



ADS-B Operations in Australia ADS-B Flight Operation Seminar

17-18 June 2010

Ed Williams
Airservices Australia

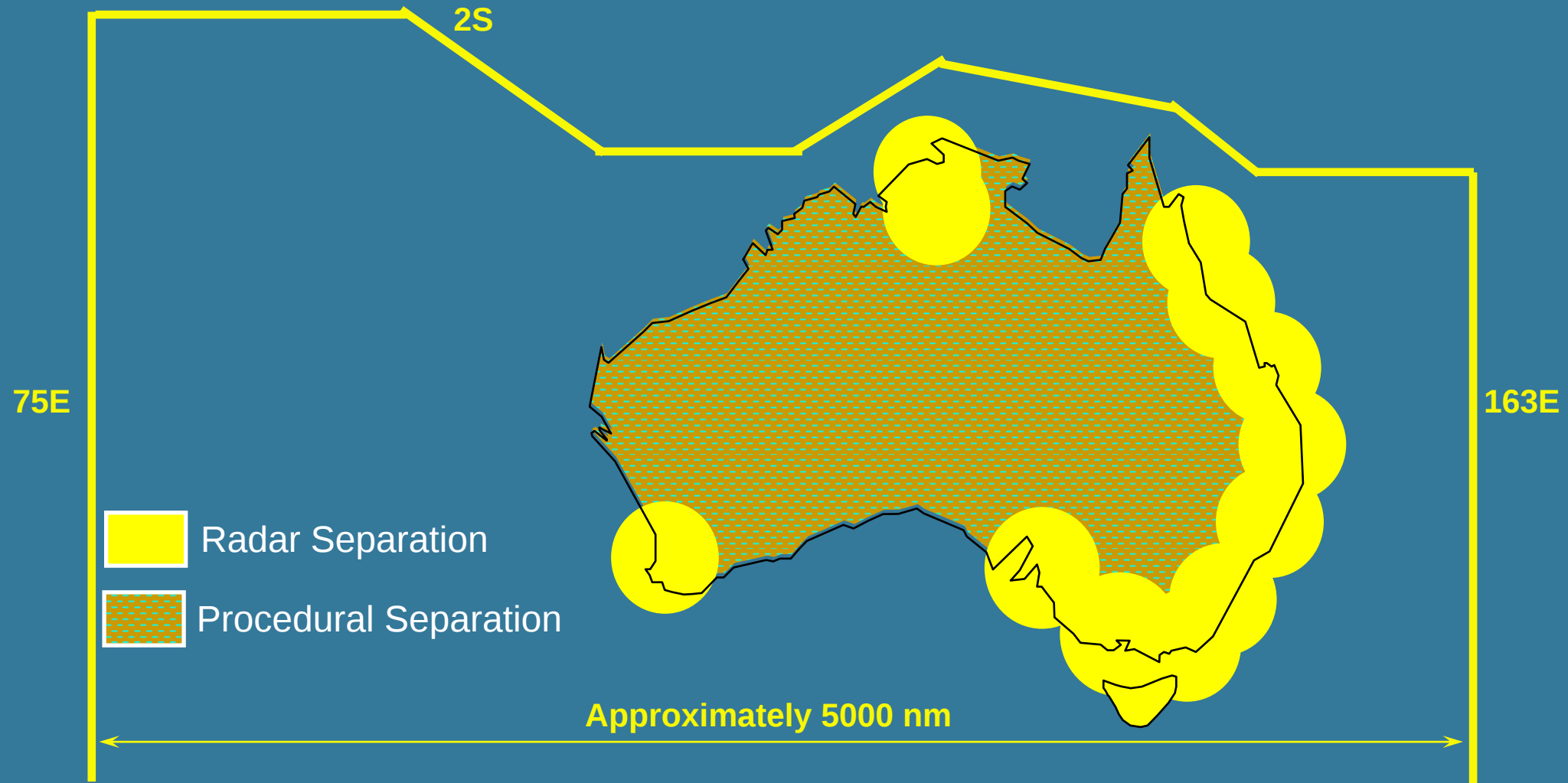
from the ground up



- China and Australia
- Surveillance Concepts
- How ADS-B works
- Bundaberg Operational Trial
- ADS-B Implementation in Australia
- Regulatory Considerations
- Sharing ADS-B Data with neighbours
- RNP – GLS Monitoring with ADS-B
- Future Applications

