International Civil Aviation Organization

Automatic Dependent Surveillance – Broadcast (ADS-B)
Study and Implementation Task Force

Brisbane, Australia, 24-26 March 2003

Agenda Item 2: Review of ADS-B Activities

e) Review aircraft equipage and future plans by airlines, business aviation and general aviation sectors

ADS-B DEPLOYMENT FROM THE AIRBORNE EQUIPAGE PERSPECTIVE

SUMMARY

This brief paper presents the perspective of an avionics subsystem manufacturer in relationship to regulatory, technological choice, and cost-benefit associated with deployment of ADS-B systems worldwide.

(Presented by Australia)

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1 BACKGROUND

1.1 ADS-B technology offers a low-cost and easily deployable surveillance capability for the Asia-Pacific region. Specifically, it holds promise in areas of little or no current surveillance coverage where conventional radar coverage is cost prohibitive. For ADS-B to be a successful alternative however both ground systems and airborne avionics must be deployed systematically to provide equitable and timely benefits to all stakeholders.

2 DATA LINK CONSIDERATIONS FOR AIRBORNE AVIONICS

2.1 There are three candidate data link technologies being considered for use as the transmission media for ADS-B messages: Mode S 1090 MHz Extended Squitter (1090ES), Universal Access Transceiver (UAT), and VHF Data Link Mode 4 (VDLm4). Of the three, 1090ES has emerged as the globally accepted ADS-B data link for all aircraft types.

2.2 The US FAA has announced plans to adopt 1090ES as a standard for aircraft that operate at high altitudes, which includes air transport, regional, and business aircraft. For aircraft operating at lower altitudes, they plan to adopt the UAT link as a standard. This would apply to light general aviation type of aircraft, and is an attempt to provide a consolidated link for traffic, weather and flight information. Although the plan specifies the use of UAT in general aviation aircraft, operators may opt to equip with Mode S data link (1090ES) capability as a means participate in the ADS-B environment.

2.3 European regulators also plan to adopt 1090ES as a standard for all aircraft to support the initial ADS-B based Airborne Separation Assistance Systems (ASAS) applications. These applications are intended to provide a strategic complement to currently deployed collision avoidance systems (TCAS/ACAS). European regulators are also investigating the use of VDLm4, and potentially UAT, to provide long-term dual link capability for ASAS applications.

2.4 The data link dialogue has created confusion and uncertainty in the overall understanding of ADS-B. Data link selection has become a focus of dispute and has drawn interest away from the benefits of ADS-B based applications, diluting the commitment of industry, regulators, and operators to implementation.

2.5 The 1090ES data link builds upon a broadly established Mode S avionics install base and fits well within the current ATM surveillance infrastructure. Other link candidates in comparison to 1090ES have technological merits, but require significant changes to surveillance infrastructure and airborne equipage, and require additional investment from all stakeholders in order to achieve broad operational use.

3 REGULATORY GUIDANCE FOR ADS-B

3.1 The technical specification for implementation of ADS-B messaging is well established and has been documented and approved by industry groups worldwide. Both RTCA and EUROCAE working groups have published documents that define the specific implementation of ADS-B messaging and functionality. Changes to these documents by the working groups are ongoing, and thus still provide small perturbations to the actual implementation details.

3.2 Regulatory guidance for certification of equipment that supports the ADS-B functionality is in progress, but is not complete. The FAA TSO for UAT ADS-B equipment has been issued, but the equivalent TSO for 1090ES has not. The JAA TSO-c112a for Mode S transponder equipment references EUROCAE ED 73a as the primary means of compliance to ADS-B requirements.

4 AIRBORNE SYSTEM CONFIGURATIONS

4.1 The cost and benefit of the ADS-B system is also dependent on the functional level of the system configuration. From the airborne perspective, three configurations are considered:

1) Transmit Only Airborne Equipage with Receive Only Ground Station(s)

This is the basic air-to-ground form of the ADS-B system. Airborne avionics have transmit only capability that broadcast ADS-B information. Ground systems have receive only capability and are interfaced to pass surveillance information to air traffic automation systems.

Cost of implementation for this configuration is minimized for both the ground and airborne infrastructure. Ground systems require receive only capability, which reduces the hardware cost associated with deployment. Airborne avionics costs are also kept to a minimum by requiring changes only to the transmit capability of ATC transponders. For most modern transponders, this can be accomplished with software modification of the transponder, and the addition of wiring to input GPS position information to the transponder for ADS-B reporting. Others not capable of software modification will require the addition or replacement of existing transponder equipment with avionics that supports ADS-B capability.

The air traffic management community realizes the direct benefit of this configuration as a low-cost, easily deployable alternative to secondary surveillance radar systems. Aircraft operators may realize indirect benefits if air traffic management provides incentives for equipage that reduce overall operating costs.

