Joint Fifth ASAS-TN2 Workshop and Second FLYSAFE Forum

Report of the Fifth Workshop and Second FLYSAFE Forum

17-19th September 2007, Toulouse

"Equipping for ASAS: Ground and Airborne Industries"

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1 Introduction

The Fifth ASAS (Airborne Separation Assistance System) Thematic Network 2 (ASAS-TN2) Workshop: "Equipping for ASAS: Ground and Airborne Industries" was held from the 17th to 19th September 2007 in Toulouse.

This workshop was the fifth in the series of five ASAS – TN2 Workshops. This workshop was designed to provide a report of the progress in global ASAS implementation and to check the alignment of development with key initiatives, primarily SESAR and NextGen. This was achieved through presentation material and chaired discussion sessions.

This report contains a summary of the presentations and 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 what still needs to be done in the implementation of ASAS as part of the global ATM (Air Traffic Management) system. Each of the workshops contributes to the annual reports and the ASAS-TN2 project will conclude with a final seminar (April 2008).

2 What is the ASAS-TN?

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-TN. The scope has now increased to address applications beyond Package 1.

ASAS-TN 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 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 inform the application maturity reporting work.

The ASAS-TN is managed by a consortium led by EUROCONTROL that includes BAE Systems, ENAV, LFV, NLR, Thales Air Systems 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).

3 Fifth ASAS-TN2 workshop

3.1 Format of the workshop

Day 1 consisted of an introductory session and update of the progress and status of worldwide ADS-B/ASAS implementation and evolving airborne separations standards.

Day 2 consisted of a session describing the precise nature of ASAS with relation to the SESAR and NextGen operational concepts. This was followed by a session giving a broad overview of the FLYSAFE project, dealing with the airborne Next Generation Integrated Surveillance System (NGISS), weather, and impact on ASAS applications. Demonstrations ran all day until the evening social event.

Day 3 consisted of a session updating industry progress on ground and airborne equipment.

3.2 Day 1 – 17th September 2007:

3.2.1 Session 0 – Welcomes and setting the scene

- **Phil Hogge** (ASAS-TN2)
- **Gil Michielin** (Thales Avionics) – see appendix for a transcript of the introductory speech.
- **Eric Hoffman** (EUROCONTROL EEC on behalf of the European Commission)

Phil Hogge welcomed delegates to the workshop and reminded them of the ASAS TN2 objectives. He also emphasised that, even though the use of ASAS is now included in the SESAR Concept of Operations, it will also be necessary to ensure that ASAS is positioned correctly in the SESAR European ATM roadmap. It is vital that the 'ASAS community':-

1. takes immediate action to ensure that suitable ASAS applications are included in the SESAR Deliverable 4 (D4); and
2. remains involved with the SESAR Joint Undertaking over the period of its work.

He pointed out that within the context of SESAR and NextGen there are short term and long term opportunities for taking advantage of ASAS. UPS is a very good example of a 'pioneer airline' obtaining benefits by using some initial Package 1 applications, and other airlines are becoming interested.

He therefore proposed that delegates considered both a short term and long term prioritisation of their work on ASAS applications.

1. In the short term, deploy ADS-B as soon as possible and concentrate on the more simple initial applications such as ATSA-SURF and ASPA-S&M. It is important, at this stage, not to dilute resources by spending too much time on a defining too many other applications.
2. Identify those more difficult applications which require work to start now so that they can reach maturity and be ready in time to meet the long term goals of SESAR and NextGen. The prime example is SSEP for which a considerable amount of early work will be required to ensure that the supporting technologies have the required performance characteristics (for example, integrity).

A.Session 1: Progress and Status of Worldwide ADS-B/ASAS Implementation and Evolving Airborne Separation Standards

4 Introduction

This session was chaired by **Peter Howlett** (Thales Air Systems) with **Nico de Gelder** (NLR) as the secretary.

The first part of this session reported on what has happened in the ASAS domain since the last workshop six months ago concerning implementation, standardization and validation. It provided an update on major ADS-B and ASAS activities in Europe and in the USA and included a presentation of EUROCONTROL's surveillance strategy.

- CASCADE & RFG – Progress and Status of Implementation and Standardisation: Jörg Steinleitner (EUROCONTROL HQ)
- FAA ADS-B Program update: Vinny Capezzuto (FAA)
- EUROCONTROL Surveillance Strategy: Mel Rees (EUROCONTROL HQ)

The second half of the session reported on research into airborne separation criteria for a number of ASAS applications.

- RESET: Alan Groskreutz (Aena)
- iFly: Henk Blom (NLR)
- NASA In Trail Procedures: Ken Jones (NASA)

5 Review of the briefings

5.1 CASCADE/RFG – update on ADS-B/ASAS/Standards: Jorg Steinleitner (EUROCONTROL HQ)

CASCADE

Brief description

The EUROCONTROL CASCADE programme co-ordinates the implementation of the first set of ADS-B applications in Europe, taking into account the requirement of global interoperability. The Programme covers both ground and airborne surveillance applications.

The European implementation policy includes two steps. The first is voluntary implementation in "pocket areas" using existing (certified) equipment. The second is implementation based on an Implementing Rule, which is currently being developed and will be published by early 2009.

CRISTAL partnerships are in place in various regions to perform trials in partnership with stakeholders in local sites of Europe ("pocket areas") where the surveillance service can be improved. These pocket areas will be the basis for a subsequent wider implementation. CRISTAL partnerships address both the Ground Surveillance infrastructure and the airborne surveillance applications.

