ICAO/FAA Workshop on ADS-B and Multilateration Implementation
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AIRBUS Solutions and Roadmap
ADS-B OUT and ADS-B IN

Presented by
Thierry TIN HIN
Airline CNS/ATM Support
AIRBUS Customer Services
thierry.tin-hin@airbus.com

1. ADS-B Reminders
2. Complete Range of AIRBUS ADS-B Solutions
3. AIRBUS Customer Support
Reminders on Surveillance Techniques

**Aircraft Position**

- **Independent**
  - Calculated by the ground
  - Primary Surveillance Radar
- **Dependent**
  - Provided by the aircraft
  - Secondary Surveillance Radar

**Non-Collaborative**

- No aircraft equipment required

**Collaborative**

- Active aircraft equipment required

**Mode A**

- SQWK code – 0000 to 7777 (4096 codes)

**Mode C**

- Barometric altitude reporting

**Mode S**

- Selective interrogation – 24-bit address (16 777 216 addresses)

- **Elementary Surveillance (ELS):**
  - 24-bit address
  - Flight number
  - Aircraft altitude
  - RA report
  - Etc.

- **Enhanced Surveillance (EHS):**
  - Selected altitude
  - Barometric pressure setting
  - Speeds: GS, TAS, IAS, Mach
  - Track, Heading
  - Etc.

ADS-Broadcast Concept

**Surveillance with ADS-B Mode S Transponder**

- **Automatic:** No action required from flight crew
- **Dependent:** Aircraft position provided by aircraft
- **Broadcast:** Transmission of data without solicitation

**ADS-B Data**

- GPS position
- Aircraft identification
- Ground speed
- Vertical speed
- Track
- Wake vortex category
- Etc.
ADS-B Applications

Surveillance with ADS-B Mode S Transponder

ADS-B OUT: Capability to transmit ADS-B data
- ADS-B NRA: Non Radar areas
- ADS-B RAD: Radar areas
- ADS-B APT: Airport surfaces

ADS-B IN: Capability to receive ADS-B data
- ATSA AIRB: Airborne operations
- ATSA ITP: In Trail Procedure
- ATSA VSA: Visual Separation on Approach
- ATSA SURF: Airport Surfaces

ATSAW (AIRBUS): Airborne Traffic Situational Awareness
Display of enriched traffic information in the cockpit

ATSAW AIRB – Airborne

Flight number
- Aircraft orientation (track)
- GPS position

Wake Vortex category
- Ground speed
- Relative altitude and vertical speed

Construction of Traffic Awareness
Visual Acquisition for See-and-Avoid
Traffic Information Broadcasts by Aircraft (Blind Broadcast)

REDUCED WORKLOAD
- Assistance to out-the-window scans
- Reduced mental effort for traffic awareness
- Optimized radio communication for traffic update

BETTER AWARENESS
- Less useless RA at level-off
- Anticipation of possible maneuvers (FL change) and developing dangerous situations (to be confirmed by ATC)
- Improved cooperation with ATC (better understanding of ATC instructions)
ATSAW ITP – In Trail Procedure

- Flight number
- Aircraft orientation (track)
- GPS position
- Wake Vortex category
- Ground speed
- Relative altitude and vertical speed

- Flight level changes on a more frequent basis
- In non-radar airspaces
- With longitudinal separations temporarily reduced

- Reduced fuel burn by flying the optimum cruise FL
- Reduced emissions
- Higher flight efficiency by flying FLs with more favorable winds
- Improved flight safety by avoiding turbulent FLs
- Increase of airspace capacity by domino effect: an ITP aircraft leaves space to other aircraft

Procedural separation

As per ICAO PANS-ATM, Doc 4444, Chapter 5:
A longitudinal separation must be maintained during the entire vertical maneuver (i.e. stages 1, 2 and 3).
Reminders on ICAO Separation Standards

Separation methods as per ICAO PANS-ATM, Doc 4444, Chapter 5:
- Mach Technique based on Time
- Mach Technique based on Distance (RNAV)
- RNAV 10
- RNP 4

Flight Level Change with new ITP Procedures

Flight crews AND ATC controllers must be trained.

1. Temporarily Reduced Separation Down to 10 NM mini.
2. Procedural separation
3. ITP criteria

For the ITP concept:
1. Before the ITP maneuver, ITP criteria must be met.
2. During an ITP maneuver, the ITP longitudinal separation between aircraft is applied.
3. At final FL, procedural separation must exist with aircraft that are already at that final FL.
## ATSAW VSA – Visual Separation on Approach

<table>
<thead>
<tr>
<th>Flight number</th>
<th>Wake Vortex category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft orientation (track)</td>
<td>Ground speed</td>
</tr>
<tr>
<td>GPS position</td>
<td>Relative altitude and vertical speed</td>
</tr>
</tbody>
</table>

### Application of the Visual Separation on Approach

- With ATSAW (easier traffic identification)
- In VMC

- Increased airport landing capacity thanks to VSA separations shorter than radar ones
- Reduced flight time thanks to the global increase of airport capacity
- Reduced probability of wake vortex encounters as ATSAW helps anticipating speed reduction from the preceding aircraft
- Reduced radio communication

### ADS-B Reminders

**Complete Range of AIRBUS ADS-B Solutions**
**ADS-B RAD: DO 260B Impacts**

- **Mainly software**
  - Minor hardware: Provisions for 2nd GPS input.

