ASAS Thematic Network 2

Report of the Second Workshop
3-5th April 2006, Roma

ASAS as an integral part of future ATM

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1 Introduction

The Second ASAS (Airborne Separation Assistance System) Thematic Network 2 (ASAS-TN2) Workshop: "**ASAS as an integral part of future ATM"** was held from the 3rd to 5th April 2006 at the Duke Hotel, Roma (Italy).

This workshop is the second of five ASAS –TN2 Workshops, and was focused on key issues with regard to ASAS implementation. The workshop was held in cooperation with the Mediterranean Free Flight (MFF) and Advanced Safe Separation Technologies and Algorithms (ASSTAR) projects.

The aim was to identify and report upon the key issues with regard to global ASAS application development and delivery. This was approached by presentation material and chaired discussion sessions. The object was to capture key issues both via the presentations and the subsequent debate sessions.

This report contains a summary of the key issues identified at the workshop.

Part of the work of ASAS-TN2 is to report annually on the status of ASAS development and to discover what is being done and needs to be done in the implementation of ASAS as part of the global ATM (Air Traffic Management) system. This workshop presented the first report of this work. Each of the workshops contributes to this process and the ASAS-TN2 project will conclude with a final seminar.

2 What is the ASAS-TN2?

ASAS-TN2 is a three-year project that is primarily a communication activity. The ASAS-TN2 is sponsored by the European Commission (DG Research).

ASAS-TN2 is a stand-alone project, following on from the work of its predecessor project ASAS-TN1. The scope has now increased to address applications beyond Package 1.

ASAS-TN1 arose out of the ASAS work within the programme of Co-Operative Actions of R&D in EUROCONTROL (CARE-ASAS). It is organised within the work programme for Competitive and Sustainable Growth of the European Community, Key action 4, New Perspectives in Aeronautics, Target Platform 4, "More Autonomous Aircraft in the Future Air Traffic Management System.

The ASAS-TN projects objective:

The main objective of the ASAS Thematic Network is to accelerate the implementation of ASAS applications in European Airspace taking into account global applicability in order to increase airspace capacity and safety.

The work of the ASAS-TN2 is threefold:

- Five Workshops and a final seminar
- Web-based documentation; and
- Annual reporting of the status and maturity of ASAS application development.

The Workshops and discussion forums inform the application maturity reporting work.

The ASAS-TN2 is managed by a consortium led by EUROCONTROL that includes BAE Systems, ENAV, LFV, NLR, Thales ATM and Thales Avionics.

In addition to the above organisations, the ASAS-TN involves a very wide range of organisations (e.g. ATM stakeholders, Universities) including pilot and controller professional associations (ATCEUC, IFATCA, IFALPA and ECA).

Second ASAS-TN2 workshop

2.1 Format of the workshop

Day 1 consisted of a session describing the plans, progress and challenges with regard to ASAS implementation. It addressed high level issues such as: (a) The place of ASAS in the ATM concept of operation, the previous workshop had shown that ASAS applications are no longer handled in isolation but are well integrated within ATM. (b) A series of keynote presentations examining the overall ASAS issues from a variety of perspectives, including pilot and controller perspectives.

Day 2 consisted of two parallel sessions, one for the MFF project and one for ASSTAR. In each of these sessions selected presentations addressed the specific results or proposed outcomes with a view to raising the key issues. In each session, the presentations were followed by a chaired discussion session.

Day 3 addressed the issues of integrating ASAS into an evolving ATM system. The session explored what ASAS would look like upon implementation and what the ATM environment, into which it must fit, would be. This session also reported the ASAS-TN2 approach to reporting on ASAS application maturity followed by concluding discussions.

2.2 Day 1 – 3rd April 2006

2.2.1 Welcomes

- **Phil Hogge**, Event Chairman

Phil Hogge welcomed the participants on behalf of the ASAS-TN2.

- **Cristiano Baldoni**, ENAV

Cristiano Baldoni welcomed the participants on behalf of ENAV.

Phil Hogge first presented the objectives of the workshop.

The first objective was to present an update of progress and plans in the ASAS domain. A result of the previous ASAS-TN2 Workshop in Malmö was that a number of ASAS applications are no longer in the R&D stage but are now in the validation phase. The two first presentations provided the status in Europe and United States concerning standards, validation and implementation plans related to the most mature applications.

The second objective was to address high levels issues and challenges concerning ASAS.

Another result from the last ASAS-TN2 workshop was that ASAS applications are no longer considered in isolation but as an integral part of ATM as reflected by the title of the present Workshop. One element is the relationship between ASAS applications and the ACAS safety net. ICAO is very cautious about this subject. The IAPA project has analyzed this relationship and its consequences on ASAS will be discussed.

By nature ATM is international and transition to new concepts needs a worldwide coordination. The current ICAO process concerning ASAS was described in the 4th presentation.

Amongst the issues and challenges related to ASAS, the acceptance and adoption by the users is a key point. The first session provides the views of pilots and controllers' representatives.

A. Session 1 Progress, Plans and challenges

3 Introduction

This session was chaired by **Pierre Gayraud** (Thales Avionics) with **Chris Shaw** (EUROCONTROL Experimental Centre) as the secretary.

- Six briefings were presented in the session:
  - CASCADE by Christos Rekkas
  - JPDO perspective on ASAS by Jay Merkle
  - IAPA When ASAS meets ACAS by Thierry Arino
  - ICAO Standardisation process by Ken Carpenter
  - Pilots' perspective by Bob Arnesen
  - Controllers' perspective by Anthony Smoker
- Chaired discussions including a formal debate at the end chaired by Phil Hogge

4 Review of the briefings

4.1 Christos Rekkas (EUROCONTROL HQ)

Brief description

CASCADE is EUROCONTROL's programme to co-ordinate the implementation of a first set of ADS-B applications, and a second generation of CPDLC and other data link services (on top of what LINK 2000+ is implementing). The Programme is organised in two Streams. In terms of ADS-B, Stream 1 covers the ground surveillance applications, whereas Stream 2 includes airborne surveillance applications.

Currently the focus of CASCADE is primarily on standardisation and validation (trials and simulations). The ADS-B standardisation work is driven by the Requirements Focus Group (with principal membership from EUROCONTROL, FAA, EUROCAE, RTCA and additional participation from Australia and Japan). Regarding validation, an initiative which catalysed the progress and the wide stakeholder involvement is the CRISTAL projects. The CRISTALs have a clear objective: to perform trials in partnership with stakeholders in local sites of Europe ("pocket areas") and bridge them to create wider regions of implementation ("crystallisation effect"). Their key driver is the local operational needs. Currently, stakeholders from twelve ECAC countries and EUROCONTROL jointly provide resources to achieve the common objective, thereby increasing efficiency and ensuring early involvement of local staff. The ADS-B/TIS-B Validation Testbed (AVT) and its components (at the EEC and locally) have a central role in this work.

The main objective of CASCADE in 2006 is the establishment of a stream 1 baseline (incl. operational scenarios, standards, business case and safety case) and a clear path towards operational approval (expected from 2008 onwards).

Key issues in the presentation

- Concrete progress towards ADS-B implementation was reported by CASCADE.
- Publication (by EUROCAE/RTCA) of the standards for ADS-B in Non Radar Airspace is expected in 2006, followed by the material for the other applications.
- Currently, more than 40% of the aircraft monitored in Europe are ADS-B (1090 Ext. Squitter) equipped, although not yet certified for operational use.

- The certification roadmap is established, describing the steps/prerequisites towards airworthiness and operational approval. Target date for EASA approval (covering the ADS-B in Non-Radar airspace and as a complement to radar) is 2007.
- CASCADE validation on ADS-B ground Surveillance will shift to pre-operational (from 2006-07 onwards) with involvement of pioneer airlines with certified avionics.
- Focus on ATSAW and pragmatic approach on S&M are also key priorities.
- Implementation plans in Europe are emerging (Sweden, Mediterranean countries).

4.2 Jay Merkle (Joint Planning and Development Office - JPDO)

Brief description

Jay works for the JPDO, a multi-agency cooperative effort for non-executive planning of the Next Generation Air Transportation System (NGATS). His presentation was a six month update on ADS-B progress in the US. He went through a reminder of the design principles and key capabilities of the NGATS concept, and a summary of the ASAS operational improvements from 2008-2025. On 9th September 2005 the FAA ADS-B program made an initial investment decision for future surveillance. One of the more significant possibilities currently being evaluated is of replacing secondary surveillance radar with ADS-B in US. A final investment decision is expected on 6th July 2006. The FAA are planning to develop a multi-segment, life cycle managed, performance based ADS-B strategy that aligns with the NGATS vision and generates value for the National Airspace System (NAS). A description of the ADS-B applications was presented showing their relationship with the segments of the schedule. The plan included deployment of ADS-B infra-structure in: Juneau (Alaska), Gulf of Mexico, Louisville by 2010.

Key issues in the presentation

- The FAA has launched a new implementation office for ADS-B and it is called the Surveillance and Broadcast Services Program.
- Final investment decision 6th July 2006.
- Implementation from 2007 to 2025.

4.3 Thierry Arino (Sofréavia)

Brief description

The IAPA (**I**mplications on **A**CAS **P**erformances due to **A**SAS implementation) project is a substantial European contribution to the understanding of the potential interaction between ACAS and ASAS procedures. Such a contribution was required given the envisaged evolution of the European ATM system, which may impact the forecast performance of both ACAS and the new ATM system itself.

The analysis made has demonstrated that the interaction with ACAS highly depends on the nature of the ASAS application and its main assumptions with regard to the type of separation applied, i.e. lateral, longitudinal or vertical separation with applicable separation minima. The investigation on the ASAS Lateral Crossing application demonstrated the influence of the separation minimum applicable during ASAS operations on the interaction with ACAS.

With regard to the ACAS / ASAS compatibility, the various simulations performed have shown to what extent a demanding ASAS application can trigger undesirable ACAS alerts. This is particularly the case for the possible issuance of frequent, but non-systematic, Traffic Alerts (TAs) against the other aircraft involved in the ASAS procedure. To avoid affecting the performance of demanding ASAS procedures, and therefore, their expected benefits, it may be necessary to revisit the current ACAS logic for TAs. Further, it will be critical to ensure that the desirable role of the 'Miss Distance Filter' of the TCAS (Traffic Alert and Collision Avoidance System) II logic version 7.0 (in preventing the issuance of undesirable Resolution Advisories (RAs)) is effective.

Finally, the safety analysis conducted within IAPA demonstrated that, if nominally operated, ACAS would continue to provide positive safety benefits during ASAS operations. The standard operational procedure should be that in ASAS procedures, as at all other times, ACAS should be operated in RA mode and the RAs that are generated should be followed, and followed promptly for best benefits.

Key issues in the presentation

- ACAS must be operated during ASAS procedures as in any ATM operations. Furthermore, the possible impact on the safety benefits provided by ACAS should be carefully assessed prior to any particular ASAS implementation.
- The ACAS constraints must be taken into account when developing ASAS applications so as to achieve an appropriate ACAS / ASAS compatibility. In this regard, particular attention should be paid to the determination of the separation minima applicable during ASAS operations.
- When implementing ASAS operations, appropriate consideration should be given to ACAS developments that would improve the compatibility with ASAS while preserving the independence of ACAS.

4.4 Ken Carpenter (QinetiQ)

Brief description

International standards are required for both operational practice and equipment to ensure that aircraft can fly internationally without undue difficulty. These standards are maintained by the ICAO Secretariat, and are negotiated between States on the direction of the Air Navigation Commission through official State Letters. ICAO Panels are one of the means that the Secretariat uses to get help from experts in this task.

A number of matters are under review in ICAO: the arrangements for standardising technical material; the number and the terms of reference of the Panels; and the whole ICAO work programme. Technical standards are in Annex 10 to the Convention on International Civil Aviation. These standards have become too detailed and too voluminous and alternatives to Annex 10 are being sought. The Surveillance and Conflict Resolution Systems Panel, which has done most work on ASAS to date, is to be renamed the Aeronautical Surveillance Panel (ASP), and its work programme has been radically redrawn.

The new work programme for ASP is technical and predominantly concerned with the ground surveillance systems that support the controller. There are just two tasks that potentially concern airborne surveillance: the development of a roadmap for the evolution of ground and airborne surveillance, which is a joint activity with operational groups, and monitoring the implementation of standardised surveillance systems. There is no provision for work on flight deck systems that provide surveillance of surrounding traffic. There are other Panels that would have an interest in the use of airborne surveillance, but the matter is not necessarily high on their agendas.