Regarding the certification of airborne equipment, a Pioneer Airline Project is underway in coordination with EASA with the objective of obtaining certification of ADS-B out (existing transponders i.e. ED102/DO-260 or DO-260A) by November 2008. An EASA Notice of Proposed Amendment (NPA) was issued in June 2007.

Key issues in the presentation

- Implementation of ADS-B in Europe has started. The first implementation sites in Europe are known. 20 airlines with more than 400 aircraft will be ADS-B pioneers. The first airworthiness approvals are imminent.
- All stakeholders should participate in the EC SES consultation process for the Surveillance Implementing Rule which includes ADS-B.

Requirements Focus Group (RFG)

Brief description

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). The first major milestone has been achieved with the publication of the ADS-B standard for Non-Radar Airspace at the end of 2006.

The next three applications to be released will be ADS-B-RAD, ATSA-ITP and ATSA-VSA.

- OSEDs are “frozen” for ADS-B-RAD and ATSA-ITP (i.e. they have reached full maturity, with the prospect of minor updates during integration as annexes to the Safety and Performance Requirements (SPR)/INTEROP document).
- SPR/INTEROP assessments for all three applications are nearing completion and document integration is to commence.
- Target dates for EUROCAE/RTCA approval are April 2008 for ATSA-ITP and ATSA-VSA (to be confirmed for the latter), and July 2008 for ADS-B-RAD.

Release of ADS-B-APT, ATSA-AIRB, ATSA-SURF material is planned around August 2009.

Target dates for ASPA-S&M and ADS-B-ADD are yet to be defined, although ASPA-S&M has been advanced as background task with a feasibility check in January 2008.

Key issues in the presentation

- The RFG is a powerful example of effective international cooperation and has successfully refined the methodology for generating standards.
- Steady progress is being made.

5.2 FAA – update on ADS-B/ASAS: Vinny Capezzuto (FAA)

Brief description

In the Next Generation Air Transportation System timeframe, the FAA has determined that the current surveillance infrastructure based on the use of Primary and Secondary Surveillance Radar systems cannot accommodate the projected capacity demands of the future. The Federal Aviation Administration (FAA) considers Automatic Dependent Surveillance-Broadcast (ADS-B) with Traffic Information Services-Broadcast (TIS-B) and Flight Information Services-Broadcast (FIS-B) a cornerstone technology solution within the investment portfolio aimed at meeting the challenges of the future.

In this context, the FAA conducted a comprehensive business case assessment of ADS-B and related broadcast services that have led the FAA to launch key elements of an ambitious plan for a nationwide deployment of ADS-B.

On August 30, 2007, the FAA awarded the ADS-B national contract to ITT Corp as the prime contractor. ITT has a team of sub-contractors, which includes AT&T, Thales, WSI, SAIC, PriceWaterhouseCoopers, Aerospace Engineering, Sunhillo, Comsearch, MCS of Tampa, Pragmatics, Washington Consulting Group, Aviation Communications and Surveillance Systems (ACSS) and NCR Corporation. In addition, ITT has partnered with L-3 Avionics Systems and Sandia Aerospace. The initial contract is worth M$207 but could reach a total value of B$1.86 if all options are confirmed. The projected date of completion of the ADS-B NAS-Wide Infrastructure Deployment (including TIS-B and FIS-B) is 2013.

In parallel with this contract for the ground segment, the FAA has initiated the process to issue by the end of September 2007 a “Notice of Proposed Rule Making” (NPRM) regarding aircraft equipage.

Key issues in the presentation

- The ADS-B national contract is not based on the acquisition of an ADS-B ground infrastructure but rather on a service approach: the delivery of ADS-B tracks to 267 “Service Delivery Points”
- Success of the ADS-B program is among other things tied to the demonstration that Radar / ADS-B and ADS-B / ADS-B cases provide equivalent or better separation error performance in comparison to the Radar / Radar case.
- Appropriate level of ADS-B equipage must be achieved in a timely manner, hence the NPRM.

5.3 EUROCONTROL Surveillance Strategy: Mel Rees (EUROCONTROL HQ)

Brief description:

The presentation describes how the EUROCONTROL Surveillance Strategy is based on three separate pillars using different surveillance techniques. These are ADS-B, SSR/SSR Mode S and (Wide Area Multilateration/Multilateration) WAM/MLAT. These techniques all require the carriage of an aircraft transponder and connection to various on-board avionic systems. In busy TMAs, where the climbing and descending aircraft pose safety hazards, primary radar cover is required as a safety net in case there is an aircraft transponder failure.

The Strategy requires two layers of Surveillance cover in all airspace (three in TMAs), however the Strategy does not impose which techniques should be used. This is left to the individual States, with their ANSPs, to decide based on operational, commercial and safety requirements.

The presentation briefly described the status of Standardisation and Certification of the newer techniques as well as explaining developments to find an economical replacement for primary radar.

The draft Interoperability Rule (IR) for Surveillance Performance and Interoperability will be based on the carriage of a Mode S transponder having 1090ES and SI capabilities. This one transponder would then accommodate all currently known Surveillance needs.

Key Issues:

- PSR still required as a safety net in busy TMAs, but cheaper alternatives are being explored.
- IR likely to require Mode S transponder (with 1090ES) as basic avionic fit in all aircraft.
- WAM/ADS-B systems likely to dominate in coming years.
- EUROCONTROL’s Surveillance Strategy integrated as part of SESAR.

