.
- 5.5. Flight inspection recordings and plotting
 - (a) Flight inspection recordings and plotting, together with the inspection reports could be done on ground and transferred to a central data repository, which could then be analyzed by customers and facilitate set-up of a Big Data system for future management and reference.

Roadmap for Mode S DAPs Implementation in APAC Region

(Agreed by Mode S DAPs WG/4 and SURICG/6)

1. INTRODUCTION

1.1 The Terms of Reference for the Mode S DAPs Working Group includes the formulation of a roadmap for DAPs Application.

1.2 An initial version of the roadmap was generated at Mode S DAPs WG/3 for adopted by SURICG/6.

1.3 The topics considered in the roadmap were:

- a) Mode S mandate;
- b) Use of II and SI mixed Codes;
- c) Radar Clustering;
- d) Use of conspicuity codes;
- e) Weather reporting capability; and
- f) Datalink Map.

1.4 However, due to the evolving and complex nature of Mode S related technology, only the roadmap of *Mode S mandate* was adopted after some amendment.

1.5 Based on current practices around the world and taking into account the situation in Asia Pacific, the Mode S DAPs WG/4 formulated the revised version of roadmap for the Asia Pacific Region.

2. SUMMARY

The revised roadmap is summarised as follows:

S/N	Issue	Proposed Roadmap	Reasons
1	Mode S Mandate	Conclusion APANPIRG/31/14 (CNS SG/24/13 (SURICG/5/3(DAPs WG3/1))) - Mode S Forward Fit Equipage in APAC Region That, States/Administrations in APAC Region be strongly encouraged to mandate that registered aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, with a date of manufacture on or after 1 January 2022 be equipped with Mode S avionics compliant with Enhanced Surveillance (EHS).	Considering that a number of DAPs applications will require EHS and that it's easy for new aircraft to be equipped with EHS. Retrofitting existing airframes with EHS will need further deliberation under challenging pandemic situation.
2	Use of II and SI mixed Codes	Proposed Draft Conclusion States with Mode S radar capable of performing II/SI mode operations are urged to transit from II code to II and	Due to higher density of radars, some states are facing a shortage of IC codes, which has to be solved by transiting from II to II and SI mixed code. It is noted that

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		SI mixed code, so as to ease the shortage of II codes. States planning to perform the transition shall coordinate with ICAO APAC to obtain the SI codes.	radars using II and SI codes can co-exist, hence there is no need for a big bang approach. However, States still have to coordinate with ICAO APAC on the allocation of SI codes. Due to some aircraft still not SI code ready, only radars with II/SI mode should be allowed to use SI
3	Radar Clustering	No proposed roadmap at the moment. But States with the competency and operational requirement may consider applying such technique.	Due to complexity and cost, only Germany and the Netherlands have implemented such techniques. It is unclear whether the benefits outweigh the cost.
4	Use of conspicuity codes	Mode A = 1000 has already being assigned as the conspicuity code.	It is foreseen that the region will need the automation systems to be able to support the conspicuity code feature before Mode S address can be used in lieu of Mode A address for selected flights. There may be a need to coordinate the efforts with ATMAS TF in the region.
5	Weather reporting capability	Not practical to mandate weather reporting capability in Mode S, as there are no ready solutions to enable such capability for current transponders (i.e. versions 0, 1, and 2). States requiring such capability should consider other means to generate weather information (such as using algorithm to derive weather information).	While weather data is one of the Mode S DAPs, only very few (<1%) aircraft has this capability. The industry does not have software patches to enable this weather feature, hence there is no point having a mandate for weather capability. Instead, some States researched algorithms to derive weather information. It is foreseen that the weather reporting capability will be available in version 3 transponders
6	Datalink Map	No proposed roadmap at the moment. States are instead urged to adopt the various SARPs and guidance material relating to reduction of frequency congestion.	It is difficult to implement and enforce datalink map with no certainty of success. It is more practical to adopt the SARPs and guidance materials relating to the reduction of frequency congestion.
7	Monitoring of 1030 and 1090 MHz usage	States with capability are urged to perform RF measurement on 1030 and 1090 MHz usage. Guidance material is proposed.	It is necessary to ensure that the RF occupancy is kept at healthy levels.

Note: The roadmap may be revisited as and when necessary. It is foreseen that for the items without roadmap, they may be reviewed in 2 to 3 year time.



**INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE**

**MODE S DOWNLINK AIRCRAFT PARAMETERS IMPLEMENTATION
AND OPERATIONS GUIDANCE DOCUMENT**

Edition 3.0 - March 2021

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PREFACE

This publication is one of the deliverables of the Mode S DAPs WG according to the Terms of Reference (TOR). It aims at providing guidance materials to States and airspace users on the use of Mode S DAPs in the Asia and Pacific Regions from both operational and technical perspectives. A working team was established to develop the contents, and China has volunteered to take lead on coordinating and consolidating inputs from members of the working team.

During Mode S DAPs WG/1 held in March 2018, the meeting considered that further development work is required before the initial draft (Edition 0.1) proposed by China and Hong Kong China becomes ready for approval. Then the working team began to develop the contents of the guidance document, China organized two internal conferences and ICAO APAC office organized a web conference for reviewing the contents. Based on numerous rounds of review and comments with joint efforts from the working team, China has revised the draft into five previous versions. Finally, Edition 1.0 was submitted for endorsement after Mode S DAPs WG/2, and published in the CNS SG/23. China revised the document and circulated it to the members of the Working Group for comments. Then Edition 2.0 was released in 2020, during CNS SG/24. The revised draft (Edition 3.0) is proposed to Mode S DAPs WG/4, and then is endorsed by the meeting.

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:

- Air Traffic Management Bureau of CAAC, China
- The Second Research Institute of CAAC, China
- Hong Kong Civil Aviation Department, China
- Civil Aviation Authority of Singapore
- Japan Civil Aviation Bureau
- Electronic Navigation Research Institute, Japan
- Airways, New Zealand
- Airservices, Australia

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1. INTRODUCTION

1.1 Purpose

This Mode S Downlink Aircraft Parameters Implementation and Operations Guidance Document (DAPs IGD) provides guidance for the planning, implementation and operational application of Mode S DAPs technology in the Asia and Pacific Regions.

The procedures and requirements for Mode S DAPs operations are detailed in the relevant States' AIP. This IGD is intended to provide key information on Mode S DAPs performance, integration, principles, procedures and collaboration mechanisms.

The content is based upon the work to date of the Mode S DAPs Working Group and various ANC Panels for the operational use of Mode S DAPs.

1.2 Background

1.2.1 Mode S and DAPs

Mode S (Select) is an extension of conventional SSR which permits selective addressing of individual aircraft equipped with Mode S transponders. Additional data known as Downlink Aircraft Parameters (DAPs) may also be extracted from the aircraft, including aircraft identification which should correspond to the ACID entered in the flight plan.

Mode S operates on the same radio frequencies (1030 and 1090 MHz) as conventional SSR systems, allowing for interrogation of Mode A/C only transponders and Mode S transponders.

Each Mode S equipped aircraft is assigned a unique ICAO 24-bit aircraft address. Using the selective interrogation capability of the Mode S SSR, Mode S Sensors are able to first acquire and then selectively interrogate a specific aircraft via its unique ICAO 24-bit aircraft address. This significantly improves the radar's detection and tracking performance, and therefore improving the ability of ATC to monitor and control the aircraft, as well as the others around it.

The innovation of Mode S resides in the use of selective addressing of aircraft which offers technical advantages over conventional SSR, such as reducing "fruit" and "garbling", providing higher integrity radar tracks.

Mode S technology has the following characteristics:

- a) selective interrogation,
- b) individual aircraft address and
- c) datalink capability.

The Mode S application includes Mode S radar system, datalink Systems, MLAT Systems, etc.

Various avionics systems onboard an aircraft receive data from sensors to provide the DAPs output. The data mainly comes from several sets of sensors, such as air data sensors (including pitot probe, static port, temperature sensor, and angle of attack sensor), inertial sensors (including position gyroscopes, rate gyroscopes and accelerometers) and magnetic sensor(s). Part of the parameters produced by other avionics systems (such as MCP/FCU, FMS, TCAS, etc.) is also defined as downlink aircraft parameters. These parameters are then sent to the transponder through standard data buses, and stored inside the

relevant transponder's 56-bit Binary Data Storages (BDS). Ground-based surveillance systems (such as MSSR or MLAT) can downlink the desired parameters using specific Mode S protocols.

For detailed information about DAPs data source, please refer to Appendix 3.

Mode S DAPs is an application of the Mode S Datalink System. The downlink standard length transaction interface shall deliver DAPs to the transponder which then makes data available to the ground surveillance systems. Each DAP shall be packed into the Comm-B format ('MB' field) and can be extracted using either the ground-initiated Comm-B (GICB) protocol, or using MSP downlink channel 3 via the data flash application.

1.2.2 Benefit of Mode S and Use of DAPs

The Mode S application reduces the weakness of Mode A/C, because of the selective interrogation reducing synchronous garble and asynchronous interference. The parity check technique improves the reliability and integrity of surveillance data. The availability of almost 17 million unique aircraft addresses, in conjunction with the automatic reporting of flight identity, alleviates Mode 3/A code shortages and enables unambiguous aircraft identification, if the correct aircraft address and/or Aircraft Identification are entered in both the flight plan and aircraft systems. The datalink technique assists the acquisition of downlink aircraft parameters, and the additional track label information improves the air situational awareness. The controller and pilot are presented with improved situation awareness, which reduces the R/T workload.

Another benefit is to maximize SSR Mode 3/A code savings. By introducing the Mode S Conspicuity Code, all aircraft identified by Mode S via DAPs (ACID) can use the same SSR Mode 3/A code. During the 6th meeting of ATM SG, the following Conclusion is adopted:

Conclusion ATM/SG/6-3: Proposed Air Navigation Plan Volume II Amendment

'A1000' was reserved for the Mode S Conspicuity Code for the ICAO APAC region.

1.3 Arrangement of DAPs IGD

The Mode S DAPs Implementation and Operations Guidance Document consists of the following parts:

Section 1	Introduction
Section 2	Acronym Lists
Section 3	Reference Documents
Section 4	Description of Mode S DAPs Data
Section 5	Implementation Principles and Phase
Section 6	System Integrity and Monitoring
Section 7	Regulations and Procedures
Section 8	Training and Competence
Section 9	Specific Examples on Mode S DAPs Applications

1.4 Document History and Management

The framework of this document was introduced in the first Working Group Meeting of Mode S Downlink Aircraft Parameters in March 2018. The Meeting agreed to further develop based on the proposed framework to a complete document for approval as a regional guidance document. A working team, consisting of volunteers from China, Hong Kong-China, Japan, Malaysia, Singapore, Thailand and

New Zealand was established by the Meeting to contribute to the content of the document. In July 2018, the completed draft of this document was ready for circulation among States for review and comment.

The aim of this document to supplement SARPs, PANS and relevant provisions contained in ICAO documentation and it will be regularly updated to reflect evolving provisions.

1.5 Copies

Paper copies of this DAPs IGD 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.

1.6 Changes to DAPs IGD

Whenever a user identifies a need for a change to this document, a Request for Change (RFC) Form (see Section 1.8 below) should be completed and submitted to the ICAO Asia and Pacific Regional Office. The Regional Office will collate RFCs for consideration by the Surveillance Implementation Coordination Group.

When an amendment has been adopted by the meeting of the Surveillance Implementation Coordination Group, then a new version of the DAPs IGD 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 the DAPs IGD will be the responsibility of APANPIRG.

1.7 Editing Conventions

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1.8 DAPs IGD Request for Change Form

RFC Nr:	

Please use this form when requesting a change to any part of this DAPs IGD. 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

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/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 :	

1.9 Amendment Record

Amendment Number	Date	Amended by	Comments
0.1	20 March 2018	China Hong Kong, China	Initial draft for consideration by Mode S DAPs WG/1
0.2	1 August 2018	China Hong Kong, China Japan Singapore Malaysia	First completed draft based on the agreed document framework in Mode S DAPs WG/1 for review and comment by States
0.3	23 August 2018	China	Based on Version 0.2 draft, China hold a meeting to discuss problems respecting the first completed draft. This is a revised document according to content of this meeting.
0.3.1	26 September 2018	China Hong Kong, China Singapore New Zealand	Based on Version 0.3 draft, States make a full comment on the content of IGD. This is a revised document according to those comments.
0.3.2	6 November 2018	China New Zealand Hong Kong, China Singapore Malaysia	Based on Version 0.3.1 draft, States discussed all comments of IGD in the Mode S DAPs WG 1st Web Conference. This is revised by the meeting decisions.
0.4	27 December 2018	China New Zealand Singapore Australia	Based on Version 0.3.2, States review and comment on the IGD. This is a revised document according to those comments.
1.0	14 March 2019	China Japan Singapore Malaysia	Consideration by Mode S DAPs WG/2
1.1	17 February 2020	China New Zealand Singapore	Modify based on Version 1.0, States review and comment on the IGD.
2.0	13 May 2020	China	Consideration by Mode S DAPs WG/3
3.0	March 2021	China	

2. ACRONYMS LIST

AA	Aircraft Address
AC	Altitude Code
ACID	Aircraft Identification
ADS-B	Automatic Dependent Surveillance-Broadcast
AICB	Air-Initiated Comm-B
AIP	Aeronautical Information Publication
ANC	Air Navigation Conference
ANSP	Air Navigation Service Provider
APAC	Asia Pacific
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Service
ATSEP	Air Traffic Safety Electronic Personnel
BDS	Comm-B Data Selector
CA	Capability
CDTI	Cockpit Display Traffic Information
CFL	Cleared Flight Level
CLAM	Cleared Level Adherence Monitoring
CNS	Communications, Navigation and Surveillance
DAPs	Downlink Aircraft Parameters
DF	Downlink Format
EASA	European Aviation Safety Agency
EHS	Mode S Enhanced Surveillance
ELM	Extended Length Message
ELS	Mode S Elementary Surveillance
ES	Extended Squitter
EUROCAE	European Organization for Civil Aviation Equipment
EUROCONTORL	European Organization for the Safety of Air Navigation
FIR	Flight Information Region
FLTID	Flight Identification (transmitted by aircraft)
FMS	Flight Management System
FS	Flight Status
FRUIT	False Relies Unsynchronized In Time
GICB	Ground-Initiated Comm-B
HMI	Human Machine Interface
IC	Interrogator Code
ICAO	International Civil Aviation Organization
ID	Identity
IFR	Instrument Flight Rules
II	Interrogator Identifier
IRF	Interrogation Repetition Frequency
MHz	Megahertz
MIP	Mode Interlace Patterns
MIT	Massachusetts Institute of Technology
MLAT	Multilateration
MSAW	Minimum Safe Altitude Warning
MSP	Mode S Specific Protocol
MTCD	Medium Term Conflict Detection
SARPs	(ICAO) Standards and Recommended Practices
SFL	Selected Flight Level

SI	Surveillance Identifier
SSR	Secondary Surveillance Radar
STCA	Short-Term Conflict Alert
UTC	Universal Time Coordinated
WAM	Wide Area Multilateration
WG	Working Group

3. REFERENCE DOCUMENTS

Id	Name of the document	Edition	Date	Origin	Domain
1	Aeronautical Telecommunications, Annex 10 - Vol. III - Communication Systems	Edition 2	2007	ICAO	
2	Aeronautical Telecommunications, Annex 10 - Vol. IV - Surveillance Radar and Collision Avoidance Systems	Edition 5	2014	ICAO	
3	Doc 9871, Technical Provisions for Mode S Services and Extended Squitter.	Edition 2	2012	ICAO	
4	Doc 9688 Manual on Mode S specific service.	Edition 2	2004	ICAO	
5	ED-73E, Minimum Operational Performance Standards for Secondary Surveillance Radar Mode S Transponders.	Edition 1	May 2011	EUROCAE	
6	ADS-B Implementation and Operations Guidance Document	Edition 11	April 2018	ICAO APAC	
7	Concept of Operations Mode S in Europe (Mode S CONOPS)	Edition 2	November 2013	Eurocontrol	
8	Mode S Elementary Surveillance (ELS) Operations Manual	Edition 1	January 2011	Eurocontrol	
9	Asia/Pacific Seamless ATM Plan		May 2015	ICAO APAC	
10	Doc 9924 Aeronautical Surveillance Manual	Second Edition	2017	ICAO	
11	Preliminary System Safety Analysis for the Mode S Elementary Surveillance	Edition 1.8	April 2004	Eurocontrol	EATMP
12	Elementary Surveillance (ELS) and Enhanced Surveillance (EHS) validation via Mode S Secondary Radar		April 2008	MIT Lincoln Laboratory	ATC Project
13	Aircraft Derived Data Validation Algorithms		August 2012	MIT Lincoln Laboratory	ATC Project
14	Doc.4444 Procedures For Air Navigation Services Air Traffic Management	Sixteenth Edition	November 2016	ICAO	
15	Clarification Mode S Transponder in an Airport/A-SMGCS Environment	Edition 1.1	3 May 2005	Eurocontrol	

16	Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System /Mode Select (ATCRBS / Mode S) Airborne Equipment	Edition E	17 March 2011	RTCA	
17	MARK 4 AIR TRAFFIC CONTROL TRANSPONDER (ATCRBS/MODE S)	Edition 4	15 November 2011	ARINC	

4. DESCRIPTION OF MODE S DAPs DATA

Inside the aircraft transponder, DAPs are stored in different BDS Registers for responding to DAPs interrogation requests by a Mode S ground system. Aircraft parameters are periodically delivered from aircraft sensors, flight management system, etc., to these registers via the downlink standard length transaction interface. BDS Registers, which have not been updated within the specified maximum update interval, are cleared or indicated as invalid and such aircraft parameters would be unavailable for ground interrogations. When a Mode S SSR sends an interrogation requesting the downlink of registers, DAPs are packed into Comm-B format (known as “MB” field) and are extracted using either the GICB protocol or Mode S specific protocols (MSPs) channel 3.

BDS Registers are identified by a two-digit hex number. For example, BDS Register for selected vertical intention, which is identified by hex number 40₁₆, is commonly written as BDS code 4, 0 in publications. Depending on the stage of Mode S implementation, i.e. Mode S ELS and Mode S EHS, the scope of Mode S DAPs data involved would be different as illustrated in the following subsections.

Detailed data format and maximum update interval of each BDS register are given in “ICAO Doc 9871 - Technical Provisions for Mode S Services and Extended Squitter”.

4.1 Mode S ELS

In Mode S ELS implementation, aircraft and ground Mode S system should be compliant with providing the following functionalities over conventional Mode A/C systems:

- a) Selective interrogation;
- b) Use of ICAO Aircraft Address;
- c) Automatic reporting of ACID;
- d) Report of transponder capability;
- e) Altitude reporting with a resolution of 25ft (subject to aircraft capability);
- f) Provision of flight status to indicate airborne or on-the-ground (subject to aircraft capability);
- g) Report of SI Code capability; and
- h) ACAS active resolution advisory report (when equipped with TCAS)

DAPs associated with Mode S ELS are stored in BDS code 1,0, BDS code 1,7, BDS code 2,0 and BDS code 3,0 registers of the aircraft’s transponder.

Table 4-1 DAPs in Mode S ELS

Register	Name	Usage
BDS code 1,0	Datalink Capability Report	To report the data link capability of the Mode S transponder/data link installation.
BDS code 1,7	Common Usage GICB Capability Report	To indicate common usage GICB services currently supported.
BDS code 2,0	Aircraft Identification	To report aircraft identification to the ground.
BDS code 3,0	ACAS Resolution Advisory Report	To report ACAS active resolution advisory

With the above functionalities properly configured, Mode S ELS could bring the following benefits to ATC operations:

- a) Provide unambiguous aircraft identification using the unique aircraft address and aircraft identification;
- b) Help to solve Mode 3/A code shortage in congested airspace, using the Mode S conspicuity code (A1000) instead of discrete Mode 3/A codes;
- c) Improve surveillance data integrity by;
 - 1) reducing synchronous garble*,
 - 2) lessening over-interrogations, and
 - 3) simplifying aircraft identification in case of false targets;
- d) Improve the accuracy of multi-surveillance tracking and safety nets with more accurate target detection from Mode S radars and high resolution in altitude reporting; and
- e) Able to process more aircraft tracks than conventional Mode A/C radars; and
- f) Able to provide ACAS active resolution advisory from suitably equipped aircraft.

*Note, while Mode S will help to reduce data garble it will not resolve the issue. Issues around multi-path and different transponder types in close proximity (e.g. Mode A/C near a Mode S transponder) mean that the return received by the radar may not be correct. In the case of a Mode A/C transponder close to a Mode S transponder, instances have been recorded where the Mode S address has been transposed into the reply from the Mode A transponder.

4.2 Mode S EHS

Mode S EHS implementation includes all the features of Mode S ELS with the addition of DAPs stored in BDS code 4,0, BDS code 5,0 and BDS code 6,0 registers of the aircraft's transponder. The following table summarizes the details of DAPs of these three registers:

Table 4-2 DAPs in Mode S EHS

Register	Name/Downlink Aircraft Parameters		Usage
BDS code 4,0	Selected Vertical Intention	MCP/FCU Selected Altitude	To provide information about the aircraft's current vertical intentions
		FMS Selected Altitude	
		Barometric Pressure Setting	
		MCP/FCU Mode	
		Target Altitude Source	
BDS code 5,0	Track and Turn Report	Roll Angle	To provide track and turn data to the ground systems.
		True Track Angle	
		Ground Speed	
		Track Angle Rate	
		True Air Speed	
BDS code 6,0	Heading and Speed Report	Magnetic Heading	To provide heading and speed data to ground systems.
		Indicated Air Speed	
		Mach Number	
		Barometric Altitude Rate	
		Inertial Vertical Velocity	

In addition to those improvements contributed by Mode S ELS in Section 4.1, Mode S EHS implementation provides the following benefits to ATC operation:

- a) Further improve multi-surveillance tracking accuracy and performance through the use of DAPs on track, turn, speed and heading of the aircraft in the track calculation;
- b) Further improve the accuracy of safety nets, e.g. Short-Term Conflict Alert (STCA), through the provision of more accurate aircraft tracks, and Medium Term Conflict Detection (MTCD), Minimum Safe Altitude Warning (MSAW), through the provision of the earlier judgment of vertical movement;
- c) Allow the implementation of new safety nets in ATM automation system for cross-checking selected aircraft vertical intention (i.e. Selected Altitude) with ATC controllers' instruction as well as verifying the barometric pressure setting applied in the aircraft with QNH setting in ATM automation system; and
- d) Improve situational awareness of ATC controllers by enabling the direct access of aircraft parameters in ATM automation system, e.g. Indicated Air Speed, Mach speed, Selected Altitude, Barometric Pressure Setting, etc.;
- e) Progressive reduction of R/T workload per aircraft.

4.3 DAPs Data Exchange Protocol Between Surveillance and ATM Automation System

The decoding of DAPs data from downlink messages is handled by ground surveillance equipment such as radars, ADS-B, MLAT and WAM ground stations. The Surveillance Data Processor (SDP) within the ATM automation system can combine multiple downlink messages into a single target report for display to controllers. All Purpose Structured EUROCONTROL Surveillance Information Exchange (ASTERIX) formats are commonly used as the protocol for target report transmission from surveillance systems to the ATM automation system.

For detailed information about ASTERIX formats please refer to the following link of EUROCONTROL web site:

<https://www.eurocontrol.int/asterix>

ASTERIX formats are categorized based on the types of surveillance data involved. ASTERIX Category 20, ASTERIX Category 21 and ASTERIX Category 48 are responsible for the DAPs data transmission from MLAT systems, ADS-B systems and radars respectively. For each ASTERIX category, the protocol format is further divided into different editions with variations on the supported DAPs data. ANSP's should carry out appropriate studies on the available protocol editions during the design stage to ensure the chosen format can cater to the scope of DAPs proposed to be implemented and that the Surveillance and ATM automation systems can correctly process the protocol selected.

For details, previous and current versions of ASTERIX Category 20, Category 21 and Category 48 specification documents can be downloaded from the following link of EUROCONTROL web sites:

<https://www.eurocontrol.int/publication/cat020-eurocontrol-specification-surveillance-data-exchange-asterix-part-14-category-20>

<https://www.eurocontrol.int/publication/cat021-eurocontrol-specification-surveillance-data-exchange-asterix-part-12-category-21>

<https://www.eurocontrol.int/publication/cat048-eurocontrol-specification-surveillance-data-exchange-asterix-part4>

IMPLEMENTATION PRINCIPLES AND PHASES

Implementation guidance is developed to progress the DAPs implementation from concept to operational use in the ICAO APAC region. In this chapter, section one addresses the implementation principles, which describes the issues of international coordination, system compatibility, data integrity and system integration, while section two addresses the implementation phase, to assist States with the management of DAPs implementation activities.

5.1 Implementation Principles

5.1.1 Stakeholders Coordination

DAPs provide useful information from aircraft which can benefit ANSP and airspace users. Improvements in efficiency and safety can be achieved, however the resultant changes in operational procedures to provide the improvements, will affect ANSPs, Regulators, Airlines, and other related airspace users. Before implementation by any State, a coordination team should be formed to study, coordinate, support and consult the implementation plans and related activities. The coordination team should include field experts on avionics, data link, surveillance infrastructures and end users.

Changes in the ATM operational procedures as the result of the use of DAPs require coordination among ATS providers, Regulators, Airlines, and where applicable, coordination among neighboring States to maximize the benefits. All States are encouraged to share their operational experiences, and to report anomalies through Mode S DAPs WG and the Surveillance Implementation Coordination Group.

Not all Surveillance and ATM automation systems are capable of processing and using DAPs, therefore investment in all related fields needs to be considered by all States. The coordination team should be consulted for future investment plans and related activities considering the technical and operational aspects. Consideration needs to be given to achieve a balance between investment and benefits.

5.1.2 System Compatibility

a) Technical:

DAPs can be obtained by different surveillance technologies such as Mode S Radar, ADS-B, MLAT and WAM, however not all the transponders can support DAPs. Different surveillance technologies in the ICAO APAC States mean that system compatibility should be considered.

Potential interference between different surveillance technologies should be fully considered before implementation, otherwise the efficiency and safety of the system cannot be ensured. Harmonization between different technologies should be considered and optimized to reduce the RF congestion on 1030MHz and 1090MHz.

Since not all aircraft are equipped with Mode S transponders, and not all the Mode S transponders have the ability to support DAPs, compatibility and efficiency should always be considered before implementation.

When DAPs are implemented, the data rate will increase compared to the conventional radar data, and the related BDS information extraction strategies should be considered. To reduce the load on the 1090MHz spectrum, only those registers intended for operational use should be interrogated/extracted.

b) Operational:

Different processing systems can support DAPs in different levels, hence the quality and information of the target may be different after the processed DAPs have been added. For example, some radar tracking

algorithms will consider DAPs as an input to the tracking, so the quality and information of the target will be a little bit different, therefore there should be compatibility considerations between different systems before use of the target data.

There are different air traffic management and operation strategies used by neighboring States. So, the operational procedures should always consider the operational compatibilities. For example, Mode A/C transponders and Mode S transponders may be working in the same area.

5.1.3 DAPs Data Integrity

DAPs data integrity should always be the first consideration when putting DAPs data into use. Since the data integrity from the source is not delivered by any related BDS register now, States are encouraged to find a reliable methodology to ensure the data integrity before the use of the data. Additionally, ongoing means of determining data integrity should be implemented, along with an ability to exclude invalid DAPs data from ATM automation systems.

States which already have experience on data integrity are encouraged to share this information with other States. The coordination team could support and harmonize this activity, and provide a standard method to evaluate the data integrity, and share the method with all the States.

5.1.4 System Integration

By introducing DAPs, the target characteristic from the source to the end user may be different compared to pre-DAPs implementation. In different phases of the processing flow of target data, DAPs can be used by different systems to improve tracking performance. Some key points in the data flow are as follows:

a) Airborne Avionics Systems

As DAPs data comes from different kinds of sensors and avionics systems on the aircraft, the reliability of the data should be ensured before the data is used operationally. Research has shown that some BDS data is missing or not updated correctly. The reasons for this need to be established, as it can mean that the use of some DAPs data is not suitable for implementation. Examples of issues include:

- 1) Older Flight Management Systems which do not provide all the DAPs data, and
- 2) Incorrect installation (e.g. onboard equipment wired to wrong registers)

b) Ground Sensor Systems

Ground sensors may use the DAPs to improve their target tracking performance, having an impact on the tracking function; the target data produced by this kind of sensors will show different characteristics to the pre-DAPs implemented tracking function, such as the turning rate, the kinematic movement and so on. Data users need to be aware of this performance improvement.

c) Ground Automation Systems

Ground automation systems can use DAPs information for a wide variety of uses, such as for tracking, safety net processing, situational awareness, en-route meteorological information sharing and so on. Ensuring DAPs information is processed and used in an appropriate way should be considered during implementation.

d) Other Surveillance Systems

Any DAPs data should be capable of being integrated with other surveillance systems data, and any potential difference and impact should be considered before use. Some of the information can be cross checked by different surveillance technologies.

- e) Other Related Systems

5.2 Implementation CHECKLIST

The purpose of this implementation checklist is to document the range of activities that need to be completed to bring a DAPs application from an initial concept to operational use. Some activities of this checklist may be specific to individual stakeholders.

5.2.1 Activity Sequence

The activities are listed in approximate sequential order. However, each activity does not have to be completed prior to starting the next activity. In many cases, a parallel and iterative process should be used to feed data and experience from one activity to another. It should be noted that not all activities will be required for all applications.

5.2.2 Concept Phase

- a) Construct operational concept:
 - 1) Purpose;
 - 2) Operational environment;
 - 3) ATM functions; and
 - 4) Infrastructure;
- b) Identify benefits:
 - 1) Safety enhancements;
 - 2) Efficiency;
 - 3) Capacity;
 - 4) Environmental;
 - 5) Cost reductions;
 - 6) Accessibility; and
 - 7) Other metrics (e.g. predictability, flexibility, usefulness);
- c) Identify constraints:
 - 1) Air-Ground interoperability;
 - 2) Compatibility with non-equipped aircraft;
 - 3) Need for exclusive airspace;
 - 4) Required ground infrastructure;
 - 5) RF spectrum;
 - 6) Integration with existing technology;
 - 7) Technology availability; and
 - 8) Actuality of existing infrastructure;

- d) Prepare business case:
 - 1) Cost benefit analysis; and
 - 2) Demand and justification.

5.2.3 Design Phase

- a) Identify operational requirements:
 - 1) Security; and
 - 2) Systems interoperability;
- b) Identify human factors issues:
 - 1) Human-machine interfaces;
 - 2) Training development and validation;
 - 3) Workload demands;
 - 4) Role of automation vs. role of human;
 - 5) Crew coordination/pilot decision-making interactions; and
 - 6) ATM collaborative decision-making.
- c) Identify technical requirements:
 - 1) Standards development;
 - 2) Prevailing avionics standards;
 - 3) Data required;
 - 4) Functional processing;
 - 5) Functional performance;
 - 6) Required certification levels; and
 - 7) Identify the infrastructure that needs upgrade.
- d) Equipment development, test, and evaluation:
 - 1) Prototype systems built to existing or draft standards/specifications;
 - 2) Upgrade and test scheme for the existing infrastructure;
 - 3) Developmental bench and flight tests;
 - 4) Acceptance test parameters; Acceptance test should be performed to ensure all the key indicators are met; and
 - 5) Select and procure technology.
- e) Develop procedures:
 - 1) Pilot and controller actions and responsibilities;
 - 2) Standardize the interaction and phraseologies;
 - 3) Controller's responsibility to maintain a monitoring function, if appropriate;
 - 4) System certification procedure should be made.
 - 5) Standard Operating Procedure should be made if the human machine interface of the system is changed.

- 6) Contingency procedures; For example duplicate Mode S address is detected;
 - 7) Emergency procedures, for example ACAS message is received;
 - 8) General procedures for unforeseen issues should be made; and
 - 9) Develop AIP and Information documentation.
- f) Prepare design phase safety case:
- 1) Safety rationale;
 - 2) Safety budget and allocation; and
 - 3) Functional hazard assessment.

5.2.4 Implementation Phase

- a) Prepare implementation phase safety case;
- b) Conduct operational test and evaluation:
 - 1) Flight deck and ATC validation simulations; and
 - 2) Flight tests and operational trials;
- c) Obtain systems certification:
 - 1) Aircraft equipment; and
 - 2) Ground systems;
- d) Obtain regulatory approvals:
 - 1) Air traffic certification of use;
- e) Impact Assessment

An impact assessment should be conducted to gauge the effect in terms of security, efficiency, operating regulations, human factors, infrastructure, environment, and so on.

- f) Implementation transition:

- 1) Promulgate procedures;

The regulatory authority shall promulgate general regulations to the participants. Each participant shall formulate corresponding detailed regulations.

- 2) Deliver training;

Training should be conducted to ensure the personnel is familiar with the standard, regulation, and technology of the Mode S DAPs implementation and operation. Licensing process could be executed if needed.

- 3) Continue data collection and analysis;
- 4) Resolve any unforeseen issues; and
- 5) Continue feedback into standards development processes;

- g) Performance monitoring to ensure that the agreed performance is maintained.

6. SYSTEM INTEGRITY AND MONITORING

6.1 Introduction

CNS and ATM environment is an integrated system including physical systems (hardware, software, and communication networks), human elements (pilots, controllers and engineers), and the operational procedures for its applications. The integration of Mode S DAPs with other surveillance technologies enables more information from an aircraft to be used to provide a safer service.

Because of the integrated nature of such system and the degree of interaction among its components, comprehensive system monitoring is recommended. The procedures described in this section aim to ensure system integrity by validation, identification, reporting and tracking of possible problems revealed during system monitoring with appropriate follow-up actions.

6.2 Personnel Licensing and Training

Prior to operating any element of the Mode S DAPs system, operational and technical personnel shall undertake appropriate training as determined by the ANSP or State Regulatory Authority, including compliance with the Convention on International Civil Aviation where applicable. Such training will ensure that personnel are familiar with the regulation, standards and requirements of the Mode S DAPs implementation and operation.

6.3 ATS System Validation

6.3.1 Safety Assessment Guidelines

To meet system integrity requirements, ANSPs or States should conduct a validation process that confirms the integrity of their equipment and procedures. Such processes shall include:

- a) A system safety assessment for new implementations is the basis for definitions of system performance requirements. Where existing systems are being modified to utilize additional services, the assessment demonstrates that the ATS Provider's system will meet safety objectives.
- b) Integration test results confirming interoperability for operational use of airborne and ground systems; and
- c) Confirmation that the ATS operation procedure is compatible with those of adjacent providers where the system is used across a common boundary.

6.3.2 System Safety Assessment

The objective of the system safety assessment is to ensure that the implementation and operation of Mode S DAPs are safe. The safety assessment should be conducted for implementation as well as any future enhancements and should include:

- a) Identifying failure or error conditions;
- b) Assigning levels of criticality;
- c) Determining risks/probabilities for occurrence;
- d) Identifying mitigating measures;

- e) Categorizing the degree of acceptability of risks; and
- f) Operational hazard ID process.

Following the safety assessment, States should institute measures to offset any identified failure or error conditions that are not already categorized as acceptable. This should be done to reduce the probability of their occurrence to an acceptable level. This could be accomplished through the automation of procedures.

6.3.3 Integration Test

States should conduct trials with suitably equipped aircraft to ensure the DAPs data meets the operational and technical requirements to provide ATS. The introduction of the Mode S DAPs will give more information about the aircraft, and should not affect the performance of the existing system. States should be satisfied by test results and analysis carried out by the ANSP.

6.3.4 ATS Operation Manuals

States may coordinate with adjacent States to confirm that their ATS operation manuals contain standard operating procedures to ensure harmonization of procedures that impact across common boundaries.

6.4 System Monitoring

During the implementation and operation of the Mode S DAPs technology, routine collection of data is necessary to ensure that the system continues to meet or exceed its performance, safety and interoperability requirements, and that operational service delivery and procedures are working as intended.

6.4.1 Consideration for System Monitoring

Mode S transponders may have been installed a long time ago to support mandatory ACAS functionality. The Mode A/C function has been permanently used by ATC, but the Mode S functions may not have been used. Any failure impacting Mode A/C would have been detected by ATC during normal operation and corrective action would have been undertaken. Before implementing Mode S for surveillance, system checks are usually made to ensure the correct operation of the Mode S transponders (e.g. continue to correctly process Mode A/C and Mode S replies), but possibly no system checks were made to ensure that the DAPs data was correct, so several undetected failures may have existed over the years of operation.

A number of Mode S transponder from different OEMs have been observed to be non-compliant with Annex 10 Volume IV requirements (e.g. no SI code capability, no reply to aircraft register extraction, incorrectly configured aircraft address, incorrect content of BDS registers), even though the transponder is certified to level 2. Although actions have been taken in some areas (mainly where Mode S has been implemented) to address these problems, some aircraft with Mode S which are not working correctly still operate (mostly in areas where Mode S has not yet been implemented).

During the initial deployment of European Mode S, it was discovered that avionics upgrade performed on some aircraft had resulted in erroneous transponder operations so that, in some cases, the aircraft could not even be detected by the ground radar. It is therefore recommended that before commencing Mode S surveillance operations in a given airspace, system monitoring be put in place for timely detection and rectification of hidden transponder problems. This will enable the ANSP and aircraft operators to remedy identified issues prior to using Mode S operationally.

The communication lines for transferring surveillance information in a Mode S radar require much higher data throughput as there is more information per aircraft. For example, compared to a Mode A/C radar, Mode S DAPs require up to three times more data throughput.

Mode S DAPs bring safety benefits even when only a portion of the traffic is properly equipped. Some aircraft can be configured to provide additional data items, but their use should be considered with caution since some airborne installations may not have been certified, hence data may be erroneous. System monitoring to validate the transmitted information is considered desirable for DAPs operation.

6.4.2 Mode S DAPs Problem Reports

During the application of the Mode S DAPs, some problems may be found during the observation of one or more specific events. Faulty Mode S DAPs data should be recorded and analyzed. Problems may be found during the routine analysis of application data. Any problem should be documented and reported to the DAPs WG.

After a problem has been found, the finder can attempt to resolve it with the appropriate party and report the solution to the DAPs WG. The problem and solution will be distributed to the DAPs WG members. If the problem has not been resolved, the problem should be reported to the DAPs WG, and members will be encouraged to resolve the problem. In many cases, a Mode S DAPs problem will be systematic across a particular aircraft or avionics configuration. Engagement with, and correction by the manufacturer may be required.

The mode S DAPs problem should be reported with the form as shown in Table 6-1.

Table 6-1 Mode S DAPs Problem Report Form

PRS#			
Start Time/Date UTC		End Time/Date UTC	
Registration		Aircraft ID	
Flight ID		ICAO Aircraft Address	
Aircraft Type			
Flight Sector/ Location			
ATS Unit			
Description / additional information			
Originator		Originator Reference number	
Organization			

PRS#:	A unique identification number assigned by the PRS Administrator to this problem report. Organizations writing problem reports are encouraged to maintain their internal list of these problems for tracking purposes. Once the problems have been reported to the PRS and incorporated in the database, a number will be assigned by the PRS and used for tracking by the SURICG.
Start Time/Date UTC:	UTC time/date when the event started.
End Time/Date UTC:	UTC time/date when the event ended.
Registration:	Registration number (tail number) of the aircraft involved.
Aircraft ID:	Coded equivalent of call sign as entered in FPL Item 7.
Flight ID:	The Flight ID/Flight Number downlinked from the aircraft.
ICAO Aircraft Address:	Unique aircraft address expressed in Hexadecimal form.

Aircraft Type:	The aircraft model involved. For the aircraft type designators please refer to ICAO Doc 8643.
Flight Sector/Location:	The departure airport and destination airport for the sector being flown by the aircraft involved in the event. For the airport indicators please refer to ICAO Doc 7910 or related AIP. Or if more descriptive, give the location of the aircraft during the event.
ATS Unit:	ICAO identifier of the ATC center or tower controlling the aircraft at the time of the event.
Originator:	Point of contact at the originating organization for this report (usually the author).
Organization:	The name of the organization (airline, ATS provider or communications service provider) that created the report.
Description:	This should provide as complete a description of the situation leading up to the problem as is possible. Where the organization reporting the problem is not able to provide all the information (e.g. the controller may not know everything that happens on the aircraft), it would be helpful if they would coordinate with the other parties to obtain the necessary information. The description should include: a) A complete description of the problem that is being reported b) The route contained in the FMS and flight plan c) Any flight deck indications d) Any indications provided to the controller when the problem occurred e) Any additional information that the originator of the problem report considers might be helpful but is not included on the list above If necessary, to contain all the information, additional pages may be added. If the originator considers it might be helpful, diagrams and other additional information (such as printouts of message logs) may be appended to the report.

6.4.3 Example of Mode S DAPs Problem

Through monitoring, it has been reported that erroneous DAPs data have been observed due to failure or improper setting/installation of Mode S equipment. A Working Paper of the ICAO Surveillance Panel Working Group (WP ASP12-20) has indicated that a lot of incorrect, outdated and even erroneous data and parameters are present for DAPs data. The errors and/or miss-matches can be frequent, including:

- a) The ACID is not always correct (erroneous)
- b) The Selected Altitude is not correct or is not updated (For example Selected Altitude data should be provided by the MCP/FCU instead of the FMS as the FMS data is usually incorrect).
- c) Mode S DAPs data does not correspond to the content of the requested register (BDS swap).

6.5 Application Analysis

During the Operation of Mode S DAPs application, the analysis is necessary to ensure that the system continues to meet or exceed its performance, safety and interoperability requirements. To analyze the Mode S DAPs applications, routine data should be recorded.

6.5.1 Data Recording

It is recommended that ATS providers and communication service providers retain the records defined below for at least 30 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.

Where possible 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. Data exchange across borders may not be possible due to different Radar or ATM message formats or to State regulatory issues.

Not only the data from ground equipment, but also the data from aircraft equipment should be recorded. By analyzing the recorded data, the exact reason for the failures can be found.

6.5.2 Local Data Collection

ATS providers and communication service providers should identify and record Mode S DAPs system component failures that have the potential to negatively impact the safety of controlled flights or compromise service continuity.

6.5.3 Avionics Problem Identification and Correction

ATS providers should develop systems or procedures to:

- a) detect Mode S DAPs avionics anomalies and faults
- b) advise the regulators and where appropriate the aircraft operators on the detected Mode S DAPs avionics anomalies and faults
- c) devise mechanisms and procedures to address identified faults

Regulators should ensure that appropriate corrective actions are taken to address identified faults.

An example of Mode S DAPs analysis is taken in Appendix 1.

6.6 Identified Issues

Several identified issues had already been recognized during the implementation of the Mode S DAPs data application in the ATM automation system. Some of them even disrupted the operation of ATC services. Thus, it is necessary to ensure the reliability of DAPs for utilization for ATC operation. This section will present some issues for helping to figure them out.

Based on the experience gained from States, the common Mode S DAPs problems are summarized under different categories in Appendix 2. It is noted that many cases of the wrong DAPs found in Mode S implementation were because of the aircraft avionics capability. Some issues resulted from human factors. Experiences showed that it was important to keep close coordination with airlines to promote the DAPs application. Airlines should be informed of the issues in time and to check their aircraft Mode S transponders promptly. At the same time, airlines need to improve their working procedures including ensuring they file flight plans correctly.

7. REGULATIONS AND PROCEDURES

Mode S DAPs involve the transmission of specific data from aircraft. These data messages can be interrogated by the ground equipment called Mode S interrogator. ATM uses the data to show the more precise and integrated situation of the surveillance aircraft. The following procedures relate to the use of Mode S DAPs data in ATS ground surveillance applications.

The implementation of the Mode S DAPs system will support the provision of high-performance surveillance, enhancing flight safety, improving the controller efficiency and reducing the workload of both the controller and pilot.

7.1 Mandating Mode S DAPs

- a) Depending on the type of operations that States are going to conduct, States will have to consider whether there is a need to publish mandates. Some operations will require all aircraft within airspace to be suitably equipped while others can still work well on a ‘best equipped best served’ basis.
- b) Use of Multilateration on airport surface is an example of an operation where it is recommended for all aircraft to be equipped with Mode S transponders. Another example is the conspicuity code environment, where Flight Identification may be used as the prime means to couple flight plans, allowing ANSPs to overcome the shortage of Mode A codes. Equipage mandates would be necessary for such operations.
- c) With appropriate software, ATM automation systems can use Mode S DAPs to provide additional information to controllers, enabling a reduction in controller workload and the enhancement of Safety Net systems. Equipage mandates are not necessary, but consideration of the nature of the services required and/or a cost-benefit study, may warrant such mandates.
- d) As of May 2018, examples of States which use Mode S DAPs without publishing mandates are Australia¹, New Zealand and Singapore. Examples of States with published mandates for Mode S DAPs are France, Germany and the United Kingdom.
- e) In publishing mandate/regulations, States should:
 - 1) Define the standards applicable to the State.
 - i. E.g. *Joint Aviation Authorities (JAA) Temporary Guidance Leaflets (TGL) 13 Revision 1* for Elementary Surveillance in version 0 and version 1 transponders; or
 - ii. E.g. *European Aviation Safety Agency (EASA) Acceptable Means of Compliance (AMC) 20-13* for Enhanced Surveillance in version 0 and version 1 transponders; or
 - iii. E.g. *Elementary Surveillance (ELS) requirements stated in European Aviation Safety Agency (EASA) CS-ACNS-Subpart D, Section 2 (i.e. CS ACNS.D.ELS)* for Elementary Surveillance in version 2 transponder; or
 - iv. E.g. *Enhanced Surveillance (EHS) requirements stated in European Aviation Safety Agency (EASA) CS-ACNS-Subpart D, Section 3 (i.e. CS ACNS.D.EHS)* for Enhanced Surveillance in Version 2 transponder
 - v. E.g. *Mode S level 2* if the requirement is simply for Airport Surface Multilateration.
 - 2) Define the airspace affected by the regulations

¹ Australia has a mandate for Mode S transponders at selected airports utilizing Multilateration for surface surveillance, but no widespread mandates for airborne DAPs usage

- i. E.g. *Within the [FIR Authority] Flight Information Region above Flight Level XXX*
- 3) Define the category of aircraft that the regulation applies to
 - i. E.g. *Aircraft with a maximum certified take-off mass exceeding 5,700 kg or having a maximum cruising true airspeed capability greater than 250 kt; or*
 - ii. E.g. *All IFR aircraft*
- 4) Define the timing of the regulations allowing sufficient time for operators to equip.
 - i. E.g. *With effect from 1 Jan 2020.*

7.2 Avionics

7.2.1 Mode S Transponder Capabilities

- a) The various levels of capabilities for Mode S Transponders are described in subsequent paragraphs. The state should select the capability as required by its operations.
- b) According to ICAO Annex 10, Vol. 4, Mode S transponders shall conform to one of five levels of capability as follows:
 - 1) Level 1 is the basic transponder. Level 1 permits surveillance based on Mode A/C as well as on Mode S. With a Mode S aircraft address, it comprises the minimum features for compatible operation with Mode S interrogators. It has no datalink capability and will not be used by international air traffic.
 - 2) Level 2 has the same capabilities as Level 1 and permits standard length datalink communication from ground to air and air to ground. It includes automatic aircraft identification reporting. This is the minimum level permitted for international flights. Data parity with overlay control (ICAO Annex 10, Vol. 4, 3.1.2.6.11.2.5) for equipment certified on or after 1 January 2020.
 - 3) Level 3 has the capabilities as level 2 and also those prescribed for ground-to-air ELM communications.
 - 4) Level 4 has the capabilities as level 3 and also those prescribed for air-to-ground ELM communications.
 - 5) Level 5 has the capabilities as level 4 and also those prescribed for enhanced Comm-B and ELM communications.
- c) Other than the various levels, transponders also can have the following features:
 - 1) Extended squitter - transponders that shall have the capabilities of level 2, 3, 4 ,or 5 and those prescribed for extended squitter operation.
 - 2) SI Capability - Transponders with the ability to process SI codes shall have the capabilities of level 2, 3, 4 ,or 5 and those prescribed for SI code operation.
 - 3) Data flash Application – transponders that implement the data flash mode.
 - 4) Hijack Mode Capability – transponders that support the Hijack Mode and have the capabilities of level 2, 3, 4, or 5.
 - 5) ACAS Compatibility –transponders compatible with ACAS.
 - 6) Antenna Diversity – in aircraft with transponder using two antennas, receivers and transmitting channels.
 - 7) According to ED-73E, Elementary Surveillance – elementary surveillance transponders will require at least a level 2 transponder and have the following capabilities:

- i. Flight status reporting;
 - ii. Barometric pressure altitude reporting
 - iii. Transponder capability (CA)
 - iv. II and SI code capable
 - v. Declaration of capability (BDS code 1,0)
 - vi. Common usage GICB capability report (BDS code 1,7)
 - vii. Mode S specific services capability (BDS code 1,8 to BDS code 1,C)
 - viii. Flight identification (BDS code 2,0)
 - ix. ACAS Active Resolution Advisory (BDS code 3,0) if equipped with ACAS II
 - x. Aircraft register (BDS code 2,1) – optional
- 8) According to ED-73E, Enhanced Surveillance – enhanced surveillance transponders have the capabilities of elementary surveillance transponders, plus the capability to provide the following DAPs:
- i. Magnetic Heading (BDS code 6,0)
 - ii. Indicated Airspeed and/or Mach No. (BDS code 6,0)
 - iii. Vertical Rate (climb/descend) (BDS code 6,0)
 - iv. True Airspeed (provided if Track Angle Rate is not available) (BDS code 6,0)
 - v. MCP/FCU Selected Altitude (BDS code 4,0)
 - vi. Ground Speed (BDS code 5,0)
 - vii. Roll Angle (BDS code 5,0)
 - viii. Track Angle Rate (if available) (BDS code 5,0)
 - ix. True Track Angle (BDS code 5,0)
 - x. Barometric Pressure Setting (BDS code 4,0)

7.2.2 Mode S Transponder Mandate

During the 31st APANPIRG meeting, the following Conclusion regarding the fitment of Mode S equipage was adopted, States/Administrations may consider the following conclusion when considering the publishing of Mode S transponder mandate.

