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

d) Review activities by Asia/Pacific States in trials and demonstration of ADS-B.

ADS-B ACTIVITIES IN THE ASIA/PAC REGIONS
(Abstract from APANPIRG/13 and its Sub-groups' Reports)

SUMMARY

This paper presents a summary of ADS-B related activities in the Asia/Pacific Regions based on the Reports of APANPIRG/13 and its sub-groups.

(Presented by the Secretariat)

1. Introduction

1.1 Substantial developments and operational trials on ADS-B had taken place and relevant information was made available to the Thirteenth Meeting of APANPIRG held in Bangkok in September 2002.

2. Discussion

A summary of ADS-B related activities and deliberations by APANPIRG/13 and its sub-groups' meetings are compiled below for reference and review by the meeting.

2.1 Automatic Dependent Surveillance (ADS) developments

2.1.1 The meeting was informed of Automatic Dependent Surveillance Broadcast (ADS-B) systems trials being conducted and implemented within the Region. The meeting noted potential benefits and low cost of ATC surveillance provided by ADS-B technology.

2.1.2 ADS-B Project in Australia

2.1.2.1 In Australia, a project was initiated to conduct an operational trial of ADS-B for ATC surveillance in a region near Bundaberg, Queensland. The project will install a single ADS-B ground station **with SSR Mode S ES 1090 MHz** receivers, equip a number of aircraft with ADS-B avionics, and modify an operational air traffic management system to process and display ADS-B tracks. The objectives of the trial were to provide and demonstrate operational benefits to airline and airspace users of ADS-B; to provide first hand operational experience of ADS-B for ATC surveillance and the use of ADS-B for separation in the Australian environment including the development of procedures and training; to provide cost-benefit information and practical information prior to deployment of **ADS-B for radar like surveillance** within Australia. It was expected that engineering would be ready in late 2002 and operational use in early 2003. It was further informed that the implementation and application of ADS-B offers considerable benefits in terms of services that are currently only provided in radar environments.

2.1.2.2 Australia provided an update in July 2002 of the progress with the ADS-B Operational trial. The ADS-B ground station has been installed and is operating providing information to the Brisbane Centre. Software changes to the ATC automation system to fully integrate ADS-B data have been developed. The software has passed through factory test and is scheduled for site tests in the next two months. Avionics is being submitted for FAA TSO in October 2002. Installation in aircraft will occur shortly thereafter. Preliminary testing of the coverage of the site has been conducted by detecting Mode S short (acquisition) squitter messages (DF11) from over flights. The DF11 messages were correctly decoded from an Air New Zealand aircraft some 290 NM from the ground station at FL360.

2.1.3 Considerations for ADS-B by Fiji

2.1.3.1 Fiji informed the meeting of its studies and plans for ADS-B. A study is currently being conducted to provide a Cost Benefit Analysis (CBA) on the implementation of ADS-B in Fiji. Trials are planned for 2003 and implementation in 2004.

2.1.3.2 It has been identified that the use of radar is not an option for the domestic airspace surveillance covering 120 NM and 300 islands spread over the seas due to the number that would be required together with the prohibitive costs (capital and operational). The lessons learnt and experiences gained enabled Fiji to move forward in search for a long-term solution for ADS in its domestic airspace as well as share those experiences with member states in the Regions. Fiji is currently undertaking a **Cost Benefit Analysis (CBA) study** in partnership with suppliers of the EUROCAT system (Thales ATM) on the integration of ADS-B information into the Eurocat system. The study is expected to be completed by October 2002. Following CBA, further discussions with Stakeholders (CAAFI, Airports Fiji Ltd, Airline operators, Government) who are also part of the National CNS/ATM Planning team would continue so that trials may be conducted in 2003.

2.1.4 ADS-B/ADS-C in Mongolia

2.1.4.1 Mongolia made a visual presentation of a successful combined ADS-B/ADS-C demonstration conducted in Ulaanbaatar from 25 to 26 September 2001. The demonstration consisted of an MIAT AN-24 aircraft equipped with ADS-B avionics + **CDTI** and one Mil-8 helicopter with ADS-B avionics, one airport vehicle with ADS-B unit and ADS-B ground station with ADS-B, FIS-B and DGNSS functions. ICAO standardized technology **VDL Mode 4** was employed for the demonstration. ADS is seen as having great potential for Mongolia for reducing infrastructure costs, as Mongolia has no civil radars but a modern ATC system and supporting infrastructure. ADS-B is considered for domestic use and ADS-C for international operations in the near-term plan. No communications service charges for ADS-B will be required as its signal and data of ADS-B can be processed locally. **The current ATM automation system (AutoTrac 2100) was capable of integrating ADS-B information.**