5.4 Issues from chaired discussions

Dragos Tonea (EUROCONTROL HQ)	AP23 is part of the FAA/EUROCONTROL Cooperative R&D programme. It is focussed on long term ADS-B and ASAS applications, beyond those in Package 1 under development in CASCADE and the RFG. The terms of reference are quite broad, but the immediate emphasis is on selecting the next generation of ADS-B applications (Package 2), developing a concept for the use of airborne separation and developing a paper recording and discussing potential issues arising in the use of airborne separation. AP23 has a methodology for selecting Package 2. It has asked for suggested ADS-B applications and received about 80. Dragos had been pleased to hear about increased emphasis on the air-air applications in Vinny Capezzuto’s presentation on the FAA’s ADS-B programme. The real value of ADS-B is in the provision of information in the cockpit. SESAR

	is going through some crucial times. It is important to provide a common US-European stance on ASAS. There are small differences between the US and Europe and these have to be handled carefully. Getting the operational descriptions (OSEDS) of the applications right will be critical. [The concept document and the issues paper are in hand. With regard to the airborne separation issues paper, which records aspects of the use of ASAS that require further study, it is important to move on to consideration of airborne separation minima.]
Jean-Pierre Magny (FAST)	Q: The military have very much experience in operating with very low longitudinal separations, e.g. formation flying and in-flight refuelling. Has this been considered? The risk assessment needs to take into account all peculiarities, e.g. different aircraft performance.
Vinny Capezzuto (FAA)	A: It is more the civil airspace that we are talking about. The military have their own dedicated airspace, their own operations and their own links. When the military enter civil airspace, it really becomes a matter of interoperability; of course FAA will work together with DoD on the issue of interoperability in common airspace.
Tony Henley (BAES)	Q: To Jörg Steinleitner. When we talk about ADS-B implementation plans, are we talking about ED102/Do-260, 260A, 260B definitions of the ADS-B link Will airlines need to reinvest to upgrade to future standards? How far can we get with ASAS applications with the current equipment? When do airlines have to implement new systems? We can kick-start applications with current technology.
Jörg Steinleitner (EUROCONTROL HQ)	A: Initial/Pioneer installations will be with ED102/Do-260 or Do-260A: Both will be accommodated though current aircraft installations are predominantly Do-260. It is planned, see last slide of my presentation, to have a joint ED102A/Do-260A+ definition of the ADS-B link in the 2010/2011 timeframe for wider scale deployment.
Tony Henley (BAES)	Q: Will Sequencing and Merging be supported by current standard equipment?
Jörg Steinleitner (EUROCONTROL HQ)	Q: Yes, I cannot see why not.
Dragos Tonea (EUROCONTROL HQ)	We can answer these questions only when we have carried out the analyses.
Bengt Nilsson (AvTech)	Q: Do you look at using aircraft intent information?
Jörg Steinleitner (EUROCONTROL HQ)	A: Not for Package 1. There is not a basic requirement for intent information, though some applications may benefit from it.
Vinny Capezzuto (FAA)	A: I agree with what Jörg is saying when looking at the next few years. Later on yes we will most likely need intent for trajectory-based operations. The trajectory planner will need and use the big picture, and that is key. But the approach is build a little, test a little, and not try to bite all at once.
Dragos Tonea (EUROCONTROL HQ)	The real answer to that will be in the RFG's SPR requirements when they are finalized. We are looking at it.
Lars Lindberg (AvTech)	Q: There is a mismatch. 4D operations rely on trajectories while with the current air-air definition the flight crew will have to work purely with the speed vector. Intent is needed for air-air separation. Can we work two paradigms?
Jörg Steinleitner (EUROCONTROL HQ)	A: We are talking in a very far timeframe; moreover air/air intent information is in the form of Trajectory Change Points (TCPs) which are to indicate short range manoeuvre intentions while 4-D trajectories are expected to be exchanged point-to-point with the ground at least in the first place.
Lars	Look at the SESAR plans for 2025.

Lindberg	
Andy Barff (EUROCONTROL EEC)	It will be a very difficult transition. For various applications we need surveillance data in the cockpit. Initially FAA is including TIS-B in their solution, CASCADE is only talking about ADS-B IN. How do we avoid the need for TIS-B IN in Europe?
Jörg Steinleitner (EUROCONTROL HQ)	TIS-B is there to get the full picture. It is not really about quality of the data. Do we require the full picture in the aircraft for the initial applications? ATSA-ITP and ATSA-VSA: not likely. (i.e. partial equipage will be sufficient for initial applications).
Andy Barff (EEC)	What about ATSA-SURF? Data on the vehicles and aircraft could be received via ADS-B or could be a consolidated picture. There we need the full picture. How do we do that with 1090 extended squitter? TIS-B will be required.
Jörg Steinleitner	Indeed the ATSA surface application is one environment where a full surveillance picture may be needed. We will have to see if 1090 can accommodate this (whether it will support TIS-B); we will have to pick this up.
Vinny Capezzuto (FAA)	The first step is to accelerate the rules. Look more specifically into airports, select airports and accelerate at some airports. We see WAM, surface multi-lateration as a back-up. One issue is whether we want to – and can afford to – equip all the vehicles. To come back to Lars's questions: how can we work in different dimensions, trajectory based operations on the ground and speed vector in the air?
Dragos Tonea (EUROCONTROL UQ)	Concerning the question about intent information I agree it needs to be clarified. There could be multiple solutions to transfer of trajectory information. Technology needs to be developed (there are plenty of options), but first the concept has to be finalised. How will we use trajectory information in the aircraft?
Phil Hogge (ASAS-TN2)	Q: What technology to transmit the trajectory is foreseen in NextGen?
Doug Arbuckle (JPDO)	A: The information that is required is very dependent on the operations you are talking about. What is meant with intent? Trajectory information could be exchanged and shared in a number of ways; the technology could be ADS-B datalink, but it will be whatever is needed to transmit the required information. It all depends on the operations you're looking at, what do we need it for. There are no specific technologies identified yet in NextGen, it is too early, the concept and needs will have to be stabilized first.
Lars Lindberg (AvTech)	Agreed with the point that it depends on the operations. He had intended to point at the need for various communities and timescales to be consistent.
Jean-Pierre Magny (FAST)	Q: How do you obtain the required integrity information?
Vinny Capezzuto (FAA)	A: The system has to be scalable and adaptable. Therefore it is performance based, and the how is not spelled out.
Bob Darby (EUROCONTROL HQ)	Q to Phil Hogge: are you satisfied that ADS-B and ASAS are fully recognized and properly addressed in SESAR
Phil Hogge (ASAS-TN2)	A: They are in the concept but no, my concerns are not allayed.

