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Operational Use of ASAS

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Background

ASAS means Airborne Separation Assurance System. The ASAS Concept was proposed by CENA in 1995 as a new and more optimistic way to address the task given to SICASP (SSR Improvements and Collision Avoidance System Panel) by ICAO on ‘Other uses of ACAS’ (see attachment).

Briefly, the ASAS Concept wants to take advantage of new technologies on board aircraft like ADS−B and Air−to−Air datalink to improve the capacity and the efficiency of ATC. The general idea is to transfer the responsibility of maintaining separation between two aircraft from the ground to the airborne side when feasible.

The ASAS concept is compatible with the existing ATM and can be introduced gradually through the definition of ASAS applications. To permit identification and assessment of the implication of a new ASAS application several generic areas need to be addressed like : operational purpose, type of airspace, benefits and constraints, safety rationale, technical requirements, pilot and controller interfaces and operational procedures. The issue of separation responsibility between the pilot and the controller during a ASAS procedure is a major issue and shall be correctly addressed.

In studying ASAS applications, a key point is to maintain the independence of ACAS. The collision avoidance function provided by ACAS shall be preserved.

An operational use of ASAS : the ASAS Crossing Procedure

The ASAS Crossing Procedure (ACP) is an example to highlight how an ASAS application could be operationally used.

In a first stage, ACP enables the pilot to assure himself his separation from another traffic in specific conditions. This procedure would be very similar to visual separation clearance currently performed in France. The main difference is that this procedure could be applied under Instrument Meteorological Conditions (IMC).

The benefits expected from this procedure are the following :

− on the ground side : the responsibility of maintaining separation is transferred to the pilot so the controller workload is reduced ;

− on the airborne side : in a lot of cases the pilot is not obliged to modify his flight path. Nevertheless, when a correction is necessary to maintain the airborne standard separation, the deviation is limited

and the manoeuvre adapted to the current flight profile.
To demonstrate ACP, a simple scenario is use : a crossing traffic situation at 90 degrees. Own aircraft which is ASAS equipped is climbing or descending. The conflicting traffic is level. This scenario occurs daily at Charles de Gaulle airport between arriving and departing aircraft.

This ASAS application is based on a **temporary** delegation of responsibility from the controller to the pilot. This delegation is made on a common agreement between the controller and the pilot, for the object of the contract i.e. the crossing, and for its duration as well. This contract is accompanied with an after ASAS clearance to permit the normal IFR continuation of the flight, and to resume navigation if necessary.

A typical ACP sequence could be :

- the controller gives the Own aircraft an initial climb or descend flight level clearance (1000 feet apart from the traffic) and traffic information about the conflicting aircraft ;
- the pilot acknowledges the clearance and says ‘full ASAS contact on conflicting traffic’. This means that the ASAS is working properly and that the pilot has positively identified the conflicting traffic with his ASAS interface ;
- the controller asks the pilot : ‘Do you agree with an ACP with the conflicting traffic ?’
- If the pilot agrees, the controller then gives the ACP clearance which includes next way point and/orcleared flight level ;
- when the ACP is performed, the pilot reports to the controller and the responsibility of maintaining separation with other IFR traffics is given back to the controller.

If for any reasons the pilot is unable to maintain his airborne standard separation, he should report to the controller e.g. ‘ASAS failure − unable to pursue ACP’. When possible, the controller would give an alternative clearance to recover IFR standard separation.

If it is too late to maintain or re−establish IFR standard separation, the ACAS equipment should provide anticollision advisories if necessary. That means that the ACP should not permit the aircraft to get so close that it would trigger an ACAS Resolution Advisory (RA) under nominal conditions.

Dependability studies should be conducted to be sure that the contingency procedure described above will be used very seldom.

SLIDES

Operational Use of ASAS

SICASP/6−WP/44

Appendix A to the Report on Agenda Item 6 6A−3

APPENDIX A

THE ASAS CONCEPT

1. Introduction

1.1 The airborne separation assurance system (ASAS) concept was developed to harness the operational potential of airborne surveillance and to ensure that the ACAS collision avoidance function is not adversely affected.

2. ASAS concept

2.1 Dependent on different classes of airspace, the air traffic control (ATC) normally has the responsibility for the provision of separation between aircraft receiving an instrument flight rules (IFR) or visual flight rules (VFR) service. This is achieved either by means of procedural separation or by radar−based surveillance. If, in certain circumstances, separation monitoring or separation provision could be performed more efficiently by means, for example, of a cockpit display of traffic information (CDTI) interpreted by the flight crew, then an opportunity exists for potential capacity improvements and more efficient use of the available airspace resource, without increasing controller workload. Exploitation of airborne surveillance capability could present an opportunity to design airborne separation procedures which offer potential efficiency improvements to ATC and more optimum flight profiles to aircraft, particularly in areas where there is no radar coverage.

