Automatic Dependent Surveillance Broadcast (ADS-B)

Flight Operations Information Package

About this information package

ADS-B provides a highly accurate and effective means for air traffic controllers to provide air traffic surveillance services outside of radar coverage.

The objective of this interactive package is to provide information to assist in the development of the pilot and dispatcher training programs necessary to support Automatic Dependent Surveillance Broadcast (ADS-B) services in Australia.

About this information package

While Airservices Australia has taken reasonable steps to ensure the accuracy of this information, Airservices Australia makes no warranty or representation that it is accurate.

Information required for operational or commercial purposes must be checked against the appropriate sources.

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About this information package

For convenience,this information package contains a number of links to websites where more relevant information can be obtained.

If running this program online, or from CD or hard drive whilst connected to the internet, clicking these links will take you out of this package and directly to the relevant web page.

Some linked pages are not under the control of Airservices Australia. Airservices Australia is not responsible for the content of any external linked site, or any changes or updates to such sites.

Additional ADS-B Education Material

An additional source of ADS-B education material is an information booklet published by the Civil Aviation Safety Authority (CASA).

This booklet is available on-line at:

http://www.casa.gov.au/wcmswr/_
assets/main/pilots/download/ads-b.pdf
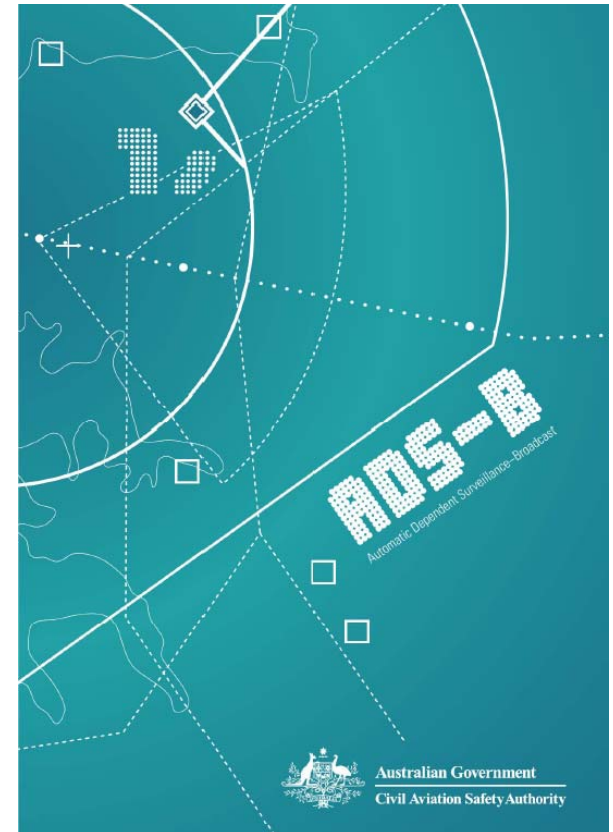
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ADS-B Flight Operations Information Package

Part 1 – Overview

Part 2 – Operating Procedures and Services

*Select a section above or **click** to start from the beginning.*

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Part 1 - Overview

- How ADS-B Works

- Avionics Overview

- ATC System Overview

- ADS-B Implementation Overview

- ADS-B Services Overview

- Avionics Requirements

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How ADS-B Works

An aircraft with ADS-B determines its position using GPS.


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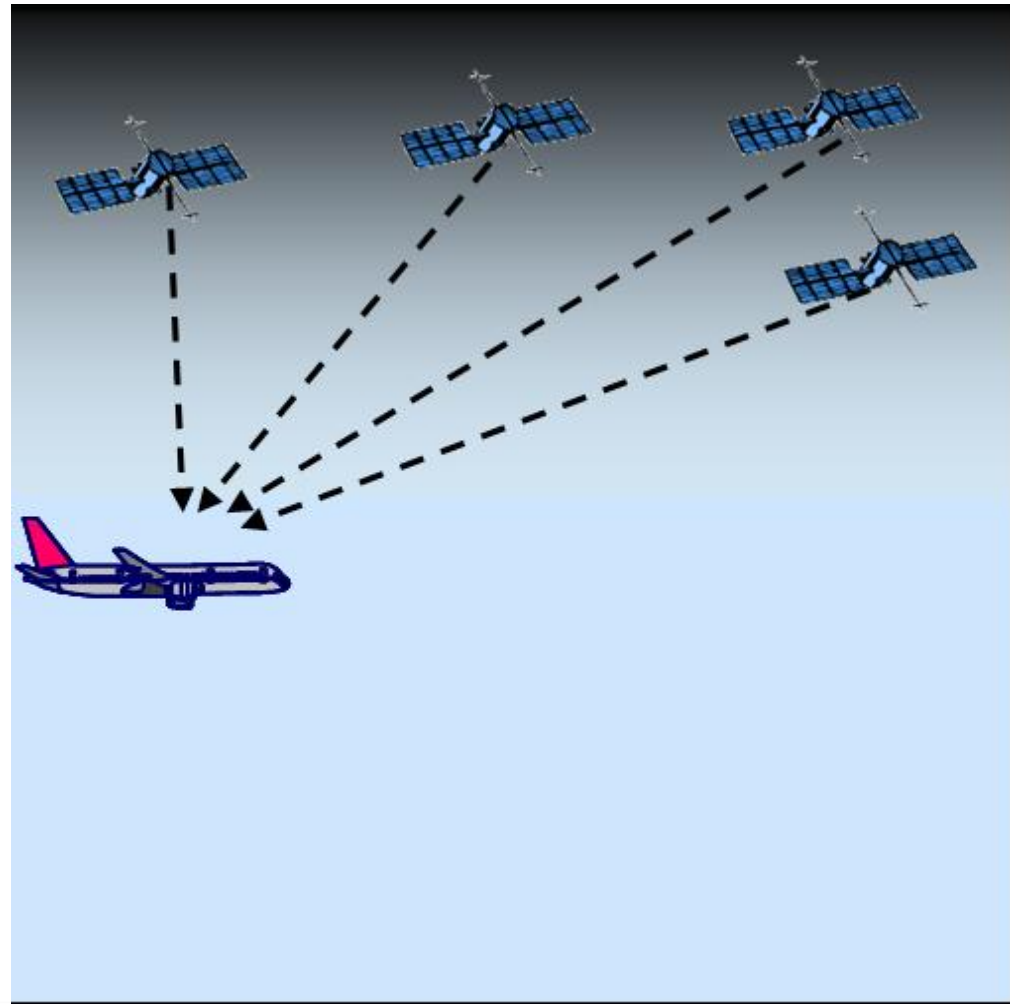
How ADS-B Works

