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.
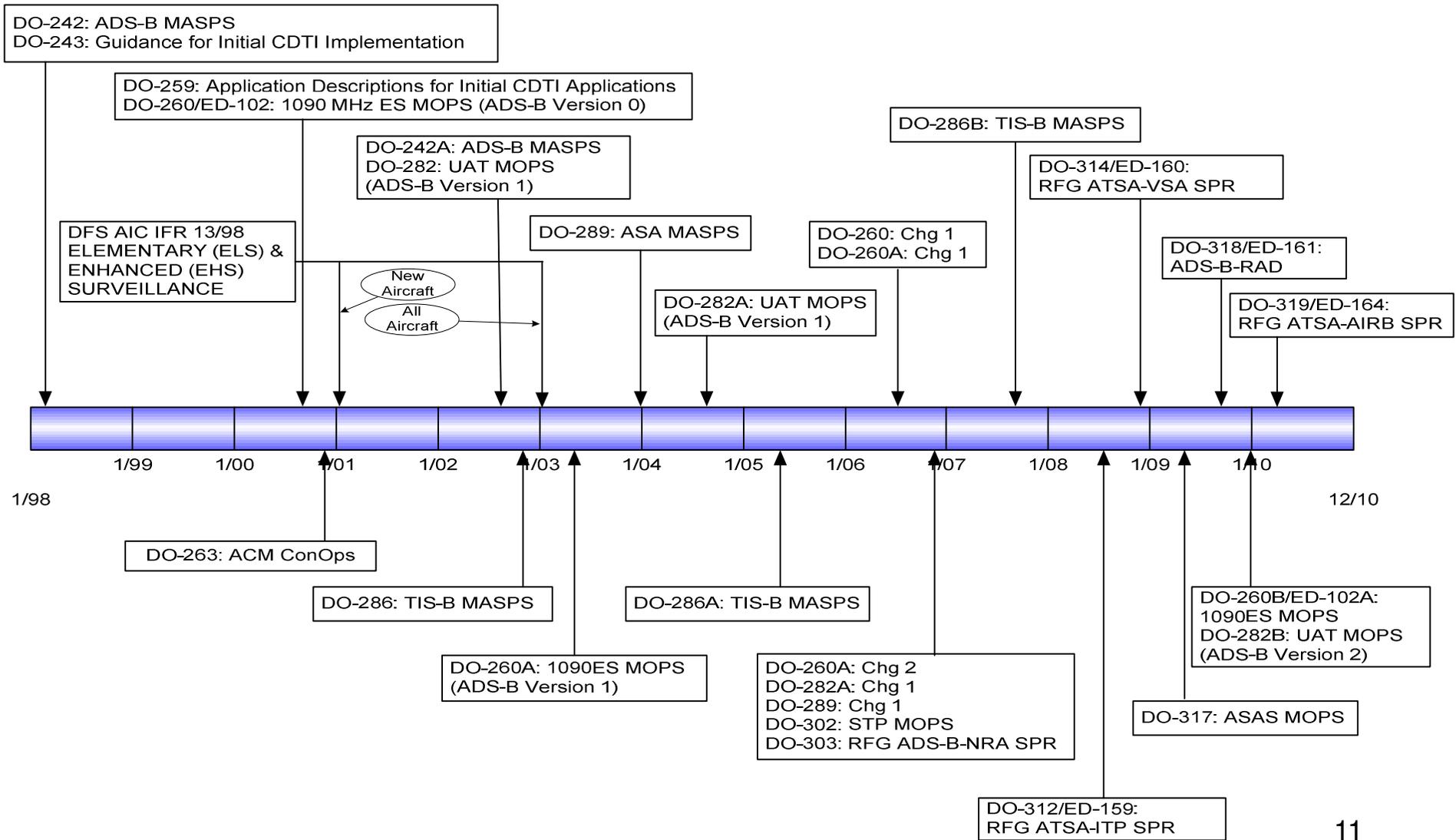
Changes Between DO-260A & DO-260B
(1090ES ADS-B Version 1 and Version 2)