2.1.5 ADS-B in Russia

2.1.5.1 The Russian Federation provided information on the proposed use of ADS-B in the Russia. The ADS-B system will utilize Russian manufactured equipment **using VDL Mode 4 data link**. An important part of the project is assessing the application of ADS-B for the purpose of supporting helicopter **operations in areas with no radar coverage**. The meeting was also informed of the limitations of ADS-C using satellite communications in the far northern latitudes. It is the intention of State Civil Aviation Authority of Russia to utilize HF data link in the very northern latitude and as a backup to satellite communications below 80 degrees North.

2.1.6 US FAA ADS-B Capstone Programme

2.1.6.1 The United States of America provided an update to the FAA ADS-B Capstone Programme. Currently 150 aircraft have been equipped **with UAT ADS-B link**, multifunction displays and GPS service. Technology being demonstrated in the FAA Capstone Project include: **cockpit display** of traffic information, controllers in Anchorage began providing ADS-B "radar like" services to aircraft in the Bethel area since 21 January 2001 which is the first use of non-radar surveillance for control purpose in the United States. The same data link that transmits target data to Anchorages also provides **weather text and graphic information to the pilots** in the Bethel area. In 2002, Alaska will complete installation of remaining ground transceivers, weather systems, and ADS-B avionics in the Bethel area, and continue to provide **ADS-B "radar-like services**. Approximately 200 commercial service airplanes and helicopters operating in the Alaska area will be equipped with the upgraded ADS-B systems. The more information regarding the programme can be found at the website http://www.alaska.faa.gov/capstone.

2.1.6.2 The United States of America informed the meeting the status of Safe Flight 21 Program. In 2001, the Safe Flight 21 program conducted an air traffic modernization forum in Memphis, Tennessee to demonstrate newly installed multilateration surveillance capabilities and the use of on-board moving map displays for monitoring surface aircraft and vehicle movement. In 2002, the multilateration system will be installed at Louisville, Kentucky, and a new automation platform for that facility to support on-going ADS-B test and evaluation efforts will be procured. The more detailed information regarding the programme can be found at the FAA's Safe Flight 21 website: http://www.faa.gov/safeflight21.

2.2 Link Selection for ADS-B

2.2.1 It was noted that ICAO had formalized two ADS-B data links with SARPs in Annex 10 (Mode S Extended Squitter and VDL mode 4), and that there was also a proposal to standardize a third data link, known as the Universal Access Transceiver (UAT). Furthermore, **it was noted that the three data links were not inter-operable.** It was further informed that decisions have been taken in Europe and North America on the selection of technology for ADS-B. It is appropriate that the Asia Pacific Region address these considerations in the immediate future.

2.2.2 In regard to the use of the Mode S extended squitter, it was noted that the aircraft ACAS II system uses a Mode S transponder and with a software change and linking of the **aircraft navigation system**, it could provide the extended squitter transmission. Manufacturers have demonstrated extended squitter software upgrades to existing Mode S transponders.

2.2.3 The meeting noted following ADS-B activities, decisions and meetings, which have contributed towards the deployment of ADS-B as a surveillance tool.

- The United States of America has formally announced that it will use 1090MHz extended squitter as the ADS-B link technology for Air Transport category aircraft;

- The United States of America had also selected UAT ADS-B link for the general aviation users;

- ICAO's Separation and Airspace Safety Panel (SASP), first Meeting of the Working Group of the Whole, agreed that an ICAO separation standard be developed for ADS-B using radar surveillance characteristics as a reference system;

- In June 2002, the Joint User Requirement Group (JURG) of Association of European Airlines and IATA concluded that 1090 MHz extended squitter ADS-B was the interoperable link;

- Airbus has indicated that it will make ADS-B out capability; using 1090 MHz extended squitter, available on all aircraft produced after early 2003. Airbus also states that retrofit kits will also be made available at that time;

- Some Boeing aircraft are already equipped with ADS-B (e.g. some British Airways B747 and B757). Boeing is expected to consider ADS-B 1090MHz extended squitter;

- squitter implementation together with other transponder changes required for Europe's enhanced surveillance and the FAA's anticipated transponder rules regarding security enhancements.