Conclusion APANPIRG/31/14 (CNS SG/24/13 (SURICG/5/3(DAPS WG3/1))) - Mode S Forward Fit Equipage in APAC Region		
What:	Regarding fitment of Mode S equipage, That, States/Administrations in APAC Region be strongly encouraged to mandate that registered aircraft with a maximum certified take-off mass exceeding 5 700 kg or having a maximum cruising true airspeed capability greater than 250 knots, with a date of manufacture on or after 1 January 2022 be equipped with Mode S avionics compliant with Enhanced Surveillance (EHS).	Expected impact: ☐ Political / Global ☐ Inter-regional ☒ Economic ☐ Environmental ☒ Ops/Technical
Why:	Considering that a number of DAPs applications will require EHS and that it's easy for new aircraft to be equipped with EHS. Retrofitting existing airframes with EHS will need further deliberation under the challenging pandemic situation.	Follow-up: ☒ Required from States
When:	16-Dec-20	Status: Adopted by PIRG

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

7.2.3 Transition Guidelines

- a) Equipage of aircraft will be achieved over a period of time. Not all aircraft will be equipped with the necessary capability. A transition plan is required to accommodate varying degrees of aircraft equipment compliance.
- b) As part of the formulation for a transition plan, States should assess the impact of having aircraft that are not suitably equipped within the affected airspace, to enable the implementation of suitable mitigating measures. States should also collect statistics on the readiness of the aircraft within the affected airspace.
- c) For different operations, the mitigation measures in the transition plan could be different. For example, if the operation is just to use the Mode S DAPs to provide useful information to the controllers, the impact of having unequipped aircraft is minor. Mitigating measures could be as simple as making the controllers aware that not all aircraft are able to provide the information. On the other hand, where mode S is mandated for airport surface Multilateration, mitigating measures for having unequipped aircraft may include having special procedures for non-equipped aircraft or the deployment of a surface movement radar.

7.2.4 Mode S Transponder Working on the Ground

Table 7-1 summarizes the requirements to inhibit or not inhibit replies from aircraft on the ground.

Table 7-1 The Requirements of Transponders on Ground

Type of interrogations	Transponder reply
Mode A/C	Should be inhibited
Mode A/C/S All Call	Shall always be inhibited
Mode S only All Call (UF =11)	Shall always be inhibited
Mode S (Roll call UF=0,4,5,16,20,21,24)	Shall not be inhibited
Acquisition Squitter (Short Squitter)	Shall be inhibited if surface type of extended squitter is transmitted
Extended Squitter (Long Squitter)	Shall not be inhibited

[Information obtained from Eurocontrol's Clarification Mode S Transponder in an Airport/A-SMGCS Environment Ed 1.1 dated 3 May 2005]

- a) Replies to Mode A/C/S all call and Mode S only all call interrogations shall always be inhibited when the aircraft declares the on the ground state. It shall not be possible to inhibit replies to discretely addressed Mode S interrogations regardless of whether the aircraft is airborne or on the ground.
- b) Mode A/C replies should be inhibited (i.e. Mode A/C transponder set to standby) when the aircraft is on the ground to prevent interference when in close proximity to an interrogator or other aircraft. Mode S discretely addressed interrogations do not give rise to such interference. An exception on the recommendation to inhibit Mode A/C replies will be at airports having Multilateration systems working with Mode A/C.
- c) Mode S transponders shall be set to the correct mode according to its flight status (i.e. airborne

mode when it's in the air and ground mode when on the ground). When an aircraft is in ground mode, replies to all call are inhibited. It is recommended that aircraft provide means to determine the on-the-ground state automatically and provide that information to the transponder.

7.3 Mode S Interrogator

7.3.1 Working Principles

The Mode S interrogator transmits interrogation to elicit replies for detection of Mode S transponders and more information from the aircraft. The use of a unique ICAO 24-bit aircraft address and provision of all the required aircraft data in one reply will reduce interrogation rates.

Each aircraft can be interrogated selectively, needing only one or two 'hits' per aircraft per scan and minimizing interference problems associated with SSR Mode A/C.

The operation of a Mode S interrogator will not interfere with the SSR performance of any aircraft equipped with a Mode A/C transponder.

A Mode S interrogator is capable of performing the conventional surveillance function with Mode A/C transponders.

7.3.2 Interrogator Codes

The Mode S system requires each interrogator to have an IC, which can be carried within the uplink and downlink transmissions. The 4-bit IC uplink field in UF11 shall contain either 4-bit II code or the lower 4 bits of the 6-bit SI codes. It is recommended that whenever possible an interrogator should operate using a single interrogator code.

The II codes shall be assigned to interrogators in the range from 0 to 15. The II code value of 0 shall only be used for supplementary acquisition. The SI codes shall be assigned to interrogators in the range from 1 to 63. The SI code value of 0 shall not be used.

The assignment of interrogator II or SI codes, where necessary in areas of overlapping coverage, across international boundaries of flight information regions, shall be the subject of regional air navigation agreements. The ICAO Asia Pacific Regional Office maintains a register of II codes used – where States have provided this information to the office. States are encouraged to provide this information to the Regional Office and update it when changes are made.

7.3.3 Mode Interlace Pattern

The particular air traffic and environment of each interrogator will influence the selection of suitable interrogation periods, interrogation repeat frequency, MIP and Probability of Reply.

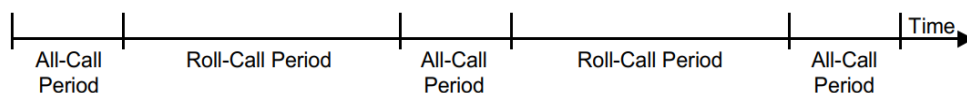


Figure.7-1 The Typical MIP

The repetition frequency and duration of the All-Call period is a local implementation issue (the stated ICAO maximum is 250Hz). The exact duration of either period will depend on the characteristics of the system such as the antenna revolution rate, the beam-width and the maximum range. There will normally

be several all-call periods (and hence roll-call periods as one will always follow the other) available to interrogate all targets in range during one revolution.

There is a careful balance between the reliable acquisition of all targets and the potential of flooding the RF environment with unwanted replies to acquisition interrogations. It is necessary to choose an appropriate Mode Interlace Pattern to manage the acquisition activities to ensure minimal interference. The default objective is to define a MIP which effectively detects and performs surveillance on classical SSR Mode A/C aircraft using Mode A/C interrogations which also detects and acquires Mode S aircraft using Mode S interrogations. The MIP is constructed in order to separate Mode A/C and Mode S all-calls from Mode S selective (roll-call) activity. MIP defines the sequences of all-call interrogation types that might be made during cycles of all-call periods. Every interrogator is likely to have different needs and hence different ways of operating.

China presented an IP about the Mode S Parameter Set during the 3rd meeting of DAPs WG. For detailed information please refer to Appendix 4.

7.3.4 DAPs Extraction by GICB Protocol

The GICB procedure is initiated by a Mode S interrogator for eliciting the Mode S DAPs containing aircraft derived data from a Mode S aircraft installation.

The GICB protocol allows for the immediate transfer of data required by the ground and the extraction of information stored in the Mode S transponder. This information (if available) is contained in the reply to an interrogation specifying the address (BDS code) of the storage location containing that information.

The interrogation with specific BDS can elicit the corresponding Comm-B data where contained in Mode S transponder's registers. The Mode S DAPs can be implemented in two stages: ELS and EHS.

The first processing step for any Mode S data link application is to obtain the transponder CA value from the aircraft. The 3-bit CA field is found in the "Mode S All-Call Reply" (DF=11) and the "Extended Squitter" (DF=17) downlinks. If CA=0, then this transponder is surveillance-only and supports no data link functions at all. If $CA \geq 4$ indicates that the Mode S transponder is fully capable of at least 56-bit short uplink and downlink message transfer. These Mode S transponders may support the ELS, EHS requirements. The values of CA= 1, 2, 3 are reserved.

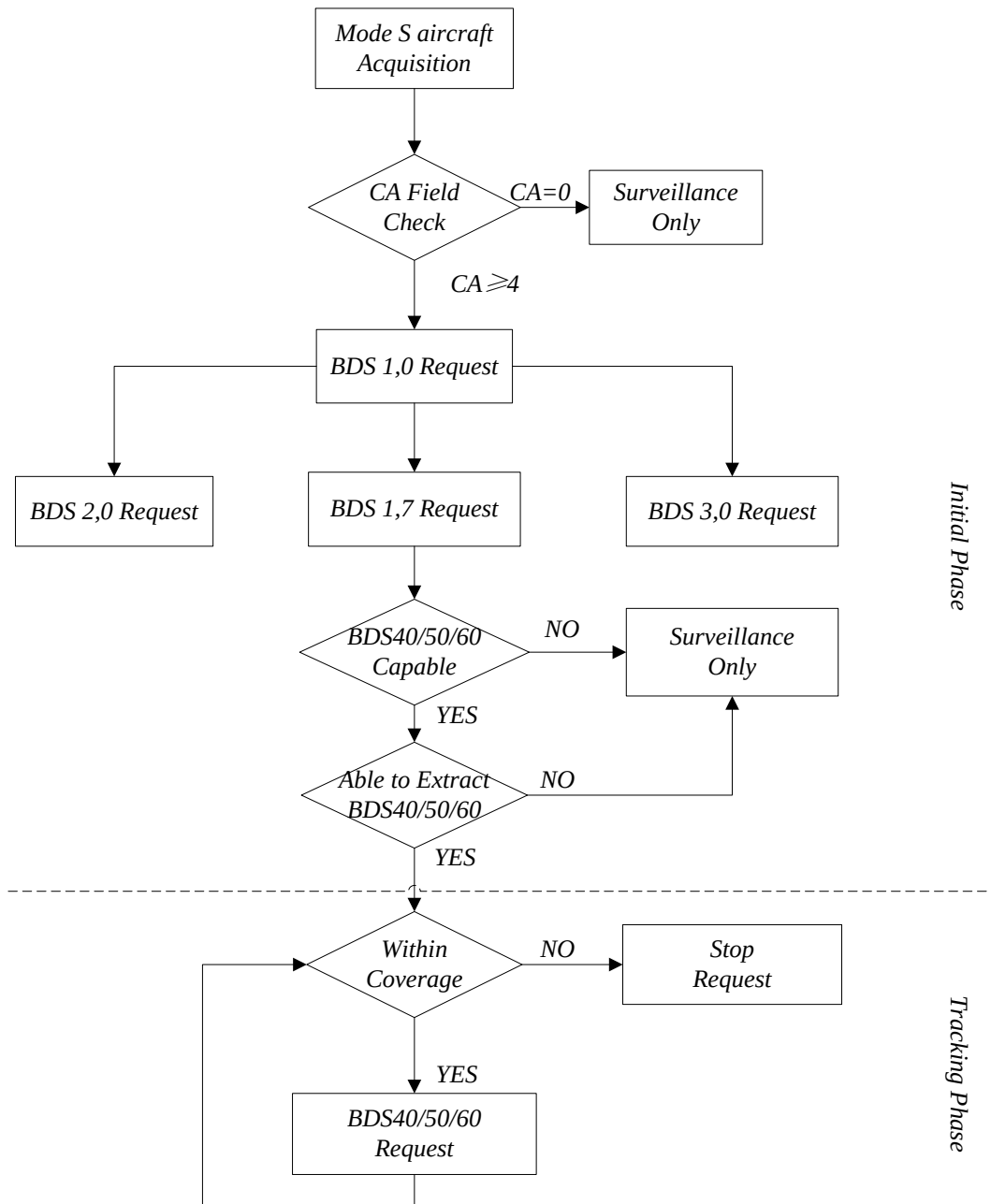


Figure.7-2 The Typical Procedure of DAPs Extraction

Given that the Mode S transponder's CA value is 4 or greater, the second processing step for any Mode S data link application is to extract the transponder's Mode S data link capability report register BDS code 1,0. Bits in this register indicate the support of such Mode S data link functions as aircraft identification (register BDS code 2,0), ACAS (register BDS code 3,0), common-usage capability (register BDS code 1,7) etc. The Mode S-Specific services capability bit in register BDS code 1,0 indicates whether the avionics installation supports further data link functions. If this bit is set, the Mode S data link application would next extract the common-usage capability register BDS code 1,7. All of the registers involved with the EHS application have bit flags assigned in this register BDS code 1,7. If the bit flag is set, it indicates that the corresponding register has been updated in a timely manner and contains valid data which can be extracted by the interrogator. The processing protocol is sufficient initialization for basic data link applications such as ELS, EHS since all their status and configuration information is available from register BDS code 1,0 and register BDS code 1,7.

So, the Mode S interrogator should transmit the selective interrogation to elicit the Mode S transponder reply with the specific formats and Comm-B data contained in the corresponding registers.

Normally, the more Comm-B data requested by the Mode S interrogator, the more information can be extracted from the aircraft transponder registers. It will also help the ATC controller get the aircraft's flight status and flight intention. However, there should be some necessary limitations for the Comm-B data request to avoid the phenomenon of Comm-B data discontinuity because of the limited Roll-Call interrogation duration.

It is suggested that the number, periodicity and priority of BDS data extraction rule be reasonably and effectively implemented according to the requirements and the number of aircraft in the airspace. The scientific strategy can ensure the ATC controller gets Comm-B data timely and effectively.

7.3.5 DAPs Extraction by AICB Protocol

The AICB procedure is initiated by a Mode S transponder for transmitting a single Comm-B segment from the aircraft installation.

Any changes in the contents of ACAS (register BDS code 3,0) triggers a downlink message via the air-initiated Comm-B broadcast protocol including the updated register contents.

An AICB sequence shall start upon the acceptance of a message intended for delivery to the ground sensor. After receipt of this message, the transponder shall set a valid downlink request code of surveillance or Comm-B reply. On receipt of this message with a valid downlink request code, the interrogator could start to extract the message.

AICB messages are announced by the transponder and are transmitted in a subsequent reply only after authorization by the interrogator. AICB messages are announced to all interrogators and can be extracted by any interrogator. The Mode S data link application should update the aircraft's "state" values with the new ones. The changed state might result in discontinuance (or reinstatement) of certain Mode S data link functions. Mode S transponder AICB broadcast messages are held active in the transponder for 18 seconds after the triggering event. Any Mode S sensor can extract the broadcast information.

7.3.6 DAPs Extraction by Comm-B Broadcast

A Comm-B broadcast is a message directed to all active interrogators in view. Messages are available for 18 seconds unless a waiting AICB interrupts the cycle. Interrogators have no means to cancel the Comm-B broadcast.

Currently, only registers of datalink capability report (register BDS code 1,0) and aircraft identification (register BDS code 2,0) make use of the Comm-B Broadcast.

7.4 ATM Automation System

7.4.1 Elementary Surveillance

For the Elementary Surveillance, the following parameters of aircraft can be beneficial to the ATM automation system:

- a) ICAO 24-bit Aircraft Address/Aircraft Identification

- 1) The ATM automation system should collect the real aircraft address/aircraft identification from the received message, and the aircraft address/aircraft identification can be shown on the control HMI to identify the aircraft.
- 2) The ATM automation system can use the aircraft address/aircraft identification to correlate an aircraft's track with the flight plan, so the use of aircraft address/aircraft identity can alleviate the shortage of Mode 3/A code. Correlation between track and flight plans is normally based on either the 24-bit aircraft address, aircraft identification, or the Mode 3/A code. The correlation will depend on their weights and priority.
- 3) The ATM automation system can also utilize the aircraft address/aircraft identification to improve the tracking function.
- 4) The ATM automation system could provide DUPE warning between aircrafts which have the same ICAO 24-bit aircraft address, same aircraft identification or the same Mode 3/A code.

b) Transponder Capability Report

The ATM automation system can collect the datalink capability of the transponder from the received message and show the information to the controller. The controller can estimate whether the aircraft with this transponder meets the requirement in the airspace

c) Altitude reporting in 25ft interval

The ATM automation system can collect aircraft altitude reporting in 25ft increments and provides valuable improvements to the quality of safety nets. The improvements should reduce the number of nuisance alerts and enhance the integrity of separation assurance.

d) Flight status (airborne/on the ground)

The ATM automation system can collect the flight status of the aircraft. Whether the aircraft is airborne or on the ground can be shown in the system to improve the situational awareness of the controller. Also, the flight status can be used to filter the aircraft on the ground in the system if necessary.

e) ACAS Resolution Advisory Report

Some of the ATM automation system can collect the ACAS Resolution Advisory Report and the information can be shown in the system to improve situational awareness of the controller. On receipt of ACAS Resolution Advisory notification, a prominent notification is displayed in a field that may be acknowledged. The indication is removed when the ACAS RA is resolved.

Note: The display of ACAS Resolution Advisory Report in ATM automation system can be turn on or turn off by user, and it is not recommended by IFATCA. The user is suggested to do the relevant safety evaluation before applying this function.

7.4.2 Enhanced Surveillance

For the Enhanced Surveillance, the following parameters of aircraft can be beneficial to the ATM automation system:

a) Selected Altitude

- 1) The ATM automation system can collect the selected altitude of the aircraft and show the information to the controller to improve the situational awareness of the controller.
- 2) The ATM automation system can generate aSFL Mismatch Alarm when the SFL chosen by the crew does not match the cleared altitude given by the controller (CFL), alerting the

controller to take appropriate action to remedy the issue. A SFL Mismatch Alarm shall be presented to the responsible controller as an indication in the coupled surveillance track label and in the associated flight strip.

- 3) The ATM automation system can also utilize the SFL to improve the accuracy of the safety net.

In MTCD function, the ATM automation system can use the selected altitude as the target climbing/descending altitude in the flight look-ahead time, and calculate the possibility of conflict with the predicted flight trajectories of other flights in the airspace through trajectory prediction. Calculations involving SFL could be more accurate, and improve the performance of MTCD.

In the MSAW function, the ATM automation system generally provides MSAW warning by using track data (heading and rate of climb/descent and mode c). The ATMs use of CFL or SFL can enhance the MSAW algorithms use of vertical data to predict MSAW alerts and reduce the number of false alerts..

b) Barometric Pressure Setting

The ATM automation system can collect the barometric data of the aircraft and show the information to the controller. The system can provide a warning when the barometric data transmitted by the aircraft does not match the parameter of the area where the aircraft is operating.

c) Roll Angle, Track Angle Rate, True Track Angle, Ground Speed, Magnetic Heading, True Airspeed

- 1) The ATM automation system can collect these parameters and may allow the display of some of the information to the controller to improve the situational awareness of the controller. This information can be displayed in various ways (e.g., a DAP Window) as offline defined, according to the requirement of the controllers. Display of some parameters, provides a clearer picture to the controllers generating a reduction in radio calls with the pilot, so the R/T usage between the controller and individual aircraft under service is reduced.
- 2) The system can make use of DAPs kinematics parameters for consistency checking, and perform a more precise tracking function.
- 3) The system can utilize the kinematics information of the aircraft to improve the accuracy of safety net functions, (e.g., Short-Term Conflict Alert (STCA)), through the provision of more accurate aircraft tracks.
- 4) The system may use True track angle, Magnetic Heading, True Airspeed and Ground Speed to calculate a wind direction and speed of a specific area, which will enable the updating of forecast winds and improve trajectory modeling in the system. The system may also show the wind information to the controller to improve the situational awareness of the controller.

d) Barometric Altitude Rate, Inertial Vertical Velocity

The ATM automation system can collect the vertical rate data of the aircraft to improve the precision of the compute altitude and the accuracy of the related alert. The system can make use of the data to realize an optimized CFL protection in STCA and MSAW analysis function.

e) Indicated Air Speed/Mach Number

The ATM automation system can acquire indicated airspeed/Mach number of the aircraft, allow ATC to monitor the aircrew compliance with the controller's instructions, and if required provide a warning to the controller when there is a mismatch.

7.5 Flight Planning

7.5.1 ICAO Flight Plan Item 7 - Aircraft Identification

ACID must be accurately recorded in item 7 of the ICAO Flight Plan form as per the following instructions:

Aircraft Identification, not exceeding 7 alphanumeric characters and without hyphens or symbols is to be entered both in item 7 of the flight plan and replicated exactly when set in the aircraft (for transmission as Flight ID) as follows:

Either,

- a) The ICAO designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, NGA213, JTR25), when in radiotelephony the call sign to be used by the aircraft will consist of the ICAO telephony designator for the operating agency followed by the flight identification (e.g. KLM 511, NIGERIA213, JESTER25).

Or,

- b) The nationality or common mark registration marking of the aircraft (e.g. EIAKO, 4XBCD, N2567GA), when:
 - 1) in radiotelephony the callsign used by the aircraft will consist of this identification alone (e.g. CGAJS), or preceded by the ICAO telephony designator for the operating agency (e.g. BLIZZARD CGAJS),
 - 2) the aircraft is not equipped with a radio.

Note 1: No zeros, hyphens, dashes or spaces are to be added when the Aircraft Identification consists of less than 7 characters.

Note 2: Appendix 2 to ICAO DOC4444 (PANS-ATM 16th edition, 2016) refers.

Note 3: Standards for nationality, common and registration marks to be used are contained in Annex 7, section 3.

Note 4: Provisions for the use of radiotelephony call signs are contained in Annex 10, Volume II, Chapter 5. ICAO designators and telephony designators for aircraft operating agencies are contained in Doc 8585 — Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services.

7.5.2 Equipment (Surveillance Equipment /SSR Equipment)

- a) ICAO Flight Plan Item 10 – Surveillance Equipment and Capabilities

When an aircraft is equipped with a Mode S Transponder, appropriate Mode S designators shall be entered in item 10 of the flight plan to indicate that the flight is capable of transmitting Mode S DAPs messages.

These are defined in ICAO DOC 4444 as follows:

‘N’ No surveillance equipment for the route to be flown is carried, or the equipment is unserviceable

SSR Mode A and C

‘A’ Mode A transponder

‘C’ Mode A and Mode C transponder

SSR Mode S

‘E’ Mode S transponder, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability

‘H’ Mode S transponder, including aircraft identification, pressure-altitude and enhanced surveillance capability

‘I’ Mode S transponder, including aircraft identification, but no pressure-altitude capability

‘L’ Mode S transponder, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability

‘P’ Mode S transponder, including pressure-altitude, but no aircraft identification capability

‘S’ Mode S transponder, including both pressure altitude and aircraft identification capability

‘X’ Mode S transponder with neither aircraft identification nor pressure-altitude capability

Note: Enhanced surveillance capability is the ability of the aircraft to down-link aircraft derived data via a Mode S transponder.

b) ICAO Flight Plan Item 18 – Other Information

Where required by the appropriate authority the ICAO AA (24 Bit Code) may be recorded in Item 18 of the ICAO flight plan, in hexadecimal format as per the following example:

CODE/7C432B

Members or states should note that use of hexadecimal code may be prone to human error and is less flexible in regard to airframe changes for a notified flight.

7.5.3 Inconsistency between Mode S Flight Planning and Surveillance Capability

Inconsistency between flight planning of Mode S and surveillance capability of an aircraft can impact ATC planning and situational awareness. States are encouraged to monitor for consistency between flight plan indicators and actual surveillance capability. Where discrepancies are identified aircraft operators should be contacted and instructed to correct flight plans, or general advice (as appropriate to the operational environment and type of flight planning problems) should be issued to aircraft operators.

Advice to Operators:

Concerning inconsistency between Mode S Flight Planning and Surveillance Capability:

- a) ICAO AA (24 Bit Code) not submitted, or submitted incorrectly.
- b) Mode S and surveillance capabilities indicators incorrectly.

The flight planning requirements and relevant designators for aircraft are described in local document reference or ICAO DOC 4444 Appendix 2. The capability of the aircraft transponder and ADS-B capability will typically be available in the transponder manual or the aircraft flight manual for the aircraft. If in doubt, consult the transponder manual, aircraft flight manual or the Licensed Aircraft Maintenance Engineer.

7.5.4 Setting Flight ID in Cockpits

a) Flight ID Principles

The Flight ID is the equivalent of the aircraft callsign and is used in both Mode S SSR and ADS-B technology. Up to seven characters long, it is usually set in airline aircraft by the flight crew via a cockpit interface. It enables air traffic controllers to identify an aircraft on a display and to correlate a radar or ADS-B track with the filed flight plan ACID. Flight ID is critical, so it must be entered carefully. Punching in the wrong characters can lead to ATC confusing one aircraft with another.

The Flight ID entered in the transponder exactly must match the ACID entered in the flight plan.

Intuitive correlation between an aircraft's flight identification and radio callsign enhances situational awareness and communication. Airlines typically use a three letter ICAO airline code in flight plans, NOT the two letter IATA codes.

b) Setting Flight ID

The callsign dictates the applicable option below for setting Mode S or ADS-B Flight ID:

- 1) The flight number using the ICAO three-letter designator for the aircraft operator if a flight number callsign is being used (e.g. QFA1 for Qantas 1, THA54 for Thai 54).
- 2) The nationality and registration mark (without hyphen) of the aircraft if the callsign is the full version of the registration (e.g. VHABC for international operations).
- 3) The registration mark alone of the aircraft if the callsign is the abbreviated version of the registration (e.g. ABC for domestic operations).
- 4) The designator corresponding to a particular callsign approved by the ANSP or regulator (e.g. SPTR13 for firespotter 13).
- 5) The designator corresponding to a particular callsign in accordance with the operations manual of the relevant recreational aircraft administrative organization (e.g. G123 for Gyroplane 123).

7.6 Contingency Plan

ANSPs should prepare appropriate contingency plans in the event of a system failure that prevents the use of Mode S DAPs.

8. TRAINING AND COMPETENCE

8.1 Introduction

Training and development play an important role in the effectiveness of organizations and to the experiences of people in work. Training on DAPs has implications in improving productivity, aviation safety and personal development. The primary goal of the training is to develop and maintain an appropriate level of trust in DAPs related module, i.e. to make ATC and ATSEP aware of the likely situations where DAPs will be effective and, more importantly, situations in which DAPs will not be so effective (e.g. sudden, unexpected maneuvers).

8.2 Training of an Air Traffic Controller (ATC) in DAPs

With the inclusion of DAPs into surveillance and ATM automation system, an ATC training plan should adopt a modular approach. This approach progressively introduces various features, functionality of the new system on one hand and allows for integration with the ATC operational procedures. Additional benefits include shorter, logical self-contained units, clear attainable goals, better evaluation of training effectiveness and simplified self-assessment.

The ANSP should develop familiarization and rating focused training to ATC prior to adoption of DAPs in Surveillance and ATM automation systems.

The ANSP should ensure that all ATC concerned are assessed as competent for the use of the relevant DAPs module.

8.3 Training of an ATSEP in DAPs

- a) The ANSP should develop an ATSEP training programme that is acceptable to the ANS Regulator prior to its implementation.
- b) As a minimum, the training programme should comprise three levels as described below:
 - 1) Level 1 (Basic training). This should comprise training on the basic Surveillance and ATM automation systems operating in the State and their impacts on the safety of aircraft operations. The ANSP should ensure every ATSEP undergoes the basic training.
 - 2) Level 2 (Qualification training). This should comprise training to develop knowledge and skills on Surveillance and ATM automation systems. The ANSP should ensure each ATSEP is trained in one or more domains depending on their job scope.
 - 3) Level 3 (Specialized training). This should comprise training on specific Surveillance and ATM automation systems installed in the State, followed by on-the-job training.
- c) The ANSP should conduct a yearly review of the training plan for each ATSEP at the beginning of the year to identify any gaps in competency or changes in training requirements and priorities the type of training required for the coming year in regards of DAPs development.
- d) The ANSP should keep records of individual ATSEP training, competency assessment and approval history, where applicable, and associated documents. The records should be kept at least until the Surveillance and ATM automation system of which the ATSEP was trained on is no longer in use with the ANSP.
- e) The individual training records for each of ATSEP should include a training plan detailing the courses completed as well as the time-frame for attending future courses as required under

his/her training plan.

8.4 Competency Assessment of an ATSEP in DAPs

- a) The ANSP should develop an assessment methodology to determine the competency of an ATSEP in accordance with the competency framework developed in PANS-Training and which should be adapted to suit the local context.
- b) The ANSP may select a person to be a competency assessor only if the person –
 - 1) is an ATSEP approved in accordance with paragraph 8.3 for the particular Surveillance and ATM automation system; and
 - 2) has received adequate training in the conduct of competency assessment, practical checks and oral questionings.
- c) A competency assessor should not conduct a competency assessment on an ATSEP who is under the direct supervision of the competency assessor, unless the assessment is done in the presence of a second independent assessor.
- d) The assessment methodology should include a process for on-going competency checking and refresher training to ensure retention of competence.

9. SPECIFIC EXAMPLES ON MODE S DAPs APPLICATION

9.1 Use of Selected Altitude

Since August 2013, Mode S data processing functions have been implemented in Chengdu ATM automation system. The system uses the select altitude data extracted from the Mode S DAPs to provide an optimized CLAM alert for controllers. The system will generate the alert when the SFL chosen by the crew does not match the cleared altitude recorded in the ATM automation system. And a time delay parameter is predefined for the response time of the flight after controllers input to the ATM automation system (typically at the time of instruction given to the pilot).

Thanks to this new kind of alert, controllers have a better awareness of the intention of the airplanes and may discover the crew's mis-operation much earlier than the traditional CLAM, and then take actions timely to avoid the potential conflict.

In April 2017, an A320 aircraft was maintaining level flight at 27600 feet with another flight flying nearby at 26600 feet. Suddenly, the crew set an error altitude 22600 feet. The ATM automation system triggered the alert immediately even before the aircraft began to descend. The controller quickly noticed the alert and informed the crew in time. The aircraft successfully stopped descend at 27400 feet.

9.2 Use of ACAS RA

With the advancement of the ASTERIX standards and DAPs application, an ATM system can handle the derived data from Aircraft, which is detected, received and transmitted through the Mode S Radar, ADS-B station, and WAM sensors . In the event that an Airborne Collision Avoidance System (ACAS) Resolution Advisory (RA), the ATM system is able to provide a visual and aural alarm warning and indicative pilot intention to the controller.

Resolution Advisory (RA) alerting function works as follows:

- A resolution advisory is present when, in the subfields I048/260, I020/260, I021/260, I021/260 or I062/380 subfield #12(ACS), the bits are set as follows:

- the first bit of the ARA field set to 1 and the RAT bit set to 0 or,
- the first bit of the ARA field set to 0, the MTE bit set to 1 and the RAT bit set to 0.

- A resolution advisory is removed when:

- the ACAS RA report subfield (I048/260, I020/260, I021/260 or I062/380 subfield #12(ACS)) contains the RAT bit set to 1, or
- An ACAS RA report is not received in the relevant Data Item of the ASTERIX report.

Besides, the Resolution Advisory Intention is populated base on the PILOT selection and according to the following table:

MTE (60)	ARA (41)	42	43	44	45	46	47	RA Selection	RA Intention
1	0	Any	0	Any	1	Any	Any	Descend	Positive descend (Descent)

									to avoid the threat)
1	0	Any	1	Any	0	Any	Any	Climb	Positive climb (Climb to avoid the threat)
1	0	Any	0	Any	0	Any	Any	Other	Other

*NOTE1: ACAS Airborne Collision Avoidance System, applied in the EURO Aviation System, has the same meaning as TCAS abbreviated to Traffic Alert and Collision Avoidance System in the USA Aviation System

*NOTE2: The function and the matters needing attention related to ACAS Resolution Advisory Report in ATM automation system, please refer to 7.4.1 e).

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9.3 Use of Mode-S DAPs data for weather forecast

Meteorological Research Institute (MRI) and Electronic Navigation Research Institute (ENRI) conducted experiments for improving weather forecast accuracy utilizing Mode S DAPs data. In this research, estimate horizontal wind and temperature from the data in registers BDS code 5,0 and BDS code 6,0 which list below.

Table 9- DAPs information for weather forecast

Register	Name	Data Item
BDS code 5,0	Track and turn report	True Track Angle
		Ground Speed
		True Airspeed
BDS code 6,0	Heading and speed report	Magnetic Heading
		Mach Number

The temperature is the function of Mach number and True Airspeed. To estimate horizontal wind speed and direction, calculating zonal wind speed and meridional wind speed from ground speed, true airspeed, true track angle and true heading angle. The true heading angle is obtained from magnetic heading angle and magnetic declination(D2010) which is given by a quadratic equation. Then the wind and temperature as observation data were used to analyze and adjust the value of the numerical model to improve weather forecast accuracy.

The results of the experiments indicate that Mode S DAPs data have the potential to improve forecasts of rainfalls and shear-lines. For details, please refer to the IP11 presented by Japan at the Mode S DAPs/3.

9.4 Use of Barometric Pressure Setting

When the aircraft is below the transition level the pilot is required to set barometric pressure setting in altimeter to local QNH/QFE. Wrong barometric pressure setting (especially QNH higher than actual) can

lead to cleared flight level deviation or more serious controlled flight into terrain, as the pilot sees higher altitude on his altimeter and the flight management system determines the lower target altitude base on barometric pressure setting and selected altitude. Every millibar of barometric pressure setting error may add 30 feet of error to altimeter and target altitude.

Constantly checking if the barometric pressure setting in DAPs is consistent with the airport's QNH can alert the controller to avoid similar situations. In Feb 2021, an aircraft was cleared to descend to 7000 feet. The pilot set the right selected altitude, but forgot to set barometric pressure setting. At that time, the airport QNH was 1013, while the crew barometric pressure setting was 1118.5. An alarm system notified the controller of this situation. The error was corrected after the controller prompted the pilot preventing a dangerous situation.

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APPENDIX 1: Mode S DAPs Analysis

a) Data Recording Configuration

Figure 1 represents an example of a configuration for data recording. The Mode S sensor sends interrogations to an individual aircraft using a unique ICAO 24-bit aircraft address. The Mode S transponder has 255 BDS Registers. Each register stores aircraft parameters data derived from FMS or other sensors. An interrogation uses GICB protocol to request a specific BDS Register data. In response to the interrogation, Mode S transponder sends a reply which contains the BDS register data.

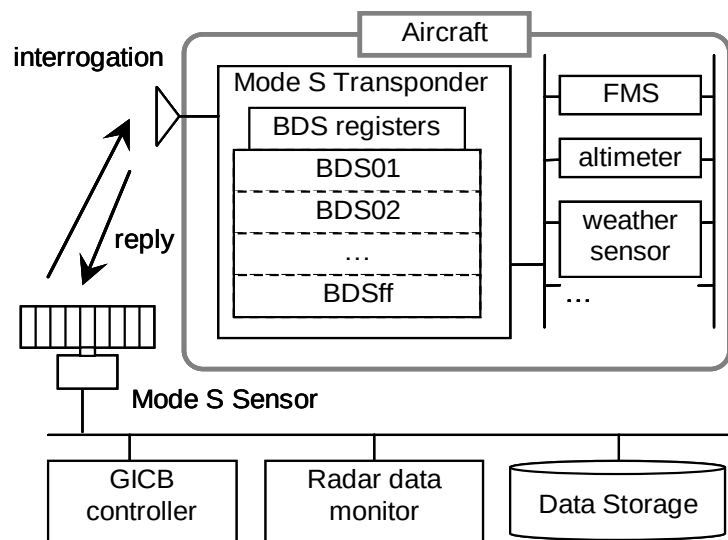


Figure1 - Example of Data Recording Configuration

b) Data Analysis

As described above section, erroneous DAPs data have been observed due to failure or improper setting/installation of Mode S avionics equipment. Bad data hinders the use of DAPs by the ATM service. To employ DAPs for ATM services, the reliability of DAPs is important. Therefore, it is necessary to analyze the recorded data to ensure reliability of the DAPs data.

If a controller finds some problem during the application of the Mode S DAPs, the ATS providers can analyze the recorded data to find the exact reason which caused the problem. If the ATS equipment has a fault which caused the problem, the ATS provider should implement a solution as soon as possible. If the ATS provider proves that the problem is caused by an avionics fault, then the problem should be reported to the appropriate party to solve the problem. The ATS providers need to devise mechanisms and procedures to address identified faults.

ATS providers should develop systems to analyze the routine recorded data. From the analyses, ATS providers can provide more information of the transponder's performance such as SI capability, datalink capability etc. The information can be used to improve the capability of the operation of Mode S DAPs equipment. By analyzing the recorded data, advice on avionics anomalies and faults, which have been detected, can be passed onto the regulators and the aircraft operators.

c) DAPs Data Validation

To ensure that Mode S DAPs are operating in conformance with the ICAO requirements, validating DAPs data is highly recommended. It has been noted that there are some drawbacks in the traditional methodology of executing tests for aircraft on the ground as follows:

- 1) Avionics for DAPs consist of several devices and functional blocks. They are interconnected, and the configuration is complicated.
- 2) Avionics and configuration differ depending on each aircraft.
- 3) It is difficult to cover the possible test patterns completely.
- 4) Ground test methodology would not detect failures or anomalies that occur after the testing.

Responding to these drawbacks, MIT Lincoln Laboratory developed and proposed a DAPs validation methodology, which monitors DAPs data received from actual flying aircraft to detect erroneous data. The MIT validation methodology is mainly categorized by two groups, static value tests and dynamic value tests.

Static value tests are executed to detect erroneous values of the bits and fields in BDS registers which do not change during a flight. Those bits and fields represent the avionics system's configuration, capability, and status information. These tests verify that those bits and fields are proper values in compliance with the ICAO regulations for DAPs applications. Table 1 shows an example of static value tests. As can be seen by the table, failed data were detected in each BDS register test. For BDS Register 20₁₆, failed data with wrong character coding were caused not due to equipment problem, but to faulty data input.

Table 1 Example of Static Value Tests

BDS Register	Test Item	Total Count		Aircraft	
		Executed	Failed	Executed	Failed
BDS code 1,0	Aircraft identification capability flag = '1'	544,980	7,183	3,615	146
BDS code 2,0	Each character conforms to ICAO 6-bit character coding	737,993	1,516	3,596	144
BDS code 4,0	Unavailable data fields are set at zero	54,248,802	1,755	3,614	4

Dynamic value tests validate the values which dynamically change according to aircraft motion, such as aircraft speed and track angle. The tests compare the DAPs values with equivalent data like radar-measured positions. If the difference between DAPs values and radar-derived parameters exceeds the acceptability threshold, the DAPs value is accounted as an error. Figure 2 represents an example of dynamic value tests. This figure indicates that ground speed differences between DAPs data and radar-derived data fall inside the threshold range.

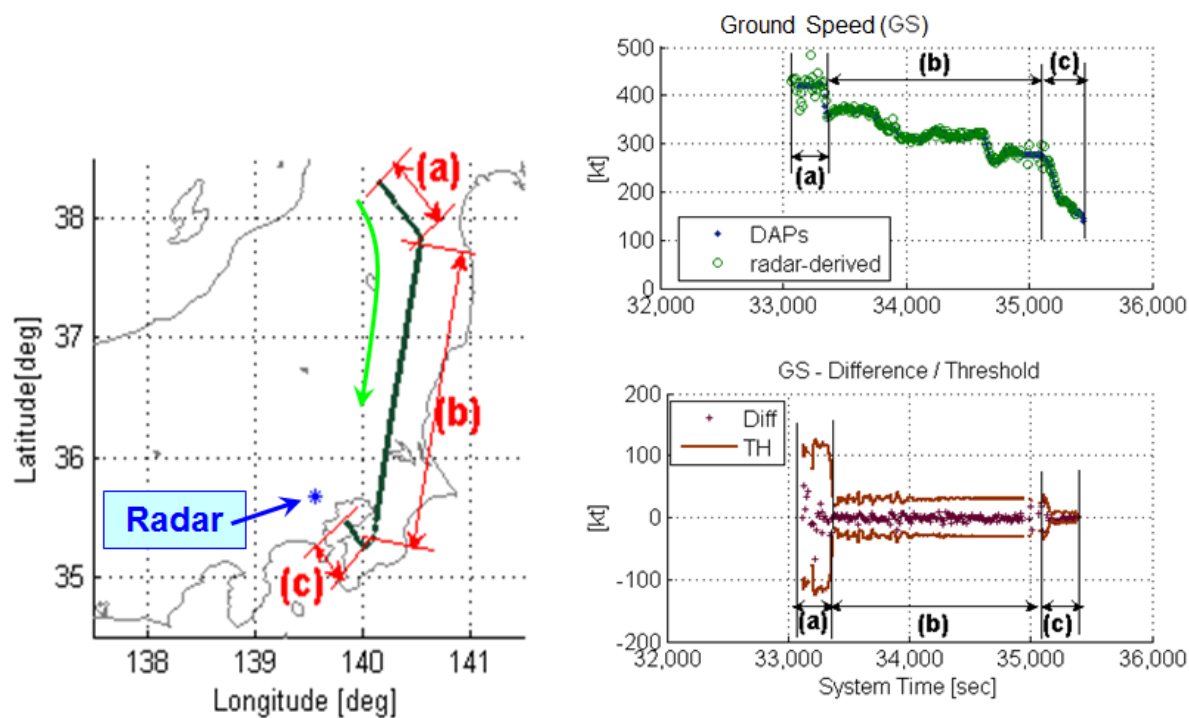


Figure 2 - Example of Dynamic Value Tests

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APPENDIX 2: LIST OF IDENTIFIED ISSUES

Ref.	Issue	Cause	Safety Implications to ATC (Yes / No)	Recommendations
1.	Wrong ground bits in DAPs led to the track decoupling from the flight plan	Through joint investigation with the airlines, it found that parts of the aircraft A were exchanged with another aircraft B for test. The malfunction part was discovered when the wrong ground bits data was found coming from the aircraft B.	Yes The wrong ground bits in DAPs could make ATM automation system display track decoupled with flight plan	
2.	Wrong aircraft identification	Many cases of wrong aircraft identification were found at the beginning of mode S operation. All related data collected and sent to the relevant airlines by the management department. Through joint investigation with the airlines, it was found that the issue is normally due to pilot's error.	Yes Wrong aircraft identification could lead to wrong flight plan coupling.	Through the joint efforts of ATMB and the airlines, the aircraft identification data became more and more accurate.
3.	Wrong Barometric Pressure	Barometric Pressure, such as BARO or QNH, is available in Mode S BDS code 4,0. Initial testing found that data above the transition level for some aircraft types would not be useful due to a mismatch between what the crew set in the cockpit, and what the aircraft Downlinked.	Yes There will display a wrong Barometric Pressure with aircraft in ATM automation system.	EASA Safety Information Bulletin SIB-2016-05R2 ("Incorrect Downlink Barometric Pressure Settings") covers this issue.
4.	Different processing between Mode A/C and Mode S Altitude	Currently, the altitude accuracy of Mode A/C radar is 100ft, while that of Mode S radar is 25ft. The altitude tracking, and display mechanism of ATM automation systems could be received both precisions altitude data.	Yes In Mode S radar and Mode, A/C radar overlapped area, the ATM automation systems might display an altitude jumping.	The altitude tracking, and display mechanism of ATM automation systems need to be optimized to avoid altitude jumping.

5.	Mode S interrogators request the aircraft transponder registers too frequently in busy airspace	If Mode S interrogators request the aircraft transponder registers too frequently in busy airspace, it may appear that the transponder registers information cannot complete the whole transmission process. The BDS parameters requesting rule needs to be set by the Mode S interrogator reasonably.	Yes ATM automation system would display track delay or intermittent interruption of radar data.	The data transmission rate of Mode S radar to feed ATM automation system needs to be selected reasonably to meet the requirements of ATC operations in busy airspace to prevent track delay or intermittent interruption of radar data.
6.	Mode S DAPs data does not correspond to the content of the requested register	It has been noted that from time to time Mode S DAPs data does not correspond to the content of the requested register. For example, the content of BDS code 5,0 is received when extracting BDS code 4,0. This phenomenon is called “BDS swap”. Table 1 represents an example data of BDS swap. The table shows the data of BDS code 0,5/4,0/5,0 data downlink from an aircraft in three sequential scans. As can be seen by the table, BDS swap occurred at 08:05:45.	Yes Wrong information could display to controller.	Different options can be implemented to decrease the impact of such as: 1. limit the number of radars extracting aircraft registers 2. implement specific filters in radar or in the surveillance data processing to discard the erroneous data (e.g. when two different registers are received with the same content they are both discarded)

7.	Duplicated aircraft address	One case was related to a local airline, wrong spare parts of the airplane were installed by mistake during maintenance. The airline replaced the spare parts after being informed. Another case was military aircraft. Another reason has been observed that in many cases the 24-bit aircraft address transmitted by the aircraft does not match its nationality (i.e. its State of Registry's block) or is otherwise incorrectly configured in the transponder. Care needs to be taken to ensure that the registration and the 24-bit address of every aircraft are processed and assigned simultaneously by the regulatory authority, and reporting mechanisms are in place to rectify incorrect configurations.	Yes The possible consequences are as follows: 1. An aircraft may be locked out in error, if it is the same beam. This may result in a new aircraft not being detected when it enters Mode S radar coverage. 2. Possible track label swap for crossing aircraft, this may result in incorrect labeling of an aircraft on the Radar screen. 3. In the technical operation of Mode S Elementary surveillance, duplicated address may result in the possible loss of a track when the two aircraft are crossing due to the interrogation scheduling within the ground station.	According to Annex 10, the aviation authority of each State is responsible for assigning 24-bit addresses to all aircraft in its registry using the block allocated by ICAO to that State. The duplicate address should be detected and reported. Without duplicate address detection, if an aircraft enters the range of the Mode S SSR with the same ICAO 24-bit address as that of an existing target, the information of the new aircraft could be erroneously associated with the existing target. Once the Mode S DAPs System detect more than one aircraft is transmitting the same ICAO 24-address, it will initiate a duplicate address report and a duplicate address condition shall be declared, and when receive new information of this address, the system should associate the information by ID or position but not the address.
8.	incorrect aircraft address in flight plan	Although the overwhelming majority aircrafts are equipped with Mode S transponders, many flight plans are not filed with the correct aircraft address in	Yes This affects the function of aircraft address correlation in ATM automation system.	

		item 18.		
9.	incorrect wind speed and direction	Aircrew round the system output figures from Spot Wind data was the main reason for variations by crew response. e.g. Recorded wind 283/42kts, crew response 280/40kts.	No	
10.	empty ACAS RA message	ASTERIX message “I048/260, ACAS Resolution Advisory Report” indicates that airplane is in ACAS RA condition. In some cases, all zero I048/260 reports are received in the ATM automation system through Mode S radar.	Yes ATM automation system may generate false ACAS alarm from Empty RA message.	ACAS message handling feature at ATM system must be checked on at its installation stage following the ACAS message flow
11.	erroneous SFL information	It is noticed ATM automation system could receive erroneous SFL information due to the BDS swap problem and other reasons.	Yes ATM automation system may generate false SFL mismatch alarm due to the erroneous SFL information.	ATM automation system could use multiple data sources to check the SFL data.
12.	Incorrect ACAS RA information	Many cases of incorrect ACAS RA information were found at the Mode S operation. After analysis the incorrect ACAS RA data, the reason is so called “BDS Swap” and only the old type of Mode S radar has the “BDS Swap” problem.	Yes Wrong information could display to controller.	Short term solution: Reject data (BDS content and/or reply) in case of difference between UF and DF. Reject BDS content (BDS 1,0; 2,0 and 3,0) in case of first byte error. Medium /long term solution: "Overlay" function is introduced in the fifth edition of Volume IV of ICAO document annex 10. the DP (data parity) field is designed to replace the AP field to check

				the BDS register number in the downlink DF20 / 21. It aims to solve BDS swap problem from the source.

