

**Automatic Dependent Surveillance-Broadcast
(ADS-B)**

**Tenth Meeting of the ICAO ADS-B Study and
Implementation Task Force
(ADS-B SITF/10)**

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Introduction

Topics

- ADS-B Out Regulatory Mandates
- ADS-B Out Implementation Plan
- ADS-B In Applications Overview
- ADS-B In Regulatory/Industry Requirements
- ADS-B In Benefits Summary
- ADS-B In Implementation
- Conclusions

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ADS-B Out Regulatory Mandates Asia Pacific Region

- Australia (CAO 20.18, Amend Order No. 3, dated Dec. 2009)
 - Mandates ADS-B Out for upper airspace (\geq FL290) in Dec 2013
 - Current Boeing production equipage meets transponder requirements
 - SA-Aware GPS receiver will be required in production 28 June 2012
 - Boeing Fleet Team Digest article published Sept 2010 providing operators a list of equipment that are SA-Aware
 - Honeywell RMA-55B Multi-Mode Receiver is not SA-Aware and will not be modified to make it SA-Aware
- Hong Kong (Airworthiness Notice 102F, Issue 2, 28 Feb 2011)
 - Implement the use of Automatic Dependent Surveillance Broadcast (ADS-B) Out:
 - After 31 Dec 2013 for aircraft flying over PBN routes L642 or M771 between FL290 and FL410
 - After 31 Dec 2014 for aircraft flying within Hong Kong FIR between FL290 and FL410
 - Must meet DO-260 (Version 0) requirements of ICAO Annex 10 and ICAO Doc 9871 Chapter 2, or DO-260A (Version 1) requirements of ICAO Doc 9871 Chapter 3
 - Means of compliance per EASA AMC 20-24 or CASA CAO 20.18 Appendix XI
 - Current Boeing production equipage meets requirements
- Singapore (CAAS AIC 14, 28 Dec. 2010)
 - Implement the use of Automatic Dependent Surveillance Broadcast (ADS-B) Out after 12 Dec 2013 within certain parts of the Singapore FIR (\geq FL290)
 - Must meet EASA AMC 20-24 or CASA CAO 20.18 Appendix XI, otherwise must fly at $<$ FL290
 - Current Boeing production equipage meets requirements
- Other Asia Pacific Regulatory Agencies
 - Expected to follow ADS-B Avionics Requirements template per APANPIRG Conclusion 21/39
 - Template states: Must meet EASA AMC 20-24 or CASA CAO 20.18 Appendix XI

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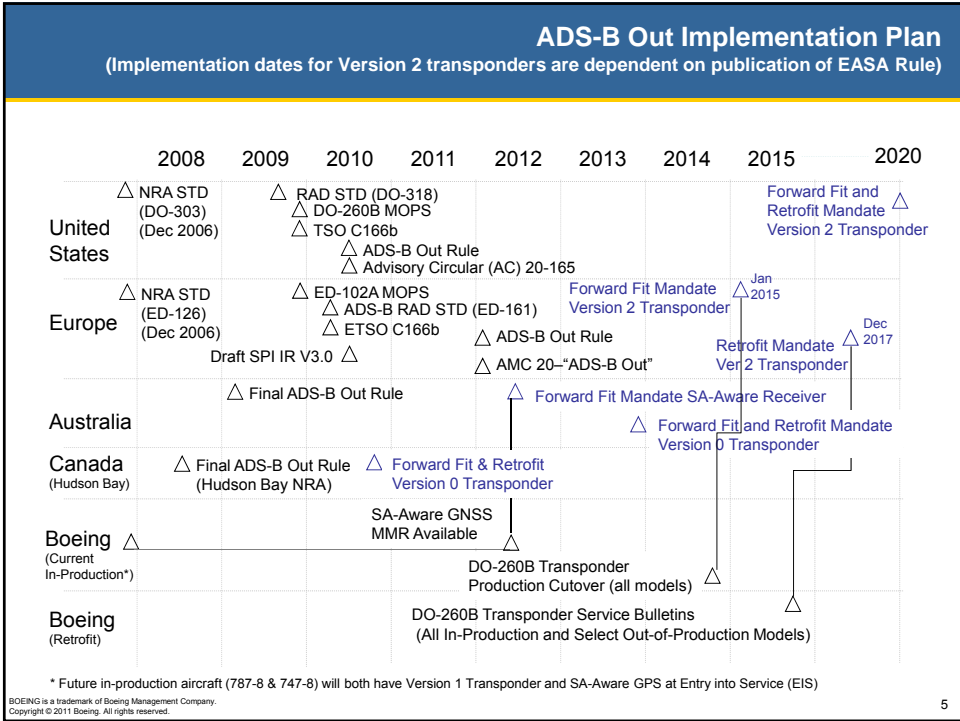
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ADS-B Out Regulatory Mandates Other Regions