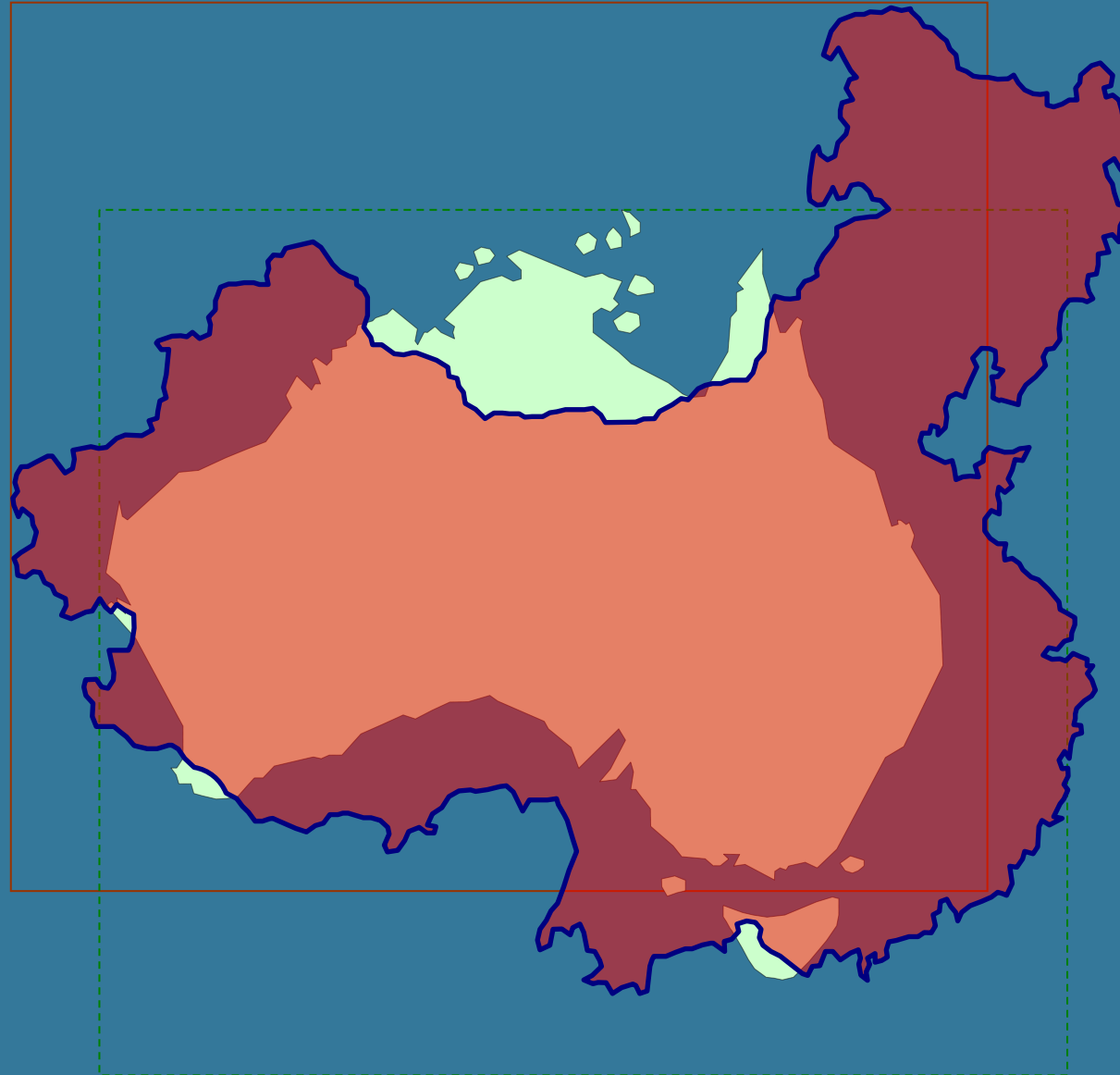
Australia's ATC Environment

Airspace inside AIRSERVICES AUSTRALIA



China & Australia large airspace

AIRSPACE AUSTRALIA AIRSERVICES AUSTRALIA

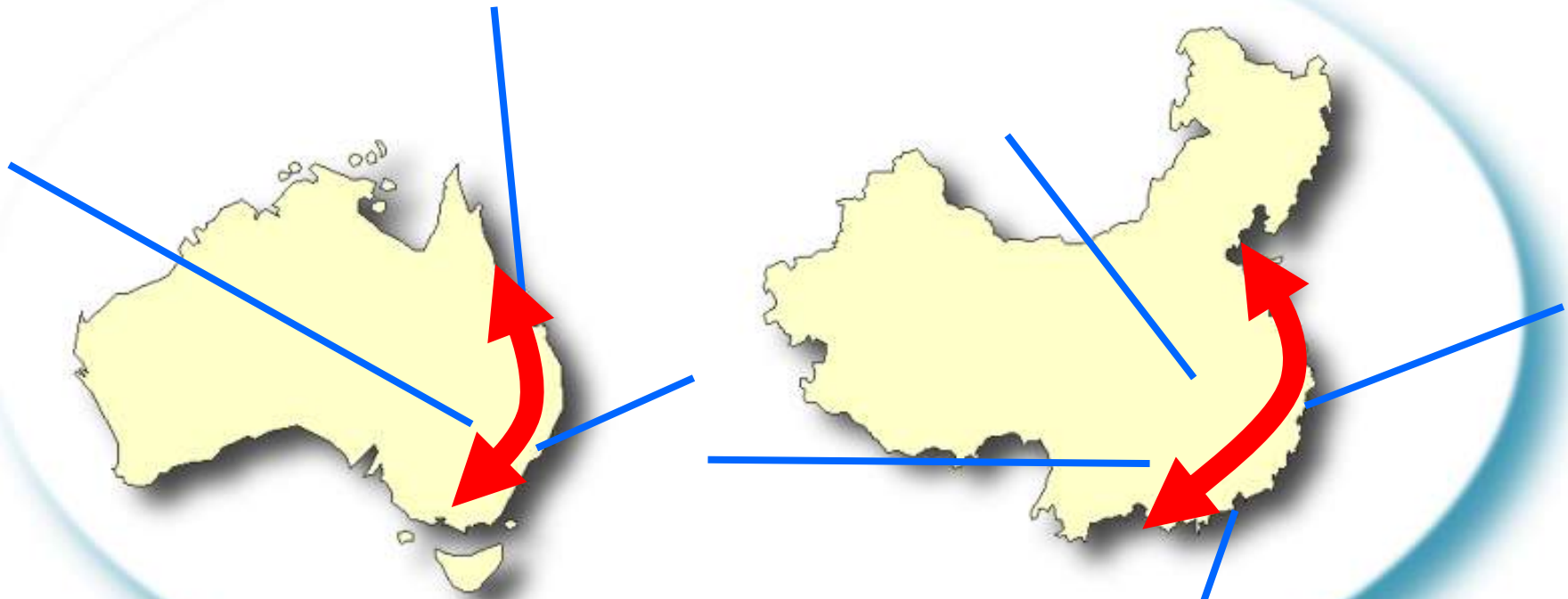


Australia & China both have

airspace | AIRSERVICES AUSTRALIA



high density **domestic sectors**



a network of **international routes**

similar traffic distribution



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- Pilots report their position
 - Using a voice channel (HF, VHF)
 - Slow, cumbersome
 - Exposed to human error
 - Broadcast: Everyone “on frequency” hears it
- Procedures and standards maintain safety
- A form of dependant surveillance
 - We rely on the pilot/aircraft navigation capability
- Large Separation Standards
 - Aircraft position uncertainty (ATC perspective)
 - Communications delays (particularly HF voice)



Radar Surveillance



- Radar measures:
 - Aircraft Position - range & azimuth
- Radar down-links:
 - Altitude & Identity
- Displayed in plan view
 - Allows smaller separation standards
 - Supports off-track & vectoring
- Expensive
- Terminal Area & high density En Route



ADS-C (Contract)



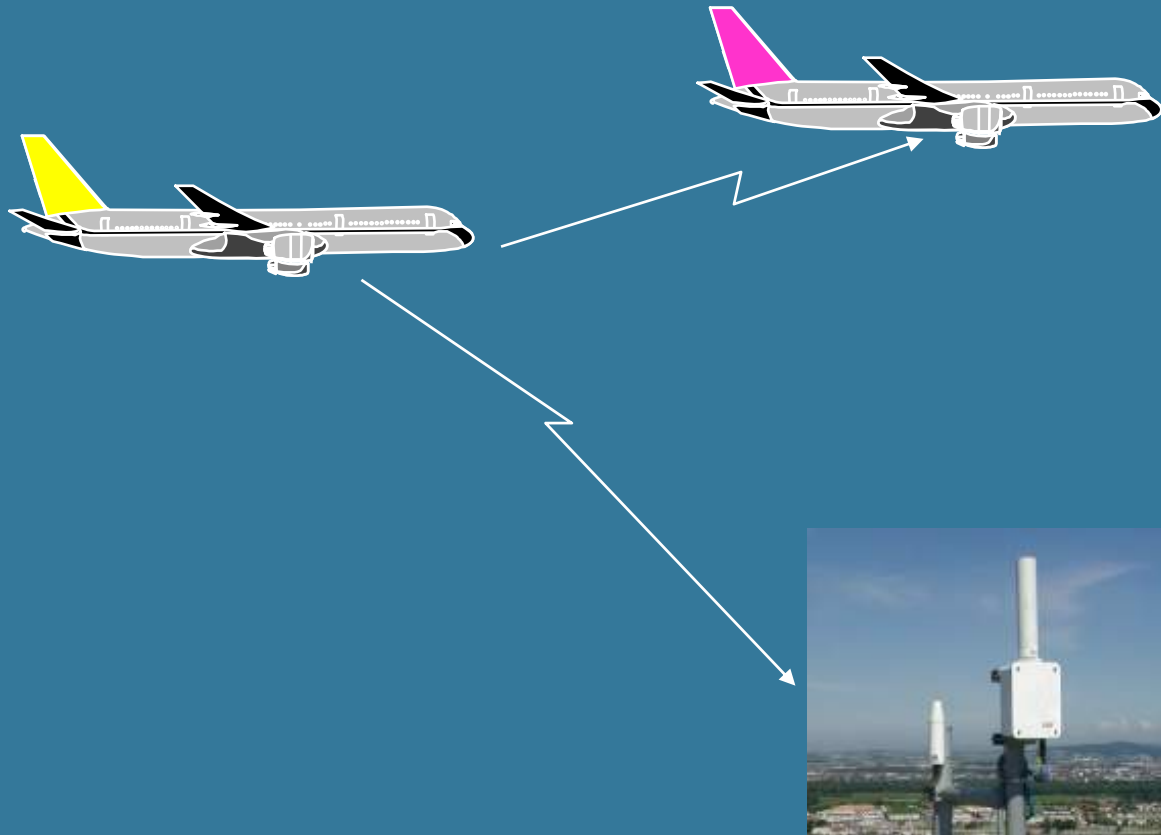
- FANS1/A Equipment in “big” aircraft
 - Expensive avionics
- Uses satellite and VHF datalinks via 3rd Party service providers
- Automatic, accurate routine reports
 - Slow update rate (typically every 14 minutes)
 - Supports exception reports & safety alerts
 - Reports are not visible to other aircraft
- Data Link Expensive
- Does not support tactical control



SITA / ARINC



What is ADS-B?



- **Automatic**
 - ✈ no pilot input required
- **Dependent**
 - ✈ Information sourced on the aircraft
- **Surveillance**
 - ✈ Aircraft Position
 - ✈ Altitude
 - ✈ Identity
 - ✈ Velocity Vector, + . . .
- **Broadcast**
 - ✈ any ground station or aircraft can receive

Automatic Position Reporting



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ADS-B "OUT"



Air-Ground Surveillance



MMR

Transponder



GNSS Receiver



Transponder

Typically two
broadcasts / sec

Identity (callsign)
Position
Altitude
Velocity Vector
Vertical Rate



ADS-B Ground Stations



Integration into ATC System

Airservices Australia

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Radar Track

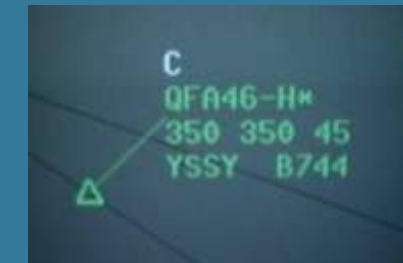


ADS - B Track

NEW SYMBOL



ADS- C Track



Flight Plan
Track



ADS-B "IN"



Enhanced "See & Avoid" Air-Air Surveillance



Traffic Displayed on MFD or PDA





- Australia
- Surveillance Concepts
- How ADS-B works
- **Burnett Basin ADS-B Operational Trial**
- ADS-B Implementation in Australia
- Regulatory Considerations
- Sharing ADS-B Data with neighbours
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- Future Applications

Burnett Basin



- Near Bundaberg
- Aircraft Surveillance
 - Radar coverage above FL120
 - ADS-B (initially) 120 Nm range