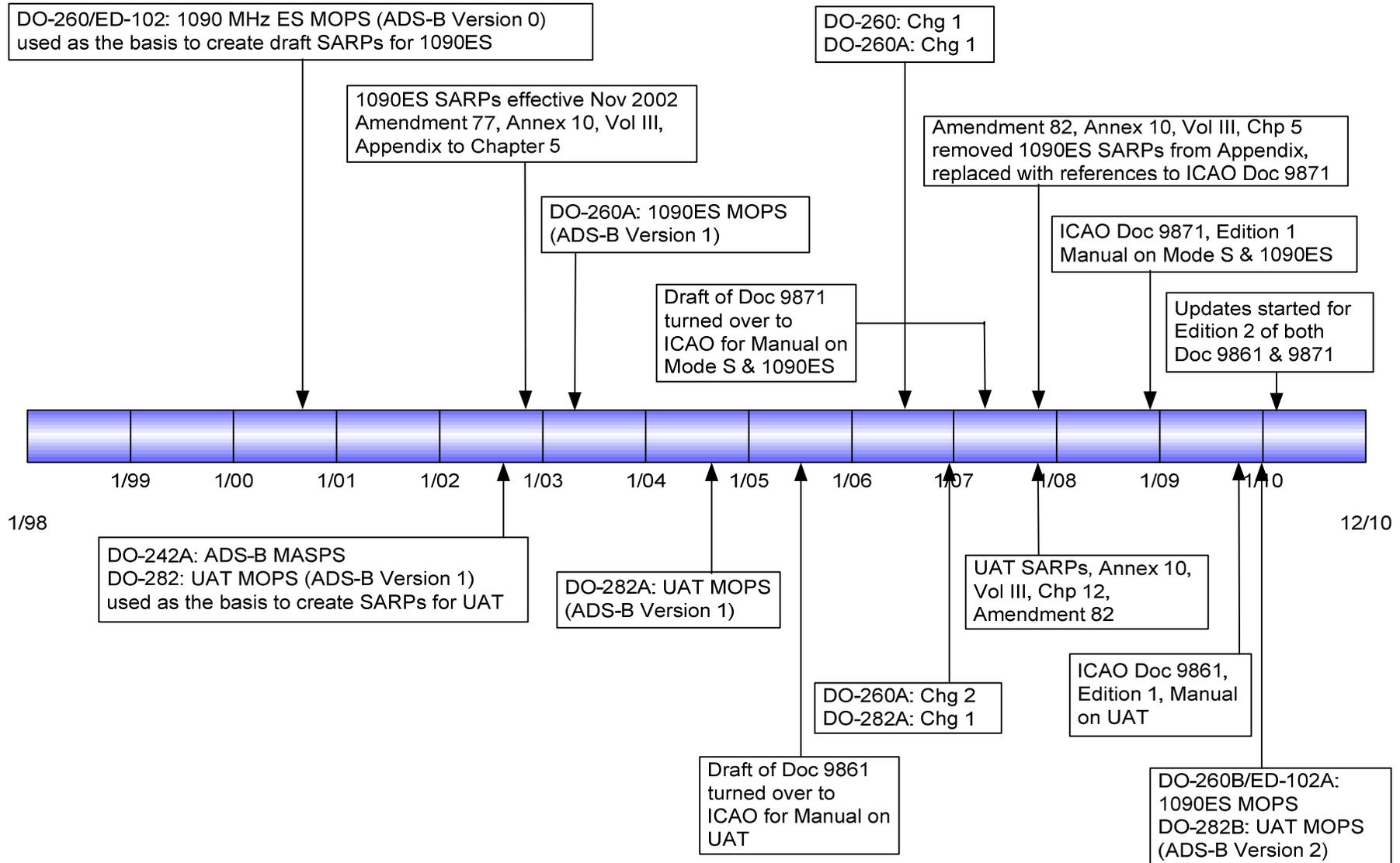| Capability	DO-260	DO-260A	DO-260B	Comments
NUC (Navigation Uncertainty Code)	✔			Baseline
Mode A Code		✔	✔	Support legacy ATC infrastructure
NACp (Navigation Accuracy Code for Position)		✔	✔	Replaced NUC
SIL (Surveillance Integrity Level)		✔		Replaced NUC
NIC (Navigation Integrity Code)		✔	✔	Replaced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

