4th Meeting of the APIRG
Communications, Navigation and Surveillance Sub-group
(Dakar, Senegal, 25-29 July 2011)

WP/20
Automatic Dependent Surveillance - Broadcast (ADS-B) Planning and Implementation issues
The ADS-B System

The ADS-B system is made up of three basis parts:

• Transponder or non-transponder transmitter.
• Signal in space.
• Receiver.
ADS-B International Standards

- 1090 ES Mode S Extended Squitter.
  - Internationally accepted.
- Universal Access Transceiver 978 MHz.
  - Currently employed in the US as a second datalink supporting GA.
- VDL Mode 4.
1090 MHz Mode S Extended Squitter (1090ES)

- ADS-B using 1090ES is a natural extension of the basic Mode S Transponder broadcast message.
- ADS-B Minimum Aviation System Performance Standards (MASPS) published as RTCA DO-242, February 1998 (the basis for ADS-B Version 0), and updated as RTCA DO-242A, June 2002 (the basis for ADS-B Version 1).
- Minimum Operational Performance Standards (MOPS) for 1090ES published as RTCA DO-260, Sept 2000 (defined ADS-B Version 0 formats), and updated as RTCA DO-260A, April 2003 (defined ADS-B Version 1 formats).
Universal Access Transceiver (UAT)

- UAT is a multi-purpose aeronautical data link supporting:
  - ADS-B,
  - Traffic Information Service – Broadcast (TIS-B), and
  - Flight Information Service - Broadcast (FIS-B).
- RTCA DO-282 (August 2002) defines formats for ADS-B Version 1 for UAT.
- RTCA DO-282A (July 2004) updated formats after the ICAO ACP development of the UAT SARPs.
- RTCA DO-282B published in December 2009 defines ADS-B Version 2 formats for UAT.
- ACP currently updating respective ICAO provisions.
VDL Mode 4

- EUROCAE has published MOPS.
- ICAO has produced SARPS and guidance material.
Changes Between DO-260 & DO-260A  
(1090ES ADS-B Version 0 & Version 1)

• 1090ES requirements changes resulted in a major version change, Version 0 to Version 1. These included:
  – Recognition that integrity and accuracy of the position data was required to be separately conveyed.
  – Lack of mature receiver requirements.
  – Additional aircraft state changes identified as required parameters for transmission.
Evolution of DO-260A to DO-260B

• Problems identified from operational experience and application development activities resulted in:
  – DO-260A Change 1 (June 2006), and
  – DO-260A Change 2 (December 2006).

• DO-260B incorporated these changes as well as further refinements/enhancements.
<table>
<thead>
<tr>
<th>Capability</th>
<th>DO-260</th>
<th>DO-260A</th>
<th>DO-260B</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUC (Navigation Uncertainty Code)</td>
<td>✓</td>
<td>✓</td>
<td>✓✓</td>
<td>Baseline</td>
</tr>
<tr>
<td>Mode A Code</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Support legacy ATC infrastructure</td>
</tr>
<tr>
<td>NACp (Navigation Accuracy Code for Position)</td>
<td>✓✓</td>
<td>✓✓✓✓✓✓✓✓</td>
<td></td>
<td>Replaced NUC</td>
</tr>
<tr>
<td>SIL (Surveillance Integrity Level)</td>
<td>✓✓</td>
<td>✓✓✓✓✓✓✓✓</td>
<td></td>
<td>Replaced NUC</td>
</tr>
<tr>
<td>NIC (Navigation Integrity Code)</td>
<td>✓✓</td>
<td>✓✓✓✓✓✓✓✓</td>
<td></td>
<td>Replaced NUC</td>
</tr>
<tr>
<td>Revise SIL to become Source Integrity Level &amp; add: SDA (System Design Assurance)</td>
<td>✓✓✓✓✓✓✓✓</td>
<td></td>
<td>Clearly separates the reporting to reflect equipment certification levels and navigation source fault detection capability</td>
<td></td>
</tr>
<tr>
<td>Revise NIC/NAC/SIL and add GVA (Geometric Vertical Accuracy)</td>
<td>✓✓✓✓✓✓✓✓</td>
<td></td>
<td>To improve vertical accuracy, decouple vertical from NIC/NAC/SIL and add GVA</td>
<td></td>
</tr>
<tr>
<td>Add ADS-B IN bits</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Enhancement to show both UAT IN and 1090ES IN receiver equipage</td>
</tr>
<tr>
<td>Changes to the Target State Report</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>To better align with available aircraft data</td>
</tr>
<tr>
<td>Offer non-diversity antenna options for small aircraft</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Lower cost of equipage for General Aviation</td>
</tr>
<tr>
<td>Revise latency requirement (limit extrapolation)</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Enhancement</td>
</tr>
<tr>
<td>New guidance on how to determine NACv</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Fix</td>
</tr>
<tr>
<td>New guidance on how to select the best position/state vector sources</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Fix</td>
</tr>
<tr>
<td>Changes to the Mode A Code transmission rates</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Improvements and squitter efficiencies</td>
</tr>
<tr>
<td>Redefine TCAS status bits</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Fix</td>
</tr>
<tr>
<td>Fixes and improvement to NIC reporting and modified surface movement field for airport surface</td>
<td>✓✓</td>
<td></td>
<td>✓✓✓✓✓✓✓✓</td>
<td>Improvements for Surface applications</td>
</tr>
</tbody>
</table>
Some Examples of ADS-B Implementation