5.5 RESET: Alan Groskreutz (Aena)

Brief description:

The main objective of the EC-funded RESET project is to identify advanced operational concepts (which complement existing European initiatives) to enable reduced separation minima for the various phases of a gate-to-gate operation in order to accommodate a x2 traffic load over Europe.

To do this, RESET started by analysing existing separation minima standards and attempting to capture the rationale that led to the determination of these minima. This proved to be rather difficult as most of the time the reasoning is not documented and safety cases are usually confidential.

RESET then intends to develop a qualitative (and quantitative where possible) separation model to help determine future separation minima standards and capture the rationale thereof.

The project will then:

- identify and prioritize potential Separation Reductions in all phases of gate-to-gate operations
- define a Future Operational Scenario and initiate a Safety Case
- perform an Economic and Efficiency Analysis
- identify, in collaboration with ICAO, EUROCONTROL, the FAA, ANSPS and national regulators how to accomplish the change for the modified separation minima.

This 3-year project started in October 2006.

Key Issues:

- Current separation minima standards are very often undocumented.
- The separation model's success is highly dependant upon learning from previous models successes and failures.
- Documentation of the rationale that leads to adopting reduced separation minima is necessary for any future assessments.
- Implementing change has higher probability of succeeding if projects are coordinated (CREDOS, RESET, SUPERHIGHWAY, etc.).

5.6 iFly: Henk Blom (NLR)

Brief description

Recent airborne self-separation projects have concentrated on areas of low traffic density, e.g. MFF (Mediterranean Free Flight) and ASSTAR (Advanced Safe Separation Technology and Algorithms). This is remarkable because self-separation was originally proposed for high density airspace. iFly exploits the HYBRIDGE mathematical techniques to address self-separation in high traffic density airspace. http://www.nlr.nl/public/hosted-sites/hybridge/

The Self Separation concept used in MFF has been evaluated through Monte Carlo simulations, and found to work well for a two aircraft head-on encounters. However, for eight aircraft encounter scenarios it is less satisfactory because of a significant delay in finding resolutions. Moreover, the resolutions found typically deviate significantly from the optimal coordinated resolution. Thus there is a need for an airborne self separation concept of operation for demanding scenarios. iFly aims to develop an advanced airborne self separation design and a highly automated ATM design for en-route traffic, which is aimed to manage a three to six times increase in current traffic levels.

The work combines expertise in air transport human factors, safety and economics with analytical and Monte Carlo simulation methodologies providing for "implementation" decision-making, standardisation and regulatory frameworks. The research is aimed at supporting SESAR and actively disseminates the results among the ATM research community. iFly will perform two operational concept design cycles and an assessment cycle comprising human factors, safety, efficiency, capacity and economic analyses. During the first design cycle, state of the art Research, Technology and Development (RTD) aeronautics results will be used to define a "baseline" operational concept. For the assessment cycle and second design cycle, innovative methods for the design of safety critical systems will be used to develop an operational concept capable of managing a three to six times increase in current air traffic levels.

Key issues in the presentation

- It is notable that recent self-separation projects have concentrated on low traffic density areas at the expense of the original concept.
- iFly builds on HYBRIDGE and addresses high density airspace.
- Existing self-separation concepts work well in two aircraft encounters, but not in multi-aircraft encounters.
- iFly aims to develop a self-separation concept that works well in multi-aircraft encounters through a sound and iterative development cycle that integrates human factors, safety and economics with analytical and Monte Carlo simulation methodologies.

5.7 NASA ITP: Ken Jones and Tom Graff (NASA)

Brief description:

Future air traffic management concepts rely on reduced separation standards and the use of airborne separation assistance systems. Research into early ASAS applications will provide insight into the nuances and details necessary to implement these future concepts. At the same time, these early applications can also provide an incentive for operators to begin voluntarily equipping with ASAS technology. The Oceanic domain is a unique environment where we can gather research data while improving operations. Oceanic operations rely on procedural separation for safe, orderly air traffic management. These operations, while safe, often result in inefficient airline operations causing them to burn additional fuel. These operations can be improved through the use of ASAS which can result in an increased amount of beneficial climbs (or descents) which will save fuel and time.