Burnett Basin

Brisbane

Sydney

2 Antennas



Bundaberg Trial



- Deployed and operationally commissioned ADS-B

- In a limited geographic area
- Equipped 9 aircraft initially
- DHC8, Shorts 360, B200, Jabiru
- B738 & A320 joined Jan 2006
- 39 aircraft including 2 h



- One ground station at site
- CAS for separation services



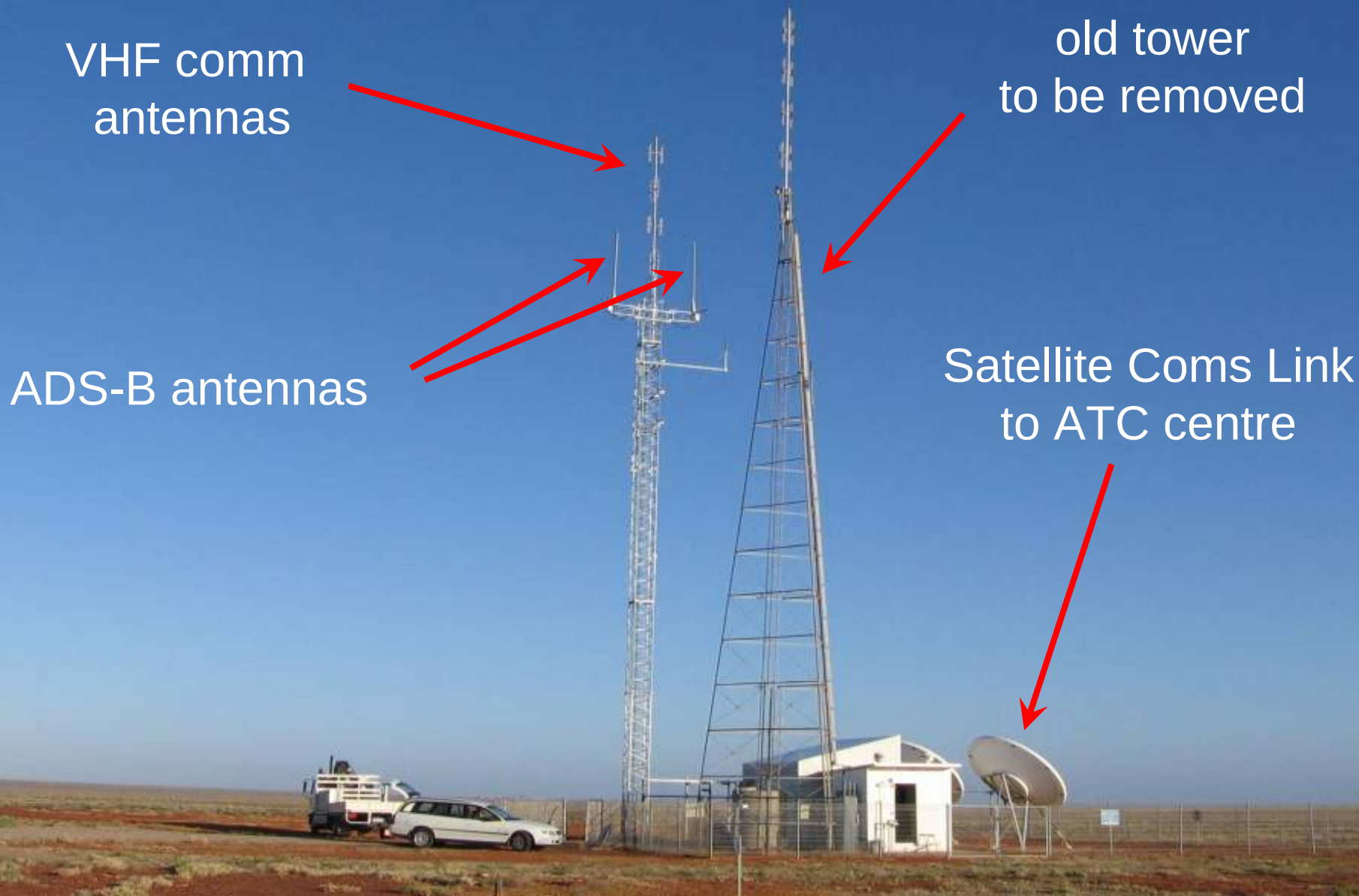
COMPLETE



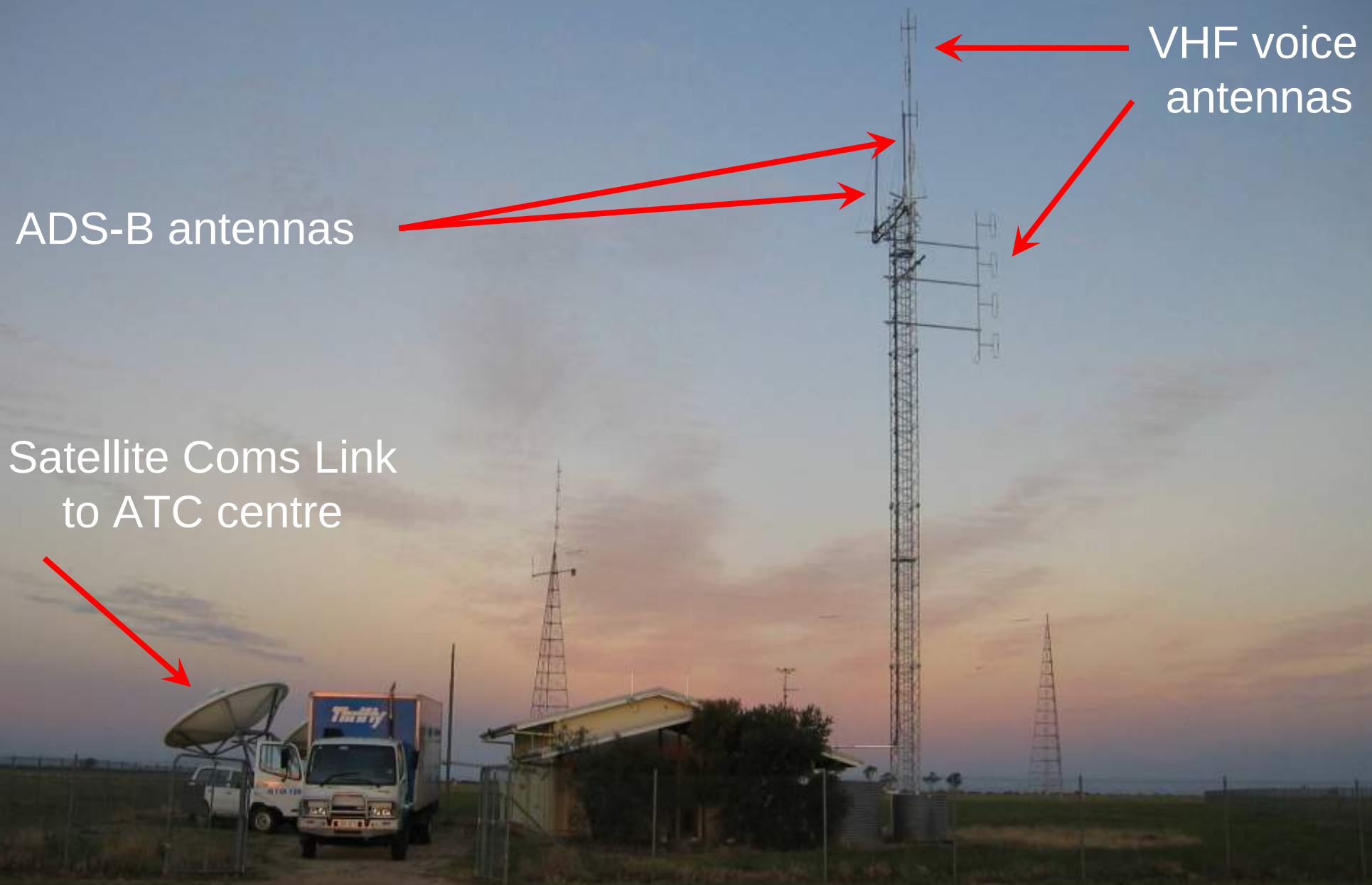
- Australia
- Surveillance Concepts
- How ADS-B works
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- **ADS-B Implementation in Australia**
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- ATC coverage of continent
 - 29 Duplicated Ground stations
 - Satellite communications links to ATC
 - ➔ ADS-B data
 - ➔ VHF air-ground voice communication
- Aircraft voluntary ADS-B equipage
- Safety benefits – RAM, CLAM, STCA
- Efficiency benefits – optimum level, off fixed routes
- Traffic above FL300
- In low density Non Radar Airspace