- **Include wiring between GPS1-XPDR and GPS2-XPDR**
  - Available on production line since 2003.

- **Hardware upgrade reduced to the minimum**

- **Transmission of new parameters (e.g. length & width code, aircraft category)**

- **FWC software upgrade**
  - Wiring FWC-XPDR.
### TCAS and ATSAW Symbols

<table>
<thead>
<tr>
<th>Other Proximate</th>
<th>TA</th>
<th>RA</th>
<th>TCAS range</th>
<th>ADS-B range</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS Only</td>
<td>![TCAS Only Symbol]</td>
<td>![TCAS Only Symbol]</td>
<td>![TCAS Only Symbol]</td>
<td>~30 NM</td>
</tr>
<tr>
<td>TCAS + ADS-B</td>
<td>![TCAS + ADS-B Symbol]</td>
<td>![TCAS + ADS-B Symbol]</td>
<td>![TCAS + ADS-B Symbol]</td>
<td>~100 NM</td>
</tr>
<tr>
<td>ADS-B Only</td>
<td>![ADS-B Only Symbol]</td>
<td>![ADS-B Only Symbol]</td>
<td>![ADS-B Only Symbol]</td>
<td></td>
</tr>
</tbody>
</table>

- **Highlighted**: Ground Speed (kt), Wake Vortex Category (L/M/H)
- **Selected**: Track oriented, Flight ID
- **Highlighted & Selected**: Flight ID, Ground Speed (kt), Wake Vortex Category (L/M/H)
ATSAW in A350 Cockpit

Same Symbology
Commonality with A320/A330/A340 operating principles

Additional Text Information

Interaction Means
A350 Cockpit interactivity = More efficient workflow

ATSAW Display Samples

Better identification of traffic
Better understanding of traffic environment
Improved flight efficiency
ATSAW Display Samples

Avionics Architecture

Applications

Cockpit Interfaces

Computer

Sensors

ADS-B OUT

ATSAW

XPDR*

TCAS*

RA

Mode S Antennas

GPS

TCAS Antennas

XPDR*

TCAS*

RA

Mode S Antennas

GPS

TCAS Antennas

A320/A330/A340

A350

* Capable of ADS-B Out

* Capable of ATSAW

Also capable of TCAS Chg 7.1
The AIRBUS Support for our Customers

**Engineering**
- Support to aircraft definition and retrofit
- In-service support

**Flight Operations**
- Flight operations expertise
- Assistance to EIS and operational approval, in-service support
- Academic briefing

**Documentation**
- AFM, FCOM, MMEL, AMM
- Computer Based Training
- Airworthiness Capability Declaration for ADS-B OUT & ATSAW
- Getting to Grips with Surveillance
Summary 1/2

Applications

**ADS-B NRA**: Non Radar Areas
**ADS-B RAD**: Radar Areas
**ADS-B APT**: Airport Surfaces

**ATSA AIRB**: Airborne
**ATSA ITP**: In Trail Procedure
**ATSA VSA**: Visual Sep. on App.
**ATSA SURF**: Airport Surfaces

More Flight Efficiency
More Safety
Less Fuel Burn
Less Emissions

**AIRBUS ADS-B OUT**

**NRA** – DO 260/260 A
EASA AMC 20-24 compliant
on A320/A330/A340/A380

**AIRBUS ATSAW**

**RAD** – DO 260B
To be available on
A320/A330/A340/A380/A350

**AIRB/VSA/ITP**
with TCAS capable of Chg 7.1
on A320/A330/A340
on A350 at EIS

**SURF**
Feasibility study in progress

Summary 2/2

**AIRBUS is ready to support its operators for ADS-B, ATSAW Entry Into Service**

Same operating principles across
A320/A330/A340 and A380/A350

**Optimized Flight Crew Workflow**

**Cockpit Commonality**
**Seamless Cockpit Integration**

**Upgradable per design**
Roadmap aligned with the Future

**ADS-B OUT / ATSAW**
The AIRBUS Solutions

**SESAR, NextGen Standard Applications**

Designed to cope with future requirements with minimum hardware changes
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFM</td>
<td>Aircraft Flight Manual</td>
</tr>
<tr>
<td>AMM</td>
<td>Aircraft Maintenance Manual</td>
</tr>
<tr>
<td>FCOM</td>
<td>Flight Crew Operations Manual</td>
</tr>
<tr>
<td>MMEL</td>
<td>Master Minimum Equipment List</td>
</tr>
<tr>
<td>RA</td>
<td>Radio Altimeter</td>
</tr>
<tr>
<td>SESAR</td>
<td>Single European Sky ATM Research</td>
</tr>
<tr>
<td>XPDR</td>
<td>Transponder</td>
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