สำนักงานการบินพลเรือนแห่งประเทศไทย
The Civil Aviation Authority of Thailand

Guidance Material for Future Air Navigation Systems (FANS)

CAAT-OPS-GM4-FANS

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Approved by

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Director General of the Civil Aviation Authority of Thailand

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0. Introduction

0.1 Background

0.1.1 Controller-pilot Data Link Communications (CPDLC) / Automatic Dependent Surveillance ADS

Future Air Navigation Systems (FANS) is an advanced system of Communication, Navigation, Surveillance, Air Traffic Management (CNS/ATM) utilizing data link and satellite communications, navigation and surveillance systems, considering validated operational experience with modern technology. Whenever FANS 1, FANS A or FANS 1/A is documented, it refers to manufacturer's programmes (e.g. FANS 1 = Boeing and FANS A = Airbus).

0.1.2 Automatic Dependent Surveillance-Broadcast (ADS-B) Operations and Operational Authorization

Countries around the world are implementing a more accurate way of tracking aircraft. Called Automatic Dependent Surveillance–Broadcast (ADS-B), the technology will eventually replace radar as the primary surveillance method for Air Traffic Control (ATC) monitoring and separation of aircraft worldwide. Many states and/or regions mandate ADS-B equipage at this time, also ADS-B ground infrastructure has been set up for implementation of ADS-B operations in Thailand airspace. Thailand plans to introduce ADS-B for the provision of Air Traffic Services, including 'radar-like' separation in a phased manner. The Automatic Dependent Surveillance Broadcast "(ADS-B) OUT" transmissions on 1090MHz Extended Squitter (1090ES) data link will be used for provision of ATS surveillance services to eligible aircraft within notified portions of Thai airspace(s). This GM provides the means to obtain operational authorization for aircraft and operators intending to use ADS-B in airspace notified for ADS-B operations

0.1.3 Communications

One of the key features of the CNS based ATM system is the availability of two-way data communications between the aircraft and the ATC system. The available means of communication between ground and air are VHF voice, HF voice, controller pilot data link communications (CPDLC) and satellite voice. CPDLC is a means of communications between controller and pilot using data link for ATC communications.

0.1.4 Navigation

The level of aircraft navigation capability required for FANS varies for the specific route and/or airspace but RNP 4 accuracy is the most common standard. Refer to GM for PBN for amplification.

0.1.5 Surveillance

In the FANS environment, surveillance is also provided by automatic dependent surveillance (ADS). ADS allow an aircraft to send flight identification, position, predicted route and weather data addressed to a specific ATS unit at specified intervals, or on the occurrence of a specific event at the request of the ATS unit. It can replace voice position reporting in specific areas.

0.2 Purpose

0.2.1 CPDLC/ADS

This Guidance Material (GM) provides guidance for the operation of Thailand registered aircraft operating worldwide using the Future Air Navigation Systems (FANS) technology and utilizing data link and satellite communications, GNSS navigation and automatic surveillance systems

0.2.2 ADS-B

The intent of this GM (Guidance Material) is to facilitate operations using Automatic Dependent Surveillance-Broadcast (ADS-B) technology which applies to all Thai aircraft and operators intending to use ADS-B.

0.3 Applicability (is Subjected to)

This guidance material applies to all Thailand operators when operating in designated airspace or routes promulgated in the particular State's AIP, where the use of data link communications and/or ADS is permitted. Whilst random routing is part of FANS, this is a separate issue as it may be conducted without data link capability and is available to all operators with RNAV accuracy capability. Therefore, this GM is not applicable to random routing only. Those operators requesting to operate on random routes without using data link (CPDLC and ADS) should apply separately to the CAAT. It should be noted that beyond the Thailand FIR, operators shall comply with the Thailand Civil Aviation Regulations and other foreign State's regulations, whichever is more restrictive.

0.4 Effective Date

15-Jul-2021

0.5 Reference (Refer Regulation)

The primary reference for the FANS operational authorization is the ICAO guidance material on CNS/ATM operations in the Asia/Pacific Region. The references are:

a) ICAO Guidance Material on CNS/ATM Operations in the Asia/Pacific Region.

b) FAA Advisory Circular AC 120-70 - Initial Air Carrier Operational Approval for Use of Digital Communications Systems.

c) ICAO Doc 4444 - Procedures for Air Navigation Services –Rules of the Air and Air Traffic Services.

d) ICAO Doc, 7030 -Regional Supplementary Procedures.

e) ICAO Doc. 9758-AN/966 - Human Factor Considerations in The Data Link Environment.

f) Global Operational Data Link Document. Available from: http://www.icao.int/APAC/Documents/edocs/GOLD_2Edition.pdf

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1. CPDLC/ADS

1.1 Definition

Term	*Definition*
Aeronautical fixed telecommunication network (AFTN)	A worldwide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics. (ICAO).
Air traffic service (ATS)	A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service). (ICAO)
Air traffic services unit (ATSU)	A generic term meaning variously, air traffic control unit, flight information Centre or air traffic services reporting office. (ICAO)
Automatic dependent surveillance — broadcast (ADS-B).	A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link. (ICAO)
Automatic dependent surveillance — contract (ADS-C)	A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports. (ICAO) Note.: The abbreviated term “ADS contract” is commonly used to refer to ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode.
Controller-pilot data link communications (CPDLC)	A means of communication between controller and pilot, using data link for ATC communications. (ICAO).
Dynamic airborne re-route procedure (DARP)	The procedure for executing a re-route clearance initiated by a request from AOC.

Term	*Definition*
Next data authority	The ground system so designated by the current data authority through which an onward transfer of communications and control can take place. (ICAO)
Performance-based navigation (PBN)	Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. Note.: Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. (ICAO)
Required communication performance (RCP) specification	A set of requirements for air traffic service provision, aircraft capability, and operations needed to support performance-based communication within a defined airspace. Note 1.: See ICAO Doc 9869 and Appendix B of this document for RCP specifications. Note 2.: The term RCP, currently defined by ICAO as “a statement of performance requirements for operational communication in support of specific ATM functions”, is used in this document to align the concept of PBC with the concept of PBN. The term RCP is now used in the context of a specification that is applicable to the prescription of airspace requirements, qualification of ATS provision, aircraft capability, and operational use, including post-implementation monitoring (e.g. RCP 240 refers to the criteria for various components of the operational system to ensure an acceptable intervention capability for the controller is maintained.