ADS-B Installation at Woomera



ADS-B Installation at Longreach



ADS-B Installation at Bourke



ADS-B Installation at Esperance



Billabong Roadhouse



ADS-B Antenna Folding Pole

27 NOV 2005

Integration into ATC System

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- Linked to FDP by 24 bit code
- Includes Safety net alerts (RAM, CLAM ...)
- Integrated into ATC training simulators
- Integrated into recording and analysis tools
- Operated for 3 years
- Trial Successful – Now normal daily operations

Radar Track

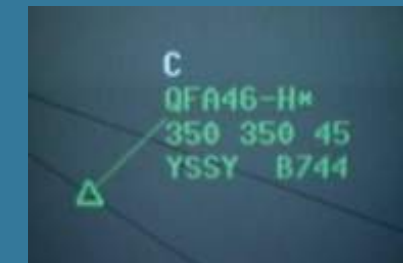


ADS - B Track



NEW SYMBOL

ADS- C Track



Flight Plan
Track



Operational on 18/12/2009

airspace outside | AIRSERVICES AUSTRALIA



- 27 (+3) Ground stations on ATC displays
- Authorised for 5 NM separation
 - all ground stations
- Controller training completed
- Operational approval granted
- NOTAM issued

C8395/09 NOTAMN

Q) YUXX/QXXXX/IV/BO/E/000/999/

A) YMMM/YBBB

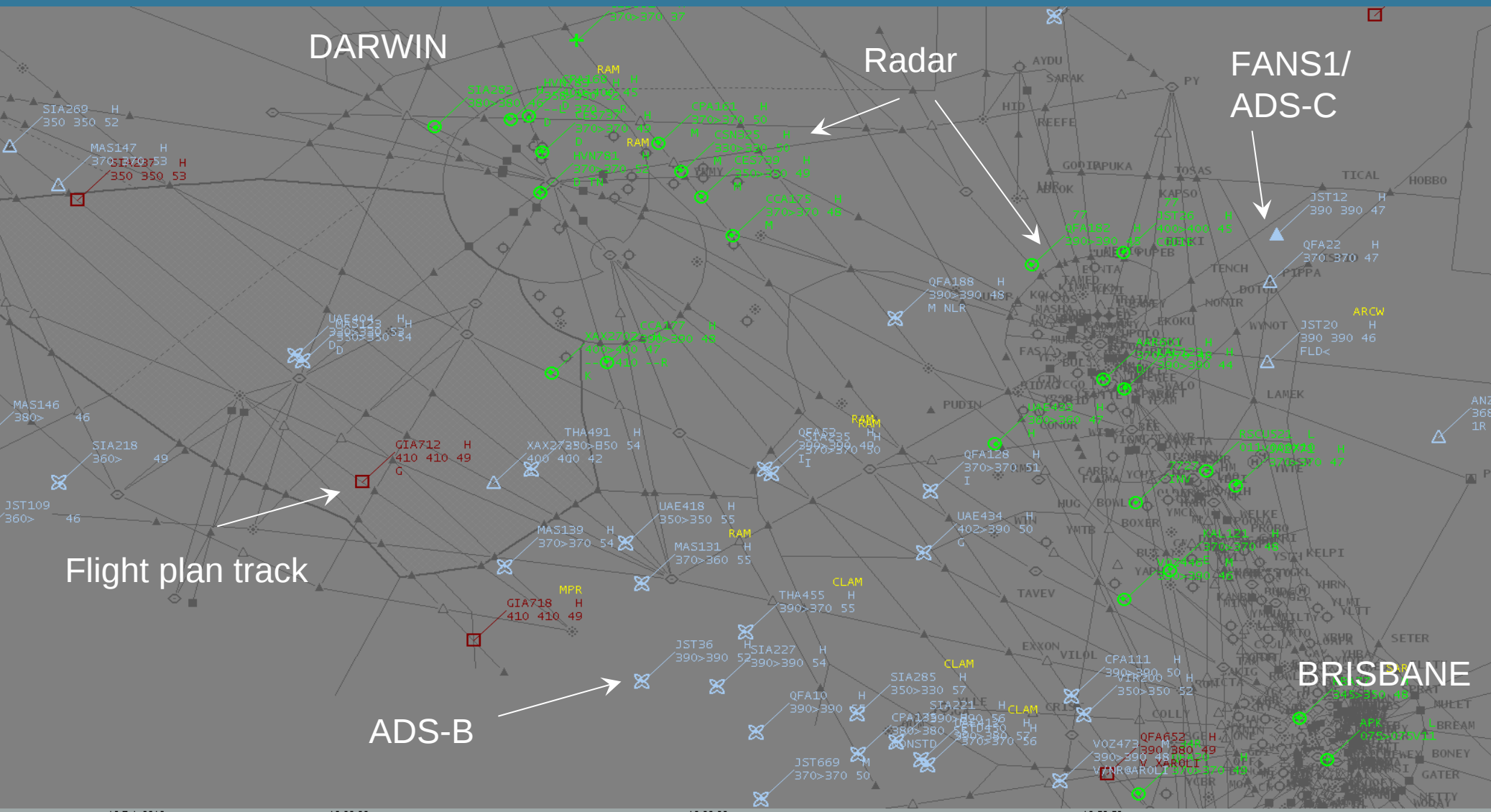
B) 0912181400 C) 1001310600 EST

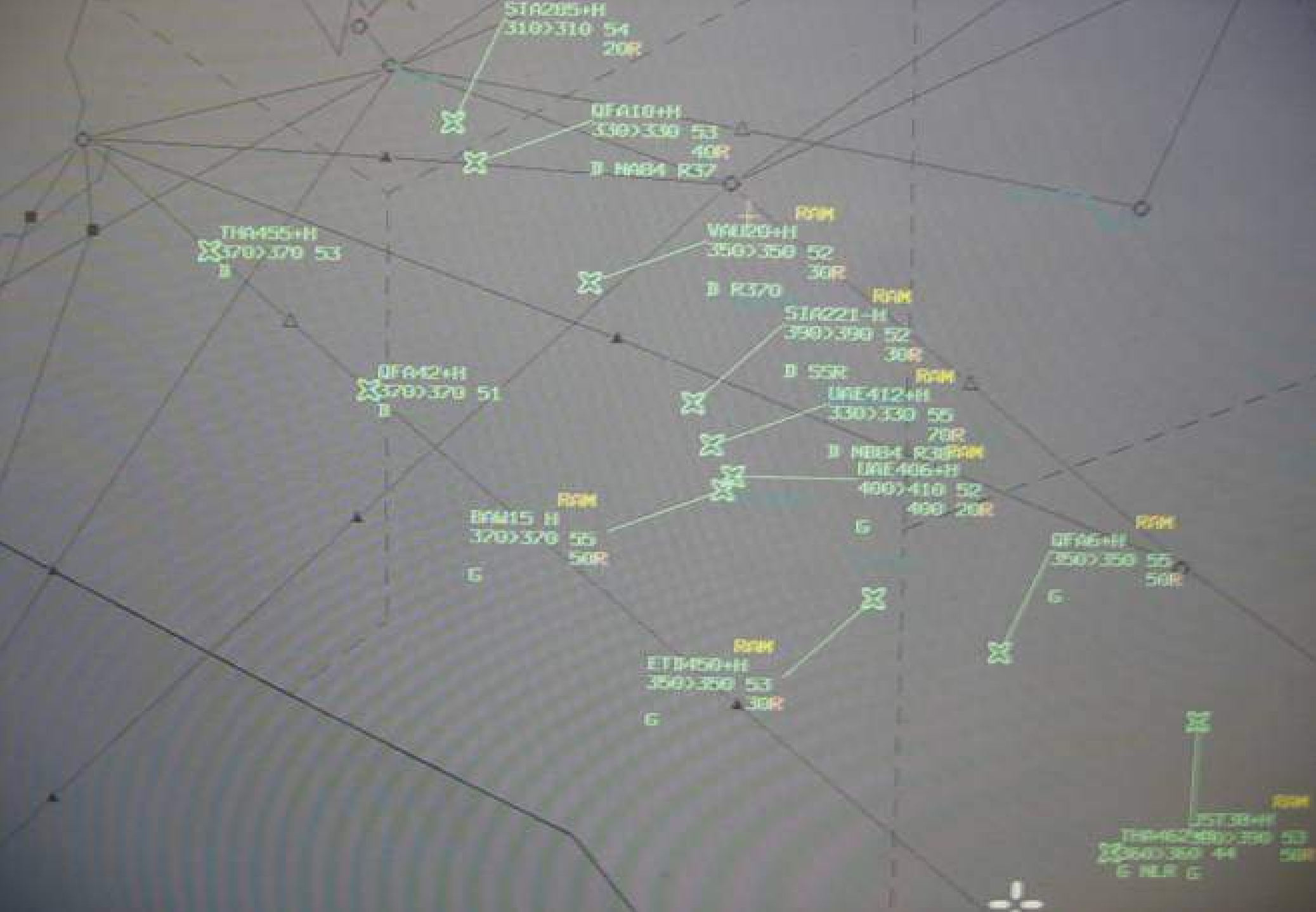
E) SURVEILLANCE SEPARATION AVBL OUTSIDE RADAR
COVERAGE IN BRISBANE AND MELBOURNE FIR DUE ADS-B
UPPER AIRSPACE PROGRAM STAGE 3 IMPLEMENTATION
COVERAGE DETAILS AVAILABLE AT

