



WORKING PAPER

TWELFTH AIR NAVIGATION CONFERENCE

Agenda Item 4: Optimum capacity and efficiency – through global collaborative ATM

4.1: Efficient management of airspace and improved flow performance through collaborative decision-making (CDM)

**COMPATIBILITY OF SAFETY NETS – OPPORTUNITIES FOR
REDUCING INCOMPATIBILITIES**

(Presented by the Presidency of the European Union on behalf of the European Union and its Member States¹; by the other Member States of the European Civil Aviation Conference²; and by the Member States of EUROCONTROL)

EXECUTIVE SUMMARY

This paper summarizes the role of short-term conflict alert (STCA) and airborne collision avoidance system (ACAS) in conflict management. Causes and possible consequences of incompatibilities are summarised and possible mitigations are identified in the following areas: harmonization of STCA; improvement of ACAS operations; display of ACAS RAs to controllers; and coordinated development of future STCA and ACAS.

Action: The Conference is invited to agree to the recommendation in paragraph 4.

1. INTRODUCTION

1.1 The ICAO *Global Air Traffic Management Operational Concept* (Doc 9854) defines three layers of conflict management: strategic conflict management; separation provision; and collision avoidance. Collision avoidance must activate when separation provision is compromised.

1.2 Dependent on airspace classification and flight rules, an air traffic control (ATC) unit provides various services. In the case of an imminent risk of collision the controller may issue avoiding instructions using phraseology that conveys the urgency of the situation. The controller may also provide traffic information. Annex 11 — *Air Traffic Services* recommends that the controller is assisted by short-term conflict alert (STCA) that generates an alert of a potential or actual infringement of separation minima but does not provide resolution advice.

¹ Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. All these 27 States are also Members of ECAC.

² Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Iceland, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

1.3 Collision avoidance advice on the aircraft is provided by the airborne collision avoidance system (ACAS). ACAS is an aircraft system based on secondary surveillance radar (SSR) transponder signals. It operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders. Annex 6 — *Operation of Aircraft* mandates equipage with ACAS II that provides vertical resolution advisories (RAs) in addition to traffic advisories (TAs).

1.4 The occurrence of an RA fundamentally changes the pilot and controller tasks for controlled flights: without an RA the controller is required to ensure separation and the pilot is required to follow ATC clearances and instructions. With the advent of an RA, the pilot is required to follow the RA and disregard any ATC clearances or instructions. The controller no longer is required to issue instructions to the affected aircraft until the pilot reports “Clear of Conflict”.

1.5 However, controllers can only become aware of an RA if they are informed in a timely manner by the pilot, which is often not the case. The related provisions in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), 15.7.3) regarding responsibilities are ambiguous. For example, the responsibilities in case of no pilot report and non-compliance with the RA are unclear. Also, no clear criteria exist to determine if and when other aircraft are affected.

2. CAUSES AND POSSIBLE CONSEQUENCES OF INCOMPATIBILITIES

2.1 STCA and ACAS are often referred to as safety nets: their presence is not intended, nor explicitly permitted, to change normal procedures (the related procedures are in the PANS-ATM under the heading “other ATC contingency procedures”). Both operate independently as far as practicable to provide redundancy.

2.2 Studies in Europe indicate that the desired behaviour could for an STCA alert at least 30 seconds before an ACAS RA. However, STCA can sometimes trigger significantly later (possibly even after the RA), providing insufficient warning time particularly in the case of sudden, unexpected manoeuvres.

2.3 STCA has limited knowledge, and ACAS none, of controller and pilot intentions and actions. Hence, when an imminent or already initiated manoeuvre will leave separation provision uncompromised, STCA and/or ACAS may trigger.

2.4 Generally, unwanted safety net alerts are disruptive, and excessive numbers of them lead to desensitized controllers and pilots. This can and sometimes does lead to delayed response to STCA alerts and to RAs not being followed, which have been contributing factors in serious incidents and accidents.

2.5 Specifically, a late STCA alert can instigate a controller instruction that interacts with ACAS by indirectly causing an RA or having impact on the pilot response to an RA.

3. POSSIBLE MITIGATIONS

3.1 The risks associated with incompatibility can be mitigated in several ways. Studies and experience in Europe show the benefits of the possible mitigations introduced in the following paragraphs.

Harmonization of STCA

3.2 STCA has not been standardized at international level, amongst other reasons because STCA must be optimized for the local operational environment. Surveys have indicated that this is a challenging task that often leads to sub-optimal performance.

3.3 A number of major accidents and incidents in the early 2000s gave new impetus to already ongoing harmonization work in Europe. A EUROCONTROL Safety nets Performance Improvement Network (SPIN) working arrangement was created, whereby experience is shared and best practices are promoted. The group has published ground-based safety nets specifications and comprehensive guidance material.

3.4 Publication of such material in an ICAO Manual for Ground-based Safety Nets would provide a recognized basis that would give further impetus to the harmonization process, both in Europe and the rest of the world. Harmonization of STCA helps to make the overall system-of-systems behaviour more predictable.

Improvement of ACAS operations

3.5 Post-operational monitoring ACAS performance in the ATC environment assists in identifying opportunities to reduce the effect on ATC by adjusting airspace design and procedures. Such strategic de-confliction measures also reduce the workload of controllers and pilots.

3.6 Furthermore, both ICAO and the Single European Sky ATM Research (SESAR) Programme have worked on reducing the frequency of RAs caused by high vertical rates shortly before levelling off. One option under study in SESAR is to automate the vertical speed reduction that is already recommended in Annex 6 before the conditions for an RA are reached.

3.7 More generally, European and worldwide experience and research results should be expeditiously incorporated in ICAO documentation for the improvement of ACAS operations.

Display of ACAS RAs to controllers

3.8 ACAS RA information has always been available for downlink via an aircraft's Mode S transponder. Until recently this information has mainly been used for monitoring purposes.

3.9 Display of RAs to controllers has been subject of research since the 1990s. But more recently, enabled by the deployment of Mode S radars, an increasing number of early adopters have started to display RAs to controllers. This creates a sense of urgency to now resolve the remaining open issues.

3.10 In particular, the ICAO provisions referred to in paragraph 1.5 of this paper do not recognize that the controller could become aware of an RA through the display. Hence, these provisions should be reviewed in order to remove the ambiguity and to take into account that RAs could be displayed to controllers.

Coordinated development of future STCA and ACAS

3.11 New concepts, reduced separation standards and significant traffic increases will put new constraints on STCA and ACAS. Moreover both must perform effectively in the most demanding environment, i.e. a performance level that is not achieved today.

3.12 STCA and ACAS were developed independently by different organizations. More importantly, whilst ACAS was and is subject to rigorous standardization and certification, STCA is not. As a result the combined behaviour of STCA and ACAS is not sufficiently predictable and not well understood.

3.13 A coordinated further development of STCA and ACAS and of future safety nets in general can provide synergies and avoid duplication of effort in the quest for safety nets that are fit for purpose in the future environment of operations.

4. ACTION BY THE CONFERENCE

4.1 The Conference is invited to:

- a) request ICAO to develop an ICAO Manual for Ground-based Safety Nets;
- b) request ICAO to review the provisions related to ground-based and airborne safety nets in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), in particular taking into account that ACAS RAs could be displayed to controllers; and
- c) request ICAO to adopt a more holistic and coordinated approach towards developing Standards and Recommended Practices (SARPs) for future ground-based and airborne safety nets.

— END —