1.2 Application

1.2.1 Process

The application for FANS authorization must follow a systematic planning process to minimize the lead-time. Only operators with proven operational competency, training and documentation in RNP, RNAV and RVSM airspace can be considered by the CAAT for FANS. The application must reference a particular aircraft registration number, unless all of the operator's aircraft are of the same type and have exactly the same equipment and software version. The application must address all of the following sections on Airworthiness Requirements, Communications and Avionic Systems Requirements, Operational Requirements, Documentation and training.

1.2.2 Requirements

The general requirements for airworthiness and operational approval are:

a) Aircraft navigation equipment certification;

b) Aircraft Data link system certification;

c) CVR for digital communications;

d) Documentation;

e) Flight Operations policy and procedures;

f) Dispatch policy and procedures;

g) Training and qualification of flight crew and dispatchers;

h) Operational demonstration;

i) Operational approval in Operations Specifications/authorization.

1.2.3 Lead-Time

To determine lead-time, operators should consider the following:

a) Aircraft modification;

b) Document amendment;

c) Training and qualification of flight crew and dispatchers;

d) The regulatory process for the issue of CAAT airworthiness and operational approvals;

e) The need to contract with a data link service provider and to register with the authorized service provider;

f) The approval or acceptance of the regulatory authorities responsible for the airspace.

1.3 Airworthiness Requirements

1.3.1 General

In case of new generation aircraft, the components of a FANS capability are normally incorporated already. However, the operator must provide all the aircraft navigation, communication and data link equipment details for each aircraft registration and include the applicable software versions to CAAT. The majority of this information should be contained in the Aircraft Flight Manual, Type Certificate Data Sheet (TCDS), AFM supplements or other appropriate documents (e.g. Service bulletins (SB) or Service Letters (SL)).

1.3.2 Equipment

The following equipment may need to be specifically approved if it has been modified:

a) Compatible SATCOM;

b) Compatible ACARS;

c) IDS with appropriate software version to support FANS;

d) Fully integrated dual GPS with appropriate software version;

e) FMC with appropriate features and software version;

f) CMC with appropriate software version;

g) Printer to support the FMC interface;

h) HFDL for polar and remote routes.

1.3.3 Flight Data Recording

It is presently a requirement that voice communications are recorded on the CVR. When voice communications are replaced by data link. There must be a recording of that communication, as specified by the CAAT, unless recorded by the FDR. Operators must submit the aircraft CVR capabilities in respect to data link communications.

1.3.4 Training

Operators must provide adequate digital communication maintenance training to ensure that their maintenance personnel or contract personnel at facilities not staffed by the operator are able to properly implement digital communications related maintenance programmes. This training includes, but is not limited to, addressing installation, modification, correction of reported system discrepancies, use of test equipment, procedures, MEL relief, and return to service authorizations. The training procedures should address testing digital communications functions while not introducing hazards with respect to simulated message traffic with an air traffic facility. All training programmes must be documented.

1.3.5 Software Updates

Operators should assure that appropriate digital communications software updates are incorporated when necessary and that both air and ground systems are able to identify and properly respond to the installed level of digital communication capability. There must be a documented mechanism for software update procedures.

1.3.6 Return to Service Policies

Digital communications return to service policies must be established to ensure proper digital communications functions when an aircraft is returned to service after a digital communications failure or maintenance action. An operator should not release an aircraft to service where digital communication functionality is required unless appropriate verification has been established.

1.4 Communication System Requirements

1.4.1 Requirements

Operators shall provide an operational control system and this must include a data link ground processor and a company communications system. There should be direct communications between operational control and ATS for strategic flight planning and coordination purposes. Any data link or CPDLC should have proven system reliability, which is measurable.

1.4.2 Communication Sources

Operators shall provide access to communications sources that are appropriate to coordinate with their aircraft and the ATC system for the purpose of exercising operational control.

These communications systems include:

a) Air/Ground Voice Communications, which may utilize one or more of the following:

   i. VHF;
   ii. HF direct communications;
   iii. HF communications relayed by an intermediate radio operator; or
   iv. SATVOICE.

b) Air/Ground Data Link Communications, which may utilize one or more of the following:

   i. VHF (dedicated or via a service provider network - ACARS);
   ii. SATCOM; or
   iii. HF.

   Note: There may be a MEL requirement for dual dissimilar data link communications equipment for polar and other routes.

c) Ground/Ground Voice Communications, which may utilize one or more of the following:

   i. Dedicated voice circuit; or
   ii. Public Telecommunication Network, which may be considered for remote locations or where infrequent communications cannot justify the cost of dedicated circuits.

d) Ground/Ground Data Link Communications, which may utilize one or more of the following:

   i. Aeronautical Fixed Telecommunication Network (AFTN);
   ii. Dedicated circuit; or
   iii. Aeronautical Telecommunication Network (ATN).

1.5 Operational Requirements

To be eligible for FANS authorization from the CAAT, the following needs to be addressed by the operator:

a) Use of GPS;

b) Use of CPDLC;

c) Use of RNP for airspace management;

d) RNAV/RNP approach procedures;

e) Enhanced FMS functions;

f) Use of ADS.

1.6 Documentation

1.6.1 Required Documentation

Operators should ensure that the following documents are in place to obtain Airworthiness and Flight Operational approval:

a) Instantaneous change notices;

b) Operating procedures;

c) Quick Reference Handbook;

d) Fault Reference Handbook (If applicable);

e) Minimum Equipment List (MEL).