- Nav Canada is providing reduced separation using ADS-B Out for Hudson Bay between FL350 and FL400 since Nov 2010
 - Current Boeing production equipage meets requirements
- Eurocontrol/EASA draft rule (SPI IR – Version 3.0) mandates ADS-B Out in production in Jan 2015 and for entire European airspace (retrofit) in Dec 2017
 - Requires new transponder standard (DO-260B)
 - Current SA-On GPS equipage meets requirements
 - Need final rule published by Jan 2012 to allow airframers time to incorporate.
 - Don't want a repeat of TCAS 7.1 where production mandate of March 2012 is still in draft and is not published!
- USA (FAR 91.225) mandated ADS-B Out for Class A, B, C airspace and Class E airspace (\geq 10Kft MSL) on 1 Jan 2020
 - Requires new transponder standard (DO-260B)
 - Requires update to GPS sensor (TBD) with a minimum of SA Aware
 - Draft AC 90-ADSB requires use of a service availability prediction tool (SAPT) to determine the ability of the positioning source (GPS) to meet the position accuracy and integrity requirements for the entire flight plan.

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ADS-B In Applications Overview

Near-Term ADS-B In Applications

- Enhanced Visual Acquisition - Airborne (EVAcq)/AIRB
- Enhanced Visual Approach (EVAApp)
- Surface Situational Awareness (SURF) – also known as Airport Surface Situational Awareness (ASSA)/Final Approach Runway Occupancy Awareness (FAROA)

These provide situational awareness only!

- In Trail Procedure (ITP) – requires interaction with ATC

Future Applications

- Interval Management (IM)
- Surface with Indications/Alerting (SURF-IA), etc.

Require target selection/coupling, alerting, and guidance!

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ADS-B In Regulatory/Industry Requirements

- No ADS-B In regulatory mandates are foreseen at this time.
- Mature standards and ANSP operational procedures are required for airlines to achieve benefit
- RTCA DO-317 – Minimum Operational Performance Standards for Aircraft Surveillance Applications System (ASAS) published in April 2009.
 - Provides equipment minimum performance standards
 - ADS-B In functions include airborne situational awareness (SA), approach SA, and airport surface SA
 - Rev A expected to be published by Dec. 2011 to include In-Trail Procedure (ITP) and harmonize multiple overlapping standards
- Recently released regulatory material:
 - ITP FAA Policy memo released 10 May 2010
 - FAA TSO C195 released 24 Sept 2010 for DO-317 ASAS MOPS+ compliance. C195a will be released after DO-317A is released.
 - FAA AC 20-172 released 28 Feb 2011 to support installation approvals for DO-317/TSO C195 ADS-B In applications. Rev A to be released after TSO C195a is released.

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ADS-B In Benefits Summary

- AIRB, EVApp, and SURF applications provide safety enhancements
- In Trail Procedure (ITP) application provides an economic benefit by increasing an aircraft's chances of being granted a higher preferential altitude, and therefore reducing fuel consumption
- Boeing ITP analysis shows annual fuel savings **per 777** aircraft of between \$10K and \$52K for North Atlantic (NAT), Central Pacific (CENPAC), and Central-East Pacific (CEPAC) oceanic regions
 - Assumes an aircraft only flies on a route that includes ITP
 - Assumes 100% ADS-B Out equipage (Version 0, 1, or 2)
 - If analysis were to include other aircraft types, other regions could be considered
 - The benefit analysis does not account for:
 - Increased situational awareness gained by flight crew
 - Less "captain added fuel" carried (in addition to legal reserve requirement)
 - More cargo carried (for long sectors where the aircraft is gross-weight limited)
 - Passenger ride comfort
- Other industry ITP analyses have also shown significant fuel savings