The absence of a common understanding of how airborne surveillance might be used suggests the need for a concept document. SCRSP was proposing to work on that, but it is not in the new programme. At a more detailed level, specific applications that could see early implementation, for example Sequencing and Merging (2015?) or the In Trail Procedure (2010?), were being examined in detail to identify their precise requirements in terms of international standards. It is known already that we need an agreed phraseology for referring to third parties simply because flight desk displays will probably display the identity of proximate aircraft in the near future.

Those developing uses for airborne surveillance need to identify precisely what must be standardised, and why. They then need to take the issue to a Member of the most appropriate Panel so that the issue can be presented to the ICAO Secretariat in the correct way. The alternative is to seek to proceed by Regional *ad hoc* agreement.

Key issues in the presentation

- How should technical material be standardised?

- Do we need standards for ASAS equipment? If so, why?
- How do we best promote operational procedures based on airborne surveillance in ICAO?
- What sort of concept document does ICAO need?

4.5 Bob Arnesen (IFALPA)

Brief description

Capt. Bob Arnesen representing IFALPA (International Federation of Air Line Pilots' Associations) and ECA (European Cockpit Association) provided the audience with the pilot perspective concerning on-board use of ASAS applications.

Bob reminded us that pilots are end users. The goal of airlines is to fly more effectively, using less fuel, flying shorter sectors with greater safety.

For the pilot community, the aims of Package 1 are not the real issue. There is no transfer of responsibility from the controller to the pilot for separation.

The real challenge for the pilot community comes with Packages 2 and 3 because there is the potential for transfer of responsibility for separation from controller to pilot. IFALPA has established a policy on transfer of separation responsibility from ATC to the cockpit. The main points are that the pilot community will support the transfer of separation responsibility to pilots only under the most regulated conditions. It does not recognise the ability of flight crews to perform safely airborne separation using existing ICAO procedures.

The procedures and phraseology have to be clearly defined and identical worldwide.

A critical factor is the pilot workload. The solution is simplicity. IFALPA is vigilant/cautious concerning displays. For example a separate CDTI should be avoided.

In summary, when maturity is attained in applications where responsibility for separation remains with the controller and the pilot is asked to perform ASAS manoeuvres, he recommends to move to live onboard long term testing and trials, using a large launch airline in and around core Europe.

Key issues in the presentation

- IFALPA considers the current ADS-B link is not secure and that measures should be taken.
- Navigational position source as well as the ADS-B link itself needs to be reliable, robust and of the highest integrity.
- IFALPA recommends taking time to fully test and try ASAS applications and not develop them too quickly to meet political agendas.
- In NRA airspace where ADS-B will be used to reduce separation between IFR flights, thereby increasing the density of IFR traffic, then that airspace should be classified at least Class C airspace so as to ensure a proper separation between IFR and VFR traffic.
- Terminology and phraseology based on the English language should be developed and implemented.

4.6 Anthony Smoker (IFATCA)

Brief description

Anthony is an Air Traffic Controller from NATS in the UK and a representative of the International Federation of Air Traffic Controllers' Associations (IFATCA). ASAS applications were considered using a series of rules that govern cognitive work – the human being working with an agent or actor. These rules were used to pose questions about the use of ASAS from the controller's perspective. Specifically, the following points were raised:

The operational context for ASAS is that it must facilitate or enable future traffic growth, and thus capacity. This will mean that controllers are busier, not less. What effect will this have upon the dimensions that make up controller workload?

Generally, we are changing the dynamics of the ATM systems, what contribution will ASAS make to this, and do we understand the effects therein?

Do we want to work with local adaptations of global ASAS rules in the operational environment?

Will ASAS generate conflicting goals for actors in the ATM system?

The information that is provided by ASAS to pilots and controllers needs to support the task that they have to carry out. However, partial information can hinder task execution as much as information overload. Care must be exercised to provide the right information at the right time, and beware the misapplication of information elements by actors. Specifically, this is the question that is asked about ATSAW. There are lessons to be learnt from the TCAS experience.

The results of a recent debate at the IFATCA conference were then presented.

Controllers find the transposition of the terms ADS-B and ASAS confusing. To resolve this confusion, IFATCA views ADS-B as surveillance. IFATCA then goes further, structuring the debate in terms of ground based and airborne surveillance. Airborne surveillance provided information, instructions (clearances) and separation (flight deck based).

IFATCA believes that the provision of information via ASAS will have an impact on the behaviour of pilots and controllers. It is identified that this will influence separation in some way.

IFATCA also contends that the responsibility for separation must be unambiguous, and that there is confusion as to what is meant by separation and spacing. Finally, IFATCA advised not to underestimate the degree of training that will need to be undertaken to achieve ASAS implementation.

Key issues in the presentation

- The IFATCA view is that ASAS is a variant of Airborne Surveillance.
- The provision of “Information” to the flight deck will have an affect upon the control process for both controllers and pilots.
- In some respects, ASAS is just a different way of doing what we do today.
- In other respects it is not as above, and this is a major shift in operations.
- Responsibility for separation must be unambiguous.
- There is confusion as to what is “Separation” and what is “Spacing”.
- Do not underestimate the amount of training that will be required - and do not forget recurrent training.

Issues from chaired discussions regarding the first three presentations

CASCADE presentation:

Christian Denke (ECA) asked can ADS-B replace radar? Doesn’t the ‘dependent’ in Automatic Dependent Surveillance – Broadcast mean that it is fundamentally different, complementary to independent radar?

Christos Rekkas answered that ADS-B operations need pushing. The trend in the next five years will be for some Air Navigation Service Providers (ANSPs) to use ADS-B in pockets and then the subsequent cost ratio of 1:20 will be difficult to ignore by others. The approach is top down, analysing operational needs first then cost.

JPDO presentation:

Jay Merkle clarified the scope of security in his presentation, it includes everything from cargo baggage screening to ADS-B.

Bob Darby (EUROCONTROL HQ) have not seen technical solution in Europe to ADS-B mis-use. Are US looking at that?

Jay Merkle answered yes, bundled in with failure modes analysis. It gets intertwined with safety analysis. An application by application approach is being taken. A particular problem may not be solved but risks should be identified and a methodology is in place.

Bob Graham (EEC) is JPDO doing anything for incentives mechanisms? e.g. for airlines to equip.

Jay Merkle answered yes, application by application e.g. Capstone project in Alaska purchased equipment. In the Gulf of Mexico, the incentive was to be able to do operations in some conditions that wouldn't be able to without. ADS-B.. ADS-B out is an enabler for all ADS-B in operations. In the case of some ski resorts with no radar, individual states are prepared to pay for ADS-B Non Radar Applications (NRA.). There is a move towards performance based approach application by application.

Tony Henley (BAESYSTEMS) In the US plan TIS-B is expected in 2010 and removed in 2025. Which applications and why?

Jay Merkle answered TIS-B is intended for general aviation at smaller airports. By 2025 there should be regional air-air solutions without ground infrastructure.

Pierre Gayraud FAA, EUROCONTROL, RTCA and EUROCAE are working with RFG. (Requirements Focus Group). Do you think this work will support JPDO?

Jay Merkle answered yes, and that there is pressure to move more quickly.

Jean-Marc Loscos (DSNA) with reference to FAA/EUROCONTROL R&D activities and time to move to implementation, is there a feeling we can get rid of R&D? Action plans produced Principles of Operation of ASAS (PO-ASAS) etc.

Christos Rekkas answered that there is still clearly appreciation for the need for R&D. RFG is very successful. Packages 2&3 are addressed by a fusion of FAA/EUROCONTROL Action plans 1 and 10. Future R&D needs to be clearly defined.

Jay Merkle answered he agrees that there is commitment to R&D and gave the example that NASA are part of JPDO.

Dragos Tonea, (EUROCONTROL HQ) confirmed that R&D requirements are recognised and actions are being taken to address this: EUROCONTROL (ATC Domain) is proposing a new Action Plan (AP24) to foster co-ordination between US and Europe on Packages 2&3. The AP24 draft Terms of Reference (ToR) and associated work plan has been distributed, on a presentation as a flimsy, during the last RFG (Brussels, 20-23/03). European endorsement of the AP24 ToR is expected by the 03/05/2006 after which it should be distributed to our US partners as a basis for discussion.

IAPA presentation:

Bart Klein Obbink (NLR) agreed that emphasis should be given to ACAS.

Thierry Arino answered yes: Yes because ACAS already exists.

Christian Denke (ECA) commented that it is a fact that ACAS is already here and it took a long time to develop. But perhaps it may be possible to update it.

Thierry Arino suggested that perhaps the role of TAs could be examined.

4.7 Debate

Phil Hogge, when introducing the debate, put as the objective the status of achievements and to identify areas of concerns and of agreement.

Status

Phil Hogge proposed that people take a look at the ASAS TN2 application maturity assessment document to get an idea of implementation candidates. The document has been distributed to the participants with the material of the Workshop. This is a peer-reviewed document containing spider web diagrams to summarise the overall maturity of each ASAS application.

Christos Rekkas reported that there is commitment from European countries. There are 6-7 countries performing ADS-B trials without external funding. From previous experience, 4D trajectory is a long story. There needs to be a standard trajectory definition which would imply re-certifying Flight Management Systems (FMS) and this is expensive.

Standards:

Phil Hogge initiated the debate by underlining Ken's point about ICAO being important because pilots and controllers need standards, particularly with respect to procedures and terminology.

Christian Denke (ECA) appreciated Ken's presentation on ICAO. He joined Ken in a plea for standardisation of procedures – "it's the only way".

Phil Hogge asked Ken what shall we do to overcome the ICAO problem?

Ken Carpenter recommended a piece-meal basis approach to 'slip' ASAS in with other ATM changes.

Christos Rekkas emphasised that RFG process of standardising procedures is underway. In this forum Europe is working with US, Australia and Japan. This international collaboration is a step towards ICAO. In a related question from Phil whether RFG are doing well enough, Christos responded yes but support is always welcome.

Dave Bowen (EUROCAE) supported Christos's comments on RFG being a good route to ICAO and gave an example of how EUROCAE aerodrome standards became ICAO standards. He pointed out that EUROCAE and RTCA are in touch with ICAO to facilitate this process.

Bob Darby (EUROCONTROL) recalled the original reason why RFG was created was to progress on ADS-B related standards for ourselves (ourselves being WG51, the EUROCONTROL ADS Programme and other European organisations working on ADS-B). The extension of RFG scope to embrace FAA and RTCA and to contribute to ICAO standards came later.

Jean-Marc Loscos (DSNA) supported Ken's views on ICAO. ACAS/TCAS has been in aircraft in the US since 1991. ICAO procedures for ACAS were established in 1996 i.e. implementation led standards. He thinks situation awareness applications should be clarified before putting them into service.

John Brown (Boeing) asked the audience to remember that RFG is developing procedures to develop safety and performance requirements. Unless there is a push for common procedures it won't happen. He gave the example of procedures developed differently for Pacific and Atlantic. Industry takes part because it needs standards to develop its boxes.

Phil Hogge said we must avoid expensive interventions on aircraft. There are different standards for the ASAS data: DO-260, DO-260A, and probably a later format for 4D downlink. How early can we standardise?

Johnny Nilsson (LFV Group) expressed concern over ADS-B link implementation and indicated that European standards for alternative link technologies exist. He also urged the audience to consider how to comply with the two EU legislations that apply to ATM, namely the R&TTE Directive that after 20 October 2005 applies to all ground ATM equipment and the Single European Sky regulations that apply to both air and ground ATM systems and constituents from March 2004. In those there are 7 + 7 Essential Requirements that are legally binding and on which a declaration of conformance has to be provided to the EU.

Pilots and controllers

Tony Henley (BAESYSTEMS) invited IFALPA and IFATCA to comment on why pilots like CDTI but controllers are not so keen.

Anthony Smoker replied they had different perspectives.

Lena Martennson (Royal Institute of Technology, Sweden) thought there was an enormous wall between pilots and controllers. They speak to each other daily but do not cooperate. When are they going to agree?

Bob Arnesen said we agree on some things.

Anthony Smoker said it's about trust. Before September 11th there was a programme for air traffic controllers to travel on the flight deck for familiarisation of cockpit operations. IFALPA and IFATCA have different perspectives, after all they actually carry out different tasks to some extent. There is a need to be clear on communication.

