International Civil Aviation Organization

SIXTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP (CNS/MET SG/16) OF APANPIRG

Bangkok, Thailand, 23 – 27 July 2012

Agenda Item 6: Surveillance

REPORT OF FEDERAL AVIATION ADMINISTRATION (FAA) ADS-B ACTIVITIES

(Presented by the United States of America)

SUMMARY

This paper presents a brief summary of recent FAA activities in the implementation of ADS-B in the United States.

This paper relates to –

Strategic Objectives
A: Safety - *Enhance global civil aviation safety*
C: Environmental Protection and Sustainable Development of Air Transport - *Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

Global Plan Initiatives:
GPI-9 Situational awareness
GPI-12 Functional integration of ground systems with airborne systems
GPI-22 Communication infrastructure

1. Introduction

1.1 This information paper provides a summary of U.S. ADS-B development and implementation activities that may be of interest to meeting participants.

2. Discussion

2.1 The U.S. Federal Aviation Administration (FAA) is delivering Surveillance and Broadcast Services (SBS) as described in this section. SBS services are provided via a set of FAA-specified service volumes in en route airspace, terminal area airspace, and on airport surfaces.

2.2 **ADS-B:** Aircraft with avionics certified and installed in accordance with FAA AC 20-165 (or an equivalent approved by FAA Aircraft Certification) will receive air traffic control (ATC) separation service in the U.S.

Note: *Specifically approved aircraft equipped with previously approved avionics (TSOC154b/TSO-C166a) are currently receiving ADS-B-only ATC separation services in Alaska and the Gulf of Mexico.*

2.3 The U.S. is supporting two ADS-B links:

- 978 MHz Universal Access Transceiver (UAT) link per FAA TSO-C154c; and
- 1090 MHz Extended Squitter (1090ES) link per TSO-C166b.

2.4 The U.S. ADS-B Final Rule requires aircraft that operate above Flight Level (FL) 180 to broadcast on the 1090ES link. The FAA is not prescribing the choice of link for aircraft flying below FL180; both links are supported and operators are free to choose whichever link meets their needs. Aircraft broadcasts go to other aircraft and to ground radio stations, where the information is processed and displayed to ATC. Where available, information from FAA radars is combined with ADS-B data to support ATC separation services.

2.5 Aircraft with ADS-B-In capability directly receive broadcasts from nearby aircraft on the same link, limited in range only by line-of-sight or received signal strength. Aircraft broadcasting on one link (example: UAT) are not received by aircraft using only the other link (example: 1090ES) and vice versa, which justifies the Automatic Dependent Surveillance – Rebroadcast (ADS-R) service described below.

2.6 On 28 May 2010, the U.S. ADS-B Final Rule was published, requiring ADS-B-Out equipage in U.S. airspace where a transponder is currently required, with compliance required after 1 January 2020. The U.S. ADS-B Final Rule also specifies requirements for broadcast information, including minimum thresholds for position/velocity accuracy and integrity.

2.7 **ADS-R:** ADS-R is a pilot advisory service that receives data from aircraft on one link and immediately rebroadcasts it on the other link. To conserve spectrum, the service identifies aircraft broadcasting that they are ADS-B-In equipped as "client" aircraft. The traffic broadcasting on the other link within a specified radius and altitude band around each client aircraft are then rebroadcast on the client's link via ADS-R. Note that ADS-R services are only available when both aircraft are within range of any ADS-B ground radio station. Since ADS-B ground stations are sited to cover current radar airspace, this means that there will be regions of airspace (typically at lower altitudes) without ADS-R coverage. Various avionics manufacturers are considering the market opportunities for ADS-B avionics with dual-link receive capability.

2.8 **TIS-B:** Traffic Information Service – Broadcast (TIS-B) is a pilot advisory service for situation awareness, gathering data from U.S. ATC radars, Wide Area Multilateration (WAM) systems such as those used in Alaska/Colorado, and surface multilateration systems like Airport Surface Detection Equipment, Model X (ASDE-X). This non-ADS-B surveillance information is broadcast as a TIS-B service through ground radio stations to participating aircraft on both links. Like ADS-R, appropriately equipped aircraft are identified as client aircraft and non-ADS-B traffic within a specified radius and altitude band around the client aircraft are selected for TIS-B. Unlike ADS-R, TIS-B messages are structured so that information about multiple aircraft can be packaged into a single TIS-B broadcast.