1.6.2 Operations Manual Policy

Operators must assess operational requirements, establish their operational policy and procedures and incorporate them in appropriate section of the Operations Manual. An example of Operations Manual policy may be:

a) Operational Issues

i. The differences between voice and data link environments.
ii. The concept of “data authority” and “next data authority”.
iii. The transfer of data authority (or address forwarding).
iv. Flight crew handling rules for ATC uplink messages, including normal and urgent instructions.
v. ADS emergency triggering.
vi. Reporting requirements.

b) Communications

i. Phraseology.
ii. Pre-formatted messages with new interpretations such as “Standby”, “Request Deferred”.
iii. The differences between free text and preformatted messages.
iv. The limitations of free text messages.
v. The limitations of preformatted messages.
vi. The need to close the loop between uplink and downlink messages.
vii. Requesting amended route clearances.
viii. The importance of ensuring that the correct downlink message for a given uplink scenario.
ix. Out of sequence messages.

c) Technology

i. Sequence of actions to be taken in case of re-route operations.
ii. Loading and viewing amended route clearances.
iii. Executing amended route clearances.
iv. Resolving duplicate waypoint issues.
v. “armable” downlinks.
vi. The types of ADS contracts.
vii. The type of information that is included in ADS reports.
viii. The pilot actions, which can trigger an ADS report.

d) Human Factors

i. the increased “head down time” for flight crew.
ii. Flight deck HMI limitations and issues.
iii. the time required for reading and interpreting uplink messages.
iv. the time required for selecting, composing and sending downlink messages.
v. the need for maintaining a shared crew awareness of the progress of ATC data link communications.
vi. situational awareness and the inability of pilots to monitor other data link transmissions in the area of operations.

1.6.3 Operations Manual Procedures

The Operations Manual should contain procedures on:

a) Cockpit preparation;

b) AFN logon;

c) CPDLC procedures;

d) ATC/crew/dispatch initiated re-route;

e) Required time of arrival;

f) Company operational control (FMC route and wind/temp data uplink);

g) Complimentary voice communications;

h) Navigation: GNSS (GPS if applicable);

i) Navigation: rules and procedures for RNP operations;

j) Surveillance (ADS);

k) DARP operation;

l) ACAS operation;

m) Weather deviation;

n) Non-normal procedures of CPDLC, DARP, RNP;

o) Contingency procedures;

p) RNP airspace/large navigation errors;

q) Minimum Equipment List.

1.6.4 Route Manual

The Route Manual must reflect the route and airspace requirements as documented in the AIP of the FIR controlling State as well as the applicable regional procedures stated in ICAO Regional Supplementary Procedures Doc. 7030.

1.6.5 Training Manual - Pilots

The Training Manual must reflect the training given, and the qualification, on equipment, procedures and operational requirements. In particular, consideration must be given to the training syllabus, training devices, training material and training staff. Whilst the provision of CPDLC and FMS MCDU (or similar equipment) in an aircraft simulator or training device is desirable, it is not a prerequisite for the operator to have this capability. However, the training must be representative of a particular aircraft type and include any digital communications system differences.

The training given and the flight crew training objectives must ensure that a pilot can demonstrate the following:

a) satisfactory knowledge of:

i. CNS/ATM concepts, terminology and architecture;
ii. CNS/ATM components – GNSS, CPDLC, ADS, operational control data link, ATN, RNP, ATM;
iii. CNS/ATM procedures appropriate to approach and departure phases of flight;
iv. CPDLC procedures – means of communications, pre-flight phase, AFN logon, exchange of CPDLC messages, transfer of connection, disconnection, abnormal cases, use of complementary voice communication;
v. Human factor considerations in the data link environment (refer to ICAO Doc. 9758-AN/966);
vi. Aircraft equipment requirements;
vii. Principles of airborne CNS/ATM equipment;
viii. Appropriate CNS/ATM operating procedures for typical navigation tasks;
ix. Contingency weather deviation procedures – sequence of actions when no ATC clearance is available;
x. RNP contingency procedures – one RNP capable LRNS, inability to navigate to the specified RNP, loss of all LRNS.

b) the ability to satisfactorily perform the following operational tasks:

i. Flight plan preparation for a flight using CNS/ATM operational procedures, including any special requirements for communications, navigation, surveillance or crew;
ii. Pre-flight check for CNS/ATM operation;
iii. Use of FMS MCDU (or similar equipment) – CNS/ATM function;
iv. AFN logon;
v. Operation of ADS;
vi. CPDLC – exchange of CPDLC messages, FIR boundary procedure, disconnection;
vii. Operation of operational control data link;
viii. Operation of SATCOM;
ix. Operation of GPS;
x. Perform contingency procedures associated with degradation of RNP;
xi. Operation of the Required Time of arrival (RTA) function;
xii. Identification of deterioration of navigation performance, cross checking procedure to identify navigation errors;
xiii. DARP operations;
xiv. Use of CPDLC under emergency or abnormal situations;
xv. Non-normal procedures – CPDLC connection and disconnection;
xvi. Appropriate interaction between two pilots in a data link environment;
xvii. Use of voice – HF, SATVOICE.

1.6.6 Aircraft Manuals

The Aircraft Manuals must reflect the actual equipment.

1.6.7 Dispatch Manual

The Dispatch Manual must reflect the procedures, the training to be given, and the qualification required. The objective of the training must ensure that a dispatcher can demonstrate:

a) satisfactory knowledge of:

i. CNS/ATM concepts, terminology and architecture;
ii. CPDLC: system description – usage and role in communications, procedures, AFN logon, exchange of CPDLC messages, transfer of connection, disconnection, abnormal cases, MEL;
iii. SATVOICE: system description – usage and role in communications, procedures;
iv. Complementary use of voice communications;
v. Operational data link communications with ATC;
vi. World Geodetic System (WGS-84);
vii. GNSS (GPS) system description – MEL;
viii. RNP concepts, routes, airspace, approval, requirements, flight planning and operational procedures;
ix. RNP contingency procedures – one RNP capable LRNS, inability to navigate to the specified RNP, loss of all LRNS;
x. ADS system description – usage and role in ATM – operational procedures– MEL;
xi. ATM: ATC flight plan, strategic coordination, flow control;
xii. DARP operations – general, sequence, procedures, abnormal circumstances;
xiii. Distress and urgency conditions and procedures.

b) the ability to satisfactorily perform the following operational tasks:

i. Flight plan preparation for a flight using CNS/ATM operational procedures, including any special requirements for navigation, surveillance or crew;
ii. Flight crew briefing;
iii. Flight watch;
iv. DARP operations.

c) a satisfactory knowledge and operational performance regarding the route and airspace requirements as documented in the AIP of the FIR controlling State and the applicable regional procedures as stated in ICAO Regional Supplementary Procedures Doc. 7030.

