CARE/ASAS Action

Information from ANC/11 related to ADS-B, ASAS and ACAS

1. Introduction

This note is an overview of the papers related to ADS-B, ASAS and ACAS that were presented at the ICAO Eleventh Air Navigation Conference (ANC/11) in Montreal, 22 September to 3 October 2003. Associated recommendations are also introduced.

The Requirement Focus Group (RFG), which is a joint activity between EUROCONTROL, FAA, EUROCAE and RTCA has the objective to develop coordinated requirements for Ground Surveillance and Airborne Surveillance applications enabled by ADS-B. During its third plenary meeting (RFG/3) in Washington on 3&4 December 2003, Francis Casaux got the action to review the ANC/11 report and to extract useful information related to ADS-B and ASAS. This note is the result of this action.

The action has been extended to include also ACAS which in several areas has an impact on ADS-B and ASAS.

This note does not replace the ANC/11 report which is the only official reference nevertheless it has the objective to help the community working on ADS-B, ASAS and ACAS to better understand the way forward as decided by ANC/11.

2. Background on ANC/11

The ANC/11 was structured with seven items:

- Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept
- Agenda Item 2: Safety and security in air traffic management (ATM)
- Agenda Item 3: Air traffic management (ATM) performance targets for safety, efficiency and regularity and the role of required total system performance (RTSP) in this respect
- Agenda Item 4: Capacity-enhancement measures
- Agenda Item 6: Aeronautical navigation issues
- Agenda Item 7: Aeronautical air-ground and air-to-air communications

More than 200 papers were presented and discussed.
The meeting elaborated more than sixty recommendations:

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The following sections are trying for each agenda item to identify the Working Papers (WPs) and the Information Papers (IPs) which are of particular interest for the ADS-B, ASAS and ACAS community. Only recommendations related to ADS-B, ASAS and ACAS are reproduced.

Text coming from ANC/11 report is in italic characters.

The author has selected a few important sentences from the ANC/11 report based on his expertise. There is nevertheless the risk that some important points may be left out. Only a careful reading to the ANC/11 report can provide the full picture.

### 3. ANC/11 opening remarks

See AN-Conf/11-WP/206 for full details.

#### 3.1. President of the Council, Dr. Assad Kotaite

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‘In the past, technological developments were driving operations. We must now shift our approach towards operational needs driving technological developments. Eventually, we must aim for a more symbiotic relationship between the two streams — technology and operations — so that we make optimum use of human and financial resources in developing an operationally sound and productive air navigation system for the 21st century.’

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‘In light of the events of 11 September 2001, we must also address security. We need to understand the vulnerabilities of air traffic management and of communications, navigation and surveillance infrastructure and to identify practical measures to eradicate or lessen their impact. Indeed, while we forge ahead in the design of our global air navigation system of the future, the fundamentals of both safety and security must be our central focus.’

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#### 3.2. President of the Air Navigation Commission, Mr. D. Galibert

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‘New separation minima and sharing of responsibility between pilots and controllers for some ATM services will also require careful safety studies and new methods for assessing and ensuring that acceptable and agreed to safety levels can be met.’

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4. Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept

See AN-Conf/11-WP/190 for full details.

4.1. Papers related to ASAS and ADS-B

4.1.1. Item 1.1: The global ATM operational concept

- WP4 - Secretariat - The global ATM Operational Concept - WP4 was developed by ATMCP (Air Traffic Management Operational Concept Panel)
- WP49 - IATA - IATA position on the global air traffic management (ATM) operational concept and the need for an ATM global implementation roadmap
- WP93 - IFATCA - Conflict management
- WP133 - Japan - Japan’s view on the global air traffic management operational concept

