ADS-B Applications

**ADS-B OUT:**
- Capability to transmit ADS-B data
- ADS-B data provided by transponder
- Need transponder ADS-B OUT capable

**ADS-B IN:**
- Capability to receive ADS-B data
- ADS-B data received by TCAS
- Need TCAS ADS-B IN capable

For ground use:
- ADS-B NRA: Non Radar areas
- ADS-B RAD: Radar areas
- ADS-B APT: Airport surfaces

For airborne use:
**ATSAW** (Airborne Traffic Situational Awareness)
- Step 2A: ATSAW operation in air
- Step 2B: ATSAW operation on ground
## CONTENTS

<table>
<thead>
<tr>
<th></th>
<th>ADS-B OUT</th>
<th>ATSAW (ADS-B IN)</th>
<th>ADS-B ROAD MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Applications &amp; mandates</td>
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<td>ADS-B OUT for NRA operations</td>
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<td>Airbus ADS-B aircraft status</td>
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<td>ADS-B OUT for RAD operations</td>
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<td></td>
<td>Conclusion</td>
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</table>
ADS-B OUT - Operational Benefits

- **ADS-B NRA (step 1A):** used in area not covered by SSR
  - Traffic management as SSR like
  - Capacity increase by reducing the separation as SSR like (e.g. 5NM)
  - Cost effectiveness for airlines (better flight level…)

- **ADS-B RAD (step 1B):** used in high density area (covered by SSR)
  - Enables to decommission redundant SSRs providing the same level of surveillance service.
  - Could be the primary mean of surveillance with radar as a back up.
  - Usable in combination with other surveillance sensors (WAM, SSR, or PSR)

- **ADS-B APT (step 1C):** used on airport surface
  - New tool for surface movement surveillance
  - Safety enhancement

**ADS-B OUT benefits:**
- Flight efficiency
- Safety
ADS-B OUT - Mandates

• **Canada** (Nav Canada): in the vicinity of Hudson Bay
  • Recommendation for **NRA** operations: **November 2010**
  • **DO-260** at the minimum

• **Australia** (Airservices Australia):
  • Mandate for **NRA & RAD** operations: **December 2013**
  • **DO-260** at the minimum, GPS SA Aware (mandate 2016)

• **Europe** (Eurocontrol):
  • Mandate for **NRA & RAD** operations: **8th January 2015** (forward fit), **17th December 2017** (retrofit)
  • **DO-260B** required, **CS.ACNS.ADS-B** compliance required

• **US** (FAA):
  • Mandate for **NRA & RAD** operations: **2020**
  • **DO-260B** required, **AC 20-165A** compliance required
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1 ADS-B OUT

- Applications & mandates
- ADS-B OUT for NRA operations
- Airbus ADS-B aircraft status
- ADS-B OUT for RAD operations
- Conclusion

2 ATSAW (ADS-B IN)

3 ADS-B ROAD MAP
Conditions to transmit ADS-B parameters on Airbus aircraft:

**A320 & A330/A340 aircraft family:**
- EHS/ADS-B wiring provision (basic)
- Transponders capable of ELS/EHS/ADS-B:
  - Acss: P/N 7517800-10005A (DO-260)
  - P/N 7517800-10100 (DO-260A)
  - Honeywell: P/N 066-01127-1402 (DO-260)
  - Rockwell Collins: P/N 822-1338-021 (DO-260)
  - All transponders proposed by Airbus in line-fit are ELS/EHS/ADS-B capable.
- MMR (any vendor) OR some GPSSU (not all)
  - In line-fit, Airbus aircraft are only fitted with MMR

**A380:**
- EHS/ADS-B parameters provided by AFDX (basic)
- AESS H04S06 (DO-260A)

• No need of pin programming to activate ADS-B data transmission.
• Need certification for operational use if required by regulation.
ADS-B OUT – Certification status for NRA

ADS-B OUT for NRA operation has been certified on all Airbus aircraft programs by EASA in compliance with AMC-20-24

• As per EASA AMC-20-24 some AIRBUS documentation are required for operational approval:
  ▸ **Update of AFM:** Statement of compliance with AMC 20-24
  ▸ **ADS-B OUT Capability declaration document:**
    - Providing description, interoperability, safety and performance demonstration, specificities…etc
    - Referenced in AFM.
    - Useful for airline discussions with its Authority