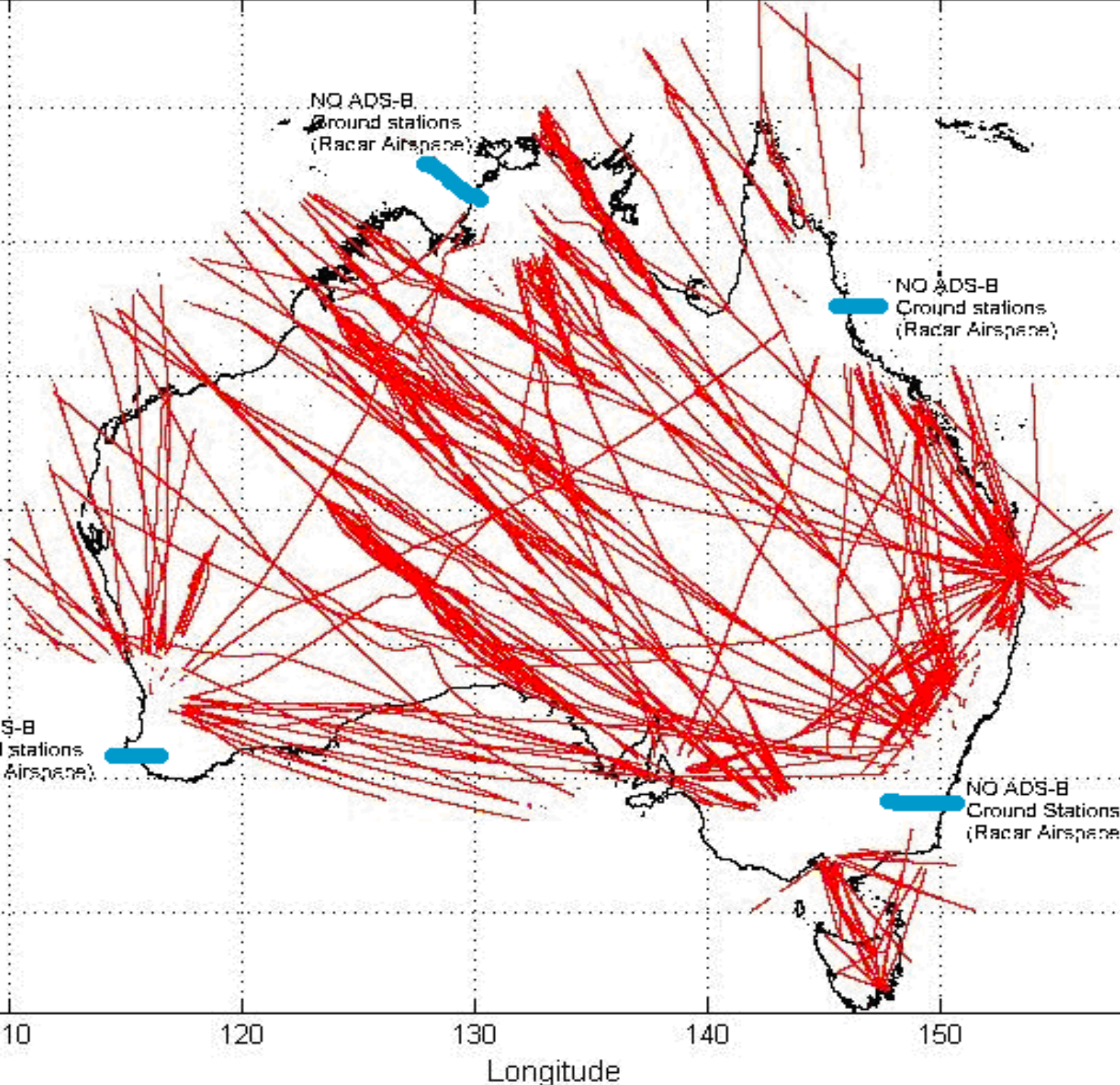
[WWW.AIRSERVICESAUSTRALIA.COM/PROJECTSSERVICES/PROJECTS/
ADSB/UAP.ASP](http://WWW.AIRSERVICESAUSTRALIA.COM/PROJECTSSERVICES/PROJECTS/ADSB/UAP.ASP)

ADS-B Tracks across Australia

Airservices Australia







ADS-B
Reports
on 10/1/2010

received by
28 ADS-B
Stations &
TAS WAM
stations

Coverage at 10,000 feet

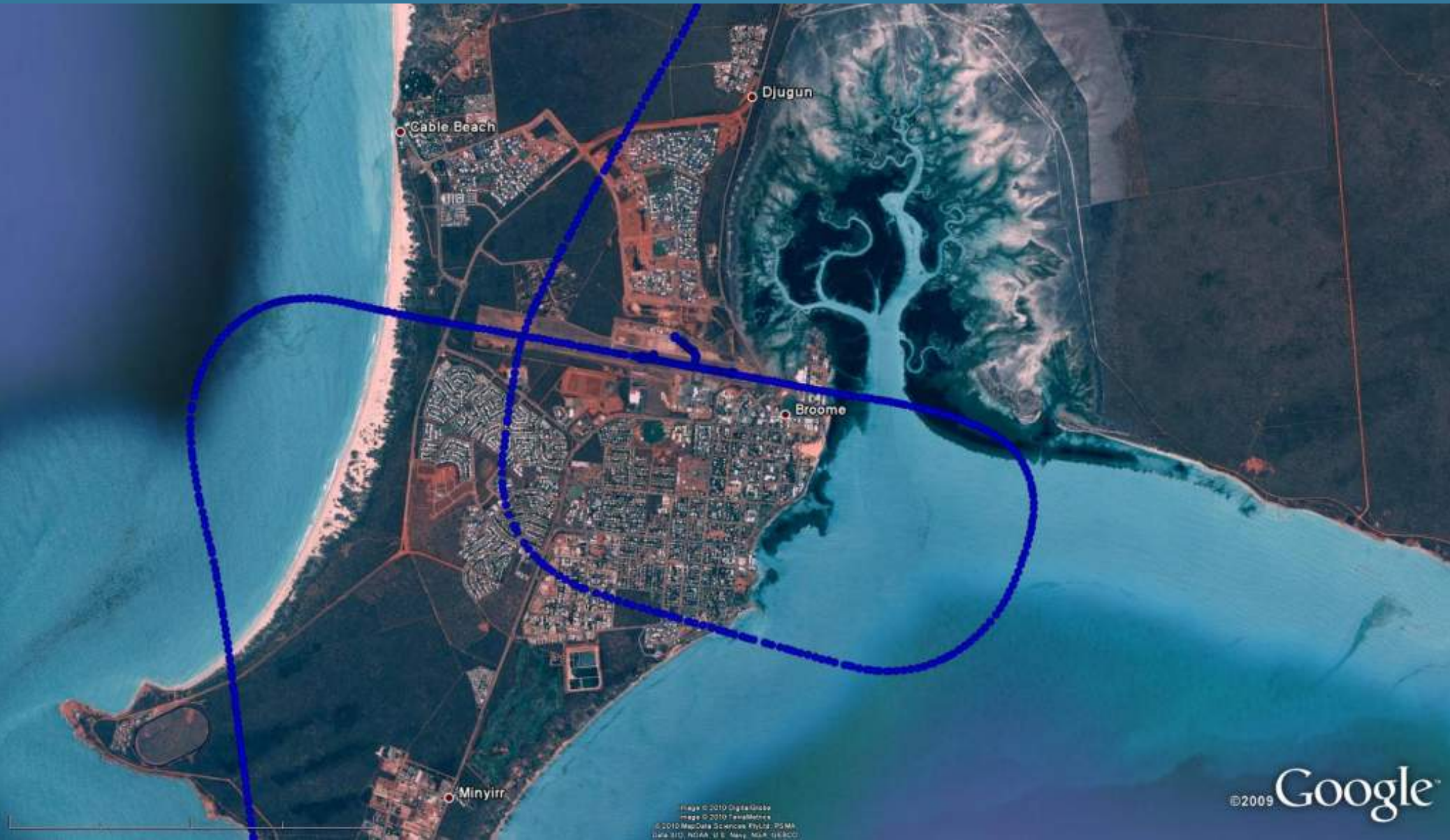
inspace | airside | AIRSERVICES AUSTRALIA