ASAS and SESAR

Tony Henley (BAESYSTEMS) didn't see a simple way to address the list of problems. But he asked are they so different to SESAR master plan issues? There needs to be a large investment. Industry cannot afford to pay for it alone.

Jean-Luc Marchand (European Commission) replied that in the context of European Commission funding of all research, 70 billion euros was requested and 50 billion was allocated of which about 2 billion goes to aeronautics not including TEN-T funding.

Phil Hogge asked where will ASAS be in SESAR?

Tony Henley BAESYSTEMS) suggested we shouldn't use the word ASAS. There are too many different interpretations. There is a need to talk more specifically e.g. where airborne sequencing and merging will be in SESAR etc.

Cristiano Baldoni (ENAV) talked about ASAS and SESAR. The approach is not to reinvent the wheel but to build on existing 'Lego' blocks with a top down approach from user requirements.

Bob Graham (EEC) pointed out that the SESAR activity has started putting operational concept elements together. And therefore the next couple of months are an important opportunity to get ASAS in SESAR. With respect to road maps from CASCADE how much commitment is there from ANSPs? Are we lacking a link?

Johnny Nilsson (LFV Group) said his colleagues are working with manufacturers for demonstrations in 2007.

Luigi Iodice (SELEX) commented that a group of ambitious airspace users are leading SESAR. Inside the European ATM master plan there will be a European ATM R&D plan. The next phase of development will be 7 years or more. ASAS will be one of the main pillars. We are missing the mechanism of how to implement the ASAS applications that we are talking about.

Tony Henley (BAESYSTEMS) reported that the SEAP (Large Scale European ADS Pre-implementation Programme) project had a trial stopped because the European Commission money was used for SESAR.

Jean-Luc Marchand (EC) said SESAR is a political tool. It is an opportunity for 300-350 million euro funding. ASAS has been a good marketing name. Why not abandon the name and go for airborne surveillance application by application.

5 Concluding remarks

In Europe, the CASCADE programme is reporting concrete progress towards ADS-B implementation. Currently more than 40% of aircraft in Europe are ADS-B out equipped, but are not yet certified. The pre-operational trials of ADS-B ground surveillance will involve some 12 countries and 16 ground stations from 2006-2007 and onwards.

JPDO from the US presented the Next Generation Air Transportation System (NGATS) vision. It envisages the implementation of ADS-B surveillance to replace secondary radar throughout the National Airspace. The final investment decision is expected in June 2006, with implementation from 2008 to 2025.

IAPA presented the analysis on the interrelationships between ACAS and ASAS. The potential constraints on ASAS are highly dependent on the applications and separations (Sequencing & Merging; Crossing & Passing were examined). These applications would need to be designed so as to eliminate RAs with a minimum separation of 5 NM.

ICAO is tending to distance itself from technical details, the current thinking being that there is too much detail in Annex 10 and that it would be better to place a greater reliance on standardisation bodies such as EUROCAE and RTCA. However, ICAO Annexes have a worldwide legal status and it would be unfortunate to lose the effectiveness of this to ensure compliance. There appeared to be a focus on ground surveillance applications of ADS-B with little enthusiasm for airborne surveillance applications.

IFALPA believed that there are no issues with Package I applications, as they do not involve a transfer of responsibility. However, for other applications where there is a transfer of responsibility, it will be necessary to have new and strict regulation. They wanted to see live onboard trials with all the normal safeguards.

IFATCA were concerned that the provision of "Information" to the flight deck will have an affect upon the control process for both controllers and pilots. Responsibility for separation must be unambiguous, and no-one should underestimate the amount of training that will be required.

These presentations were followed by a good debate. It has been suggested that rather than merely to discuss ASAS in general it would be better to include each application naturally with other ATM changes.

Delegates confirmed that the RFG is the right path for progressing the applications through ICAO, and that this was helped by the close contacts of EUROCAE/RTCA with ICAO. A comment was made from the floor that, during human factors research, pilots and controllers seemed to live in separate worlds and that this should be addressed. The IFATCA and IFALPA delegates did not feel that there was a problem. Everyone considered that it was important in the next couple of months to get ASAS in SESAR.

B. Session 2 – ASSTAR User Forum 1: progress in ASAS application development and validation

6 Introduction

This session was chaired by **Tony Henley** from BAESYSTEMS with **Rob Ruigrok** from NLR as the secretary.

The session was organised so as to feed the discussion among the participants:

- Six briefings presented in the session:
  - ASSTAR overview by Richard Watters
  - Crossing and passing operational scenarios, by Jean-Marc Loscos
  - Algorithm design for crossing and passing by John Anderson
  - Oceanic applications by Nico de Gelder
  - Benefit appraisal for oceanic applications by Terry Johnson
  - ASSTAR safety approach and preliminary issues by Claudio Vaccaro

6.1 Introduction by the session leader

The chairman began by reaffirming the importance of SESAR as the only viable means of developing a European ATM Master plan which can command wide censuses. He urged all attendees to contribute to the activity and recommended that those not invited to the External Workshop last week should contact the SESAR project so that they are included in future.

The key objective of this first ASSTAR User Forum is to disseminate ASSTAR results obtained to date in order to secure the appropriate involvement of major stakeholders on the project activity. In particular, we will present the project objectives and approach and work completed to date. We need feedback from the participants and will be encouraging them to provide their feedback with the clear goal of contributing to the development of ASSTAR and the ASAS themes covered. The feedback will be used to help shape the future direction and technical content of the project.

The second and final ASSTAR User Forum will be held in 2007 with the objective of disseminating project results, findings, recommendations and lessons learnt.

7 Review of the briefings

7.1 Richard Watters (BAE SYSTEMS)

Brief description

The aim of the ASSTAR project is to research the operational and safety aspects of selected ASAS Package 2 applications in order that the potential benefits may be realised by airspace users in the 2010 timeframe and beyond. Applications included in the project include advanced Crossing & Passing applications in radar airspace and In-Trail Procedure applications in oceanic airspace.

Specifically ASSTAR should identify a number of well-defined ASAS Package 2/3 applications and get a common endorsement between the airlines and ANSPs on the proposed applications. The project will address ASAS manoeuvre design and execution including the definition of supporting procedures. It will identify air and ground installation and implementation issues and carry out a high-level benefit analysis. In parallel a safety assessment will be conducted and it will report on the impact of the new applications on regulations.

Regular project User Workshops are include in the programme (two have been held to date) and Public User Forums are planned (of which this is the first) to achieve wider dissemination and elicit responses from a broad representation of the Air Transport community.

Consortium Partners:

BAE Systems (UK) (Project Co-ordinator)

National Aerospace Laboratory – NLR (NL)

Sistemi Innovativi per il Controllo del Traffico Aereo - Sicta (IT)

Direction des Services de la Navigation Aérienne - DSNA (FR)

Euro Telematik (GE)

University of Glasgow (UK)

Thales Avionics (FR)

EUROCONTROL Experimental Centre (FR)

National Air Traffic Services - NATS (UK)

Technological Educational Institute of Piraeus (GR)

HELLAS JET (GR)

University of Zilina (SL)

Key issues in the presentation

Richard invited forum participants to:

- Express concerns, ideas, wishes, expectations and suggestions to contribute to the development of ASSTAR and the ASAS themes covered.
- Identify any key questions still to be addressed to secure the support of the major stakeholders.
- Establish any technical changes required to be evaluated for inclusion in the on-going studies, in order to improve the quality and acceptability of the ASSTAR results.

7.2 Jean-Marc Loscos (DSNA)

Brief description

Jean-Marc introduced the presentation with the clear statement that the applications proposed explicitly involve the delegation of responsibility from the controller to the flight crew to execute a crossing manoeuvre with respect to one designated target aircraft with the controller remaining responsible for separation with respect to any other aircraft.

The application directly builds on the existing visual clearance procedure but using the capabilities of ADS-B to allow wider operational applicability. A specific requirement is that the procedures be designed in such a way as NOT to trigger ACAS alerts.

Jean-Marc then outlined one of the target applications, the Lateral Crossing, which allows a suitably ASAS equipped aircraft to modify its **horizontal** trajectory in order to achieve ***lateral separation*** by itself (airborne separation) from another converging controlled flight *independently of vertical profile* with no change in current ground separation minima. From direct measurements of real operations the opportunity for using the application was assessed at 3 per hour per sector.

A possible phraseology for the ATCO /Pilot dialogue was presented as follows:

- ATCO: For ASAS crossing, identify “Target ID”
- ✈ Clearance: OK, target at 11 o’clock and 55 NM
- ATCO: pass behind target, then resume to WPT.
- ✈ Clearance: passing behind / [unable to pass behind]
- (ATCO: target ID, for information, you are under ASAS crossing) *optional*
- ✈ Clearance: Clear of traffic, on course to WPT.

- ATCO: Roger.

The presentation finished with a set of questions relating to: the need for controller tools, pilot controller acceptability, and the issues of workload/task sharing and phraseology.

Key issues in the presentation

- ➔ The application builds on existing visual clearance procedures.
- ➔ A transfer of responsibility is a key element of the application.
- ➔ Compatibility with ACAS is a design requirement.
- ➔ Before initiating the manoeuvre, the ATCO checks that it will be contained in an airspace envelope that is clear of surrounding traffic. The ATCO is responsible for surrounding separation.
- ➔ Before initiating the application, the ATCO will ensure that the target aircraft will adhere to its own route.
- ➔ There is significant opportunity for use of the application:
    - From actual radar data of 2 Feb 06 traffic in 2 sectors in France over a 24hr period, 331 encounters were identified among which 41 % (>144) could support the ASAS Crossing procedure.
    - This represents on average 3 potential ASAS Procedures per hour per sector.

7.3 John Anderson (University of Glasgow)

Brief description

The presentation provided a description of selected ASAS C&P applications from the perspective of the manoeuvre types, the airborne operational logic and the implementation approach. The alternative approaches to ASAS resolution manoeuvres were then discussed, including Conflict Detection and Resolution (CD&R) options and a consideration of sources of uncertainty. The resulting need for Robust ASAS manoeuvres was then explained; with 'Robust' implying algorithms with designed in 'tolerance' to uncertain environmental parameters while satisfying safety and efficiency criteria, minimising 'false alarms' and unnecessary manoeuvres and maximising safety.

The key Sources of Trajectory prediction errors were identified as:

- Flight mode errors/uncertainty in climb/descent
- Wind and (vertical) wind gradient uncertainty
- Aircraft performance errors
- Aircraft weight errors
- Aircraft turn dynamics omission
- Flight crew response latency
- (Post-COT) intent errors
- ADS-B failures and data anomalies

Future work includes a survey of candidate CD&R processes and algorithms, the implementation of geometric and graph-based search methods in the ASAS test-bed, the development of the 'Robust' manoeuvre concept (with particular emphasis on climb/ descent applications) and the preparation of algorithms for advanced simulation.

7.4 Nico de Gelder (NLR)

Brief description

Nico de Gelder described the current Oceanic procedures over the North Atlantic and indicated that some significant benefits are expected from ASAS applications in this area.

The North Atlantic is an organised system of tracks with 5-6 parallel tracks. Longitudinal separation is 10-15 minutes, lateral separation is 60 NM and vertical separation is 1,000 ft. It is foreseen that from 2009 these limits will be reduced to 30/30 NM separation using RNP-4, ADS-C and direct controller-pilot communication.

Hereafter, Nico described the four ASSTAR selected applications to be studied in the Oceanic environment:

- In Trail Procedure (ATSA-ITP)
- In Trail Procedure (ASEP-ITP)
- In Trail Follow (ASEP-ITF)
- Free Flight on an Oceanic Track (SSEP-FFT)

In Trail Procedure (ATSA-ITP)

In the ATSA-ITP application, the aircraft is expected to climb (at least) 2000 ft. The flight crew will check for potentially blocking aircraft at the intermediate level 1000 ft above. In the case where there is a blocking aircraft (Reference Aircraft), the flight crew checks for compliance with the ATSA-ITP initiation conditions:

- procedural separation exists at the desired flight level.
- potentially blocking aircraft has qualified ADS-B Out.
- distance from the blocking aircraft exceeds 15 (or 20) NM.
- closure rate does not exceed 20 (or 30) kts.
- own aircraft (ITP aircraft) can climb with at least 300 fpm.