2.1.1 ASAS could provide a CDTI for interpretation by the flight crew and other relevant aircraft state data provided by other aircraft within surveillance range. The ASAS data provision would require to be of sufficient integrity to permit, where appropriate, the transfer of the responsibility for aircraft separation from ATC to the flight crew. An ASAS CDTI would also improve the situational awareness of the flight crew.

2.1.2 It is recognized that, where potential ASAS benefits can be demonstrated, changes to the air traffic management (ATM) system to realize the potential would need to be incremental in nature. This would permit a controlled transition to a future air navigation systems (FANS) ATM system which incorporates co−operative ASAS.

Note.— In the context of this document, an ASAS application refers to a specific operational use of an ASAS (e.g. station keeping).

3. Airborne surveillance and communications

3.1 One system which employs airborne surveillance is ACAS. The purpose of ACAS is a last resort safety system to avoid mid−air collisions or near−collisions. The traffic alert and collision avoidance system (TCAS) II, which will conform to ACAS II SARPs, is being introduced globally. In addition to the collision avoidance function resolution advisory (RA) display, TCAS II implementations provide the flight crew with a cockpit display of proximate traffic which aids visual acquisition and improves situational awareness. The effectiveness of that traffic display for other uses, for example, as an ASAS CDTI, is to a large extent limited by the TCAS II surveillance performance, which has not been designed for use other than by the collision avoidance function and which is also constrained by the need to limit secondary surveillance radar (SSR) interference. However, two other areas where airborne surveillance developments could provide the means to achieve a viable ASAS are:

> a) the development of automatic dependent surveillance broadcast (ADS−B) techniques. This is expected to provide high integrity, regularly broadcast, and aircraft position data; and
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> b) the use of broadcast data via Mode S extended squitter to enhance the capabilities of the traffic display that is normally fitted with ACAS. In this case, the ACAS hybrid surveillance concept ensures that ACAS continues to provide collision avoidance protection that is independent of ASAS.

3.2 In both these cases, additional aircraft state data which could be required for an ASAS application could be acquired via an appropriate air−air data link, for example, the ACAS crosslink. The data required for ASAS applications need not be restricted to surveillance data nor to the data conveyed by any broadcast technique.

4. ASAS ATM applicability

4.1 ASAS has the potential to offer significant benefits in all classifications of airspace. ASAS would permit the flight crew to acquire the other relevant aircraft in the airspace, and it could enable responsibility for separation during the ASAS application to be transferred from ATC to the pilot. It is reasonable to assume that, for an ASAS application to provide improved efficiency or capacity, the authorized separation would be either less than that applied by the current ATC procedure, or would permit the traffic to achieve the current authorized standard separation minima more often. Reduced separation minima could also provide optimum flight profiles to an increased percentage of aircraft.

4.1.1 The United States Federal Aviation Administration (FAA) trial In−Trail−Climb (ITC) procedure is an example of a potential ASAS application relevant, in particular, to areas where radar coverage is not available. The FAA, in response to the need for improved ATM efficiency in Pacific oceanic airspace and perceived potential economic benefit to aircraft operators, is undertaking an ITC operational trial in the Oakland and Anchorage FIRs. This procedure utilizes pilot interpretation of TCAS II traffic display range information. In this trial, the provision of separation between the aircraft taking part in the procedure remains the responsibility of the controller.

4.1.2 ASAS applications in airspace where there is radar coverage could also provide significant operational benefit. An example of such an ASAS application which could provide significant operational dividend is the Paired Approach concept. This concept envisions the maintenance, through surveillance based on received ADS−B aircraft position data, of a dual runway approach capability to airports with closely spaced parallel runways that, during weather conditions of low ceiling and poor visibility, would otherwise revert to a single runway approach capability due to ATC separation requirements. The goal is to develop a paired approach procedure that increases arrival capacity in low ceiling and poor visibility weather conditions, and also improves the level of safety over that associated with the closely spaced visual approaches in use today.

4.1.3 Therefore, it is probable that proposed ASAS applications will require surveillance performance levels in excess of that currently provided by ACAS. The requirement will include high integrity aircraft position data, intent and other selected data to be received via an appropriate air−to−air data link. This data could be displayed either by stand−alone surveillance traffic displays of received ADS−B aircraft position data or by traffic displays that show extended squitter data which are shared with ACAS.

5. ASAS standardization considerations

5.1 ASAS will be a safety critical system. Therefore, it is essential to address criticality issues including system integrity and redundancy. The level of system performance and integrity to provide separation assurance will be more demanding than those for ACAS.