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.

RTCA and EUROCAE ADS-B Documentation

DO-242: ADS-B MASPS
DO-243: Guidance for Initial CDTI Implementation

DO-259: Application Descriptions for Initial CDTI Applications
DO-260/ED-102: 1090 MHz ES MOPS (ADS-B Version 0)

DO-286B: TIS-B MASPS

DO-242A: ADS-B MASPS
DO-282: UAT MOPS
(ADS-B Version 1)

DO-314/ED-160:
RFG ATSA-VSA SPR

DFS AIC IFR 13/98
ELEMENTARY (ELS) &
ENHANCED (EHS)
SURVEILLANCE

DO-289: ASA MASPS

DO-260: Chg 1
DO-260A: Chg 1

DO-318/ED-161:
ADS-B-RAD

New Aircraft

All Aircraft

DO-282A: UAT MOPS
(ADS-B Version 1)

DO-319/ED-164:
RFG ATSA-AIRB SPR

1/98   1/99   1/00   1/01   1/02   1/03   1/04   1/05   1/06   1/07   1/08   1/09   1/10   12/10

DO-263: ACM ConOps

DO-286: TIS-B MASPS

DO-286A: TIS-B MASPS

DO-260B/ED-102A:
1090ES MOPS
DO-282B: UAT MOPS
(ADS-B Version 2)

DO-260A: 1090ES MOPS
(ADS-B Version 1)

DO-260A: Chg 2
DO-282A: Chg 1
DO-289: Chg 1
DO-302: STP MOPS
DO-303: RFG ADS-B-NRA SPR

DO-317: ASAS MOPS

DO-312/ED-159:
RFG ATSA-ITP SPR

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ICAO SARPs and ADS-B Documentation

DO-260/ED-102: 1090 MHz ES MOPS (ADS-B Version 0) used as the basis to create draft SARPs for 1090ES

DO-260: Chg 1
DO-260A: Chg 1

1090ES SARPs effective Nov 2002 Amendment 77, Annex 10, Vol III, Appendix to Chapter 5

Amendment 82, Annex 10, Vol III, Chp 5 removed 1090ES SARPs from Appendix, replaced with references to ICAO Doc 9871

DO-260A: 1090ES MOPS (ADS-B Version 1)

ICAO Doc 9871, Edition 1 Manual on Mode S & 1090ES

Draft of Doc 9871 turned over to ICAO for Manual on Mode S & 1090ES

Updates started for Edition 2 of both Doc 9861 & 9871

1/99   1/00   1/01   1/02   1/03   1/04   1/05   1/06   1/07   1/08   1/09   1/10

1/98

12/10

DO-242A: ADS-B MASPS
DO-282: UAT MOPS (ADS-B Version 1) used as the basis to create SARPs for UAT

DO-282A: UAT MOPS (ADS-B Version 1)

UAT SARPs, Annex 10, Vol III, Chp 12, Amendment 82

DO-260A: Chg 2
DO-282A: Chg 1

ICAO Doc 9861, Edition 1, Manual on UAT

Draft of Doc 9861 turned over to ICAO for Manual on UAT

DO-260B/ED-102A: 1090ES MOPS
DO-282B: UAT MOPS (ADS-B Version 2)

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.

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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.

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