1.7 Operational Demonstration

Prior to granting operational approval, the CAAT shall verify the following has been satisfied;

a) The conduct operational trials of the procedures for the FANS1/A (+) CNS/ATM operations;

b) Operator readiness by ensuring that;

i. Operational policies and procedures are in place, and incorporated in the appropriate manuals;
ii. The aircraft equipment and associated software is complete and certified;
iii. Flight crew training and qualification is complete;
iv. Dispatcher training and qualification is complete.

c) Communication system is operational and where aircraft tracking system is required, it is recommended air operator track their ADS-C equipped aircraft, in accordance with the aircraft tracking provisions of Annex 6 Part I, 3.5.

1.8 Authorization

1.8.1 CAAT Authorization

The FANS authorization will be part of the Operation Specifications issued to an air transport operator or as an addendum to the authorization for a private operator. There will be two separate authorizations; one for random routing and another for the use of CPDLC and ADS.

1.8.2 Foreign Authorization

Once authorized by the CAAT, the operator is required to obtain a separate authorization from the FIR controlling State responsible for the use of digital communications in their airspace. This authorization may be in the form of a letter or the amendment of the Operations Specifications issued to that operator by the foreign State (e.g. FAA, CASA). The operator must submit copies of those authorizations to the CAAT.

1.9 Continuing Surveillance

Operators should conduct their own continuing surveillance on the following areas, as they will be audited by the CAAT in order to retain the authorization:

a) Checking the Mandatory Occurrence Reports for abnormality;

b) Checking Voyage Reports that can affect FANS;

c) Result or comments made during FANS operational trial or subsequent checks;

d) Assessment of Operation dispatch centre and flight watch team capabilities;

e) Use of CPDLC and ADS equipment;

f) Continuation training evaluation;

g) Expansion of data link applications (load sheet, V speeds, mass & balance etc.);

h) Cross-checking that operations are in accordance with the appropriate ICAO Regional Supplementary Procedures and/or Aeronautical Information Publication for that airspace.

1.10 Reporting Action

Unsafe conditions or performance related to data link operations such as a data link event, which potentially could affect continued safe operations, must be reported to the FIR controlling State and must be reported to the CAAT in accordance with the Civil Aviation Authority of Thailand Requirement No.22/2562 on “Report of Civil Aviation Occurrences”.

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2. Automatic Dependent Surveillance-Broadcast (ADS-B) Operations and Operational Authorization

2.1 Overview

ADS-B provides Air Traffic Control (ATC) with a means of surveillance in designated airspace, which allows application of reduced separation standards for more efficient use of the airspace. Currently, ADS-B provides surveillance coverage in several regions of the world, including portions of Europe, Australia, United State, Canada, and in the Asia-Pacific region. Additional International Civil Aviation Organization (ICAO) regions and Member States are expected to implement ADS-B in their airspace and/or on specific airways and routes in the near future. In addition, some states and/or regions require Extended Squitter (ES) Version 2 to be transmitted by specific dates after 2020.

2.2 Certification and Installation of ADS-B Out Equipment

ADS-B OUT transmitting equipment should be of an approved type meeting the specifications contained in International Civil Aviation Organization (ICAO) Annex 10: Aeronautical Telecommunications, Volume IV – Surveillance and Collision Avoidance Systems and Technical Provisions for Mode S Services and Extended Squitter (Doc 9871/AN460) to the convention on International Civil Aviation or that has been certified as meeting.

a) European Aviation Safety Agency (EASA) – Acceptable Means of Compliance (AMC) 20-24 – Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHz Extended Squitter dated 02 May 2008.

b) European Aviation Safety Agency (EASA) – CS-ACNS.D.ADS-B – Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance Subpart D – Surveillance (SUR).

c) The current version of Federal Aviation Administration (FAA) – Advisory Circular (AC) No: 20-165(_) (or later versions) – Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out Systems or any equivalent (such as Title 14 of Code of federal Regulations (14 CFR) 91.227 or Technical Standard Order (TSO) C166(_) – Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)).

d) The equipment configuration standards in Appendix XI of Civil Aviation Order (CAO) 20.18 of the Civil Aviation Safety Authority of Australia (CASA) dated 16 December 2014 and amendment thereof or any equivalent (such as Appendix 4 and 5 of CAO 82.5 – Conditions on Air Operators' Certificates authorizing regular public transport operations in high capacity aircraft or CASA Advisory Circular (AC) 21-45 – Airworthiness Approval of Airborne Automatic Dependent Surveillance Broadcast Equipment). or

e) Other standards acceptable by CAAT.

2.3 ADS-B System Description

2.3.1 ADS-B System Architecture

The ADS-B system architecture is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft, typically by using the Global Navigation Satellite Systems (GNSS) and transmitting this and additional information about the aircraft to ground-based and/or space-based stations for use by ATC; to ADS-B equipped aircraft; and to other aviation service providers.

2.3.2 ADS-B Operating Frequencies

The ADS-B system operates on three channels: 1090, 978 Megahertz (MHz) or VDL (VHF Data Link) Mode 4.

a) 1090 MHz Frequency. The 1090 MHz frequency is associated with current Mode A, C, and S transponder operations. ADS-B information is included in Mode S Transponders' Extended Squitter (ES) transmit messages, and referred to as 1090ES or ES in this GM.

b) 978 MHz Frequency. ADS-B equipment operating on 978 MHz are referred to as Universal Access Transceivers (UAT) in this GM.

c) VDL Mode 4. ADS-B equipment operating on VHF Digital Link Mode 4 satisfying surveillance applications to any of the 25 kHz channels from 112 MHz to 137 MHz are referred to as VDL M4 in this GM.