NASA helped develop the ADS-B In-Trail Procedures (ITP) concept and has been working on the development of procedures, safety analyses, algorithms and engineering models that would enable a service provider/airline sponsored field trial of oceanic in-trail climb and descent using ASAS. Recently NASA completed a thorough batch analysis of the use of ITP in the North Atlantic Organized Track System. The analysis demonstrated that ITP and ASAS equipment will enable a significant amount of flight level changes. NASA also conducted an ITP concept evaluation experiment which examined the role and workload of pilots in this operational concept. NASA also participated in an AirServices Australia experiment that examined ITP from a controller's perspective. Both experiments found ITP to be valid and acceptable to pilots and controllers with no significant increase in workload. NASA has also been working with RFG and ICAO in the development of appropriate procedures development and safety analyses.

Key Issues:

- Development and research into early ASAS applications can provide valuable insight into future concepts and applications
- Oceanic domain is a unique environment that can provide valuable data while providing benefits to airline operators
- Batch analyses have shown there is an operational benefit achieved through the use of ASAS
- Pilot and controller experiments have determined the workload associated with ITP is no higher than current day operations
- ICAO has recognized ADS-B ITP as one of the first new separation standards that involves significant airborne ADS-B roles and responsibilities; this has involved some unique safety analyses and procedure development

5.8 Issues from chaired discussions

Wim Huson (USE2ACES)	Q: The low hanging fruit, for the ITP application, is not only to be found on the organised tracks but also on flights between the Caribbean and Europe (you can be stuck a couple of thousand feet below your optimum level for 6-7 hours), and between South-America

	and USA (~5 hours at non-optimum level). And what about the case you avoid a diversion, the savings in time and fuel are enormous.
Ken Jones (NASA)	A: Agree with you, the North Atlantic track system is more restricted, the crossing time is limited and you cannot get a step climb in the first two hours since there are reasons they are not granted it upon entry in the first place. In other areas more benefits might be gained, for example on routes between Middle East region and Australia flights get stuck 4000 ft low for 10 hours.
Phil Hogge (ASAS TN2)	BA costed one diversion, (e.g.) as the result of a bomb threat, at around $1m.
Jean-Pierre Magny (FAST)	Q: In your experiments, did you consider offset routes to climb/descend through the level of other aircraft?
Ken Jones	A: No, we used a more conservative case; offset procedures were not included in the batch simulations and we do not take credit for them. We tried to be as conservative as possible.
Phil Hogge (ASAS-TN2)	Q: I have flown your [self-separation] simulations and I like them. However, the question is the integrity of the ADS-B link, and whether we need two of them?
Henk Blom (NLR)	A: Integrity is included in the risk assessment, and with the risk assessment you can capture the requirements needed to satisfy the Target Level of Safety. What we never did so far is to check it against Do-260 or Do-260A. So, the safety studies can provide the integrity requirements and then the check with 260(A) will tell us whether or not the currently defined ADS-B link satisfies these requirements. However it needs to be pointed out that the current safety assessment (Hybridge) on self-separation only provides point estimates. What is also needed are uncertainty and bias estimates in order to know the range of safety numbers.
Jean-Pierre Magny (FAST)	When we talk about integrity it is not only the integrity of the link, the integrity problem is much wider. It also concerns the sources of position information, on-board architecture and crew training. It is also an issue of culture; integrity issues are always fully allocated to either ground or air. Now we are talking about an integrated air-ground solution. No high integrity air-ground systems have been developed since the autoland development some 30 years ago. The autoland involved both airborne and ground components requiring high integrity and continuity. We tend to be overly constrained by the Air/Ground boundary.
Pierre Gayraud (Thales Avionics)	Concerning Phil's question you must consider three aspects: Integrity is mainly an issue related to position integrity of transmitting aircraft. But also continuity is of importance, mainly in relation to the link. Continuity requirements might perhaps result in dual links. And finally we should not forget the cost and complexity of the solutions.
Henk Blom	Henk observed that ED78A does not take into account a combination of hazards, and hazards do interact. There is disconnection between ICAO and ED-78A; they are using different methodologies to assess safety and to capture requirements.
Lars Lindberg (AvTech)	What are the numbers per flight for ITP? How much will be saved? What is the bottom line number?
Ken Jones	[Ken said he would love to be able to give an answer, but one of the results of his research is that a NASA employee of scientific discipline cannot answer these costing-type questions]. It all depends on how you as operator, how do you operate? North Atlantic only, North Atlantic and Pacific? And for instance have you as operator already installed EFB's on-board of aircraft for other applications. The batch simulations showed that for many flights the difference in fuel is small, almost zero, but on one day it can make a huge difference on a single flight. The results of the batch simulations will be available publicly later this year, so all the information is then available in order that operators can examine it in relation to their specific operations.
Tom Graff (NASA/NIA)	Actual assignment of fuel burn models is not accurate and sensitivity of some aircraft types to non-optimum altitudes. NASA wanted to specify the benefit mechanism, it is up to the airlines to do the actual benefits case including the outlier case of diversion. Another issue from the NASA study is that ITP is a climb through manoeuvre and that