• Others Airbus documentation update (not required by EASA):
  ▸ **FCOM:** System description.
  ▸ **MEL:** As required by regulations.
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1. ADS-B OUT
   - Applications & mandates
   - ADS-B OUT for NRA operations
   - Airbus ADS-B aircraft status
   - ADS-B OUT for RAD operations
   - Conclusion

2. ATSAW (ADS-B IN)

3. ADS-B ROAD MAP
### ADS-B OUT - ADS-B in-service aircraft status

#### ADS-B in service installation status (December 2012)

<table>
<thead>
<tr>
<th>Aircraft family</th>
<th>A320</th>
<th>A330/A340</th>
<th>A380</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total number of a/c</strong></td>
<td>5429 (5013) **</td>
<td>1324 (1228) **</td>
<td>101 (64) **</td>
</tr>
<tr>
<td>Nb of a/c NOT ADS-B OUT capable</td>
<td>1171 (1523) **</td>
<td>104 (109) **</td>
<td>0 (0) **</td>
</tr>
<tr>
<td>Nb of a/c ADS-B OUT capable (*)</td>
<td>4258 (3490) **</td>
<td>1220 (1119) **</td>
<td>101 (64) **</td>
</tr>
</tbody>
</table>

(*) ADS-B OUT capable means the aircraft is equipped with the required equipment (transponder, MMR…)

** Does not include configuration changes managed through STC

- More the a/c are recent more they are ADS-B OUT capable
- Increase of ADS-B OUT capability in 1 year
- Total of Airbus a/c ADS-B OUT capable: 81% (74% in March 2012)

---

(80x481) ADS - B OUT
(180x481) ADS - B in
(312x481) service aircraft status

(April 2013)

Aircraft family

- A320
- A330/A340
- A380

Number of a/c:

- **5429** (5013) **
- **1324** (1228) **
- **101** (64) **

** Does not include configuration changes managed through STC.
### ADS-B OUT - ADS-B in-service aircraft status

**• ADS-B in service installation status (December 2012)**

<table>
<thead>
<tr>
<th>Aircraft family</th>
<th>Total number of a/c</th>
<th>Does not include configuration changes managed through STC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nb of a/c NOT ADS-B OUT capable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nb of a/c ADS-B OUT capable (*)</td>
<td>Nb of a/c ADS-B OUT capable without AMC-20-24 compliance (**)</td>
</tr>
<tr>
<td></td>
<td>1171 (1523)</td>
<td>104 (109)</td>
</tr>
<tr>
<td></td>
<td>22% (30%)</td>
<td>8% (9%)</td>
</tr>
<tr>
<td></td>
<td>104 (109)</td>
<td>104 (118)</td>
</tr>
<tr>
<td></td>
<td>8% (9%)</td>
<td>8% (9%)</td>
</tr>
<tr>
<td></td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>0% (0%)</td>
<td>0% (0%)</td>
</tr>
<tr>
<td><strong>Nb of a/c ADS-B OUT capable (%)</strong></td>
<td>4258 (3490)</td>
<td>3282 (2858)</td>
</tr>
<tr>
<td></td>
<td>78% (70%)</td>
<td>60% (57%)</td>
</tr>
<tr>
<td></td>
<td>1220 (1119)</td>
<td>326 (400)</td>
</tr>
<tr>
<td></td>
<td>92% (91%)</td>
<td>25% (33%)</td>
</tr>
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<td></td>
<td>101 (64)</td>
<td>8 (20)</td>
</tr>
<tr>
<td></td>
<td>100% (100%)</td>
<td>8% (31%)</td>
</tr>
<tr>
<td></td>
<td>100% (100%)</td>
<td></td>
</tr>
</tbody>
</table>

- **Even if the a/c is capable (81%), operators don’t request AMC-20-24 compliance if not necessary (21% only)**
- **Most of them wait for mandates**
  - Authorities are urged to provide mandate.

(*) ADS-B OUT capable means the aircraft is equipped with the required equipments (transponder, MMR...)