2.3.3 ADS-B Avionics Operating Modes

ADS-B avionics can have the ability to both transmit and receive information.

a) ADS-B OUT. The transmission of ADS-B information from aircraft is known as ADS-B OUT.

b) ADS-B IN. The receipt of ADS-B information by an aircraft is known as ADS-B IN.

2.3.4 ADS-B IN Pilot Applications

ADS-B in the Cockpit Display of Traffic Information (CDTI) offers an enhance of safety and efficiency. As variety of aircraft equip with ADS-B IN avionics, more applications may further improve safety, increase capacity and reduce harmful aircraft emissions, such as:

a) Automatic Dependent Surveillance – Rebroadcast (ADS-R);

b) Traffic Information Service – Broadcast (TIS-B);

c) Flight Information Service – Broadcast (FIS-B);

d) In Trail Procedure (ITP);

e) Ground-based Interval Management – Spacing (GIM-S);

f) ADS-B Traffic Awareness System (ATAS) or Airborne Traffic Situational Awareness (ATSAW).

2.4 Operating Procedure

2.4.1 System Operation Familiarity

All operators should use the applicable Airplane Flight Manual (AFM), Airplane Flight Manual Supplement (AFMS), Rotorcraft Flight Manual (RFM), Rotorcraft Flight Manual Supplement (RFMS), Pilot's Operating Handbook (POH), or other required Operating handbooks or Manuals (OM), to become familiar with the proper operation of the installed ADS-B system and any procedures expected of the user for indications and operations of normal, reduced performance or failures within the system.

2.4.2 Understanding Failure Indicators within the System

Since many ADS-B system installations will be upgraded to existing transponders (Mode S), there may be limited ability to indicate ADS-B failures. Mode S transponders with ADS-B functionality may indicate a device failure (loss of transponder/ADS-B) and input failures (loss of position source, such as GNSS) with the same indicator light. Operators should refer to their AFM, AFMS, RFM, RFMS, POH, and other operating handbooks and manuals for information on the differences between device failures and function failures, and the implications and procedures associated with each failure type.

2.4.3 Transponder Operation and ADS-B Transmissions

For ADS-B system installations integrated within a transponder that share control features, operators should be aware that disabling the transponder may also disable ADS-B transmissions, resulting in a loss of Secondary Surveillance Radar (SSR) services and Traffic Alert and Collision Avoidance System (TCAS)/TCAS II operation, if so equipped.

2.5 Operational Authorization to Conduct ADS-B Operations

CAAT authorization is required for all Thai aircraft and operators to conduct ADS-B OUT and ADS-B IN operations in airspace designated for ADS-B operation. Commercial operators will be issued an Operations Specification (Ops Spec) and General Aviation a “Specific Approval” for ADS-B operation.

2.5.1 Initial Request for Authorization

a) Thai operators seeking to conduct ADS-B OUT operations in ADS-B designated airspace must first contact the CAAT office to indicate their intent. When making the initial request, the operator should be prepared to provide the following:

   i. Documented compliance of applicable requirements;
   ii. The proposed plan to conduct operations under the authorization; and
   iii. The identification of the appropriate Point(s) of Contact (POC) for coordination during the CAAT authorization process.

2.5.2 Required Documentation for Submission of Formal Request

a) Documentation Guidance.

The following paragraph provides general guidance on the documentation required for submission of a formal request for issuance of this authorization. At the discretion of Flight Operations Standards Department, CAAT, additional information may be required based on any unique aspects of specific operations.

b) Letter of Request for Issuance of Authorization.

The operator must submit a letter of request to CAAT requesting issuance of the authorization. The letter of request should include statements indicating the following:

i. Area(s) of intended operation;
ii. Type of aircraft (make, model, and series (M/M/S)) to be used in the operations, aircraft registration number/mark, serial number;
iii. Description of ADS-B OUT equipment to be used. Make, model, part number and version of ADS-B transmitter and positioning source(s);
iv. Description of ADS-B IN application(s) to be used, if applicable;
v. Revision of aircraft qualification documents (Airplane Flight Manual (AFM), Pilot's Operating Handbook (POH), etc.);
vi. Establishment of applicable operational procedures and practices;
vii. Revision of applicable operations manuals and checklists;
viii. Revision of ADS-B OUT / IN system maintenance procedures;
ix. Establishment of periodic maintenance for the ADS-B OUT / IN system;
x. Revision of Minimum Equipment List (MEL), if applicable;
xi. Revision of pilot training; and
xii. Revision of dispatcher training, if applicable.

2.5.3 Compliance Documentation

Operators must submit documentation that demonstrates compliance with any document as in Para 2.2 above, the documents must have been demonstrated as meeting.

a) EASA Acceptable Means of Compliance (AMC) 20-24 – Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHz Extended Squitter dated 02 May 2008.

b) EASA CS-ACNS.D.ADS-B – Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance Subpart D – Surveillance (SUR).

c) The current version of FAA Advisory Circular (AC) No: 20-165(_) (or later versions) – Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out Systems or any equivalent (such as Title 14 of Code of federal Regulations (14 CFR) 91.227 or Technical Standard Order (TSO) C166(_) – Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 MHz).

d) The equipment configuration standards in Appendix XI of Civil Aviation Order (CAO) 20.18 of the Civil Aviation Safety Authority of Australia dated 16 December 2014 and amendment thereof or any equivalent (such as Appendix 4 and 5 of CAO 82.5 – Conditions on Air Operators' Certificates authorizing regular public transport operations in high capacity aircraft or CASA Advisory Circular (AC) 21-45 – Airworthiness Approval of Airborne Automatic Dependent Surveillance Broadcast Equipment). or

e) Other documents acceptable by CAAT (such as Radio Technical Commission for Aeronautics (RTCA) DO-260 (or later version) – Minimum Operational Performance Standards (MOPS) for 1090 MHz Extended Squitter or Technical Standard Order (TSO) C166b – Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz), etc.).