Table 1 Example Data of BDS Swap

BDS Register	Time of Scan		
	08:05:35	08:05:45 (BDS swap occurred)	08:05:55
BDS code 0,5	605f80c056966f	a3280030a40000	605f845303ce8d
BDS code 4,0	a3280030a40000	a3280030a40000	a3280030a40000
BDS code 5,0	fff8cf1f800489	a3280030a40000	ffb8cf1f80048a

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APPENDIX 3: A Brief Introduction of Mode S DAPs Data Source

1. Introduction

1.1 During the 2nd meeting of ICAO APAC Mode S DAPs WG, China presented an information paper regarding the Mode S DAPs data source, the meeting was of the view that the content of the paper will help in the understanding of the basic mechanism of avionics relevant to surveillance application and implementation of DAPs.

-Refer to Mode S DAPs WG/2 IP05 “Preliminary Study of DAPs Data Sources”

1.2 The Mode S DAPs provides useful information on aircraft that will enhance ATM operations. More attention should be paid when introducing Mode S DAPs and it's important to clearly understand what these parameters are and where these parameters come from. This text provides give some brief information about the parameters.

2. Mode S DAPs ELS and EHS

2.1 Mode S DAPs-based surveillance includes ELS (Elementary Surveillance) and EHS (Enhanced Surveillance).

2.2 Most of the ELS parameters are capability parameters of the aircraft, hence are static. They can be used for improved aircraft identification, and have less direct impact on ATC operations. The ELS parameters are shown in Table 2.1.

Table 2.1 ELS Parameters Information

Register	DAP Set	Bits	Units	Quantity	Range
ELS	24-Bit Aircraft Address (AA)	NA	NA	NA	NA
	Transponder Capability (CA)	NA	NA	NA	NA
	Flight Status (FS)	NA	NA	NA	NA
	Altitude Reporting in 25ft	NA	ft	25	[-1000, 50175]
	BDS 1,0 Datalink Capability Report	56	NA	NA	NA
	BDS 1,7 Common GICB Capability Report	56	NA	NA	NA
	BDS 2,0 Aircraft Identification Report	56	NA	NA	NA
	BDS 3,0 ACAS Resolution Advisory Report	9-22	NA	NA	NA

2.3 EHS parameters are more related to the aircraft's intention and status, and most of them are dynamic. The implementation of EHS parameters has a larger impact on controllers. The EHS parameters are shown in Table 2.2.

Table 2.2 EHS Parameters Information

Register	DAP Set	Bits	Units	Quantity	Range
EHS	Selected Altitude (MCP/FCU)	2-13	ft	16	[0, 65520]
	BDS 4,0 Selected Altitude (FMS)	15-26	ft	16	[0, 65520]
	Barometric Pressure Setting	28-39	mb	0.1	[0, 410]
	BDS 5,0 Roll Angle	3-11	dg	45/256	[-90, +90]

	True Track Angle	14-23	dg	90/512	[-180, +180]
	Ground Speed	25-34	kt	2	[0, 2046]
	Track Angle Rate	37-45	dg/s	8/256	[-16, +16]
	True Airspeed	47-56	kt	2	[0, 2046]
BDS 6,0	Magnetic Heading	3-12	dg	90/512	[-180, +180]
	Indicated Airspeed	14-23	kt	1	[0, 1023]
	Mach No	25-34	NA	2.048/512	[0, 4.092]
	Barometric Altitude Rate	37-45	ft/min	32	[-16384, +16352]
	Inertial Vertical Velocity	48-56	ft/min	32	[-16384, +16352]

3. Mode S DAPs Data System

3.1 The ELS and EHS parameters originate from various sensors and cockpit settings. After being organized by the avionics systems, the information is being sent to the transponder through standard aircraft data buses, and subsequently formatted by the transponder and stored inside the relevant Binary Data Storages (BDS). The ground-based surveillance system could downlink desired DAPs by specific Mode S GICB (Ground Initiated Comm-B) protocol.

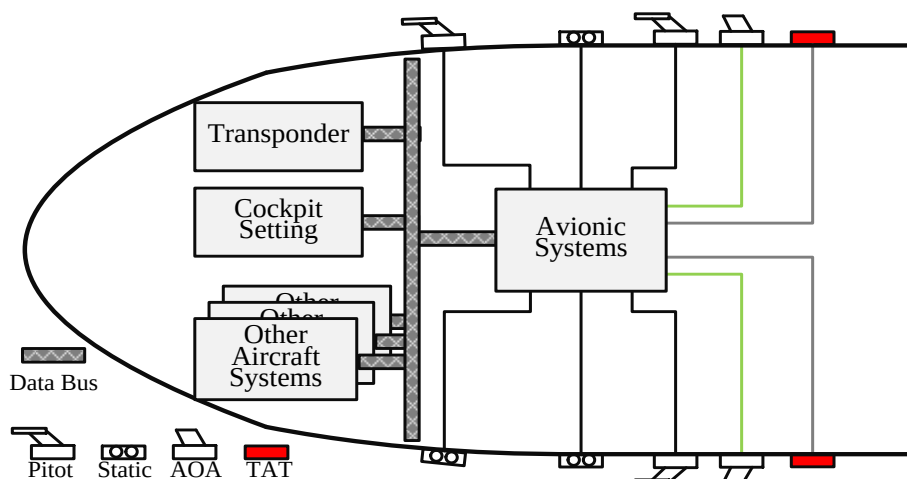


Figure 3.1 Typical DAPs Data Source Block Diagram

Transponder and TCAS Computer

3.2 The most common standard of the civil aircraft transponder, the Mark 4 Air Traffic Control Transponder, is based on the ARINC 718A standard. There are 3 main interface plugs defined on the rear panel, namely TP (Top Plug), MP (Middle Plug), and BP (Bottom Plug).

3.3 The airborne collision avoidance system, Traffic Computer TCAS and ADS-B Functionality, is based on the ARINC 735B standard. There are 6 main interface plugs defined on the rear panel, namely LTP (Left Top Plug), LMP (Left Middle Plug), LBP (Left Bottom Plug), RTP (Right Top Plug), RMP (Right Middle Plug) and RBP (Right Bottom Plug).

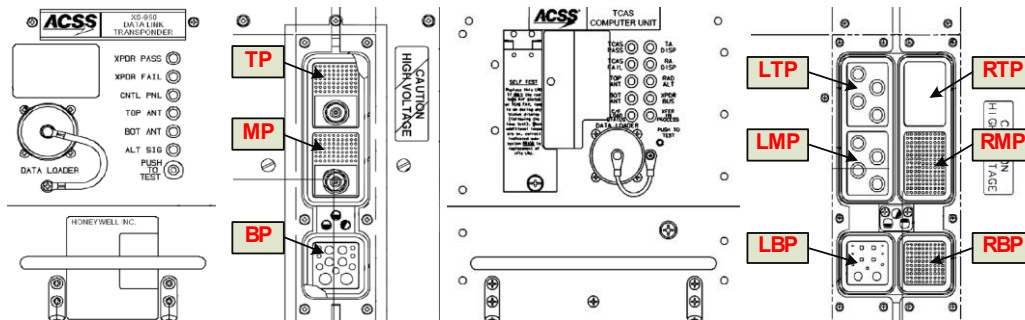


Figure 3.2 Transponder and TCAS Computer Examples from ACSS

Data Bus

3.4 The most common data bus, the Digital Information Transfer System, is based on the ARINC 429 standard. The standard defines the data transfer between most of the avionics systems. There are also other standards such as the ARINC 629 used on Boeing B777, Airbus A330 and A350, as well as the ARINC 664 (AFDX, Avionics Full Duplex Switched Ethernet) used on A380 and B787.

Avionics and DAPs Data

3.5 The Aircraft Address (AA) is a parameter programmed into the aircraft frame after the address is allocated by the State registration authority. Normally there are 2 ways to program this parameter, one is to program the pins of the MP (connected for “1”, open for “0”), and the other is to use Aircraft Personality Module (ARINC 607) to store the address, and then interface to the MP.

Note: For more detailed information about Aircraft Address, refer to ARINC 718A Attachment 2B. For APM implementation guidelines, refer to ARINC 718A Attachment 9.

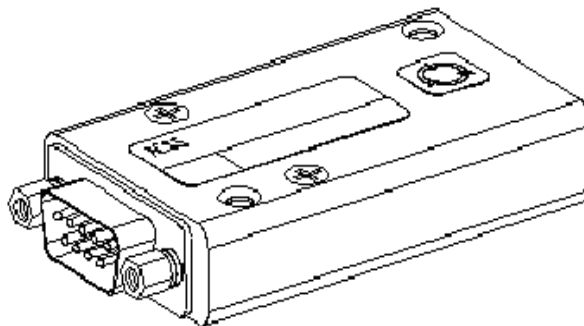


Figure 3.3 APM Example from ACSS

3.6 The Transponder Capability (CA) is a result of the combination of on-the-ground status and transponder capability level. Normally the on-the-ground status is automatically indicated by the weight sensor fitted on the aircraft, but some GA planes use manual means to indicate the status by switching the transponder knob to the GND option. The transponder receives on-the-ground status from the TP pins (5J and 5K), make validation of the status with Ground Speed, Radio Altitude or Airspeed, and then announce the status. The transponder capability level is a static value which is fixed after manufacturing.



Figure 3.4 TT31 Mode S Transponder from TRIG

3.7 The Flight Status (FS) is a result of combination of the on-the-ground status, SPI, and Alert. The on-the-ground is the same as in 3.6, the SPI is from pushing IDENT function button of the transponder by pilot, and the Alert is produced by changing Mode A code (If changed to 7500, 7600, 7700, that's permanent alert; and if changed to other codes, that's 18 seconds temporary alert).

3.8 The Common Usage GICB Capability Report is generated by the transponder itself by detecting the corresponding input data availability, and then set the corresponding bit related to that GICB register.

3.9 The main source of Aircraft Identification is from FMS, input by pilot through Flight ID (or Flight No) menu, and the related data transmitted to transponder by specific data bus (ARINC 429 Labels 233~237). If the Flight ID is empty, then the Aircraft Registration data may be provided within another data bus (ARINC 429 Labels 301-303).

3.10 According to TCAS standard (ARINC 735B Chapter 3.3.4.1), the Datalink Capability Report and the Resolution Advisories Report are sent to the Transponder from TCAS Computer by specific protocol (TGD-TCAS to Transponder data transfer protocol, and Transponder to TCAS data transfer protocol is named XGD. The data bus used is ARINC 429 Label 270). The data are sent from RMP of the TCAS Computer to TP of the Transponder, related pins refer to Figure 3.5.

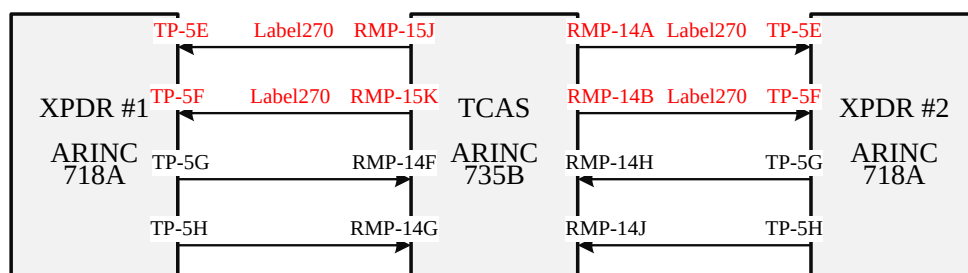


Figure 3.5 Illustrations of Datalink Capability and RA Report Transfer

3.11 There are 2 kinds of Selected Altitude, one is from MCP/FCU (Boeing's Mode Control Panel and Airbus's Flight Control Unit), and the other is from FMS (Flight Management System). The first one is set by the pilot in response to a controller's instruction during the flight, the second one is calculated by the FMS automatically to achieve the best cost-efficient.



Figure 3.6 MCP of Boeing B787 & FCU of Airbus A380

3.12 The Barometric Pressure Setting (BPS) is also located in the MCP/FCU, and set by the pilot rotating the knob to the pressure value comes from the aerodrome's ATIS (Automatic Terminal Information System).

3.13 The other parameters mainly come from the sensors onboard the aircraft, the sensors are organized in 3 groups, the air data sensors, the inertial sensors and the magnetic sensor.

3.14 The air data sensors are used to sense the medium through which the aircraft is flying, including pitot (static) probe, static port, temperature sensor, angle of attack sensor. Typical sensed parameters are total pressure (Pt), static pressure (Ps), pressure changing rate, air temperature (TAT), and angle of attack. Derived data includes Barometric Altitude (ALT), Indicated Airspeed (IAS), Vertical Speed (VS), Mach (M), Static Air Temperature (SAT), Total Air Temperature (TAT), True Airspeed (TAS) and Angle of Attack (AOA). The simplest system provides ALT and IAS.



Figure 3.7 Air Data Sensors and Integrated Sensor on Airbus A380

3.15 The inertial sensors are used to detect the motion of the aircraft in a universal reference system, including position gyroscopes, rate gyroscopes and accelerometers. By detection of the 3D dynamic of the aircraft, derived data includes Ground Speed (GS), Wind Speed, Wind Direction, True Track Angle, Roll Angle, and Track Angle Rate and so on.

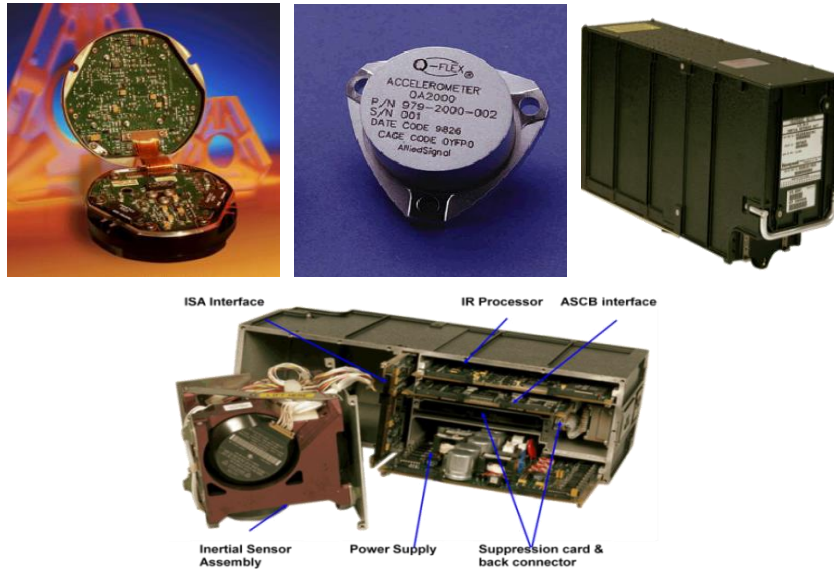


Figure 3.8 Gyro, Accelerometer and LASEREF IV IRU from Honeywell

3.16 The magnetic sensor is used to sense the direction and to find the magnetic north, and give out the main parameter of Magnetic Heading. The world magnetic model is show below:

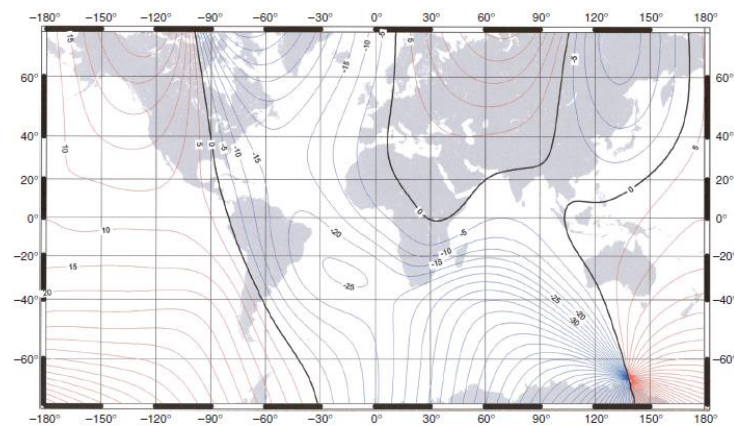


Figure 3.9 World Magnetic Model 2000

3.17 Some airplane platform uses an integrated solution to process these data, each air data sensor is connected with an Air Data Module (ADM) which converts the analog data to digital data and make the compensation of the instrumental and positional error. These data then feed to the input of Air Data Inertial Reference Systems (ADIRS) to calculate all the parameters mentioned before. And after that the parameters are sent to transponder and other avionics systems by the Data Bus.

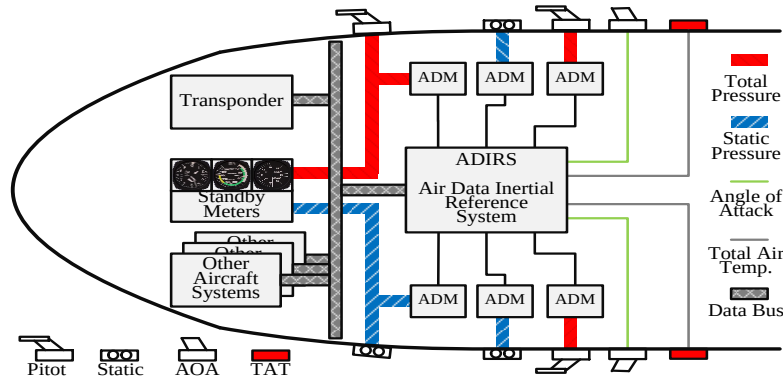


Figure 3.10 Typical ADIRS Architecture

3.18 The most commonly used data bus for parameters from ADIRS is ARINC 429 (and the newest evolution is AFDX invented by Airbus and implemented in various new aircrafts like A380 and B787), and the standard ARINC 429 Labels used by these parameters are as follows:

Table 3.1 ADIRS Parameters Used Labels of ARINC 429

No	DAP Item	Label
1	Mach No.	205
2	Indicated Air Speed	206
3	True Air Speed	210
4	Barometric Altitude Rate	212
5	Ground Speed	312
6	True Track Angle	313
7	Magnetic Heading	320
8	Roll Angle	325
9	Track Angle Rate	335*
10	Inertial Vertical Velocity	365

**Note: This label in GAMA configuration is not used for Track Angle Rate*

3.19 By using these parameters, the aircraft dynamic is illustrated as in Figure 3.11.

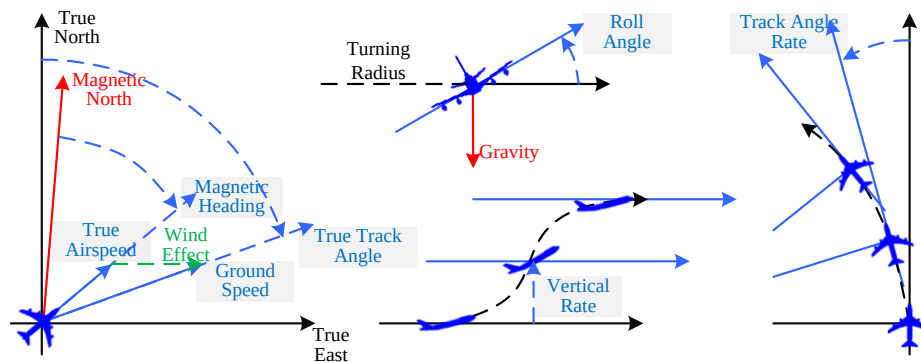


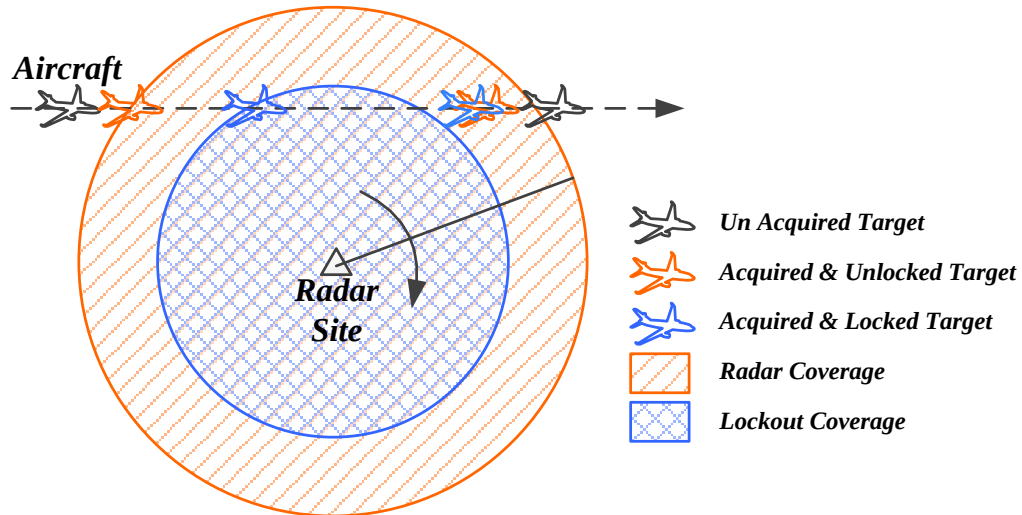
Figure 3.11 Illustration of Aircraft Dynamic

left to blank

APPENDIX 4: Mode S Parameter Set

Radar Coverage *R*

1.1 The Mode S radar coverage is defined as the farthest target the radar will process. If the Mode S radar uses a lockout map, the difference of the two coverage ranges should be noticed.



1.2 The radar coverage will decide the minimal All-Call period, this is to say, the time of All-Call period should:

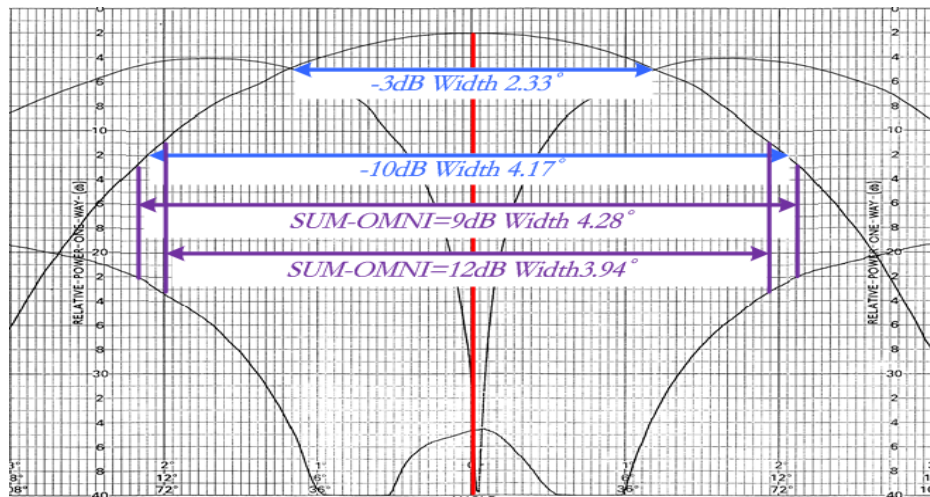
$$T \geq \frac{R * 2 * 1852}{3 * 10^8}$$

Antenna Period *T_a*

2.1 The antenna period is the time of a successful antenna rotation, this time actually has very important influence of the total time resource of the radar. Lower antenna rotation speed will provide rich antenna period, hence time resource of the radar. The most commonly used antenna period is 4000ms (15rpm) and 6000ms (10rpm) for terminal surveillance radar.

Antenna Beamwidth *B*

3.1 Most of the secondary surveillance radar uses the same LVA antenna, the beam is more or less the same, and the standard interrogation beam has a -3dB width of $2.45^\circ \pm 0.25^\circ$. In Mode S interrogation, the suppression requirement actually allow to use a wider beam width than -3dB width, most of the radar choose 3.8° or roughly the -10dB beam width.



Time on Target T_t

4.1 The time on target is the total time amount the radar beam covers the target during one scan, it defines the time resource upper limit for one dedicated target, it is determined by both the antenna period and the beamwidth, and the relation is as follows:

$$T_t = \frac{T_a}{360} * B$$

4.2 It should be noticed that during a mix air operation (Conventional targets and Mode S targets flying in the same area in the same time), there is a need for the Necessary Transaction. That is during an antenna scan, there should be at least 4 transactions between the radar and the conventional target, in order not to miss conventional target.

All-Call Period T_{ac} and Roll-Call Period T_{rc}

5.1 The All-Call period and Roll-Call period setting are different radar by radar, but there should be some principles:

- 1) All-Call period should long enough to allow the coverage requirement;
- 2) During the time on target, the Necessary Transaction should be guaranteed;
- 3) Time resource should allocate to Roll-Call as much as possible; and
- 4) Algorithm should be used to optimize the scheduling in the Roll-Call period.

Mode Interlace Pattern MIP

6.1 Mode Interlace Pattern defines the radar operating mode setting. The setting is related to the specific radar environment, hence there is no standard MIP.

6.2 All the modes Mode S radar can use is listed in the following table:

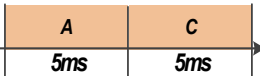
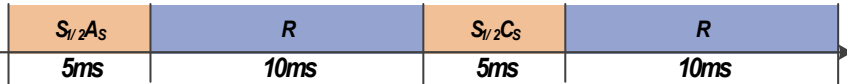
No.	Mode	Description	Pulse Used
1	A	Mode A interrogation	8μs between P1 and P3
2	C	Mode C interrogation	21μs between P1 and P3
3	A _S	Mode A Only All-Call	8μs between P1 and P3, and short P4
4	C _S	Mode C Only All-Call	21μs between P1 and P3, and short P4
5	S _L	Mode ACS All-Call	8μs, 21μs between P1 and P3, and Long P4
6	S _{PO}	Mode S Only All-Call P for PR,O for LO	2μs between P1 and P2, and P6 UF11 inside P6
7	R	Mode S Roll-Call	2μs between P1 and P2, and P6 UF0/4/5/16/20/21 inside P6

6.3 For a specific MIP, the describe phraseology defines as follows, and also one example is listed below:

Mode[Time]/ Mode[Time]/ Mode[Time]/.....

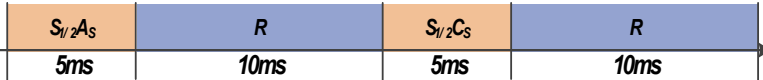
Note: The All-Call and Roll-Call periods are separated by “/”, the “Mode” is one of the Modes listed above, and the “[Time]” stands for the duration of the periods.

6.4 An example is show as follows:

No.	Mode	MIP
1	Conventional	A[5.0]/C[5.0]
		 Mode A and Mode C repeat, both duration are 5ms
2	Mode S #1	S _{1/2} A _S [5.0]/S _{1/2} C _S [5.0]/R[10.0]
		 2All-Call periods and 1 Roll-Call period repeat, All-Call duration is 5ms, Roll-Call duration is 10ms In the first All-Call, the PR=1/2, and use Mode A with short P4 In the second All-Call, the PR=1/2, and use Mode C with short P4
3	Mode S #2	S _{1/2} A _S [5.0]/R[10.0]/S _{1/2} C _S [5.0]/R[10.0]
		 1All-Call,1Roll-Call,1All-Call,1Roll-Call repeat, All-Call duration is 5ms, Roll-Call duration is 10ms In the first All-Call, the PR=1/2, and use Mode A with short P4 In the second All-Call, the PR=1/2, and use Mode C with short P4

Interrogation Repetition Frequency **IRF**

7.1 The Mode S introduced the Roll-Call period, which makes the interrogation repetition frequency a little bit different from the Conventional Mode. There is a need to define the interrogation repetition frequency by Mode IRF_{Mode}. Normally use IRF stands for the IRF_{AC} of Conventional mode and IRF_S of the Mode S All-Call. One example is listed below:

No.	MIP	IRF
1	A[5.0]/C[5.0] 	IRF _A =100Hz IRF _C =100Hz IRF _{AC} =200Hz
2	S _{1/2} A _s [5.0]/R[10.0]/S _{1/2} C _s [5.0]/R[10.0] 	IRF _A =38.5Hz IRF _C =38.5Hz IRF _{AC} =76.9Hz IRF _S =76.9Hz IRF _R =76.9Hz

DAPs Extraction Strategy

8.1 The DAPs extraction strategy normally includes the BDS number, extraction priority, extraction period, and re-extraction.

1) BDS number stands for the setting of the number of BDSs which radar is going to extract. It doesn't include the ELS registers, these registers should not be extract periodically;

2) Extraction priority stands for the priority of each BDS when the radar is performing extraction, the priority should be in accordance to the user's needs;

3) Extraction period stands for the period of the dedicated BDS extraction, normally described by the antenna scan number;

4) Re-extraction stands for the function of re-extraction of the dedicated BDS in the same beam dwell when the extraction is failed, but it's not recommend to re-extraction of more than 2 times.

Mode S Parameter Set Example

9.1 The following is an example of the Mode S Parameter Set:

No.	Parameter	Unit	Value	Note
1	R Coverage Range	NM	200	Equivalent All-Call Time $\frac{200 * 2 * 1852}{3 * 10^8} * 10^3 \approx 2.47ms$
2	Ta Antenna Period	ms	3800	Antenna Rotation Period
3	B Work Beamwidth	°	3.8	Mode S Work Beamwidth Normally Greater Than -3dB width of 2.45°
4	Tt Time on Target	ms	40.1	The Time on Target In One Scan $\frac{3.8}{360} * 3800 \approx 40.1ms$
5	Tac	ms	3.0	Equivalent Coverage Range

	All-Call Period			$\frac{3 * 10^8 * 3.0 * 10^{-3}}{1852 * 2} \approx 243\text{NM}$
6	Trc Roll-Call Period	ms	7.0	This Period Related To The Extraction Efficiency
7	MIP	—	—	$S_{1/2}A_s[3.0]/R[7.0]/S_{1/2}C_s[3.0]/R[7.0]$ The diagram shows a sequence of four segments: $S_{1/2}A_s$ (3ms), R (7ms), $S_{1/2}C_s$ (3ms), and R (7ms). The segments are represented by colored bars: orange for $S_{1/2}A_s$ and $S_{1/2}C_s$, and blue for R. Arrows indicate the duration of each segment.
8	IRF _{AC}	Hz	100	Interrogation Repetition Frequency of Mode S All-Call
9	DAPs Extraction	—	—	No. of BDS: 3 (BDS 4,0 5,0 6,0) Extra. Priority: BDS 4,0 6,0 5,0 Extra. Period: 1 Scan Re-Extraction: Yes

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE



REGIONAL SUPPLEMENT
TO
THE ASTERIX INTERFACE CONTROL DOCUMENT (ICD)
FOR THE ASIA/PAC REGION

THIRD EDITION

October 2021

Issued by the ICAO Asia/Pacific Regional Office, Bangkok

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*Regional Supplement to the
All Purpose **ST**ructured **E**urocontrol **SuR**veillance
Information **EX**change (ASTERIX) ICD
for the ASIA/PAC Region*

System Area Code (SAC)

ADDRESSING SCHEME OF SURVEILLANCE DATA EXCHANGE

1. General

In order to avoid ambiguity, every system shall have a unique identification in an area where ASTERIX is used for the exchange of.

2. Syntax

The ASTERIX System Identifier format shall be composed of two subfields as illustrated:

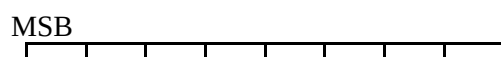


	Field Name	Element Type	Field Size
SAC	System Area Code	Binary	One octet
SIC	System Identification Code	Binary	One octet

2.1 System Area Code (SAC)

2.1.1 The SAC field shall consist of an eight-bit number assigned to a country or a territory.

2.1.2 The SAC field format shall be as illustrated below:



b8	b7	b6	b5	b4	b3	b2	b1

Where: b represents a binary digit and the MSB stands for Most Significant Bit

2.1.3 System Identification Code (SIC)

2.1.3.1 The SIC shall consist of an eight-bit number assigned to every system (surveillance station, processing system, server, etc.) located in the geographical area or country defined by the SAC..

2.1.3.2 The SIC field format shall be as illustrated below:

MSB

b8	b7	b6	b5	b4	b3	b2	b1

Where: b represents a binary digit and MSB stands for the Most Significant Bit

2.1.4 The individual SICs are assigned by the National Administration concerned within the area identified by the SAC and are published in the this Document. SIC is managed by State and there is little value for ICAO APAC to manage the SIC. Considering the workload to manage the SIC and the negligible benefits, ICAO APAC will not manage SIC.

2.1.5 Within a country or territory identified by a SAC up to 256 individual codes (SICs) can be assigned.

2.1.6 The SICs shall be indicated by decimal and presented by binary in their relevant tables.

2.1.7 **Recommendation** *The assignment of SICs could be divided into groups by different functions and facilities categories.*

3. Assignment of the Systems Identifiers

3.1 System Area Codes

3.1.1 One SAC is assigned to each country or territory.

3.1.2 **Recommendation** *When needed, more than one SAC could be assigned to a single country or territory, for example, to differentiate between civil and military applications.*

3.1.3 The SACs allotment is provided in the Table 1 - System Area Codes (SAC)

3.1.4 Amendments to the System Area Codes (SAC) shall be coordinated by ICAO ASIA/PAC Regional office.

System Area Code (SAC) Allotment Scheme
(by country alphabet order and even hexadecimal numbers)

Table 1 - System Area Codes

SAC (Hexad)	Country/ Geographical Area	Binary Representation	SAC (Hexad)	Country/ Geographical Area	Binary Representation
A2	Afghanistan	1010 0010	44	Maldives	0100 0100
02	American Samoa	0000 0010	46	Marshall Islands	0100 0110
04	Australia	0000 0100	48	Micronesia	0100 1000
A4	Australia	1010 0100	50	Mongolia	0101 0000
06	Bangladesh	0000 0110	52	Myanmar	0101 0010
08	Bhutan	0000 1000	54	Nauru	0101 0100
10	Brunei Darussalam	0001 0000	56	Nepal	0101 0110
12	Cambodia	0001 0010	58	New Caledonia	0101 1000
16	China	0001 0110	60	New Zealand	0110 0000
1A	China	0001 1010	62	Niue Island	0110 0010
1C	China	0001 1100	64	Pakistan	0110 0100
A6	China	1010 0110	66	Palau	0110 0110
AA	China	1010 1010	68	Papua New Guinea	0110 1000
18	Hong Kong, China	0001 1000	72	Philippines	0111 0010
40	Macao, China	0100 0000	74	Republic of Korea	0111 0100
20	Taibei, China	0010 0000	76	Samoa	0111 0110
22	Cook Islands	0010 0010	78	Singapore	0111 1000
24	DPR. of Korea	0010 0100	80	Solomon Islands	1000 0000
26	Fiji	0010 0110	82	Sri Lanka	1000 0010
28	French Polynesia	0010 1000	84	Thailand	1000 0100
30	India	0011 0000	86	Tonga	1000 0110
32	Indonesia	0011 0010	88	Tuvalu	1000 1000
34	Japan	0011 0100	90	United States	1001 0000
36	Kiribati	0011 0110	92	Vanuatu	1001 0010
38	Lao PDR.	0011 1000	94	Vietnam	1001 0100
42	Malaysia	0100 0010	96	Wallis Islands	1001 0110

* 14, 70 is intentionally left blank

Revised TERMS OF REFERENCE

STUDY GROUP UNDER SURICG ON SHARING OF SURVEILLANCE DATA IN SWIM

Working Arrangement of the Study Group

Membership: The Study Group under SURICG on Sharing of Surveillance Data in SWIM (“Study Group”, “SURSG” as acronym) shall be composed of subject matter experts from Member States involved in the provision of surveillance services and SWIM development as well representatives from Member States with an interest to contribute to the works of the SURSG. The SURSG may invite representatives of International Organizations recognized by the ICAO Council, Industry Partners or interested parties representing important civil aviation interests to participate in its work in consultative capacity.

Participants of SURSG/1 (*in alphabetical order*):

Australia, China, Hong Kong - China, India, Indonesia, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Singapore, Thailand, United States, Viet Nam, CANSO, IATA, ICCAIA.

The SURSG shall have one elected Chair.

The SURSG shall have Task Leads and Sub-Task Leads for tasks detailed in the “Deliverables to meet the Objectives”, which currently features 4 main Tasks together with their sub-tasks. Members may volunteer to subscribe to the tasks and sub-tasks. Task Leads and Sub-Task Leads are to be selected through coordination and agreement among the respective task or sub-task subscribers.

Meetings: While the SURSG is established in ad hoc nature, it shall convene face-to-face/web meeting to achieve its TOR. Outcome of its meetings shall be reported to and sought endorsement from the SURICG. Progress of the SURSG shall also be shared with SWIM TF and CRV OG via their nominated representatives joining the SURSG.

Task Leads and Sub-Task Leads shall convene meetings as necessary and in formats as appropriate to discuss and work on their tasks to achieve the scheduled deliverables making reference to Deliverables Template, a template of which is provided on the last page of this ToR.

Task Leads and Sub-Task Leads shall attend the SURSG meetings and in between SURSG meetings, ad-hoc or regular meetings to harmonize their work or resolve issues.

Schedule and delivery: Subject to the extent of prioritized applications considered by the SURSG, the schedule for delivery of the SURSG shall be decided by the SURSG, which shall update the SURICG accordingly.

The Objectives of Study Group are to:

- 1) Study, provide expert views and recommendations:
 - a) to achieve harmonized sharing of surveillance data in SWIM in the Asia and Pacific Regions (APAC) according to Surveillance Strategy adopted by APANPIRG and in support of ICAO’s GANP and ASBU initiatives; and

- b) on the possible models of sharing surveillance data in SWIM in the SWIM environment, in consideration of the SWIM technical infrastructure, SWIM information service, CRV infrastructure and any applicable governance, and technical requirements.
- 2) Review, identify and provide expert views and recommendations to address major issues, raised to the SURSG by ICAO APAC, in the technical, operational or regulatory aspects of surveillance data sharing to facilitate the implementation of surveillance from “departure to destination” in APAC.

Deliverables to meet the Objectives:

- 1) To submit not fewer than 1 Progress Report per year to SURICG and SWIM TF, with the latest report submitted at least 2 months prior to convening of the SURICG meeting on the Study Group deliverables (listed in 2 to 4 below);
- 2) To study, identify and make recommendations on the **possible and practical** models for surveillance data sharing in SWIM in APAC with considerations of:
 - a) Concept of use/operation;
 - b) System design considerations of individual participant that shares surveillance data such as system robustness, data security and integrity, data latency, fallback arrangements and system recovery;
 - c) General requirements from perspective of collaborative sharing of surveillance data such as centralized/decentralized surveillance data processing, data repository, service registry, service resilience and service recovery;
 - d) Required commitments of data sharing participants such as commitment of resources and costs;
 - e) Implementation roadmap and time frames with consideration of
 - (i) An incremental approach/a comprehensive approach at the outset;
 - (ii) Type(s) of surveillance data to be shared; and
 - (iii) Information exchange model for surveillance data in SWIM;
 - f) SWIM technical infrastructure, SWIM information service, CRV infrastructure;
 - g) Other currently available or emerging technologies; and
 - h) ICAO Global Air Navigation Plan (GANP) and Aviation System Block Upgrades (ASBU) as well as APAC Seamless ANS Plan.
- 3) To prepare, based on its works in 2) above, a report on the possible implementation of surveillance data sharing in SWIM in APAC inclusive of the following:
 - a) Recommendations for:
 - (i) An incremental approach/a comprehensive approach at the outset in surveillance data sharing;
 - (ii) Type(s) of surveillance data to be shared; and
 - (iii) Exchange model of surveillance data in SWIM.
 - b) Pros and cons and cost effectiveness for the possible models that have been considered and a recommendation on the best approach or parallel approaches;
 - c) Concept(s) of Operations of the recommended approach(es);
 - d) Required commitments of participating Member States who share their surveillance data;
 - e) Required commitments of Member States who access the shared surveillance data; and
 - f) Draft multi-lateral agreement on surveillance data sharing and data consumption.
- 4) To develop guidance materials to assist Members States participating in the sharing of surveillance data and Member States accessing the shared surveillance data.

Template of Deliverables

		Efforts thus far
1	Study, provide expert views and recommendations: a) to achieve harmonized sharing of surveillance data in SWIM in the Asia and Pacific Regions (APAC) according to Surveillance Strategy adopted by APANPIRG and in support of ICAO's GANP and ASBU initiatives; and b) on the possible models of sharing surveillance data in SWIM environment, in consideration of the SWIM technical infrastructure, SWIM information service, CRV infrastructure, and any applicable governance, and technical requirement.	
2	Review, identify and provide expert views and recommendations to address major issues, raised to the SURSG by ICAO APAC, in the technical, operational or regulatory aspects of surveillance data sharing to facilitate the Mode S DAPs implementation in APAC.	
Deliverables to meet the Objectives:		Efforts thus far
1	To submit not fewer than 1 Progress Report per year to SURICG and SWIM TF , with the latest report submitted at least 2 months prior to convening of the SURICG meeting on the SURSG deliverables (listed in 2 to 4 below)	
2	To study, identify and make recommendations on the possible and practical models for surveillance data in SWIM in APAC with considerations of : a) Concept of use/operation; b) System design considerations of individual participant that shares surveillance data such as system robustness, data security and integrity, fallback arrangements and system recovery; c) General requirements from perspective of collaborative sharing of surveillance data such as centralized/decentralized surveillance data processing, data repository, service registry, service resilience and service recovery; d) Required commitments of data sharing participants such as commitment of resources and costs; e) Implementation roadmap and time frames with consideration of: (i) An incremental approach/a comprehensive approach at the outset; (ii) Type(s) of surveillance data to be shared; and (iii) Information exchange model for surveillance data in SWIM. f) SWIM technical infrastructure, SWIM information service, and CRV infrastructure; g) Other currently available or emerging technologies; and	

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	h) ICAO Global Air Navigation Plan (GANP) and Aviation System Block Upgrades (ASBU).	
3	To prepare, based on its works in 2) above, a report on the possible implementation of surveillance data sharing in SWIM in APAC inclusive of the following: a) Recommendations for: (i) An incremental approach/a comprehensive approach at the outset in surveillance data sharing; (ii) Type(s) of surveillance data to be shared; and (iii) Information Exchange model for surveillance data in SWIM. b) Pros and cons and cost effectiveness for the possible models that have been considered and a recommendation on the best approach or parallel approaches; c) Concept(s) of Operations of the recommended approach(es); d) Required commitments of participating Member States who share their surveillance data; e) Required commitments of Member States who access the shared surveillance data; and f) Draft multi-lateral agreement on surveillance data sharing and data consumption.	
4	To develop guidance materials to assist Members States participating in the sharing of surveillance data and Member States accessing the shared surveillance data.	

ADS-B IMPLEMENTATION STATUS IN THE APAC REGION

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
AFGHANISTAN	ADS-B & Multi Lateration system installed.				subject to safety assessment
AUSTRALIA	A total of 50 ADS-B ground stations and 28 WAM stations are operational (Total 78) ATC readiness since 2004 ADS-B data sharing with Indonesia operational since 2/2011. ASMGCS using multilateration and ADS-B is operational in Brisbane, Sydney, Melbourne and Perth November 2016 – ADS-B converted to “radar like” Cat 48 for use in Melbourne Terminal Area and Perth Terminal Area in early 2017. CMATS replacing the current ATM system is expected to be fully operational in 2026 period.	2009/effective date of mandating in upper airspace 12/12/2013. An ADS-B mandate for all IFR aircraft applies from 2/2017. Some limited exemptions for foreign registered aircraft and some private operations.	All airspace for IFR aircraft from 2/2017	2.5NM, 3NM and 5 NM surveillance separations. 3/2016 - Manual of ATC updated to include 3 nautical mile separation using ADS-B in terminal control unit. 3/2017 – 2.5NM separation authorized using ADS-B when also used with radar. Vectoring allowed using ADS-B Precision Runway Monitoring for Sydney WAM	WAM is operating in Tasmania since 2010 with 5 NM separation service. WAM is also operating in Sydney for 3 NM separation service in TMA and for precision runway monitoring function. CASA has approved the use of reduced specification ADS-B avionics to support ADS-B IN and ATC situational awareness for VFR aircraft

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
BANGLADESH	Bangladesh has a plan to install four ADS-B ground stations to be installed at Dhaka, Cox's Bazar, Saidpur and Barisal Airports by 2019. ADS-B data will be integrated with new ATM system at Dhaka. Bangladesh has also a plan to install MLAT stations to provide surface movement control at HSIA, Dhaka as well as TMA coverage as a backup and complimentary RADAR coverage to the Dhaka MSSR.				Bangladesh is willing to share ADS-B data with neighbouring States to enhance the safety and surveillance capability in the sub-region.
BHUTAN	ADS-B ground infrastructure feasibility study will be completed in the middle of 2020.	Equipage mandate will be issued once after the completion of feasibility study.			
BRUNEI DARUSSALAM	5 ADS-B ground stations with WAM functionality installed in 2015 and full operation in October 2016. ADS-B/WAM data are fused with radar data in the TopSky ATC Automation system (Thales) to enhance full radar surveillance coverage for Brunei Darussalam. Memorandum of Understanding (MOU) on ADS-B data sharing with Singapore and Brunei				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	Darussalam is expected to sign in April 2019.				
CAMBODIA	3 ADS-B ground stations installed at Phnom Penh, Siem Reap and Stung Treng City since 2011 and able to provide full surveillance coverage for Phnom Penh FIR. Cambodia is willing to share data with others.				
CHINA	5 UAT ADS-B stations are used for flight training of CAFUC. The upgrade to 1090ES ADS-B stations project has already started in 2017, and the project is planned to finish by 2022. 308 ADS-B stations nationwide have already finished the final acceptance activities. 4 ADS-B stations operational in Sanya FIR since 2008. Chengdu-Jiuzhai and Chendu - Lhasa route with 9 ADS-B stations.	The operation of national ADS-B Service is implementing in step -by-step way. Phase I: from October 10, 2019 ➤ ADS-B control services will be provided in APP where radar control services are not available; ➤ ADS-B control services will be implemented in control area above 8400m (inclusive) where Radar control services are not available; ➤ Radar control services will be provided, using integrated surveillance data of ADS-B and radar, in control areas above 8400m (inclusive) where radar control services are available.	The ADS-B mandate published in October 2020, in a separated AIC Nr.09/19 named “Implementation of ADS-B Control Services”		

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	9 ADS-B stations deployed on the routes H15 and Z1 by the end of 2015. 19 ADS-B stations at the small airport.	Phase II: from December 31, 2020 ➤ ADS-B control services will be provided in APP and ACC where radar control services are not available; ➤ Radar control services will be provided, using integrated surveillance data of ADS-B and radar, in APP and ACC where radar control services are available; and ➤ ADS-B equipment will be used at the tower of transport airports to display flight movements.			
HONG KONG CHINA	A larger-scale A-SMGCS covering the whole Hong Kong International Airport put into operational use in April 2009. Data collection/ analysis on aircraft ADS-B equipage in Hong Kong airspace conducted on quarterly basis since 2004. ADS-B trial using a dedicated ADS-B system completed in 2007.	AIP supplement issued on 29 Aug 2014 with 8 Dec 2016 as effective date.	HKFIR at or above FL290	5NM surveillance separation	Fully implemented ADS-B in HKFIR by phased approach to ensure safe and smooth integration of ADS-B into the Air Traffic Management System to provide aircraft separation service since November 2018.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	ADS-B out operations over PBN routes L642 and M771 at or above FL 290 within HK FIR was effective in December 2013 and within HK FIR at or above FL 290 has been effective since December 2016. ADS-B ground station infrastructure completed in 2013. ADS-B signal provided by Mainland China to cover southern part of Hong Kong FIR commenced in 2010 and has been put into operational use after commissioning of the new ATMS since November 2016.				
MACAO, CHINA	Mode S MSSR coverage available for monitoring purposes.				Airspace – ATZ only
DEMOCRATIC PEOPLE’S REPUBLIC OF KOREA	ADS-B has been used as back-up surveillance of SSR since 2008.				
FIJI ISLANDS	ADS- B /multilateration ground stations installed. Situations awareness service provided in 2013.	ADS-B mandate commencing from 31 st December 2013	Mandate for domestic registered aircraft.		