If these conditions are met, the flight crew can ask for an ATSA-ITP manoeuvre to climb 2000 ft. The controller will check if the Reference Aircraft is the only blocking aircraft, the speed difference is less than 0.03 Mach and the Reference Aircraft has not been cleared to manoeuvre. If this is all okay, the controller can give the ATSA-ITP clearance to climb 2000 ft. The flight crew will re-assess the ATSA-ITP initiation conditions and perform the ATSA-ITP climb/descent with at least 300 fpm. Monitoring of the reference aircraft is not required.

The anticipated benefits of this application are enabling more frequent flight level changes for better flight efficiency (fuel savings) and improved safety by avoiding turbulent flight levels. This application is currently being standardised in the RFG, as part of ASAS Package 1.

In Trail Procedure (ASEP-ITP)

The ASEP-ITP manoeuvre is very similar to ATSA-ITP manoeuvre. The procedure and responsibilities are however different. Compared to ATSA-ITP, in ASEP-ITP the blocking aircraft is designated as the target aircraft. The flight crew is given the responsibility for separation assurance during the manoeuvre, which means that the flight crew has to monitor and maintain the separation during the manoeuvre. This is the main difference with ATSA-ITP.

The anticipated savings are the same as for ATSA-ITP.

In Trail Follow (ASEP-ITF)

ASEP-ITF enables the Oceanic Controller to designate a Target Aircraft and instruct a Clearance Aircraft to remain behind the Target Aircraft by a fixed time or distance and to maintain that longitudinal separation. The ASEP-ITF can be used in a similar manner to ASEP-ITP, with the difference that for a climb, the delegated aircraft is not now crossing the target aircraft level, but is in fact getting behind the target aircraft at the target aircraft level. The altitude change is now 1000

ft instead of 2000 ft as in ASEP-ITP. This means that also the initial ASEP-ITF conditions are respected in that the target aircraft is at least, say, 2 minutes ahead of the delegated aircraft.

The anticipated savings are the same as for ASEP-ITP. In addition, there is potential to reduce controller workload if the ITF procedure is used at the Oceanic entry points. Further, it will enable more aircraft to fly on the flight levels of an oceanic track, so improving track occupancy.

Free Flight on an Oceanic Track (SSEP-FFT)

In the SSEP-FFT application, the flight crew will engage the Free Flight mode upon entry to the dedicated Oceanic Free Flight Track. From that moment on, the pilots are responsible for separation with all aircraft on the oceanic track. Conflict Prevention, Conflict Detection and Conflict Resolution functions make sure conflicts are properly prevented and/or detected. The resolutions are only in the vertical and speed domain.

The anticipated benefits of SSEP-FFT are better flight efficiency, improved track occupancy and improved safety through:

- enabling more aircraft at the flight levels of a track (due to lower longitudinal separation criteria).
- enabling more frequent flight level changes or even cruise climbs.
- enabling more freedom in speed selections.

Key issues in the presentation

- For every application, Nico has provided detailed questions and key issues to the audience in his presentation. The audience was invited, also after the workshop, to provide comments.

7.5 Terry Johnson (BAE SYSTEMS)

Brief description

Terry Johnson presented the benefits appraisal of the ASSTAR selected Oceanic applications. At the moment, the benefit analysis has been qualitative.

The principal benefits from ASAS Oceanic applications arise from improved flight efficiency because the applications allow an aircraft greater flexibility to fly at a preferred flight level and speed.

The improved flight efficiency leads to benefits in the form of reduced fuel consumption, reduced gaseous emissions, potential for increased payload, reduced contingency fuel if the maximum fuel requirement can be predicted with greater certainty, reduced maintenance costs due to reduced flight time, and more.

Additional benefits identified involve reduced ATC provision (ASEP-ITF and SSEP-FFT), reduced turbulence and possible safety improvements through improved traffic situational awareness.

Interestingly, some foreseen (monetary) benefits were rejected in the qualitative analysis:

- Improved predictability
- Increased capacity
- Flight time savings

Within the timeframe of the project, several fast-time simulations will be performed, providing the quantitative data on the benefits of the various applications. For these simulations, a common starting point prior to Oceanic transit will be chosen, together with a common end point.

Key issues in the presentation

- A review has been undertaken of ASAS oceanic applications.
- Some potential benefits identified prior to the review were found to be non-applicable.
- The principal monetary benefits have been identified as arising from flight efficiency improvements.
- Flight efficiency improvements will be evaluated by simulation methods.

7.6 Claudio Vaccaro (SICTA) / Giuseppe Graniero (SICTA)

Brief description

Giuseppe Graniero presented the ASSTAR safety approach and preliminary safety issues.

The ASSTAR policy is to apply a layered safety approach.

- Step 1 will identify the safety metrics.
- Step 2 will review the ASSTAR application descriptions and work done by others such as RFG and MFF.
- In step 3 the hazards will be identified. Giuseppe stressed that ASSTAR will not start from scratch but will build on work done by others. Existing Operational Hazard Assessments will be adapted where applicable. This is the qualitative safety assessment.
- Step 4 will provide the safety objectives.
- And step 5 will generate the safety scenarios. A quantitative safety assessment will investigate the operational safety performance. In this step the safety targets and target level of safety will be checked for compliance. Remaining safety concerns and safety recommendations will be provided.

For one of the ASSTAR applications, Lateral Crossing & Passing, Giuseppe presented the preliminary safety issues. Besides the well-known target misidentification, the trajectory predictions uncertainty is one of the other main safety issues. It concerns both the trajectory prediction of the target aircraft as used in the crossing and passing algorithms and the predictability of the own aircraft trajectory and potential interaction with third party aircraft (i.e. the 'safe' manoeuvre boundaries).

Finally, Giuseppe gave an overview of the planned ASSTAR safety activities for the Oceanic applications. It became clear that within the scope of the ASSTAR project it is not feasible to perform a full-scale safety analysis. The ASSTAR project is identifying the most critical safety areas for the selected ASAS applications and will focus their effort in these areas.

Key issues in the presentation

- A layered safety approach is adopted.
- Definition of Targets for safety quantification according to the ESARR4 Guidelines and ICAO Regulations
- Existing safety work will be adapted as far as practical.
- The most critical safety issues will be identified.
- These issues will be investigated both qualitatively and quantitatively.
- ASSTAR safety work will provide an early feedback to concept and procedures

8 Issues from chaired discussions

8.1 Radar Applications

John Brown (BOEING) observed that the RFG has shelved C&P – no interest shown by operational stakeholders

J-M Loscos (DSNA) experience from MA-AFAS (spacing) MFF (with & without delegation) showed that to be useful C&P had to be an Airborne Separation category task i.e. Package 2 which is outside the current scope of the RFG – There is no benefit if the controller needs to monitor.

Bob Arnesen (IFAPALA) how is the target identified (clock / distance) … is this seriously the only information used? This was discussed at length in ATC/IFALPA team where it was agreed that only ICAO Flight ID is consistent (not transponder one); it is the one in the flightplan & that goes into the FMS. But note that not every pilot is a native English speaker – letters/numbers can be misinterpreted. Callsign differences between R/T and flightplan and that shown on the display (e.g. SAA123, SPRINGBOCK) are a problem.

John Brown (BOEING) totally agreed that there is an issue to resolve on the flightplan flight ID vs. the one in the FMS. Regarding the clock / distance read back – this is to confirm that the right aircraft is identified.

Anthony Smoker (IFACTA) controller has an issue with using RT callsign. The callsign is there – so controllers will use it. One cannot reliably only use clock position to positively identify target.

Chris Shaw (EUROCONTROL EEC) a more open position can be taken regarding Package 2/3 environment. Consider possibility of a rapid datalink with perhaps mouse selectable targets.

Bill Reabe (FAA) ATC: Multiple comm. syndrome – is this providing ability to reduce separation?

Jean-Marc Loscos (DSNA) even if number messages are increased, the controller can anticipate the conflict (some minutes before he would have done it mentally) then delegate to the crew; so he is relieved from the continuous execution of this crossing that would be necessary if it were managed directly by the ATCO. Operational controllers in Charles de Gaulle & Bordeaux positively accept this scenario.

Anthony Smoker (IFATCA) even if the manouevre is delegated, is the controller still responsible for separation? Additionally, the controller still retains the crossing situation mentally – for strategic planning, and for ensuring that other proximate traffic remains separated form the delegated pair.

Claude Chamayou (DSNA) ASEP-C&P clearly implies DELEGATING separation to the crew.

Anthony Smoker (IFATCA) in the event of an error committed by pilot or controller, or if STCA triggers, or a TCAS event – how is recovery carried out? Such alerts can be triggered by external factors such as military traffic operating in the airspace and not under the control of the active sector, or a level bust in a sector below the active control sector.

Claude Chamayou (DSNA) like today - if ground separation "fails" the next layer is the safety net.

Anthony Smoker (IFATCA) issue: the closer you get to the point of closest approach, then you need large headings to attain the separation standard => this uses up more airspace, and may embrace other sectors or traffic in the delegated manouvere.

Soren Wikerud (LFV) the presentations used four different names: reference aircraft, target, lead, or traffic. (Target is used for military).

John Anderson (University of Glasgow) possible due to incorrect use of terms in a given presentation.

J-M Loscos (DSNA) the group has identified specific nomenclature. MFF used “target”; RFG/ITP used “reference”. For delegated separation, nomenclature rules in the group are clearance a/c, target a/c.

Bernhard Wolfmayr (Austrocontrol) is there a need to inform the target aircraft?

Jean-Marc Loscos (DSNA) information given to the target included proposed optional information (cf. slide); extrapolated from French visual clearance experience.

Bernard Hasquenoph (DSNA) general procedure when crossing executed by controller: “Target A/C” keeps heading, “Clearance A/C” given heading. But does not issue; “resume own navigation” to Target for communications. Reason – it would require 2 extra R/T messages.

Bob Arnesen (IFALPA) are you just crossing behind, or are you specifying a distance as well? It is important that the crossing distance takes account of the weight category of the 'target' aircraft in view of weight vortex concerns the (737 following a 747). The a/c wake category must go into the algorithm.

Panel: The ADS-B message includes a/c weight category information & the algorithm is constructed as per target a/c wake category. The controller should not use the target a/c type as a parameter of the instruction – the airborne algorithm will use that information in the algorithm on board.

John Brown (Boeing) ATCO delegating separation – does he not expect the separation minima will be the same as ATCO applied separation?

Bernard Hasquenoph (DSNA) the controller usually applies radar separation depending on his radar type (monopulse down to 3, en-route up to 12) & tools. When airborne separation is applied, the controller should "not" expect same separation => the airborne separation will be based on high performance NAV (GNSS).

Anthony Smoker (IFATCA) how does the controller terminate & transition a/c back onto initial route? How does the controller cancel the delegation manoeuvre & recover to the standard modus operandi?

Bernard Hasquenoph (DSNA) second point not yet fully analysed; contingency procedure expected plus ICAO contingency of 1/2 vertical separation.

Serge Lebourg (Dassault Aviation) asked about pilot workload,. i.e. adding separation to collision avoidance responsibility – should we consider auto-TCAS?

Bernard Hasquenoph (DSNA) this is not really required.

ICAO: Flight crew already has responsibility for collision avoidance – and applies own separation in case that it has to be applied.

ENAV Experimental Centre. The controller issues are:

- Callsign
- Target informed
- Increase of R/T comm.
- Lateral – controller not sure of deviation ("does not know what the aircraft will do")

Johnny Nilsson (LFV) clean-up phraseology ambiguity:

There are 3 different headings and 3 different airspeeds: -We now have the chance to remove the ambiguities - what is unambiguous (instead of heading) is Ground Track.

3 different headings (are they of interest?) – Track is what you need – implying 3 different airspeeds.

What are the capabilities and relationship to phraseology if Trajectory Change Points become available? Lots of Controller issues that came out of MFF would be removed, and would feed ground probes (e.g. MTCD) if TCP used.

John Anderson (University of Glasgow) algorithms should provide pilots with displayed information that will be the most appropriate.

Jean-Marc Loscos (DSNA) (D/L)datalink – we put ourselves in near-term approach (extrapolate from current) and not impose too many options. In France, we consider that D/L should be available soon; it is launched and can be used – but other D/L issues (latency, integrity, availability) need to be considered.

In G2G: D/L was used to transmit info (callsign …): unambiguous, safer, and strategic instructions (not tactical).