2.5.4 Documentation should include:

a) Aircraft Qualification Airworthiness Compliance Documentation. Documentation from the aircraft manufacturer stating in the Airplane Flight Manual (AFM), Airplane Flight Manual Supplement (AFMS) or Pilot's Operating Handbook (POH) that the proposed aircraft complies with, needs to provide AT LEAST a statement of compliance that the ADS-B System complies with;

i. Applicable documents in Para 2.2 or 2.5.3, or
ii. Version 0 Extended Squitter (ES) as specified in ICAO Annex 10, Volume IV, 5th Edition, Chapter 3 Paragraph 3.1.2.8.6, Chapter 5 (including Amendment 85 to ICAO Annex 10, Volume IV, 4th Edition) and Chapter 2 of the ICAO Doc 9871 (equivalent to Radio Technical Commission for Aeronautics (RTCA) DO-260 or European Organization for Civil Aviation Equipment (EUROCAE) ED-102), or Later/Enhanced Versions*, and
iii. If deviations are applicable, deviations including those stated in PART II para 2.2, 2.5.3 and 2.5.3.a) i., as appropriate, must be included or referenced.

Note*: After 2020, Version 2 ES as specified in Chapter 4 of ICAO Doc 9871 (equivalent to RTCA DO-260B, EUROCAE ED-102A or TSO C166b) will become more common in the Asia Pacific region. The FAA and EASA ADS-B mandates for 2020 will require this version. Operators are encouraged to equip forward fit for newly manufactured ADS-B, Aircraft having a maximum certified takeoff weight of 5700 kg or greater, or having a maximum cruising true airspeed capability of greater than 250 knots, with ADS-B avionics compliant to Version 2 ES or Later Version.

b) Operational Procedures and Practices.

As applicable, company Operation Manuals (OM) must address the general and special characteristics of the ADS-B, and the proposed area(s) of operation.

c) Operations Manuals and Checklists

The Airplane Flight Manual (AFM), Airplane Flight Manual Supplement (AFMS), Aircraft Operating Manual (AOM), Flight Operations Manual (FOM), Pilot's Operating Handbook (POH), and associated checklists, as applicable to the specific operator, must include information to be used for the specific operation requested and be carried on the aircraft. The Operations Manual (OM) or equivalent manual should include a system description, limitation, operational, contingency and emergency procedures, and training elements for use of the ADS-B OUT / IN application. Operations Manuals (OM) should indicate that Direct Controller Pilot Communications (DCPC) must be available at all times (e.g., Very High Frequency (VHF), Controller-Pilot Data Link Communication (CPDLC), etc.) including the recommended phraseology. Operations Manuals (OM) and checklists should contain the operational aspects described in the provisions of ICAO Annex 6 and relevant procedures contained in the Aeronautical Information Publications (AIP) published by the appropriate authorities, such as indicate that:

i. If flight crew receive equipment indications showing that position being broadcast by the ADS-B OUT system is in error (e.g. GPS anomaly), the crew should inform the Air Traffic Service Provider (ATSP), as appropriate, using any published contingency procedures.
ii. When there is not an independent Flight Deck Control selection between the ADS-B OUT (on/off) function and the ATC transponder (on/off) function, the crew must be fully aware that disabling the ADS-B function will also disable the transponder and Traffic Alert and Collision Avoidance System (TCAS)/TCAS II functions.

d) Maintenance Procedures.

The operator must submit documentation indicating the proposed maintenance procedures that address the Instructions for Continued Airworthiness (ICA) provided by the manufacturer of the installed ADS-B equipment and periodic verification check of aircraft-derived data used by the ADS-B system. Maintenance procedures must also include periodic verification (using suitable ramp test equipment or other acceptable means) that the correct ICAO 24 Bit address assigned to each aircraft is being transmitted by the ADS-B OUT system. Maintenance Tests should check the correct functioning of ADS-B system fault detectors, if any.

e) Establishment of Periodic Verification Checks of the ADS-B OUT System.

The operator should provide documentation that indicates that periodic checks for the installed ADS-B OUT system are established and the maintenance task shall be incorporated in Approved Maintenance Program (AMP).

f) Revision of Minimum Equipment List (MEL).

The operator must submit documentation for proposed MEL (if used) revisions that reflect the functional requirements of the ADS-B system and address appropriate dispatch procedures of the aircraft with the ADS-B OUT and ADS-B IN (if applicable) system unserviceable or partially unserviceable.

g) Flight Crew Training.

Aircraft operators should ensure that fight crew are thoroughly familiar with all relevant aspects of ADS-B applications. Flight crew conducting operations under this authorization must be trained in the use and limitations of the installed ADS-B system, unless one of the crewmembers is an ADS-B trained trainer, as appropriate. Operators must submit documentation that details the method and content of the flight crew training to be conducted. Flight crew training must address the following:

i. General understanding of ADS-B operating procedures;
ii. Specific ADS-B associated phraseology applicable to specific regions of operation;
iii. General understanding of the ADS-B technique and technology;
iv. ADS-B system operation, including normal/abnormal procedures;
v. Characteristics and limitations of the flight deck human-machine interface, including an overview of ADS-B environment and system descriptions;
vi. Need to use and correct entry of the ICAO defined format for entry of the Aircraft Identification (ID) or Aircraft Registration marking as applicable to the flight;
vii. Operational procedures regarding the transmission of solely the generic emergency flag in cases when the flight crew actually selected a discrete emergency code (if implemented, e.g., 7500, 7600 or 7700) and Special Position Identification (SPI);

viii. Indication of ADS-B transmit and/or receive capability within the ICAO Flight Plan;
ix. Handling of data source errors (e.g., discrepancies between navigation data sources or GPS anomaly);
x. ADS-B functions and system related MEL application procedures;
xi. Incident reporting procedures; and
xii. Crew Resources Management (CRM) and associated Human Factors issues.

Note: General aviation operators must submit a statement that the operator's pilots have knowledge of current air traffic ADS-B directives for the intended areas of en-route operation and will comply with applicable regulations.

h) Flight Dispatcher/Flight Operations Officer (FOO) Training.