An aircraft with ADS-B determines its position using GPS.

The aircraft then broadcasts that position at rapid intervals, along with identity, altitude, velocity and other data.

Dedicated ADS-B ground stations can receive the broadcasts and relay the information to air traffic control for precise tracking of the aircraft.
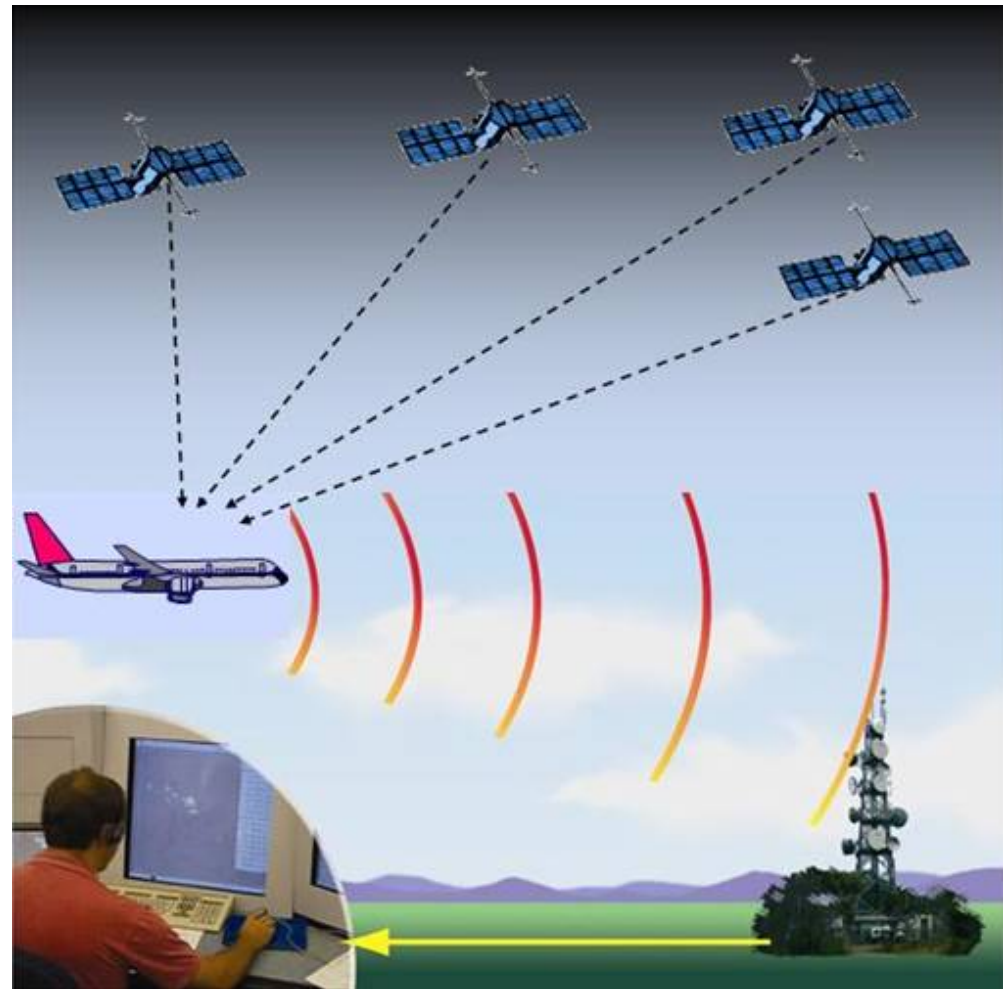
How ADS-B Works

ADS-B data is broadcast every half-second on a 1090 MHz, digital data link and, like radar, is limited to "line-of-sight." The ability of a ground station to receive a signal depends on altitude, distance from the site and obstructing terrain.