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
FRANCE <i>(French Polynesia)</i>	ATM system is ready for ADS-B sensors/Installation of 5 first GS expected at beginning of 2017. 2 nd stage with implementation of 7 GS and associated VHF coverage.			5 NM for airspace under coverage.	
INDIA	ASMGCS (SMR + Multilat) is operational at Delhi, Mumbai, Chennai, Kolkata, Bangalore, Hyderabad, Jaipur, Amritsar, Lucknow, Ahmedabad and Guwahati Airports. ASMGCS (SMR+MLAT) proposed at Cochin and Bhubaneswar (VOCI&VEBS) Expected to be completed by March 2022. ADS-B Ground Stations are installed at 36 locations to cover continental and Oceanic airspace. Out of these 36 ADS-B ground receivers, 25 receivers have been operationalized and remaining 11 ADS-B ground	AIP supplement issued on 25 th October, 2018 with effective date of implementation from 01 st January 2019 which was subsequently revised through NOTAM G1995/18 to be effective from 01 st January 2020.	On all ATS Routes within continental airspace at and above F290.	a) 5 NM within 60 NM of ADS-B ground station i.e. in the terminal airspace served by the ADS-B receiver. b) 10 NM beyond 60NM of ground station i.e. in the en route airspace.	Standalone ADS-B based APP Surveillance service provided at VOCL, VOCB, VEPT, VEAT and VIJP. MSSR/ADS-B integrated mode APP Surveillance service provided at VILK, VOML, VEBN and VANP.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	receivers will also be operationalized soon. ATM automation systems at 22 ATC Centres are capable of processing ADS-B data.				
INDONESIA	All 30 ADS-B ground station have been met with DO260B in November 2019; The 18 new ADS-B ground stations, with DO260B capability, will be established to cover the traffic in terminal and area. The 7 ADS-B ground station has been installed in Papua. The rescheduling of completion for 11 ground stations in 4Q2021. The ADS-B ground stations has been integrated to 9 ATC systems and 3 others will follow after being upgraded.		Starting on 23rd April 2020, Indonesia has implemented mandatory ADS-B equipment for all transport aircraft category flying at all level (SFC up to FL600) in 2 ACCs, 9 TMAs and 10 Airports.	Using 5 NM separation standard.	ADS-B data sharing had been conducted by Indonesia with Australia and Singapore. LOA of collaboration in ADS-B data sharing has been achieved with India. LOA of collaboration in ADS-B data sharing are under reviewing by Malaysia, Philippines and PNG.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
JAPAN	Multilateration Systems for surface monitoring have been implemented at eight airports PRM (WAM) has been implemented at Narita Airport and Haneda Airport. En-route WAM system have manufactured for four areas and will be put into operation in FY2021 Plan to evaluate accuracy of ADS-B information under RAD condition.				
KIRIBATI					
LAO PDR.	2 ADS-B ground stations were installed in Vientiane and Luangprabang Int'l Airport in 2015 and the ADS-B data is fused with MSSR data target in the ATM Automation system. 3 additional ADS-B ground stations (DO-260B compliant) will be completed the installation at existing MSSR sites (Xiengkhouang, Savannakhet and Champasack) by 2016 to Q1				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	of 2017 to enhance the full ADS-B coverage of Lao FIR.				
MALAYSIA	Ground Infrastructure: Kuala Lumpur FIR: 1. Installation of two (2) ADS-B GS in Langkawi and Genting has been completed in October 2017. 2. Upgrading of Kuala Terengganu ADS-B for ADS-B Version 2 capability is to be completed at the end of Dec 2021. 3. Operation of all three ADS-B in new Kuala Lumpur ATC System is to be completed in Dec 2021. Kota Kinabalu FIR: Four (4) new ADS-B will be installed in Kuching, Bintulu, Kota Kinabalu and Sandakan, to be completed in Dec 2021. Implementation Plan: Phase 1: ADS-B services on specific ATS routes and Flight Levels within Kuala Lumpur FIR, target date Mar 2021. Phase 2: ADS-B as secondary means of surveillance within the Kuala Lumpur FIR for en-route airspace. Target date: Mar 2022.	AIC Issued on September 2017. AIP Supp on 16 Jan 2020.	Phase 1: On ATS routes N571, P628, L510, P627, L645 and P574 at FL 290 to FL 410 within Kuala Lumpur FIR Phase 2: En-route airspace	ICAO approved surveillance separation.	

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	Phase 3: ADS-B used as the primary means of surveillance for en-route airspace. (TBA)				
MALDIVES	4 ADS-B stations installed in Nov. 2012 (2 at Male' Ibrahim Nasir Intl Airport, 1 at Kulhudhuffushi Island in the North and 1 at Fuah Mulah Island in the South to cover 95% of the FIR at/above FL290. Maldives' ADS-B is integrated with the ATM system (in November 2013), and under observation prior to commencing trials. Maldives has planned to share ADS-B data with its adjacent FIRs. Updated by email				Seaplane in Maldives equipped with ADS-B for AOC purpose. These seaplanes have ADS-B IN functions as well.
MARSHALL ISLANDS					
MICRONESIA (FEDERATED STATES OF)					

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
MONGOLIA	Ten ADS-B ground stations for combination SSR and filled the surveillance gaps implemented in 2015 and integrated with ATM system and trial operation in early 2016.				
MYANMAR	a) The ADS-B Implementation Update - The five ADS-B ground stations have been installed in Myanmar. Among them, SITTWE and CoCo Island ground stations are installed in 2014, and are DO260 compliant. The other 3 stations, YANGON, MANDALAY and MYEIK airport ground stations are DO260B compliant and installations were finished in 2016. - All ADS-B data are fused with MSSR data in the TopSky ATC Automation system (Thales) in 2016 and using as MSSR backup in Yangon ACC. b) The ADS-B data sharing update between neighbouring States - Myanmar and India signed the MOU agreement for ADS-B data	Doing ADS-B data analysis and statistic for ADS-B equipped Aircraft in Yangon FIR.			Supplement radar and fill the gaps to improve safety and efficiency ADS-C/CPDLC integrated in Yangon ACC since 2010.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	sharing on 6th May 2015. ADS-B data sharing test between Agartala (India) - Sittwe (Myanmar), and Port Blair (India) - CoCo Island (Myanmar) have been accomplished between technical teams since June 2018. At present, the shared ADS-B data from Myanmar side is now using as backup automation system at Kolkata for test purpose. But, Myanmar side is needed to discuss with ATM manufacturer for operational use of the India's Data at Yangon ACC. - Myanmar have planned to install new ADS-B Station in the 2nd quarter of 2019 at LASHIO Airport located in north-eastern part of Myanmar closed to the China-Myanmar border near the LINSO transfer point on A599 ATS route. After the installation finished, the ADS-B data sharing process can be proceeded between Myanmar and China.				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipped mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
NAURU					
NEPAL	Four ADS-B ground stations have been installed in 2019 at Kathmandu (Phulchowki), Bhairahawa, Nepalgunj and Dhangadi.				Safety assessment will be done soon.
NEW CALEDONIA	Three ADS-B ground stations commissioned in 2010 to cover international traffic at La tontouta airport serving Tontouta ACC & APP. It is used for Situation awareness and SAR.				
NEW ZEALAND	MLAT and ADS-B data from WAM system centred in and around Queenstown. Provides surveillance coverage for TOWER and Approach Surveillance using 5NM separation for NZQN and ENROUTE coverage of the southern half of the South Island of New Zealand MLAT and ADSB data from the NZAA MLAT system to support surface movements control at NZAA	Current: ADSB mandate FL245 and above in the NZCC FIR from DEC 31, 2018, active Proposed: ADSB mandate for all controlled airspace from DEC 31, 2022, promulgated by NZCAA (Delayed from 2021 by 1 year due to COVID) Current: Since July 2018, all new aircraft registered in New Zealand, or any currently registered aircraft upgrading transponder(s) are required to install DO260B transponder(s) which meet the NZCAA rule set. The	Current: All controlled airspace within the NZCC FIR FL245 and above. Proposed: All controlled airspace within the NZCC FIR	5NM surveillance separation in enroute controlled airspace, and 3NM surveillance separation in Terminal approach controlled (Class C) airspace.	Currently situational awareness surveillance targets are displayed for ADS-B targets from which the data supplied does not meet the requirements for surveillance separation.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	ADSB data at 6 domestic aerodromes to provide ADSB APT surface movements control 34 ADSB-B Ground stations for Enroute, Terminal and ADSB APT services	rule specifies the minimum Technical Standing Orders (TSO) or transponder GNSS receiver models for position input into ADS-B			
PAKISTAN	Tender for procurement of 5 ADS-B stations issued to be installed at Pasni, Lakpass, Rojhan, Dalbandin and Laram-top. Contract expected to be finalized by end of 2016. These stations will be DO260B compliant and operational by end of 2017.				
PAPUA NEW GUINEA	Initially 7 ADS-B sites to be deployed across PNG to provide seamless coverage above FL285. Three (3) sites installed as of December 2017. Two (2) of these are operational. First site to be installed May/June 2017, with remainder to be completed in 2018. Additional 7 sites to be rolled-out in the 2018/19 timeframe. Site location will be dependent on infrastructure, security and an analysis of Phase 1 site performance.	An ADS-B mandate is on CASA PNG roadmap, however legislation yet to be developed. The Australian mandates will largely drive equipage for overflights (e.g. East-Asia to Australia/South Pacific). Expectation is that PNGASL (the ANSP) will lead development of ADS-B mandate framework. Initial steps may include mandate above F245 – but will depend on performance of Phase 1 ADS-B deployment.	None	Air Traffic Control <u>Approach/ Arrivals</u> 2018 – 5NM 2019 – 3NM (approach) <u>Upper Airspace (>FL245)</u> 2017/18 – Situational awareness. 2018/19 – 5NM	

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	PNGASL (ANSP) will commence a transition to new ATM automation system in May 2018. The system will support fusion of ADS-B and RADAR data. 5 mile separation to be provided using ADS-B and fused ADS-B/Radar from May 2018. From 2018 onwards, PNGASL will be looking to share ADS-B data with Indonesia and Australia.	Country-wide mandate not envisaged before 2021/22.		Note: Implementation dictated by training requirements and new ATM system transition priorities. Flight Service <u>Directed Traffic (FIS)</u> 2019 – Situational awareness	
PHILIPPINES	One ADS-B GS installed at the Manila ATM Center for situational awareness. One ADS-B Ground Station installed at Bataraza, Palawan for data sharing with Singapore. Additional ground stations are planned to be installed in Laoag Airport, Tagaytay, Jomalig Island, Puerto Princesa Airport, Mt. Majic Mactan, and General Santos “Tambler” Airport.				

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State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
REPUBLIC OF KOREA	Installed 10 ADS-B receivers and in operation since May 2020. 3 more receivers will be installed by 2024.	To be confirmed.	To be confirmed.	To be confirmed.	
SINGAPORE	The airport MLAT system was installed in 2007 and “far-range” ADS-B sensor was installed in 2009. ATC system has been processing ADS-B data since 2013.	AIC was issued on 28 December 2010/effective from 12 Dec.2013. ADS-B OUT equipment requirement for all aircraft operating on selected ATS routes within the WSSS FIR from 27 January 2022. ADS-B OUT equipment requirement for all aircraft operating within the WSSS FIR from 26 January 2023. AIP updated in May 2018 to reflect the ADS-B equipment certified as meeting: a. EASA - (AMC 20-24), or b. EASA CS-ACNS (Subpart D - Surveillance - SUR), or c. FAA - Advisory Circular No: 20-165A (or later versions), or d. The equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of CASA.	At and above FL290, affecting the following ATS routes L642, L644, M753, M771, N891 & N892 At and above FL290, affecting the following ATS routes L517, L625, L649, M758, M767, M768, M772 & N884.	40nm implemented on ATS routes L644 and N891. 20nm implemented on ATS routes L642, M771, M753 and N892.	Safety case was completed end of November. 2013.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
SRI LANKA	Total of 5 ADS-B Ground Receiving Stations and 01 Central Processing Station have been installed in March 2017. ADS-B Data is fused with Multi-sensor Data, including MSSR and ADS-C in the ATM system at Colombo ACC Ratmalana was launched for operational used on 15 Nov. 2017. New ATM system planned for operational at APP Centre in 2018 will also be capable of fusing Multi-sensor Data, including MSSR and ADS-B	Revised Date of Equipage mandate would be 31st Dec 2020. Ref: AIC A02/16 (Initially AIC A02/14 was issued in November 2014)	All ATS Routes within Colombo TMA	Initially 5 NM within Approach Radar Coverage, 8 Nm within Area Radar Coverage & Procedural Separation minima outside Radar Coverage.	On completion of a safety assessment, use of ADS-B alone for ATC separation purposes.
THAILAND	Five ADS-B ground stations (DO-260B and lower compliant) have been primarily installed for research and development purpose and are being undergone the approval process to be used for air traffic services with a target date by the end of 2021.	The airspace re-structure and aircraft equipage mandate are planned to be studied in 2021 and are expected to be started implementation in 2022.	TBD	TBD	

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State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	The new ATM automation system was successfully implemented in Q1 2020. It can The ATS surveillance data sharing with the adjacent FIRs was approved in principle in October 2018.				
TONGA	Trial planned for 2017				
UNITED STATES	The US identified required ADS-B Service Volumes in 2007. Using data from over 600 terrestrial radio sites, the US domestic ADS-B system became operational in 2014. As of 1 January 2020, ADS-B aircraft equipage is mandated in most controlled airspace within the US. Over 160,000 US registered aircraft are now equipped. ADS-B is available to U.S. air traffic control facilities for ATC separation; all En Route Centers and major Terminal facilities are using ADS-B for ATC separation.	The U.S. ADS-B Out rule (14 CFR 91.225 and 14 CFR 91.227) was issued in May 2010 and specifies that the ADS-B Out mandate is effective on 1 January 2020.	Class A, B, and C airspace, plus Class E airspace above 10,000 ft MSL. See 14 CFR 91.225 for details.	The U.S. is using both terminal and en route (5nm) separation criteria, depending on the specific airspace and available surveillance information. Terminal separation includes the following separation criteria: - 3nm - 2.5nm - independent parallel approach operations down to 3600 ft centreline separation - dependent	The U.S. has implemented integrated WAM/ADS-B in the following terminal areas: Charlotte LAX Implementation of integrated WAM/ADS-B is being considered for additional U.S. terminal areas.

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State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/ effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
				parallel approach operations down to 2500 ft centreline separation (currently 1.0 nm diagonal distance).	
VANUATU					
VIET NAM	Two phases ADS-B implementation plan adopted. Phase 1 implemented in March 2013. Phase 2 commenced in 2015 for whole lower and upper Hanoi FIR and 2018 for Ho Chi Minh FIR	AIC issued on 20 June 2013/ADS-B mandating effective from 12 December 2013 in Ho Chi Minh FIR.	M771, L642, L625, N892, M765, M768, N500 and L628 At/above FL290.		Operators required to have operational approval from State of aircraft registry.

**TERMS OF REFERENCE OF
SURVEILLANCE IMPLEMENTATION COORDINATION GROUP (SURICG)**

Consists of objectives and deliverables as follows:

The Objectives of the SURICG are to:

- 1) *Ensure continuous and coherent development of the Surveillance parts of the Asia/Pacific Regional Air Navigation Plan (APAC e-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 Surveillance systems and services identified in the Aviation System Block Upgrades (ASBU) modules, APAC ANP, and Asia/Pacific Seamless ATM Plan elements using the project management principles where appropriate; and*
- 3) *Review, identify and address major issues in technical, operational, safety and regulatory aspects to facilitate the implementation or provision of efficient Surveillance services in the Asia and Pacific Regions.*

Deliverables to meet the Objectives:

- 1) *Progress report to be submitted to CNS SG addressing the SURICG deliverables (listed in 2 to 13 below);*
- 2) *Surveillance parts of the APAC ANP to be reviewed and aligned with work programme of States and, as necessary, amendment proposals prepared to update the APAC ANP to reflect changes in the operational and global requirements;*
- 3) *To review the outcome of the Surveillance Panel, SAS Panel, AN-Conf, APANPIRG and CNS SG related to surveillance, revise and update a tasks list and action items for the SURICG and formulate relevant Working Groups to work on those tasks / action items;*
- 4) *To develop regional targets/metrics for planning, implementation, measurement and monitoring of Surveillance systems and services;*
- 5) *To review and update the Surveillance Strategy by considering currently available and emerging technologies with respect to concept of operations, relative costing, technical and operational performance and maturity of alternative technology/solutions such as primary radar, secondary radar including Mode-S, ADS-B, Multilateration, ADS-C, multi-static primary radar (MPSR) and existing and emerging technology for detection of UAS including RPAS;*
- 6) *To study and identify applicable multilateration applications in the Asia and Pacific Regions considering:*
 - *Concept of use/operation*
 - *Required site and network architecture*
 - *Expected surveillance coverage*
 - *Cost Benefits Analysis*
 - *Recommended separation minimums*

- 7) To study and identify applicable Mode S radar applications in the Asia and Pacific Regions considering:
- Concept of use/operation
 - Required site and network architecture
 - Expected surveillance coverage
 - Cost of system
 - Matching functionality required in ATC automation system
 - the use of Enhanced MODE S data (DAPS)
- 8) To develop an implementation plan for ADS-B applications in the Asia and Pacific Regions including implementation target dates taking into account:
- available equipment standards;
 - readiness of airspace users and ATS providers;
 - identifying sub-regional areas (FIRs) where there is a positive cost/benefit for implementation of ADS-B and associated VHF voice communications; and
 - developing a standardised and systematic task-list approach to ADS-B implementation; and
 - major traffic flows.
- 9) To coordinate ADS-B implementation plan and concept of operations with other ICAO regions where ADS-B implementation is going on and with relevant external bodies such as EUROCONTROL, EUROCAE, RTCA and Industry;
- 10) To encourage research and development, trials and demonstrations in the field of Surveillance and other relevant areas; ,
- 11) Facilitate ~~implementationsharing~~ of surveillance ~~information~~data sharing (including DCPC) and ~~sharing surveillance information and~~ expertise between States through organizing educational seminars and providing guidance materials to educate States and airspace users
- 12) To support the ICAO in making specific recommendations, developing guidance materials, aimed at improving the Surveillance services by the use of existing and/or new procedures, facilities and technologies; and
- 13) Draft Conclusions and Decisions to be formulated relating to matters in the field of Surveillance that come within the scope of the APANPIRG or CNS Sub-group work plan.

[Note: The Implementation Coordination Group, while undertaking the tasks, should take into account of the work being undertaken by SAS, Surveillance Panels with a view to avoid any duplication.

The Implementation Coordination Group will report to CNS Sub-group and CNS Sub-group will coordinate with ATM Sub-group.]

Membership:

All APAC member States/Administrations providing air navigation services in the Asia and Pacific Regions.

The Surveillance Implementation Coordination Group shall normally invite representatives of International Organizations recognized by the ICAO Council and Industry partners as required by the group which represent important civil aviation interests to participate in its work in a consultative capacity.



**INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE**

**ADS-B IMPLEMENTATION AND
OPERATIONS GUIDANCE DOCUMENT**

Edition 14.0 - August 2021

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Appendix 3 – A Template for ADS-B Mandate/Regulations for Aircraft Avionics

Appendix 4 – An Example of Advice to Operators Concerning Inconsistency between ADS-B Flight Planning and Surveillance Capability

Appendix 5 – Checklist of Common Items or Parameters for the Monitoring of ADS-B System

Appendix 6 – Baseline ADS-B Service Performance Parameters

Appendix 7 – Guidance Material on Generation, Processing and Sharing of ASTERIX Category 21 ADS-B Messages

Appendix 8 – ICAO Guidance Material on 1 090 Mhz Spectrum Issues and Proper Management of 24-Bit Aircraft Addresses Associated with Unmanned Aircraft

1. INTRODUCTION

The Eleventh ICAO Air Navigation Conference held in 2003 recommended that States recognize ADS-B as an enabler of the global ATM concept bringing substantial safety and capacity benefits; support the cost-effective early implementation of it; and ensuring it is harmonized, compatible and interoperable with operational procedures, data linking and ATM applications.

The Twelve ICAO Air Navigation Conference held in 2012 endorsed the Aviation System Block Upgrades (ASBU) to provide a framework for global harmonization and interoperability of seamless ATM systems. Among the Block Upgrades, the Block 0 module “Initial Capability for Ground Surveillance” recommends States to implement ADS-B which provides an economical alternative to acquire surveillance capabilities especially for areas where it is technically infeasible or commercially unviable to install radars.

This ADS-B Implementation and Operations Guidance Document (AIGD) provides guidance material for the planning, implementation and operational application of ADS-B technology in the Asia and Pacific Regions.

The procedures and requirements for ADS-B operations are detailed in the relevant States’ AIP. The AIGD is intended to provide key information on ADS-B performance, integration, principles, procedures and collaboration mechanisms.

The content is based upon the work to date of the APANPIRG ADS-B Study and Implementation Task Force (SITF), the Surveillance Implementation Coordination Group (SURICG) and various ANC Panels developing provisions for the operational use of ADS-B. Amendment to the guidance material will be required as new/revised SARPs and PANS are published.

1.1 ARRANGEMENT OF THE AIGD

The AIGD consists of the following Parts:

Section 1	Introduction
Section 2	Acronyms and Glossary of Terms
Section 3	Reference Documents
Section 4	ADS-B Data
Section 5	ADS-B Implementation
Section 6	Template of Harmonization Framework for ADS-B Implementation
Section 7	System Integrity and Monitoring
Section 8	Reliability and Availability Considerations
Section 9	ADS-B Regulations and Procedures
Section 10	Security Issues Associated with ADS-B

1.2 DOCUMENT HISTORY AND MANAGEMENT

This document is managed by the APANPIRG. It was introduced as draft to the first Working Group meeting of the ADS-B SITF in Singapore in October 2004, at which it was agreed to develop the draft to an approved working document that provides implementation guidance for States. The first edition was presented to APANPIRG for adoption in August 2005. It is intended to supplement SARPs, PANS and relevant provisions contained in ICAO documentation and it will be regularly updated to reflect evolving provisions.

1.3 COPIES

Paper copies of this AIGD are not distributed. Controlled and endorsed copies can be found at the following web site: <http://www.icao.int/APAC/Pages/edocs.aspx>

Copy may be freely downloaded from the web site, or by emailing APANPIRG through the ICAO Asia and Pacific Regional Office who will send a copy by return email.

1.4 CHANGES TO THE AIGD

Whenever a user identifies a need for a change to this document, a Request for Change (RFC) Form (see Section 1.6 below) should be completed and submitted to the ICAO Asia and Pacific Regional Office. The Regional Office will collate RFCs for consideration by the Surveillance Implementation Coordination Group.

When an amendment has been agreed by a meeting of the Surveillance Implementation Coordination Group then a new version of the AIGD 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 the AIGD will be the responsibility of APANPIRG.

1.5 EDITING CONVENTIONS (Intentionally blank)

1.7 AMENDMENT RECORD

Amendment Number	Date	Amended by	Comments
0.1	24 December 2004	W. Blythe H. Anderson	Modified draft following contributions from ADS-B SITF Working Group members. Incorporated to TF/3 Working Paper #3.
0.2 (1.0)	24 March 2005	H. Anderson	Final draft prepared at ADS-B SITF WG/3
0.3 (1.1)	03 June 2005	Nick King	Amendments following SASP WG/WHL meeting of May 2005
0.4	15 July 2005	CNS/MET SG/9	Editorial changes made
1.0	26 August 2005	APANPIRG/16	Adopted as the first Edition
2.0	25 August 2006	Proposed by ADS-B SITF/5 and adopted by APANPIRG/17	Adopted as the second Edition
3.0	7 September 2007	Proposed by ADS-B SITF/6 and adopted by APANPIRG/18	Adopted as the second amendment (3 rd edition)
4.0	5 September 2011	Proposed by ADS-B SITF/10 and adopted by APANPIRG/22	Adopted amendment on consequential change to the Flight Plan and additional material on the reliability and availability for ADS-B ground system
5.0	14 September 2012	Proposed by ADS-B SITF/11 and adopted by APANPIRG/23	Included sample template on harmonization framework
6.0	June 2013	Proposed by ADS-B SITF/12 and adopted by APANPIRG/24	Revamped to include the latest ADS-B developments and references to guidance materials on ADS-B implementation
7.0	September 2014	Proposed by ADS-B SITF/13 and adopted by APANPIRG/25	(i) Included guidance materials on monitoring and analysis of ADS-B equipped aircraft (ii) Included guidance materials on synergy between GNSS and ADS-B (iii) Revised ATC Phraseology (iv) Included clarification on Flight Planning
8.0	September 2015	Proposed by ADS-B SITF/14 and adopted by APANPIRG/26	(i) Updated the guidance materials on monitoring and analysis of ADS-B equipped aircraft (ii) Updated the categories of reported ADS-B avionics problems (iii) Updated the guidance materials on ADS-B flight plan

			(iv) Updated the guidance materials on disabling ADS-B transmissions (v) Remove reference to operational approval for use of ADS-B Out by ATC
9.0	September 2016	Proposed by ADS-B SITF/15 and adopted by APANPIRG/27	(i) Included a list of additional functional requirements for ADS-B integration (ii) Addition of a checklist of common items or parameters for monitoring of ADS-B System (iii) Amendment to emphasize the issue on potential incorrect processing of DO-260B downlinks by ADS-B ground stations during upgrade (iv) Updated the list of known ADS-B avionics problems (v) Included a general recommendation of technical solution on acquisition of Mode 3/A code information via Mode S downlink for DO-260 aircraft in ADS-B implementation with Mode A/C SSR environment
10.0	June 2017	Proposed by SURICG/2	(i) Updated “B787 position error with good NUC” in the list of known ADS-B avionics problems. (ii) Included new problem type “Incorrect Ground Bit Setting in ADS-B Avionics Downlink Data” and “A350 ADS-B on-ground performance” in the list of known ADS-B avionics problems. (iii) Amendment to the template for ADS-B Mandate / Regulations for Aircraft Avionics. (iv) Included a general recommendation to use ADS-B in overcoming the limitations of Mode A/C radar technology. (v) Included a general recommendation on carrying out ICAO Aircraft Address Monitoring

			(vi) Aligned to replace NACp for NAC throughout the document (vii) Aligned to use ICAO Aircraft Address throughout the document
11.0	April 2018	Proposed by SURICG/3	(i) Editorial Updates – including /replacing ADS-B SITF with SURICG (Sections 1, 1.4, 2.1, 7.5.1, 7.5.5, 7.5.6, 7.6, 7.8.2) (ii) Correction of HPL Definition (Section 2.2) (iii) Update of reference documents as in Attachment 2 of WP/02 (iv) Include reference to APRD (Section 7.5.1) (v) Update of sample regulations (Section 9.2) (vi) Update in Position Reporting Performance (Section 9.3.2) (vii) Update in GNSS Integrity Prediction Service (Section 9.3.3) (viii) Update name of RASMAG in Sharing of ADS-B Data (Section 9.3.4) (ix) Clarification of reporting rate requirements (Section 9.4.1) (x) Use of Ident during ADS-B emergencies.(Section 9.12) (xi) Appendix 1 missing from Version 10 – reinstate. (xii) Appendix 2 – update for available APRD. (xiii) Update to B787 service bulletin status. (Attachment A in Appendix 2) (xiv) replace "Date UTC" to "Start Time/Date UTC", replace "Time UTC" to "End Time/Date UTC" and related contents in the Report Form (Section 7.8.1) (xv) replace description of "Date UTC" as "UTC Time/Date when the event occurred", replace description of "Time UTC" as "UTC Time/Date when the event ended" as sometimes the problem will lasts across mid-night. (Section 7.8.2)

			(xvi) In Remote Control & Monitoring (RCMS) part, suggest to replace "ASTERIX Output Load" to "ASTERIX Output Load and Link Status" (Appendix 5) (xvii) Update on DO260A EMG issue (Section 9.12) (xviii) Update the link to the Guidance Material on generation, processing and sharing of ASTERIX (Section 4) (xix) Reference to Space based ADS-B and ATC automation as in WP12 is added under 5.1.4.4.6 (xx) Updated Section 4 Managing the Problem in Appendix 2 to incorporate the General mechanism and procedure for blacklisting aircraft (xxi) Updated the Attachment A to Appendix 2 – List of known ADS-B avionics problems (xxii) Added Appendix 6 – Baseline ADS-B Service Performance Parameters (xxiii) Added Appendix 7 – Guidance Material on Generation, Processing and Sharing of ASTERIX Category 21 ADS-B Messages
12.0	April 2019	Proposed by SURICG/4	(i) Added procedures on handling GPS time and week counters rollover (Section 9.13) (ii) Added two new problem types to Attachment A of Appendix 2 “List of known ADS-B avionics problems”, including: ○ Rockwell TSS-4100 Geometric Altitude Reporting as Pressure Altitude ○ Improper NACv reporting (iii) Updated the status of known ADS-B avionics problems in Attachment A of Appendix 2 “List of known ADS-B avionics problems”, including:

			○ B787 position error with good NIC ○ Rockwell TSS-4100 track extrapolation issue ○ Embraer 170 track jumping issue ○ Airbus Single Aisle production wiring issue ○ Boeing 777-300ER production wiring issue
13.0	September 2020	Proposed by SURICG/5	(i) Updated the status of known ADS-B avionics problems in Attachment A of Appendix 2 “List of known ADS-B avionics problems”, including B787 NACv = 0 Issue (ii) Updated Section 5.1.4.5.1 on ICAO Aircraft Address Monitoring (iii) Added the following new sections: ○ Use of ADS-B for Airport Surface Movement (Section 9.3.6) ○ 1090 Mhz Spectrum and 24-bit Aircraft Address Issue with Unmanned Aircraft Systems (UAS) (Section 9.3.7) ○ Measures for Enhancing the Security of ADS-B (Section 10.3) ○ Time Difference of Arrival (TDOA) Based Position Verification Method (Section 10.3.1)
14.0	August 2021	Proposed by SURICG/6	(i) Added the following new issue to the “List of known ADS-B avionics problems” in Attachment A of Appendix 2 ○ Honeywell Primus II RCZ Issue

2. ACRONYM LIST & GLOSSARY OF TERMS

2.1 ACRONYM LIST

ACID	Aircraft Identification
ADS-C	Automatic Dependent Surveillance - Contract
ADS-B	Automatic Dependent Surveillance - Broadcast
AIGD	ADS-B Implementation and Operations Guidance Document
AIP	Aeronautical Information Publication
AIT	ADS-B Implementation Team
AMSL	Above Mean Sea Level
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APRD	ADS-B Avionics Problem Reporting Database
ARINC	Aeronautical Radio Incorporated
ATC	Air Traffic Control (or Air Traffic Controller)
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSP	ATS Provider
ATSU	ATS unit
CNS	Communications, Navigation, Surveillance
CRC	Cyclic Redundancy Check
CDTI	Cockpit Display Traffic Information
DAIW	Danger Area Infringement Warning
FIR	Flight Information Region
FLTID	Flight Identification
FMS	Flight Management System
FOM	Figure of Merit used in ASTERIX messaging
GPS	Global Positioning System (USA)
HPL	Horizontal Protection Level
ICAO	International Civil Aviation Organization
MSAW	Minimum Safe Altitude Warning
MTBF	Mean Time Between Failures
MTCA	Medium Term Conflict Alert
MTTR	Mean Time To Restore
NACp	Navigation Accuracy Category
NIC	Navigation Integrity Category
PRS	Problem Reporting System
RAI	Restricted Area Intrusion
RAM	Route Adherence Monitoring
RAIM	Receiver Autonomous Integrity Monitoring
RFC	Request for Change
RNP	Required Navigation Performance
SIL	Source Integrity Level
SITF	Study and Implementation Task Force
STCA	Short Term Conflict Alert
SURICG	Surveillance Implementation Coordination Group

2.2 GLOSSARY OF TERMS

ADS-B In	An ADS-B system feature that enables the display of real time ADS-B tracks on a situation display in the aircraft cockpit.
ADS-B Out	An ADS-B system feature that enables the frequent broadcast of accurate aircraft position and vector data together with other information.
Asterix 21	Eurocontrol standard format for data message exchange
FOM (Figure of Merit)	A numeric value that is used to determine the accuracy and integrity of associated position data.
HPL (Horizontal Position Limit)	The containment radius within which the true position of the aircraft will be found for 99.999% of the time, or the probability indicated by the reported SIL value (DO-260A/B).
NACp (Navigational Accuracy Category)	Subfield used to announce the 95% accuracy limits for the horizontal position data being broadcast.
NIC (Navigational Integrity Category)	Subfield used to specify the containment radius integrity associated with horizontal position data.
NUCp (Navigation Uncertainty Category)	A numeric value that announces the integrity of the associated horizontal position data being broadcast.
SIL (Source Integrity Level)	Subfield used to specify the probability of the true position lying outside the containment radius defined by NIC without being alerted.

3. REFERENCE DOCUMENTS

Id	Name of the document	Reference	Date	Origin	Domain
1	Annex 2: Rules of the Air	Tenth Edition Including Amendment 43 dated 10/11/16	July 2005	ICAO	
2	Annex 4: Aeronautical Chart	Eleventh Edition including Amendment 59 dated 10/11/16	July 2009	ICAO	
3	Annex 10: Aeronautical Telecommunications, Vol. IV – Surveillance Radar and Collision Avoidance Systems	Fifth Edition	July 2014	ICAO	
4	Annex 11: Air Traffic Services	Fourteenth Edition	July 2016	ICAO	
5	Annex 15: Aeronautical Information Services	Fifteenth Edition	July 2016	ICAO	
6	PAN-ATM (Doc 4444/ATM501)	Sixteenth Edition	November 2016	ICAO	
7	Air Traffic Services Planning Manual (Doc 9426/AN924)	First Edition including Amendment 4 30/12/92	1984	ICAO	
8	Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689/AN953)	First Edition including Amendment 1 dated 30/8/02	1998	ICAO	
9	Doc 9859 Safety Management Manual (SMM)	Third Edition	2013	ICAO	
10	Technical Provisions for Mode S Services and Extended Squitter (Doc 9871/AN460)	Second Edition including Amendment 1 dated 09/01/17	2012	ICAO	
11	Aeronautical Surveillance Manual (Doc 9924)	Second Edition	2017	ICAO	
12	ICAO Circular 326 AN/188 “Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation”.	First Edition	2012	ICAO	
13	Regional Supplementary Procedures (Doc 7030)	Fifth Edition including Amendment 9 dated 25/04/14	2008	ICAO	
14	Minimum Operational Performance Standards (MOPS) for 1090 MHz Automatic Dependent Surveillance – Broadcast (ADS-B) – including Change 1	RTCA DO-260 September 13, 2000 Change 1 to	2000 2006	RTCA	

		RTCA DO-260 June 27, 2006			
15	Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)	RTCA DO-260A April 10, 2003	2003	RTCA	
	Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B) – Change 1	RTCA DO-260A Change 1 June 27, 2006	2006		
	Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B) – Change 2	RTCA DO-260A Change 2 December 13, 2006	2006		
16	Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services (TIS-B)	RTCA DO-260B December 2, 2009	2009	RTCA	
	Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B) – Corrigendum 1	RTCA DO-260B December 13, 2011	2011		

4. ADS-B DATA

APANPIRG has decided to use 1090MHz Extended Squitter data link for ADS-B data exchange in the Asia and Pacific Regions. In the longer term an additional link type may be required.

To ensure interoperability of ADS-B ground stations in the Asia Pacific (ASIA/PAC) Regions, during the 16th APANPIRG Meeting held in August 2005, the ASTERIX Category 21 version 0.23 (V0.23) which had incorporated DO260 standard was adopted as the baselined ADS-B data format for deployment of ADS-B ground stations and sharing of ADS-B data in the ASIA/PAC Regions. At this time, DO260A and DO260B standards were not defined.

This baselined version provides adequate information so that useful ATC operational services, including aircraft separation, can be provided. V0.23 can be used with DO260, DO260A and DO260B ADS-B avionics/ground stations to provide basic ATC operational services. However, V0.23 cannot fully support the more advanced capabilities offered by DO260A and DO260B.

As the avionics standards changed through the different versions of DO260, the ADS-B ground station processing also needed to change, so that downlinks received from aircraft would be correctly interpreted in construction of the ASTERIX Category 21 messages. It is important that States with “older generation” ADS-B ground stations designed to support DO260 or DO260A, take action to upgrade to support the latest ADS-B avionics standard as well as the older standards. DO260B avionics will become more common in the Asia Pacific region as the FAA and European ADS-B mandates for 2020 require this version.

States intending to implement ADS-B surveillance and share ADS-B data with others might consider to adopt a more updated version of ASTERIX in order to make use of the advanced capabilities offered by DO260A and DO260B compliant avionics.

A guidance material on generation, processing and sharing of ASTERIX Cat. 21 ADS-B messages is provided at **Appendix 7** for reference by States.

In this guidance material, the ADS-B data contained inside ASTERIX Cat 21 are classified as Group 1 (mandatory), Group 2 (Desirable) and Group 3 (Optional). It is required to transmit all data that are operationally desirable (Group 2), when such data are received from the aircraft, in addition to the data that are mandatory (Group 1) in ASTERIX messages. Whether Group 3 optional data will need to be transmitted or not should be configurable on item-by-item basis within the ADS-B ground station depending on specific operational needs.

It is considered necessary that all data that are mandatory in ASTERIX messages (i.e. Group 1 data items) and operationally desirable (i.e. Group 2 data items) when such data are received from aircraft, should be included in data sharing. In the event that the data have to be filtered, the list of optional data items (i.e. Group 3 data items) needs to be shared will be subject to mutual agreement between the two data sharing parties concerned.

5. ADS-B IMPLEMENTATION

5.1 INTRODUCTION

5.1.1 Planning

There are a range of activities needed to progress ADS-B implementation from initial concept level to operational use. This section addresses the issues of collaborative decision making, system compatibility and integration, while the second section of this chapter provides a checklist to assist States with the management of ADS-B implementation activities.

5.1.2 Implementation team to ensure international coordination

5.1.2.1 Any decision to implement ADS-B by a State should include consultation with the wider ATM community. Moreover, where ADS-B procedures or requirements will affect traffic transiting between states, the implementation should also be coordinated between States and Regions, in order to achieve maximum benefits for airspace users and service providers.

5.1.2.2 An effective means of coordinating the various demands of the affected organizations is to establish an implementation team. Team composition may vary by State or Region, but the core group responsible for ADS-B implementation planning should include members with multidiscipline operational expertise from affected aviation disciplines, with access to other specialists where required.

5.1.2.3 Ideally, such a team should comprise representatives from the ATS providers, regulators and airspace users, as well as other stakeholders likely to be influenced by the introduction of ADS-B, such as manufacturers and military authorities. All identified stakeholders should participate as early as possible in this process so that their requirements can be identified prior to the making of schedules or contracts.

5.1.2.4 The role of the implementation team is to consult widely with stakeholders, identify operational needs, resolve conflicting demands and make recommendations to the various stakeholders managing the implementation. To this end, the implementation team should have appropriate access to the decision-makers.

5.1.3 System compatibility

5.1.3.1 ADS-B has potential use in almost all environments and operations and is likely to become a mainstay of the future ATM system. In addition to traditional radar-like services, it is likely that ADS-B will also be used for niche application where radar surveillance is not available or possible. The isolated use of ADS-B has the potential to foster a variety of standards and practices that, once expanded to a wider environment, may prove to be incompatible with neighbouring areas.

5.1.3.2 Given the international nature of aviation, special efforts should be taken to ensure harmonization through compliance with ICAO Standards and Recommended Practices (SARPs). The choice of systems to support ADS-B should consider not only the required performance of individual components, but also their compatibility with other CNS systems and prevailing avionics standards.

5.1.3.3 The future concept of ATM encompasses the advantages of interoperable and seamless transition across flight information region (FIR) boundaries and, where necessary, ADS-B implementation teams should conduct simulations, trials and cost/benefit analysis to support these objectives.

5.1.4 Integration

5.1.4.1 ADS-B implementation plans should include the development of both business and safety cases. The adoption of any new CNS system has major implications for service providers, regulators and airspace users and special planning should be considered for the integration of ADS-B into the existing and foreseen CNS/ATM system. The following briefly discusses each element.

5.1.4.2 Communication system

5.1.4.2.1 The communication system is an essential element within CNS. An air traffic controller can now monitor an aircraft position in real time using ADS-B where previously only voice position reports were available. However, a communication system that will support the new services that result from the improved surveillance may be necessary. Consequently, there is an impact of the ongoing ADS-B related work on the communication infrastructure developments.

5.1.4.3 Navigation system infrastructure

5.1.4.3.1 ADS-B is dependent upon the data obtained from a navigation system (typically GNSS), in order to enable its functions and performance. Therefore, the navigation infrastructure should fulfill the corresponding requirements of the ADS-B application, in terms of:

- a) Data items; and
- b) Performance (e.g. accuracy, integrity, availability etc.).

5.1.4.3.2 This has an obvious impact on the navigation system development, which evolves in parallel with the development of the surveillance system.

5.1.4.4 Other surveillance infrastructure

5.1.4.4.1 ADS-B may be used to supplement existing surveillance systems or as the principal source of surveillance data. Ideally, surveillance systems will incorporate data from ADS-B and other sources to provide a coherent picture that improves both the amount and utility of surveillance data to the user. The choice of the optimal mix of data sources will be defined on the basis of operational demands, available technology, safety and cost-benefit considerations.

5.1.4.4.2 ADS-B is one of the cost-effective means in complementing and overcoming limitations of Mode A/C radars, including false targets, aircraft positions temporarily not displayed and split tracks, which could cause aircraft display issues on radar screens for ATC irrespective of brands of Air Traffic Management System being used. Within busy airspace, aircraft could be managed at close lateral distance while vertically separated. In

such situation, Mode A/C radars sometimes provide garbled detection, in the form of false targets due to overlapping replies from two or more aircraft. In the case of ADS-B, ADS-B data are broadcast in an omni-directional, random and periodic intervals without suffering from the same issue. In addition, automatic data validation is usually done at ADS-B receivers to ensure integrity of ADS-B information received from the aircraft.

- 5.1.4.4.3 A guidance material on issues to be considered in ATC multi-sensor fusion processing including integration of ADS-B data is provided on the ICAO website <http://www.icao.int/APAC/Pages/edocs.aspx> for reference by States.
- 5.1.4.4.4 Acquisition of Mode 3/A code for DO-260 aircraft through Mode S downlink

There is a potential problem for some of the air traffic management systems (ATMS) for fusion of ADS-B targets with Mode A/C SSR targets, because a common identifier to the aircraft, Mode 3/A code, is not available through ADS-B. Then ATMS can only rely on proximity analysis of aircraft position and Mode C altitude to determine whether detections from two distinct types of surveillance sources belong to the same aircraft. This matching technique might introduce ambiguity in associating ADS-B with Mode A/C SSR targets for fused display.

States may consider enhancing their ADS-B ground stations to listen to Downlink Format 5 and 21 (DF 5 and 21) of Mode S interrogation replies which carry the Mode 3/A code of the same aircraft. As a result, ADS-B target reports of the same DO-260 aircraft can be filled with Mode 3/A code acquired from Mode S downlink to facilitate matching with Mode A/C SSR targets before transmitting to the ATMS.

The transmission of DF 5 and DF 21 messages from a Mode S aircraft requires to be triggered by ground-based Mode S interrogators, either through active or passive interrogation. For active interrogation, Mode S interrogators can be installed alongside with ADS-B ground stations for actively triggering DF 5 and DF 21 messages transmission from the aircraft. The interrogators shall follow ICAO standard to perform periodic all-call and roll-call to the aircraft in range. For passive interrogation, the ADS-B ground stations will only passively listen to the DF messages from the aircraft for acquiring the Mode 3/A code. It is required to ensure that Mode S interrogations are performed by external systems, such as A-SMGCS, MLAT system or Mode S radar under their coverage.

The above provides an interim solution during transition from Mode A/C SSR to Mode S SSR. After upgrading to Mode S SSR, ATMS can have an alternative means to make use of Flight ID or ICAO Aircraft Address to perform association between ADS-B and Mode S radar targets without ambiguity.

- 5.1.4.4.5 A guidance material on processing and displaying of ADS-B data at air traffic controller positions is provided on the ICAO website “<http://www.icao.int/APAC/Pages/edocs.aspx>” for reference by States.

- 5.1.4.4.6 Most of the ATC automation systems that support terrestrial ADS-B will also support space-based ADS-B without modifications. For more guidance, reference can be made to WP/12 on "ATC Automation Requirement and Space-based ADS-B" delivered during 3rd meeting of the SURICG.

5.1.4.5 Additional Functional Requirements for ADS-B Integration

- 5.1.4.5.1 The following list of functions could be considered by each individual States to see whether they are suitable for their own operational needs or applicable to local environment from ADS-B integration point of view:

- The priority of ADS-B sensor position data vs radar data could be adaptable;
- For ADS-B aircraft, receipt of the Mode S conspicuity code could trigger use of the Flight ID / ICAO Aircraft Address for flight plan correlation;
- If, due to sensor or aircraft capability limitation, no SSR code is received for an aircraft, the system could use Flight ID/ ICAO Aircraft Address for track correlation;
- For correlation based on Flight ID, the received ID could exactly match the ACID of the flight plan;
- For correlation based on ICAO Aircraft Address, the received address could match the address entered in the flight plan item 18 CODE/ keyword;
- The system could generate an alert for a correlated flight for which the Flight ID from the track does not match the flight plan ACID and/or the ICAO Aircraft Address from the track does not match the code given in the flight plan Item 18 CODE/ keyword;
- The system could allow the setting of ADS-B above or below the radar sources within the Surveillance Data Processor Tile Set on a per-tile basis;
- Priority could only apply to data received at or above the adapted NUCp, NACp, NIC, and/or SIL thresholds;
- The system could be configurable to either discard ADS-B data or display the track with an indication of ADS-B degradation if the received NUCp, NACp, NIC, or SIL is below an adapted threshold;
- If the system is configured to display the degraded track, the degraded position and status could only be displayed if there are no other surveillance sources available;
- The system could allow the adaptation of ADS-B emergency codes to map to special Mnemonics;

- The system could include an adaptable Downlinked Aircraft Parameters (DAP) field that invokes a popup with the following information from Mode-S and ADS-B aircraft:
 - Magnetic Heading
 - True Track Angle
 - Indicated Airspeed/Mach Number
 - Groundspeed
 - Track Angle Rate
 - True Airspeed
 - Roll Angle
 - Selected Altitude
 - Vertical Rate
- The system could generate a conformance alert if the Selected Altitude and the Cleared Flight Level do not match.
- The system could monitor¹ the ICAO Aircraft Address of individual aircraft and generate alert for the following cases:
 - ICAO Aircraft Address does not match with that specified in flight plan ICAO Aircraft Address is all 0 or F (expressed in hexadecimal)
 - ICAO Aircraft Address is not defined in ICAO's allocation
 - Duplicate ICAO Aircraft Address detected within single sensor in the same time-frame
 - Duplicate ICAO Aircraft Address detected within multi-sensors in the same time-frame ICAO Aircraft Address changes during the flight
 - Aircrafts whose state identification number is not match with the state information registered in its flight plan
 - Aircrafts whose state identification number is not defined in SARPs (Annex 10)
 - Mode-S transponder of which P4 pulse was not detected
 - Mode-A/C transponder replied to Mode-S all call

5.1.5 Coverage Predictions

- 5.1.5.1 Reliable and robust analysis and planning of ADS-B coverage to support seamless ATM initiative requires accurate and reliable coverage modelling. States should ensure that surveillance engineering/technical teams are provided with modelling tools to provide accurate and reliable coverage predictions for ATM planning and analysis.

¹ Monitoring could be done by ATM system or other systems of the States/Administration

5.2 IMPLEMENTATION CHECKLIST

5.2.1 Introduction

The purpose of this implementation checklist is to document the range of activities that needs to be completed to bring an ADS-B application from an initial concept to operational use. This checklist may form the basis of the terms of reference for an ADS-B implementation team, although some activities may be specific to individual stakeholders. An example of the checklist used by AirServices Australia is given at Appendix 1.

5.2.2 Activity Sequence

The activities are listed in an approximate sequential order. However, each activity does not have to be completed prior to starting the next activity. In many cases, a parallel and iterative process should be used to feed data and experience from one activity to another. It should be noted that not all activities will be required for all applications.

5.2.3 Concept Phase

a) construct operational concept:

- 1) purpose;
- 2) operational environment;
- 3) ATM functions; and
- 4) infrastructure;

b) identify benefits:

- 1) safety enhancements;
- 2) efficiency;
- 3) capacity;
- 4) environmental;
- 5) cost reductions;
- 6) access; and
- 7) other metrics (e.g. predictability, flexibility, usefulness);

c) identify constraints:

- 1) pair-wise equipage;
- 2) compatibility with non-equipped aircraft;
- 3) need for exclusive airspace;
- 4) required ground infrastructure;
- 5) RF spectrum;
- 6) integration with existing technology; and
- 7) technology availability;

d) prepare business case:

- 1) cost benefit analysis; and
- 2) demand and justification.

5.2.4 Design Phase

a) identify operational requirements:

- 1) security; and
- 2) systems interoperability;

b) identify human factors issues:

- 1) human-machine interfaces;
- 2) training development and validation;
- 3) workload demands;
- 4) role of automation vs. role of human;
- 5) crew coordination/pilot decision-making interactions; and
- 6) ATM collaborative decision-making;

c) identify technical requirements:

- 1) standards development;
- 2) prevailing avionics standards;
- 3) data required;
- 4) functional processing;
- 5) functional performance; and
- 6) required certification levels;

d) equipment development, test, and evaluation:

- 1) prototype systems built to existing or draft standards/specifications;
- 2) developmental bench and flight tests; and
- 3) acceptance test parameters; and
- 4) select and procure technology;

e) develop procedures:

- 1) pilot and controller actions and responsibilities;
- 2) phraseologies;
- 3) separation/spacing criteria and requirements;
- 4) controller's responsibility to maintain a monitoring function, if appropriate;
- 5) contingency procedures;
- 6) emergency procedures; and
- 7) develop AIP and Information documentation

f) prepare design phase safety case:

- 1) safety rationale;
- 2) safety budget and allocation; and
- 3) functional hazard assessment.