2.9 **FIS-B:** Flight Information Service - Broadcast **(**FIS-B) is a pilot advisory service supported by the FAA that is only broadcast on the UAT link. The FIS-B message set contains Airman's Meteorological Information, Aviation Routine Weather Report (METAR) and Unscheduled Specials, Next Generation Radar (NEXRAD) precipitation reflectivity, Pilot Reports (urgent and routine), Significant Meteorological Information, Terminal Area Forecast and unscheduled Amendments, Winds and Temperatures Aloft, Notices to Airmen (NOTAMs) important to flight safety, and Status of Special Use Airspace.

2.10 The FAA is considering additional products for the FIS-B service in the future. Products under consideration include Echo tops, Lightning strikes, Severe Weather Forecast Alerts and Severe Weather Watch Bulletin, Ceilings, Digital Automated Terminal Information Service, Icing (Current/Forecast Potential), Terminal Weather Information for Pilots, and Turbulence. Service Delivery Approach and Implementation Status 2.11. As of 23 March 2012, 418 radio sites of over 700 planned sites were constructed and 371 radio sites have been declared operational by the FAA. The latest map of the operational radios can be found at: http://www.faa.gov/nextgen/flashmap.

FAA ADS-B Development Strategy

2.11 The tables below show the overall FAA ADS-B development strategy for 2011-2017. ATC Separation Services will be implemented on a facility-by-facility basis by declaring Initial Operational Capability (IOC) at each site. Most major facilities will achieve IOC by the end of 2013, but implementation will continue at some smaller terminal facilities until 2015, due to the need for automation system modernization at those facilities.

Service Delivery Points for ATC Separation Services									
	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	Operational
En route	2	0	4	15	3	0	0	0	2 of 24
Terminal	2	1	16	45	52	43	0	0	3 of 159
Surface (Advisory)	2	0	14	15	5	1	5	2	2 of 44

Pilot Advisory Services								
	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	Actual/Planned
Radio Station Installations	11	43	211	101	134	186	46	418/730

2.12 ATC Surface Advisory Services refer to ADS-B services provided by FAA at those locations where surface surveillance systems exist, which include both the ASDE-X and the new Airport Surface Surveillance Capability (ASSC) that is currently under development. Implementation of ATC Surface Advisory Services will continue until 2017 in conjunction with the deployment of ASSC.

2.13 Pilot applications and pilot advisory services are available to aircraft equipped with ADS-B-In capability. Pilot Advisory Services (ADS-R, TIS-B, and FIS-B) are activated as each ADS-B ground station is declared operational.

Air Traffic Control Separation Services

2.14 Since late 2009, the FAA has been delivering ATC separation services to aircraft equipped with ADS-B Version 1 avionics (TSO-C154b/TSO-C166a). Between 2009 and 2011, the following key-sites achieved IOC:

- Louisville Terminal Radar Approach Control (TRACON);
- Houston Air Route Traffic Control Center (ZHU) Gulf of Mexico airspace;
- Philadelphia TRACON; and
- Airspace in the vicinity of Juneau, Alaska.

2.15 For Terminal Approach Control (TRACONs), ATC separation services are provided using fused radar and ADS-B. Based on this operational experience, FAA made an In-Service Decision (ISD) for SBS on 22 September 2010, indicating that the use of ADS-B and WAM are operationally suitable as surveillance sources for ATC Separation Services in the United States. As with any complex system, there were a set of issues raised during the testing and evaluation phase that are being addressed. These issues, documented in ISD Action Plans, are being resolved, as needed, to enable activation of ADS-B for ATC Separation Services in the initial production sites.