4.1.2. Item 1.2: Enabling concepts in support of the global ATM operational concept

- WP6 - Secretariat - Automatic dependent surveillance – broadcast Concept of Use – WP6 was develop by OPLINKP (Operational Data Link Panel)
- WP41 - United States - Initial automatic dependent surveillance – broadcast (ADS-B) applications for global interoperability – This paper recommends that ICAO a) accept the Package I of ADS-B applications, applications, as being defined and validated by joint United States/European activities, to be used as the basis for ICAO activities to define the operational provisions for an initial global set of ADS-B applications; and b) accept the forthcoming joint RTCA and EUROCAE technical standards for the Package I ADS-B applications as the basis for the development of ICAO Standards and Recommended Practices (SARP) and guidance material.
- WP64 - Secretariat - Airborne separation assistance system (ASAS)
- WP66 - United States - United States endorsement of the automatic dependent surveillance - broadcast (ADS-B) Concept of Use
- WP68 - Sweden - Delegation of separation, benefits and required changes
- WP86 - Eurocontrol - Initial ground surveillance and airborne surveillance applications enabled by ADS-B. WP86 invites the conference to: a) endorse the content of Package 1, set of applications to be used for initial implementation using ADS-B; and b) recognize the need to implement Package 1, as part of the proposed roadmap of ADS-B application packages, to meet the future air traffic management requirements in terms of capacity, safety and efficiency.
- WP127 - Australia - Automatic dependent surveillance-broadcast (ADS-B) for air-to-ground surveillance
- WP128 - Australia Asia/Pacific regional strategies for ADS-B implementation
- WP148 – IATA - IATA position on the implementation of ADS-B
- WP171 - Mongolia - Automatic dependent surveillance in Mongolia
- IP5 - Secretariat - Circular on airborne separation assistance system (ASAS). IP5 was developed by SCRSP (Surveillance and Conflict Resolution System Panel).
- IP28 - United States - Safe Flight 21: Alaska Capstone and the Ohio River Valley
- IP62 - Italy - ASAS pre-operational trials in Europe: The “Mediterranean free flight” programme
4.1.3. Item 1.3: The need for a global air navigation plan

No specific WP or IP was identified.

4.1.4. Item 1.4: The role of airborne collision avoidance systems (ACAS) technologies

- WP31 - Secretariat - Airborne collision avoidance system II (ACAS II)
- WP34 – Secretariat - The role of collision avoidance in future ATM systems
- WP69 - Sweden - ACAS, the last safety net
- WP77 - France - Compatibility between ACAS and the air traffic control system
- WP87 - Eurocontrol - The European experience in the implementation of ACAS II
- WP111 - Russian Federation - Controller/pilot interaction in solving the problem of conflict resolution
- WP130 - Colombia - Airborne collision avoidance system (ACAS) effectiveness
- WP140 - IFALPA ACAS improvements — Downlink of RAs
- WP150 - African States - Implementation of airborne collision avoidance system II (ACAS II) in the Africa-Indian Ocean (AFI) region
- IP7 - Secretariat Historical and future role of the airborne collision avoidance system (ACAS)
- IP15 - France - Experimentations conducted by France involving gliders equipped with transponders in the vicinity of one ACAS-equipped aircraft
- IP45 - China - China’s policies on and implementation of ACAS II

4.2. Recommendations related to ADS-B, ASAS and ACAS

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Recommendation 1/1 — Endorsement of the global ATM operational concept

That:

a) ICAO, States and planning and implementation regional groups (PIRGs), consider the global ATM operational concept as the common global framework to guide planning for implementation of ATM systems and to focus all ATM development work;
b) the global ATM operational concept be used as guidance for development of ICAO CNS/ATM related provisions;
c) States with the support of the other members of the ATM community undertake work to validate the seven components in the global ATM operational concept;
d) ICAO, States and PIRGs develop transition strategies for implementation of ATM systems based on the global ATM operational concept; and
e) ICAO align its technical work programme to facilitate future work related to the global ATM operational concept.

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Recommendation 1/6 — Endorsement of the automatic dependent surveillance-broadcast (ADS-B) concept of use and recommendations for further work

That ICAO:

a) follow research and development work in the area of ADS-B applications, and update/maintain the ADS-B concept of use as necessary;
b) work cooperatively with other international bodies to ensure that the ADS-B concept of use is properly aligned with existing operational and technical documents;
c) utilize the ADS-B concept of use, in its current form and as it matures, as a basis for development of SARPs and guidance material for air-to-air and air-to-ground surveillance applications; and

d) ensure that all future work on the ADS-B concept of use is aligned with the ATM operational concept and meets the emerging ATM requirements that emanate therefrom.