Operators must submit a detailed description of the proposed Flight Dispatcher/Flight Operations Officer (FOO) (if required/used, as applicable) training to be conducted. Flight Dispatcher/Flight Operations Officer (FOO) training must address the following:

i. ICAO flight planning, fuel loading, and route change procedures associated with ADS-B operations;
ii. ADS-B region-specific area of applicability and requirements;
iii. Dispatch of aircraft with the ADS-B system unserviceable or partially unserviceable.

i) Incident Reporting Procedure.

Significant incidents associated with ATC surveillance information transmitted by the ADS-B data link that affects or could affect the safe operation of the aircraft will need to be reported in their occurrences report system and need to submit report to Asia Pacific ADS-B Avionics Problem Reporting Database (APRD) which is accessible to authorized users via https://applications.icao.int/ADSB-APRD/login.aspx.

Note: ADS-B problem report system and reporting form refer to 'INTERNATIONAL CIVIL AVIATION ORGANIZATION ASIA AND PACIFIC OFFICE, ADS-B IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT' edition11-July 2018.

2.6 Examples of ADS-B Airspace Specific Area of Applicability and Requirements

2.6.1 AUSTRALIA

Currently mandated, any aircraft that is operated at or above FL290 and all IFR aircraft must carry serviceable ADS-B transmitting equipment that complies with an approved equipment configuration (by meeting the conditions for approval set out in Appendix XI of Civil Aviation Order (CAO) 20.18.

2.6.2 UNITED STATES

On 1 January 2020, all aircraft operating with in the US airspace defined in 14 CFR 91.225 – Automatic Dependent Surveillance - Broadcast (ADS-B) Out equipment and use, will be required to transmit the information defined in 14 CFR 91.227 – Automatic Dependent Surveillance - Broadcast (ADS-B) Out equipment performance requirements, using ADS-B Out avionics. In general, operators flying at 18,000 feet and above will require equipment which use 1090ES.

2.6.3 EUROPE and AFRICA Regions

In accordance with Commission Regulation (EU) No 1207/2011, expected from 7 June 2020, aircraft having a maximum takeoff mass greater than 5,700 kg or a maximum cruising true speed greater than 250 knots and operating flights as general air traffic in accordance with Instrument Flight Rules (IFR) in the airspace within the ICAO EUR and AFI regions where EU Member States are responsible for the provision of Air Traffic Services (ATS) are to be compliant with CS ACNS Subpart D Section 4 – 1090 MHz Extended Squitter ADS-B Out.

a) SOUTH AFRICAN REP.

From 1 April 2020, all aircraft operating under IFR must carry a serviceable Mode S and ADS-B transponder that meet the current standard.

2.6.4 ASIA-PACIFIC Region

a) CHINA

Requirements of Operation in ADS-B Service Airspace within Urumqi CTA via 1090 MHz extended squitter data link ADS-B out technique is applicable to fly above FL276 (FL8400m) and 12500m (inclusive).

b) HONG KONG

All aircraft flying at or above FL290 within Hong Kong FIR, shall be installed with ADS-B equipages complying with the requirements.

c) INDIA

The ADS-B Out mandate for all aircraft flying on PBN routes in Indian continental airspace with designators L, M, N, P, Q, T and routes A201, A347, A465, A474, A791, B211, B466, G450, R457, R460, R461, W15, W19, W20, W29, W41, W43, W45, W47, W56S/N, W67, W111, W112, W114, W115, W118, W153, at or above FL290 has been postponed until 1 January 2020.

d) INDONESIA

From 1 January 2018, all aircraft flying within Jakarta FIR and Ujung Pandang FIR at or above FL290 must carry serviceable ADS-B transmitting equipment (Mode S Transponder and GNSS source position) that meet the performance standards.

e) MALAYSIA

The surveillance of en-route ATS route air traffic within certain part of Kuala Lumpur FIR not covered by radar surveillance will be implemented. Malaysia has mandated the compulsory requirement for aircraft to carry serviceable ADS-B on 31 December 2019 when operating on ATS routes N751, P628, L510, L645, and P574 at FL290 to FL410 within airspace bounded by Kuala Lumpur FIR boundary.

f) SINGAPORE

Aircraft that operates on ATS Routes L642, L644, M753, M771, M904, N891, N892, Q801, Q802, Q803 and T611 within airspace bounded by 073605N 1090045E, 040713N 1063543E, 041717N 1061247E (MABLI), 044841N 1052247E (DOLOX), 045223N 1041442E (ENREP), 045000N 1034400E, thence north along the Singapore FIR boundary to 070000N 1080000E at or above FL290 must carry serviceable ADS-B transmitting equipment that has been certified as meeting standards.

g) TAIWAN

With effective from 31 December 2019, 0000UTC, all aircraft flying at or above FL290 within Taipei FIR shall carry ADS-B Out equipages complying with the requirements.

h) UNITED ARAB EMIRATES

Referred to General Civil Aviation Authority (GCAA) CAR-OPS 1.867 ADS-B a), an operator shall not operate an aeroplane under IFR after 01 January 2020, unless it is equipped with ADS-B OUT capability demonstrated against Certification Specifications.

i) VIETNAM

From 1 July 2018, aircraft having maximum takeoff weight of 15,000kg or heavier and operating within Ha Noi and Ho Chi Minh FIRs must be ADS-OUT equipped and operated.
From 1 January 2020, aircraft having maximum takeoff weight of 5,700kg or heavier and operating within Ha Noi and Ho Chi Minh FIRs must be ADS-OUT equipped and operated.