5.2 To maintain the safety benefit provided by ACAS, it is essential to ensure that ASAS does not adversely affect the integrity of the ACAS collision avoidance function. Any reduction in independence would introduce common points of failure between ASAS and ACAS which would result in a reduced over−all level of safety compared with independent functionality. Specifically, if ACAS becomes linked with the separation assurance function, there is a danger that an error in any common element leading to a loss of separation would also lead to an ACAS failure. An obvious example would be the use of ADS−B positional information for both ASAS and ACAS: if that data were in error, then the same error would be propagated through both systems. It is important that an ASAS should not be viewed as an "improved ACAS", even if ASAS equipment shares extended squitter data and a traffic display with ACAS.

5.3 Examination of a specific, representative, use of ASAS, applied to a template, will provide the means to develop a manual and to progress standardization of ASAS. This will also provide guidance to those who propose uses of ASAS.

6. Development of ASAS Manual and SARPs − Template framework

6.1 To permit identification and assessment of the implications of each proposed ASAS application, the proposal should address several generic areas:

a) definition of the ASAS application. The application proposal should contain a clear, accurately expressed statement which covers:

1) the operational purpose of the application;

2) the type of airspace for which it is proposed, for example, for en−route, terminal or oceanic airspace;

3) the applicability to instrument flight rules (IFR) and visual flight rules (VFR);

4) the applicability to a radar or non−radar environment; and

5) the required aircraft separation minima;

b) application benefits and constraints. The benefits expected to be achieved from the ASAS procedure should be listed. Similarly, the anticipated constraints should be exposed. For example, the application might be expected to increase ATM capacity and provide improved economic returns for an operator, but a constraining factor might be that all aircraft in the sector would require to be ASAS−equipped before the procedure could be applied;

c) safety rationale. An initial safety assessment, which also addresses issues of criticality, should be provided. At this stage, this needs to be done at a high level, but it should demonstrate an acceptable intrinsic safety level of the application without the need for ACAS (a comprehensive safety analysis of the application would be undertaken at a later stage in the standardization process);

d) requirements for surveillance and aircraft state data. The proposal should contain an assessment of the minimum surveillance and aircraft state data requirements necessary for the proposed application;

e) requirements for data link. The proposal should include assessment of the air−to−air and air−to−ground data link requirements;

f) requirements for the pilot interface. The proposal should identify the pilot interface requirements needed for the application. This should include an assessment of the following related areas:

- human factor aspects;
- display requirements, for example, the minimum acceptable size and resolution of the cockpit display;
- aural indications, for example, enunciation and aural "attention getters"; and
- failure and mode selection indicators, for example, mode or failure visual indicator "flags" and aural "attention getter";

g) requirements for ATC interface. The proposal should assess the ATC and other potential ground interface requirements. For example, the requirement for the airborne surveillance data to be downlinked to ATC, and conversely, ATC data uplinked to the ASAS pilot interface. Human factor aspects should be addressed; and

h) operational procedures. The proposal should provide information on the proposed operational procedures including:

1) a description of the pilot and controller actions and responsibilities when initiating, authorizing and terminating the procedure;
2) the proposed ASAS separation between aircraft which is to be applied by the pilot during the execution of the procedure;
3) an indication of proposed new, or new usage of current, radiotelephony (RTF) phraseology;
4) the limiting factors which could affect the application of the procedure, for example, type of airspace, equipment requirements for other aircraft in the airspace, flight crew consent requirements (can the procedure be imposed by ATC?), flight conditions, etc;
5) if appropriate, the controller's responsibility to maintain a monitoring function; and
6) the proposed contingency procedures. ASAS will be a co−operative system, which will rely on information provided by other aircraft. In the event of received corrupted data or ASAS failure which causes an inability to maintain the ASAS procedure, contingency procedures must permit the effective and safe re−application of standard separation by the controller.

7. Responsibility for aircraft separation

7.1 The SICAS Panel, in consultation with other ICAO panels, will develop a generic policy recommendation which addresses the issue of separation responsibility during an ASAS procedure.

8. Summary

8.1 The SICAS Panel has both technical and extensive operational expertise in the use of airborne surveillance technology. It has developed the ASAS concept. This will seek to achieve improvements to ATC efficiency and airspace capacity by exploiting the operational potential of airborne surveillance and relevant CNS technologies. An appropriate methodology has been defined for the development of SARPs for ASAS, which will take account of the operational and technical issues, including the need to address ASAS criticality, compatibility of ASAS with ACAS, whilst at the same time maintaining the independence of ACAS from ASAS.