5.2.5 Implementation phase

a) prepare implementation phase safety case;

b) conduct operational test and evaluation:

- 1) flight deck and ATC validation simulations; and
- 2) flight tests and operational trials;

c) obtain systems certification:

- 1) aircraft equipment; and
- 2) ground systems;

d) obtain regulatory approvals:

- 1) air traffic certification of use;

e) implementation transition:

- 1) Promulgate procedures and deliver training
- 2) continue data collection and analysis;
- 3) resolve any unforeseen issues; and
- 4) continue feedback into standards development processes;

f) performance monitoring to ensure that the agreed performance is maintained.

5.2.5.1 Once the implementation project is complete, ongoing maintenance and upgrading of both ADS-B operations and infrastructure should continue to be monitored, through the appropriate forums.

6. HARMONIZATION FRAMEWORK FOR ADS-B IMPLEMENTATION

6.1 BACKGROUND

- 6.1.1 It is obvious that full benefits of ADS-B will only be achieved by its harmonized implementation and seamless operations. During the 6th meeting of ADS-B SEA/WG in February 2011, Hong Kong, China initiated to strengthen collaboration among concerned States/Administrations for harmonized ADS-B implementation and seamless operations along two ATS routes L642 and M771 with major traffic flow (MTF). An ad-hoc workgroup comprising concerned CAAs/ANSPs from Hong Kong, China, Mainland China, Vietnam and Singapore was subsequently formed to elaborate and agree on a framework regarding implementation timelines, avionics standards, optimal flight levels, and ATC and engineering handling procedures. As a coherent effort, ADS-B implementation along ATS routes L642 and M771 has been harmonized while Hong Kong, China and Singapore have published respective Aeronautical Information Circulars and Airworthiness Notices on ADS-B mandates for these two routes with effect on 12 December 2013.
- 6.1.2 It is considered that the above implementation framework for ATS routes L642/M771 would serve as a useful template for extension to other high density routes to harmonize ADS-B implementation. Paragraph 6.2 shows the detailed framework.

6.2 TEMPLATE OF HARMONIZATION FRAMEWORK FOR ADS-B IMPLEMENTATION

Harmonization Framework for ADS-B Implementation along ATS Routes L642 and M771			
No.	What to harmonize	What was agreed	Issue / what needs to be further discussed
1	Mandate Effective	Singapore (SG), Hong Kong (HK), China (Sanya) : 12 Dec 2013 Vietnam (VN) : to be confirmed	
2	ATC Operating Procedures	No need to harmonize	Refer to SEACG for consideration of the impact of expanding ADS-B surveillance on ATC Operating Procedures including Large Scale Weather procedures.
3	Mandate Publish Date	No need to harmonize	To publish equipment requirements as early as possible.

4	Flight Level	SG, HK, CN : - At or Above FL290 (ADS-B airspace) - Below FL290 (Non-ADS-B airspace) VN to be confirmed	
5	Avionics Standard (CASA/AMC2024)	SG - CASA or AMC2024 or FAA AC No. 20-165 HK - CASA or AMC2024 or FAA AC No. 20-165 VN - CASA or AMC2024 or FAA AC No. 20-165 CN - CASA or AMC2024 or FAA AC No. 20-165	ADS-B Task Force agreed that DO260B will be accepted as well. SG, HK, and CN agreed their ADS-B GS will accept DO260, DO260A and DO260B by 1 July 2014 (Note 1)
6	Flight Planning	Before 15 Nov 2012, as per AIGD On or after 15 Nov 2012, as per new flight plan format	
7	Aircraft Equippage		
7a)	Procedures if Aircraft Not Equipped or Aircraft without a Serviceable ADS-B Transmitting Equipment before Flight	SG, HK, CN : FL280 and Below VN to be confirmed	

7b)	Aircraft Equipped but Transmitting Bad Data (Blacklisted Aircraft)	For known aircraft, treat as non ADS-B aircraft.	Share blacklisted aircraft among concerned States/Administration
8	Contingency Plan		
8a)	Systemic Failure such as Ground System / GPS Failure	Revert back to current procedure.	
8b)	Avionics Failure or Equipped Aircraft Transmitting Bad Data in Flight	Provide other form of separation, subject to bilateral agreement. From radar/ADS-B environment to ADS-B only environment, ATC coordination may be able to provide early notification of ADS-B failure.	Address the procedure for aircraft transiting from radar to ADS-B airspace and from ADS-B to ADS-B airspace.
9	Commonly Agreed Route Spacing	SEACG	Need for commonly agreed minimal in-trail spacing throughout.

Note 1: Also included two ADS-B GS supplied by Indonesia at Matak and Natuna

7. SYSTEM INTEGRITY AND MONITORING

7.1 INTRODUCTION

The Communications, Navigation, Surveillance and Air Traffic Management (CNS/ATM) environment is an integrated system including physical systems (hardware, software, and communication networks), human elements (pilots, controllers and engineers), and the operational procedures for its applications. ADS-B is a surveillance system that may be integrated with other surveillance technologies or may also operate as an independent source for surveillance monitoring within the CNS/ATM system.

Because of the integrated nature of such system and the degree of interaction among its components, comprehensive system monitoring is recommended. The procedures described in this section aim to ensure system integrity by validation, identification, reporting and tracking of possible problems revealed during system monitoring with appropriate follow-up actions.

These procedures do not replace the ATS incident reporting procedures and requirements, as specified in PANS-ATM (Doc 4444), Appendix 4; ICAO's Air Traffic Services Planning Manual (Doc 9426), Chapter 3; or applicable State regulations, affecting the reporting responsibilities of parties directly involved in a potential ATS incident.

7.2 PERSONNEL LICENSING AND TRAINING

Prior to operating any element of the ADS-B system, operational and technical personnel shall undertake appropriate training as determined by the States, including compliance with the Convention on International Civil Aviation where applicable.

Notwithstanding the above requirement and for the purposes of undertaking limited trials of the ADS-B system, special arrangements may be agreed between the operator and an Air Traffic Services Unit (ATSU).

7.3 SYSTEM PERFORMANCE CRITERIA FOR AN ATC SEPARATION SERVICE

A number of States have introduced ADS-B for the provision of Air Traffic Services, including for surveillance separation. The ICAO Separation and Airspace Safety Panel (SASP) has completed assessment on the suitability of ADS-B for various applications including provision of aircraft separation based on comparison of technical characteristics between ADS-B and monopulse secondary surveillance radar. It is concluded that that ADS-B surveillance is better or at least no worse than the referenced radar, and can be used to provide separation minima as described in PANS-ATM (Doc 4444) whether ADS-B is used as a sole means of ATC surveillance or used together with radar, subject to certain conditions to be met. The assessment result is detailed in the ICAO Circular 326 AN/188 "Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation".

Regarding the use of ADS-B in complex airspace (as discussed in ICAO Circular 326), complex airspace may be considered to be airspace with the following characteristics:

- Higher aircraft density
- Higher route crossing point density
- A higher mixture of different aircraft performance levels
- A higher rate of aircraft manoeuvring (as distinct from straight and level flight).

The following recommendations need to be considered:

1. Whether complex or not, States are urged to consider whether the current or required surveillance system performance is better, equivalent or worse than the SASP reference.
2. If the current or required surveillance system used by a State is lower or equivalent in performance than the reference MSSR used in Circular 326 Appendix A, then that State may use the Appendix C performance criteria.
3. If the current or required surveillance system used by a State is higher performance than the reference MSSR used in Circular 326 Appendix A, then the State must ensure that the ADS-B system achieves the more demanding performance.
4. State should undertake, in all cases, a safety assessment that ensures that any additional risks and safety requirements already identified for the airspace where ADSB or MLAT is to be implemented, or any newly identified risks, are effectively controlled and risk is reduced to an acceptable level.

States intending to introduce ADS-B separation minima shall comply with provisions of PANS-ATM, Regional Supplementary Procedures (Doc 7030) and Annex 11 paragraph 3.4.1. States should adopt the guidelines contained in this document unless conformance with PANS-ATM specifications requires change.

7.4 ATC SYSTEM VALIDATION

7.4.1 Safety Assessment Guidelines

To meet system integrity requirements, States should conduct a validation process that confirms the integrity of their equipment and procedures. Such processes shall include:

- a) A system safety assessment for new implementations is the basis for definitions of system performance requirements. Where existing systems are being modified to utilize additional services, the assessment demonstrates that the ATS Provider's system will meet safety objectives;
- b) Integration test results confirming interoperability for operational use of airborne and ground systems; and
- c) Confirmation that the ATS Operation Manuals are compatible with those of adjacent providers where the system is used across a common boundary.

7.4.2 System safety assessment

The objective of the system safety assessment is to ensure the State that introduction and operation of ADS-B is safe. This can be achieved through application of the provisions of Annex 11 paragraph 2.27 and PANS-ATM Chapter 2. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

- a) Identifying failure conditions;
- b) Assigning levels of criticality;
- c) Determining risks/ probabilities for occurrence;
- d) Identifying mitigating measures and fallback arrangements;

- e) Categorising the degree of acceptability of risks; and
- f) Operational hazard ID process.

Following the safety assessment, States 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.

Guidance material on building a safety case for delivery of an ADS-B separation service is provided on the ICAO APAC website “<http://www.icao.int/APAC/Pages/edocs.aspx>” for reference by States.

7.4.3 Integration test

States should conduct trials with suitably equipped aircraft to ensure they meet the operational and technical requirements to provide an ATS. Alternatively, they may be satisfied by test results and analysis conducted by another State or organization deemed competent to provide such service. Where this process is followed, the tests conducted by another State or organization should be comparable (i.e. using similar equipment under similar conditions). Refer also to the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc9689).

7.4.4 ATS Operation Manuals

States should coordinate with adjacent States to confirm that their ATS Operation Manuals contain standard operating procedures to ensure harmonization of procedures that impact across common boundaries.

7.4.5 ATS System Integrity

With automated ATM systems, data changes, software upgrades, and system failures can affect adjacent units. States shall ensure that:

- a) A conservative approach is taken to manage any changes to the system;
- b) Aircrew, aircraft operating companies and adjacent ATSU(s) are notified of any planned system changes in advance, where that system is used across a common boundary;
- c) ATSUs have verification procedures in place to ensure that following any system changes, displayed data is both correct and accurate;
- d) In cases of system failures or where upgrades (or downgrades) or other changes may impact surrounding ATS units, ATSUs should have a procedure in place for timely notification to adjacent units. Such notification procedures will normally be detailed in Letters of Agreement between adjacent units; and
- e) ADS-B surveillance data is provided with equal to or better level of protection and security than existing surveillance radar data.

7.5 SYSTEM MONITORING

During the initial period of implementation of ADS-B technology, routine collection of data is necessary in order to ensure that the system continues to meet or exceed its performance, safety and interoperability requirements, and that operational service delivery and procedures are working as intended. The monitoring program is a two-fold process. Firstly, summarised statistical data should be produced periodically showing the performance of the system. This is accomplished through ADS-B Periodic Status Reports. Secondly, as problems or abnormalities arise, they should be identified, tracked, analyzed and corrected and information disseminated as required, utilizing the ADS-B Problem Report.

Guidance materials on monitoring and analysis of ADS-B Avionics Performance are given at Appendix 2. Checklist of common items or parameters that could be considered for monitoring is summarized at Appendix 5 for reference.

7.5.1 Problem Reporting System (PRS)

The Problem Reporting System is tasked with the collection, storage and regular dissemination of data based on reports received from SURICG members. The PRS tracks problem reports and publish information from those reports to SURICG members. Problem resolution is the responsibility of the appropriate SURICG members.

The PRS Administrator shall:

- a) prepare consolidated problem report summaries for each SURICG meeting;
- b) collect and consolidate ADS-B Problem Reports; and
- c) maintain a functional website (with controlled access) to manage the problem reporting function.

The PRS is managed through the Asia Pacific ADS-B Avionics Problem Reporting Database (APRD) which is accessible to authorized users via <https://applications.icao.int/ADSB-APRD/login.aspx>.

7.5.2 The monitoring process

When problems or abnormalities are discovered, the initial analysis should be performed by the organization(s) identifying the problem. In addition, a copy of the problem report should be entered in to the PRS which will assign a tracking number. 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 forward the information to the PRS. It is essential that all information relating to the problem is documented and recorded and resolved in a timely manner.

The following groups should be involved in the monitoring process and problem tracking to ensure a comprehensive review and analysis of the collected data:

- a) ATS Providers;
- b) Organizations responsible for ATS system maintenance (where different from the ATS provider);

- c) Relevant State regulatory authorities;
- d) Communication Service Providers being used;
- e) Aircraft operators; and
- f) Aircraft and avionics manufacturers.

7.5.3 Distribution of confidential information

It is important that information that may have an operational impact on other parties be distributed by the authorised investigator to all authorised groups that are likely to be affected, 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. The default position is that all states agree to provide the data which will be de-identified for reporting and record keeping purposes.

7.5.4 ADS-B problem reports

Problem reports may originate from many sources, but most will fall within two categories; reports based on observation of one or more specific events, or reports generated from the routine analysis of data. The user would document the problem, resolve it with the appropriate party and forward a copy of the report to the PRS for tracking and distribution. While one occurrence may appear to be an isolated case, the receipt of numerous similar reports by the PRS could indicate that an area needs more detailed analysis.

To effectively resolve problems and track progress, the problem reports should be sent to the nominated point of contact at the appropriate organization and the PRS. The resolution of the identified problems may require:

- a) Re-training of system operators, or revision of training procedures to ensure compliance with existing procedures;
- b) Change to operating procedures;
- c) Change to system requirements, including performance and interoperability; or
- d) Change to system design.

7.5.5 ADS-B periodic status report

The ATS Providers should complete the ADS-B Periodic Status Report annually and deliver the report to the regional meeting of the SURICG. The Periodic Status Report should give an indication of system performance and identify any trend in system deficiencies, the resultant operational implications, and the proposed resolution, if applicable.

Communications Service Providers, if used, are also expected to submit Periodic Status Reports on the performance of the networks carrying ADS-B data at the annual regional meeting of the SURICG. These reports could also contain the details of planned or current upgrades to the network.

7.5.6 Processing of Reports

Each group in the monitoring process should nominate a single point of contact for receipt of problem reports and coordination with the other parties. This list will be distributed by the PRS Administrator to all parties to the monitoring process.

Each State should establish mechanisms within its ATS Provider and regulatory authority to:

- a) Assess problem reports and refer them to the appropriate technical or operational expertise for investigation and resolution;
- b) Coordinate with aircraft operators;
- c) Develop interim operational procedures to mitigate the effects of problems until such time as the problem is resolved;
- d) Monitor the progress of problem resolution;
- e) Prepare a report on problems encountered and their operational implications and forward these to the PRS;
- f) Prepare the ADS-B periodic status report at pre-determined times and forward these to the Secretary of the annual meeting of the SURICG; and
- g) Coordinate with any Communication Service Providers used.

7.6 APANPIRG

APANPIRG, with the assistance of its contributory bodies, shall oversee the monitoring process to ensure the ADS-B system continues to meet its performance and safety requirements, and that operational procedures are working as intended. The APANPIRG'S objectives are to:

- a) review Periodic Status Reports and any significant Problem Reports;
- b) highlight successful problem resolutions to SURICG members;
- c) monitor the progress of outstanding problem resolutions;
- d) prepare summaries of problems encountered and their operational implications; and
- e) assess system performance based on information in the PRS and Periodic Status Reports.

7.7 LOCAL DATA RECORDING AND ANALYSIS

7.7.1 Data recording

It is recommended that ATS Providers and Communication Service Providers retain the records defined below for at least 30 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.

7.7.2 Local data collection

ATS providers and communications service providers should identify and record ADS-B system component failures that have the potential to negatively impact the safety of controlled flights or compromise service continuity.

7.7.3 Avionics problem identification and correction

ATS providers need to develop systems to:

- a) detect ADS-B avionics anomalies and faults
- b) advise the regulators and where appropriate the aircraft operators on the detected ADS-B avionics anomalies and faults
- c) devise mechanisms and procedures to address identified faults

Regulators need to develop and maintain systems to ensure that appropriate corrective actions are taken to address identified faults.

7.8 ADS-B PROBLEM REPORT

7.8.1 Report Form			PRS #
Start Time/Date UTC		End Time/Date UTC	
Registration		Aircraft ID	
Flight ID		ICAO Aircraft Address	
Aircraft Type			
Flight Sector/ Location			
ATS Unit			
Description / additional information			
Originator		Originator Reference number	
Organization			

7.8.2 Description of Fields

Field	Meaning
Number	A unique identification number assigned by the PRS Administrator to this problem report. Organizations writing problem reports are encouraged to maintain their own internal list of these problems for tracking purposes. Once the problems have been reported to the PRS and incorporated in the database, a number will be assigned by the PRS and used for tracking by the SURICG.
Start Time/Date UTC	UTC time/date when the event occurred.
End Time/Date UTC	UTC time/date when the event ended.
Registration	Registration number (tail number) of the aircraft involved.
Aircraft ID (ACID)	Coded equivalent of voice call sign as entered in FPL Item 7.
ICAO Aircraft Address	Unique ICAO Aircraft Address expressed in Hexadecimal form (e.g. 7432DB)
Flight ID (FLTID)	The identification transmitted by ADS-B for display on a controller situation display or a CDTI.
Flight Sector/Location	The departure airport and destination airport for the sector being flown by the aircraft involved in the event. These should be the ICAO identifiers of those airports. Or if more descriptive, the location of the aircraft during the event.
Originator	Point of contact at the originating organization for this report (usually the author).
Aircraft Type	The aircraft model involved.
Organization	The name of the organization (airline, ATS provider or communications service provider) that created the report.
ATS Unit	ICAO identifier of the ATC Center or Tower controlling the aircraft at the time of the event.
Description	This should provide as complete a description of the situation leading up to the problem as is possible. Where the organization reporting the problem is not able to provide all the information (e.g. the controller may not know everything that happens on the aircraft), it would be helpful if they would coordinate with the other parties to obtain the necessary information. The description should include: • A complete description of the problem that is being reported • The route contained in the FMS and flight plan • Any flight deck indications • Any indications provided to the controller when the problem occurred • Any additional information that the originator of the problem report considers might be helpful but is not included on the list above If necessary to contain all the information, additional pages may be added. If the originator considers it might be helpful, diagrams and other additional information (such as printouts of message logs) may be appended to the report.

7.9 ADS-B PERFORMANCE REPORT FORM

Originating Organization

Date of submission

Originator

Report Period

TECHNICAL ISSUES

OPERATIONAL ISSUES

GENERAL COMMENTS

8. RELIABILITY & AVAILABILITY CONSIDERATIONS

Reliability and Availability of ADS-B systems should normally be equivalent or better than the reliability and availability of radar systems.

Guidance material on Reliability and Availability standards for ADS-B systems and supporting voice communications systems are included in the document “Baseline ADS-B Service Performance Parameters” at **Appendix 6**.

The “Baseline ADS-B Performance Parameters” document contains three Tiers of service performance parameters with different reliability and availability standards for each Tier. The appropriate Tier should be selected for the type of ADS-B service intended:

- (a) Tier 1 standards are for a high performance traffic separation service;
- (b) Tier 2 standards are for a traffic situational awareness service with procedural separation; and
- (c) Tier 3 standards are for a traffic advisory service (flight information service)

To achieve high operational availability of ADS-B systems to support aircraft separation services, it is necessary to operate with duplicated/redundant systems. If one system fails, the service continues using an unduplicated system. This is acceptable for a short period, whilst the faulty system is being repaired, because the probability of a second failure during the short time window of repairing is low.

However, it is necessary to ensure that the repair does not take too long. A long repair time increases the risk of an unexpected failure (loss of service continuity); which in turn, introduces potential loss of service (low availability) and loss of aircraft operational efficiency and/or safety impacts.

Checklist of common items or parameters that could be considered for monitoring is summarized at Appendix 5 for reference.

8.1 Reliability

8.1.1 Reliability is a measure of how often a system fails and is usually measured as Mean Time Between Failure (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 ADS-B data to the ATC centre. I.e: Failure of the ADS-B system rather than an equipment or component failure.

8.1.2 Poor system MTBF has a safety impact because typically it causes unexpected transition from one operating mode to another. For example, aircraft within surveillance coverage that are safely separated by a surveillance standard distance (say, 5 NM) are unexpectedly no longer separated by a procedural standard distance (say 15 mins), due to an unplanned surveillance outage.

8.1.3 In general, reliability is determined by design (see para 8.3 B below)

8.2 Availability

8.2.1 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.

8.2.2 Poor availability usually results in loss of economic benefit because efficiencies are not available when the ATC system is operating in a degraded mode (eg using procedural control instead of say 5 NM separation).

8.2.3 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.

8.2.4 Availability is calculated as

$$\text{Availability (Ao)} = \text{MTBF} / (\text{MTBF} + \text{MDT})$$

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 organisations use Mean Time Between Outage (MTBO) rather than MTBF.

8.2.5 Availability is directly a function of how quickly the SYSTEM can be repaired. Ie: 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.

8.3 Recommendations for high reliability/availability ADS-B systems

A: **System design** can keep system failure rate low with long MTBF. Typical techniques are:

- to duplicate each element and minimise single points of failure. Automatic changeover or parallel operation of both channels keeps system failure rates low. Ie: the system keeps operating despite individual failures. Examples are :
 - Separate communication channels between ADS-B ground station and ATC centre preferably using different technologies or service providers eg one terrestrial and one satellite
- Consideration of Human factors in design can reduce the number of system failures due to human error. E.g. inadvertent switch off, incorrect software load, incorrect maintenance operation.
- Take great care with earthing, cable runs and lightning protection to minimise the risks of system damage
- Take great care to protect against water ingress to cables and systems
- Establish a system baseline that documents the achieved performance of the site that can be later be used as a reference. This can shorten troubleshooting in future.
- System design can also improve the MDT by quickly identifying problems and alerting maintenance staff. Eg Built in equipment test (BITE) can significantly contribute to lowering MDT.

B: Logistics strategy aims to keep MDT very low. Low MDT depends on logistic support providing short repair times. To achieve short repair times, ANSPs usually provide a range of logistics, including the following, to ensure that the outage is less than a few days:

- ensure the procured system is designed to allow for quick replacement of faulty modules to restore operations
- provide remote monitoring to allow maintainers to identify the faulty modules for transport to site
- provide support tools to allow technicians to repair faulty modules or to configure/setup replacement modules
- provide technicians training to identify & repair the faulty modules
- provide local maintenance depots to reduce the time it takes to access to the site
- provide documentation and procedures to “standardise” the process
- use an in-country spares pool to ensure that replacement modules are available within reasonable times
- use a maintenance contract to repair faulty modules within a specified turnaround time. I.e.: to replenish the spares pool quickly.

Whilst technical training and remote monitoring are usually considered by ANSPs, sometimes there is less focus on spares support.

Difficulties can be experienced if States :

- a) Fail to establish a spares pool – because procurement of spares at the time of failure can bring extensive delays due to :
- b) obtaining funds
- c) obtaining approval to purchase overseas
- d) obtaining approval to purchase from a “sole source”
- e) difficulties and delays in obtaining a quotation
- f) delays in delivery because the purchase was unexpected by the supplier
- g) Fail to establish a module repair contract resulting in :
 - long repair times
 - unplanned expenditure
 - inability for a supplier to repair modules because the supplier did not have adequate certainty of funding of the work

Spares pool

ANSPs can establish, preferably as part of their acquisition purchase, adequate spares buffer stock to support the required repair times. The prime objective is to reduce the time period that the system operates un-duplicated. It allows decoupling of the restoration time from the module repair time.

Module repair contract

ANSPs can also enter into a maintenance repair contract, preferably as part of their acquisition purchase, to require the supplier to repair or replace and deliver failed modules within a specified time – preferably with contractual incentives/penalties for compliance. Such support contracts are best negotiated as part of the acquisition contract when competition between vendors is at play to keep costs down. Sometimes it is appropriate to demand that the support contractor also keep a certain level of buffer stock of spares “in country”.

It is strongly recommended that maintenance support is purchased under the same contract as the acquisition contract.

The advantages of a module repair contract are:

- The price can be determined whilst in the competitive phase of acquisition – hence avoids excessive costs
- The contract can include the supplier bearing all shipping costs
- Can be funded by a define amount per year, which support the budget processes. If the costs are fixed, the supplier is encouraged to develop a reliable system minimising module repairs.
- It avoids delays and funding issues at the time of the module failure

Other typical strategies are:

- Establish availability and reliability objectives that are agreed organization wide. In particular agree System response times (SRT) for faults and system failure to ensure that MDT is achieved. An agreed SRT can help organizations to decide on the required logistics strategy including number, location and skills of staff to support the system.
- Establish baseline preventative maintenance regimes including procedures and performance inspections in conjunction with manufacturer recommendations for all subsystems
- Use remote control & monitoring systems to identify faulty modules before travel to site. This can avoid multiple trips to site and reduce the repair time
- Have handbooks, procedures, tools available at the site or a nearby depot so that travel time does not adversely affect down time
- Have adequate spares and test equipment ready at a maintenance depot near the site or at the site itself. Vendors can be required to perform analysis of the number of spares required to achieve low probability of spare “stock out”
- Have appropriate plans to cope with system and component obsolescence. It is possible to contractually require suppliers to regularly report on the ability to support the system and supply components.
- Have ongoing training programs and competency testing to ensure that staff are able to perform the required role

The detailed set of operational and technical arrangements in place and actions required to maintain a system through the lifecycle are often documented in a Integrated Logistics Support Plan.

C: Configuration Management aims to ensure that the configuration of the ground stations is maintained with integrity. Erroneous configuration can cause unnecessary outages. Normally configuration management is achieved by :

- Having clear organizational & individual responsibilities and accountabilities for system configuration.
- Having clear procedures in place which define who has authority to change configuration and records of the changes made including, inter alia
 - The nature of the change including the reason

- Impact of the change & safety assessment
- An appropriate transition or cutover plan
- Who approved the change
- When the change was authorized and when the change was implemented
- Having appropriate test and analysis capabilities to confirm that new configurations are acceptable before operational deployment.
- Having appropriate methods to deploy the approved configuration (Logistics of configuration distribution). Suggested methods;
 - Approved configuration published on intranet web pages
 - Approved configuration distributed on approved media

D: Training & Competency plans aim to ensure that staff has the skills to safety repairs Normally this is achieved by:

- Conduct of appropriate Training Needs Analysis (TNA) to identify the gap between trainee skill/knowledge and the required skill/knowledge.
- Development and delivery of appropriate training to maintainers
- Competency based testing of trainees
- Ongoing refresher training to ensure that skills are maintained even when fault rates are low

E: Data collection & Review :

Regular and scheduled review should be undertaken to determine whether reliability/availability objectives are being met. These reviews need to consider :

- Reports of actual achieved availability & reliability
- Data regarding system failures including “down time” needs to be captured and analysed so the ANSP actually knows what is being (or not being) achieved.
- Any failure trends that need to be assessed. This requires data capture of the root cause of failures
- Any environmental impacts on system performance, such coverage obstructions such as trees, planned building developments, corrosion, RFI etc. Changes in infrastructure may also be relevant including air conditioning (temperature/humidity etc.) and power system changes.
- System problem reports especially those that relate to software deficiencies (design)
- System and component obsolescence
- Staff skills and need for refresher training

9. ADS-B REGULATIONS AND PROCEDURES

9.1 INTRODUCTION

ADS-B involves the transmission of specific data messages from aircraft and vehicle systems. These data messages are broadcast at approximately 0.5 second intervals and received at compatible ground stations that relay these messages to ATSU(s) for presentation on ATS situation displays. The following procedures relate to the use of ADS-B data in ATS ground surveillance applications.

The implementation of the ADS-B system will support the provision of high performance surveillance, enhancing flight safety, facilitating the reduction of separation minima and supporting user demands such as user-preferred trajectories.

9.2 ADS-B REGULATIONS

As agreed at APANPRIG 22/8, States intending to implement ADS-B based surveillance services may designate portions of airspace within their area of responsibility by:

- (a) mandating the carriage and use of ADS-B equipment; or
- (b) providing priority for access to such airspace for aircraft with operative ADS-B equipment over those aircraft not operating ADS-B equipment.

In publishing ADS-B mandate/regulations, States should consider to :

- define the ADS-B standards applicable to the State. For interoperability and harmonization, such regulations need to define both the standards applicable for the aircraft ADS-B position source and the ADS-B transmitter.
- define the airspace affected by the regulations and the category of aircraft that the regulation applies to.
- define the timing of the regulations allowing sufficient time for operators to equip. Experience in Asia Pacific Regions is that major international carriers are having high equipage rates of ADS-B avionics. However the equipage rates of ADS-B avionics for some regional fleets, business jets and general aviation are currently low and more time will be required to achieve high equipage rates.
- establish the technical and operational standards for the ground stations and air traffic management procedures used for ADS-B separation services, including the associated voice communications services.

States may refer to Appendix 3 on the template for ADS-B mandate/regulations for aircraft avionics. Some States listed below have published their ADS-B mandate/regulations on their web sites that could also be used for reference.

(a) Civil Aviation Safety Authority (CASA) of Australia

Civil Aviation Order 20.18 Compilation No. 4) 2014, Civil Aviation Order 82.1 (Compilation No. 13) , Civil Aviation Order 82.3 (No. 18), Civil Aviation Order 82.5 (No. 19)
<https://www.legislation.gov.au/Details/F2017C01115/Download>”

(b) Civil Aviation Department (CAD) of Hong Kong, China

Aeronautical Information Publication Supplement No. A01/16 dated 1 February 2016
“https://www.ais.gov.hk/HK_AIP/supp/A01-16.pdf”

(c) Civil Aviation Authority of Singapore (CAAS)

Aeronautical Information Publication (eAIP) Part 2 ENR 1.8 – Regional Supplementary Procedures – Section 7 – Automatic Dependent Surveillance Broadcast (ADS-B) Out exclusive airspace within parts of the Singapore FIR

“<https://fpl-1.caasaim.gov.sg/aip/2018-03-14/final/2018-03-14/html/index-en-GB.html>”

(d) Federal Aviation Administration (FAA)

ADS-B Out Performance Requirements To Support Air Traffic Control (ATC) Service, Final Rule

<http://www.gpo.gov/fdsys/pkg/FR-2010-05-28/pdf/2010-12645.pdf>

States are encouraged to mandate forward fit for newly manufactured aircraft on and after 1 January 2020, having a maximum certified takeoff weight of 5700kg or greater, or having a maximum cruising true airspeed capability of greater than 250 knots, with ADS-B avionics compliant to Version 2 ES (equivalent to RTCA DO-260B) or later version².

9.3 FACTORS TO BE CONSIDERED WHEN USING ADS-B

9.3.1 Use of ADS-B Level data

The accuracy and integrity of pressure altitude derived level information provided by ADS-B are equivalent to Mode C level data provided through an SSR sensor and subject to the same operational procedures as those used in an SSR environment. Where the ATM system converts ADS-B level data to display barometric equivalent level data, the displayed data should not be used to determine vertical separation until the data is verified by comparison with a pilot reported barometric level.

9.3.2 Position Reporting Performance

The ADS-B data from the aircraft will include a NUCp/NIC/SIL/NACp categorization of the integrity and accuracy of the horizontal position data. This figure is determined from NIC/ NACp/ SIL values for DO260A/B compliant avionics and NUC values for DO260/ED102 compliant avionics.

In general, for 5NM separation, if the HPL value used to generate ADS-B quality indicators (NUC or NIC) is greater than 2 nautical miles the data is unlikely to be of comparable quality to that provided by a single monopulse SSR. ADS-B data should not be used for separation unless a suitable means of determining data integrity is used.

The key minimum performance requirements for an ADS-B system to enable the use of a 3 NM or 5 NM separation minimum in the provision of air traffic control is provided in the ICAO Circular 326 (especially Appendix C).

ADS-B reports with low integrity may be presented on situation displays, provided the controller is alerted (e.g. by a change in symbology and/or visual alert) to the change and the implications for the provision of separation. An ANS Provider may elect not to display ADS-B tracks that fail to meet a given position reporting performance criterion.

9.3.3 GNSS Integrity Prediction Service

² Subject to endorsement by CNS/SG/22 in July 2018

ADS-B uses GNSS for position determination. As such, availability of GNSS data has a direct influence on the provision of a surveillance service.

ATS Providers may elect to use a GNSS integrity prediction service to assist in determining the future availability of useable ADS-B data. The integrity prediction service alerts users to potential future loss or degradation of the ADS-B service in defined areas. When these alerts are displayed, the system is indicating to its users that at some time in the future the ADS-B positional data may be inadequate to support the application of ADS-B separation. It is recommended that the prediction service is made available to each ATSU that is employing ADS-B to provide a separation service, to ensure that air traffic controllers are alerted in advance of any predicted degradation of the GNSS service and the associated reduction in their ability to provide ADS-B separation to flights that are within the affected area. This is similar to having advance warning of a planned radar outage for maintenance.

ADS-B should not be used to provide separation between aircraft that will be affected by an expected period of inadequate position reporting integrity.

If an unpredicted loss of integrity occurs (including a RAIM warning report from aircrew) then;

- (a) ADS-B separation should not be applied by ATC to the particular aircraft reporting until the integrity has been assured; and
- (b) The controller should check with other aircraft in the vicinity of the aircraft reporting the RAIM warning, to determine if they have also been affected and establish alternative forms of separation if necessary.

9.3.4 Sharing of ADS-B Data

ADS-B Data-sharing for ATC Operations

Member States should consider the benefits of sharing ADS-B data received from aircraft operating in the proximity of their international airspace boundaries with adjacent States that have compatible technology in an effort to maximize the service benefits and promote operational safety.

Data sharing may involve the use of the data to provide separation services if all the requirements for delivery of separation services are satisfied. In some cases, States may choose to use a lower standard that supports surveillance safety nets and situational awareness whilst operations are conducted using procedural separation standards.

Any agreement on the sharing of surveillance data should be incorporated in Letters of Agreement between the States concerned. Such agreements may also include the sharing of VHF communication facilities.

A template for ADS-B data-sharing agreement is provided on the ICAO APAC website “<http://www.icao.int/APAC/Pages/edocs.aspx>” for reference by States.

ADS-B Data-sharing for Safety Monitoring

With endorsement of the methodology by both the ICAO Separation and Airspace Safety Panel (SASP) and the Regional Airspace Safety Monitoring Advisory Group (RASMAG), ADS-B data can be used for calculating the altimetry system error (ASE) which is a measure of the height-keeping performance of an aircraft. It is an ICAO requirement that aircraft operating in RVSM airspace must undergo periodic monitoring on height-keeping performance. The existing

methods to estimate aircraft ASE include use of a portable device, the Enhanced GPS Monitoring Unit, and ground-based systems called Height Monitoring Unit/Aircraft Geometric Height Measurement Element. The use of ADS-B data for height-keeping performance monitoring, on top of providing enhanced and alternative means of surveillance, will provide a cost-effective option for aircraft operators. States are encouraged to share ADS-B data to support the height-keeping performance monitoring of airframe.

Civil/Military ADS-B Data-sharing

Civil/military data sharing arrangements, including aircraft surveillance, were a key part of civil/military cooperation in terms of tactical operational responses and increasing trust between civil and military units.

Aircraft operating ADS-B technology transmit their position, altitude and identity to all listeners, conveying information from co-operative aircraft that have chosen to equip and publicly broadcast ADS-B messages. Thus there should be no defence or national security issues with the use and sharing of such data.

Some military transponders may support ADS-B using encrypted DF19 messages, but these data are normally not decoded or used at all by civil systems. In most cases today, tactical military aircraft are not ADS-B equipped or could choose to disable transmissions. In future, increasing numbers of military aircraft will be ADS-B capable, with the ability to disable these transmissions. ADS-B data sharing should not influence the decision by military authorities to equip or not equip with ADS-B. Moreover, it is possible for States to install ADS-B filters that prevent data from sensitive flights being shared. These filters can be based on a number of criteria and typically use geographical parameters to only provide ADS-B data to an external party if aircraft are near the boundary.

A guidance material on advice to military authorities regarding ADS-B data sharing is provided on the ICAO APAC website “<http://www.icao.int/APAC/Pages/edocs.aspx>” for reference by States.

9.3.5 Synergy of ADS-B and GNSS

States intending to implement GNSS/PBN or ADS-B should consider the efficiency of implementing the other technology at the same time due to the inherent efficiencies in doing so. GNSS systems provide navigation solutions to IFR aircraft for the conduct of enroute, terminal and non-precision approaches. The use of GNSS/PBN can provide higher performance and higher safety. Transition to GNSS can avoid significant ground infrastructure costs.

ADS-B systems provide surveillance based upon GNSS position source. ADS-B provides high performance and high update surveillance for both air-air and ATC surveillance. Transition to ADS-B can avoid the costs associated with ground based radar infrastructure. ADS-B system installations rely on acceptable GNSS equipment being installed in the aircraft to provide the position source and integrity.

If the fleet is equipped with ADS-B, they will already have most of the requirements to use GNSS for navigation satisfied. Similarly, if aircraft have suitable GNSS on board, they will have a position source to support ADS-B. It is noted however, that some care is needed to ensure that the requirements of GNSS/PBN and surveillance are both satisfied.

There is significantly less cost for these systems to be installed in an aircraft at the same time. A single installation of GNSS & ADS-B will involve :

- a single design activity instead of two

- a single downtime instead of two
- installation of the connection between GPS and ADS-B transponder
- a single test, certification and aircraft flight test

For the affected aviation community (ANSP, regulator and operator), the lessons learnt and issues faced in both GNSS and ADS-B have significant commonality. This can lead to efficiencies in Industry education and training.

9.3.6 Use of ADS-B for Airport Surface Movement

Both DO321/ED-163 and the EUROCONTROL guidance for the provision of ATS using ADS-B for Airport Surface Movement state the horizontal position accuracy needs to be ≤ 10 meters at 95%, which translates into a positional accuracy of $\text{NACp} = 10$.

However, most of the currently deployed GNSS horizontal position sources provide values leading to either a $\text{NACp} = 9$ (30 meters) or a $\text{NACp} = 8$ (92 meters), whilst the actual position accuracy could reach 2 to 3 meters. Provided that the position source is GNSS-based, States can consider to use the following ADS-B quality indicators to determine the horizontal positional accuracy:

- DO260
 - $\text{NUCp} > 6$
- DO260A
 - $\text{NACp} \geq 8$
 - $\text{NIC} > 0$
 - $\text{SIL} = 2$
- DO260B
 - $\text{NACp} \geq 8$
 - $\text{NIC} > 0$
 - $\text{SIL} = 3$

Guidance documents recommend implementing some form of horizontal positional accuracy monitoring for using ADS-B positional data with accuracy down to $\text{NUCp} > 6$ or $\text{NACp} \geq 8$ for airport surface movement. Visual monitoring by controllers of vehicles on taxiways and runways can be considered as an initial monitoring of the horizontal positional accuracy within the airport. In addition, States can consider to evaluate the performance of ADS-B tracks against reference tracks from proven surveillance systems, e.g. tracks from MLAT systems with certified accuracy, to show that ADS-B data is suitable for ground surveillance and falls within the requirements of international standards.

For ADS-B only tracks with quality indicators below the required accuracy, States are encouraged to keep the display of the tracks in the surveillance display with due discrimination on the track symbols in order to enhance the situation awareness of controllers.

9.3.7 1090 Mhz Spectrum and 24-bit Aircraft Address Issue with Unmanned Aircraft Systems (UAS)

Proper and efficient utilization of available bandwidth and capacity at 1 090 MHz is a key element to ensure the safe and reliable operation of aeronautical surveillance systems, including secondary surveillance radar (SSR), automatic dependent surveillance broadcast (ADS-B) and airborne collision avoidance systems (ACAS). Studies conducted by ICAO expert groups have identified certain issues and potential technical concerns to the operation of these surveillance systems in the presence of large numbers of unmanned aircraft (UA), if those UA are equipped with an ADS-B OUT transmitter on 1 090 MHz and operating at very low levels.

Recognizing issues associated with those UA which may adversely affect safety for all aircraft in the area, ICAO has developed guidance material (see Appendix 8) to assist States in validating the utilization of 1 090 MHz and for withholding 24-bit aircraft addresses to UA unless certain criteria have been met. States are encouraged to make use of the guidance material as well as any other related provisions to ensure that the surveillance capabilities being provided by the aforementioned surveillance systems.

9.4 Reporting Rates

9.4.1 General

The ADS-B system shall maintain a reporting rate that ensures at least an equivalent degree of accuracy, integrity and availability as specified by the performance requirements of a radar system that is used to provide a similar ATC service. The standard reporting rate is approximately 0.5 second from the aircraft, but the rate of update provided to the ATM system (for the situation display) may be less frequent (e.g. 5 seconds), provided performance requirements for the service are achieved. Reporting rate requirements are included in the document “Baseline ADS-B Service Performance Parameters” which is available at Appendix 6.

9.5 SEPARATION

9.5.1 General

ADS-B data may be used in combination with data obtained by other means of surveillance (such as radar, flight plan track, ADS-C) for the application of separation provided appropriate minima as determined by the State are applied. It should be noted that the quality of communications will have a bearing on the determination of appropriate minima.

All safety net features (MSAW, STCA, MTCA, RAM and DAIW/ RAI etc) should possess the same responsiveness as equivalent radar safety net features.

9.5.2 Identification Methods

Some of the methods approved by ICAO for establishing identification with radar, may be employed with ADS-B (see PANS-ATM chapter 8). One or more of the following identification procedures are suggested:

- a) direct recognition of the aircraft identification in an ADS-B label on a situation display;
- b) transfer of ADS-B identification;
- c) observation of compliance with an instruction to TRANSMIT ADS-B IDENT.

Note: In automated systems, the “IDENT” feature may be presented in different ways, e.g. as a flashing of all or part of the position indication and associated label.

9.5.3 ADS-B Separation

ADS-B Separation minima has been incorporated by ICAO in PANS-ATM (Doc 4444), and in Regional Supplementary Procedures (Doc 7030).

In a mixed surveillance environment, States should use the larger separation standard applicable between aircraft in the conflict pair being considered.

9.5.4 Vertical separation

9.5.4.1 Introduction

The ADS-B level data presented on the controllers situation display shall normally be derived from barometric pressure altitude. In the event that barometric altitude is

absent, geometric altitude shall not be displayed on displays used for provision of air traffic services. Geometric altitude may be used in ATM systems for other purposes.

9.5.4.2 Vertical tolerance standard

The vertical tolerances for ADS-B level information should be consistent with those applied to Mode C level information.

9.5.4.3 Verification of ADS-B level information

The verification procedures for ADS-B level information shall be the same as those employed for the verification of Mode C level data in a radar environment.

9.6 AIR TRAFFIC CONTROL CLEARANCE MONITORING

9.6.1 General

ADS-B track data can be used to monitor flight path conformance with air traffic control clearances.

9.6.2 Deviations from ATC clearances

The ATC requirements relating to monitoring of ADS-B traffic on the situation display should be similar to those contained in PANS-ATM Ch.8.

9.7 ALERTING SERVICE

For ADS-B equipped aircraft, the provision of an alerting service should be based on the same criteria as applied within a radar environment.

9.8 POSITION REPORTING

9.8.1 Pilot position reporting requirements in ADS-B coverage

States should establish voice and/or CPDLC position reporting procedures consistent with those applicable with radar for aircraft that have been identified by ATC.

9.8.2 Meteorological reporting requirements in ADS-B airspace

ATSUs may promulgate in the AIP meteorological reporting requirements that apply within the nominated FIR. The meteorological reporting data required and the transmission methods to be used by aircrew shall be specified in AIP.

9.9 PHRASEOLOGY

9.9.1 Phraseology Standard

States should use common phraseology for both ADS-B and radar where possible, and should note the requirement for ADS-B specific phraseology in some instances. States shall refer to PANS ATM Chapter 12 for ADS-B phraseology:

ADS-B EQUIPMENT DEGRADATION

ADS-B OUT OF SERVICE (appropriate information as necessary).

TO REQUEST THE CAPABILITY OF THE ADS-B EQUIPMENT

a) ADVISE ADS-B CAPABILITY;

*b) ADS-B TRANSMITTER (data link);

*c) ADS-B RECEIVER (data link);

*d) NEGATIVE ADS-B.

* Denotes pilot transmission.

Note: For (b) and (c) – the options are not available for aircraft that are not equipped.

TO REQUEST RESELECTION OF AIRCRAFT IDENTIFICATION
REENTER FLIGHT IDENTIFICATION.

Note: For some aircraft, this option is not available in-flight

TERMINATION OF RADAR AND/OR ADS-B SERVICE
IDENTIFICATION LOST [reasons] (instructions).

TO REQUEST THE OPERATION OF THE MODE S OR ADS-B IDENT FEATURE
SQUAWK IDENT.

Note: For some standalone ADS-B equipage affecting General Aviation, the option of
“TRANSMIT ADS-B IDENT” may be available

TO REQUEST AIRCRAFT SWITCHING TO OTHER TRANSPONDER OR TERMINATION
OF ADS-B TRANSMITTER OPERATION

- a) SWITCH TO OTHER TRANSPONDER
- b) STOP ADS-B TRANSMISSION. SQUAWK (code) ONLY.

Note:

a) In many cases the ADS-B transmitter cannot be operated independently of the SSR transponder and switching off the ADS-B transmission would also switch off the SSR transponder operation

b) “STOP ADS-B TRANSMISSION” applies only to aircraft that have the facility to switch off the ADS-B transmission, while maintaining SSR operation.

9.9.2 Operations of Mode S Transponder and ADS-B

It should be noted that independent operations of Mode S transponder and ADS-B will not be possible in many aircraft (e.g. where ADS-B is solely provided by 1090 MHz extended squitter emitted from the transponder). Additionally, some desirable but optional features of ADS-B transmitters may not be fitted in some aircraft. Controller training on this issue, as it relates to the following examples of radio telephony and/or CPDLC phraseology is recommended.

9.9.2.1 STOP ADSB TRANSMISSION or STOP SQUAWK

Issue: In most commercial aircraft, a common “transponder control head” is used for SSR transponder, ACAS and ADS-B functionality. In this case, a pilot who complies with the instruction to stop operation of one system will also need to stop operation of the other systems – resulting in a loss of surveillance not intended or expected by the controller.

ATC need to be aware that an instruction to “Stop ADS-B Transmission” may require the pilot to switch off their transponder that will then stop all other functions associated with the transponder operations (such as ACARs etc). Pilots need to be aware of their aircraft’s equipment limitations, the consequences of complying with this ATC instruction, and be aware of their company policy in regard to this. As with any ATC instruction issued, the pilot should advise ATC if they are unable to comply.

Recommendation: It is recommended that the concatenated phrases STOP ADSB TRANSMISSION, SQUAWK (code) ONLY or STOP SQUAWK, TRANSMIT ADSB ONLY are used. It is recommended that controller training highlights the possible consequences of **issuing** these instructions and that pilot training highlights the consequences of **complying** with this instruction. It is also recommended that aircraft operators have a clearly stated policy on procedures for this situation. Should a pilot respond with UNABLE then the controller should consider alternative solutions to the problem that do not remove the safety defences of the other surveillance technologies. This might include manual changes to flight data, coordination with other controllers and/or change of assigned codes or callsigns.

Very few aircraft provide the capability to turn off ADS-B without turning off TCAS. It is not recommended to switch off ATC transponders (& remove TCAS protection). The only action for most pilots of aircraft transmitting misleading ADS-B data in response to ATC requests is to recycle the transponder, or switch to the alternate transponder as appropriate. Besides, aircraft that do not support ADS-B OFF should have the details included in the flight manual including the undesirability of disabling TCAS.

9.9.2.2 STOP ADSB ALTITUDE TRANSMISSION [WRONG INDICATION or reason] and TRANSMIT ADSB ALTITUDE

Issue: Most aircraft will not have separate control of ADSB altitude transmission. In such cases compliance with the instruction may require the pilot to stop transmission of all ADSB data and/or Mode C altitude – resulting in a loss of surveillance not intended or expected by the controller.

Recommendation: It is recommended that, should the pilot respond with UNABLE, the controller should consider alternative solutions to the problem that do not remove the safety defences of other surveillance data. This might include a procedure that continues the display of incorrect level information but uses pilot reported levels with manual changes to flight data and coordination with other controllers.

9.9.2.3 TRANSMIT ADS-B IDENT

Issue: Some aircraft may not be capable or the ADSB SPI IDENT control may be shared with the SSR SPI IDENT function.