ADS-B already
provides
significant
coverage in
lower level
airspace

Broome

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Image © 2010 TerraMetrics
© 2010 MapData Science Pty Ltd - PSMA
Data: SIO, NOAA, U.S. Navy, NGA, GEBCO

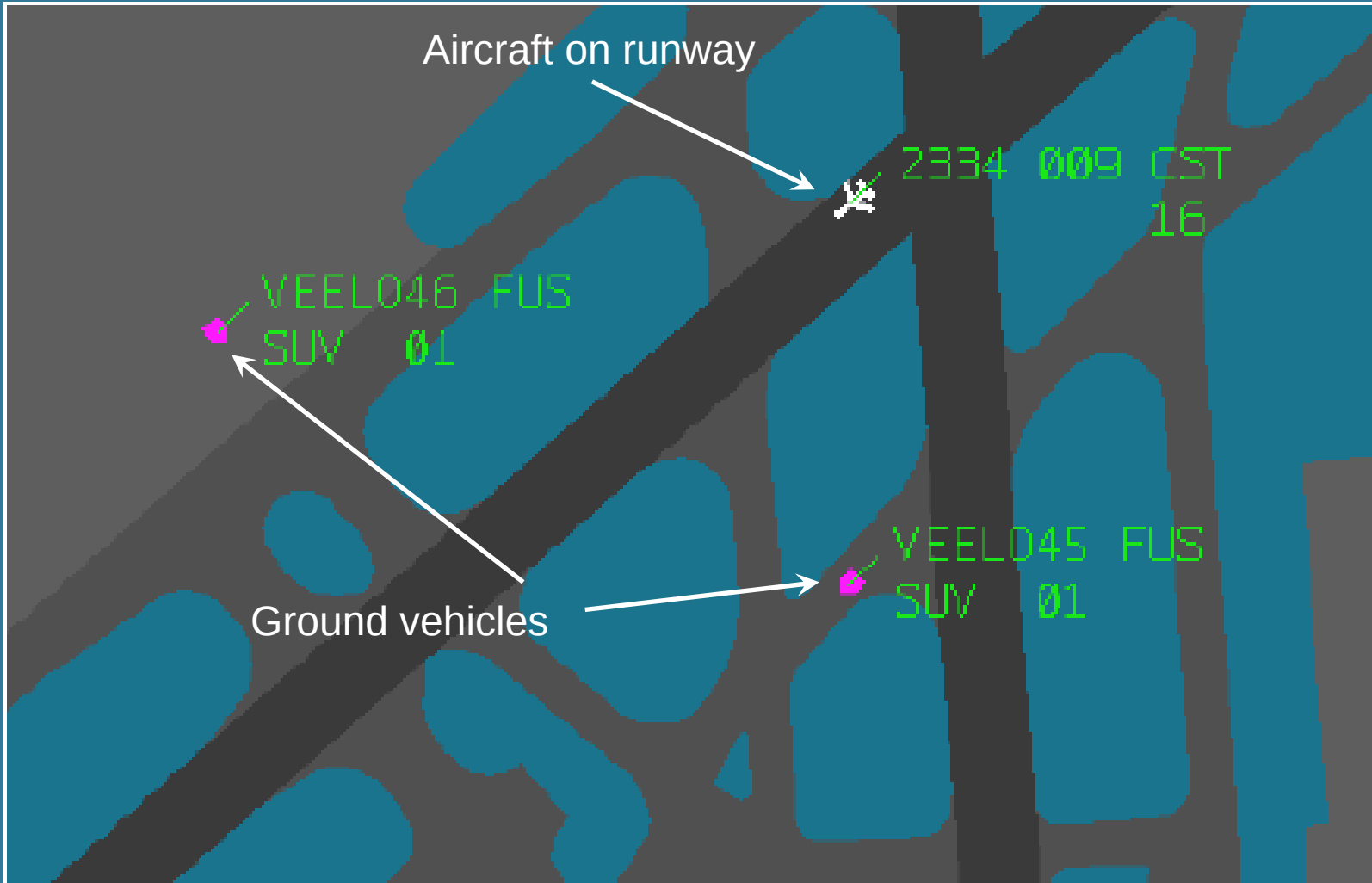
Broome

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Surface Movement ADS-B

Airspace | Airservices Australia



Sydney

Melbourne

Brisbane

Perth

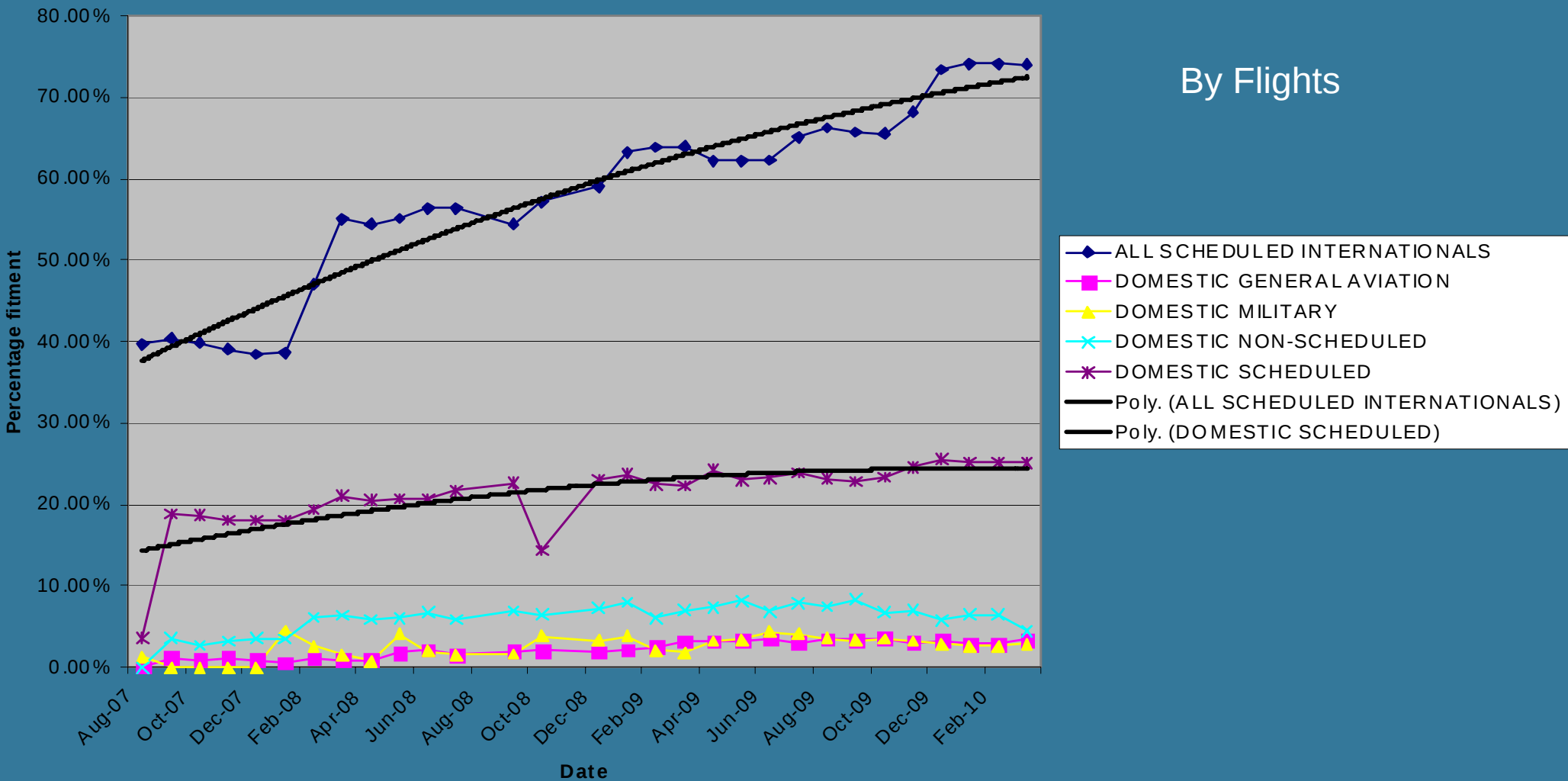


ADS-B Fitment rate over time

Airservices Australia



ADS-B FITMENT RATES OVER TIME





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Manual of Standards Approved

AIR SERVICES AUSTRALIA



Australian Government
Civil Aviation Safety Authority

I, WILLIAM BRUCE BYRON, Director of Aviation Safety, on behalf of CASA, make this instrument under regulation 172.022 of the *Civil Aviation Safety Regulations 1998*.

