ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept
1.4 The role of airborne collision avoidance systems (ACAS) technologies :

ACAS, THE LAST SAFETY NET

(Presented by Sweden)

SUMMARY

This paper summarises the roles and differences of ACAS and ADS-B, and presents the argument that a collision avoidance function must remain available in case ADS-B/ASAS functions are lost. It identifies that the Mode S extended squitter is not independent of ACAS and therefore may not be suitable for some ASAS applications that involve spacing and separation delegated to the aircrew. It notes that VDL Mode 4 is independent of ACAS and therefore is suitable for supporting ASAS.

Proposed action by the Conference is in paragraph 5.

1. INTRODUCTION

1.1 ICAO has standardized the airborne collision avoidance system (ACAS) and automatic dependent surveillance – broadcast (ADS-B).

1.2 ACAS uses protocols based on the Mode S radar system to allow aircraft to determine if there is a risk of collision between them. It provides aural warnings to pilots if a potential collision is predicted. ACAS is a “last resort” safety net that is activated only when the primary means of separation provision has failed.

1.3 ADS-B is the key enabler for airborne separation assistance systems (ASAS). Using ADS-B, ASAS initially will provide improved traffic situation awareness for aircrews and, in the longer term, enable some of the controller's responsibilities to be delegated to the aircrew. Four broad categories of ASAS applications have been identified:

a) traffic situational awareness;

b) airborne spacing;

c) airborne separation; and

d) airborne self-separation (from all traffic).

1.4 ICAO has developed Standards and Recommended Practices (SARPs) for Mode S extended squitter as an enhancement to ACAS and with possible application for ADS-B. It will enable improved performance of ACAS and will help reduce radio frequency interference caused by ACAS, which is becoming the dominant source of interference on the 1090 MHz secondary surveillance radar (SSR) channel in high-density areas. Like ACAS, Mode S extended squitter is based on the protocols of the Mode S radar system.

1.5 ICAO has also developed SARPs for VDL Mode 4, primarily as an ADS-B system. It operates in the VHF communications band and is independent of ACAS. VDL Mode 4 is complementary to the Mode S extended squitter.

2. THE DIFFERENCE BETWEEN ACAS AND ADS-B

2.1 Collision avoidance and ADS-B data are to a great extent similar, and may even be presented to aircrew on similar (or the same) displays. Therefore, some confusion may result in the differences between them and it may at first sight appear appropriate to combine their use. This would be a mistake.

2.2 ASAS is defined as an aircraft system based on airborne surveillance that provides assistance to the flight crew supporting the separation of their aircraft from other aircraft. It therefore helps aircraft to maintain the separation minima applicable in that airspace or for that manoeuvre.

2.3 The purpose of ACAS is to prevent collision, as a last resort, when the primary means of separation provision has failed. Therefore ACAS should only operate[1] in the event of failure of conventional separation equipment or procedures, or of ASAS equipment or procedures.

[1] Note. However, that the ICAO ASAS circular prepared by the SCRSP ASAS SG has identified that there may be some interaction between ACAS and ASAS conflict detection and resolution.

3. THE NEED FOR INDEPENDENCE BETWEEN ACAS AND ADS-B

3.1 The Aeronautical Mobile Communications Panel (AMCP) and the Surveillance and Conflict Resolution System Panel (SCRSP) have long recognised the need to maintain independence between ACAS and ASAS (and therefore between ACAS and ADS-B). If the systems have common failure modes, then one failure could prevent separation provision **and** collision avoidance. This would have severe safety implications and compromise safety particularly in applications where some controller responsibility has been delegated to the aircrew.

3.2 In the ICAO ASAS circular (draft) the need for ACAS and ASAS independence is identified. It is stated that *"it is essential to preserve the independence of ACAS"*. It also states that ways in which the independence might be lost include:

a) *"The use of ACAS data by aircraft surveillance and separation systems ..."*

b) *"The use by ACAS of data that are used for separation provision ..."*

3.3 In addition to sharing data between ACAS and separation provision, there are other ways that independence can be lost. One of these is in sharing the communications frequency and/or the equipment for both functions. Mode S extended squitter shares one of the ACAS communications frequency (1 090 MHz) and many aircraft will share common equipment (transponders and antennas) for both extended squitter and ACAS.

3.4 Furthermore, the most common implementation of ACAS (as the traffic collision avoidance system, TCAS) is not a redundant system. This is in contrast to systems used to provide separation, which are invariably implemented as dual (or greater) redundant systems. Given the sharing of equipment defined above, this is a further practical issue associated with the use of Mode S extended squitter for ASAS.

3.5 For the above reasons, reliance on the Mode S extended squitter for ADS-B may limit or prevent some types of ASAS applications. In particular, spacing and separation applications (paragraphs 1.3 b) to d) above refer), which involve delegation from the controller to the aircrew, may not be possible.

3.6 VDL Mode 4 is completely independent of ACAS and does not share communications frequencies or equipment. This enables separation assistance to be kept totally independent from collision avoidance systems.

4. SUMMARY

4.1 This paper has summarised the roles and differences of ACAS and ADS-B, noting that ACAS provides a collision avoidance function that must remain independently available in case separation assurance is lost.

4.2 It has identified that use of Mode S extended squitter is not independent of ACAS and therefore may not be suitable for some ASAS applications that involve spacing and separation delegated to the aircrew. It has also noted that VDL Mode 4 is independent of ACAS and therefore is suitable for supporting ASAS.

5. ACTION BY THE CONFERENCE

5.1 The Conference is invited to:

a) note the information provided in this paper;

b) agree that ACAS shall be kept as a last resort safety-net, a collision avoidance system that will warn pilots in emergency situations when other normal provisions have failed;

c) agree that ADS-B may be used for ASAS applications during normal operations, subject to the finalisation of these applications;

d) recognise that availability of ADS-B data on cockpit displays will increase the pilot situational awareness, thus improving the surveillance function in a way that is expected to reduce the probability that collision avoidance systems will be activated;

e) agree that ICAO provisions for ACAS, including the Mode S extended squitter, should retain independence from ADS-B so as not to compromise the safety-net function of the collision avoidance system; and

f) note that the VDL Mode 4 system for ADS-B is independent of ACAS.

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