The maximum range of each ground station can exceed 250 nautical miles. In airspace immediately surrounding each ground station, surveillance coverage will extend to near the surface.

~ 500 Nautical Miles

Ground Station

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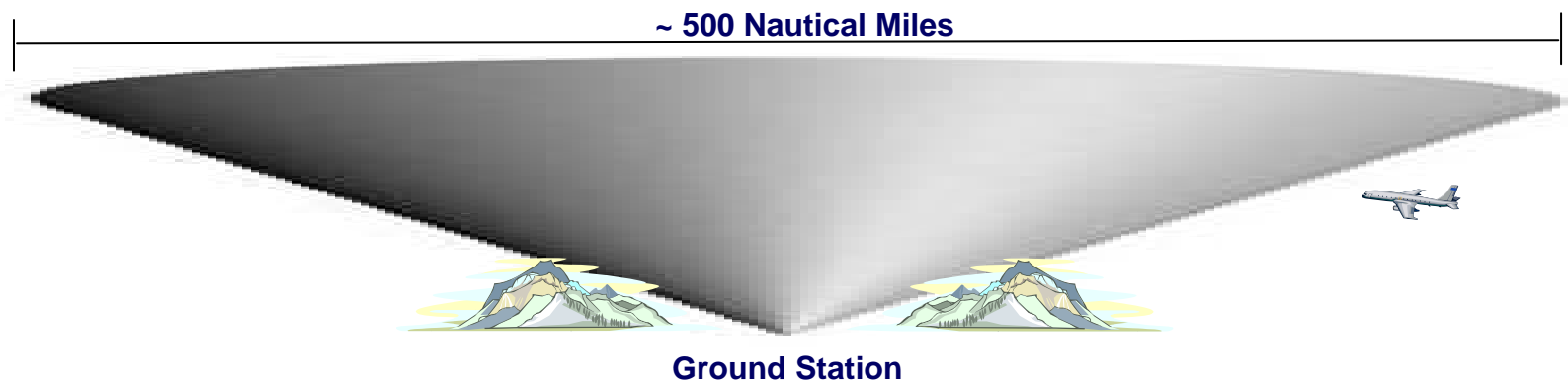
Avionics Overview

In most installations today, ADS-B transmissions are a function of the aircraft's Mode S transponder(s). Only transponders with the appropriate software, and connections to the GPS receiver (and FMS if so fitted) can transmit ADS-B data.

ADS-B transmissions are automatically activated when the transponder is activated.

Selection of IDENT provides an identification indication in the ADS-B message.
Selection of Standby Mode inhibits ADS-B transmissions as well as SSR interrogation replies.

Indicative only

Avionics Overview

Some ADS-B installations may not share controls with the SSR transponder, meaning that independent operation of the two systems may be required.

Refer to relevant operator manuals for correct operation.

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Avionics Overview

The ADS-B transmitter autonomously broadcasts various aircraft parameters every half-second which may include:
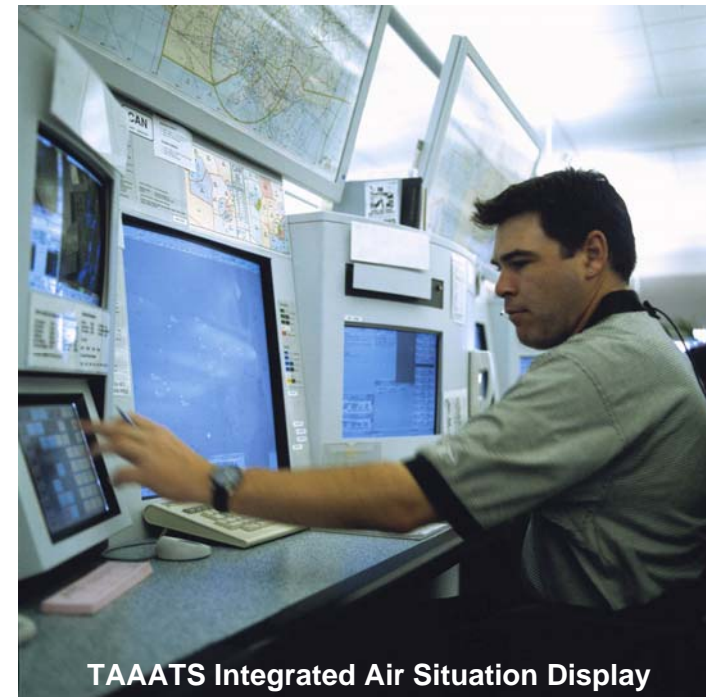
- Flight Identification (flight number callsign or registration)
- ICAO 24-bit Aircraft Address (globally unique airframe code)
- Position (latitude/longitude)
- Position Integrity/Accuracy (GPS horizontal protection limit)
- Barometric and Geometric Altitudes
- Vertical Rate (rate of climb/descent)
- Track Angle and Ground Speed (velocity)
- Emergency Indication (when emergency code selected)
- Special Position Identification (when IDENT selected)

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ATC System Overview

ADS-B processing and display functions have been integrated into The Australian Advanced Air Traffic System (TAAATS).

TAAATS receives position and altitude information from a number of sources. Radar, ADS-B, ADS-C (FANS1/A) and pilot position reports can all be used to track the flight.

The shape of the position symbol is an indication to the controller of the source of the position information being used to track the flight.