Bruce Byron
Director of Aviation Safety and
Chief Executive Officer

March 2006

Manual of Standards Part 172 Amendment

10.2.1 Use of ADS-B surveillance

10.2.1.1 ADS-B may be used alone, or in combination with radar, for the provision of air traffic services if:

- (a) reliable ADS-B coverage exists in the area; and
- (b) identification of ADS-B equipped aircraft is established and maintained; and
- (c) the ADS-B data indicates that:
 - (i) the HPL does not exceed 0.5 NM; and
 - (ii) the probability of the HPL information being erroneous is less than 1×10^{-5} per flight hour.

Note These values are equivalent to a NUC_P of 5 as defined in ICAO Annex 10, Volume III, Part 1, Chapter 5, Appendix, or a NIC of 6 and a SIL of 2 as defined in RTCA DO-260A.

10.2.2A Operation of ADS-B transmitters

10.2.2A.1 If the situation display shows that the air ADS-B-equipped aircraft is different from what the pilot is expecting, the pilot must ask the pilot to confirm aircraft identification.

10.2.2A.2 If, after a pilot has been instructed to operate the aircraft's ADS-B transmitter to show assigned aircraft identification or to change call sign, the aircraft identification on the situation display is different from that assigned to the aircraft, the pilot must be instructed by the pilot to re-enter the assigned aircraft identification.

10.2.2A.3 If the identification of an aircraft as shown on the situation display is different from that assigned to the aircraft, and a request under subsection 10.2.2.2 is received, the discrepancy, ATC must ask the pilot to confirm that the correct aircraft identification has been selected.

10.2.2A.4 If the discrepancy continues following confirmation by the pilot that the aircraft identification has been set on the ADS-B identification feature:

- (a) tell the pilot of the persistent discrepancy; and
- (b) if possible, correct the label showing the aircraft identification on the situation display; and
- (c) tell the next control position and any other interested unit using the ADS-B identification purposes of the erroneous aircraft identification to the pilot.

[11] Subsection 10.5.4.6

omit

radar standard

substitute

ATS surveillance system separation minimum

AIP Sup → AIP

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TELEPHONE:
1300 -306- 630
(local call - Aust. wide,
except from mobile
phone)
FAX: 02-6268 5111

AUSTRALIA ^{AIP} SUPPLEMENT (SUP)

AERONAUTICAL INFORMATION
SERVICE
AIRSERVICES AUSTRALIA
GPO BOX 367
CANBERRA ACT 2601

H25/06

FILE: 2005/5354-03

E-mail: publications.unit@airservicesaustralia.com **DATE : 28 JUN 06**

AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) IMPLEMENTATION OF NEW ATS TECHNOLOGY IN AUSTRALIAN AIRSPACE

will eventually be 28 ground stations
and provide surveillance capability
above FL300 over continental Australia.

**NOW INCORPORATED
INTO AIP**

4. APPLICATION TO RECEIVE ADS-B DERIVED ATS SERVICES IN AUSTRALIAN AIRSPACE

4.1 To receive an ADS-B derived ATS surveillance service in Australian airspace, aircraft operators must make application to Airservices Australia. Only aircraft meeting the criteria for ADS-B operations in Australia shall be eligible to receive ADS-B derived services.

Note: ADS-B data from ineligible aircraft will not be displayed to ATC.



TELEPHONE: 1300-306-630 (local call - Aust wide, except from mobile phone) FAX: 02 6268 5111	AUSTRALIA AERONAUTICAL INFORMATION SERVICE AIRSERVICES AUSTRALIA GPO BOX 367 CANBERRA ACT 2601	AIP SUPPLEMENT (SUP)	H34/10
E-mail: publications.unit@airservicesaustralia.com		DATE: 03 JUN 10	

MODE S TRANSPONDER REQUIREMENTS FOR AIRCRAFT IDENTIFICATION TRANSMISSION

1. INTRODUCTION

1.1 This AIP SUP describes requirements for correct transmission of Mode S Aircraft Identification.

2. BACKGROUND

2.1 Mode S transponders (either stand alone or associated with ADS-B transmitters) may include the capability for transmitting a preset,

Pilots must
enter
Flight ID
(FPL item 7):

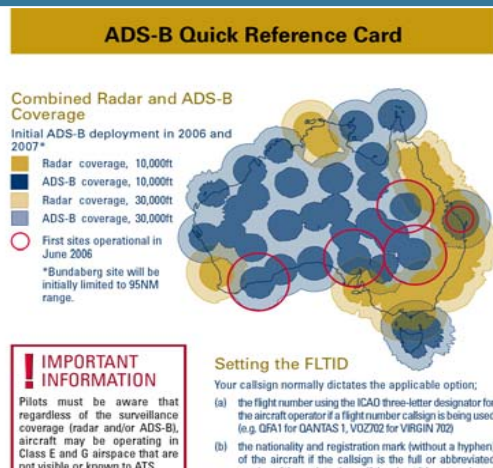
- CSN 1234
- CES 5678

Pilot Education Material Provided

AIR SERVICES AUSTRALIA



- ADS-B booklet to all pilots April 2006
- Web-based flight ops information package April 2006
- General aviation FAQ & presentations
 - ✓ <http://www.airservicesaustralia.com/pilotcentre/projects/adsb/faq.asp>
 - ✓ <http://www.airservicesaustralia.com/pilotcentre/projects/adsb/presentations.asp>



ADS-B Phraseology Quick Reference		
The following table gives an overview of the new Radar and ADS-B phraseology.		
Circumstance	Radar phraseology	ADS-B phraseology
Termination of radar and/or ADS-B service	IDENTIFICATION TERMINATED [DUE (reason)] (instructions)	
Radar or ADS-B ground equipment unavailability	SECONDARY RADAR OUT OF SERVICE (appropriate information as necessary) or PRIMARY RADAR OUT OF SERVICE (appropriate information as necessary)	ADS-B OUT OF SERVICE (appropriate information as necessary).
To request the 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 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
To request reselection of FLT ID*	IDENTIFICATION REQUEST	IDENTIFICATION REQUEST
To request the operation of the IDENT feature*	SQUAWK [(code)] [AND] IDENT	TRANSMIT ADS-B IDENT
To request termination of SSR transponder or ADS-B	STOP SQUAWK [TRANSMIT ADS-B ONLY]	STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY]



<http://www.casa.gov.au/pilots/download/ADS-B.pdf>

ADS-B Requirements



- Approved GNSS receiver
- Approved Transponder
- Means to enter Flight ID
- ADS-B requirement:
 - currently voluntary – aircraft given operational priority
 - after 12/12/2013 - required for ops above FL 290
- GNSS Receiver requirements
 - Must use Hpl for integrity
 - New aircraft after 28/6/2012 must have SA aware
- ADS-B signals must comply stds (DO260 / A / B ...)

Why TSO-C145/146/196 Avionics



- Why TSO-C156/146/196 for ADS-B or CASA Approved equivalent
- Availability and Continuity
- TSO requires:
 - Output of HPL
 - Non assumption of SA on (big impact on HPL)
- NO requirement for SBAS/WAAS Signal
- TSO-C129a + FDE + SA aware
 - considered equivalent



ATC ADS-B Separation Standards



- ICAO ADS-B Separation Standard
 - based on comparative assessment with radar
 - 5 nautical mile and
 - 3 nautical mile
- Developed and agreed by SASP & OPLINK Panels
- Published in PANS ATM Doc 4444