(**) the AMC-20-24 compliance has to be requested by airline to Airbus (AFM, FCOM update...)
ADS-B OUT - ADS-B in-service aircraft status

• ADS-B transmission issues

- Jump issue with Rockwell Collins transponder TPR-901
  - Jump of the aircraft position
  - Probable root cause: alphabetagamma tracking filter too much sensitive
  - Some aircraft have been “blacklisted”
  - Investigation on going – Tests planned April 2013 – Analysis report from Rockwell Collins waited end of April 2013
  - A Service Bulletin exists for Boeing. Request to have the same SB for Airbus.
  - If no results/agreement found, Airbus will replace TPR-901 by others supplier’s transponder
ADS-B OUT - ADS-B in-service aircraft status

• ADS-B transmission issues

➢ Jump back issue due to Honeywell ADIRU HG2030XXXX
  - Frequent jump back of the aircraft position
  - Only seen with current DO-260 transponders
  - Probable root cause: Synchronisation issue between ADIRU HWL and transponder – More significant impact with new HWL ADIRU (TBC)?
  - Action: Airbus investigation with suppliers support (laboratory tests...)
  - Potential solution: Connect directly MMR & transponder (that will be done for all new DO-260B transponders)
    • For ACSS, install transponder DO-260A P/N-10100 (already directly connected with MMR) - Refer SB 320-34-1466 (A320 a/c family) and SB 330-34-3251 (A330)
    • For Honeywell, no solution available before the future HWL DO-260B transponder (end 2015 - TBC)
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   Conclusion

2 ATSAW (ADS-B IN)

3 ADS-B ROAD MAP
ADS-B OUT – RAD application

**ADS-B OUT for RAD (application for high density airspace)**

- RAD is more demanding (new parameters, better performance…)
- Enables to decommission redundant SSRs providing the same level of surveillance service.
- Would be the primary means of surveillance with radar as a back up → US strategy
- Usable in combination with other surveillance sensors (WAM, SSR, or PSR) → Europe strategy
- Requirements for RAD operations:
  - AC-20-165 (FAA) and CS-ACNS-ADSB (EASA – not published yet)
  - Requirements to be compliant with DO-260B
  - Updates in ADS-B OUT set of messages/performance
## DO-260B - Scope of the modifications

<table>
<thead>
<tr>
<th>Systems level</th>
<th>Aircraft level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>XPDR:</strong></td>
<td><strong>Wiring:</strong></td>
</tr>
<tr>
<td>• SW update</td>
<td>• XPDR direct link to 2 MMRs (reduced latency)</td>
</tr>
<tr>
<td>• HW update</td>
<td>• XPDR link to FWC/SDAC (new failure)</td>
</tr>
<tr>
<td><strong>MMR</strong></td>
<td><strong>Specific P/P:</strong></td>
</tr>
<tr>
<td>• Demonstration of compliance (accuracy, availability, latency analysis etc..)</td>
<td>• GPS antenna position</td>
</tr>
<tr>
<td></td>
<td>• NACv (navigation accuracy category)</td>
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<tr>
<td></td>
<td>• SDA (system design assurance)</td>
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<td></td>
<td>• Length &amp; width code</td>
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<tr>
<td></td>
<td>• a/c category</td>
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<tr>
<td></td>
<td>• ADS-B IN capability</td>
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<tr>
<td></td>
<td>• ADS-B parity</td>
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<tr>
<td></td>
<td>• Antenna monitoring</td>
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<td></td>
<td>• SDAC P/P to declare the failure on SA</td>
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<tr>
<td></td>
<td>• FWC P/P to declare the failure on LR</td>
</tr>
<tr>
<td><strong>FWC/SDAC:</strong></td>
<td><strong>Documentation:</strong></td>
</tr>
<tr>
<td>• New failure message: NAV ADS-B RPTG FAULT</td>
<td>• AFM, FCOM update</td>
</tr>
<tr>
<td><strong>FMS:</strong></td>
<td></td>
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<tr>
<td>• Flight id shall be modifiable during the flight</td>
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</table>
## DO-260B - Min standards and preliminary schedule