TAAATS Integrated Air Situation Display

What the Air Traffic Controller Sees

Integrated air situation display.

Positions from ADS-B and other sources displayed on a single screen.

ADS-B derived position

RADAR derived position

Computer predicted position based on pilot position reports
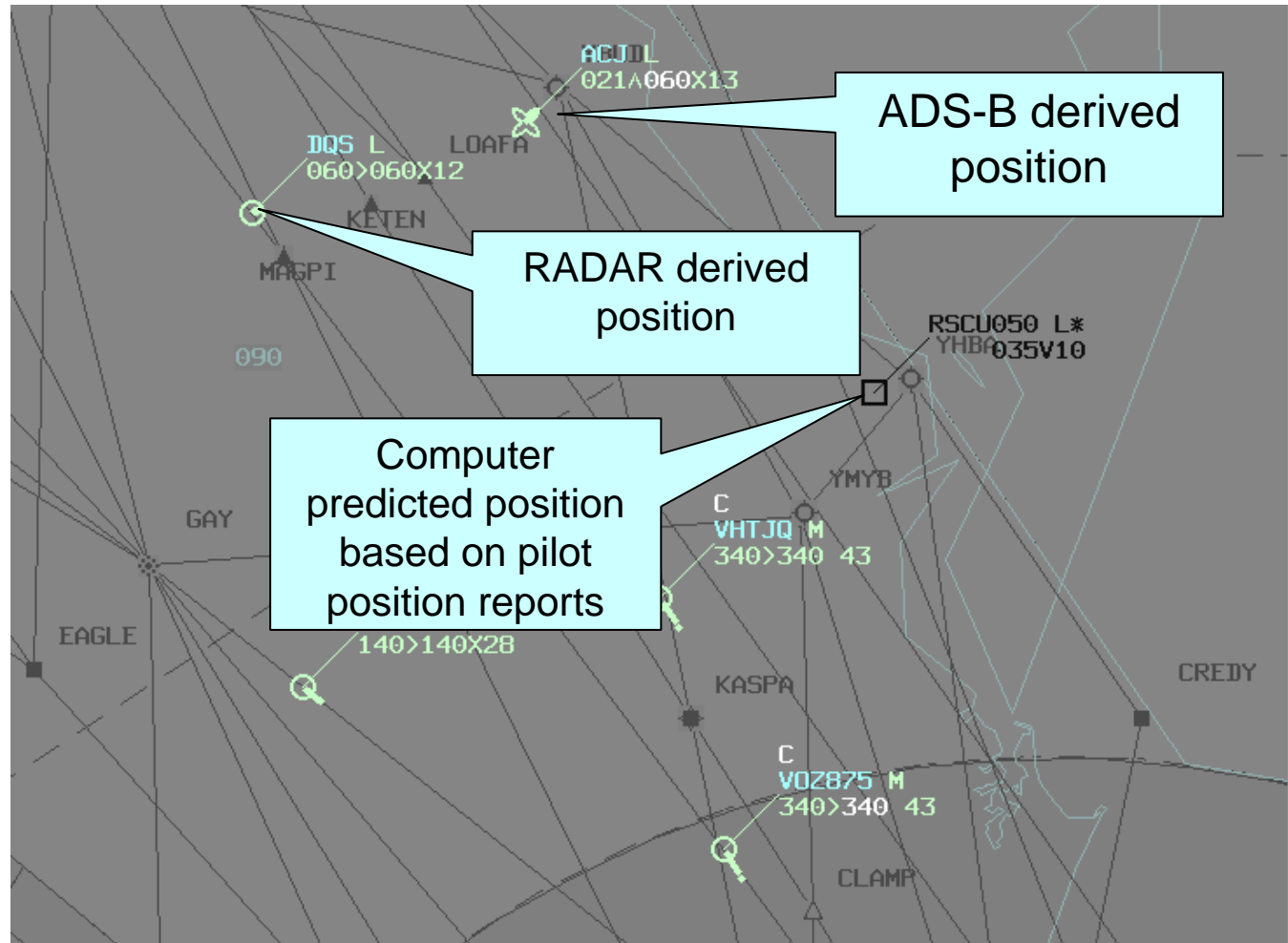
Correlation with the ATS Flight Plan

The ATC system uses the flight identification (flight number) broadcast by the avionics to correlate ADS-B position to information contained in a stored ATS flight plan.

It is therefore important that the Flight ID or flight number entered in the avionics exactly matches the Aircraft Identification in the ATS flight plan.

For airline flights, this is typically the ICAO 3 letter airline designator plus flight number.

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ADS-B Implementation Overview

Airservices Australia has expanded its air traffic surveillance capabilities using a network of 33 Automatic Dependent Surveillance Broadcast (ADS-B) ground stations.

The ground stations are strategically located across the continent to complement existing radar coverage resulting in nationwide ATC surveillance capability above 30,000 feet.