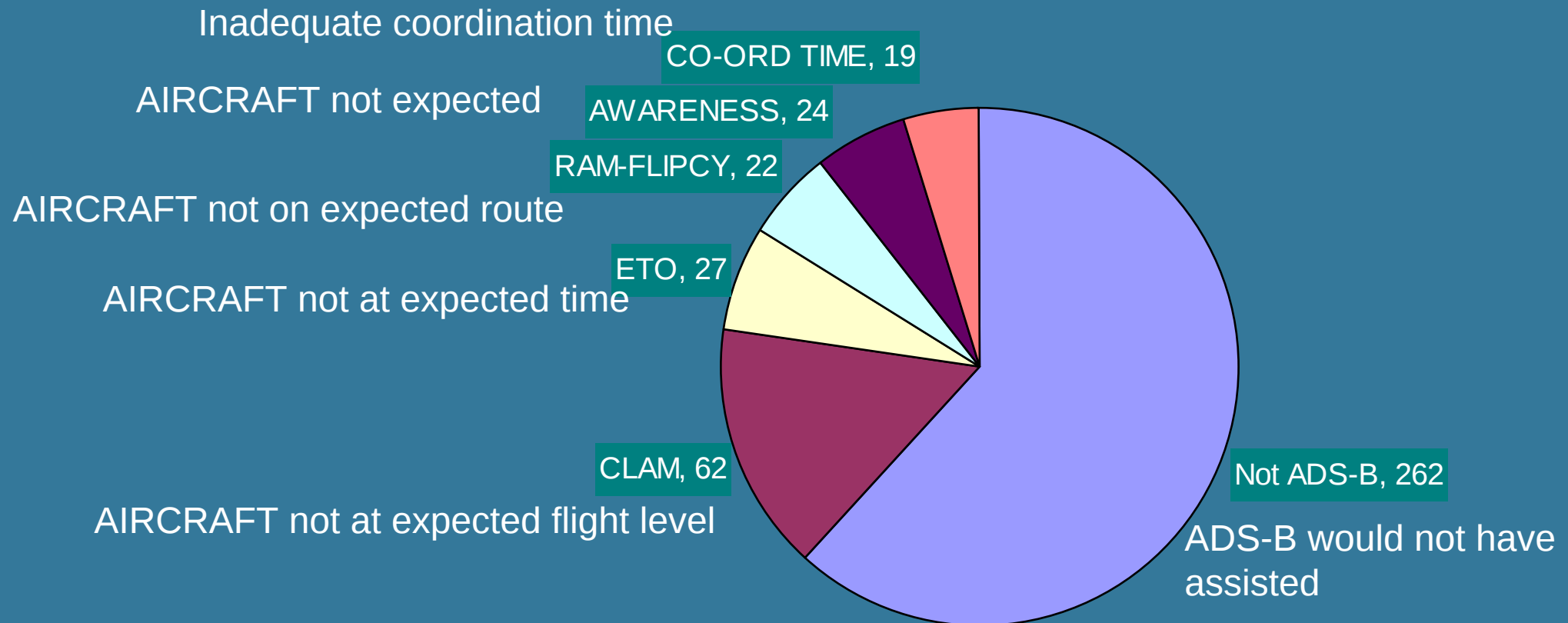
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FIR boundary Incident review

airspace assistance SERVICES AUSTRALIA



Summary All Incidents

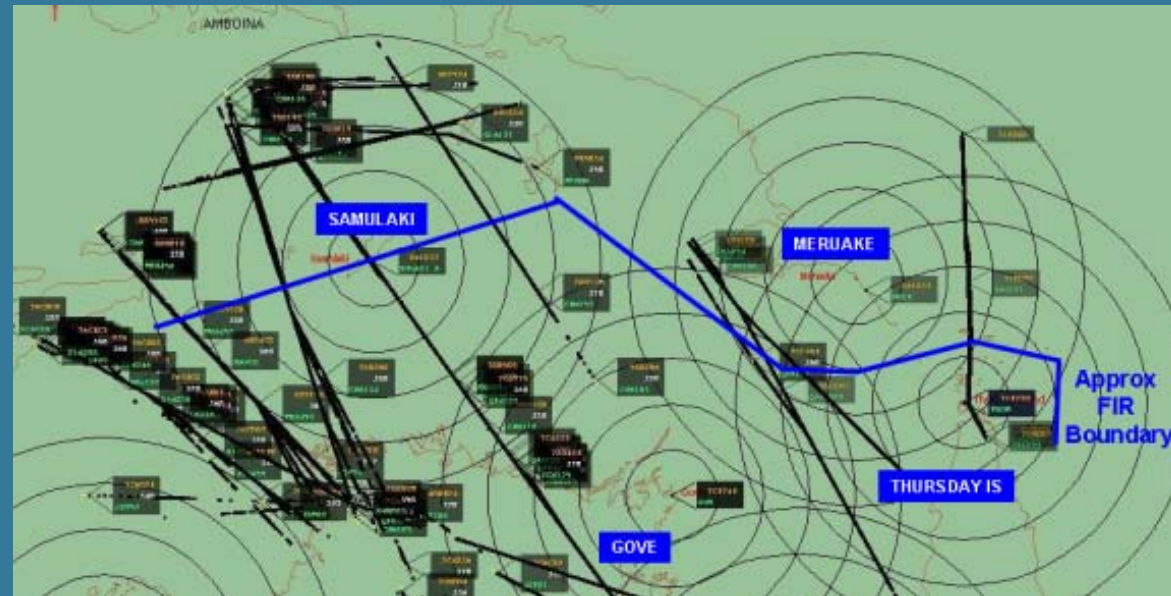




Significant Progress



- Project approved by Airservices & DGCA
- Gove & Thursday Is operating (Australia)
- Merauke & Saumlaki operating (Indonesia)



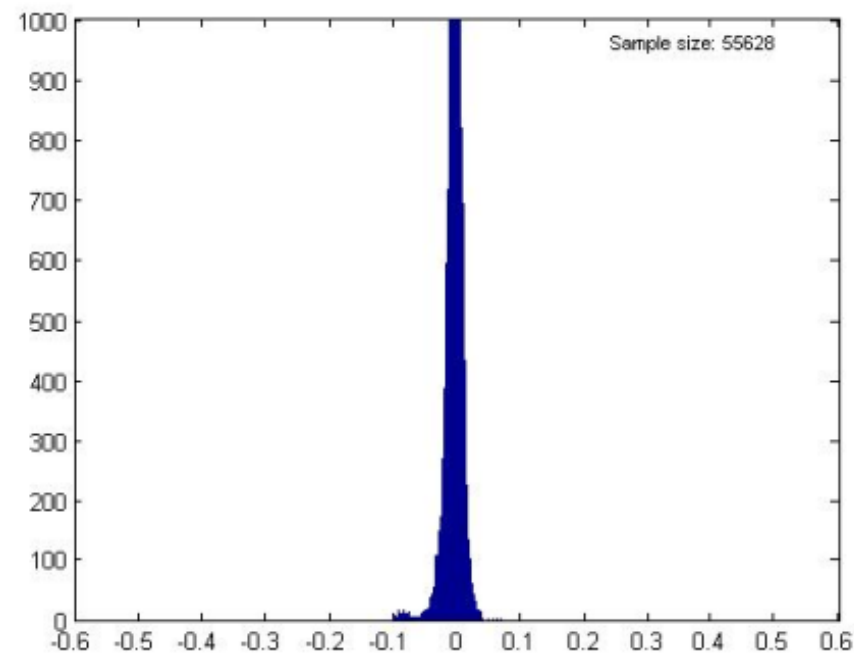
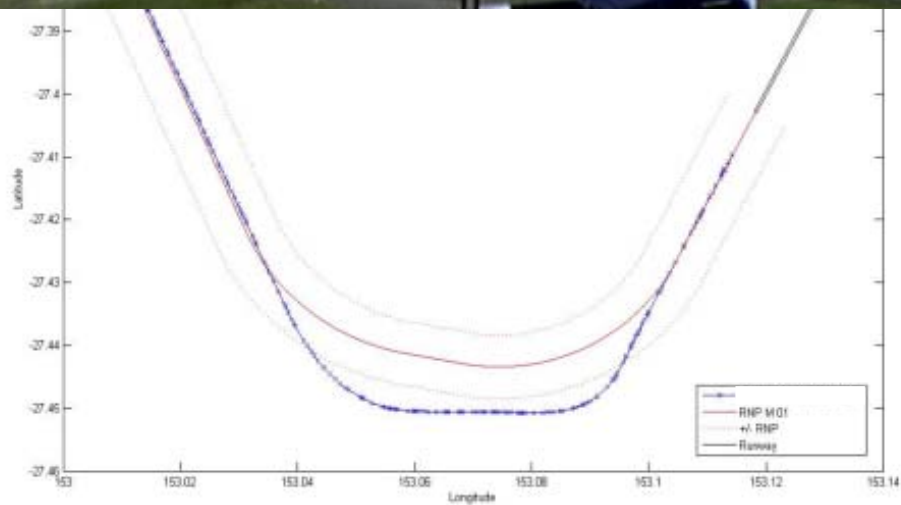
- Draft agreement prepared for review by other Government agencies



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RNP & GLS Monitoring

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Cockpit Display of Traffic

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General situational awareness

Other aircraft in proximity

In Trail Procedures

Visibility of other aircraft position

ADS-B gives distance to aircraft in front

Supports Procedure to climb / descend through an occupied level

Desired Altitude

FL360

FL350

FL340



Pass Behind Application

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Courtesy of BAe Systems

53



Nav Spec	Avionics
RNAV 10 (RNP 10)	Inertial with or without VOR/DME update; or GNSS
RNAV 5	DME-DME, Inertial with VOR/DME update; or GNSS
RNAV 2	DME-DME, Inertial with VOR/DME update; or GNSS
RNAV 1	DME-DME, Inertial with VOR/DME update; or GNSS
RNAV(GNSS)	GNSS

Nav Spec	Avionics
RNP 4	GNSS with inertial (only found in modern jet aircraft)
RNP 2	GNSS (with or without inertial)
RNP 1	GNSS (with or without inertial)
RNP 0.3 RNP APCH	GNSS (with or without inertial)
RNAV (GNSS)	GNSS (with or without inertial)

ADS-B Position data source **GNSS**



Discussion

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