Recommendation: It is recommended that controllers are made aware that some pilots are unable to comply with this instruction. An alternative means of identification that does not rely on the ADSB SPI IDENT function should be used.

9.10 FLIGHT PLANNING

9.10.1 ADS-B Flight Planning Requirement – Flight Identity

The aircraft identification (ACID) must be accurately recorded in section 7 of the ICAO Flight Plan form as per the following instructions:

Aircraft Identification, not exceeding 7 characters is to be entered both in item 7 of the flight plan and replicated exactly when set in the aircraft (for transmission as Flight ID) as follows:
Either,

- a) The ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, BAW213, JTR25), when:

in radiotelephony the callsign used consists of the ICAO telephony designator for the operating agency followed by the flight identification (e.g. KLM 511, SPEEDBIRD 213, HERBIE 25).

Or,

- b) The registration marking of the aircraft (e.g. EIAKO, 4XBCD, OOTEK), when:

- 1) in radiotelephony the callsign used consists of the registration marking alone (e.g. EIAKO), or preceded by the ICAO telephony designator for the operating agency (e.g. SVENAIR EIAKO),
- 2) the aircraft is not equipped with radio.

Note 1: No zeros, hyphens, dashes or spaces are to be added when the Aircraft Identification consists of less than 7 characters.

Note 2: Appendix 2 to PANS-ATM refers. ICAO designators and telephony designators for aircraft operating agencies are contained in ICAO Doc 8585.

9.10.2 ADS-B Flight Planning Requirements

9.10.2.1 ICAO Flight Plan Item 10 – Surveillance Equipment and Capabilities

An appropriate ADS-B designator shall be entered in item 10 of the flight plan to indicate that the flight is capable of transmitting ADS-B messages.

These are defined in ICAO DOC 4444 as follows:

- B1 ADS-B with dedicated 1090 MHz ADS-B “out” capability
- B2 ADS-B with dedicated 1090 MHz ADS-B “out” and “in” capability
- U1 ADS-B “out” capability using UAT
- U2 ADS-B “out” and “in” capability using UAT
- V1 ADS-B “out” capability using VDL Mode 4
- V2 ADS-B “out” and “in” capability using VDL Mode 4

During the ADS-B SITF/13 meeting held in April 2014, clarification of the B1 and B2 descriptors was recommended as follows. This will be progressed for change to ICAO DOC 4444, but may take some time for formal adoption:

- B1 ADS-B “out” capability using 1090 MHz extended squitter
- B2 ADS-B “out” and “in” capability using 1090 MHz extended squitter

States should consider use of the revised descriptors in AIP.

9.10.2.2 ICAO Flight Plan Item 18 – Other Information

Where required by the appropriate authority the ICAO Aircraft Address (24 Bit Code) may be recorded in Item 18 of the ICAO flight plan, in hexadecimal format as per the following example:

CODE/7C432B

States should note that use of hexadecimal code may be prone to human error and is less flexible in regard to airframe changes for a notified flight.

9.10.2.3 Transponder Capabilities

When an aircraft is equipped with a mode S transponder, that transmits ADS-B messages, according to ICAO Doc 4444, an appropriate Mode S designator should also be entered in item 10; i.e.: either S

- E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability, or
- L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability.

During the ADS-B SITF/13 meeting held in April 2014, clarification of the E and L descriptors was recommended as follows. This will be progressed for change to ICAO DOC 4444, but may take some time for formal adoption:

- E Transponder — Mode S, including aircraft identification, pressure-altitude and ADS-B capability, or
- L Transponder — Mode S, including aircraft identification, pressure-altitude, ADS-B and enhanced surveillance capability.

States should consider use of the revised descriptors in AIP.

9.10.2.4 Inconsistency between ADS-B Flight Planning and Surveillance Capability

Inconsistency between flight planning of ADS-B and surveillance capability of an aircraft can impact on ATC planning and situational awareness. States are encouraged to monitor for consistency between flight plan indicators and actual surveillance capability. Where discrepancies are identified, aircraft operators should be contacted and instructed to correct flight plans, or general advice (as appropriate to the operational environment and type of flight planning problems) should be issued to aircraft operators. An example of such advice is provided at Appendix 4.

9.10.3 Setting Aircraft Identification (Flight ID) in Cockpits

(a) Flight ID Principles

The aircraft identification (sometimes called the flight identification or FLTID) is the equivalent of the aircraft callsign and is used in both ADS-B and Mode S SSR technology. Up to seven characters long, it is usually set in airline aircraft by the flight crew via a cockpit interface. It enables air traffic controllers to identify and aircraft on a display and to correlate a radar or ADS-B track with the flight plan data. Aircraft identification is critical, so it must be entered carefully. Punching in the wrong characters can lead to ATC confusing one aircraft with another.

It is important that the identification exactly matches the aircraft identification (ACID) entered in the flight notification.

Intuitive correlation between an aircraft's identification and radio callsign enhances situational awareness and communication. Airline aircraft typically use a three letter ICAO airline code used in flight plans, NOT the two letter IATA codes.

(b) Setting Flight ID

The callsign dictates the applicable option below for setting ADS-B or Mode S Flight ID:

- (i) the flight number using the ICAO three-letter designator for the aircraft operator if a flight number callsign is being used (e.g. QFA1 for Qantas 1, THA54 for Thai 54).
- (ii) the nationality and registration mark (without hyphen) of the aircraft if the callsign is the full version of the registration (e.g. VHABC for international operations).
- (iii) The registration mark alone of the aircraft if the callsign is the abbreviated version of the

registration (eg ABC for domestic operations).

- (iv) The designator corresponding to a particular callsign approved by the ANSP or regulator (e.g. SPTR13 for firespotter 3).
- (v) The designator corresponding to a particular callsign in accordance with the operations manual of the relevant recreational aircraft administrative organization (e.g. G123 for Gyroplane 123).

9.11 PROCEDURES TO HANDLE NON-COMPLANT ADS-B AIRCRAFT OR MIS-LEADING ADS-B TRANSMISSIONS

ADS-B technology is increasingly being adopted by States in the Asia/Pacific Region. Asia/Pacific Region adopted 1090 extended squitter technology. Reliance on ADS-B transmissions can be expected to increase over the coming years.

Currently a number of aircraft are transmitting ADS-B data which is misleading or non-compliant with the ICAO standards specified in Annex 10. Examples include:

- a) aircraft broadcasting incorrect message formats;
- b) aircraft broadcasting inertial positional data and occasionally indicating in the messages that the data has high integrity when it does not;
- c) using GPS sources that do not generate correct integrity data, whilst indicating in the messages that the data has high integrity;
- d) transmitting ADS-B data with changing (and incorrect) flight identity; and
- e) transmitting ADS-B data with incorrect flight identity continuously.

If the benefits of ADS-B are to flow to the aviation industry, misleading and non-compliant ADS-B transmissions need to be curtailed to the extent possible.

The transmission of a value of zero for the NUCp or the NIC or the NACp or the SIL by an aircraft indicates a navigational uncertainty related to the position of the aircraft or a navigation integrity issue that is too significant to be used by air traffic controllers.

As such, the following procedure currently stipulated in the Regional Supplementary Procedures Doc 7030³, shall be applicable in the concerned FIRs on commencement of ADS-B based surveillance services notified by AIP or NOTAM:

If an aircraft operates within an FIR where ADS-B-based ATS surveillance service is provided, and

- a) carries 1090 extended squitter ADS-B transmitting equipment which does not comply with one of the following:
 - 1) EASA AMC 20-24; or
 - 2) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia; or

³ SURICG/2 recommended States/Administrations to update their ADS-B Avionics Equipage Requirements to align with the template in Appendix 3

- 3) installation in accordance with the FAA AC No. 20-165 – Airworthiness Approval of ADS-B; or
- b) the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information;

then:

- a) except when specifically authorized by the appropriate ATS authority, the aircraft shall not fly unless the equipment is:
 - 1) deactivated; or
 - 2) transmits only a value of zero for the NUCp or NIC or NACp or SIL

States may elect to implement a scheme to blacklist those non-compliant aircraft or aircraft consistently transmitting mis-leading ADS-B information, so as to refrain the aircraft from being displayed to ATC. Please refer Appendix 2 for guidance in implementing the blacklist scheme.

A sample template is given below for reference by States to publish the procedures to handle non-compliant ADS-B aircraft or misleading ADS-B transmissions in their ADS-B mandate/regulations:

After <insert earliest date that ADS-B may be used for any relevant operational purpose> if an aircraft carries ADS-B transmitting equipment which does not comply with :

- (a) European Aviation Safety Agency - Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHZ Extended Squitter (AMC 20-24), or
- (b) European Aviation Safety Agency - Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance Subpart D — Surveillance (SUR) (CS-ACNS.D.ADS-B), or
- (c) Federal Aviation Administration – Advisory Circular No: 20-165A (or later versions) Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) Out Systems, or
- (d) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia.

or the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information;

the aircraft must not fly unless equipment is:

- (a) deactivated; or
- (b) set to transmit only a value of zero for the NUCp or NIC or NACp or SIL.

Note:

1. It is considered equivalent to deactivation if NUCp or NIC or NACp or SIL is set to continually transmit only a value of zero.
2. Regulators should take appropriate action to ensure that such regulations are complied with.
3. ATC systems should discard ADS-B data when NUC or NIC or NACp or SIL =0.

9.12 EMERGENCY PROCEDURES

ATC surveillance systems should provide for the display of safety-related alerts and warnings, including conflict alert, minimum safe altitude warning, conflict prediction and unintentionally duplicated SSR codes and aircraft identifications.

The ADS-B avionics may transmit emergency status messages to any ADS-B ground station within coverage. The controller receiving these messages should determine the nature of the emergency, acknowledge receipt if appropriate, and initiate any assistance required. An aircraft equipped with ADS-B might operate the emergency and/or urgency mode as follows:

- a) emergency;
- b) no communications;
- c) unlawful interference;
- d) minimum fuel; and/or
- e) medical.

Selection of an emergency transponder code (e.g. 7600) automatically generates an emergency indication in the ADS-B message. However, some ADS-B transponders may only generate a generic emergency indication. That means, the specific type of emergency, e.g., communication failure, is not always conveyed to the controller in an ADS-B environment. The controller may only receive a generic emergency indication irrespective of the emergency codes being selected by the pilot.

In some early ADS-B avionics configurations, when a generic emergency indication is being transmitted, a request to “Transmit ADS-B Ident” or “Squawk Ident” may not result in the Ident indication being displayed in the ATC System. This is because the emergency and ident flags share the same data elements in the ADS-B downlink message.

Due to limitations of some ADS-B transponders, procedures should be developed for ATC to confirm the types of emergency with pilots based on operational needs of States.

In contrast to DO260 avionics, for DO-260A avionics, the transmission of an Emergency/Priority status message in the ADS-B message set will also include the original MODE A code allocated by ATC. When the aircraft resets the MODE A code to the original allocated code the ground station can retain the Emergency/Priority status in the Asterix message, for up to 100 seconds, even though the aircraft is no longer squawking an emergency code. This situation can generate confusion as to the actual status of the aircraft.

Executive control responsibility

The responsibility for control of the flight rests with the ATSU within whose airspace the aircraft is operating. However, if the pilot takes action contrary to a clearance that has already been coordinated with another sector or ATSU and further coordination is not possible in the time available, the responsibility for this action would rest with the pilot in command, and performed under the pilot's emergency authority.

Emergency procedures

The various circumstances surrounding each emergency situation preclude the establishment of exact detailed procedures to be followed. The procedures outlined in PANS-ATM Chapter 15 provide a general guide to air traffic services personnel and where necessary, should be adapted for the use of ADS-B.

9.13 PROCEDURES TO HANDLE GPS TIME AND WEEK COUNTER ROLLOVER

The GPS system is often used in the ATC environment, including:

- to time stamp surveillance data with the “time of applicability” of the data. This allows positional data to be “extrapolated” to the time of display and allows old data to be discarded.
- to time synchronise ATC systems to the correct time, so that when it uses surveillance data, it can determine the “age” of the data.
- to time stamp recorded data and maintenance data

Thus accurate time is important to minimise incorrect positional data being presented to ATC and to ensure that valid data is not discarded – amongst other important technical roles in synchronising various computer servers in a network.

9.13.1 GPS TIME – COUNTERS AND LEAP SECONDS

The GPS navigation message contains information about the current date and time in the form of a sequential week counter (representing the number of weeks elapsed since the last time this counter was reset to zero). This counter is 10 bits long and this resets to zero every 1024 weeks (19.6 years). GPS week zero started at 00:00:00 UTC on January 6, 1980, and the week number became zero again on August 21, 1999. A rollover event occurred on 6 April 2019.

ATC systems use UTC. The difference between GPS time and UTC changes whenever a “leap second” is inserted in UTC. Wikipedia says that “one-second adjustment that is occasionally applied to civil time Coordinated Universal Time (UTC) to keep it close to the mean solar time at Greenwich, in spite of the Earth's rotation slowdown and irregularities”. This is done in coordination with the international community.

The GPS messages sent by the satellites includes the difference between GPS time and UTC, thus allowing the GPS receivers to calculate UTC.

9.13.2 GPS RECEIVER ISSUES

Each GPS receiver has firmware/software that computes UTC from the GPS time counters and from the known offset. In the past some GPS receivers have not coped well with these changes. The triggers occur very infrequently and in some cases they have not been adequately tested.

This can cause incorrect UTC time to be output following some events such as:

- Software deficiencies highlighted by the week number rollover. The rollover occurs each 19.6 years
- Deficiencies at leap second introductions (at intervals greater than 1 year)
- Loss of GPS-UTC time offset (sometimes at power off in devices not using non-volatile storage). Typically this can result in up to 15 minutes of incorrect time data until the offset is restored from the satellite messages.

Other problems such as receiver lock up (service failure) can occur when the GPS receiver is exposed to rare real world events or stimuli.

9.13.3 ATC SYSTEM RISKS AND MITIGATION

ANSPs and regulators need to be aware of the potential issues that may arise from GPS receivers that inadequately process events and stimuli.

Possible mitigations that could be considered include:

- Testing GPS receivers with a GPS test tool that simulates possible events/ stimuli
- Co-ordination with GPS receiver manufacturers
- Disconnect GPS receivers just before expected events – and check the output before reconnecting the GPS receiver. (in this case the ANSP would be relying on the ability of the ATC or surveillance system to operate for a period without the GPS synchronisation).

10. SECURITY ISSUES ASSOCIATED WITH ADS-B

10.1 INTRODUCTION

ADS-B technologies are currently “open systems” and the openness is an essential component of successful use of ADS-B. It was also noted that ADS-B transmission from commercial aircraft is a “fact of life” today. Many commercial aircraft are already equipped with ADS-B and have been transmitting data for some time.

It was noted that there has been considerable alarmist publicity regarding ADS-B security. To a large extent, this publicity has not considered the nature and complexity of ATC. Careful assessment of security policies in use today for ADS-B and other technologies can provide a more balanced view.

10.2 CONSIDERATIONS

A list of ADS-B vulnerabilities categorised into threats to Confidentiality, Integrity and Availability has been reviewed and documented into the guidance material on security issues associated with ADS-B provided on the ICAO APAC website “<http://www.icao.int/APAC/Pages/edocs.aspx>” under “Restricted Site” for reference by States. States could contact ICAO Regional Office to get access to the guidance material. The following recommendations are made to States :

- (a) While ADS-B is recognized as a key enabling technology for aviation with potential safety benefits, it is recommended that States made aware of possible ADS-B security specific issues;
- (b) It is recommended that States note that much of the discussion of ADS-B issues in the Press has not considered the complete picture regarding the ATC use of surveillance data;
- (c) For current ADS-B technology implementation, security risk assessment studies should be made in coordination with appropriate national organisations and ANSPs to address appropriate mitigation applicable in each operational environment, in accordance with ATM interoperability requirements; and
- (d) Future development of ADS-B technology, as planned in the SESAR master plan for example, should address security issues. Studies should be made to identify potential encryption and authentication techniques, taking into consideration the operational need of air to ground and air to air surveillance applications. Distribution of encryption keys to a large

number of ADS-B receivers is likely to be problematic and solutions in the near and medium term are not considered likely to be deployed worldwide. Internet based encryption strategies are not deployable when ground stations are pass receivers.

10.3 MEASURES FOR ENHANCING THE SECURITY OF ADS-B

10.3.1 TIME DIFFERENCE OF ARRIVAL (TDOA) BASED POSITION VERIFICATION METHOD

One of the technologies for enhancing ADS-B security is TDOA-based position verification, which is able to mitigate false targets caused by spoofing. In a case of spoofing, the position of the emitter (attacker) is likely to differ from the position contained in the ADS-B signal. Such positional difference can be detected by means of TDOA.

When an emitter (aircraft or spoofing emitter) transmits an ADS-B signal, (at least) two receivers detect the signal and measure the time of arrival (TOA). The difference of the TOAs between the two receivers is a TDOA. Next, decoding the ADS-B signal obtains the position contained in the signal. A calculation using the ADS-B position and the known receiver positions obtains the expected TDOA.

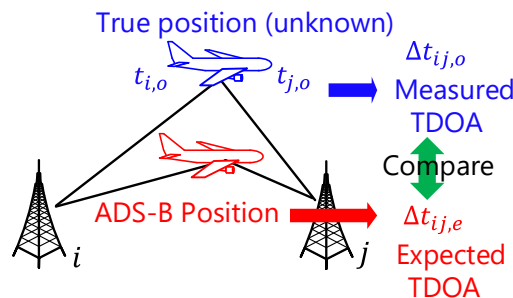


Figure 10.3.1.1 Illustration of the Procedures of TDOA method

The measured and expected TDOAs are compared. The TDOA difference is large in a case of spoofing and small in a case of a legitimate aircraft, as illustrated in Figure 10.3.1.2 (a) and (b), respectively. Therefore, a threshold can be used to make a decision; if the TDOA difference is smaller than the threshold, the position is determined as valid. If the TDOA difference is larger than the threshold, the position is determined as anomalous (spoofing).

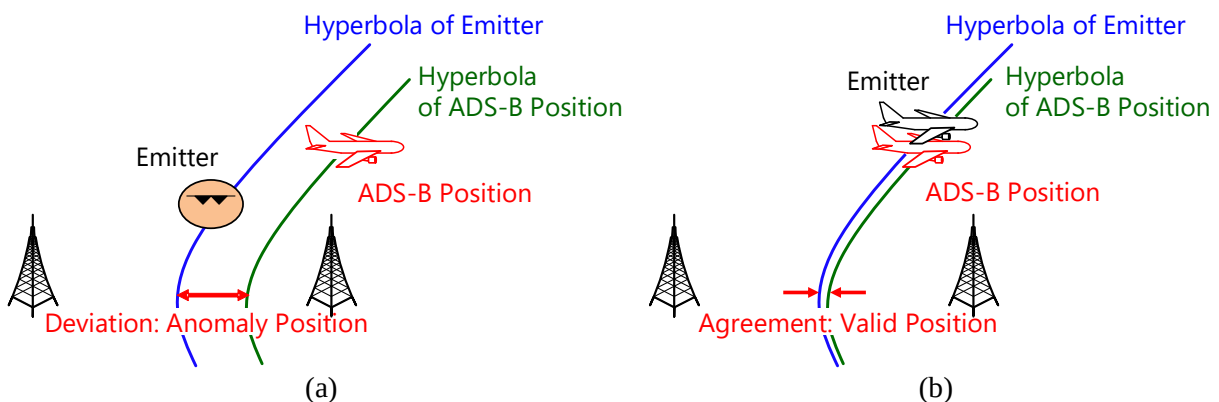


Figure 10.3.1.2 Illustration of (a) case of spoofing, and (b) case of legitimate aircraft

Commissioning Readiness		
The requirement for this form is specified in the System Management Manual (Section 11.2 of V4), C-MAN0107		
Project/Task Name	SAP Project/Task ID:	Sites or Locations affected:
Documentation prepared by:	Date:	Commissioning Date:
Affected System(s)	System Criticality	Change Consequence Level
Brief Description of Change:		

Commissioning Readiness Endorsement		
The endorsement of this form by the appropriate authorities as specified in the System Management Manual certifies that the requirements detailed in this form (with the exception of the non-critical deficiencies ¹ listed herein) have been completed prior to the commissioning of the system change or new system.		
Chief Engineer or Technical or Maintenance Authority		
Name:	Signature:	Date:
Designation:		
Name:	Signature:	Date:
Designation:		
Chief Operating/User Authority or Operating/User Authority		
Name:	Signature:	Date:
Designation:		

Records Management Instructions
Place the completed Commissioning Readiness Form, together with any support documents on the Project file
Provide a copy of the completed Commissioning Readiness Form to P&E, Asset Lifecycle Manager, Planning and Integration

Note 1: Non-critical deficiencies (NCD) are those outstanding technical and operational issues that do not prevent the safe and effective use or maintenance of the facility, but will be addressed in a specified and agreed time. NCDs shall be listed on the Commissioning Certificate (C-FORMS0300) and recorded in the relevant system (ASID / HEAT / SAIR). It is preferable for each NCD to be recorded as a separate Issue.

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Item No:	Requirement:	Requirement Reference: (Procedure/Instruction used to specified required input)	Completed or N/A	Evidence of Compliance (If a requirement is N/A, a reason why it is N/A is required to be entered)
1	OPERATIONAL SAFETY			
1.1	Provide a link to the completed SCARD SCARD Template (AA-TEMP-SAF-0042) Note: For unregulated systems the SCARD shall be used to assess the impact of the change and perform a preliminary hazard analysis	Safety Change Management Requirements AA-NOS-SAF-0104	Completed ☐ N/A ☐	Link to SCARD
1.2	The outcome of the SCARD will be the requirement for one of the following for commissioning: Safety Statement – included in SCARD or standalone Safety Statement which must provide Airservices Australia management with sufficient information to demonstrate that safety has been considered and the change presents minimal or no safety issues. Safety Plan & Safety Assessment Report, or Safety Plan & Safety Case Safety Plans, Safety Assessment Reports and Safety Cases are required to be available in the Document Search Database	Safety Change Management Requirements AA-NOS-SAF-0104 Document Search Database	Completed ☐ N/A ☐	Link to Safety statement or Link to Safety Plan & Safety Assessment Report or Link to Safety Plan & Safety Case
1.3	Safety risk management process completed and includes - any new hazards / impact to existing hazards identified? - controls identified and in place? and - residual risk justified and accepted.	Safety Risk Management Procedures AA-PROC-SAF-0105	Completed ☐ N/A ☐	
1.4	Impacts on the Operational Risk Assessments from residual risks have been assessed and implemented using Operational Risk Assessment Change Request and Acceptance Record – AA-FORM-SAF-0032	Operational Risk Assessment AA-NOS-SAF-0006 Safety Risk Management Procedures AA-PROC-SAF-0105	Completed ☐ N/A ☐	Link to Operational Risk Assessment Change Request and Acceptance Record:
1.5	Arrangements for monitoring and review of risks are in place including arrangements for safety performance monitoring following the transition.	Safety Risk Management Procedures AA-PROC-SAF-0105	Completed ☐ N/A ☐	
1.6	CASA have approved / accepted or been advised of the change, as applicable	Safety Change Management Requirements AA-NOS-SAF-0104	Completed ☐ N/A ☐	

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Item No:	Requirement:	Requirement Reference: (Procedure/instruction used to specified required input)	Completed or N/A	Evidence of Compliance (If a requirement is N/A, a reason why it is N/A is required to be entered)
2 WORKPLACE HEALTH & SAFETY				
2.1	Initial WHS Hazard Identification must be completed as per the template AA-TEMP-SAF-0020	Safety Risk Management Procedures AA-PROC-SAF-0105 Initial WHS Hazard Identification AA-TEMP-SAF-0020 Workplace Health and Safety Risk Management Summary AA-TEMP-SAF-0016	Completed ☐ N/A ☐	Link to completed Workplace Health and Safety Management Summary AA-TEMP-SAF-0016
2.2	Ensure employees and stakeholders are consulted when significant changes to work arrangements are being considered.	Working Together Workplace Consultation AA-PROC-SAF-0009	Completed ☐ N/A ☐	
2.3	Tower Access / Classification assessed? Working at Heights Safety Checklist & Daily Toolbox Meeting (F098) Fall arrest facility / equipment available	Working at Heights PROC-157 Working at Heights Safety Checklist & Daily Toolbox Meeting F098	Completed ☐ N/A ☐	
2.4	WHS hazard controls are in place - Safe Work Method Statement completed - Plant risks managed - Radhaz survey completed, published on the Avnet and general public & occupational exposure boundaries identified	Safe Work Method Statement AA-TEMP-SAF-0017 Managing WHS Risk for Contractors and Projects AA-PROC-SAF-0012 Plant Risk Management PROC-134 RF Radiation, Surveys & Health & Safety Mgmt PROC-121	Completed ☐ N/A ☐	Link to completed Safe Work Method Statement AA-TEMP-SAF-0017 Link to completed F131 Plant Risk Management Checklist
2.5	At the completion of works ensure WHS Inspections are completed and hazard controls are in place. Building condition; clean, undamaged, all work completed.	Conducting Workplace Safety Inspections AA-PROC-SAF-0008	Completed ☐ N/A ☐	

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Item No:	Requirement:	Requirement Reference: (Procedure/instruction used to specified required input)	Completed or N/A	Evidence of Compliance (If a requirement is N/A, a reason why it is N/A is required to be entered)
3	ENVIRONMENT			
3.1	Environmental Impact must be assessed using the Environmental Impact Screening & Assessment Criteria for Changes to On-ground Activities Assistance in assessing the Environmental Impact can be obtained from Environment and Climate Change Unit in Environment Group.	Environmental Screening & Assessment Criteria for Changes to On-ground Activities AA-REF-ENV-0010 Environmental Assessment of Changes to On-ground Activities AA-NOS-ENV-2.200	Completed ☐ N/A ☐	Link to completed Environmental Impact Screening and Assessment Form If a stage 2 assessment is required provide ARMS reference and links to any Permits, Master Development Plans and relevant correspondence as required.
3.2	Environmental Clearance obtained for ATM changes as per AA-NOS-ENV-2.100 Assistance in assessing the Environmental Impact can be obtained from Environment and Climate Change Unit in Environment Group.	Environment Assessment Process for ATM Changes AA-NOS-ENV-2.100	Completed ☐ N/A ☐	Provide ARMS reference and NRFC reference if ATM change required
4	PEOPLE- SUPPORT			
ATC TRAINING				
4.1	ATC Training Needs Analysis completed and Training Plan developed?		Completed ☐ N/A ☐	Link to Training Needs Analysis and Training Plan
4.2	Sufficient number of trained, rated and endorsed ATC staff available.		Completed ☐ N/A ☐	Number Trained:
4.3	ATC staff individual training records in SAP database have been updated		Completed ☐ N/A ☐	
4.4	Plans are in place to complete any outstanding training, rating, and endorsement of remaining ATC staff (Normally an identified hazard)		Completed ☐ N/A ☐	HAZLOG Register No:

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TECHNICAL TRAINING				
4.5	Training Needs Analysis completed and Training Plan developed for system support staff and field maintenance staff?		Completed ☐ N/A ☐	Link to Training Needs Analysis and Training Plan
4.6	TechCert codes have been created, assessment criteria developed or existing assessment criteria has been amended	TechCert codes TechCert Guides and Forms	Completed ☐ N/A ☐	Link to TechCert Guides and Forms
4.7	Sufficient system support staff and field maintenance staff appropriately trained?		Completed ☐ N/A ☐	
4.8	Are plans in place to complete any outstanding training and certification of system support staff and remaining field maintenance staff?		Completed ☐ N/A ☐	
4.9	Field maintenance staff hold the relevant TechCert to perform duties.	Technical Certification PROC-141	Completed ☐ N/A ☐	
4.10	Statutory / special licensing obtained by field maintenance staff including high risk work competencies and licensing requirements?		Completed ☐ N/A ☐	
4.11	ABS and FMS staff training details sent to Technical Training Coordinator and training records updated as required?	Training PROC-119	Completed ☐ N/A ☐	
4.12	TechCert details sent to FMS System Support to update the Qualifications (TechCert) Database	Technical Certification PROC-141	Completed ☐ N/A ☐	
LOGISTICAL SUPPORT				
4.13	CMRD have been consulted regarding special test equipment, test beds, etc		Completed ☐ N/A ☐	

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4.14	CMRD / NDC have been consulted regarding spares holdings and repair of LRUs from this equipment or in-house support of Depot Level Support Contract / repair contract		Completed ☐ N/A ☐	
4.15	TEMACC advised of any specialised test equipment requirements.	Test Equipment Management PROC-150	Completed ☐ N/A ☐	
4.16	Maintenance support contracts in place (external and/or internal)? — Appropriate vendor and/or internal support? — Appropriate Level 3 maintenance arrangements		Completed ☐ N/A ☐	
4.17	Test equipment provided to maintenance base. Note: Test equipment purchasing and calibration requirements detailed in Engineering Execution Readiness form.		Completed ☐ N/A ☐	
4.18	Specialised hardware or software system support and field maintenance tools, test / patch leads, adaptors, isolators, electronic discharge protection (mats, straps), etc supplied?		Completed ☐ N/A ☐	
4.19	System Business Continuity/ Disaster Recovery provisions supplied/updated?		Completed ☐ N/A ☐	
4.20	Spares – Supplied, storage correct, transport cases supplied?	Management of Goods & Supplies PROC-118	Completed ☐ N/A ☐	
4.21	Spares – Software / firmware loaded, tested & configured?		Completed ☐ N/A ☐	
4.22	Service Restoration Times (SRT) established?	Airways Service Data PROC-207	Completed ☐ N/A ☐	

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4.23	Conduct Hardware physical configuration audit and ensure SAP Plant Maintenance has updated information of all installed and/or demolished equipment (including monitoring circuits) and sent to System Operations SAP PM DATA CHANGES	Equipment Installed/Demolished Advice SAP Data Input Form F104	Completed ☐ N/A ☐	Link to Email from SAP PM Support confirming update/s
5	PROCEDURES			
	ATC DOCUMENTATION			
5.1	System Requirements documentation including Operating Concept or Business Process Rules - produced/updated and approved?		Completed ☐ N/A ☐	Link to documentation
5.2	Manual of Air Traffic Services (MATS) reviewed / updated. Aeronautical information publications (AIP Book, AIP SUPP, AIC, DAP, ERSA, Charts, etc) reviewed / updated. Amendment times are determined by the AIS Distribution Schedule	AA Publications AIS Distribution Schedule	Completed ☐ N/A ☐	NRFC No.
5.3	National ATC Procedures Manual (NAPM) and any other relevant ATC procedures reviewed / updated.		Completed ☐ N/A ☐	NRFC No.
5.4	ATC contingency / continuity plans reviewed / updated.	ATS Contingency Plans Business Continuity Plans C-BCP	Completed ☐ N/A ☐	ATS-CP No: C-BCP No:
5.5	NOTAM and/or AIP SUP issued / amended / cancelled	Works Planning PROC-213 Refer also LOA3024	Completed ☐ N/A ☐	NOTAM No:
5.6	ATC Temporary Local Instruction (TLI) issued notifying Operational staff of change?	Temporary Local Instructions & Database	Completed ☐ N/A ☐	NRFC No.

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USER DOCUMENTATION				
5.7	User/operator manuals updated		Completed ☐ N/A ☐	
5.8	User/operator procedures provided/updated as applicable		Completed ☐ N/A ☐	
5.9	On-line user/operator documentation completed and published		Completed ☐ N/A ☐	
5.10	ARFF instructions updated		Completed ☐ N/A ☐	
5.11	Other Business Groups instructions updated?		Completed ☐ N/A ☐	
TECHNICAL DOCUMENTATION				
5.12	Software design documents updated, adequate and supplied to system support?		Completed ☐ N/A ☐	
5.13	Software and/or dataset Version or Release Description Documentation supplied and adequate?		Completed ☐ N/A ☐	Link to Version Description Document or Release Description Document
5.14	Software installation procedure and instructions supplied/updated and adequate?		Completed ☐ N/A ☐	Link to Installation Procedure

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5.15	SMP: System Management Plan created / updated and adequate?	SMP Template	Completed ☐ N/A ☐	SMP No:
5.16	SCP: System Contingency / continuity plans supplied/updated and adequate?	SCP Template	Completed ☐ N/A ☐	SCP No:
5.17	Technical drawings updated and listed in Data Viewer and list supplied to system supporters and field maintenance staff.	Technical Drawing Management PROC-178	Completed ☐ N/A ☐	
5.18	Technical handbooks/manuals supplied to ABS or FMS Engineering/IT support and field maintenance staff (base and site copy).	Document Management PROC-103	Completed ☐ N/A ☐	
5.19	On-line system support and field maintenance documentation completed and published		Completed ☐ N/A ☐	
5.20	Technical documentation registered and placed under documentation control	Document Management PROC-103	Completed ☐ N/A ☐	
5.21	Appropriate engineering performance requirements specified and issued for ongoing use? System Specification documentation supplied/updated and adequate?	System Performance Requirements & Reporting Specification ASYS-106	Completed ☐ N/A ☐	
5.22	Configuration & Modification AEI: Equipment and System Modifications and Configuration (for hardware and software), and Software Release Authorisations are documented in a Part 2 AEI (or other approved documentation)	Development of Maintenance Instructions for Equipment PROC-151	Completed ☐ N/A ☐	AEI No/s: Link to documentation detailing configuration and modification
5.23	Maintenance AEI: Maintenance requirements, including Performance Inspection tolerances, have been defined and documented in AEIs (or other approved documentation). (AEI Part 3.4.7)	Development of Maintenance Instructions for Equipment PROC-151	Completed ☐ N/A ☐	AEI No/s:

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5.24	AEI: New maintenance AEIs trialled by maintenance staff	Development of Maintenance Instructions for Equipment PROC-151	Completed ☐ N/A ☐	
5.25	TTD: Temporary Technical Dispensation raised and published on the Document Search database.	Temporary Technical Dispensations PROC-153	Completed ☐ N/A ☐	TTD No:
5.26	Site Manifest updated	Site Manifests FMS-304	Completed ☐ N/A ☐	
6	SYSTEM			
DESIGN REQUIREMENTS				
6.1	System Requirements documentation including Operating Concept or Business Process Rules - supplied/updated and approved?	Design Control PROC-146	Completed ☐ N/A ☐	Links to documentation
6.2	Standards – Installation and equipment comply with all relevant Australian Standards? Building Codes - Structures comply with the relevant Building Codes? The relevant Australian Standards and Building Codes are to be determined by the Chief Engineer, Technical Authority or Maintenance Authority	Australian Standards Design Control PROC-146	Completed ☐ N/A ☐	
6.3	Other applicable Federal and/or State licensing requirements met? The relevant licensing requirements are to be determined by the Chief Engineer, Technical Authority or Maintenance Authority	Design Control PROC-146	Completed ☐ N/A ☐	

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6.4	Electrical Mechanical, Structure and Building impacts have been assessed as adequate or modifications organised and completed through consultation with Engineering Branch, P&E? (Power supply capability / airconditioning capacity / mast loadings)	Design Control PROC-146	Completed ☐ N/A ☐	
6.5	Earthing and Lightning Protection meets Aircservices requirements?	Earthing and Lightning Protection Systems for Operational Facilities AEI 3.1504 Site Earthing and Lightning Protection Systems for Existing Installations AEI 2.3011	Completed ☐ N/A ☐	
6.6	Battery Procurement as per Aircservices requirements?	Lead Acid Batteries (Stationary) Procurement and Acceptance Testing AEI-3.7050 Panel Contract Arrangement C-PROC0140	Completed ☐ N/A ☐	
6.7	Assessing the impact of information systems against corporate objectives (7 Ticks process).	Information Technology Application Certification – 7 Ticks MI-0804 and PROC-190	Completed ☐ N/A ☐	Link to completed 7 Ticks Interim Certificate or Final Certificate
6.8	IT Security measures appropriate and in place (ie. to ensure effective security and control practices to minimise the risks of unauthorised access, inappropriate use, modification, destruction or disclosure of electronically held data).	IT Security Roles and Responsibilities Statement MS-0013 Information Security MI-0808 ICT Resources – Conditions of Use MI-0829	Completed ☐ N/A ☐	

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6.9	Information Security	Information Security C-PROC0184	Completed ☐ N/A ☐	Link to completed security risk management plan
INSTALLATION REQUIREMENTS				
6.10	Has met the regulation and safety requirements for Telecommunications Installations. Cable Markers installed (external)? Equipment complies with ACMA statutory requirement Telecommunication Labelling (Customer Equipment and Customer Cabling) Notice 2001 as amended (i.e. 'A' ticked on the equipment compliance plate)	Implementing Regulation and Safety Requirements for Telecommunications Installations PROC-138 Installation of Optical Fibre Cable - Underground AEI 4.5001 Underground Cable Marking AEI 4.3001	Completed ☐ N/A ☐	Link to Telecommunications Cabling Advice
6.11	MDF/IDF Records created / updated? Labelling/Colour Coding – Rack, Cable, Chassis, etc. ?	Colour Coding of RJ45 Patch Leads for Voice and Data Installations AEI 7.3241	Completed ☐ N/A ☐	
6.12	Transmitters licence label affixed	Radio Communication Transmitter Labelling AEI 7.4238	Completed ☐ N/A ☐	
6.13	Electrical Certificate of Testing and Safety or Testing and Compliance on connection to a source of electricity (i.e. installation conforms to AS3000) are required to be supplied as soon as possible after connection or testing of any electrical installation or change. Labelling – Switch Boards, etc Meets Airservices Electrical Cable Colour Coding requirements?	Electrical Safety Regulation 2002 Sections 15 and 159 AS 3000 – Aust Standard Electrical Cable Colour Coding AEI 3.1502	Completed ☐ N/A ☐	Links to Electrical Certificates

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6.14	All modifications complete and scratch plate labels affixed to equipments	Identification of Airways Systems Equipment Hardware Modifications PROC-154	Completed ☐ N/A ☐	
6.15	Integration with National Technical Monitoring has been organised and completed through Engineering Branch, P&E?		Completed ☐ N/A ☐	
6.16	Alarm monitoring installed and tested at TOC for local and remote site?		Completed ☐ N/A ☐	
6.17	Source media – supplied/backed up, stored, registered with system support?	Software Media Archival and Storage PROC-147	Completed ☐ N/A ☐	
6.18	Site installable media – supplied/backed up, appropriately stored and registered by field maintainers?	Software Media Archival and Storage PROC-147	Completed ☐ N/A ☐	
6.19	Software licences provided, registered and appropriately stored? (Including details of any third party licensing)		Completed ☐ N/A ☐	
6.20	Update HEAT and/or ASID database to incorporate new system/version number and assign issue management roles?		Completed ☐ N/A ☐	

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DESIGN CONFIRMATION				
6.21	Airservices Physical Security requirements met. The minimum security requirements are specified in C-GUIDE0157. Physical Security advise can be obtained from the relevant Security Advisor in Security and Crisis Planning, Safety & Environment Physical Access requirements are determined and established Siting and accommodation impact has been assessed as being satisfactory or modifications organised through National Property?	Physical Security – Critical Operational Facilities C-GUIDE0157 Site Management PROC-170	Completed ☐ N/A ☐	
6.22	Network data load impact has been assessed as being satisfactory or modifications organised and completed through Engineering Branch, P&E?		Completed ☐ N/A ☐	
6.23	Spectrum licences (either cancelled if no longer required or for new licenses including if antenna moves by more than 10 metres)	Frequency Management: Obtaining a Frequency Assignment and Licence AEI 7.4202	Completed ☐ N/A ☐	
6.24	New system or system change acceptance tests (software and/or hardware) satisfactorily completed against the approved system requirements? – Test Plans provided? – FAT, SAT, UAT test results complete, passed to the required level and provided? – Test identified defect listings and re-test information provided?	System Management Manual SMM Design Control PROC-146	Completed ☐ N/A ☐	
6.25	Battery Acceptance Tests as per Airservices requirements?	Lead Acid Batteries (Stationary) Procurement and Acceptance Testing AEI-3.7050	Completed ☐ N/A ☐	Link to Battery Acceptance Test Results

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6.26	Standard Operating Conditions (SOCs) / Site Configuration Data (SCD) established / approved	Standard Operating Conditions & Site Configuration Data Management PROC-143	Completed ☐ N/A ☐	
6.27	Flight Test results supplied and satisfactory	Certification of Radio Navigation Aid Facilities AEI 7.4003	Completed ☐ N/A ☐	
6.28	Equipment operation is as per AEI specifications and any additionally specified requirements? Relevant requirements and performance specifications to be determined by the Chief Engineer, Technical Authority or Maintenance Authority		Completed ☐ N/A ☐	
7 TRANSITION				
PLANNING				
7.1	Does the system meet all critical user and technical requirements?		Completed ☐ N/A ☐	
7.2	If non-critical deficiencies are proposed to be accepted into operation, are they managed and tracked via ASID, HEAT or SAIR, including responsibilities and timings and attached to the Commissioning Certificate?		Completed ☐ N/A ☐	
7.3	Cutover Plan prepared and authorised by: – Appropriate level of engineering authority? – Appropriate level of User Authority?	Cutover Plan C-TEMP0045	Completed ☐ N/A ☐	Link to Cutover Plan
7.4	Works plan created at least 7 days before deployment	Works Planning PROC-213	Completed ☐ N/A ☐	Works Plan No.

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NOTIFICATION				
7.5	Industry education / notification been completed?		Completed ☐ N/A ☐	
7.6	Relevant Business Managers advised of impending change?		Completed ☐ N/A ☐	
7.7	Change requester and/or sponsor notified?		Completed ☐ N/A ☐	
7.8	System Operations' TOC and Service Desk notified and accepted operating responsibility for the change.		Completed ☐ N/A ☐	
7.9	ABS/FMS Manager has accepted maintenance responsibility		Completed ☐ N/A ☐	
7.10	Notify the following (as appropriate) that the system is at "OPERATIONAL READINESS" and provide details of commissioning and any system changes: ATC System Supervisor, Melbourne (ATC) System Supervisor, Brisbane (ATC) National ATC Systems Manager Operating Authority (relevant)	Sys to Svc List	Completed ☐ N/A ☐	

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7.11	Notify the following (as appropriate) that the system is at “ENGINEERING READINESS” and provide details of commissioning and any system changes: P&E Technical Authority (relevant) Technical Operations Centre – Director Service Desk -Airways SAP PM Support	Sys to Svc List	☐ Completed ☐ N/A	

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COMMISSIONING CERTIFICATE

The requirement for this form is specified in the System Management Manual (Section 11.2 of V4), C-MAN0107

Project/Task Name	SAP Project/Task ID:	Sites or Locations affected:
Documentation prepared by:	Date:	Commissioning Date:
Affected System(s)	System Criticality	Change Consequence Level
Brief Description of Change:		

Commissioning Approval

The approval of this document by the appropriate authorities as specified in the System Management Manual certifies that the new system or system change is satisfactory to meet the specified service and performance requirements; that system operating and support requirements are in place; that required user and technical training is adequately provisioned; as detailed in the Commissioning Readiness Form and consequently the new system or system change is declared fit-for-purpose and can be deployed and operated until formally decommissioned or otherwise revoked.

This approval is provided subject to the non-critical deficiencies¹ listed herein.

Chief Engineer, Technical or Maintenance Authority

Name	Signature:	Date
Designation:		

Name:	Signature:	Date:
Designation:		

Chief Operating/User Authority or Operating/User Authority

Name:	Signature:	Date:
Designation:		

Records Management Instructions

Place the completed Commissioning Certificate, together with the completed Commissioning Readiness form on the Project file

Provide a copy of the completed Commissioning Certificate, and the completed Commissioning Readiness Form to P&E, Asset Lifecycle Manager, Planning and Integration

Note 1: Non-critical deficiencies are those outstanding technical and operational issues that do not prevent the safe and effective use of the facility by users or prevent effective technical maintenance, but will be addressed in a specified and agreed time.

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Guidance Materials on Monitoring and Analysis of ADS-B Avionics Performance

1 Introduction

- 1.1 The APANPIRG has endorsed the following Conclusion during its 24th Meeting to encourage States/Administration to exchange their ADS-B performance monitoring results and experience gained from the process :

Conclusion 24/45 - Exchange ADS-B Performance Monitoring Result

“That, States be encouraged to exchange findings/result of their ADS-B performance monitoring including experience gained in conducting the required performance monitoring.”

- 1.2 Since the ADS-B mandate for some airspace in the Region became effective in December 2013, monitoring and analysis on avionics performance of ADS-B equipped aircraft has become an increasingly important task for concerned States. The fully functional ADS-B Avionics Problem Reporting Database (APRD) was launched on the 21 July 2017. The database is placed at ICAO APAC website in the restricted area with name: APAC ADS-B Avionics Problem Reporting Database accessible via <https://applications.icao.int/ADSB-APRD/login.aspx>. States are encouraged to make full use of the APRD for reporting ADS-B avionics problems and sharing experience as well as follow-up actions through the APRD web-page.
- 1.3 This document serves to provide guidance materials on monitoring and analysis of avionics performance of ADS-B equipped aircraft, which is based on the experience gained by States.

2 Problem Reporting and Feedback

- 2.1 For ADS-B avionics problems, it is critical that an appropriate reporting and feedback mechanism be established. It is highly desirable that those discovering the problems should report them to the appropriate parties to take action, such as study and analyse the problems, identify the root causes, and rectify them. Those action parties include :-
- (a) Air Navigation Service Providers (ANSPs) – upon detection of any unacceptable ADS-B reports from an aircraft, report the observed problem to the performance monitoring agent(s), if any, and the Aircraft Operators for investigation. In addition, ANSPs should take all actions to avoid using the ADS-B reports from the aircraft until the problem is rectified (e.g. black listing the aircraft), if usage of such reports could compromise safety.
 - (b) Regulators – to initiate any appropriate regulatory action or enforcement.

- (c) Aircraft Operators – to allow avionics specialists to examine the causes and as customers of the avionics manufacturers ensure that corrective action will take place.
- (d) Avionics Manufacturers and Aircraft Manufacturers – to provide technical evidence and knowledge about the problem and problem rectification

2.2 Incentives should be received by those parties acting on the problems including :-

- (a) Regulations that require deficiencies to be rectified
- (b) Regulatory enforcement
- (c) Consequences if conduct of operations with problematic equipment (e.g. no access to the airspace requiring healthy equipment)

2.3 When an ADS-B avionics problem is reported, it should come along with adequate details about the problem nature to the action parties. In addition, the problem should be properly categorised, so that appropriate parties could diagnose and rectify them systematically.

3 Problem Categorisation

3.1 Regarding ADS-B avionics, their problems are quite diversified in the Region but can be categorized to ensure they will be examined and tackled systematically.

3.2 Based on the experience gained from States, the common ADS-B avionics problems in the Region are summarized under different categories in Attachment A. It is noted that only a relatively minor portion of the aircraft population exhibits these problems. It must be emphasized that aircraft transmitting incorrect positional data with NUC = 0 or NIC = 0 should not be considered a safety problem. The data transmitted have no integrity and shall not be used by ATC. This situation exists for many aircraft when their GNSS receivers are not connected to the transponders.

4 Managing the Problem

4.1 There are two major approaches to manage the problems :-

(a) Regulatory approach

Regulations which require non-approved avionics to disable ADS-B transmission (or transmit “no integrity”), and the concerned operators to file flight plans to indicate no ADS-B equipage. APANPIRG has endorsed this approach which is reflected in the Regional Supplementary Procedures (Doc 7030).

(b) Blacklist approach

Filtering out (“black listing”) any airframes that do not comply with the regulations or transmitting bad data, and advising the regulator of the non-

compliance. This approach is temporary which allows the ANSP to protect the system whilst regulatory action is underway.

While deciding on whether an aircraft transmitting erroneous ADS-B data should be added into the blacklist, the following factors will be critically assessed:

- i. Impact and risk to ATC operational safety
Use of erroneous ADS-B data to maintain separation may potentially contribute to loss of separation or ATC coordination error.
- ii. Frequency of erroneous position
Whether it is occasional or frequently broadcast of erroneous position.
- iii. Amount of deviation
This can be a track jumping problem which is of significant safety impact to ATC or just an occasional small position jump which is not detectable in ATC with insignificant impact.
- iv. Others
Such as the ICAO aircraft address received from ADS-B being inconsistent with the aircraft registration, Flight ID entered via cockpit interface mismatched with aircraft callsign in the Flight Plan, etc.