ADS-B Ground Station

Integrated Air Situation Display
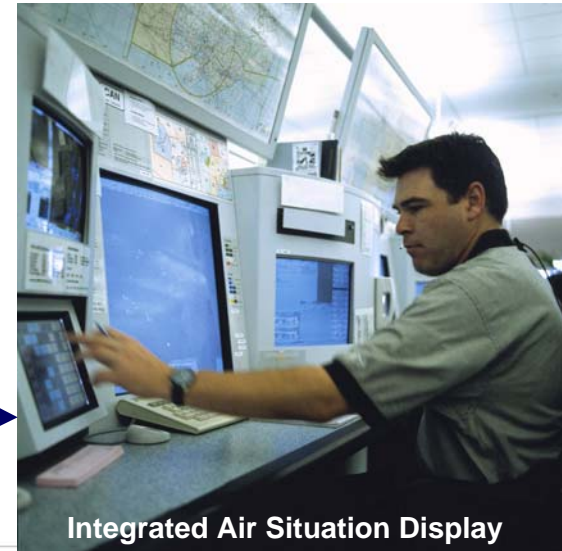
Combined Radar and ADS-B Coverage
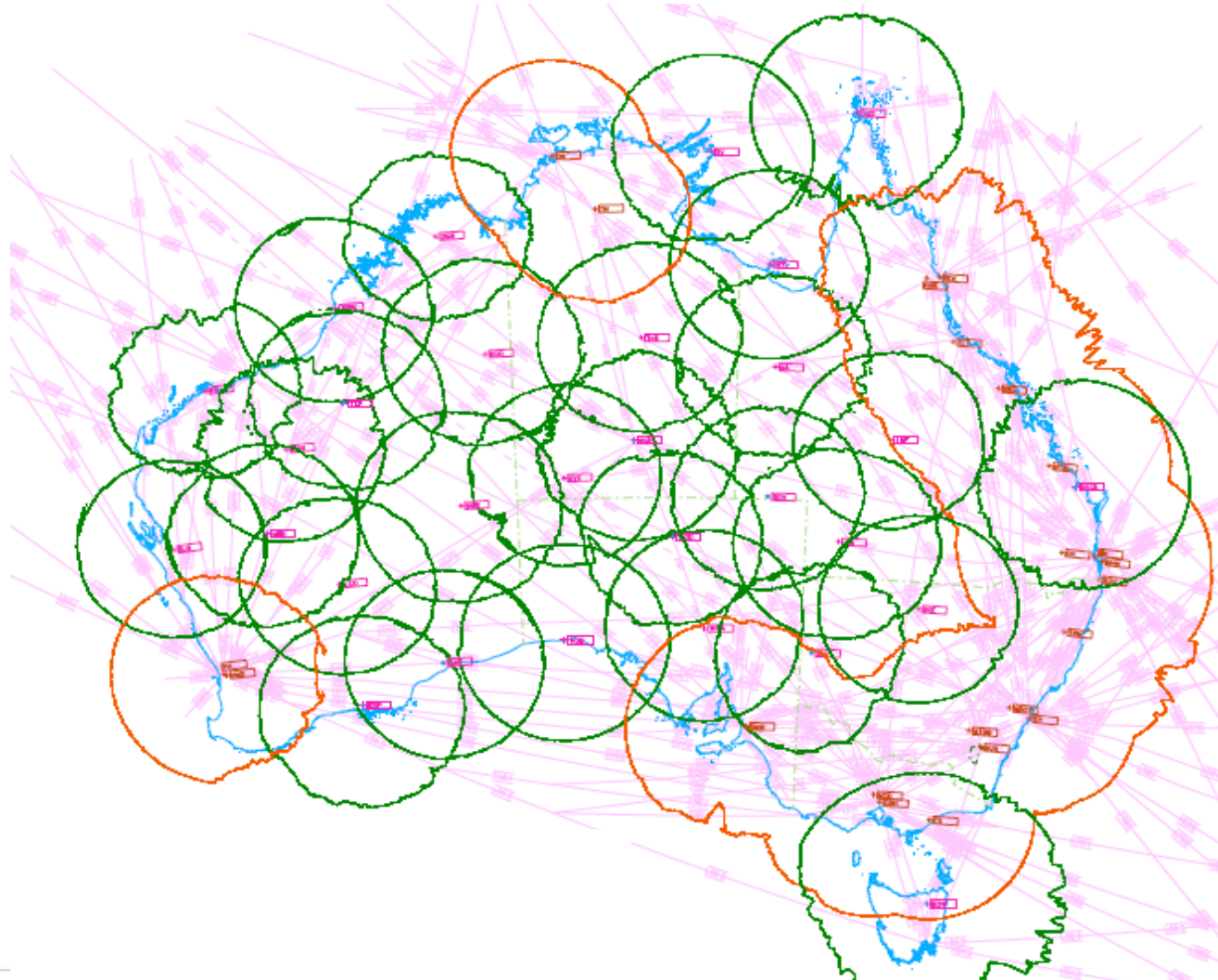
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ADS-B Services Overview

Since December 2009, ADS-B has been used to deliver surveillance separation services, between equipped aircraft, in controlled airspace, similar to radar separation services.

Air Traffic Control can apply a separation standard of 5nm between radar and/or ADS-B identified aircraft.

Within ATS surveillance system coverage, identified aircraft receive priority over non-identified aircraft as per AIP ENR 1.4. para 10.1(j)

ADS-B provides a safety net alerting capability to ATC, enhancing overall aviation safety

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ADS-B Services Overview

ADS-B is also used to deliver surveillance services, including radar-like traffic advisories in uncontrolled airspace, at selected remote locations where coverage exists.