### Forward-fit preliminary schedule - For information only

<table>
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<td>ACSS T3CAS std2</td>
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<td>ACSS XS-950</td>
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<td>HWL/SELEX ATC</td>
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<td>NOT ON TIME</td>
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<td>RC GLU-925 (-920 &amp; -925)</td>
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<td>HWL RMA-55B</td>
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<td>TLS 755</td>
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<td>RC GLU-925 (-630 SBAS)</td>
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<td>H2-F7 (SA)</td>
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<td>HWL FMS2 H2 (SA)</td>
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<td>TLS FMS2 S4/S5/S6 (SA)</td>
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<td>HWL FMS2 P2/P3 (LR)</td>
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</table>

**Workshops (Technical analysis, program decision...)**

- Eur Mandate FWD fit
- Eur Mandate Retrofit
- US Mandate FWD + Retrofit

- NOT PLANNED ON SA/LR/A380

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DO-260B - Compliance status

- **CS.ACNS.ADS-B & AC 20-165A** provide guidance for the installation and airworthiness approval of ADS-B Out equipment

- Requirements are not identical
  - AC 20-165A requirements more stringent in terms of expected availability

<table>
<thead>
<tr>
<th>Requirements</th>
<th>CS.ACNS.ADS-B</th>
<th>AC 20-165A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position Latency</td>
<td>Total latency TOA&lt;= 1.5s</td>
<td>Total ADS-B latency from TOM&lt;=2s</td>
</tr>
<tr>
<td></td>
<td>No specific req on GPS latency</td>
<td>TOM-TOA &lt;=0.5 sec</td>
</tr>
<tr>
<td></td>
<td>XPDR lat &lt;=0.6s</td>
<td>GPS latency&lt;=0.9s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XPDR lat &lt;=0.6s</td>
</tr>
<tr>
<td>Position source Availability</td>
<td>No availability requirement</td>
<td>Availability of the position at &gt;99.9% (operational requirement). For FAA, SBAS meet such requirement.</td>
</tr>
<tr>
<td>Flight id shall be modifiable</td>
<td>Required</td>
<td>No specific requirement</td>
</tr>
<tr>
<td>during the flight</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

→ Impact on FMS (retrofit)     → Impact under study

---

TOM: Time Of Measurement (time between signal reception by the GPS antenna and signal transmission by the ATC antenna)
TOA: Time Of Applicability (time between entry of GPS calculator and signal transmission by the ATC antenna)
## DO-260B - MMR compliance status

### Analysis to be done on all MMR

<table>
<thead>
<tr>
<th>Supplier</th>
<th>MMR</th>
<th>comments</th>
<th>CS.ACNS.ADS-B</th>
<th>AC 20-165A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collins</td>
<td>GLU 920</td>
<td>ILS/GPS - SA On Production cut off in progress</td>
<td>Should be compliant - Analysis on going to confirm the compliance</td>
<td>Compliant with restriction – (availability requirement not met)</td>
</tr>
<tr>
<td></td>
<td>GLU 925 (P/N-430)</td>
<td>ILS/FLS/GLS/GPS SA Aware</td>
<td>Should be compliant - Analysis on going to confirm the compliance</td>
<td>Compliant with restriction – (availability requirement not met)</td>
</tr>
<tr>
<td></td>
<td>GLU 925 (P/N-630)</td>
<td>ILS/FLS/GLS/GPS/ SBAS TSO C145c (planned to be installed on A350 only)</td>
<td>Should be compliant - Analysis on going to confirm the compliance</td>
<td>Compliant – due to SBAS capability</td>
</tr>
<tr>
<td>Honeywell</td>
<td>RMA 55B</td>
<td>ILS/GPS SA On</td>
<td>Should be compliant - Analysis on going to confirm the compliance</td>
<td>Compliant with restriction – (availability requirement not met)</td>
</tr>
<tr>
<td>Thales</td>
<td>TLS755</td>
<td>ILS/GPS or ILS/MLS/GPS SA Aware</td>
<td>Production cut off</td>
<td>Production cut off</td>
</tr>
</tbody>
</table>
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   ADS-B OUT for NRA operations
   Airbus ADS-B aircraft status
   ADS-B OUT for RAD operations
   Conclusion

2 ATSAW (ADS-B IN)

3 ADS-B ROAD MAP
Conclusion

• End 2012, 81% of Airbus aircraft are ADS-B OUT capable – 21% only have requested the AMC-20-24 compliance → Wait for mandate