For S&M: did not use D/L as tactical.

Maria del Mar Tabernero (AENA) why did you call these 'radar' applications and not include ADS-B as potential ground surveillance solution to support the applications?

Jean-Marc Loscos (DSNA) focused on Mode-S, looks at ABS-B , but do not believe that in core area ADS-B responds to needs. Today-> tomorrow transition: today ATCOs rely on radar – so we need to understand how the ASAS could be integrated into the environment.

Bob Arnesen (IFALPA) ANSPs' upgrade to ground system is on-going to include conflict prediction in system => can see these a long time ahead.

Based on this advanced ability available on ground, a simple instruction can be given to the aircraft to turn – small heading change.

Cedric D'Silva (THALES Avionics) on-board you can calculate an optimized trajectory (as done for the FMS today), with data not available in the ground system: atmospheric and meteo conditions to be considered.

Mario del Mar Taberno (AENA) we should identify 2 types of airspace: Surveillance/non Surveillance vs. RADAR.

John Brown (BOEING) this application is not going to go into operation so soon (2020?). How does this transition into 4D environment?

Tony Henley (BAE SYSTEMS) should support a tactical manoeuvre and still maintain a 4D contract.

Chris Shaw (EEC) i.e; keep the FMS engaged and still execute tactical & strategic combination.

8.2 Oceanic Applications

Walter Dollman (QANTAS) SSEP-FFT: Is target aircraft expected to fly straight during procedure? If not, how does aircraft using procedure know about intent of target?

Nico de Gelder (NLR) the issue will be handled by conflict detection/resolution application in both aircraft. The procedures will be based on state information only. Intent information on target aircraft is not foreseen to be required. It should be noted that both aircraft in FFT will be active.

Pierre Gayraud (Thales Avionics) shouldn't the safety assessment for ASEP-ITP be very different from that for ATSA-ITP? The safety concerns for ATSA have been addressed by the RFG and are relatively easy, while the ASEP procedures need in-depth analysis, similar to that for ground surveillance.

Bart Klein Obbink (NLR) ASSTAR does not claim to take the safety case to the very end, but rather to compare the applications and their safety benefits. The difference in the applications will be taken into account, but the methodology to assess this will be the same. The results on risk calculation prepared by NASA for ATSA-ITP will be taken into account and changes for ASEP-ITP will be quantified.

Richard Barhydt (NASA) the RFG has identified the major safety concerns with ASEP; mitigation means are required in case of ASEP equipment failure.

Richard Watters (BAE SYSTEMS) ASSTAR will do a preliminary assessment of hazards and identify differences in the cockpit application between ATSA and ASEP. (Differences not known, yet) This preliminary assessment will then be taken into account for the infrastructure and procedures definition. ASSTAR hopes to be able to identify and address relevant risks (e.g. loss of functionality, incorrect display of information...). Integrity issues of position sources will not be investigated in detail, the existence of such sources with sufficient accuracy and integrity will be taken for granted.

General discussion (Andy Barff, Richard Barhydt, Christian Denke):

Analogy to DME-based separation. There is a need to also provide new separation standards for ground controllers in case of ATSA-ITP. ADS-B separation minima are not yet defined by ICAO (unlike DME separation).

Requirement for 10NM. Values of ATSA-ITP (distance/closure rate) are set to ensure that 10NM is maintained during entire procedure under all circumstances.

Pierre Gayraud (Thales Avionics) will ADS-B be used just to confirm information obtained otherwise in ATSA-ITP?

Bart Klein Obbink (NLR) the only relevant source of surveillance information in both ATSA-ITP and ASEP-ITP is derived from ADS-B and own navigation. The information available for ATC is not sufficiently accurate to allow any ITP procedure. Also in this respect, there is not much difference between the two applications.

Richard Watters (BAE SYSTEMS) in ASEP-ITP, there will be a "confirmation" of the feasibility by the ground controller during initiation, but no monitoring on the ground during the procedure.

Taji Shafaat (Boeing) how does a pilot determine during ASEP the quality of the ADS-B report of the target aircraft?

Christian Denke (ECA) RNP categories are defined, will these be used in ASSTAR?

Nico de Gelder (NLR) there are two options, either define minimum RNP values for ASEP, or to use the actual position integrity values being reported by ADS-B. Problem with second solution is that the integrity value may change during the procedure. Current plan in ASSTAR is to base it on RNP-4.

Christian Denke (ECA) currently on oceanic: RNAV-10. DME-based: RNP-1. ASSTAR plan: RNP-4.

Robert McPike (NATS) algorithms may depend on RNP-type of aircraft involved in procedure.

Andy Barf (EUROCONTROL EEC) & Pierre Gayraud (Thales Avionics)

Difference in requirements on accuracy should be remembered:

RNP: includes requirements on accuracy of position AND guidance.

ADS-B: only involves position.

Bart Klein Obbink (NLR) yes, for ASSTAR we will need only position accuracy. Procedures will require specification of minimum accuracy values and must not be used if these minima are not met. RNP category may be used as an INDICATION of position accuracy, but this is not certain, yet.

Richard Barhydt (NASA) it should be noted that even the higher minima of 10 NM provides HUGE benefits compared to the current separation minima!

Eric Hoffmann (EEC) in 2009, RNP-4 with 30/30 separation is expected. What is then left of the ASSTAR benefits? Doesn't this make the proposed applications obsolete?

A (not given): The 2009 RNP-4 scenario is not certain. ASSTAR is working on procedures that work today and can be implemented in the current, real environment.

Bob Darby (EUROCONTROL HQ) RNP values are based on comparison between GPS accuracy and a RADAR reference. What is the reference definition for the oceanic airspace?

Bart Klein Obbink (NLR) this is a valid point, but we should remember that ASSTAR is a research project and can not solve this. RFG needs to address this. ASSTAR will focus on the "delta" of the different applications.

Bob Darby and Richard Barhydt these issues (minima values) do apply for ATSA, as well, but the problem with ASEP is the change in responsibility!

Richard Watters (BAE SYSTEMS) if we were to stretch the use of new technology to the full extent, we would struggle to get aircraft equipped. We need to be pragmatic in order to get a solution out as soon as possible to as many aircraft as possible.

Christian Denke (ECA) why does ASSTAR not investigate lateral manoeuvres (i.e. overtaking) in ASEP? Isn't this useful in oceanic airspace? And why not allow horizontal manoevures in SSEP-FFT? There is a need to overcome limitations introduced by preceding traffic!

Nico de Gelder (NLR) for the first 6 months of ASSTAR, several manoeuvres were investigated, including lateral overtaking. But we needed to focus on a few procedures. After the user feedback at the first User Workshop, lateral overtaking was not on the top of the list, potentially due to high requirements on aircraft equipage. Also, an overtaking manoeuvre in oceanic airspace will take quite long (several hours), due to relatively small speed differences.

Taji Shafaat (Boeing) is the crew required to monitor the separation during ITP? If so, doesn't this require some sort of alerting function?

Nico de Gelder (NLR) for ATSA-ITP, there is neither a need nor a requirement for monitoring once the clearance has been issued. In fact, the ATSA equipment may fail completely during the manoeuvre without affecting the procedure at all.

For ASEP-ITP, the crew needs to monitor, but the manoeuvre will take only a few minutes.

For ITF, which can last several hours, alerting is required.

Bart Klein Obbink (NLR) although crews are not supposed to monitor in the ATSA-ITP application, they have the means and they will actually do it; compare this to the current custom to scan the ACAS display.

Presumably, crews will act if the situation does not develop as expected although the description of ATSA-ITP does not seem to admit this, and does not present procedures. The ATSA-ASEP application instead requires the crew to monitor, and does provide an alert in case of a potential conflict and will provide procedures. All this can be expected to bring safety benefits.

Andy Barff (EUROCONTROL EEC) why does ASSTAR not work on FFT procedures on ALL oceanic tracks?

Nico de Gelder and Richard Watters we would love to do that, but the project scope is limited. Integrity requirements for such a scenario are extremely high and installation may thus be difficult. The restriction not to allow lateral passing lowers requirements for certification.

Christian Denke (ECA) has ASSTAR accessed the very real issue of strong wind patterns in limited areas, creating a dynamically changing separation situation? This effect could lead to situations where the target aircraft is flying into a strong headwind with subsequent drop in ground speed much earlier than the following aircraft, thus creating a fast closure rate between the two aircraft. Current observations show great susceptibility of FMS ETA value to such wind patterns. (ETA changes several minutes within a very short time frame.)

Nico de Gelder (NLR) this is not a problem, if separation is given as a time value and measurements are based on time comparisons between the aircraft. We have not yet selected, whether we will use time-based or distance-based separation for the various ASSTAR applications.

Christian Denke (ECA) this is a very significant issue, the system design must accept these situations.

Richard Watters (BAE SYSTEMS) all participants should raise further questions in the next 2 days and also have a look at the list of ASSTAR questions presented by Nico de Gelder.

Further feedback via e-mail is appreciated.

9 Concluding remarks

9.1 Radar Applications

- Target identification and feedback from pilot (clock / distance) & Flight ID/callsign use.
- Informing the target aircraft was considered to be optional.
- The best place to calculate an optimized trajectory is on-board (as done for the FMS route today - it contains data not available in the ground system: atmospheric, met. conditions, aircraft performance specific to each aircraft…)
- Concept can manage ASAS tactical manoeuvres and still use 4D (i.e; keep the FMS engaged and execute both tactical & strategic).
- Datalink is an option, particularly for Trajectory Change Points but idea was not to impose too many options, especially since other Datalink issues (latency, integrity, availability) need to be considered.
- ASEP-C&P clearly implies DELEGATING separation responsibility to the crew. In case of error the procedure remains identical as today: ICAO contingency procedure; if separation "fails", next layer is safety net => ground: 1/2 vertical separation exists. Similar for airborne separation failure: aircrew already has responsibility for collision avoidance – and applies own separation if it has to be applied. (Auto TCAS not favoured).
- Separation minima vary today as a function of surveillance means (monopulse: 3Nm, en-route ~12Nm); airborne separation has no obvious reason to be the same, moreover, it is based on high performance NAV (GNSS), so should provide higher performance separation.
- ASAS C&P pilot-controller transaction needs to be minimized in line with current procedure.
- Controller may also retain the crossing situation mentally – for his next step strategic planning – but continuous monitoring of the involved aircraft crossing manoeuvre is removed.

- ATCO can anticipate the conflict well in advance compared to when he would trigger the ATCO controlled crossing, avoiding a large heading change.
- Consider that the applications fall into the Airborne SEParation category – Controller not needed to monitor, otherwise operational interest will be nil.
- Target aircraft wake category is a parameter in the ASAS algorithm and the data should be available from ADS-B.
- Nomenclature / terminology / phraseology to be standardised
- In considering a transition scenario (today-> tomorrow), the ATCO relies on radar, so the primary objective is to understand how ASAS will be integrated into the radar environment.

9.2 Oceanic Applications

- In the SSEP-FFT applications, all aircraft are “active” and will prevent, detect and resolve conflicts with all other aircraft on the Free Flight Track.
- Integrity of ADS-B position information in relation to the RNP concept is to be further explored.
- The ATSA-ITP is considered to be defined by RFG. From the safety perspective, ASSTAR will look for the “delta” between ATSA-ITP and ASEP-ITP. Given the discussion at this workshop, it is questioned if ATSA-ITP is an ATSA or in fact an ASEP application. RFG and ASSTAR are invited to further explore this.
- The reference case for the North Atlantic should be properly chosen. The current procedural separation over the NAT will be replaced in 2009 by 30/30 and RNP 4.
- Alerting for the ITP and ITF applications is to be further detailed.
- SSEP on the organised track system is chosen in ASSTAR to address the user need for a “stepped” implementation towards full SSEP. However, ASSTAR or follow-on projects are encouraged to use the lateral options in both ASEP and SSEP.
- Impact of headwinds on ASEP-ITF needs to be taken into account and a time-based strategy is likely to be employed.

Finally, all participants are invited to answer the questions as raised in the various ASSTAR presentations. Further feedback via e-mail to Richard Watters is appreciated.

C. Session 3a – ASAS implementation the MFF experience

10 Introduction

This session was chaired by **Billy Josefsson** from LFV with **Pietro Rotundo** from ENAV as the secretary.