Warning: ADS-B equipage is not mandatory – however will be mandatory for operations at/above FL290 from 12th December 2013. Pilots must be aware that aircraft without ADS-B and not under air traffic control responsibility may be operating in some classes of airspace and will not be visible or known to ATC.

ADS-B derived traffic advisory services can only be provided in respect to other ADS-B equipped aircraft.

Avionics Requirements

A small number of ADS-B installations do not meet the requirements for ADS-B derived air traffic services in Australia.

Because of this, aircraft operators who wish to take advantage of ADS-B services must confirm that aircraft avionics meet standards specified by the Australian Civil Aviation Safety Authority (CASA).

For more information, see Advisory Circular 21-45 at:

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c45.pdf

Avionics Requirements

Aircraft with demonstrated non-complying ADS-B transmission will be notified by ATC at the time of detection.

The pilot in command will be requested to contact ATC on completion of the flight for additional information regarding the observed issue.

ATC must be notified of fault correction within 24 hours or ADS-B services for that aircraft will be withdrawn.

ADS-B services will be restored within 48 hours when advice is received of corrective action.

End of Part 1

This concludes Part 1 of the Airservices Australia ADS-B flight operations information package. For more information on the ADS-B Project, visit the ADS-B website at:

http://www.airservicesaustralia.com/projects/ads-b/operational-information

Click here to go to Part 2 – Operating Procedures and Services

Click here to review Part 1

Automatic Dependent Surveillance Broadcast (ADS-B)

Flight Operations Information Package

Part 2 – Operational Procedures and Services

Part 2 – Operating Procedures and Services

Overview

Pre-flight

In-flight

Phraseology

Separation Services

Traffic Advisory Services

Emergencies

Cockpit Display of Traffic Information

ADS-B Operating Procedures and Services

ADS-B is part of a hierarchy of surveillance data sources, with primary and secondary radar having the highest display priority in the ATS surveillance system.

ADS-B will be used as a source of aircraft position and altitude information when an equipped aircraft is beyond or below radar coverage within the service volume of an ADS-B ground station (a line of sight facility).

In general, ADS-B services and procedures are identical to those provided within radar coverage. Some changes to phraseology and terminology in AIP have been made in recent years to remove specific references to "radar."

ADS-B is used by ATC outside of radar coverage

Pre-flight: Flight Notification Procedures

Operators who meet the Australian requirements for ADS-B operations must indicate ADS-B capability in the flight notification (ATS flight plan) when planning to operate in Australian airspace.

This is indicated by entering the transponder and ADS-B capability in Item 10b of the ATS flight plan.

Example:

(FPL-ABC123-IS
-B738/M-SDHIRWZ/LB1
-YSSY0105
-N0453F370 DCT SY H185 ENTRA Y245 BANDA H185 CG/N0452F360 Q69 ITIDE DCT HBA DCT
-YHBA0116
-EET/YBBB0009 REG/VHABC SEL/MQBF OPR/ABACUS AIRLINES PER/C NAV/RNP10 GPSRNAV)

Pre-flight: Flight Notification Procedures

Field 10b entries for indicating carriage of ADS-B in Australia include:

One of:

E: Mode S transponder with Flight ID, pressure altitude and extended squitter (ADS-B) capability.

or

L: Mode S transponder with Flight ID, pressure altitude, extended squitter (ADS-B) capability and enhanced surveillance capability.

And one of:

B1: ADS-B out using 1090MHz

or

B2: ADS-B in and out using 1090MHz

Pre-flight: Entry of Flight Identification (FLTID)

ADS-B avionics transmit the Flight Identification (flight number) set in the avionics or flight management system.

The ATC system uses that identification to correlate ADS-B position with the information contained in a filed flight plan.

When entering the Flight Identification (flight number), pilots should ensure it exactly matches the Aircraft Identification in the ATS flight plan.

(FPL-ABC123-IS
-B738/M-SDHIRWZ/LB1
-YSSY0105

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Common **ERRORS** when entering Flight ID

The following are some commonly seen Flight ID entry errors seen by ATC:

- Using IATA 2 letter airline designator, instead of ICAO 3 letter airline designator (**AB**123 instead of ABC123) ☒

- Entering of wrong flight number (eg from a previous leg) (ABC122 instead of ABC123) ☒

- Entering leading zeros (ABC**0**123 instead of ABC123) ☒

- Entering spaces (ABC_123 instead of ABC123) ☒

- Entering departure/destination points/alternate (BNEMEL) ☒

- Entering **VH**ABC when flight planned as ABC ☒

Pre-flight: Entry of Flight Identification (FLTID)

If, for operational or equipment limitation reasons, the flight identification cannot match the aircraft identification in the flight plan, the ICAO 24-bit Aircraft Address (24 bit code) must be entered in Item 18 of the flight notification preceded by "CODE/"

The Aircraft Address is a globally unique, digital identification for the aircraft which is also broadcast and is expressed as a 6-character alphanumeric code as shown in the example below.

```
(FPL-ABC123-IS
-B738/M-SDHIRWZ/LB1
-YSSY0105
-N0453F370 DCT SY H185 ENTRA Y245 BANDA H185 CG/N0452F360 Q69 ITIDE
DCT HBA DCT
-YHBA0116
-EET/YBBB0009 REG/VHABC SEL/MQBF OPR/ABACUS AIRLINES PER/C
NAV/RNP10 GPSRNAV CODE/7C3A21)
```

Pre-flight: Knowledge of Aircraft Capabilities

It is possible that only a portion of the aircraft in an aircraft operator's fleet are ADS-B equipped.