	we have to have gaps at other levels to enable these manoeuvres. Both Ken and Tom put in a plug for in trail follow
Pierre Gayraud	In the presentation [of Alan Groskreutz] it was stated that en-route the doubling of capacity can be obtained with current 5 NM separation standards. However in current operations the actual separation between aircraft is more in the order of 7 to 10 miles. Did you consider the margin between separation minima and the separation controllers actually apply?
Alan Groskreutz (AENA)	The short answer is no. We looked more at demand and capacity, the realisation of capacity is referred to in this question.
Pierre Gayraud	In the realisation of the 5 NM minimum separation you have to take into account a certain buffer, with airborne separation you could be closer to the 5 NM.
Henk Blom	In the ATM community there seems to be a lack of knowledge/background of how we defined the current separation minima. It is important to get a good understanding of how it works if we want to make changes in the future.
Andy Barff (EUROCONTROL EEC)	In SESAR it is identified that controller workload is the limiting factor, not the separation standard. In Europe, it is hard to handle more than 17-18 A/C per controller. The transfer of separation responsibility to the aircraft within SESAR is an open offer to the ASAS community.
Phil Hogge (ASAS-TN2)	Ken, you said that ITP was stepped climb, yet ideally we should be aiming at cruise climb. The Concorde had to use the principle of cruise climb to enable its operations. The reason that cruise climb is not in other aircraft is because the ATM system cannot cope with it. However, self-separation horizontally could enable cruise climbs. The question is: what is the saving between cruise climb and step climb at present? Have you looked at it?
Ken Jones	In the North Atlantic the delta between step climbs and cruise climbs does not result in big fuel saving differences. It is not so important for subsonic aircraft, 100ft steps or 1000ft steps doesn't matter much
Tom Graff	I did cruise climbs on the Pacific and I could not see a real difference. Subsonic aircraft are not so sensitive to step climbs as supersonic, and so 1000ft steps are ok compared to cruise climb.
Lars Lindberg	What is more important is the descent/approach phase. What you win en-route you will lose in the descent if you don't do Continuous Descent. In New York you lose 1.5 tonnes of fuel per flight from top of descent to touchdown, and in Frankfurt 600 kg per flight also from top of descent to touchdown.

6 Demonstrations & Posters:

List of demonstrations:

- FLYSAFE	FLYSAFE Consortium
- ASSTAR	DSNA (Philippe Louyot and Thierry Miquel)
- SafeRoute	ACSS (Christophe Hamel)
- ADS-B/TIS-B Airborne Trials	SELEX (Gianluca Gabatel)
- ITP	NASA (Tom Graff)

ENAC Poster: Master in Cooperative Avionics
More information on: http://www.enac.fr/masavi

B.Session 2: ASAS in Future European and US ATM Concepts

7 Introduction

This session was chaired by **Jean-Claude Richard** (Air Traffic Alliance) with **Giorgio Matrella** (ENAV) as the secretary.
This session focused precisely on how ASAS fits into the SESAR and NextGen operational concepts.

8 Review of the briefings

8.1 Introduction to NextGen & ASAS in NextGen Concept: Doug Arbuckle (JPDO)

Brief description

This presentation described the Air Traffic Management (ATM) concepts in the NextGen ConOps v2.0 (see <http://www.jpdo.gov/library/NextGen_v2.0.pdf>, with an emphasis on how Aircraft Separation Assistance Systems (ASAS) are included in the NextGen ConOps.

The briefing began with an overview of the "Air Traffic Management Operations" chapter of the NextGen ConOps and described the key envisioned characteristics of ATM and the Separation Management function in the NextGen timeframe (circa 2025). Then the briefing discussed why ASAS is required to meet NextGen needs and what types of ASAS operations are envisioned in NextGen.

The briefing concluded with a discussion of ASAS safety from a NextGen perspective and the notional phased approach for how the U.S. Joint Planning and Development Office sees ASAS being implemented.

Key issues in the presentation

- While it seems clear that automated conflict detection is required in NextGen (whether performed on the ground or on aircraft), the overall appropriate level of automation in Separation Management, and the human interaction with such automation, remain a major research question.
- While most agree that airborne Merging and Spacing offers benefits and is "implementable" in the near-term, there are many open questions about how Delegated-Separation will work (especially since it is so broadly defined) and what the relative costs and benefits will be. Much more research is needed to better define such operations and assess them objectively in terms of feasibility and costs/benefits.
- Self-Separation is even more controversial, with many doubters and detractors. However, to date, conclusive research results have not established the feasibility or infeasibility of self-separation, nor its costs/benefits.
- Technical issues aside, the cultural and operational changes implied by Delegated-Separation and Self-Separation will present significant challenges that must be at addressed in any R&D activity that progresses toward implementation.
- Given the above, international collaboration in developing ASAS systems and procedures that are globally interoperable is critically important.

8.2 Issues from chaired discussions

Cédric D'Silva (Thales Avionics).	Q In NextGen strategies, ATSAW seems to allow an increase of capacity while in SESAR's view [it] will be possible only after implementing ASPA.
Douglas Arbuckle	**A**. We didn't mean ATSAW like Europeans mean, but in the way that the US DOD uses