2) Transmit/Receive Airborne Equipage with Receive Only Ground Station(s)
Adding receiver capability to the airborne equipage enables air-to-air ADS-B messaging. For TCAS/ACAS equipped aircraft with existing Mode S receive capable hardware, software modifications can be made to accept and process the ADS-B messages. For non-TCAS/ACAS equipped aircraft, an additional 1090MHz receiver is required to enable the reception of ADS-B messages.

Once airborne ADS-B reception is enabled by the receiver, the information provided must be processed and displayed on the cockpit instrumentation. This is referred to as Cockpit Display of Traffic Information (CDTI). Although the symbology and implementation of CDTI displays is straightforward from the technical perspective, the actual integration of ADS-B information and CDTI displays is made difficult by the variation in the display equipage on individual aircraft. Modern or new aircraft with "glass" cockpits and multi-function displays make the incorporation of CDTI simpler, but still require re-certification of the display capability. Older aircraft and most general aviation aircraft not equipped with adaptable display capability must install additional equipment to support the display of ADS-B information. The broad variations in airborne equipage cause this effort to be costly for both avionics manufacturers and operators.

3) Transmit/Receive Airborne Equipage with Receive/Transmit Ground Station(s)
Transmit capability added to the ground station enables the uplink of traffic information from the automation system to aircraft equipped with ADS-B receivers. This is referred to as Traffic Information System (TIS) on 1030MHz, and Traffic Information System – Broadcast (TIS-B) when provided on 1090MHz. This allows ADS-B equipped aircraft to receive traffic information regarding aircraft that may not be equipped with ADS-B transmitters, i.e. those that have been detected by the primary radar of the air traffic automation system. This would also provide an exchange capability of traffic information derived from dissimilar ADS-B equipage, e.g. between 1090ES and UAT equipped aircraft. This configuration provides diminishing value to stakeholders as more aircraft are equipped with ADS-B equipment.

5 COST-BENEFIT CONSIDERATIONS FOR AIRCRAFT OPERATORS AND AIR TRAFFIC MANAGEMENT

5.1 For any avionics system used by airlines and other aircraft operators, the benefit associated with the use of a technology is carefully considered against the cost of ownership. Traditional surveillance systems such as radar passively detect and display targets of interest to air traffic specialists. Little if any airborne equipage considerations are required to deploy such a surveillance system. In contrast, Secondary Surveillance Radar (SSR) and ADS-B systems require the integration and participation of both the airborne and ATM environments in order for the system to function properly.

5.2 ADS-B technology opens the possibility of ATC surveillance in the remote areas of Australia where radar is not a cost-effective solution. Airservices Australia has the objective of using ADS-B to provide aircraft separation services equivalent to radar. Enhanced safety and commercial benefit will result when compared to today's non-radar procedural separation services for these areas.

5.3 ADS-B systems may make operational benefits available to participating aircraft. These benefits include the following depending on the capabilities of the Air Traffic Control systems:

- Provide radar like separation services during approach, allowing decreased separation criteria (i.e., <5 miles)
- Increase safety throughout the coverage area through provision of ground based safety alerts, weather alerts, announcement of minimum safe altitude warnings, danger area infringement warnings, as well as clearance and route compliance monitoring.

- Reduce pilot and controller workload by removal of routine position reporting and procedural control.
- Provide enhanced situational awareness to pilots when the aircraft is equipped with CDTI.

6 RECOMMENDATION AND ACTION REQUIRED

6.1 REGARDING DATA LINK CONSIDERATIONS:

- Establish policies on data link preference for 1090ES to accelerate ADS-B implementation by focusing on applications benefits and not data link technology.
- Study future demand and capacity of data link technologies for long-term viability of ADS-B functionality.

6.2 REGARDING REGULATORY ISSUES:

- Recommend priority for regulatory updates to TSO documentation for ADS-B functionality in Mode S avionics. Issuance of regulatory guidance for globally accepted 1090ES data link technology should be higher priority than that of regionally accepted UAT or VDLm4.
- Collaborate with worldwide regulatory agencies to draw conclusions regarding technology alignment across international airspace.

6.3 REGARDING AIRBORNE EQUIPAGE CONFIGURATIONS:

- Adopt evolutionary approach to airborne equipage that builds upon existing installations.
  – Minimize impact to airborne equipage by providing incentives (operational or financial) to those that have elect to upgrade or replace equipment with transmit only ADS-B capability.
  – Provide additional incentives (operational or financial) to those that have CDTI and TIS capability.

6.4 REGARDING COST BENEFIT OF ADS-B:

- Identify the expected operational benefits that operators can use to establish positive cost benefit within their own organizations.
- Study the merits and shortcomings of incentive based approaches and/or mandates for ADS-B equipage. Establish clear approach to implementation that is equitable for all stakeholders.
- Define and promote technology and economic benefits for regional operators.
- Obtain input from all market segments including air transport, regional, business, and general aviation regarding perceived benefits and acceptable associated costs of equipage.

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