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ADS-B In Benefits Summary

ITP is used in Oceanic Regions



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ADS-B In Implementation

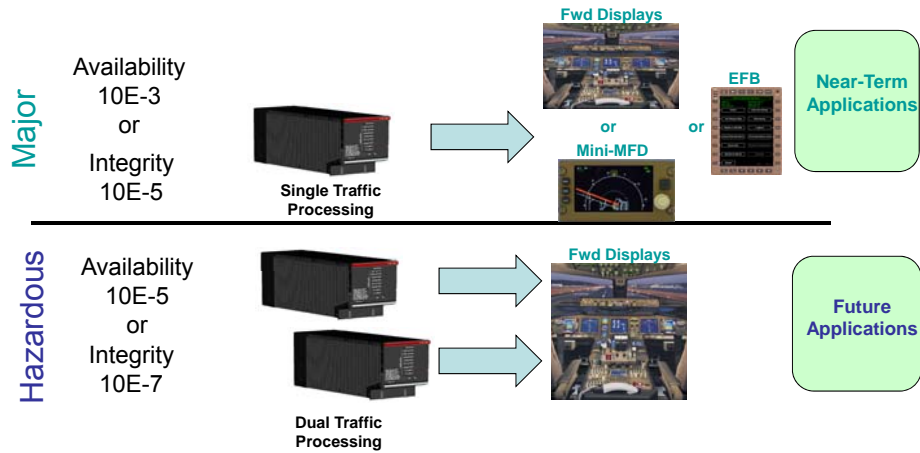
- Operational procedures for ADS-B In applications are in the trial phase.
- Boeing's goal is to develop equipage architectures that have growth capability.
- We believe this to be the most economic and technically sound approach for our customers.
- Boeing prototyping CDTI and ITP displays. Flight deck human machine interface requirements are near completion.
- Research and feasibility studies are on-going:
 - 787 program for ADS-B In / CDTI applications
 - Other production models for CDTI applications on Electronic Flight Bag (EFB) and on Forward Displays.
 - Retrofit solutions for non-production models are also being explored.

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ADS-B-In Implementation Architecture Drivers

The Functional Hazard Category for each of the ADS-B In applications drives the architecture

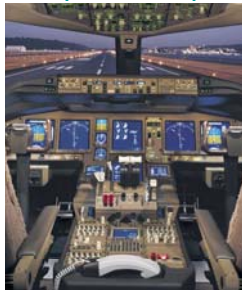


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ADS-B In Implementation Possible CDTI/AMM Displays

Forward Displays (777 shown)



Near-Term
747-400
747-8
787

Future
All Models

Class 3 Electronic Flight Bag (EFB)



Near-Term
737NG
767-400
777

(777 location)
(737NG & 767-400 location –
outboard & down by the
pilot's seat)

Mini-MFD

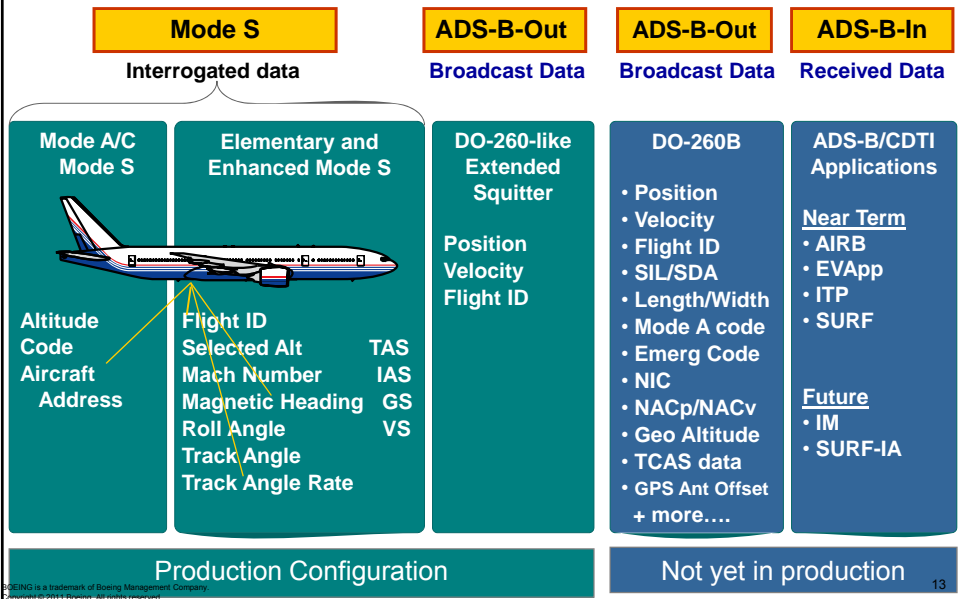


Near-Term
717
737-3/4/500
757-200/300
767-200/300
MD-10/MD-11

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ADS-B-In Implementation Boeing Production Evolution



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Conclusions

- Support ADS-B Out. We will meet ADS-B Out mandates.
 - Collaborative agreement with the FAA to investigate and implement, where appropriate, activities that would accelerate ADS-B Out (and ADS-B In) equipage of aircraft.
- Support ADS-B In. We must maximize the value of equipage solutions, while recognizing that retrofit equipage upgrades are complex and expensive.
 - We are conducting forward fit studies on ADS-B-In to ensure requirements compliant and cost-effective architectures with growth capability
 - We are evaluating retrofit display solutions, including Class 3 EFBs
- Coordinate with Air Navigation Service Providers (Canada, Australia, Europe, US) to ensure common airborne requirements global harmonization
- Engage with airlines and industry partners on rulemaking around the world
- Continue industry standards support

Boeing Aero Magazine Article on ADS-B:

http://www.boeing.com/commercial/aeromagazine/articles/qtr_02_10/2

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