2.7 Related Documents

ICAO Regional Guidance. Regulatory guidance and general information for ADS-B OUT operations for specific ICAO regions can be found in the following publications:

a) ICAO Annex 10, Aeronautical Telecommunications, Vol. IV – Surveillance Radar and Collision Avoidance Systems, Fifth Edition, July 2014;

b) ICAO Annex 10, Aeronautical Telecommunications, Vol. III – Communication Systems, Part I – Digital Data Communication Systems, Second Edition, July 2007;

c) ICAO Doc 9871/AN460, Technical Provisions for Mode S Services and Extended Squitter, Second Edition including Amendment dated January 9, 2017;

d) ICAO ADS-B Implementation and Operations Guidance Document (AIGD) for the Asia and Pacific Regions – Edition 11.0, July 2018;

e) RTCA/DO-260 (equivalent to EUROCAE/ED-102), Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance - Broadcast (ADS-B), 13 September 2000 and Change 1, 27 June 2006;

f) RTCA/DO-260A, Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B), 10 April 2003, Change 1, 27 June 2006 and Change 2, 13 December 2006;

g) RTCA/DO-260B (equivalent to EUROCAE/ED-102A), Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Services - Broadcast (TIS-B), 2 December 2009 and Corrigendum 1, 13 December 2011;

h) EASA AMC 20-24, Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHZ Extended Squitter, dated 2 May 2008;

i) EASA CS-ACNS, Certification Specification and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance, dated 17 December 2013;

j) 14 CFR Part 91, 91.225, Automatic Dependent Surveillance - Broadcast (ADS-B) Out Equipment and Use;

k) 14 CFR Part 91, 91.227, Automatic Dependent Surveillance - Broadcast (ADS-B) Out Equipment Performance Requirements;

l) FAA Order 8900.1, Flight Standards Information Management Systems (FSIMS), Volume 3, Chapter 18, Section 3, Part A Operations Specifications—General, Operations Specifications/Management Specifications/Letter of Authorization A153, Automatic Dependent Surveillance-Broadcast (ADS-B) Operations Outside of U.S.- Designated Airspace, current edition;

m) FAA Notice 8900.269 OpsSpec/MSpec/LOA A153 ADS-OUT Operations Outside of U.S.- Designated Airspace;

n) FAA AC 20-165(_), Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out Systems;

o) FAA AC 20-172(_), Airworthiness Approval for ADS-B IN Systems and Applications;

p) FAA AC 90-114(_) Change 1, Automatic Dependent Surveillance Broadcast (ADS-B) Operations;

q) TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on Frequency of 978 Megahertz (MHz);

r) TSO-C166b, Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz);

s) TSO-C195, Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA);

t) CASA CAO 20.18, Aircraft Equipment – Basic Operational Requirements, Instrument 2014;

u) CASA CAO 82.5, Condition on Air Operators' Certificates Authorizing Regular Public Transport Operations in High Capacity Aircraft, Current Edition;

v) CASA AC 21-45, Airworthiness Approval of Airborne Automatic Dependent Surveillance Broadcast Equipment;

w) CAAS AIC 14/10, Introduction to Automatic Dependent Surveillance Broadcast (ADS-B) OUT Service within Parts of the Singapore FIR, Current Edition;

x) TCCA AC 700-009, Automatic Dependent Surveillance-Broadcast, Issue 2; and

y) GCAA CAR Part IV Operations Regulations, CAR-OPS 1.867 ADS-B (OUT and IN), Issue 5).

2.8 Operational Manual

2.8.1 Automatic Dependent Surveillance Broadcast (ADS-B) Operations

a) ICAO's Asia-Pacific Regional Group has decided to use the 1090 MHz (Mode S) Extended Squitter datalink as the globally interoperable link for ADS-B operations. ICAO has also issued a number of technical and operational standards to support its introduction.

b) Operators wishing to operate in ADS-B airspace are to submit their proposed procedures to the Authority for acceptance, prior to including such procedures in their operations manual. All operators requiring ADS-B approval shall apply to the Authority.

c) For flights in ADS-B airspace, an aircraft shall be equipped with the ADS-B OUT equipages that have been certificated as meeting:

i. EASA Acceptable Means of Compliance AMC 20-24 'Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHZ Extended Squitter';
ii. EASA Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance (CS-ACNS.D.ADS-B) – Subpart D – Surveillance (SUR);
iii. FAA Advisory Circular (AC) No: 20-165(_) (or later versions) – Airworthiness Approval of Automatic Dependent Surveillance - Broadcast (ADS-B) Out Systems or any equivalent (such as Title 14 of Code of federal Regulations (14 CFR) 91.227 or Technical Standard Order (TSO) C166(_) – Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz));
iv. The equipment configuration standards in Appendix XI of Civil Aviation Order CAO 20.18 of the Civil Aviation Safety Authority of Australia or any equivalent (such as Appendix 4 and 5 of CAO 82.5 – Conditions on Air Operators' Certificates authorizing regular public transport operations in high capacity aircraft or CASA Advisory Circular (AC) 21-45 – Airworthiness Approval of Airborne Automatic Dependent Surveillance Broadcast Equipment); or
v. Other reputable authority standards acceptable by the CAAT.

d) For utilization of ADS-B In applications, an aircraft shall be equipped with the ADS-B IN equipages that have been certificated as meeting:

i. FAA Advisory Circular (AC) No: 20-172(_) (or later versions) – Airworthiness Approval of ADS-B IN Systems and Applications or any equivalent (such as or Technical Standard Order (TSO) C195 – Avionics Supporting Automatic Dependent Surveillance - Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)); or
ii. Other reputable authority standards acceptable by the CAAT.

e) The criteria for granting the ADS-B approval are:

i. The continuing airworthiness of ADS-B system must be assured. As part of the operational approval process, existing established maintenance practices or a proposed maintenance programme for the aircraft needs to be reviewed to ensure that it meets relevant requirements;
ii. The Minimum Equipment List needs to reflect the functional requirements of the ADS-B system;
iii. Appropriate flight operations training programme and operational procedures are established to ensure that pilots are knowledgeable about ADS-B operations, their on-board operational equipment, their area(s) of operations and specific requirements.

2.9 ADSB (ADS-B OUT and IN)

ADS-B means Automatic Dependent Surveillance – Broadcast, a surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and Global Navigation Satellite System (GNSS). It refers to a surveillance technology where ADS-B OUT equipped aircraft broadcast position, altitude, velocity, and other information, as applicable, in support of both air-to-ground and air-to-air surveillance applications.

2.9.1 ADS-B OUT

An operator shall not operate an aeroplane under IFR ADS-B Airspace, unless it is equipped with ADS-B OUT and approved by the CAAT.

2.9.2 ADS-B IN

An operator shall not operate an aeroplane utilized with the ADS-B IN capability unless approved by the CAAT.

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