(NASA/JPDO)	the term. If. If you know more about your environment this may allow you to increase the capacity
Cédric	**Q**. Have you estimated the level of reliability?
Doug	**A**. Not explicitly, the required reliability is very application dependent.
Jean Pierre Magny (FAST).	**Q** If Safety is a key issue, training should be considered the base of safety? How do we manage to consider the entire system based on pilots/ATCO involvement? You said a definitive proof of safety is required in nominal and non-nominal situations. They referred to extensive need for training, of both pilots and controllers. How have you managed this training problem taking account of the complete system?
Doug	**A**. When we introduce a new operation/concept, the tendency is to use simulations but this incorporates your present ignorance. To cope with a new concept is a great challenge, since you may need to manage a brand new environment that has never previously been experienced. To an extent, the only way we can prove safety is through just doing it. We have to approach this through an evolutionary approach. Regulators get big eyes when we talk about this. We cannot rely on experience with the present systems because people who built the present systems are dead. This is a grand challenge, and a big cultural issue.
Rose Ashford (NASA/JPDO)	Today's separation standards have evolved over a long period. Presently we haven't a firm knowledge of how current separation standards have been determined; which is ok as we have a history (which proves the safety case). For this reason, in ASAS research we initially made a comparison with the current system. A lot of safety cases are done by comparison, however we cannot use comparison if we are changing the basis of separation completely. In ASEP we might need to face how separation is determined from the first step.
Doug	This pushes us into doing TLS calculations, which are viewed as being very much more difficult.
Ken Jones (NASA)	The ITP is being done by the TLS approach, not by the comparison method.
Phil Hogge (ASAS TN2)	Q. Are we comfortable with a system where the automation goes beyond capabilities of a human?
Jean-Pierre Magny	A We can make comparison with WAAS (Wide Area Augmentation System). To prove it safe (for approaches?), they had to make reference to ILS work, which was developed over the course of 50 years, to reach the high level of present safety. This forced them to perform engineering simulations and adopt an aggressive approach. Our task is much more difficult. When we start to analyse a new concept we should [at least] require the same level of current safety. Higher levels of safety required now – this is a problem we face together.
Frank Alexander (NW Airlines).	Q Flight Crew Automation – not comfortable with these category 3B ILS approaches. How quickly can we implement "comfort levels" of a system by building redundant automation?
Tom Graff (NASA/NIA)	A From the pilot's perspective (like Frank) "if there was not intervention capability in Cat 3 ILS then there would not be Cat 3 ILS". If we stay in ILS domain, we can say that CAT3B approach is not touched by the crew, but it is a very intensive exercise. If we need to address capacity an increased level of automation is needed. However, the point is not the level of automation but the reliability of the system that allows automation.
Jean-Marc Loscos (DSNA).	Q In SESAR operational concept, all our experience is that Human In the Loop is a safety enhancer. In the same spirit, we don't like UAVs[!] The human is essential in separation provision. If we want to still make comparison with ILS, we can say that the

	gap with ASAS is that ILS provides navigation performance to only one a/c at a time, while for the ASEP application it is requested to combine not only navigation performance but also surveillance performance.
Doug	A. We got to the point where it became clear that the capacity is limited by the human being. We agreed that whatever loops the human is in, they have to be fully involved. We should clearly define what tasks the ATCO needs to be in control of and the ones that they don't need to; we have decided that Human In the Loop (HIL) shouldn't be in the detection of the conflict. But we have also decided that the human is involved in the resolution.
Wim Huson (USE2ACES)	Q How has this been tackled in fly-by-wire systems? I see an analogy.
Jean-Marc Loscos	Q Agrees with Doug's approach and reported that the ERASMUS project addressed a context where pilots and ATCO were not aware of an automation loop such as subtle speed adjustment (subliminal control, too small to be perceived). The [main] problem is more focussed in the conflict detection phase than in conflict resolution. In order to solve a conflict, humans need to understand [comprehend] what is going on (conflict detection is for this reason an aspect where human should be always involved). How can we perform conflict resolution with or without detection?
Doug	A. Clarified that the system would explain what the conflict is, but the human is not involved in identifying that there is a conflict.
Henk Blom (NLR)	Q. When we mention HIL we are taking into account not only a single human - since in ATM we have the entire ground and air system.
Doug	A. Humans don't perform well in generic detection; we are strongly biased that we cannot achieve the performance we require if humans are the agents responsible for identifying conflicts.
Henk	Q. In the future pilots and ATCO will be working closely in the same loop and this may cause troubles in defining responsibilities?
Doug	A. In any system you need to define clearly the role of each actor involved. There will be rules of engagement.
Jean-Pierre Magny (FAST)	A FADEC (Full Authority Digital Engine Control) in new engines does not allow the pilot to act on the engines. The solution was very stringent certification. There are a few manufacturers who mange it, but many fail. The same could be said of fly by wire. Also observed that visual cues can be very misleading. To rely on an automatic system we need to agree that automation should compute a proposed solution rather than solve the situation.
Jean Pierre Magny	FAST. To rely on an automatic system we need to agree that automation should compute a proposed solution rather than solve the situation.
Nico de Gelder (NLR)	Q. In segregated airspace, separation management as well as trajectory management services are taken away; why don't we need Trajectory Management (TM) in segregated airspace?
Doug	A. Aircraft are usually flying either from a busy airspace or to a busy airspace. Therefore we need to meet constraints at these boundaries. You are going to have to be scheduled. We now think that some Trajectory Management (TM) will be required in segregated airspace. If the system provides no TM, it might hurt the user of the system. TM service provision will still be required by the ANSPs.
Vinny Capezzuto (FAA)	Q. Our plan is to test systems with the right Con Ops and requirements. Will we adjust the Con Ops, not just the specs? What is the schedule?