It is therefore important for flight planning and operational reasons that dispatchers and pilots know which aircraft are equipped for ADS-B operations in Australia.

Operators should have processes in place to ensure dispatchers and flight crew are aware of fleet ADS-B capability and ICAO aircraft address if applicable.

Are we ADS-B equipped?
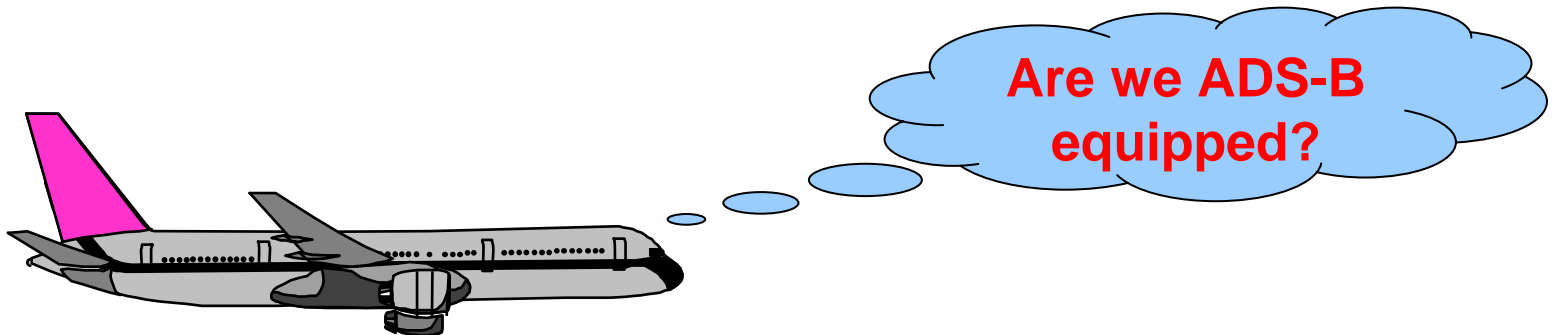
Confirmation of ADS-B Operation

When ADS-B transmissions from an aircraft flight planning as ADS-B equipped are not being received within ADS-B coverage:

ATC will say: "ADSB TRANSMISSIONS NOT RECEIVED, CONFIRM ADSB OPERATIONAL"

If pilot advises yes, ATC may say "SELECT SECONDARY TRANSPONDER"

If able, the pilot should switch to a secondary transponder.

When ADS-B transmissions from an ADS-B equipped aircraft are not received, ATC will file an Event Report. Air crew should also log the event so that ADS-B functionality can be checked by the aircraft operator.
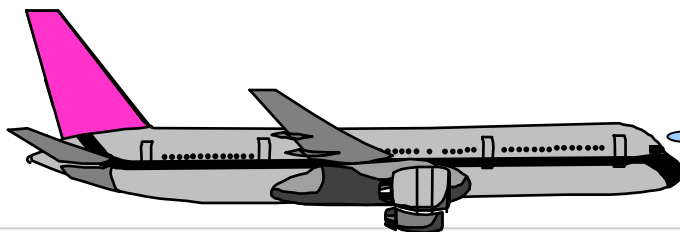
Is ADS-B OK?

Correction of Flight ID in Flight

If Flight ID has been entered incorrectly, ATC will instruct the pilot to "RE-ENTER ADS-B AIRCRAFT IDENTIFICATION"

If able, the pilot must then re-set the FLTID to exactly match the Aircraft Identification in the ATS flight notification.

If the pilot is unable to re-set the FLTID in flight then advise ATC that you are UNABLE TO COMPLY.

In Flight: Identification

Aircraft operating in an ADS-B service environment are identified using the same techniques used in radar identification. The phrase IDENTIFIED is used for both ADS-B and radar identification.

Some avionics installations may have a separate control panel for ADS-B and SSR functions. Therefore, the phrase SQUAWK IDENT will continue to be used in radar coverage with the phrase TRANSMIT A-D-S-B IDENT used in ADS-B coverage.

ABACUS ONE TWENTY THREE, TRANSMIT A-D-S-B IDENT

In-flight: Termination of Surveillance Services

The generic phrase, IDENTIFICATION TERMINATED is now used to advise termination of both radar and ADS-B derived surveillance services.

ABACUS ONE TWENTY THREE, IDENTIFICATION TERMINATED, FREQUENCY CHANGE APPROVED

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Phraseology

Phraseology associated with the provision of ADS-B services is generally aligned to radar. Surveillance Service phraseology is set out in AIP GEN 3.4 – 5.15.

The following tables indicate where differences between radar and ADS-B phraseology apply.