2.16 The initial terminal production sites are Houston TRACON for the Standard Terminal Automation Replacement System (STARS) and New York TRACON for the Common Automated Radar Terminal System (CARTS). The activities that are being completed for CARTS and STARS include updating the software baselines to support ATC terminal separation for ADS-B-only targets (for aircraft equipped with AC 20-165 avionics). End-to-end system testing is being conducted to validate the separation standards analyses for ADS-B-to-ADS-B and ADS-B-to-radar separation services.

2.17 The initial En Route Automation Modernization (ERAM) production site is ZHU. ZHU will implement ADS-B data integration with ERAM in phases. The first phase provides ADS-B data to ERAM via a "virtual radar" interface now being used by the ZHU En Route Host system to provide separation services in the Gulf of Mexico airspace. In the second phase, ERAM will be provided with ADS-B data to enable ATC separation services using a fused ADS-B and radar picture that will be used for additional Air Route Traffic Control Centers (ARTCCs) after ZHU.

2.18 By 2015, FAA plans to integrate ADS-B surveillance data in the Advanced Technologies and Oceanic Procedures (ATOP) automation platform to support ATC separation services in oceanic airspace for which the U.S. is responsible.

Pilot Advisory Services

2.19 The deployment of Pilot Advisory Services (broadcast of TIS-B/ADS-R and FIS-B) continues. As of 23 March 2012, Pilot Advisory Services were operational in the following Service Volumes:

- 23 en route transmission facilities (15 Centers, 6 special Alaska volumes, 2 special Gulf of Mexico volumes);
- 95 terminal transmission facilities; and
- surface transmission facilities.

2.20 The latest updated information on FAA SBS deployment can be found on the FAA website as described previously.

Pilot Applications

2.21 The FAA is developing a number of pilot applications that are expected to provide benefits to operators who choose to equip their aircraft with ADS-B-In avionics which receive, process, and display ADS-B and TIS-B data from surrounding aircraft and ground transmitters. In addition to providing benefits directly to operators, these applications will help accelerate the understanding of ADS-B and provide a path to future applications.

Interval Management (IM)

2.22 Interval Management (IM) introduces a new method for flight crews and ATC to achieve a desired spacing between aircraft in all phases of flight. The initial applications of these operations will take place for arriving aircraft in en route airspace to a terminal area metering fix consistent with today's instrument flight rules (IFR) procedures and criteria.

2.23 IM operations consist of a ground capability called Ground Interval Management - Spacing (GIM-S) to schedule/manage the arrival traffic flow, and a flight deck capability (FIM-S) to allow the aircraft to efficiently manage the interval assigned by air traffic control. The FAA is implementing the requirements for the capabilities in GIM-S via two FAA automation programs: Time-Based Flow Management (TBFM) and ERAM.

2.24 The FAA has several airline partners prepared to support operational data collection and benefits measurement as the initial FIM-S capabilities are established. The FAA supported the efforts of a joint RTCA/EUROCAE working group to develop the Safety, Performance and interoperability Requirements (SPR) document for FIM-S (also known as ASPA-IM), which resulted in RTCA DO-328.

2.25 RTCA SC-186 and EUROCAE WG-51 have begun initial work on the Minimum Operational Performance Standards (MOPS) for FIM avionics. This effort is expected to conclude in late 2013.

Airport Traffic Situation Awareness with Indications & Alerts (SURF-IA)

2.26 The FAA funded multiple activities to support the development of a SPR for the surface situation awareness with indications and alerts (SURF-IA) application (published as RTCA DO-323). As part of this, Honeywell and ACSS conducted demonstrations of SURF-IA application prototypes in the Seattle area and the Philadelphia area. The FAA made the reports of these demonstrations available to SC-186 and other interested parties via the RTCA workspace for SC-186. The demonstrations validated a suspected line-of-sight issue and identified an unexpected ADS-B "drop-out" issue for surface operations. The line-of-sight issue occurs for airports where terrain and/or buildings obstruct portions of intersecting runways that may be used simultaneously. The ADS-B drop-out issue can cause ADS-B transmissions of one aircraft within line-of-sight of another aircraft to not be received due to radio frequency multi-path interference. Both of these issues are being studied by the FAA to determine their scope and potential mitigations.