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**Recommendation 1/7 — Ground and airborne automatic dependent surveillance-broadcast (ADS-B) applications for global interoperability**

That ICAO and States:

a) recognize ADS-B as an enabler of the global ATM operational concept bringing substantial safety and capacity benefits;

b) support the cost-effective early implementation of packages of ground and airborne ADS-B applications, noting the early achievable benefits from new ATM applications; and

c) ensure that implementation of ADS-B is harmonized, compatible and interoperable with respect to operational procedures, supporting data link and ATM applications.

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**Airborne separation assistance system (ASAS)**

1.2.2.15 An update of progress achieved by the Surveillance and Conflict Resolution Systems Panel (SCRSP) with development of an airborne separation assistance system (ASAS) was presented. It was noted that ASAS had been defined by SCRSP as an aircraft system based on airborne surveillance that provided assistance to the flight crew supporting the separation of their aircraft from other aircraft. It was further noted that ASAS might support a part of the conflict management and traffic synchronization functions of the operational concept.

1.2.2.16 It was noted that a range of ASAS applications had been envisaged which encompassed increasing flight crews’ situational awareness related to traffic, and assisting the flight crews in maintaining separation from other aircraft. The meeting was made aware that ASAS applications would require a surveillance capability, based largely on ADS-B and traffic information service - broadcast (TIS-B).

1.2.2.17 Four categories of candidate ASAS applications had been identified by the SCRSP as traffic situational awareness applications; airborne spacing applications; airborne separation applications; and airborne self-separation applications.

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**Recommendation 1/15 — Implementation of airborne collision avoidance system (ACAS) provisions**

That States take immediate action to implement, in appropriate national documentation, the ACAS provisions contained in Amendment 28 to ICAO Annex 6 — Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes, and in Amendment 12 to the Procedures for Air Navigation Services — Operations (PANS-OPS, Doc 8168), Volume I.

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1.2.4.5 During the discussions, the meeting was reminded of the roles of ACAS and ADS-B and the differences between them, noting that ACAS provided a collision avoidance function that must remain independently available in case separation assurance was lost. It was further agreed that:

a) ACAS should be kept as a last resort, collision avoidance safety-net;

b) the availability of ADS-B data on cockpit displays would 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; and

c) ICAO provisions should ensure that ACAS retains independence so as not to compromise the safety-net function of the collision avoidance system;

1.2.4.6 In the context of the above, the meeting agreed that it was important that collision avoidance remain independent from separation provision and that in the selection of surveillance
technologies, the consequences of the selection of collision avoidance systems should be taken into account through appropriate safety assessments.

1.2.4.7 The meeting discussed the possibility of making available to the air traffic controller, a display of the “aircraft RA status” as it was considered that this might enhance the awareness of ground personnel that aircraft under their control may deviate from a cleared flight profile in response to an ACAS command. Several technical considerations were noted in this respect. During the discussions it was noted that there may be significant human factors considerations involved with implementation of such technology and these should be thoroughly investigated and taken into account prior to a decision as to whether or not to implement.

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Recommendation 1/16 — Provisions related to airborne collision avoidance systems (ACAS)

That ICAO review current provisions and investigate the need to develop new provisions to enhance the effectiveness of ACAS as follows:

a) provisions in Annex 6, Part II concerning training of general aviation pilots in the operation of ACAS;

b) provisions in Annex 10, Volume IV concerning performance of the ACAS II collision avoidance logic;

c) provisions concerning the training of air traffic control personnel;

d) the registering by the parametric flight recorder of resolution advisory commands; and

e) air traffic control provisions in ICAO Annexes 2 and 11 and the PANS-ATM.

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1.2.4.14 The meeting was presented with a paper which was prepared as additional supporting material to assist in the discussions on the role of collision avoidance in the future ATM system. It was recalled that the role of collision avoidance as defined in the operational concept was described under the concept component of conflict management, wherein three layers of conflict management were defined. These were: strategic conflict management, separation provision and collision avoidance and were stated in the operational concept as follows:

"Collision avoidance is the third layer of conflict management, and must activate when the separation mode has been compromised. Collision avoidance is not part of separation provision, and collision avoidance systems are not included in determining the calculated level of safety required for separation provision. Collision avoidance systems will, however, be considered part of the ATM safety management. The collision avoidance functions and the applicable separation mode, although independent, must be compatible."