Circumstance	Radar Phraseology	ADS-B Phraseology
To request an aircraft's SSR or ADS-B capability	ADVISE TRANSPONDER CAPABILITY	ADVISE ADS-B CAPABILITY
To advise the aircraft's SSR or ADS-B capability	TRANSPONDER (ALPHA, CHARLIE *or* SIERRA *etc. as shown in the Flight Plan*) Or NEGATIVE TRANSPONDER	ADS-B TRANSMITTER (TEN NINETY DATALINK) *or* ADS-B RECEIVER (TEN NINETY DATALINK) *or* NEGATIVE ADS-B

Phraseology

| Circumstance	Radar Phraseology	ADS-B Phraseology
To request transmission of pressure altitude*	SQUAWK CHARLIE	TRANSMIT ADS-B ALTITUDE
To request termination of pressure altitude transmission due to faulty operation*	STOP SQUAWK CHARLIE WRONG INDICATION	STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION or reason)]

* Note that some ADS-B installations may not provide for entry of Flight ID, transmission of IDENT or isolation of pressure altitude by the pilot. Most ADS-B installations share controls with the SSR transponder, meaning that independent operation of the two systems is not possible. If it is not possible to comply with a particular instruction simply advise ATC and request alternative instructions.

Separation Services

ADS-B is used almost identically to radar.

Like radar, a 5 NM minimum separation standard may be applied between ADS-B equipped aircraft.

Procedural separation will continue to be applied between ADS-B and non-ADS-B aircraft outside of radar coverage.

ADS-B   5 Nm   **ADS-B**

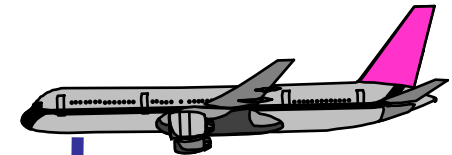**ADS-B**   Procedural Separation Standard   **Non ADS-B**
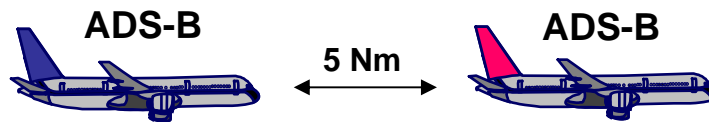
Impact of Satellite Geometry on Separation

The position information provided to air traffic control in an ADS-B message is derived from the aircraft's GPS receiver and includes a position integrity value based on satellite geometry.

For ATC to apply 5 NM separation to an ADS-B position, the integrity value must effectively guarantee the aircraft is within 0.5 miles of where it reports it is.

If an ADS-B report shows low position integrity, procedural separation must be used.

If the integrity value provided by the avionics falls below that value, the controller must revert to procedural separation.

Impact of Satellite Geometry on Separation

The predicted satellite geometry over Australia is monitored by an Airservices Australia ground system.

This system provides a warning to air traffic controllers if the predicted satellite geometry indicates that GPS-derived positions in a particular area may not have the "guaranteed" accuracy required for 5 NM separation services.

Controllers will temporarily suspend 5 NM separation services in areas where these circumstances occur.

Traffic Advisory Services

Air Traffic Controllers will provide Surveillance Information Service (SIS) in Class E and G airspace at locations within ADS-B coverage where ADS-B equipped aircraft regularly operate.

Warning: Pilots must be aware that regardless of the source of surveillance (radar or ADS-B), aircraft may be operating in Class E and G airspace that are not be visible to ATC.

ADS-B derived traffic advisory services can only be provided in respect to other ADS-B equipped aircraft.

Emergencies

Selection of an emergency transponder code, e.g. 7600, automatically generates an emergency indication in the ADS-B message, however, many transponders only transmit a generic ADS-B emergency indication.

That means the specific type of emergency, e.g. communications failure, may not be conveyed to controllers in an ADS-B environment for some avionics installations.

Note: Some general aviation installations may not broadcast any form of ADS-B emergency indication.

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Emergencies

Selection of an emergency transponder code, e.g. 7600, automatically generates an emergency indication in the ADS-B message, however, many transponders only transmit a generic ADS-B emergency indication.

That means the specific type of emergency, e.g. communications failure, is not always conveyed to controllers in an ADS-B environment.

The controller may receive only a generic EMG indication regardless of the code selected.

EMG
ABC123 M
330 330 46

Indicative only

Emergencies

Due to the emergency processing limitations of many ADS-B transmitters, the following procedure shall apply.

If an emergency indication is received from an aircraft in ADS-B airspace and the flight crew does not verbally communicate the nature of the emergency, the controller will initiate procedures for suspected unlawful interference.

Phraseology: ***<call sign> CONFIRM SQUAWKING ASSIGNED CODE***

If no response from the pilot is received within a reasonable time, the controller will assume the possibility of unlawful interference.

Note: Some transponders cannot transmit an ADS-B "IDENT" (SPI) while an emergency transponder code is selected.

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Cockpit Display of Traffic Information

Some aircraft may have ADS-B derived traffic information capabilities on a cockpit multi-function display.

Because regulations and standards for the use of cockpit display of traffic information (CDTI) do not yet exist, pilots must not use displayed traffic information to presume control instructions or to self separate in any class of airspace.

Conclusion

This concludes Part 2 of the Airservices Australia ADS-B Flight Operations Information Program. For more information on the ADS-B Project, visit the ADS-B website at:

http://www.airservicesaustralia.com/projects/ads-b/operational-information

Click here to review Part 2

Click here to review Part 1 - Overview