After deciding to put an aircraft into the blacklist list, the following procedures will be carried out:

- i. Informing the concerned aircraft operator/regulatory authority
The concerned aircraft operator/regulatory authority will be notified of the decision and the rationale before putting the aircraft into the exclusion list.
- ii. Pre-processing of flight plan concerned
As the blacklist mechanism involves filtering out the ADS-B data of the subject aircraft, from operational perspective, air traffic controllers need to be aware in advance that the concerned aircraft plans to operate in their FIR. A flight plan pre-processing system may locate the flight plan by checking against the 24-bit address or aircraft registration in the blacklist, and issue an alert to the air traffic controllers if appropriate, such as automatically insert a remark in the Item 18 of the concerned flight plan before feeding the flight plan into the ATC Automation System, and the ATC Automation System may issue an alert to the air traffic controllers with a specific label annotated in the corresponding electronic flight strips.
- iii. Coordinate with adjacent Area Control Centre (ACC)
Upon posting of pending inbound flights with corresponding electronic flight strips indicating non-ADS-B equipage or in the blacklist, the air traffic controllers shall inform the upstream ACC that transfer of that particular flight will not be accepted at the ADS-B exclusive airspace. It is important to carry out this coordination action as early as possible as the upstream sector may have difficulty to adjust the flight route at the transfer stage.
- iv. Handling of an aircraft for removal from the blacklist once rectification action had taken place

Once notification from the aircraft operators/regulatory authorities is received that the problem has been rectified, performance of the aircraft will be closely monitored when it flies to the concerned FIR. If the aircraft shows the observed problem has been resolved, the aircraft will be removed from the blacklist. The aircraft operator/regulatory authority will also be notified accordingly.

5 Systematic Monitoring and Analysis of the Problem

States using ADS-B should have in place systematic ways to identify and manage ADS-B deficiencies similar to that described below :-

5.1 Reporting Deficiencies

States using ADS-B should have in place systematic ways to identify ADS-B deficiencies including :-

- (a) Systematic capture of ATC reported events and engineering detected events into a database; and
- (b) Manual or automatic detection of anomalous avionics behavior independent from controller reports

5.1.1 ATC Reported Deficiencies

ATC procedures should exist that allow services to continue to be provided safely, as well as to capture relevant information for later analysis. This should include :-

- (a) ATC request for the pilot to select the alternate transponder; and
- (b) ATC to adequately record the circumstances including Flight ID, ICAO Aircraft Address (if readily available) accurate time, Flight plan, and pilot provided information.

5.1.2 Non ATC reported deficiencies

5.1.2.1 Where capability is available, States should also identify non ATC reported deficiencies.

5.1.2.2 Without overlapping radar coverage: ADS-B data may be examined for the following :-

- (a) NUCp of each ADS-B reported position is smaller than required for service delivery for more than 5% of total number of ADS-B updates;
- (b) NIC, NACp, SIL are smaller than required for service delivery for more than 5% of total number of ADS-B updates;

- (c) ICAO Aircraft Address (i.e. I021/080) is inconsistent with the flight planned registration (REG) based on each state's ICAO Aircraft Address allocation methodology;
- (d) Flight ID entered via cockpit interface and downlinked in ADS-B data (i.e. I021/170 in Asterix CAT 21) is a mismatch¹ with aircraft callsign in the ATS Flight Plan;
- (e) Inconsistent vertical rate compared to flight level change; and
- (f) Inconsistency of position reports and presence of "jumps."

5.1.2.3 Overlapping radar coverage: For States that have overlapping radar coverage, a systematic means to monitor and analyze ADS-B could be considered in addition to relying on ATC to report the problem, or utilising the evaluation criteria in 5.1.2.2 above.

This can be achieved by comparing radar information with ADS-B reported position, velocity, flight level and vertical rate change data as well as examining the ADS-B quality indicators and Flight Identification (FLTID) contained in the ADS-B reports.

For each ADS-B flight, its ADS-B data could be compared with its corresponding radar information. For example, this would allow analysis to determine if the following pre-defined criteria are met :-

- (a) Deviation between ADS-B reported position and independent referenced radar position is greater than 1NM², with the indication of good positional quality in the quality indicators for more than 5% of total number ADS-B updates. A sample screen shot of a system performing the analysis automatically is given at Attachment B for reference.

5.2 Managing and Processing Deficiencies

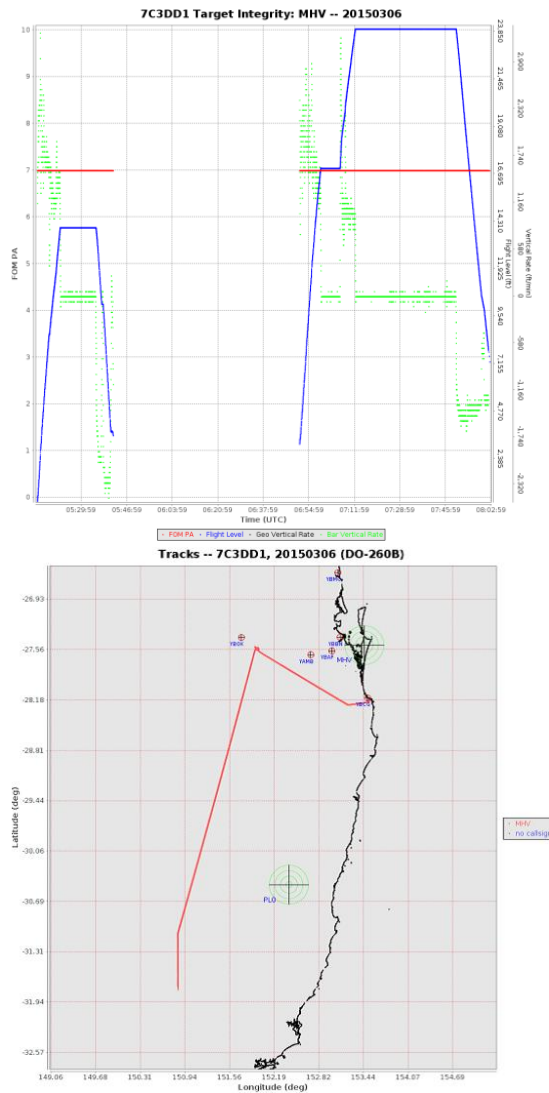
Whether detected by ATC or not, all deficiencies should trigger:

- (a) Systematic recording of the details of each occurrence such as date/time of occurrence, ICAO aircraft address and flight plan information should be obtained. Graphical representations such as screen capture of radar and ADS-B history

¹ A missing Flight ID, or a Flight ID with only "spaces" should not be considered a mismatch.

² For example, the deviation between ADS-B and radar tracks could be set to 1NM in accordance with ICAO Circular 326 defining position integrity ($0.5\text{NM} < \text{HPL} < 1\text{NM}$) for 3NM aircraft separation use, on assumption that radar targets are close to actual aircraft position. The values of ADS-B quality indicators (NUCp, NACp, SIL, NIC) could be chosen based on the definition in ICAO Circular 326 on Position Accuracy and Position Integrity for 3NM aircraft separation minimum. A threshold of 5% is initially set to exclude aircraft only exhibiting occasional problems during their flight journey. The above criteria should be made configurable to allow fine-tuning in future. Evaluation of ADS-B vs radar may alternatively expose radar calibration issues requiring further investigation.

tracks, graphs of NUCp/NIC value changes versus time and deviation between radar and ADS-B tracks along the flight journey would be desirable. Examples of typical graphical representations are shown below :-



- (b) Systematic technical analysis of each detected issue using ADS-B recorded data, to ensure that all detected issues are examined and addressed. Typically this will need:
- systems to record ADS-B data, replay ADS-B data and analyze ADS-B data
 - staff and procedures to analyze each report
 - A database system to manage the status of each event and to store the results of each analysis
- (c) Procedures to support engagement with operators (domestic & foreign), regulators, other ANSPs, Airframe OEMs and avionics vendors to ensure that each issue is investigated adequately and maximize the probability that the root cause of the event is determined. The procedures could include :-

- Data collection procedures;
- Telephone & email contact details; and
- Mechanisms for reporting, as appropriate, to the Asia Pacific ADS-B Avionics Problem Reporting Database (APRD)

* * * * *

Attachment A – List of known ADS-B avionics problems

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
1.	Track Jumping problem with Rockwell Collins TPR901 (See Figure1)	Software issue with TPR901 transponder initially only affecting Boeing aircraft. Does not occur in all aircraft with this transponder. Subsequent investigation by Rockwell Collins has found that the particular transponder, common to all of the aircraft where the position jumps had been observed, had an issue when crossing ± 180 degrees longitude. On some crossings (10% probability), errors are introduced into the position longitude before encoding. These errors are not self-correcting and can only be removed by a power reset of the transponder. The problem, once triggered can last days, since many transponders are not routinely powered down.	Yes. Will present as a few wild/large positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Problem is very “obvious”. Could result in incorrect longitudinal position of Flight Data Record track. Can trigger RAM alerts.	Rockwell Collins has successfully introduced a Service Bulletin that solves the problem in Boeing aircraft. The problem is known to exist on Airbus aircraft. Rockwell has advised that a solution is available in their DO260B upgrade. Rockwell Collins may not have a fix for some time. Workaround solutions are being examined by Airbus, Operators and Airservices Australia. The only workaround identified at this time is to power down the transponders before flight to states using ADS-B – after crossing longitude 180. It can be noted that in Airbus aircraft it is not possible to safely power down the transponder in flight. Airbus have prepared a procedure to support power down before flight. Airservices Australia have negotiated with 2 airlines to enact this procedure prior to flights to Australia. An additional partial workaround is :

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				to ensure that procedures exist for ATC to ask the pilot to changeover transponders if the problem is observed. Since there is a 10% chance of the problem occurring on each crossing of ± 180 degrees longitude, the chance that both transponders being affected is 1%. There is no complete workaround available for flights that operate across 180 degrees longitude directly to destination without replacing the transponder. Airbus advised that a new TPR901 transponder compliant with DO260B is available from December 2015. This new transponder does not have such problem.
2.	Rockwell Collins TDR94 Old version. The pattern of erroneous positional data is very distinctive of the problem. (See Figure 2)	Old software typically before version -108. The design was completed before the ADS-B standards were established and the message definitions are different to the current DO260. Rockwell has recommended that ADS-B be disabled on these models.	Yes. Will present as a few wild positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Also causes incorrect altitude reports. Problem is very “obvious”.	Problem well known. Particularly affects Gulfstream aircraft which unfortunately leave the factory with ADS-B enabled from this transponder model. Rockwell has issued a service bulletin recommending that ADS-B be disabled for aircraft with this transponder software. See Service Information Letter 1-05 July 19, 2005. It is easy to disable the transmission.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
3.	Litton GPS with proper RAIM processing	Litton GNSSU (GPS) Mark 1 design problem. (Does not apply to Litton Mark II). GPS does not output correct messages to transponder.	No. Perceived GPS integrity changes seemingly randomly. With the GPS satellite constellation working properly, the position data is good. However the reported integrity is inconsistent and hence the data is sometimes/often discarded by the ATC system. The effected is perceived extremely poor “coverage”. The data is not properly “protected” against erroneous satellite ranging signals – although this cannot be “seen” by ATC unless there is a rare satellite problem.	This GPS is installed in some older, typically Airbus, fleets. Data appears “Correct” but integrity value can vary. Performance under “bad” satellite conditions is a problem. Correction involves replacing the GNSSU (GPS) which is expensive. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
4.	SIL programming error for DO260A avionics	Installers of ADS-B avionics using the newer DO260A standard mis program “SIL”. a) This problem appears for DO260A transponders, with SIL incorrectly set to 0 or 1 (instead of 2 or 3) b) As the aircraft enters	No. First report of detection appears good (and is good), all subsequent reports not displayed because the data quality is perceived as “bad” by the ATC system. Operational effect is effectively no ADS-B data. Hence no risk.	Would NOT be included in a “black list”. Aircraft with “Dynom avionics” exhibit this behavior. They do not have a certified GPS and hence always set SIL = 0. This is actually correct but hence they do not get treated as ADS-B equipped.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		coverage, the ADS-B ground station correctly assumes DO260 until it receives the version number. c) The transmitted NIC (DO260A) is interpreted as a good NUC (DO260) value, because no SIL message has yet been received. The data is presented to ATC.		
5.	Garmin “N” Flight ID problem (See Figure 3)	Installers of Garmin transponder incorrectly set “Callsign”/Flight ID. This is caused by poor human factors and design that assumes that GA aircraft are US registered.	Yes. Flight ID appears as “N”. Inhibits proper coupling.	Can be corrected by installer manipulation of front panel. Does not warrant “black list” activity.
6.	Flight ID corruption issue 1 – trailing “U” Flight ID’s received : GT615, T615U ,NEB033, NEB033U, QF7550, QF7550U, QF7583, QF7583U, QF7585, QF7585U, QF7585U, QF7594, QFA7521, QFA7531, QFA7531, QFA7531U, QFA7532, QFA7532U, QFA7532W, QFA7550, QFA7552,	TPR901 software problem interfacing with Flight ID source. Results in constantly changing Flight ID with some reports having an extra “U” character.	Yes. Flight ID changes during flight inhibits proper coupling or causes decoupling.	Affects mainly B747 aircraft. Boeing SB is available for Rockwell transponders and B744 aircraft. Rockwell Collins have SB 503 which upgrades faulty -003 transponder to -005 standard. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
	QFA7581			
7.	Flight ID corruption issue 2	ACSS software problem results in constantly changing Flight ID. Applies to ACSS XS950 transponder Pn 7517800-110006 and Honeywell FMC (pn 4052508 952). ACSS fix was available in Sept 2007.	Yes. Flight ID changes during flight inhibits proper coupling or causes decoupling.	Software upgrade available. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
8.	No Flight ID transmitted	Various causes	No. Flight ID not available. Inhibits proper coupling.	Aircraft could “fail to couple with Flight Data Record”. Not strictly misleading – but could cause controller distraction.
9.	ACSS Transponder 10005/6 without Mod A reports NUC based on HFOM.		Yes. Appears good in all respects until there is a satellite constellation problem (not normally detectable by ground systems).	Not approved and hence not compliant with CASA regulations. If known could be added to black list. Configuration is not permitted by regulation.
10.	Occasional small position jump backwards (See Figure 4)	For some older Airbus aircraft, an occasional report may exhibit a small “jump back” of less than 0.1 nm Root cause not known	No. Not detectable in ATC due to extrapolation, use of latest data and screen ranges used.	ATC ground system processing can eliminate these.
11.	Older ACSS transponders report integrity too conservatively	Design error reports integrity one value worse than reality	No. In poor GPS geometry cases the	Can be treated in the same manner as a loss of transponder capability.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
			ATC system could discard the data when the data is in fact useable. Will be perceived as loss of ADS-B data.	
12.	Intermittent wiring GPS transponder	ADS-B transmissions switch intermittently between INS position and GPS position.	Yes. Normally the integrity data goes to zero when INS is broadcast, but sometimes during transition between INS and GPS, an INS position or two can be broadcast with “good” NUC value. Disturbing small positional jump.	If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
13.	Wrong ICAO Aircraft Address	Installation error	No. No direct ATC impact unless a rare duplicate is detected.	This is not a direct ADS-B problem, but relates to a Mode S transponder issue that can put TCAS at risk. Cannot be fixed by black list entry. Needs to be passed to regulator for resolution.
14.	Toggling between high and low NUC (See Figure 5)	Faulty GPS receiver/ADS-B transponder	No. ATC will see tracks appear and disappear discretely. No safety implications to ATC.	While it is normal for NUC value to switch between a high and low figure based on the geometry of GPS satellites available, it is of the view that more should be done to examine this phenomenon. It is observed that such switching between high and low NUC occurs on certain airframe and

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				not on others. The issue was raised to the airlines so as to get a better understanding. On one occasion, the airline replied that a module on their GPS receiver was faulty. On another occasion, the airline replied that one of the ADS-B transponder was faulty. Good NUC was transmitted when the working transponder was in use and poor NUC was transmitted when the faulty ADS-B transponder was in use.
15.	Consistent Low NUC (See Figure 6)	GNSS receivers are not connected to the ADS-B transponders.	No. Data shall be filtered out by the system and not detectable in ATC	Not considered a safety problem but a common phenomenon in the Region – the concerned aircraft will be treated equivalent to “aircraft not equipped with ADS-B”. While it is normal for aircraft to transmit low NUC, it is of the view that “consistent low NUC” could be due to the avionics problem (e.g. GNSS receiver is not connected to the ADS-B transponder). It is recognised that operators may not be aware that their aircraft are transmitting unexpected low NUC / NIC values, due to equipment malfunction. Hence, it is desirable for States to inform the operators

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				when unexpected low NUC values are transmitted, where practicable. Concerned airline operators are required to take early remedial actions. Otherwise, their aircraft will be treated as if non-ADS-B equipped which will be requested to fly outside the ADS-B airspace after the ADS-B mandate becomes effective.
16.	ADS-B position report with good integrity (i.e. NUC >= "4") but ADS-B position data are actually bad as compared with radar (met criteria 5.2(a))	Faulty ADS-B avionics	Yes. As the ground system could not "automatically" discard ADS-B data with good integrity (i.e. NUC value >=4), there could be safety implications to ATC.	The problem should be immediately reported to the concerned CAA/operators for problem diagnosis including digging out the root causes, avionics/GPS types etc., and ensure problem rectification before the ADS-B data could be used by ATC. Consider to "blacklist" the aircraft before the problem is rectified.
17.	FLTID transmitted by ADS-B aircraft does not match with callsign in flight plan (see Figures 7a – 7d)	Human errors	Yes. Could lead to screen clutter - two target labels with different IDs (one for radar and another for ADS-B) being displayed, causing potential confusion and safety implications to ATC.	Issue regulations/letters to concerned operators urging them to set FLTID exactly match with callsign in flight plan.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
18	B787 position error with good NIC	<u>Issue 1:</u> Software issue - surveillance system inappropriately “coasts” the position when data received by the transponder is split across multiple messages. System seems to self correct after some time. Can be corrected by surveillance system power off. <u>Issue 2:</u> Data packets were not being distributed to the transponder when the internal timing between different elements of the Integrated Surveillance System became synchronized.	Yes. Misleading position presentation which is typically detected by ATC observing aircraft “off track” when in fact it is “on-track”.	Boeing performed a change to the B787 Type Certificate for incorporation of the upgraded ISS software in March of 2017. All B787 aircraft delivered after Line number 541 have the upgraded ISS software which corrects this issue. Boeing released Service Bulletin B787-81205-SB340036-00 on 30 June 2017. Note that this Service Bulletin is available at no cost to the operator, and includes the concurrent requirement to implement Boeing Service Bulletin B787-81205-SB340005-00. On 5 Nov 2018, FAA issued Airworthiness Directive 2017-NM-118-AD, effective 10 Dec 2018, which requires application of Boeing SB B787-81205-SB340036-00 by 10 Dec 2019. EASA has invoked this AD for States under its jurisdiction. States and Operators are urged to implement the service bulletin immediately and report to FAA or ICAO APAC Office. As of 9 Sep 2020, 32 B787 aircraft were on the NSAL; 18 of these

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				aircraft have been detected within U.S. ADS-B coverage during 2020. The FAA is coordinating with State Regulators who have operators with B787 aircraft on the NSAL.
19	A number of airlines have reported or experienced ADS-B outages for complete flight sectors in A330 aircraft. Appears as low reliability ADS-B and has afflicted both A & B side at same time.	Being actively investigated. One airline has implemented on-board recording which confirms that the MMRs are not providing HIL/HPL to the transponder whilst continuing to provide HFOM, GPS alt etc	No. Equivalent to a failed transponder.	Aircraft must be managed procedurally if outside radar coverage.
20	A380 flight ID lost after landing	For the A380 fleet, it has been confirmed that for some seconds after landing, the flight ID is set as invalid by FMS to AESS. Consequently, the current AESS design uses, as per design, the Aircraft Registration Number as a back-up source for A/C flight identification field in ADS-B broadcast messages.	No.	The correction to this logic is planned for next AESS standard release; planned for 2017.” Only a problem for arriving aircraft on surface surveillance systems.
21	A350 ADS-B On-ground Performance	On departure, A350 aircraft will initially use INS derived position for ADS-B reports when taxiing and only use GNSS when entering the runway. INS positions can	Yes. where ADS-B is used for surface movement display	Airbus is in discussion with FAA and EUROCONTROL about this issue.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		drift leading to inaccurate position reports.		
22	Incorrect Ground Bit Setting (GBS) in both Mode S Interrogation Reply and ADS-B Downlink	Occasionally, some airborne aircraft will incorrectly set ground bit as “1” meaning they are on ground, while some landed aircraft incorrectly set ground bit as “0” meaning they are airborne. This could confuse the ATC system, by not showing the airborne targets as the system thought they are on ground, or forming tracks for landed targets triggering alarms against other taking-off aircraft.	Yes. Misleading information shown on ATC system. Aircraft not visible to TCAS and will not reply to all-call interrogations.	States/Administrations contact the concerned airline operators for remedial actions.
23	Rockwell TSS-4100 track extrapolation issue.	The TSS-4100 shares software with the Rockwell Collins ISS transponder in the B787, and the software defect in the B787 ISS reported at SURICG/2 also exists in the TSS-4100.	Yes. Misleading position presentation which is typically shown on ATC system.	FAA Airworthiness Directive (AD) 2017-22-14 was issued on 20 Dec 2017. The compliance date for this AD is 20 Dec 2018 (or 750 hours in service, whichever occurs first). FAA has not detected any aircraft with this issue since the AD compliance date and will not further report on it, as it is considered resolved.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
24	Embraer 170 track jumping issue	Unknown as being a random, occasional issue with no clear fault diagnosis available from Honeywell. FAA has decided that when the next E170 aircraft is detected with this issue, it will be immediately placed on the FAA's No Services Aircraft List (NSAL). Simultaneously, FAA will notify Embraer and Honeywell of the affected aircraft and request that appropriate engineering personnel be sent to inspect and test the affected aircraft.	Yes. Misleading position presentation which is typically shown on ATC system.	In all of the cases of this issue to date, removing and replacing the transponders cleared whatever the issue was. This issue has never recurred on the same aircraft. Bench testing by Honeywell avionics engineering of the removed transponders has revealed no faults or anomalies. As such, States/Administrations to consider removing and replacing the transponders concerned if issue observed. The FAA has since learned from discussions with the OEM that most recent events detected by FAA generated an "ADS-B NOT AVAIL" Crew Alerting System (CAS) message. When flight crews report this message, airline maintenance replaces the transponder(s), which resolves the problem. To date, this has consistently occurred before FAA monitoring detected the problem and engaged with the airline. The root cause for this issue remains unknown.
25	Airbus Single Aisle production wiring issue	FAA has observed 17 Airbus Single Aisle aircraft from two airlines with missing	No.	Airbus released three Service Bulletins to correct this issue, which existed in 128 Airbus Single Aisle

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		Length-Width Codes (LWC is a message element in DO-260B/ED-102A that is required by both the US and European mandates). FAA believes that this was a production line wiring issue.		aircraft. As of 1-Dec-2018, all of the aircraft which operate at US airports with ADS-B surface surveillance were corrected. The FAA will not further report on this issue.
26	Boeing 777-300ER production wiring issue	FAA has observed at least 10 Boeing B777-300ER aircraft with missing or improper NACv/SDA/eCat/LWC message elements (these are message elements in DO-260B/ED-102A that are required by both the US and European mandates (eCat is FAA shorthand for Emitter Category). After notification, Boeing reported to FAA that this was a production line parity pin wiring issue.	No.	On 7 July 2017, Boeing released Service Bulletin SB 777-34-0281 to correct this issue. Boeing has informed FAA that all affected B777 operators have been notified. The FAA will not further report on this issue.
27	Rockwell TSS-4100 Geometric Altitude Reporting as Pressure Altitude	This issue exists in any TSS-4100 installed with TSSA-4100 software RCPN 810-0052-100, RCPN 810-0052-101, or RCPN 810-0052-102. All of the following must be true for the issue to occur: (1) TSS is the selected transponder;	Yes.	At present, the FAA regulator has determined that this issue occurs too rarely to warrant issuing an Airworthiness Directive or a Special Airworthiness Information Bulletin (SAIB). Rockwell Collins has released updated software, RCPN 810-0052-110, to address this issue. Refer to

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		(2) TSS is receiving valid pressure altitude; (3) TSS is receiving valid GPS data with an integrity of NIC 9 or better; and (4) The mode of operation for the transponder must be "ALT OFF". Note that in an SBAS service area, only condition (4) would be considered uncommon. When the issue exists, the TSS will insert geometric altitude information into the ADS-B Airborne Position Squitter, but this altitude will be encoded as if it were pressure altitude. The net effect is that, when this issue occurs, the TSS-4100 reports geometric altitude information as if it were pressure altitude. In many cases, this will be incorrect altitude information.		SIL TSSA-4100-10-1 titled, "TSSA-4100 Field Loadable Software", RCPN 523-0818785.
28	NACv reporting greater	The FAA has detected a	No.	While there is no known urgent issue

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
	than 2	number of aircraft which consistently report NACv = 3 and NACv = 4. Per FAA AC 20-165B section 3.3.3.7.3, “A NACv = 3 or NACv = 4 should not be set based on GNSS velocity accuracy unless you can demonstrate to the FAA that the velocity accuracy actually meets the requirement.” EASA CS-ACNS states that “There is currently no established guidance on establishing a NACv performance of ‘three’ or better.” Therefore, it appears that there are improperly configured ADS-B installations operating in the U.S.		with these findings, as no known ATC or airborne application requires NACv values exceeding two, FAA does have long-term intentions of deploying surveillance tracking and alerting prediction algorithms in ATC automation which will use real-time NACv values. ICAO States planning to make similar improvements should be aware of this situation.
29	B787 NACv = 0 Issue	FAA noted certain B787s exhibiting a relatively high percentage of NACv =0 reports. Starting with line number 442 (June 2016), Honeywell Integrated Navigation Receiver (INR) P/N 940-	No.	The erroneous NACv=0 condition clears at the next power up of the ISSPU. Boeing has issued guidance urging B787 operators to not intermix INR P/N 940-2001-002 or -004 (which do not output HFOMv) with INR P/N 940-2001-008 (which does output

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		2001-008 was introduced, which has an HFOMv output. Boeing investigations revealed a software flaw in the ISSPU that causes an erroneous NACv=0 reporting condition on B787s equipped with a mixed set of Honeywell INR part numbers. This condition occurs when the ISSPU switches between an INR with an HFOMv output and an INR without an HFOMv output.		HFOMv) until the ISSPU software has been updated per an available Boeing Service Bulletin. This guidance was provided in Boeing Fleet Team Digest 787-FTD-34-19005 (dated 21 Dec 2019). As of 9-Aug-2020, FAA has observed no significant occurrences of this issue within U.S. ADS-B coverage during the prior two months.
30	Honeywell Primus II RCZ issue	FAA observed that a number of operators equipped with the Honeywell Primus II integrated system were filing flight plans as ADS-B equipped, but not transmitting ADS-B. Honeywell had identified an issue where the ADS-B Out capable RCZ transponder and Radio Management Unit (RMU) components of the Primus II system will not broadcast ADS-B data if powered on under specific conditions. Also, the Radio	No	In October 2015, Honeywell released a Service Information Letter (Publication Number D201507000061) to notify customers of these power up conditions, the effect it would have on the Primus II equipment, and a potential work around to address the problem. In December 2019, Honeywell released Service Bulletin (SB) (Publication Number A21-2254-148) providing required modifications for the RMU to correct the ON/OFF logic for the ADS-B Out functionality.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		Management Unit (RMU) will fail to notify the flight crew that ADS-B Out functionality is disabled.		The FAA has been working in collaboration with Honeywell to update the existing Service Information Letter to emphasize the importance of updating the RMU with the latest SB, to include implementing the option of configuring the ADS-B Out installation through a strap setting to provide indication of the ON/OFF control of ADS-B to the flight crew. The latest revision of the Service Information Letter will be referenced as part of the FAA issued Special Airworthiness Information Bulletin (SAIB) expected to be released before the end of December 2021.



Figure 1 - Track Jumping problem with TPR901



Figure 3 - Garmin "N" Flight ID problem

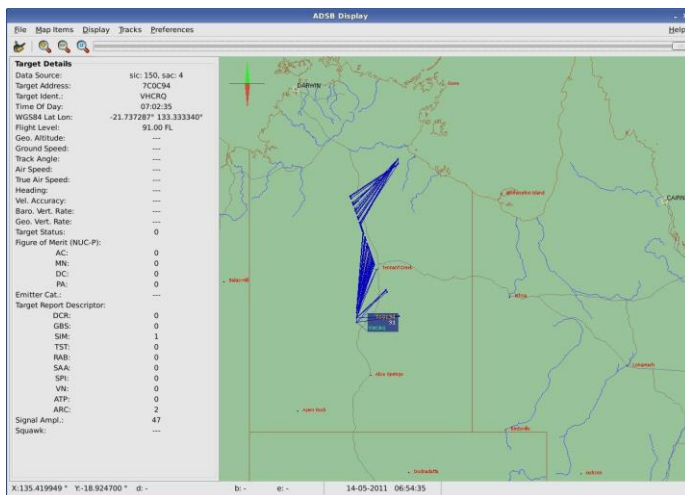


Figure 2 - Rockwell Collins TDR94 Old version. The pattern of

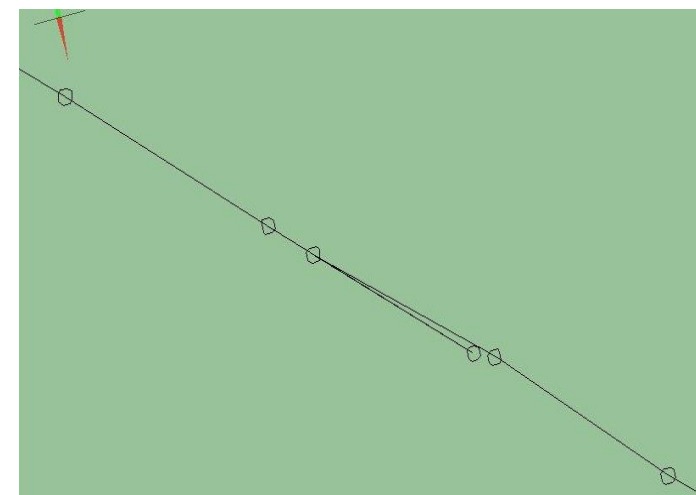


Figure 4 - Occasional small position jump backwards

erroneous positional data is very distinctive of the problem

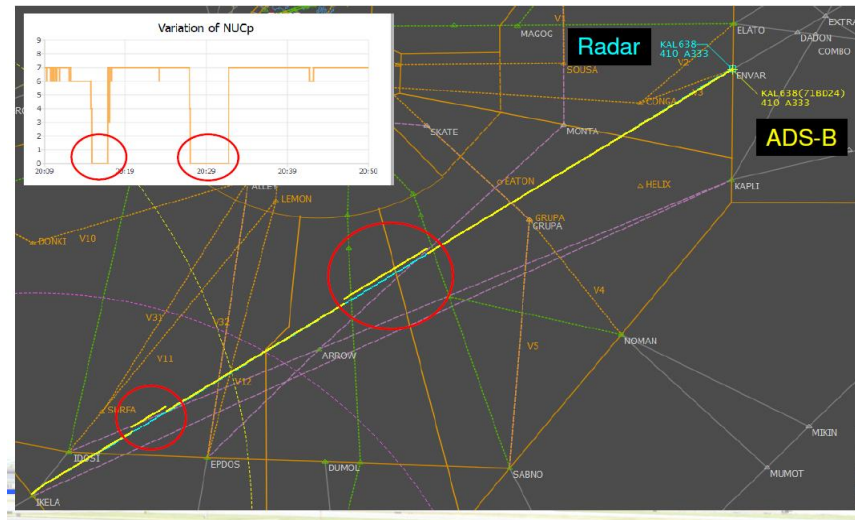


Figure 5 - NUC value toggling

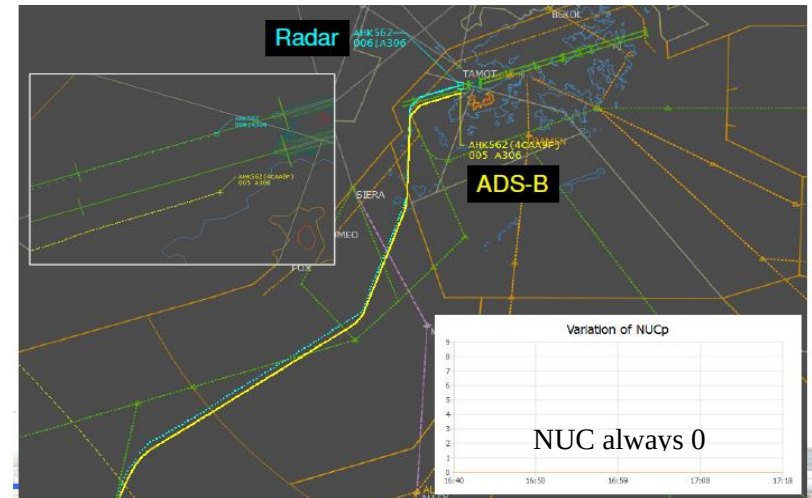


Figure 6 – Consistent low NUC

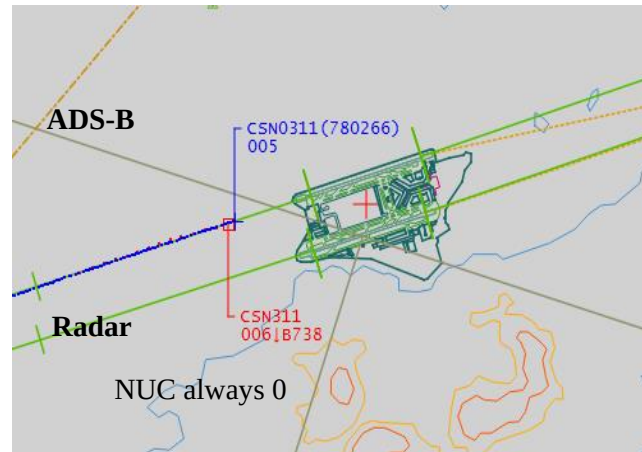


Figure 7a - Additional zero inserted

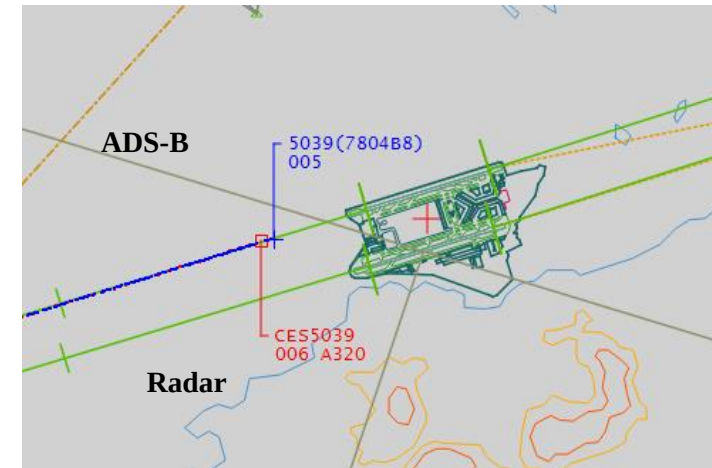


Figure 7b - ICAO Airline Designator Code dropped

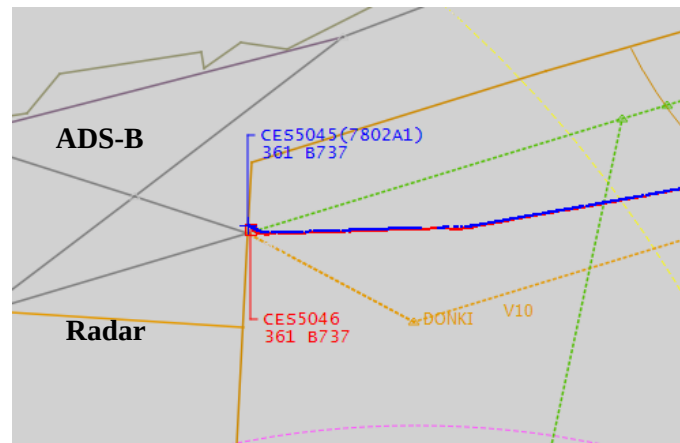


Figure 7c - Wrong numerical codes entered

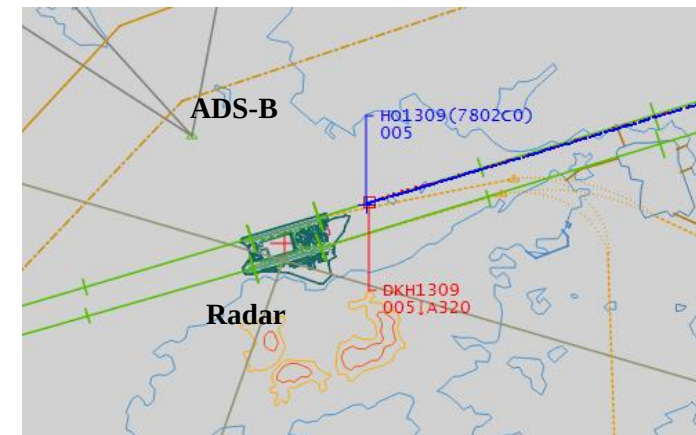
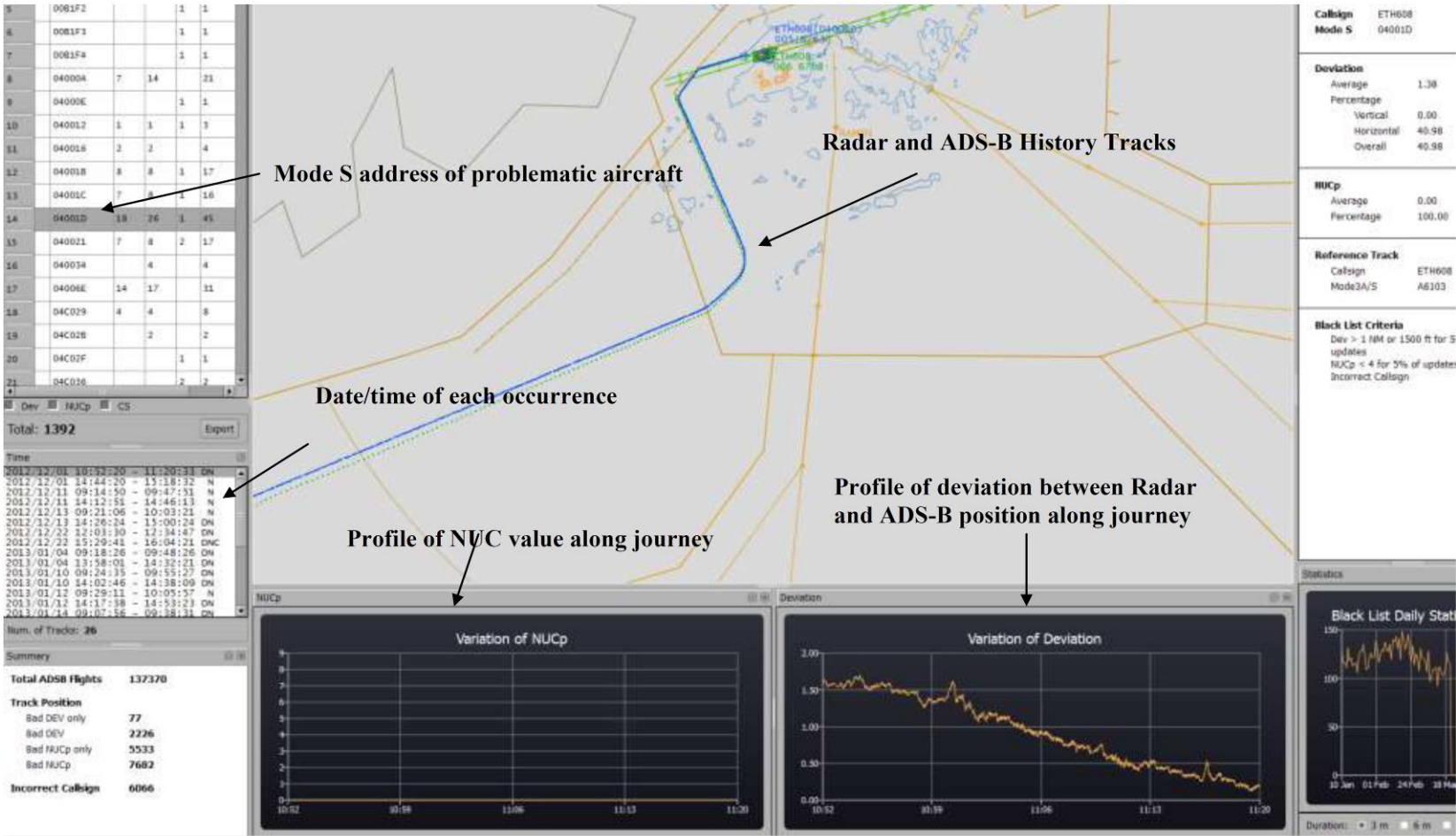


Figure 7d - IATA Airline Designator Code used

Attachment B - Sample screen shot of a system to monitor and analyse performance of ADS-B avionics



A Template for ADS-B Mandate/Regulations for Aircraft Avionics

- (1) On and after dd/mm/yyyy, if an aircraft carries 1090MHz extended squitter (1090ES) ADS-B transmitting equipment for operational use in xxxxxxxx territory, the equipment must have been certificated as meeting :¹
- (a) European Aviation Safety Agency - Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHz Extended Squitter (AMC 20-24), or
 - (b) European Aviation Safety Agency - Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance Subpart D — Surveillance (SUR) (CS-ACNS.D.ADS-B), or
 - (c) Federal Aviation Administration – Advisory Circular No: 20-165A (or later versions) Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) Out Systems, or
 - (d) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia.
- (2) On and after dd/mm/yyyy, if an aircraft operates on airways (insert routes).....at or above FLXXX.....(or in defined airspace boundaries at or above FLXXX):²

The aircraft must carry serviceable 1090MHz extended squitter (1090ES) ADS-B transmitting equipment that has been certificated as meeting :-

- (a) European Aviation Safety Agency - Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHz Extended Squitter (AMC 20-24), or
 - (b) European Aviation Safety Agency - Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance Subpart D — Surveillance (SUR) (CS-ACNS.D.ADS-B), or
 - (c) Federal Aviation Administration – Advisory Circular No: 20-165A (or later versions) Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) Out Systems, or
 - (d) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia.
- (3) An aircraft carrying 1 090 MHz extended squitter (1090ES) ADS-B equipment shall disable ADS-B transmission unless:
- (a) the aircraft emits position information of an accuracy and integrity consistent with the transmitted value of the position quality indicator; or
 - (b) the aircraft always transmits a value of 0 (zero) for one or more of the position quality indicators (NUCp, NIC, NACp or SIL); or

¹ This paragraph ensures all aircraft operating in the airspace, if equipped with ADS-B, are compliant to standards.

² This paragraph provides mandate requirements within certain parts of the airspace

- (c) the operator has received an exemption granted by the appropriate ATS authority.

Note: States are urged to include at least the standards stated in the template. States may include other standards allowed by the State's regulations.

An Example of Advice to Operators Concerning Inconsistency Between ADS-B Flight Planning and Surveillance Capability

1 Background

Newer technologies for aircraft surveillance are now available – such as Mode S and ADS-B – which in many aircraft are installed as replacements for older Mode A/C transponders.

Air Traffic Control makes use of these new capabilities, and uses the Flight Plan information as a decision support tool – to allow the Air Traffic Controller to predict the surveillance capability of a particular aircraft before it enters radar or ADS-B coverage.

Requirements for ADS-B and Mode S (**insert local reference document if applicable**) may mean that if flight planning does not accurately reflect the aircraft capability, services may be withheld (for example if ADS-B is mandatory, but not indicated on the flight plan – **this section to be modified for local requirements**).

2 Flight Planning Requirements for Transponder and ADS-B

The flight planning requirements for aircraft are described in (**local document reference or ICAO DOC 4444 Appendix 2**) and repeated below.

Surveillance Equipment

N if no surveillance equipment for the route to be flown is carried, or the equipment is unserviceable

OR

INSERT one or more of the following descriptors, to a maximum of 20 characters, to describe the serviceable surveillance equipment and/or capabilities on board:

SSR Modes A and C

A Transponder — Mode A (4 digits — 4 096 codes)

C Transponder — Mode A (4 digits — 4 096 codes) and Mode C

SSR Mode S

E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability

H Transponder — Mode S, including aircraft identification, pressure-altitude and enhanced surveillance capability

I Transponder — Mode S, including aircraft identification, but no pressure-altitude capability

L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability

P Transponder — Mode S, including pressure-altitude, but no aircraft identification capability

S Transponder — Mode S, including both pressure altitude and aircraft identification capability

X Transponder — Mode S with neither aircraft identification nor pressure-altitude capability

Note : Enhanced surveillance capability is the ability of the aircraft to down-link aircraft derived data via a Mode S transponder.

ADS-B

B1 ADS-B with dedicated 1 090 MHz ADS-B “out” capability¹

B2 ADS-B with dedicated 1 090 MHz ADS-B “out” and “in” capability¹

U1 ADS-B “out” capability using UAT

U2 ADS-B “out” and “in” capability using UAT

V1 ADS-B “out” capability using VDL Mode 4

V2 ADS-B “out” and “in” capability using VDL Mode 4

3 Additional information

The capability of your aircraft transponder, and ADS-B capability, will typically be available in the transponder manual, or in the aircraft flight manual for the aircraft. For General Aviation aircraft, the most common configurations for filing in the flight plan item 10b will be (listed in order of capability).

EB1 – An ADS-B equipped aircraft would typically file this to indicate the Mode S transponder capability with ADS-B out.

S – The majority of Mode S transponders (without ADS-B) will support pressure altitude information and Flight ID transmission.

C – For aircraft with an older Mode A/C transponder – most of which provide pressure altitude capability.

Less common configurations in General Aviation will include:

¹ Based on current version of ICAO Doc 4444

H, LB1 or LB2 – Enhanced surveillance capability is more usually associated with higher end aircraft. ADS-B IN (B2) is relatively rare at this time, but may be available for some aircraft.

I, P or X – Most Mode S transponders will support Flight ID and pressure altitude, so these configurations are not common.

A – some low end GA aircraft may not provide pressure altitude information.

U1 or U2 – these ADS-B technologies are only authorized in a limited number of countries in the Asia Pacific Region.

Planning designations not to be used in Asia Pacific:

V1 or V2 – these ADS-B technologies are not authorised for use in Asia Pacific Region.

Remember:

Always flight plan the correct surveillance capability for your aircraft. If in doubt, consult the transponder manual, aircraft flight manual, or your Licenced Aircraft Maintenance Engineer.

Checklist of Common Items or Parameters for the Monitoring of ADS-B System

1 ADS-B Ground Station

Site Monitoring

- Receiver Sensitivity
- Antenna Cable
- GPS Health
- Coverage Check
- Probability of Detection
- Station Service Availability
- Receiver Status

Remote Control & Monitoring (RCMS)

- CPU Process Operation
- Temperature
- ASTERIX Output Load and Link Status
- Time Synchronization
- GPS Status
- Power Status
- Site Monitor Status
- Memory Usage
- Software Version (Operating System and RCMS Application)

Logistic Support Monitoring

- Record all failures, service outage and repair/return to service times

2 ADS-B Equipage Monitoring

- Update and maintain list of ADS-B equipped airframe details database
- Identify aircraft non-compliant to regional mandate

3 ADS-B Avionics Monitoring

- Track Consistency
- Valid Flight ID
- Presence of NACp/NIC/NUC Values
- Presence of Geometric Altitude
- Correctness of ICAO Aircraft Address

- Avionics Configuration and Connections
- Update and maintain list of aircraft with faulty avionics

4 ADS-B Performance Monitoring

- Percentage of aircraft with good integrity reports
- Accuracy of ADS-B Horizontal Position (Based on a reference sensor)
- Deviation between Geometric and Barometric Height
- Monitor the number of position jumps
- Message interval rate

5 ADS-B Display on ATC Display

- Split Track – ADS-B reported position might be off
- Coupling Failure – Wrong aircraft ID
- Duplicated ICAO Aircraft Address
- Display of data block

BASELINE ADS-B SERVICE PERFORMANCE PARAMETERS

The following table provides guidelines for various performance requirements of ADS-B Category (Tier) 1, 2 or 3 services that States may consider when acquisition of an ADS-B managed service agreement with a service provider:

Service Parameter	Guidance	Category 1 (Tier 1) 5Nm separation capable commensurate with Radars (separation/vectoring/high performance with reliability, integrity & latency)	Category 2 (Tier 2) Situational awareness similar to ADS-C (safety-net alerts, SAR, supports procedural separation without voice, not 5nm separation)	Category 3 (Tier 3) Position Reporting with Enhanced Flight Operation
Aircraft Updates	Recommended	0.5 second < Interval < 5 seconds as Operationally required	0.5 second < Interval < 20 seconds as Operationally required	0.5 second < Interval < 60 seconds as Operationally required
	Maximum	0.5 second < Interval < 10 seconds as Operationally required		
Network Latency	Recommended	95%: < 2 seconds of receiver-station output	95%: < 15 seconds of receiver-station output	95%: < 60 seconds of receiver-station output
Reliability 1	Recommended	2 autonomous receiver-stations including antenna, each providing data, no common point of failure	1 unduplicated receiver-station including antenna	1 unduplicated receiver-station including antenna
Reliability 2 - MTBF	Recommended	Each receiver-station including antenna to have MTBF >10,000 hrs	Each receiver-station including antenna to have MTBF >10,000 hrs	Each receiver-station including antenna to have MTBF >10,000 hrs
Reliability – Communications Infrastructure	Recommended	Completely duplicated, no common point of failure	Unduplicated, MTBF > 400 hrs	Unduplicated, MTBF> 200 hrs
Reliability – Total ADS-B Service	Recommended	Total Service MTBF >50,000 hrs	Total Service MTBF > 400hrs	Total Service MTBF> 200 hrs
Availability – Total ADS-B Service	Recommended	Total Service Availability > .999	Total Service Availability >.95	Total Service Availability >.90

Service Parameter	Guidance	Category 1 (Tier 1) 5Nm separation capable commensurate with Radars (separation/vectoring/high performance with reliability, integrity & latency)	Category 2 (Tier 2) Situational awareness similar to ADS-C (safety-net alerts, SAR, supports procedural separation without voice, not 5nm separation)	Category 3 (Tier 3) Position Reporting with Enhanced Flight Operation
Integrity – Ground Station	Recommended	Site monitor System Monitoring	Site monitor System Monitoring	System Monitoring
	Minimum	System Monitoring	Not required	Not required
Integrity – Data Communications & Processing	Recommended	All systems up to ATM system, errors < 1 x 10E-6	All systems up to ATM system, errors < 1 x 10E-6	All systems up to ATM system, errors < 1 x 10E-6

The choice of category (tier) could be based upon a number of factors including the following,

- a) The desired service
- b) The available budget
- c) The available ATC automation system & its capabilities and/or interim display systems
- d) ATC training and ratings
- e) Availability of appropriately tailored ATC procedures

States could initially choose one level and transition to another at a later time. For example, Category (Tier) 2 could be used to add additional safety nets/situational awareness and gain operational experience during the initial stage, moving later to a full separation service using Category (Tier) 1.