1.2.4.15 The meeting was made aware that in the context of the above, collision avoidance was seen as the last layer of conflict management and was activated in order to avoid disaster. It was stressed that separation provision and collision avoidance were not the same, that there was a functional difference and that the operational concept definition of a third layer was deliberate.

1.2.4.16 Most importantly, the meeting agreed with the notion that collision avoidance systems should be considered part of overall ATM safety management. However, it was further recognized that in line with today’s understanding, collision avoidance systems should not be mixed with separation provision, nor be included in determining the calculated level of safety required for separation provision.

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5. Agenda Item 2: Safety and security in air traffic management (ATM)

See AN-Conf/11-WP/197 for full details.

5.1. Papers related to ASAS and ADS-B

- WP45 - IFATCA - The human in future air traffic control (ATS) systems
- WP73 - Sweden - Increased safety and security by knowledge of position and intent
- WP109 - Interstate Aviation Committee - On the use of airborne collision avoidance system
- WP112 - Russian Federation - The role of human factors in ensuring air traffic safety

5.2. Recommendations related to ADS-B, ASAS and ACAS

2.2.9 It was noted that a “system”, under this concept, was composed of people, procedures, technologies and information interacting to perform a task. ....

Recommendation 2/1 — A framework for system safety

That ICAO investigate appropriate mechanisms for the development and implementation of a framework for a uniform and system-wide approach to safety, and the application of this framework to:

a) the harmonization of provisions relating to safety assessment and safety management in relevant Annexes and Procedures for Air Navigation Services (PANS); and

b) the harmonization of the approaches to safety assessment in the development of safety-related standards and recommended practices (SARPs).

2.2.42 The meeting also discussed a broad range of issues related to other aspects of human factors and their importance in the achievement of safety, and agreed that human factors was an important issue in the establishment of effective ATM safety management systems.

2.2.43 The discussions identified a range of human factors considerations, in addition to the issues of organizational culture addressed earlier, which could affect the safety of an ATM system. These included, inter alia, the interaction of human operators with automated systems, interface design, workplace issues such as lighting, temperature and noise levels, and the provision of adequate rest facilities. The meeting noted that ICAO guidance was available in Human Factors Guidelines for Air Traffic Management (ATM) Systems (Doc 9758), and that considerable emphasis had also been placed on human factors considerations in the draft Manual on Safety Management for Air Traffic Services.

2.2.44 The meeting noted that in the development of some of the options proposed in the ATM operational concept, there would be a need to clearly identify the proper allocation of tasks between air traffic controllers, pilots and automated systems.

2.2.45 The meeting recognized that there would be a need to address issues of responsibility and liability, for example, in situations where a controller would not be able to intervene if pilots or automated systems were not able to maintain separation.

6. Agenda Item 3: Air traffic management (ATM) performance targets for safety, efficiency and regularity and the role of required total system performance (RTSP) in this respect

See AN-Conf/11-WP/203 for full details.
6.1. Papers related to ASAS and ADS-B

WP8 - Secretariat - The concept of required total system performance (RTSP)

6.2. Recommendations related to ADS-B, ASAS and ACAS

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3.3.1 The meeting reviewed the results of the work of the Air Traffic Management Operational Concept Panel (ATMCP) to date on the subject of performance and required total system performance (RTSP). The panel had identified air traffic management performance, including the notion of RTSP, as a key aspect of the ATM operational concept and had therefore decided to introduce RTSP in the operational concept. The purpose of the discussion was to clarify and develop the next steps of RTSP development on the basis of the initial arguments related to the feasibility of RTSP as a method to measure performance of the ATM system.

3.3.2 It was pointed out that the performance work undertaken by the ATMCP was only of an initial nature, and that further substantial work remained, in order to have the subject of ATM performance covered at the desired level of clarity.

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7. Agenda Item 4: Capacity-enhancement measures

See AN-Conf/11-WP/204 for full details.

7.1. Papers related to ASAS and ADS-B

No specific WP or IP was identified.