- Australia, Canada, Europe and the US have commissioned ADS-B systems operating today.
- Other states are considering ADS-B as a future surveillance solution and have trials either planned or underway.
Next Steps

• Tenth meeting of the Working Group (WG) of the ASP held in Toulouse, France (11 to 15 April 2011), to prepare for the second meeting of the Working Group of the Whole (WGW/2) which is planned to be held at the ICAO HQ in September 2011.

• It was decided that the ASP WGW/2 should be held from 29 to 30 September 2011 (after the Eleventh WG meeting to be held from 26 to 28 September) with only two agenda items:
  – I. Proposed amendments to existing provisions on surveillance and collision avoidance systems in light of operational experience; and
  – II. Future work
A - Proposed amendments to existing provisions

- The main topic under I would be proposed amendments to Annex 10 Vol IV introducing a new version of extended squitter messages (Version 2 equal to RTCA DO 260 B) and a edition of Manual on Technical Provisions for Mode S Services and Extended Squitter (Doc 9871) that contains all message formats and requirements of the new version.

- Compared to earlier versions, Version 2 redefines the ADS-B integrity by treating source of the data and the system separately and in this respect, defines the necessary parameters. It also includes the transmission of selected altitude, selected heading and barometric pressure setting of the aircraft. Version 2 messages also provide for the transmission of Mode A codes and the presence of the ACAS resolution advisory (RA) in the flight deck.
A-Proposed amendments to existing provisions

- There won’t be any guidance material for the flight testing of ADS-B and MLAT at the subject meeting as the work has not sufficiently matured and moreover, there is no urgency for such material as major ADS-B implementations which can provide the basis for the development of the material are years away.
B-Future work

• Under II, the meeting will propose a new work programme which includes, inter alia, the development of low-power and low-cost ADS-B OUT/IN units for:
  – airport surface vehicles to prevent runway incursions; and
  – light aviation (e.g. gliders) to improve the general situational awareness in uncontrolled airspace.

• The proposed new work programme also includes the development of multistatic radar which uses the emissions of other radio transmitters (e.g. broadcasting stations) to get a fix on the aircraft. Obviously this would be to enable the implementation of aeronautical surveillance systems at much lower costs.

• The foreseen completion dates for new work items is the end of 2015. The report of the ASP WGW/2 is to be reviewed by the Air Navigation Commission in late 2011.
Conclusion

• The CNS/SG is invited to:
  – Note the evolution of ADS-B standards and future work;
  – Request AFI States to establish a regulatory framework for ADS-B based on applicable standards.

-END-