Five briefings were presented in the session:

- MFF outline by Maurizio Zacchei
- Civil-Military Cooperation as a key factor of ASAS implementation by Ltc. Maurizio Smanio
- MFF safety case for ASAS spacing and separation by Alberto Pasquini
- MFF avionic issues as addressed during flight trials by Sileno Goedicke
- MFF economic appraisal of a possible implementation by David Booker

11 Review of the briefings

11.1 Maurizio Zacchei (ENAV)

Brief description

MFF is a pre-operational programme aimed at defining, testing and validating Free Route (FR) and ASAS applications and procedures within en-route scenarios in Free Flight airspace (FFAS) and Managed Airspace (MAS) as well as the transition between the two. All the ASAS applications (S&M and C&P) have been tested with two levels of delegation: A3 (so called ASAS Spacing) where ATCOs remain responsible of the separation; and A4 (so called ASAS Separation) where responsibility for the separation was totally transferred to the air crew.

Key issues in the presentation

- MFF is a five-year programme co-funded by the European Commission DG TREN within the TEN-T Framework; Experts from nine countries with different cultural backgrounds participated in the programme; **VDL Mode 4** proven adequate for ADS-B & TIS-B and compliant with ADS-B requirements through several validation exercises and live flight trials.

11.2 Ltc. Maurizio Smanio (Italian Air Force)

Brief description

This presentation presented the results of the Italian Air Force experience in MFF Real Time Simulations. The presentation highlighted the favourable opinions from military controllers on usability of the ASAS S&M technique, especially in terminal areas. On the other hand the ASAS Crossing & Passing (C&P) was found not feasible to implement mainly due to the effort required to set up a C&P condition, e.g. cumbersome phraseology and complexity of traffic in a high density area.

Key issues in the presentation

- Full understanding of the military requirements, constraints and opportunities was realised in the MFF programme. This added realism to all the scenarios.
- From Military ATCOs point of view ASAS S&M reduced the workload.
- A major constraint for the Air Force is the fact that they need to be compatible with the "civil" ground and on board technology. There is a physical constraint - need for space in cockpit, further the costs are up to three times the costs for a civil aircraft.
- Crossing & Passing was found too complex to be used.

11.3 Alberto Pasquini (Deep Blue)

Brief description

The aim of the safety assessment of the Mediterranean Free Flight (MFF) project was to evaluate the possible risks implied with the use of the MFF procedures. The process adopted was based on the Safety Assessment Methodology of EUROCONTROL and the ED78A Guidelines. Safety objectives were identified using a comparison with the current Air Traffic Management safety level, to guarantee that the adoption of MFF procedures does not increase and, where possible, decreases the number of ATM induced accidents. The presentation described the approach adopted, with emphasis on the usage of operational expert opinion, on the benefits and problems experienced, and on the main results concerning the safety of ASAS Spacing and ASAS Separation and of the safety requirements identified during the assessment.

Key issues in the presentation

- Reusable results allow further investigation and fine tuning of the ASAS Applications.
- Early feedback to the project to steer the project activities. Safety assessment was an active process along the entire programme.
- C&P application was found not acceptable due to lack of room for recovery procedures.
- Non-nominal events were simulated to evaluate the "system" reliability.

11.4 Sileno Goedicke (ENAV)

Brief description

In preparation for the MFF Flight Trials an appropriate ASAS avionics suite was designed and implemented. During the Flight Trials 240 flying hours were spent examining ASAS applications between real aircraft, and real aircraft vs. simulated ones. A retrofit solution was implemented to comply with airworthiness authority specifications for temporarily installations. Full integration with the navigation avionics was the ultimate goal but not possible to realize within MFF.

Key issues in the presentation

- Pilot workload was considered high due to the retrofit solution (separated display and input device); ASAS functions and algorithms must be integrated with FMS and Air Data Computer Traffic picture, and ASAS information should be integrated within the Navigation Display in a flexible way.
- Intent information was identified as critical for C&P.
- Need for monitoring function e.g. visual / aural alert identified in the case of infringement on separation.

11.5 David Booker (EUROCONTROL HQ)

Brief description

The MFF programme investigated the implementation costs for ground and airborne equipment and the potential operational benefits, cost savings and environmental impact of the MFF

applications. Costs were derived for applications A1 to A3 but no cost information could be determined for ASAS Separation and Airborne Self Separation Assurance and no capacity benefits were evaluated. Thus, only a partial evaluation could be carried out.

Key issues in the presentation

- About half of the aircraft operating in Europe use MFF airspace and thus a large proportion of the European fleet would have to be equipped.
- Due to the large number of aircraft involved, the high cost of airborne equipage and the relatively low cost of ground equipment, the majority of the costs (>90%) are incurred directly by the aircraft operator.
- Cost for the airborne equipage required for military aircraft are about three times higher than those for civil aircraft.
- Because of the use of data from the secondary surveillance radars in the MFF area by centres outside the MFF area and for approach control, the scope for rationalisation of the existing infrastructure is limited.
- Simulations derived the potential time and fuel savings which may be produced by the Free Routes application. On the basis of these, a very high return on investment (81%) would be achieved. However, the time savings consisted of small savings averaging 1.6 minutes per flight and it is doubtful whether these may be turned into a useable operational benefit. Considering only the fuel savings, the return on investment is negative.

The Mediterranean area is a very good one for testing and validation activities but it is not the area of Europe where the major operational benefits may be expected to be derived. However, since the equipment required for MFF is likely to enable aircraft to benefit from ATM developments elsewhere, MFF should be seen in the context of similar developments throughout Europe and beyond.

12 Issues from chaired discussions

Economic appraisal feedback

- Proportion of cost for implementation is around 10% for ANSPs and 90% for Airlines however the figures must be seen in a wider context.
- Avionics is already becoming cheaper as industry better understands the requirements, standards are being developed and the market is slowly increasing.
- Avionics for military needs cost three times the civil ones.
- Even if retrofit solution is possible it is strongly recommended that ASAS/ATSAW functionalities will be integrated with FMS, Air Data Computer and Navigation Display.
- Retrofit solutions could help during the transition phase.
- Approx 45% of aircraft are eligible for retrofit solution. “Electronic flight bag” EFB could be the preferred step. EFB will be possible to install where there is limited space.

Operational feedback

- Flight efficiency is progressively improved especially considering transit phase between flights. Maybe new metrics are required to evaluate the system efficiency. However it was also noted that ongoing initiatives are in progress to increase transparency and increase efficiency e.g. CDM / SWIM.
- ATCOs workload reduction should be evaluated in terms of cost saving taking into account the possible capacity gain where demand is higher than capacity.
- Redundancy of onboard equipment may not be a solution in time critical situations due to too long a “warm up time”.

- Backup is important but actors should be confident in and trust their own tools, methods and procedures.
- Even if figure of merit of position data is available for each system, there is a strong pilot requirement for a consistent airspace classification including separation minima.
- Availability of downloaded intent data will reduce ATCO workload and help ATCOs to deal with C&P in a more efficient way.
- Involvement of the military from the beginning is fundamental for valuable results.

13 Concluding remarks

MFF evaluated the feasibility of some key ASAS applications in a very pragmatic way taking safety and operational aspects into account. The S&M application was in general found feasible for en-route for all actors including military ATCOs. The C&P was found less mature and even unsafe mainly due to the lack of intent information and the non-availability of dedicated ATC tools to support the set up of C&P. Further, the economic appraisal together with the safety case gave additional valuable information and indications about the areas that need further investigations.

The MFF results are believed to be valid for other contexts and environments in particular the safety and the operational outcome. Further, the MFF results are applicable to the current implementation roadmap in the Mediterranean area.

D. Session 3b – ASAS/ADS-B in the Mediterranean

14 Introduction

This session was chaired by **Giancarlo Ferrara** from ENAV with **Giorgio Matrella** also from ENAV as the secretary.

- Four briefings presented in the session:
  - MFF: The key results by Andy Barff
  - G2G: AMAN and ASAS spacing in the future ATM system by Vincenzo Melgiovanni
  - CRISTAL MED: A local ADS-B enabled Mediterranean solution by Cristiano Cantoni
  - SESAR: The way ahead by Cristiano Baldoni

15 Review of the briefings

15.1 Andy Barff (EUROCONTROL EEC)

Brief description

MFF studied all aspects of "freer flight" in the Mediterranean area from Free Routing to ASAS Self Separation. Whilst these 2 concepts at either end of the scale proved to be feasible with potential benefits, the study of other applications such as ASAS Spacing and ASAS Separation did not have such clear results. The presentation tries to clarify the situation and provide a clear picture of current understanding of these applications often described as "limited delegation" and offer a way forward for the integration of ASAS in future ATM.

Key issues in the presentation

Free Route

- Can be successfully applied in the Medium/Low density airspace of the Mediterranean.
- Problems encountered in denser traffic regions close to the North Mediterranean coast.
- Where the concept is appropriate:
  - ✓ 3% saving in fuel burn compared with current operations (fixed route + widespread direct routing).
  - ✓ Potential problems identified and solutions described (Mil areas, controller support etc.)

ASAS Self separation

- ASAS Self-Separation appears very beneficial for airlines.
- No showstoppers found for ASAS Self-Separation in challenging environments.
- Potentially very efficient – minimal ground infrastructure, most efficient flight trajectory therefore also good for the environment.
- Concept of tolerance. Separation standard and violation. Margin to be used.

ASAS Spacing

- ASAS Spacing can be applied to arriving streams of traffic under optimum conditions:
  - ✓ Route structure (ideally PRNAV) and sectorisation.
  - ✓ Early preparation of the traffic.
  - ✓ Minimum of interfering traffic.
  - ✓ Consider CPDLC to reduce R/T and increase safety.
  - ✓ Training must not be underestimated – ASAS Spacing is a new way of working.
- Focus should be on "in-trail" applications - Remain Behind and Merge (plus Heading and Merge under specific circumstances).
- Crossing and Passing rejected as a "Spacing" application:
  - ✓ Hazards, complexity, additional issues identified.
  - ✓ Lengthy set-up, monitoring/uncertainty workload.
- Keep It Simple!
  - ✓ Current controller instructions are very simple – for good reasons.

ASAS Separation

- Not deeply investigated due:
  - ✓ Legal issues will have to be overcome.
  - ✓ No separation standard yet established.
  - ✓ Potentially a second step after ASAS Spacing.
  - ✓ EC asked MFF to concentrate on ASAS Package 1 (Spacing).
- Controllers appreciated the concept and would use it in Mediterranean airspace – particularly in areas of poor surveillance.
- Need to know the area within the manoeuvre will be contained.

15.2 Vincenzo Melgiovanni (ENAV)

Brief description

The presentation reported a summary of the G2G programme, which is one of the most important ATM projects funded by the European Commission, within the 5th Framework Programme.

The high level project objective is to define and validate a European gate to gate operational concept.

To this end ENAV has been involved in organising and conducting the RTS3A at the ENAV Experimental Centre in Rome, where the integration of ASAS spacing procedures and AMAN were evaluated in a realistic working environment based on the extended Rome TMA.

Investigated Operational Concepts were:

- AMAN, Arrival Management improvement.
- ATCO CWP and Working Methods improvement.
- ASAS Spacing Applications.
- E-TMA/TMA Co-ordination.

Three different organisations were tested:

- Baseline (replicating, as close as possible the current operational Rome ACC environment).
- AMAN (Rome ACC environment with introduction of the AMAN System).
- AMAN/ASAS (Rome ACC environment with introduction of both AMAN and ASAS).

Key issues in the presentation

- ASAS Spacing applications allowed controllers to better comply with the Instructions/Advisories provided by AMAN.
- It was extremely difficult to comply with AMAN advisories and/or apply ASAS spacing applications in unusual circumstances such as runway closure or severe weather.
- When using AMAN/ASAS a better distribution of the workload is created between the EXE and PLAN Controller.
- Better spacing application results achieved when implemented at least 80 NM from the IAF.
- Phraseology must be refined.
- ASPA S&M needs adequate recovery procedures in case of failure modes.
- Target should be aware of its involvement in ASAS spacing.
- Re-designed ATS geography can increase benefits when involving AMAN/ASAS concepts.
- ATCOs should be provided with suitable tools for assessment of delegation feasibility (probe facilities).

15.3 Cristiano Cantoni (ENAV)

Brief description

CRISTAL-MED is a pioneering programme aiming at the validation of some of the ADS-B Package 1 applications that are expected to solve local operational constraints.