2.27 The FAA subsequently collected surface ADS-B data at Philadelphia International Airport (PHL) in October 2010 and confirmed that multipath was interfering with the incident ADS-B signals at multiple locations on the airport surface. This multipath phenomenon creates "blind spots" at which ADS-B-transmitting aircraft could not be seen by ADS-B-In systems. FAA is collecting additional data to characterize this problem and develop potential mitigation alternatives for consultation with industry and other nations.

2.28 RTCA DO-323 documents the position accuracy/integrity performance requirements that are needed to minimize false alarm rates during surface operations. Depending on runway/taxiway geometries, the performance requirements are generally very demanding, exceeding the requirements of the U.S. ADS-B Final Rule. Many of the requirements can only be achieved with some form of augmentation (satellite-based or ground-based), or are projected to be achievable with future "dual frequency" GPS and/or multi-constellation GNSS receivers.

2.29 At this time, due to the above-described technical issues, funding limitations, and the challenging performance requirements of this application, the FAA does not currently plan to initiate MOPS development activities for SURF-IA until 2014 or later.

Vehicle ADS-B

2.30 The FAA is promoting ADS-B for use with vehicles on airport surfaces to improve runway safety. Any vehicle (e.g., a tug, fuel truck, snowplow, or rescue and fire fighting vehicle) can be equipped to transmit location information to ATC, pilots, vehicle drivers, or airport operators. In the U.S., ADS-B transmissions will only be permitted from ground vehicles that are in the airport movement area (and subject to ATC clearances).

2.31 While not mandating vehicle ADS-B, the FAA is encouraging airport operators to equip appropriate vehicles. In addition to significant improvements in runway safety, airport managers could use ADS-B information to track assets more efficiently. This would be especially useful with rescue vehicles in case of an accident.

2.32 The FAA has issued AC 150/5220-26 for Airport Ground Vehicle ADS-B-Out Squitter Equipment, which helps airport managers understand how to determine which vehicle transponders meet FAA performance requirements, inform the FAA of the airport's intent to proceed with vehicle ADS-B, request unique ICAO identifying numbers for vehicles to be equipped, and request a transmit license.

2.33 As of March 2012, the FAA was evaluating the first vehicle ADS-B out squitter unit for compliance to the FAA Vehicle Squitter Performance Specification. The first unit utilizes the UAT ADS-B link which is the preferred Vehicle Squitter Unit link as stated in the Advisory Circular. Extensive operational testing and evaluations are expected to continue through April 2012 or until successful completion of all performance tests. The successful unit will be added to the Advisory Circular as a Qualified Product.

2.34 The FAA intends to make the ADS-B Vehicle Squitters eligible for Airport Improvement Plan (AIP) Funding. That will allow eligible airport authorities choosing to procure qualified Vehicle Squitter Units to use AIP funds to do so.

ADS-B Service Availability Prediction Tool (SAPT)

2.35 The SAPT is being developed pursuant to an ADS-B Aviation Rulemaking Committee (ARC) recommendation. The ARC's concern was the difficulty a user would have in predicting the expected availability of a given Global Positioning System (GPS) accuracy/integrity performance level over a planned route of flight.

2.36 The SAPT assumes the minimum performance requirements for Global Navigation Satellite System (GNSS) sensors, as required in the appropriate TSOs. The SAPT prediction is based upon; (1) the time, route and airspace of the planned flight; (2) ADS-B-related avionics on the subject aircraft; and (3) the announced status of the GPS satellite constellation.

2.37 Currently, FAA is considering the enhancement of adding further information to the SAPT about the availability of secondary surveillance radar coverage and wide-area multilateration surveillance coverage. Such an enhancement would allow operators to understand whether alternative surveillance sources could mitigate a temporary reduction in GPS accuracy/integrity performance within airspace along their planned route of flight.

2.38 SAPT is envisioned as one method for an operator to assess the availability of required ADS-B performance for a flight. Operators also may choose to use an alternative FAA-approved prediction tool.

3. Action by the Meeting

3.1 The meeting is invited to note the information contained in this paper.

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