7.2. Recommendations related to ADS-B, ASAS and ACAS

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4.2.2 The meeting noted that the ATM operational concept and all enablers to enhance capacity and improve aircraft operations, such as 4-dimensional trajectory and ADS-B, would need to be adaptable to the unique operational environment and needs of the different States and regions. Additionally, there was a range of economic, legal, political, financial, environmental and institutional issues that varied from region to region. The meeting further noted that the planning processes at the global, regional and national levels should provide a well-understood, manageable and cost-effective sequence of improvements that kept pace with user needs, culminating in a system meeting safety, security, capacity, efficiency and environmental demands. The ATM operational concept provided the basis from which the ATM requirements, objectives and benefits would be derived, thereby providing the foundation for the development of regional and national ATM implementation plans.

4.2.3 It was recognized that States and regions were different from each other with different requirements needing different solutions, which was a fundamental aspect of the ATM operational concept. At the same time, plans of all States needed to be aligned to the greatest extent possible, to ensure that solutions were internationally standardized and integrated, and did not unnecessarily impose multiple equipment carriage requirements in the air components of the ATM system, or multiple systems on the ground.

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Recommendation 4/1 — Harmonization of air navigation systems between regions

That ICAO:

  a) maintain, and develop further, a coordination mechanism between regions for planning and implementation of capacity-enhancing measures and ATM performance improvement between regions for a harmonized evolution aimed at enhancing aviation efficiency and safety;

  b) be systematically involved in any regional initiatives aiming at enhancing ATM capacity and performance; and

  c) urge States, who have not already done so, to establish national CNS/ATM coordination and implementation committees, with a point of contact to be made known to the respective ICAO Regional Office, so as to facilitate harmonized transition to CNS/ATM systems.

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See AN-Conf/11-WP/205 for full details.

No specific WP, IP or recommendation was identified.

9. **Agenda Item 6: Aeronautical navigation issues**

See AN-Conf/11-WP/201 for full details.

No specific WP, IP or recommendation was identified.

10. **Agenda Item 7: Aeronautical air-ground and air-to-air communications**

See AN-Conf/11-WP/202 for full details.

10.1. **Papers related to ASAS and ADS-B**

- WP14 - Secretariat - Comparative analysis of ADS-B data links
- WP91 - ICCAI A - VHF data link Mode 4 considerations
- WP104 - United States - Strategy for global interoperability of automatic dependent surveillance - broadcast (ADS-B)
- WP137 - Eurocontrol - European recommendation on an ADS-B data link selection
- WP147 - Russian Federation - ADS-B in the future ATM system
- IP12 - Secretariat - Comparative analysis of ADS-B data links
- IP18 - United States - The UAT’s role in the United States FAA ADS-B link decision
- IP35 - Japan - Status of ADS-B activity in Japan
10.2. Recommendations related to ADS-B, ASAS and ACAS

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**Recommendation 7/1 — Strategy for the near-term introduction of ADS-B**

That States:

a) note that a common element in most of the approaches currently adopted for early implementation of ADS-B is the selection of the SSR Mode S extended squitter as the initial data link; and

b) take into account this common element to the extent possible in their national and regional implementation choices in order to facilitate global interoperability for the initial introduction of ADS-B.

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**Recommendation 7/2 — Support of longer term ADS-B requirements**

That

a) States recognize that in the longer term the current SSR Mode S extended squitter technology may not be able to fully satisfy all of the requirements for ADS-B services in all airspaces; and

b) ICAO continue development of technical standards for ADS-B link technologies, including SSR Mode S extended squitter, VDL Mode 4 and UAT, with special attention being paid to ICAO ADS-B operational requirements, frequency spectrum availability and aircraft integration issues.

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11. Concluding remarks

The reader should be reminded again that this note is not intended to replace ANC/11 report.

From an RFG perspective, the outcomes of ANC/11 are very positive:

- The global ATM operational concept is open to new improvements;
- A set of Ground Surveillance and Airborne Surveillance applications has been identified for early implementation;
- SSR Mode S extended squitter is recognised as the initial ADS-B data link to support early implementation of GS and AS applications.

RFG deliverables are expected to contribute to:

- The improvement of the global ATM operational concept document, which is considered as a 'living document that would have to be revisited from time to time;
- The update of the ADS-B concept of use; and
- The development of the ASAS manual.
- The development of SARPs and guidance material related to ADS-B and ASAS.