• ADS-B OUT European Mandate for RAD operation planned January 2015 in fwd-fit and December 2017 in retrofit
  • Requires S/W and H/W transponders change. All Airbus transponders will be updated to be DO-260B compliant (Honeywell not on time)
  • No major development risk identified in Forward-fit for the time being
    – MMR analysis on going to verify the compliance.
  • Risk on Retro-fit concerning peripheral systems availability
    – Mainly FMS, MMR → costly retrofit

• US Mandate for RAD operation planned 2020 (fwd-fit & retrofit)
  • Impact of AC-20-165A requirements are under study
  • Analysis on going to identify potential risk
ADS-B OUT - Conclusion

8 Jan 2015 (FF) & 17 Dec 2017 (RF)
NRA & RAD
DO-260B

Mandate on going
NRA & RAD (?)
DO-260B (?)

Dec 2013
NRA & RAD
DO-260

Nov 2010
NRA
DO-260

Europe

Asia Pacific
Task Force

Canada

USA

Australia

January 2020 RF & FF
NRA & RAD
DO-260B

Under study or development

Airbus aircraft already compliant
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1. ADS-B OUT
   - Applications & mandates
   - ADS-B OUT for NRA operations
   - Airbus ADS-B aircraft status
   - ADS-B OUT for RAD operations
   - Conclusion

2. ATSAW (ADS-B IN)

3. ADS-B ROAD MAP
Step 2. ATSAW
Display of other aircraft ADS-B information in the cockpit

• Step 2A: ATSAW operation in air
• Step 2B: ATSAW operation on ground

OBJECTIVES

✈ Flight efficiency:
▷ Flight level,
▷ Fuel saving,
▷ Runway throughput

✈ Safety
▷ Traffic situational awareness,
▷ Aircraft identification

ADS-B IN
A/C information is received
- IN the airborne
- into the TCAS
• Fully integrated solution
• Traffic displayed on the primary field of view
• Limited impact (no new equipment)
ATSAW

- ATSAW improves flight efficiency

- Improves cooperation with ATC (better understanding of ATC instructions)
- Improves the detection of opportunity to Flight Level change in standard separation

- Fuel saving
- Reduction of CO2 emission

Opportunity to climb?
ATSAW BENEFITS

• ATSAW reduces pilots workload
  ➢ Reduces mental effort for traffic awareness

• ATSAW improves efficiency in approach
  ➢ Enhances identification and information of target aircraft
  ➢ Increases runway capacity

• ATSAW improves the safety
  ➢ Awareness of traffic situation
  ➢ Enhanced identification of target aircraft
  ➢ Runway & taxiway occupancy awareness (ATSAW on ground)
  ➢ Collision risk anticipation (ATSAW on ground)

• ATSAW paves the way to future Spacing applications
ATSAW Certification & Availability

**ATSAW step 2A is certified on A330/340 & A320 aircraft families**

- ATSAW for operations in air (step 2A) will be available with:

  - **T3CAS** from ACSS
    - Certified on A320 & A330/A340 aircraft family

  - **TCAS TPA-100B** from Honeywell
    - Certified on A320 & A330/A340 aircraft family

  - **TCAS TTR-2100** from Rockwell Collins
    - Development launched (Certification mid 2015)
CONTENTS

1. ADS-B OUT
   - Applications & mandates
   - ADS-B OUT for NRA operations
   - Airbus ADS-B aircraft status
   - ADS-B OUT for RAD operations
   - Conclusion

2. ATSAW (ADS-B IN)

3. ADS-B ROAD MAP
ADS-B AIRBUS – ROAD MAP

Step 1

- **ADS-B OUT**
  - Step 1A for NRA
  - Step 1B for RAD (DO-260B)

Step 2

- **ATSAW (ADS-B IN)**
  - Step 2A (ATSAW in Air)

Next steps

- **Step 2B (ATSAW on Ground)**
- **Spacing**
- **Airport Surface Alerts**

**CERTIFIED**
- End 2014 (TBC)

**A320**: Certified
**A330/340**: Certified
**A350**: EIS
**A380**: post A350 EIS

**From 2015**
QUESTIONS?

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