Note: The Performance Based Surveillance Sub Group of the ICAO Surveillance Panel is reviewing performance standards for surveillance systems generally. A future update to the requirements in the above table may be based on the outcomes of that panel.

**GUIDANCE MATERIAL ON
GENERATION, PROCESSING & SHARING of ASTERIX
CATEGORY 21 ADS-B MESSAGES
(Including Attachments A, B, C & D)**

1. INTRODUCTION

1.1 The “All Purpose Structured Eurocontrol Surveillance Information Exchange” (ASTERIX) Category 21 is a data format standard globally accepted by the Air Traffic Management (ATM) system manufacturing industry for sharing of ADS-B data with ATM automation system.⁸ Asterix Category 21 data is used to convey ADS-B data from ADS-B receiver stations to ATC processing and display system. This guidance material discusses various aspects of this process. Since the ASTERIX Category 21 edition 0.23 was issued in November 2003, it has undergone continuous revisions with some 19 subsequent editions. The focus of this guidance material is to concentrate on 1090ES ADS-B data using:

- a) RTCA DO-260 (Version 0);
- b) RTCA DO-260A (Version 1); and
- c) RTCA DO-260B (Version 2)

1.2 The ASTERIX Category 21 edition 1.0 issued in August 2008 fully incorporated the DO260A standard while edition 2.1 issued in May 2011 fully incorporated the latest DO260B standard. The latest edition (as at April 2018) is edition 2.4.

2. ASTERIX CAT 21 IN ASIA AND PACIFIC REGIONS

2.1 To ensure interoperability of ADS-B receiver stations in the Asia Pacific (ASIA/PAC) Regions, during the 16th APANPIRG Meeting held in August 2005, the ASTERIX Category 21 edition 0.23 which had incorporated DO260 standard was adopted as the baselined ADS-B data format for deployment of ADS-B receiver stations and sharing of ADS-B data in the ASIA/PAC Regions. At that time DO260A and DO260B standards were not defined.

3. CHOICE OF ASTERIX VERSION NUMBER

3.1 The Asterix standard has been developed over many years. Stability in the standard is desirable so that ADS-B receiver station designers and ATM automation designers and manufacturers can build interoperable systems with confidence. Because ADS-B technology has been evolving over the years, and will continue to do so, it is not surprising that the Asterix standard has also developed along with the ADS-B link technology standards to grasp the best benefits of its intended design.

3.2 During 2005, Asia Pacific decided to use Ed0.23 as the edition for sharing ADS-B data between states. This version provides adequate information so that useful ATC operational services can be provided including ATC 3 nautical mile and 5 nautical mile separation services. Ed0.23 can be used with DO260, DO260A and DO260B ADS-B avionics/receiver stations to provide basic ATC operational

services. However, Ed0.23 cannot fully support all the capabilities offered by DO260A and DO260B.

3.3 Nearly all Ed0.23 data items can be “re-constructed” from a received Ed2.1 data stream. However, most of the special DO260A/B data items cannot be “re-constructed” from an Ed0.23 data stream. In terms of domestic use and data sharing with other ANSPs concerning ADS-B data, several options exist for ANSPs as follows:

Option	Domestic use	Data sharing
1	Ed0.23	Ed0.23. This is the default and basic standard.
2	Ed2.1	Ed0.23. This will require some conversions to occur, probably through an ADS-B format conversion and filter system (see Paragraph 11), between a domestic system and a foreign system. Difficulties may exist if the domestic ATM system requires special DO260A/B data items, since they cannot all be re-constructed from the external foreign Ed0.23 data stream.
3	Ed2.1	Ed2.1. Must negotiate bilaterally with data sharing partner regarding exact version to be used to achieve the intended functions.

Note: In this table, Ed2.1, a later DO260B compliant Asterix Cat 21 edition, is chosen as a representation of an Asterix Cat 21 edition after Ed0.23. There exists other Asterix CAT 21 editions (e.g. 0.26, 1.3, 2.4 etc.) after Ed0.23 that could be used by ANSPs for domestic and data sharing use.

4. SPECIFICATION OF ASTERIX MESSAGE PROCESSING

4.1 Care is needed to understand the difference in specifications :

4.2 **Asterix Cat 21:** Defines the characteristics of the data ON the interface including fields that are mandatory on the interface.

4.3 **ADS-B receiver station specifications:** To define the Asterix standard, the ANSP must also define which optional Asterix data items are required to be delivered on the Asterix interface, when the appropriate data is received from the aircraft. It is desirable that suppliers be required to:

- a) indicate how the receiver station processes and outputs every received DO260, DO260A and DO260B data element into an Asterix data element/field; and
- b) indicate which and how each Asterix data element and field presented at the output are populated.

4.4 **ATM automation system specifications:** Defines which received Asterix data element and fields are processed and how they are processed. Also defines which Asterix optional data fields are required by the ATM automation systems (if any). ANSPs that specify ADS-B receiver stations and ATM automation systems need to consider carefully and clearly about what they desire to achieve. Specifications which simply require compliance with a particular Asterix edition will be

⁸ FAA utilise Asterix Cat 33 for ADS-B message distribution.

inadequate in most circumstances. In particular ANSPs, together with their suppliers should :

- a) Specify the Asterix standard edition to be used. This defines the message formats that are placed on the link between ADS-B receiver station and downstream systems like ATM automation, recording & analysis systems, bypass ATC systems and foreign ANSPs. The edition will define which messages elements are mandatory in each message (very few fields) and a large number of optional fields. The optional fields can only be filled if relevant data is received from the aircraft. The optional fields will only be filled if the receiver station specification requires them to be filled.
- b) Specify the ADS-B receiver station behaviour so that when data is received from the aircraft, the receiver station is required to fill appropriate optional Asterix data fields.
- c) Specify the ATM automation system behaviour including appropriate semantic and syntax checks applied to the Asterix data, including any triggers for the system to discard data. The processing applied to each received Asterix data field should be specified. The ATC system should discard any messages with unexpected Asterix categories without discarding messages with known and defined Asterix categories.

5. MANDATORY FIELDS : ASTERIX AND 1090ES ADS-B

5.1 Asterix Cat 21 has been designed to support multiple datalinks. It has been defined to support data fields which are not available in the 1090ES standards. Therefore some data items and fields are not relevant when 1090ES is used.

5.2 The standard itself defines various items as optional or mandatory. This is defining what is ON the interface. It does NOT specify the behaviour of the transmitting receiver station nor the behaviour of the receiving ATM automation system.

5.3 When a single link technology has been chosen it may be sensible to diverge from the formal Ed0.23 standard to reduce the required Asterix datalink bandwidth. E.g.: in an environment with only 1090ES, it is unnecessary to transmit “Link Technology Indicator”. Asterix Cat 21 Ed 2.1 allows this selection.

Data Items	Description	Mandatory (M) or Optional (O) items as per ASTERIX Category 21	
		Version 0.23 Specification	Version 2.1 Specification
I021/010	Data Source Identification	M	M
I021/030	Time of Day	M	N/A
I021/071 or I021/073	Time of Applicability of Position or Time of Message reception for position	N/A	One of these is must be transmitted
I021/040	Target Report Descriptor	M	M
I021/080	Target Address	M	M
I021/210	Link Technology Indicator/MOPS version	M	O

6. GENERATION OF ASTERIX AT AN ADS-B RECEIVER STATION

6.1 The following general principles should be adopted:

6.2 Commensurate with link bandwidth availability, transmit all mandatory Asterix data items and also transmit those Asterix data items that are operationally desirable. That is, when the appropriate aircraft transmission is received by the ADS-B receiver station, the data should be transmitted to the ATC system for operational use or for technical recording and analysis use. If no aircraft transmission data is received to fill an Asterix data item during any update cycle, the data item should not be included in the Asterix data stream to reduce bandwidth requirements.

6.3 **Group 1 (Mandatory Data Items):** An Asterix Cat21 message should not be transmitted unless the mandatory data items defined in Appendix A are all present.

6.4 **Group 2 (Desirable Data Items) :** The data items defined in Appendix B are operationally desirable which should always be transmitted in the Asterix Cat 21 messages whenever the data are received by the 1090ES receiver station from aircraft (if allowed by the relevant Asterix standard chosen).

6.5 **Group 3 (Optional Data Items) :** The data items defined in Appendix C are considered optional and may or may not need to be transmitted depending on availability of such data from aircraft and/or other specific operational needs.

6.6. **Group 4 (Future Data Items):** The following data are defined in the DO260A and DO260B standards but are not yet defined in the Asterix standard. This group is provided for information only. It illustrates the need for system designers to provide for future adaptability when possible and when cost effective to do so. Not only will the Asterix standard continue to evolve, but changes to DO260 can also be anticipated within the decade.

- a) Target heading: Information from DO260A/B Target state and status

messages (On condition messages). These could be used for detection of pilot errors in selection of heading/altitude; and

- b) GPS Offset: Could be used to more accurately display aircraft position on an airport surface, or better detect that an aircraft has passed an airport hold point.

6.7 When developing a specification for an ADS-B receiver station, it is considered necessary that the specification requires the transmission of all data items that are operationally desirable (Group 2), when such data are received from the aircraft, in addition to the data items that are mandatory (Group 1) in Asterix messages. Whether Group 3 optional data items will need to be transmitted or not should be configurable on item-by-item basis within the ADS-B receiver station depending on specific operational needs.

7. PROCESSING OF ASTERIX ADS-B DATA AT THE ATC SYSTEM

7.1 An Asterix Cat21 message should not be accepted by the ATC system for processing unless it includes at least all the Group 1 data items.

7.2 The ATC system should process all received Asterix Cat21 message data items that bring operational benefits (i.e. Group 2 data items). An ATM automation specification should require that the system appropriately process those Group 2 data items depending on specific operational need. Whether the ATC system will process Group 3 optional data items will depend on specific operational needs.

8. DATA SHARING OF ASTERIX ADS-B DATA

8.1 In principle, all data receiving from the shared ADS-B receiver station should be delivered to the receiving party as far as practicable without filtering, unless owing to technical reasons such as the need to convert the data from one ASTERIX format to another, or it is requested by the receiving party of the data.

8.2 It is considered necessary that all data items that are mandatory in Asterix messages (i.e. Group 1 data items) and operationally desirable (i.e. Group 2 data items) when such data are received from aircraft, should be included in data sharing. In the event that the data have to be filtered, the list of optional data items (i.e. Group 3 data items) needs to be shared will be subject to mutual agreement between the two data sharing parties concerned.

9. ISSUE RELATED TO DO260A

9.1 Support of DO260A using Asterix Cat 21 Ed0.23

- a) DO260A was developed after Ed0.23 of Asterix was defined. Therefore, Ed0.23 does not directly support DO260A. However, receiver station software can generate useful Ed0.23 Asterix data from DO260A reports through use of the following techniques;

- b) A useful I021/090 Figure of Merit can be generated from DO260A messages. Some implementations have a table, which defines the FOM/PA to be generated for each combination of SIL, NIC and NAC. The contents of the table can be offline defined to generate the appropriate FOM/PA values. The downstream ATC system can then process DO260A reports as if they were DO260 reports; and
- c) If there is a particular need for the ATC system to have access to the NIC/NAC or SIL or other data item that exist in DO260A (but not in DO260), then users may need to consider a more recent version of Cat 21.

9.2 Support of DO260A using Asterix Cat 21 Ed 1.0 or Ed 2.1 (or later versions)

- a) When DO260A is used, then the ANSP could decide to use Asterix Cat 21 Ed 1.0 (or later versions) or Ed 2.1 (or later versions); and
- b) Readers are invited to carefully examine the DO260A fields (see Appendix D) to determine if the benefits of additional DO260A fields are large enough to warrant adoption of Asterix Cat 21 Ed 1.0 (or later versions) or Ed 2.1 (or later versions).

10. ISSUE RELATED TO DO260B

10.1 Support of DO260B using Asterix Cat 21 Ed 0.23

- a) DO260B was developed some years after DO260A. Therefore, Asterix Cat 21, Ed 0.23 does not directly support DO260B;
- b) The same techniques used for processing DO260A can be used for processing DO260B, however, the table used must account for NIC supplement B & NIC supplement C, and may also wish to account for SDA; and
- c) If there is a particular need for the ATC system to have access to the new data items offered by DO260B, then users may need to consider a more recent version of Cat 21 (e.g. Ed 2.1 or later versions).

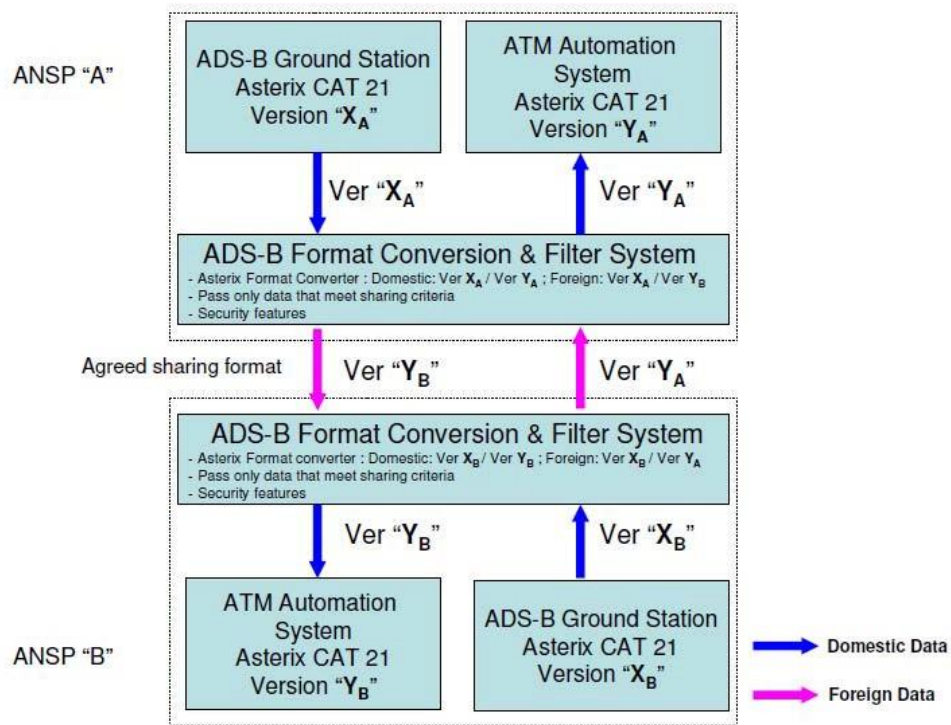
10.2 Support of DO260B using Asterix Cat 21 Ed 2.1 or later versions

- a) If DO260B is used, then the ANSP could decide to use Asterix Cat 21 Ed 2.1 or later; and
- b) Readers are invited to carefully examine the DO260B data items (see Appendix D) to determine if the benefits of additional DO260B data items are large enough to warrant adoption of Asterix Cat 21 Version 2.1 or later.

11. ADS-B FORMAT CONVERSION AND FILTER SYSTEM

11.1 It is clear that the evolution of 1090ES ADS-B transmission will continue. Avionics software will be upgraded to provide additional or changed functionality. As a result Asterix standards will also continue to evolve, and ATC systems will need to be adaptable to be able to cope with new functionality requirements and new message standards.

11.2 The use of an ADS-B format conversion & filter (ADS-B FC&F) system between domestic ADS-B systems and data shared with other states is a cost-effective way to provide the necessary protection and flexibility in this evolution. Such a system provides ADS-B format conversion between domestic and foreign ADS-B systems. While decoupling one ADS-B Asterix environment from another, the system allows information that meets specific sharing criteria to be passed through for data sharing. By doing so, loading on the ATM automation systems to process ADS-B data and bandwidth requires to transmit the ADS-B data could then be reduced. The system also allows independent domestic format changes without disruption to the foreign environment. A typical structure could be as shown below:



7 Attachment A - Group 1 (Mandatory Data Items)

Data Items	Description	Ed 0.23	Ed 2.1	Remarks
I021/010	Data Source Identification	X	X	Identifies source of data. Important if validity checks are performed as an anti spoofing capability. Validation that the data is received from an approved ADS-B receiverstation. Data received from a receiver station should not be processed if the position of the reported aircraft is an unreasonable distance away from the known location of the ADS-B receiver station. Where space based ADS-B is used and a nominal station location is defined, such range processing limits will need to account for the coverage supplied.
I021/030	Time of Day	X		Necessary to extrapolate the ADS-B data to time of display. Data received with a Time of Day too far in the past should be discarded. This data is too old.
I021/071 or I021/073	Time of Applicability of Position or Time of Message reception for position		X	Necessary to extrapolate the ADS-B data to time of display. Data received with a Time of Day too far in the past should be discarded. This data is too old.
I021/040	Target Report Descriptor	X	X	Indicates if report is a duplicate, on the receiver, is a simulated target, is a test target. This needs to be checked by ATC system prior to processing. If the data indicates that the report is a test target or a simulated target, it is normally processed differently to “real” targets.
I021/080	Target Address	X	X	Included in all 1090ES downlink messages, so always available. Used for report/report linkage in ATC tracking.
I021/090	Figure of Merit/Quality Indicators	X	X	Position cannot be used without quality indicator. If the quality of the positional data does not meet the requirements the data should be discarded.
I021/130	Position in WGS-84 co-ordinates	X	X	Report cannot be used without position

Attachment B - Group 2 (Desirable Data Items)

Data Items	Description	Ed 0.23	Ed 2.1	Remarks
I021/008	Aircraft operational status		X	TCAS capability, Target state reporting capability, CDTI capability, Single/dual aircraft antenna. It is desirable to have immediate knowledge of RA event.
I021/020	Emitter Category	X	X	Aircraft or vehicle type
I021/140	Geometric Altitude/Height	X	X	Useful for RVSM monitoring. Not normally used for ATC application. Could perhaps be used as an indicator of correct QNH setting in aircraft.
I021/145	Flight Level	X	X	Flight level is an important information to ATC
I021/155	Barometric Vertical Rate	X	X	Used for predictive tools and safety nets. Either
I021/157	Geometric Vertical Rate	X	X	Barometric vertical rate or Geometric vertical rate is provided by the aircraft – not both. However, the ATC system can calculate vertical rate from multiple flight level reports if these data items are not available.
I021/160	Ground Vector	X	X	Provides excellent vector to support extrapolation of positional data to time of display. However, the ATC system can calculate the velocity vector (ground vector) from multiple position reports. I021/160 however, is normally far superior that ATC system calculation.
I021/170	Target Identification	X	X	This is the callsign/Flight ID is extremely useful for ATC and matching to the flight plan (if any). Target identification is only sent once per 5 seconds. Some receiver stations designs attach the target identification (if known from previous recent downlinks) even if not received in the last 5 seconds. The field can be missing at the edge of ADS-B coverage – for flights inbound to coverage.

I021/200	Target Status	X	X	This is the emergency type and is highly desirable.

Attachment C - Group 3 (Optional Data Items)

Data Items	Description	Ed 0.23	Ed 2.1	Remarks
I021/077	Time of report transmission		X	Time of applicability is relevant for ATC system processing. Time of transmission is less relevant.
I021/032	Time of Day Accuracy	X		Maximum error in Time of day. Normally the maximum value is known by the ANSP because of station design.
I021/095	Velocity Accuracy	X		If using GPS, velocity accuracy will be adequate if the Position quality is accurate.
I021/072	Time of applicability of velocity		X	Can be managed by a velocity data time out in receiver station.
I021/075	Time of message reception of velocity		X	Normally velocity is in the same Asterix message as position. Velocity data time out in receiver station.
I021/161	Track number		X	Tracking can be performed by ATC system. Also the 24 bit code (aircraft address) could be used as a pseudo track number.
I021/110	Trajectory Intent	X	X	Defined in DO260 but not transmitted by any known product. Not defined in DO260A or DO260B
I021/146	(Intermediate) Selected Altitude	X	X	Target altitude : Information from DO260A/B Target state and status messages (On condition messages). These could be used for detection of pilot errors in selection of heading/altitude.
I021/148	Final State Selected Altitude	X	X	
I021/015	Service identification		X	Type of Service (VDL4, Ext Squitter, UAT, TIS-B VDL4, TIS-B Ext Squitter, TIS-B UAT, FIS-B VDL4, GRAS VDL4, MLT). Not useful to most ATC systems.
I021/016	Service management		X	Update rate or whether data driven output from GS. Normally known by receiver.

Data Items	Description	Ed 0.23	Ed 2.1	Remarks
I021/074	Time of message reception of position – high resolution		X	High resolution is designed to support MLAT system processing by receiver. Not required for pure ADS-B.
I021/076	Time of message reception of velocity – high resolution		X	High resolution is designed to support MLAT system processing by receiver. Not required for pure ADS-B.
I021/210	MOPS version/ Link Technology Indicator	X	X	Maybe useful for statistics about equipage. Not operationally relevant
I021/070	Mode 3/A code		X	Could be used for legacy ATC system that do not use Flight ID
I021/165	Rate of Turn/Track Angle rate	X	X	Not transmitted in DO260, DO260A or DO260B messages
I021/271	Surface capabilities and characteristics		X	
I021/132	Message amplitude		X	Useful for technical analysis. Not operationally relevant
I021/250	Mode S MB data		X	
I021/260	ACAS resolution advisory report		X	
I021/400	Receiver ID		X	
I021/295	Data ages		X	
I021/150	Air Speed	X	X	Defined in standards but only sent in absence Ground vector information. Can't be used for extrapolation unless wind speed known.
I021/151	True Air Speed	X	X	
I021/152	Magnetic Heading	X	X	Defined in standards but only sent in absence Ground vector information.
I021/220	Met Report	X	X	Not transmitted in DO260, DO260A or DO260B messages
I021/230	Roll Angle	X	X	Not transmitted in DO260, DO260A or DO260B messages
I021/131	Position in WGS-84 coordinates, high resolution		X	

Attachment D - Differences among DO260, DO260A, DO260B

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information
Introduction of Navigation Integrity Category (NIC) to replace Navigation Uncertainty Category (NUC _P)	NUC _P is used.	NIC is used to replace NUC _P .	More levels of NIC available. Vertical component removed.	NIC is shown in Ed1.0 and above. More levels of NIC (shown as PIC) are available in v2.1.	The additional quantum levels of NIC would allow the ANSP more flexibility in deciding whether the NIC is considered as 'good' (if required) However, for 3 NM & 5 NM separation with HPL 1Nm and 2 Nm respectively, this additional quantum is not useful.
Quality Indicator for Velocity (NUC _R and NAC _V)	NUC _R is used.	Replaced with NAC _V . Definition remains the same.	Vertical component removed.	Available in Ed0.23 and above.	Vertical component is not available for DO260B.
Surveillance Integrity Level and Source Integrity Level (SIL)	Not available.	Surveillance Integrity Level is used.	Renamed as Source Integrity Level. Definition is changed to exclude avionics fault.	Available in Ed1.0 and above.	The SIL will allow the user to further assess the integrity of the reported position (if required). NB: An implied SIL exists for DO260 aircraft if they always use GPS. However DO260 aircraft do not provide SIL.
System Design Assurance (SDA)	Not available.	Not available.	To address probability of avionics fault.	Available in Ed2.1.	The SDA will indicate the robustness of the system. ANSPs may decide on a minimum SDA for ADS-B services. If this action is taken then DO260 and DO260A aircraft will be unable to meet the criteria.

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information
Navigation Accuracy Category (NAC _P)	Not available.	Derived from HFOM and VFOM.	Relies only on HFOM.	Available in Ed1.0 and above.	A reported accuracy is not provided by DO260. However, an estimated accuracy can be derived from NUC – assuming that NUC is HPL based.
Geometric Vertical Accuracy (GVA)	Not available.	Not available.	Derived from VFOM.	Available in Ed2.1.	Geometric altitude accuracy is not normally required for operational purposes.
Barometric Altitude Integrity Code (NIC _{BARO})	Not available.	To indicate integrity of barometric altitude.	Same as DO-260A	Available in Ed1.0 and above.	The NIC _{BARO} indicates the integrity of the barometric height. ANSPs could indicate to the controller that Barometric data has not been verified, however, aircraft without dual barometric systems/air data computers may be unable to provide a non zero NIC _{BARO} as data could be unnecessarily discarded.
Length / Width of Aircraft	Not available.	Provide an indication of aircraft size.	Same as DO-260A	Available in Ed1.0 and above.	The width / length indicate the size of the aircraft. This information may be used as an input for generating alerts on airport surface movement control.

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information
Indication of capabilities	Only show status of TCAS and CDTI.	More information available including capability to send Air Reference Velocity, Target State and Trajectory Change reports. Status of Identity Switch.	Additional information on type of ADS-B in (i.e. 1090ES in or UAT in).	Available in Ed1.0 and above, except availability of 1090ES/UAT in and information on GPS antenna offset.	Indication on the availability of 1090ES in / UAT in may allow the controller to anticipate a potential request for in-trail procedure clearance. NB: ITP requires decision support aids which are more complex than ADS-B IN alone.
Status of Resolution Advisory	Not available.	Information on whether Resolution Advisory is active.	Same as DO-260A	Available in Ed1.0 and above,	Indication of the resolution advisory status allows the controller to know whether the pilots were alerted about the potential conflict.
GPS offset	Not available.	Indication on whether GPS offset is applied.	Information on GPS antenna offset is provided.	GPS offset status is available in Ed1.0 and above. Information on GPS offset is not available in ASTERIX	Indication on GPS offset may be one of the inputs for generating alerts on airport surface movement control.
Intention	Not available.	Able to indicate intended altitude and heading.	Same as DO-260A	Intended altitude is available in Ed0.23. Intended heading is not available in ASTERIX.	The intended heading and flight level can be used as an input to the trajectory prediction algorithm in the Short-Term Conflict Alert.

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information
Target Status	Not available.	Not available.	Indication of Autopilot mode, Vertical Navigation mode, Altitude Hold mode, Approach Mode and LNAV Mode.	Vertical Navigation mode, Altitude Hold mode and Approach Mode are available in Ed 0.23 and above LNAV Mode is available in Ed2.1	The target status allows the controller to know the mode that the aircraft is in. i.e.: It could be presented to ATC.
Resolution Advisory	Not available.	Not available.	Availability of Active Resolution Advisories; Resolution Advisory complement record, Resolution Terminated; Multiple Threat encounter; Threat Type indicator; and Threat Identity data.	Available in Ed1.0 and above.	The Resolution Advisory will help the controller know the advisories that are provided to the pilots by the ACAS. This helps prevent the controller from giving instructions that are in conflict with the ACAS.

	DO-260	DO-260A	DO-260B	Availability of data in Asterix CAT 21	Potential uses of additional information
Mode A	DO260 change 1, allows this using test message in USA only. This was not implemented in actual products.	Broadcasted using test message in USA only.	Broadcasted worldwide as a regular message.	Available in Ed0.26 and above.	The Mode A allows flight plans to be coupled with the ADS-B tracks (supports legacy ATM automation system).

Appendix 8**ATTACHMENT to State letter SP 44/2-19/77****GUIDANCE ON 1 090 MHZ SPECTRUM ISSUES AND PROPER MANAGEMENT OF 24-BIT AIRCRAFT ADDRESSES ASSOCIATED WITH UNMANNED AIRCRAFT (UA)**

Note. — This document is an unedited advance version of an ICAO publication as approved in principle, by the Secretary General, which is made available for convenience. The final edited version will be included in the next amendment to the Aeronautical Surveillance Manual (Doc 9924), which will be published in due course.

1. Background

1.1 The frequencies 1 030 and 1 090 MHz, acting as a frequency pair, support several aeronautical surveillance systems including secondary surveillance radar (SSR), multilateration (MLAT), airborne collision avoidance systems (ACAS) and automatic dependent surveillance-broadcast (ADS-B). Aircraft are interrogated by ground SSR/MLAT (or other aircraft, in the case of ACAS) on 1 030 MHz and reply (or broadcast) on 1 090 MHz with information such as their position, altitude and velocity vector.

1.2 The increasing density of ground-based and on-board surveillance systems using the 1 030/1 090 MHz frequencies is currently raising concerns, especially in dense airspaces. Ultimately it may result in a reduction to the overall performance of ACAS as well as the SSR/MLAT and ADS-B systems. In addition, the increased usage of ADS-B OUT applications for safety of life services and potential future evolution of those applications, such as space-based ADS-B, have raised serious concerns of potential congestion at 1 090 MHz. To ensure continued safe operation for all aircraft, proper and efficient utilization of available bandwidth at 1 090 MHz is required. This may include, when necessary, limiting access to 1 090 MHz by certain users.

1.3 Furthermore, it is important to note that those aeronautical surveillance systems rely on a limited capacity 24-bit aircraft address scheme. The allocation of a 24-bit aircraft address and its correct configuration in aircraft is a key element for safe operation of aircraft and associated protocols used to support communication and surveillance systems.

1.4 As defined in Annex 10 — *Aeronautical Telecommunications*, Volume III — *Communication Systems*, aircraft addresses are allocated in blocks by ICAO to the State of Registry or to the common mark registering authority. Using its allocated block of addresses, the State of Registry or the common mark registering authority assigns an individual aircraft address to each suitably equipped aircraft entered on a national or international register.

1.5 It is essential for States to recognize that their allocated block of 24-bit aircraft addresses is a finite and valuable asset. There are only 16 777 214 aircraft addresses in total and many of those have already been allocated to States of Registry or common mark registering authorities. Aircraft traffic growth has been forecast to double in the next 15 years and to manage these addresses in a sustainable manner, States need to validate whether new aircraft address allocation requests by aircraft operators fit the conditions defined in Annex 10, Volume III.

2. Issues identified in relation to operation of unmanned aircraft

2.1 As described above, concerns are being raised about congestion of the 1 090 MHz frequency and shortage of 24-bit aircraft addresses. The rapid growth in the number of UA is making those concerns more severe.

2.2 Exponential increase of the safety risk due to 1 090 MHz congestion

2.2.1 A recent study indicates that large numbers of UA (one UA per 2 square kilometres) operating at low level (less than 500 feet above ground level) in a typical high-density terminal airspace (760 ADS B-equipped aircraft operating within a 200 NM radius and from ground level to FL180) can

interfere with ADS-B ground station reception of ADS-B reports when the transmit power of each UA is 1 watt or higher.

Note. — Some other studies indicate that even a low power (0.1W) transmission from large numbers of UA can reduce the coverage range of ADS-B.

2.2.2 All studies reviewed conclude that the operation of ADS-B OUT by a large number of UA raises a serious concern for the safety of other aircraft in the same airspace.

2.3 Future depletion of 24-bit aircraft addresses

2.3.1 The 24-bit aircraft address scheme was not designed for a very large number of aircraft. Some studies predict that based on the present growth of UA, there will be over a million such vehicles by 2025. Based on these current projections, it will be impossible to accommodate all UA in the current scheme.

2.3.2 In some situations UA may require a 24-bit aircraft address, for instance if the UA fly in controlled airspace or in proximity to traditional manned aircraft. States will need to evaluate such situations on a case-by-case basis when receiving a new aircraft address application from the UA community.

Note. — As described in the Manual on Remotely Piloted Aircraft Systems (RPAS) (Doc 10019), an aircraft which is intended to be operated with no pilot on board is classified as unmanned and an unmanned aircraft which is piloted from a remote pilot station is a remotely piloted aircraft (RPA) (refer to the following figure).

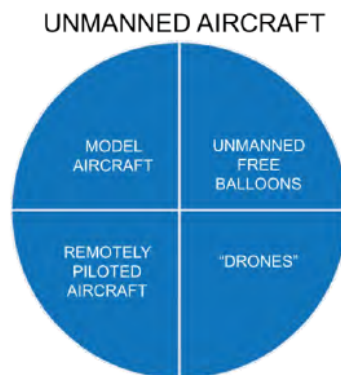


Figure 1-1 Unmanned aircraft

3. Procedure to ensure proper utilization of 1 090 MHz and for non-allocation of (24-bit) aircraft address for UA

3.1 There is increasing pressure to use 1 090 MHz Mode S or ADS-B OUT applications by UA. Given the large forecasted increase of UA and the fact that transmissions from their transponders or ADS-B OUT devices will impact the already congested use of 1 090 MHz by existing aeronautical surveillance and collision avoidance systems, States are urged to:

- 1) perform radio frequency spectrum analysis to analyse the degree of congestion of 1 090 MHz and, based on the outcome of this analysis, consider how 1 090 MHz ADS-B UA operations might impact the performance of the air navigation service provider (ANSP)-operated surveillance

systems in airspace of interest as well as the automatic collision avoidance systems on board aircraft operating in that airspace;

- 2) formulate the circumstances and define procedures to determine the potential requirement for 1 090 MHz ADS-B OUT equipage on UA in order to allow or prohibit such equipage as appropriate. During this process, States should consider:
 - the degree to which individual UA may or may not require air traffic services. For example, a UA operating in uncontrolled airspace may not be required to use ICAO-compliant aeronautical surveillance systems; and
 - the degree to which the operation of individual UA may or may not interoperate in the airspace with traditional manned aircraft. For example, if UA are not operating in proximity to traditional manned aircraft, then the use of ICAO-compliant aeronautical surveillance equipment by UA may not be justified.
- 3) in cases where UA are not required to equip with ICAO-compliant aeronautical surveillance equipment, States should not allocate 24-bit aircraft addresses.

Note. — 24-bit aircraft address allocation should be a part of the UA registration or operator approval process. For guidance material on reliable usage of 24-bit aircraft addresses, refer to Annex 10, Volume III and Doc 9924.

Presentation of the initial proposal:

1. The *Background* and *Comments* are provided in *italic text*.
2. The text of the proposed amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

a) ~~Text to be deleted is shown with a line through it.~~	text to be deleted
b) New text to be inserted is highlighted with grey shading.	new text to be inserted
c) ~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

**REVISED TERMS OF REFERENCE OF
ASIA AND PACIFIC
ATM AUTOMATION SYSTEM TASK FORCE (ATMAS/TF)**

Consists of objectives and deliverables as follows:

The Objectives of the APAC ATMAS/TF are to:

- 1) *Keep abreast of the latest developments in ATM automation systems and associated technologies to cope with forthcoming development and implementation of ICAO SARPs, the Global Air Navigation Plan (GANP), the Global Aviation Safety Plan (GASP) and Asia/Pacific Seamless Air Navigation Service (ANS) Plan (APSAP);*
- 2) *Facilitate the implementation, enhancements, operation and maintenance of ATM automation systems and services identified in the Aviation System Block Upgrades (ASBU) elements and APSAP elements using the project management principles where appropriate;*
- 3) *Ensure continuous and coherent development of the ATM automation systems that is harmonized with adjacent regions to enhance systems robustness, resilience, interoperability and cybersecurity; and*
- 4) *Review, identify and address major issues in technical, operational, safety and regulatory aspects to facilitate the implementation or provision of safe, efficient and orderly ATM services.*
- 5) *Encourage collaboration among ANSPs in implementing ATM automation systems so as to reduce operating costs and enable quick implementation of new requirements to cope with new challenges.*
- 6) *Follow up, oversee and share experiences of the AIDC implementation and provide a coordination framework among States for wider and effective implementation of AIDC across the APAC region.*

Deliverables to meet the Objectives:

- 1) *To submit progress report to the ICAO CNS Sub-group while keeping ATM Sub-group informed of addressing the APAC ATMAS/TF deliverables (listed in 2 to 7 below);*

2) 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 in relation to ATM automation systems;

3) To review outcome of the AN-Conf., DGCA Conference, APANPIRG, CNS Sub-group, ATM Sub-group, RASMAG, and SURICG related to ATM automation systems, revise and update a tasks list and action items for the ATMAS/WG;

4) To study and identify applicable applications, share experience, and recommend the best industry practice in the Asia and Pacific Regions considering:

- Systems planning and design
- Open / Service Oriented Architecture
- HMI adaptation, data synchronization and operational enhancements
- Safety nets
- ICAO roadmap in the GANP / ASBU
- Systems interoperability
- Standardization of information exchange
- AIDC Implementation
- Operation and maintenance practice
- Acceptance and certification
- Flight inspection
- Cybersecurity
- Safety assessment
- Training
- Transition

5) To encourage research and development, trials and demonstrations of applications and technologies, and, as necessary, steer for the sharing of this information and expertise between States/Administrations through organizing educational seminars and symposia to educate States/Administrations and airspace users;

6) To formulate draft Conclusions and Decisions relating to matters in the field of ATM automation systems that come within the scope of the APANPIRG, CNS Sub-group, ATM Sub-group, and RASMAG work plan; and

7) To collaborate with relevant international organization (such as EuroControl) for harmonisation of ATM system requirements.

Timeframe for Deliverables:

For deliverable item 2 on guidance materials, it is anticipated that a first draft could be made available in 3 years after establishment of the Task Force for seeking endorsement by CNS Sub-group, after which the guidance materials would be updated/enhanced on an on-going basis. For other deliverable items 3-7, they will be made available as appropriate subject to review by the Task Force. The life time of the Task Force would be subject to review after endorsement of the first edition of the guidance materials.

Meeting:

The APAC ATMAS/TF shall convene annually with at least one face-to-face meeting per year, which is supplemented by teleconference meetings (e.g. WebEx) as appropriate.

Membership:

All APAC member States/Administrations providing air navigation services in the Asia and Pacific Regions. APAC members should nominate Subject Matter Experts from Civil Aviation Authorities, ANSPs, and other organizations with strong background in engineering and operation in relation to ATM automation systems to participate into the Task Force. The Task Force would also invite representatives of International Organizations recognized by the ICAO Council as representing important civil aviation interests to participate in its work in a consultative capacity.

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. 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. Both States also agreed to implement CRV as soon as practical to resolve the existing COM deficiencies.	CAA. Afghanistan and CAA. Pakistan	June 2020	A

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ACTION ITMES OF CNS SG/25					
Action Item	Subject	Status / Target Date	Action Party	Status	Remarks / follow-up
25-1	SWIM TF to consider modifications proposed by Australia in Flimsy/02 in coming task lead meetings and SWIM TF/6 and to present revised ToR, if any as the outcomes of discussion, in CNS SG/26	CNS SG26	SWIM TF, ICAO Secretariat	Open	
25-2	The ICAO Secretariat will prepare a working paper to present in RASG-APAC/11 as an outcome of CNS SG/25 discussion for considering 5G potential interference with radio altimeter as a potential hazard.	RASG-APAC/11	ICAO Secretariat	Open	
25-3	The Member States/Administrations were requested to review and submit the updates to ICAO APAC Regional Office for the updates on various facilities listed in e-ANP Vol II Part III Table CNS II-APAC 2 for new international aerodromes added in 2021 by filling the PfA template specified in section 2.4 and send it to ICAO APAC Regional Office	CNS SG/26	Member States, ICAO Secretariat	Open	
25-4	The Chair of CNS SG invited the ICAO Secretariat to carry out the same review on e-ANP volumes in ATM aspects.	CNS SG/26	ICAO Secretariat	Open	
25-5	The Chair of CNS SG invited ICAO APAC Regional Office to follow up with ICAO Headquarter on regional network cybersecurity issue	CNS SG/26	ICAO Secretariat	Open	

ACTION ITMES OF CNS SG/25					
Action Item	Subject	Status / Target Date	Action Party	Status	Remarks / follow-up
25-6	The meeting requested ICAO to consider organizing another webinar on this subject on how Information Security Requirements for Exchange of Information over IP can be implemented by Member States in a pragmatic manner	CNS SG/26	ICAO Secretariat	Open	

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List of Working/Information Papers/Flimsies and Presentations

WP/IP/SP Number	Agenda	Subject	Presented by
WORKING PAPERS			
WP/01	1	Provisional Agenda	Secretariat
WP/02	2	Outcomes of APANPIRG/31, APANPIRG/31 Midyear Review and 8 th PIRG-RASG Regional Coordination Meeting on CNS	Secretariat
WP/03	2	Air Traffic Management and Airspace Safety Monitoring Outcomes	Secretariat
WP/04	3.1	Review Report of the Eighth Meeting of the Aeronautical Communication Services Implementation Coordination Group (ACSICG/8)	Secretariat
WP/05	3.2	AMHS Readiness Status for Supporting IWXXM Traffic of the States/Administrations	Secretariat
WP/06	3.3	Review of Outcomes of APA TF/7 Meeting	Secretariat
WP/07	3.4	Review Report of the Fifth Meeting of System Wide Information Management Task Force (SWIM TF/5)	Secretariat
WP/08	4.2	Review Report of the Fifth Meeting of Spectrum Review Working Group (SRWG/5)	Secretariat
WP/09	4.3	ICAO Position for ITU WRC-23	Secretariat
WP/10	5	Review Report of the Eighth Meeting of Performance Based Navigation Implementation Coordination Group (PBNICG/8)	Secretariat
WP/11	5	Review of Report of the Third Meeting of GBAS/SBAS Implementation Task Force (GBAS/SBAS ITF/3)	Secretariat
WP/12	5.3	Updation of Catalogue of Asia and Pacific Flight Inspection and Flight Validation Service Providers	Secretariat
WP/13	6.1	Review Report of Sixth Meeting of the Surveillance Implementation Coordination Group (SURICG/6)	Secretariat
WP/14	7.1	Review Report of the Second Meeting of ATM Automation Systems Task Force (ATMAS TF/2)	Secretariat
WP/15	8.1 & 8.2	Review of Regional CNS Requirements in ICAO APAC e-ANP, Seamless ANS Plan and Updates on National Air Navigation Plan (NANP)	Secretariat

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WP/IP/SP Number	Agenda	Subject	Presented by
WP/16	8.3	Updates on Beijing Declaration Implementation Related to CNS	Secretariat
WP/17	9	Review Status of CNS Deficiencies	Secretariat
WP/18	10.1	Review Outcomes of Small Working Group Study on Human Factor Issues of ATSEP	Secretariat and IFATSEA
WP/19	11.1	Outcomes of ICAO Asia Pacific Regional Cybersecurity Webinar	Secretariat
WP/20	13	Impact of COVID-19 to CNS Works in 2021	Secretariat
WP/21	14	CNS Points of Contact	Secretariat
WP/22	2	Updates on CNS SG/24 and APANPIRG/31 Conclusions/Decisions and Action Items	Secretariat
WP/23	5.4	The BDS Standardization and Application in Civil Aviation	China
WP/24	12	UAS-Based PAPI Inspection Technology in China	China
WP/25	12	Trial Inspection on CNS outstations by Drone to Enhance Maintenance Work in Hong Kong, China	Hong Kong, China
WP/26	5.4	Update of Flight Inspection Guidance Material (FIGM) for APAC Region	China & Hong Kong, China
WP/27	12	Development of an Integrated Safeguarding Surface to Uphold Flight Safety while Facilitating Infrastructure/Building Developments in Hong Kong	Hong Kong, China
WP/28	8	Updates on ICAO Annex 10 VI RPAS C2 Link	Secretariat
WP/29	3.5	Proof of Concept for Exchanging Aeronautical, Flight and Weather Data through SWIM Platform	India
WP/30	3	Member States Support for CNS SG and Contributory Bodies Meetings - 2022	Secretariat
WP/31	8	Seamless ANS Plan and Monitoring Update	Secretariat
WP/32	11.1	Implications of Cybersecurity and associated Requirements for CRV Operations	USA
WP/33	11.2	Cybersecurity in Air Navigation Activities	Secretary

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WP/IP/SP Number	Agenda	Subject	Presented by
INFORMATION PAPERS			
IP/01	-	Meeting Bulletin	Secretariat
IP/02	3.2	AMHS Connections between APAC and EUR/NAT	Secretariat
IP/03	3.1	Outcomes of ICAO Asia Pacific Implementation of CRV Webinar	Secretariat
IP/04	3.4	Outcomes of SWIM Workshop	Secretariat
IP/05	4.3	Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc. 9718, Volume II)	Secretariat
IP/06	4.3	5G Implementation and Potential Impacts on Aircraft Radio Altimeters	Secretariat
IP/07	5.4	Proposals for the Amendment of Annex 10, Volume I, on DFMC and GBAS	Secretariat
IP/08	6.1	Outcomes of ICAO APAC Implementation of ADS-B Webinar	Secretariat
IP/09	6.2	Resolution of Conflicting Text in Doc. 8071 Vol. III Regarding Flight Inspections	Singapore and Secretariat
IP/10	3.1	CRV Post Implementation Issues in Bhutan	Secretariat
IP/11	5.4	Compatibility of other GNSS Positioning Services with Aviation Services	Australia
IP/12	4.3	Status of 5G Implementation in Australia	Australia
IP/13	6.2	Mode S Activities Update in China	China
IP/14	5.4	Research on Operational Quality Analysis of Instrument Landing System Based on Airborne DAR Data	China
IP/15	12	Standard Establishment of Data Link for UAS-Based Flight Inspection in China	China
IP/16	12	The Implementation of A-SMGCS Level IV Operation in Beijing Daxing International Airport	China
IP/17	4.1	Update of AeroMACS Application and Specification in China	China
IP/18	3.5	SWIM Implementation in Japan	Japan
IP/19	5.4	Concept of Operations for GNSS Event Reporting	Singapore
IP/20	5.4	Status of GBAS Implementation in Japan	Japan

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WP/IP/SP Number	Agenda	Subject	Presented by
IP/21	5.4	SBAS Status Update in Japan	Japan
IP/22	8.1	The Long-term Vision for the Future Air Traffic Systems of Japan (CARATS)	Japan
IP/23	3.5	Future Plans for Implementation of New ICAO SARPS Compliant AMHS in India	India
IP/24	6.2	Implementation of Space-Based ADS-B Surveillance for the Oceanic Regions of Indian FIRs	India
IP/25	7.2	Future Plan for ATM Automation System Implementation in India	India
IP/26	7.2	The Implementation of the Weather Data Converter for a Legacy Automation System as an Interfacing to TDWR	Republic of Korea

PRESENTATIONS

SP/01	12	Uniting the Things that Fly - How to Integrate ATM and UTM for a Safer APAC Sky	Frequentis
SP/02	7.2	Approach Spacing Tool - Concept and Feature Overview	Thales
SP/03	11.2	Cybersecurity in ATM System of Systems Approach - Patch Management	Thales
SP/04	11	Information Security Requirements for Exchange of Information over IP	Secretariat
SP/05	12	Application of Knowledge Graph in Air Traffic Management	China State Key Laboratory

FLIMSIES

Flimsy 01	14	CNS Meeting Planning in 2022	Secretariat
Flimsy 02	3.4	Review Report of the Fifth Meeting of System Wide Information Management Task Force (SWIM TF/5)	Australia
Flimsy 03	12	Standard Establishment of UAS-based Flight Inspection System in China	China
Flimsy 04	11	Information Security Requirements for Exchange of Information over IP	Secretariat