ASAS concepts are not directly involved in CRISTAL-MED, but ADS-B in the workshop context is seen as an opportunity to highlight ADS-B potentials that can result in an important enabler also for ASAS future implementations.

The program aims at validating four ADS-B out services:

- Ground ATC surveillance in non-radar airspaces.
- Ground ATC surveillance in radar airspaces.
- Airport Surface Surveillance.
- Provision of Aircraft Derived Data (ADD) – only for local investigations.

ADD has been considered for this stage a non-mature service for this validation step. However, some CRISTAL-MED partners at local level are still investigating ADD issues.

For all the applications, the whole project followed the guidelines provided by the RFG. A first step analysis to correctly approach these applications has shown different maturity levels for the concerned services, as reported also in the ASAS-TN2 WP3 document. As a matter of fact, many activities have highlighted good progress in NRA, with relevant examples in Australia and important implementation activities that are now being implemented in La Reunion. For ADS-B-APT and ADS-B-RAD there is a lot of work to perform at requirement definition level, but many issues have

already been collected at local level and CRISTAL-MED is an example of how local ANSPs can be proactive in deploying global guidelines and focusing validation activities where real operational need currently exists.

CRISTAL-MED is divided into two phases. The first can be considered as preparatory to the second phase, which comprises validation activities that will take place in sites identified on the basis of the existing operational constraints. In the second phase, validation will not be tackled for the sake of validation itself, instead the target is to obtain operational acceptance for a real pre-operational implementation. The first phase is currently ongoing and is specifying validation exercises and procedures to be applied at operational level.

Among the overall added value of the project, will be the definition of a common strategy for implementation. Common technical specification for both local deployments and the network will allow to faster overall operational acceptance and expedite local implementation. The overall model created at local level will allow a flexible reuse for other local implementation.

Key issues in the presentation

- Targeted ADS-B out applications addressed not as a general concept but to be deployed and validated at local level.
- Synergies among the Consortium to allow optimization of effort and to share different experiences.
- Different maturity levels taken into account for the applications concerned; this had a strong impact on ATCOs' review of proposed procedures.
- ADS-B applications to be implemented where real operational need exists.
- Operational needs already identified in local environments for the five CRISTAL-MED partners.
- Validation planning activities still ongoing: the target is the definition of validation objectives and exercises.
- The 2nd phase target is operational acceptance of ADS-B proposed applications.
- Operational acceptance performed in a stepped approach with technical validation at the very first steps.

15.4 Cristiano Baldoni (ENAV)

Brief description

SESAR addresses the limitations of ATM in the near future. Single European Sky addresses the regulatory framework and highlights the need for an innovative ATM system for Europe and a plan which each stakeholder can commit to. SESAR will use these requirements to deliver the new European ATM system and draw up a Master Plan.

The project is set on industrial principles, through a 6 step process leading to its final result. Each step will bring valuable deliverables for the Community.

A traditional bottom-up approach will be limited to the "Short term improvement plan (2008-2012)" which will bring together all on-going initiatives and available/mature technologies in an achievable detailed working plan, to optimise the performances of the legacy systems and processes and improve their interoperability.

A Top-Down approach will deliver the ideal target ATM System, a vision shared for the first time by all Air Transport stakeholders. This will be the technological layer for SES, toward which all Europe commits to converge within the next 15 years.

Its Master Plan will guarantee a step-by-step approach to the target, suitable and sustainable for all European regions.

A consortium has been formed consisting of a large portion of ATM Industry has signed a contract and is committed to deliver a plan which will stick to those key aspects:

- ✓ Build on / deliver benefits as envisaged in SES legislation.
- ✓ Meet airspace user requirements.
- ✓ Focus future activities via well defined ATM Master Plan:
  - Owned by all stakeholders.
- ✓ Guarantee current / future investments lead to mutual business benefit.
- ✓ Accelerate deployment of technological & operational improvements.
- ✓ Co-ordinate air – ground infrastructure developments.

The major objectives are:

- ✓ To define future high level ATM network performance requirements:
  - To 2020 and beyond (capacity, safety, cost).
- ✓ To identify the target ATM system for 2020.
- ✓ To identify globally interoperable and harmonised ATM solutions:
  - Future concept of operations.
  - Technical systems architecture & specifications.
- ✓ To define how to achieve the above:
  - Detailed and phased implementation and deployment plan (viable transition scenarios for ANSPs, airspace users and airports).
  - Detailed Research & Technology & validation work programme.
  - Legislative, financial and regulatory framework.

<u>Key issues in the presentation</u>

- SESAR intends to follow a pragmatic approach for incremental improvement as has been the case in most of the Master Plans conceived in the last decade.
- A traditional bottom-up approach will bring together all on-going initiatives and available/mature technologies in an achievable detailed working plan, to optimise the performances of the legacy systems and processes to improve their interoperability. (2008-2012).
- A Top-Down approach will deliver the ideal target ATM System that will be the technological layer for SES, toward which all Europe commits to converge within the next 15 years.
- The recently signed contract shall accelerate deployment of technological & operational improvements and guarantee current / future investments lead to mutual business benefit.
- ASAS further developments have to be incorporated into SESAR ongoing activities.

16 Issues from chaired discussions

MFF Free Route and self-separation were extremely promising in the Mediterranean region and clearly defined the benefits in low and medium traffic density environments. ASAS applications should be referenced to the appropriate context. If we want to fit ASAS into a new environment, we need to redesign a proper ATM system. Airway structures should be further addressed, and P-RNAV routes seem to be the proper enabler. Also a well structured environment such as in oceanic areas could use properly the appropriate ASAS applications.

In Trail Procedure seems to be good in the upper airspace, especially when the flow is organised properly in advance. On the other hand an early organisation may not be sufficiently adaptable and flexible to the changing environment. Usually a system becomes less flexible when the capacity limit is approached. If there is no capacity issue, aircraft can fly at their requested levels and start their descents at their optimum TOD.

In high-density airspace the goal is to reduce tactical intervention. C&P applications in managed high-density airspace are much more difficult to implement, taking into account the manoeuvring area and possible interference with other traffic. No clear benefits were identified for ASEP applications especially in the core Europe area, since these concepts seems better adapted for low density areas with poor surveillance.

INTENT Data may help to organise traffic earlier and facilitating the implementation of ASAS applications. MFF results have shown that INTENT Data may help in heading and merge instruction. The idea is to make better use of the existing information from the aircraft to feed the ground system. A common view might reduce tactical intervention. INTENT Data could also feed the airborne side. On the other hand we should clearly define what information we want from the FMS and taking into account the latency of the data-link operations that may affect its possible benefits.

It was noted that INTENT Data may facilitate the implementation of the Continuous Descent Approach. On the other hand optimising one single aircraft's best performance does not optimise the overall ATM system performance. The primary need is to address the best average performance of the overall ATM system. .

There is a strong impulse on local implementation for ADS-B out applications. Especially NRA / RAD, which looks most promising for solving local operational constraints with high resource optimisation. APT also has been strongly advocated for solving local operational problems, adding important improvements to the whole local environment concerned.

Countries must group together to find synergies towards implementation. The Mediterranean experience shows clear benefits in terms of common activity definition leading to operational acceptance.

For local validation purposes, especially technical, ongoing activities devoted to validation and certification in Australia and in CASCADE local programmes will be fully exploited and taken into account at Mediterranean level.

It is very important for ASAS / ADS-B validation results to provide the right vision for SESAR. The selection process of the most promising operational concepts identified by SESAR will have to be based on robust CBA.

It is of the outmost importance to focus on community education, and to try to involve more people and have a common understanding of the ASAS / ADS-B issues.

17 Concluding remarks

- Free Route and Self Separation are extremely promising in the Mediterranean region (low and medium traffic density).
- Need to redesign a proper ATM system if we want to fit ASAS into a new environment. Airway structures should be further addressed, and P-RNAV routes seem to be the proper enabler.
- In trail procedures are promising in the oceanic scenario due to the well-structured environment. Same conclusions are applicable for the upper airspace.
- Early Traffic Synchronisation coupled with a sufficient degree of flexibility in the ATM system may be helpful for ASPA procedures.
- In managed high density airspace C&P applications are less feasible due to the uncertainty of the ASAS manoeuvring area and possible interference with other traffic.
- INTENT Data, can provide useful information to support ASAS implementation.
- Countries must group together to find synergies towards ADS-B out implementation. The Mediterranean experience (CRISTAL-MED) shows clear benefits in terms of common activity definition leading to operational acceptance.
- The selection process of the most promising operational concepts performed by SESAR has to be based on robust CBA.
- Key issues for ASAS / ADS-B implementation is to ensure the SESAR buy in and to share results with all the aviation community.

E. Session 4. Integrating ASAS in an evolving ATM system

18 Introduction

This session was chaired by **Peter Howlett** from Thales ATM with **Tony Henley** from BAESYTEMS as the secretary.

Six briefings were presented in the session:

- Short summary of day 2
- ASAS application maturity assessment by Bill Booth
- Airbus views ob implementing ASAS by Christophe Maily
- An ANSPs implementation plan by Luc Deneufchâtel
- Getting ready for ASAS by Jan van Doorn
- ASAS in tomorrow's airspace by Anthony Smoker

19 Review of the briefings

19.1 Bill Booth (ASAS-TN2)

Brief description

Bill gave a quick overview of the work undertaken in WP3 of ASAS-TN2 to develop a maturity assessment of ASAS applications. A first version was available at the workshop and participants were invited to review and comment on this document.

This is a living document that will be periodically updated to reflect progress made on the various applications in the timeframe of ASAS-TN2.

19.2 Christophe Maily (Airbus)

Brief description

Main challenges of ATM (increase capacity, increase absolute level of safety, respect environment, improve predictability, improve robustness of schedule, and ensure global interoperability) could be facilitated by ASAS, but ASAS is not the only enabler to be considered.

Generally speaking, there are three enablers to future ATM: Communication (CPDLC), Navigation (RNP) and Surveillance (ADS-B/ASAS).

Airbus sees ASAS as an enabler to the future ATM for specific situations, such as Sequencing and Merging, and to relieve the controller from certain tasks/responsibilities, under the condition that the airspace is adapted to allow this type of operations:- new navigation capabilities; ensure predictability; provide tools for controllers; delegation of tasks from controller to the flight crew.

The Airbus roadmap on ADS-B is based on a stepwise approach:

- 1st step: ADS-B OUT for ground use
- 2nd step: ATSAW
- 3rd step: Spacing
- 4th step: Separation

For each step, Airbus associates a defined industrial architecture:- ADS-B transmitter; then ADS-B receiver + displays; then coupling with FMS/AutoPilot. Separation architecture is currently not studied.

- 1st step: ADS-B OUT for ground use:
    - Certification planned for end 2006, to answer Australian needs.
- 2nd step: certification planned for end 2008, for an integrated solution (i.e. traffic displayed on Navigation Display).
- 3rd step: no current plans, 3 years minimum after launch due to the systems impacted.
- 4th step: no current plans regarding separation. Self-separation requires more research before credible plans can be established.

CASCADE has a good pragmatic approach (standardization, validation), SESAR will be a good enabler to get commitment from the aeronautical community, and funding mechanism where return on investment is difficult to achieve.

Key issues in the presentation

➔ Self-separation not mature enough to be implemented in aircraft and does not appear to be compatible with increased predictability. We should avoid delaying intermediate steps because of potential constraints linked to future applications. Priority and standardization efforts should be given to initial Ground and ATSA applications.

19.3 Luc Deneufchâtel (DSNA)

Brief description

1. Regarding ADS-B out, DSNA is involved in several activities for several years. Those activities are of various natures:

For ADS-B, two initiatives are in progress to validate basic principles:

- ADS-B RAD in Corsica (CRISTAL Med frame work).
- ADS-B APT at Marseille aerodrome (CRISTAL Med frame work).

For operational purposes:

- ADS-B NRA in la Réunion.

The operational deployment of ADS-B out at La Réunion is organised in a stepwise approach dependent on the performance evaluations and on a successful safety analysis. As a first step, ADS-B out will produce no change to the operational procedures at La Réunion. As a second step, potential operational changes (reduction of the traffic separation minima) could be introduced but not before mid 2009, depending on proper completion of validation and successful safety analysis.

After this pilot site implementation and if successful, DSNA should decide on the opportunity to continue ADS-B out implementation:

- New Caledonia (ADS-B NRA).
- French Polynesia (ADS-B NRA & ADS-B RAD).
- Metropolitan France (ADS-B RAD).