2.2.4 The upgrading of existing Mode S transponders required the implementation of a link between the navigation system and the transponder. Due to the technical simplicity, the provision of Extended Squitter from most aircraft already equipped with ACAS is expected to be inexpensive. This is totally consistent with the existing ICAO Annex 10 provisions and the development path of Mode S and ACAS.

2.2.5 One possibility is the creation of a Mode A/C transponder unit that can additionally, only squitter DF=18. If such avionics unit were produced, including a suitable GPS engine inside the same unit, then an easy transition from SSR to ADS-B could result. Standards for such GPS engines do not yet exist, and consequently there are few (if any) suitable products currently in the marketplace.

2.3 Cost/benefit analysis of ADS/B Implementation

2.3.1 The meeting noted that ADS-B offered the potential for Asia Pacific to significantly increase ATC surveillance capabilities at a low cost. It was further noted that an ADS-B ground station could be deployed for less than 15 percent of the cost of radar. Also, ADS-B supports the provision of additional information direct to the pilot such as Cockpit Display of Traffic Information (CDTI).

2.3.2 Australia stated that ADS-B would offer potential for Asia Pacific region to significantly increase ATC surveillance capabilities at a low cost. An approximation of current ATC surveillance radar coverage based upon data extracted from FASID and an indicative example of coverage that could be achieved by ADS-B were presented. It was informed that ATC coverage in excess of 250 nautical miles has already been demonstrated at an Australia's ADS-B ground station. It is estimated that an ADS-B ground station could be deployed for less than 15% of the cost of radar. An indicative cost for deployment of a high quality duplicated ADS-B ground station is between US$300,000 USD and $600,000.- each including project management and data communications feeding back to an ATC centre. Lower cost alternatives also exist. It was estimated that 33 new ADS-B ground stations with estimated cost less than US$20 M would be required for ATC coverage for South East Asia and 21 new ADS-B ground stations at cost less than US$13 M would be required for the South Pacific area. Data feeds from ADS-B could use the Eurocontrol Category 21 ASTERIX data exchange format. The benefits that could be obtained for equipped aircraft in areas of ADS-B coverage includes:

a) Improvements in safety
- Short term conflict alert;
- Danger area infringement warning;
- Cleared level adherence monitoring;
- Route adherence monitoring;
- Minimum safe altitude monitoring.

b) Improvements in FIR crossing coordination
- Improved situational awareness;
- Ability to detect coordination failures eg: mismatches between actual aircraft level and coordination level.

c) Improvements in efficiency
- Potentially the ability to use ADS-B radar like separation standards in lieu of existing procedural standards;
- Ability to detect that aircraft have "passed" and hence issuance of preferred cleared levels;
- Increase probability of states being able to offer user preferred routes.

2.3.3 Operational benefits may be made available to ADS-B equipped aircraft operating in airspace served by ADS-B ground stations. These benefits could include the following depending on the capabilities of the Air Traffic Control system:

- Provision of radar like separation services allowing decreased separation minima compared to procedural control;

- Increased likelihood of preferred levels and in some increased likelihood of preferred routes and hence decreased fuel burn and lower operating costs;

- Reduced pilot and controller workload by removal of routine position reporting and management;

- Increased safety through provision of ground based safety alert protection including short-term conflict alert, minimum safe altitude warning, danger area infringement warning, cleared level adherence monitoring and route adherence monitoring.

2.3.4 The United States of America informed that expected benefits of ADS-B includes: increased access to airspace, increased arrival and departure rates, reduced flight delays and distances flown, increased predictability of flight times and distances flown, reduced deviations from the intended route, and increased flexibility in the routes flown and increased safety. ADS-B can provide additional surveillance coverage and fill gaps in radar coverage. Successful Safe Flight 21 demonstrations, coupled with supporting analyses in the areas of business case, safety and risk will be used to determine if these applications should be made operational.

2.3.5 The meeting recognized that to realize the benefits of ADS-B, aircraft avionics need to be deployed and ground system provided. In this regard, it was noted that the users had placed utmost importance on both providers and users realizing the safety and economic benefits of implementing CNS/ATM capability, in particular existing systems. Achieving immediate benefits would gain support from users to invest in the next generation of CNS/ATM systems.

3. <u>Action by the Meeting</u>

3.1 The meeting is invited to note and review the information provided in this paper.