2. Regarding ASAS applications, DSNA has been involved in several R&D projects since the beginning; they cover:

- Airborne Traffic Situational Awareness.
- Aircraft Spacing in Sequencing and Metering context.
- Aircraft Separation.

The objective of all these R&D activities is to identify the real issues and to be in a better position to correctly quantify the expected benefits.

The single ASAS application foreseen by DSNA as really promising is Spacing within a Sequencing and Merging concept at a limited number of busy airports:

- Benefits identified are mainly in terms of capacity and efficiency.
- Partial answer to the need for runway capacity increase in all weather conditions by reducing the separation margin in approach from today's practices.

Key issues in the presentation

1. Implementation of ADS-B out in a real environment is raising some basic issues that need to be properly addressed and solved:

- Resolution of the integrity issue on the positioning data (ADS-B out issue): today's observations need to be properly investigated.
- Elaboration of consistent airworthiness rules for ADS-B out first (this is the key point for any ASAS applications).

Those issues require a standardization activity and a validation activity from real experience, and that implies early deployment of ADS-B out capabilities.

2. Regarding ASAS application implementation, there is a strong prerequisite that must provide the answers to:

- Issues identified above.
- Definition of the minimum ratio between ASAS capable aircraft and non-capable aircraft operating at the same airport to show that there is sufficient benefit to move ahead (minimum threshold definition).
- Identification of the potential issues associated with airborne implementation on various categories of aircraft including light and GA fleet.
- Identification of the impact of all system failure modes on the expected capacity gain by definition of the reduction of margin to be applied from today's sequencing separation margins.
- Introduction of CDTI to support ATSAW applications raises some issues:
    - Impact of this introduction on crew workload needs to be further evaluated in the context of different traffic and environment conditions.
    - Impact on ATC needs also to be further investigated as has been done with TCAS before its implementation (it has been proven to be a very useful exercise).
    - This leads to the need to clearly address the information filtering rules to be applied on CDTI.

3. No real deployment of ASAS application will take place before all lessons from the ADS-B out implementations are really taken into account.

4. Safety analysis needs to be conducted as soon as possible in order to really identify the requirements for the link performance (latency, integrity, availability).

5. Scenarios of integration within the current ATM for the contemplated applications need to be elaborated and matured to identify potential easy implementation at some specific site.

DSNA considers that a stepwise approach is needed to proceed with future ASAS implementation.

19.4 Jan van Doorn (EUROCONTROL EEC)

Brief description

Jan Van Doorn started with 2 challenging claims:

- "We are not implementing fast enough"
- "We are not preparing the future"

The US are starting to implement – ADS-B surveillance, spacing applications. Australia is starting to implement – ADS-B surveillance.

Europe has undertaken a lot of research over 10-15 years with little return but is not implementing. Europe has defined Package 1 but is looking at Package 0.25 implementation!!

Despite the fact that the capacity of the ATM system has almost caught up with demand in the past years due to a temporary decline of traffic, demand is taking off again and capacity will not be able to keep pace without major changes.

We are now running out of quick wins: the scope for capacity increase by re-sectorisation and airspace restructuring in the core area is rapidly decreasing.

Where could ASAS fit?

WP3 in ASAS TN provides a glimpse of maturity: NRA and Spacing look relatively mature – what's holding them back? Why are we not implementing? What do we have to do to convince?

We need to innovate the business case. Australia is making decisions to implement!! The US are renting out the boxes!!

What can we exploit in Europe?

- Possibly exploit the 1090 ES equipage rate (35% already).

Integrated future Research:

- Europe lacks a long term large scale Air / Ground Integration Programme.
- We need to build upon SESAR, FP7 and local bottom up approaches to make this happen.

Rely on the strengths of each concept element:

- 4D for flow management, planning and avoidance of overloads to ensure system efficiency.
- ADS-B / ASAS for local tactical control to ensure safety and maximise capacity.

We need to put ASAS Package 1 into SESAR!

Speaking as a scientist, Jan added that we need a new vision for 2030/2040. Near term deployment considerations and transition issues should not detract us from entertaining a long term vision that can show the way.

Dare to take risks!!!

19.5 Anthony Smoker (IFATCA)

Brief description

The ASAS-TN team suggested that an innovation gap existed between the potential of the design solutions of the research and development community, and the ability for ANSPs to realise this

potential. The reasons for this are numerous. For example, changes in the operational environment are a contribution, as are external factors that an ANSP has to confront.

In the context of ASAS, the design solutions that led to the definition of PO-ASAS applications were influenced by the perceived need, identified by the Research and Development community, to overcome known problems in the operational environment. This can lead to a poor fit of the ASAS applications with the control mechanisms that they are intended to work with.

Therefore, it was hypothesised, is it possible to exploit ASAS in ways outside the current imagination of both the ANSP and R&D community that better suit the needs of the system users? Specifically, is it possible, by using ASAS in conjunction with other elements of envisaged technological and procedural changes, to unleash hitherto unexploited capacity in the ATM system? This unexploited capacity, the ASAS-TN team refers to as "New Space".

Two examples were presented, in some detail, to illustrate what may be possible.

20 Issues from chaired discussions

Ken Carpenter (QinetiQ) made 4 suggestions / pleas:

- Can we kill off ASPA-C&P?
- Can we keep it simple?
- Do not exaggerate the significance of ACAS with respect to ASAS.
- RFG and Package 1 are not ambitious enough and address too short a timescale. There is built-in obsolescence in Package 1.

Regarding ASAP-C&P, Ken's understanding from debates during the workshop is that the amount of R/T exchange required to set up, monitor and end the delegation of the C&P manoeuvre outweighs the benefits.

Jean-Marc Loscos (DSNA) it is not that simple, C&P was proposed because there were definite benefits expected in certain situations. There is also a contract underway to define C&P and it cannot be ignored.

Tony Henley (BAE Systems) there is potential in C&P, maybe not as currently defined in Package 1.

Jean-Luc Marchand (European Commission) work underway on C&P is part of a research activity and research doesn't always lead to success. You should not scrap ASPA-C&P too early. There might be interesting results to be reused later on.

Serge Lebourg (Dassault Aviation) Crossing & Passing will happen: when pilots are able to see the other aircraft on their CDTI, they will start asking controllers to perform ASPA-C&P.

Thierry Arino (Sofréavia) C&P was initially proposed by DSNA because there was a definite operational need (cf. clearance for visual separation) and this is still true.

Johnny Nilsson (LFV) both encouraged and discouraged by the presentations; some still seem to hang on to radar technology. Key thing is communication efficiency between air and ground. Calling 1090 ADS-B is hijacking of terminology. There are problems with 1090 technology. We should save money and develop the new technologies – think ahead.

Eric Wischmann (Euro Telematik AG) there is a problem of identification. Use existing technology - via ADS-B to send target data from ground to aircraft. This is an issue SESAR should address.

Bob Arnessen (IFALPA) in a question to Luc Deneufchâtel about La Réunion: what airspace categories are being envisaged with ADS-B, because IFALPA have concerns at the use of ADS-B NRA for IFR traffic with rising densities? Bob recommends that the airspace be upgraded to class C at least, to ensure that the mix of IFR and VFR does not become a problem.

Luc Deneufchâtel (DSNA) replied that the implementation in La Réunion would be 2-step: first implement the technology without procedure change, then when proven, change the procedures and airspace categories, but only in a coordinated fashion with neighbouring FIRs. What airspace

categories and procedures can be achieved will depend on aircraft mix and whether or not mandate decisions are taken.

Bob Arnessen (IFALPA) traffic positional information quality is seen as an issue by IFALPA, and pleased to see that DSNA are taking this very seriously.

Phil Hogge (ASAS TN2) given that SESAR requires an operational concept by 2007, how do we propose to act in order for ADS-B and ASAS to get their place in SESAR.

Ben Stanley (Helios) suggests we engage this through the operational concept activity of SESAR. Ben was interested in the ideas put forward in A. Smoker's presentation. He reflected that ASPA-S&M could play a role in en-route flow management through adequate functions in the FMS.

Christian Denke (ECA) came back to the debate on the integrity of position. IFALPA take the view that any new conceptual or material changes call for requirements specifications, but also operational performance specifications. Associated with this comes a need for pre-implementation monitoring as well as post-implementation monitoring of performance similar to what was put in place for RVSM.

Christos Rekkas (EUROCONTROL HQ) CASCADE is already starting this, and this will grow into an extensive activity. Need a bridge with US and Australia to carry out monitoring globally and systematically.

Bob Darby (EUROCONTROL HQ) post-implementation monitoring is an essential requirement to satisfy the safety regulator.

Charles Buntin (FAA Safeflight 21 programme office) implementation of compliance monitoring is in place in the US, but they are just changing the process – there are about 5000 ADS-B equipped aircraft in US, increasing 200 per month. However, approximately 80% of these aircraft are currently radiating incorrect or incomplete information. Charles encourages closer coordination and interaction between US and European initiatives in this area.

Dragos Tonea (EUROCONTROL HQ) we need to explore the way that ASAS is being developed for SESAR. TMA concepts are using CDA and P-RNAV, but it is up to the ASAS community to lead the move to integrate ASAS and the potential for ASAS in such environments. There is a clear need to provide a concept of use for airborne surveillance applications, explaining how they are going to be used together with other ATM system elements.

Mark Watson (NATS) his division at NATS is involved in both ground based surveillance and airborne surveillance: ground based surveillance is making quicker progress, but airborne applications still have a long way to go. Things have moved on from the early days. NATS observes similar findings as in the US with 20 % equipped with ADS-B, albeit inaccurate. We should be careful not to be too greedy by putting additional requirements e.g. intent data,

Charles Buntin (FAA Safeflight 21 programme office) it seems that part of the world is aiming at DO260 compliance, but FAA will mandate DO-260A + TSO 166A. This should be coordinated. He added that the US was somewhat behind Europe on advanced airborne applications and focusing much more on ground surveillance, aiming at shutting down secondary radars and ground movement radars while keeping primary radars in the foreseeable future. A key issue to be resolved in the US is to stimulate the avionics industry to build low cost ADS-B avionics for GA and business aircraft.

21 Conclusions and Recommendations

The attendance of 120 stakeholders and the quality of the discussions show a continuing global interest in ASAS activities.

While there are very concrete standardisation activities at a technical level, e.g. RFG, there seems to be little global coordination typically on the more operational aspects and at ICAO level.

The RFG is doing the detailed technical work however this also depends on operational aspects (e.g. phraseology) on which it has no mandate. ICAO, through its regional coordination activities, has a significant role to play on this issue.

Consistent with the requirement that ASAS be considered as an integral component of the ATM system, work is planned in Europe, through proposed FP6 Episode 3 project, to validate key ASAS applications (beyond surveillance) within the framework of SESAR, building on existing CASCADE validation work.

Work is needed on the definition of applications that go beyond current RFG scope (e.g. Package 2). Existing working arrangements would then need to be extended to ensure their development.

There is a growing interest in the use of ADS-B for ground surveillance with very concrete deployment plans. However, there is a risk to global interoperability arising from the lack of an agreed single standard for 1090ES. This is not a simple issue as different ADS-B ground surveillance environments may lead to different technical requirements.

There is an urgent requirement for airworthiness and operational approval authorities to increase their involvement in the current ADS-B development.

ACAS (with current separation standards) appears to be compatible with currently considered ASAS applications.

ASAS concept elements and benefits need urgently to be made visible and described to SESAR.

Recommendations

- RFG work should be continued and strengthened.
- Particular emphasis now needs to be given to developing robust procedures to support the new ASAS applications.
- ASAS needs to be formally addressed by the relevant ICAO operational panels in addition to the technical ones.
- The ADS-B 1090ES standards need to be addressed to ensure consistent aircraft equipage and interoperability.
- SESAR needs proactively to be made aware of the concepts and benefits of ASAS applications.
- There is the need for structure and formalise the definition of advanced ATM/ASAS concepts including Package 2 and Package 3 applications.

22 Dissemination

All the presentations made during this workshop are available through the project website at the following address:

http://www.asas-tn.org

The key messages and conclusions of the workshop will be:

(1) Delivered to the European Commission;

(2) Given wider dissemination via the activities of the ASAS-TN2; and

(3) Provide an input to the ASAS-TN Work Package 3 ASAS application maturity work.

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