Doug	A. We plan to update the NextGen Con Ops at least once in a year.
Mel Rees (EUROCONTROL HQ)	Q. EUROCONTROL. With Link 2000+, if it goes wrong the ATCO can fall back on VHF radio comms. There may come a time when the ATCO can no longer resolve the a/c in event of data-link failure. In this situation, reliance on datalink is much more important. For example, in VDL2, would the pilot be required to switch to a second VDL link, or have a redundant link? If ADS-B fails during an ASAS scenario, would we require the use of a 2nd ADS-B or some other link entirely (using more data frequency spectrum for back up data links).
Doug	A. We haven't discussed it at this level of detail.
Vinny Capezzuto	Our view is based on ASAS performance applications and not about the associated communication mediums. We will stipulate performance.
Doug	In my conversations with Jim, it seems he is doing the controller bit only and not weather, so there plainly have to have many links. Data communications currently aimed at safety critical applications. Different users will have different choices. All these are user decisions, not specified by JPDO.
Mel	Q. If there is a controller, delegated separation applications could have very severe communications requirements. In case of failure the ATCO is responsible for separation. We should develop an appropriate level of automation.
Cédric	A. We need to take into account the reliability of the system. It is not an emergency you are trying to resolve, but simple availability of the system. Relying on performance alone will lead to a multiplicity of solutions, which is bad.
Tony Henley	Q. Do you have an idea on how to determine timeline and benefits from M&S in USA?
Doug	A. The limit is when aircraft will be equipped in order to perform ASAS application (more related with FAA thoughts). The timeline is dependent on when manufacturers deliver to customers. UPS has announced what they are doing, and expects more benefits as they move on. Our role is to consider if this is applicable to other users. The benefits analysis depends also on what you think it is needed to do and when it is thought to be applied. FAA is trying to calculate benefits but this depends on many assumptions.
Tony Henley	Q. Do you think mandates are required?
Doug	A. Personally; yes future mandates will be required.
Vinny	Benefits are subject to continuous process. My slide yesterday showed benefits from about 2018, including from CDAs.
Doug	Super density operations imply a minimum standard of equipage and performance by those playing the game.
Phil Hogge	Q. The NTSB investigation of the Lexington accident recommended moving maps on board the aircraft in the airport environment. Do you have any views on the desirability of ATSA-SURF?
Doug	A. ALPA are very supportive of this. The question is also to define the level of safety needed and how much you have available to spend for it. In super-density operations, aircraft are going to know which turn off to take. [Context is also an important issue since in a crowded environment ADS-B may be seen as a proper means to support safety].
James Hudson (Helios)	Q In ATM there are many partners involved, what is the mechanism for making collaborative decisions?
Doug	A. We thought about this, but not enough; we should of course focus on the cooperation approach. It sounds easier than it is. Need to consider gaming, and trying to ensure that gamers take the decision you want.

8.3 Introduction to SESAR: Susanne Reed (SESAR)

Brief description

The SESAR Definition Phase targets the launch of a new and revolutionized ATM System in Europe. The major goal of this first phase is to define the performance based ATM Target Concept (D3) including the respective transition and deployment steps (D4), which need to be taken in the appropriate timeframe. All information will be documented in the so-called ATM Master Plan (D5) and the work programme for the first 5 years of implementation (D6).

The SESAR Consortium is just about to finalize the ATM Target Concept – a great achievement considering that it comes with the agreement from all stakeholder categories. Many features of the SESAR ConOps need to be further validated during the next phases of SESAR but the SESAR Consortium is confident that it will support the expected traffic growth for 2020 requiring twice as much capacity than today. To achieve this goal, it will be of critical importance that e.g. the ground and airborne infrastructure will be directly connected within the European ATM architecture; that the airports operations will be integrated into the ATM world and that a common data infrastructure will be integrated which will be available to all stakeholders as the basis for decision-making.

The definition of the SESAR ConOps is the fundamental basis for the future ATM system in Europe; it provides a common goal towards which all related activities (e.g. research, validation, deployment, integration) will be aligned!

Key issues in the presentation

- Global Interoperability is a key topic within the SESAR activities
- The SESAR ConOps is defined (D3) – its implementation is the core foundation from which further SESAR activities will derive.
- Many new functions, technologies, procedures of the SESAR ConOps will need to be further analysed and researched to further analyse their promised benefits and to ensure their safe deployment.
- The SESAR JU will coordinate all R&D activities to implement the SESAR ConOps by 2020.

8.4 ASAS in SESAR Concept: Andy Barff (SESAR)

Brief description

The SESAR ATM environment is based on the management of precision trajectories. A precise trajectory will be collaboratively agreed prior to departure. Processes are described through which the agreed trajectory will be authorised, revised and updated. SESAR foresees a series of ATM Capability Levels to assure the linear development of both air and ground ATM components. ATM-2 in 2013 includes ADS-B-IN permitting CDTI based ATSA and ASPA applications.

The key SESAR implementation date of 2020 (ATM-3) is characterised by the inclusion of ASAS Separation (ASEP) and 3D VNAV capabilities, whilst ASAS Self-Separation (SSEP) is included in ATM-4 (2025+). The SESAR concept provides multiple opportunities for ASAS to contribute fully towards the ambitious SESAR performance targets. Primarily ASAS is expected to deliver safety performance in the airport environment, contributing greatly towards the SESAR objective of eliminating collisions on the ground. Airport capacity will benefit from the advantages of ASPA techniques associated with time based spacing, maximising runway throughput, and then, from 2020, ASEP applications may contribute to airport surface and closely spaced parallel runway operations in low visibility. Airspace capacity will be enhanced by the reduction of controller task load per flight including the delegation of separation and other tasks to the flight crew. ASAS techniques will enable aircraft to fly closer to their optimum trajectory therefore enhancing efficiency.

Finally SESAR proposes that airspace should not be segregated on the basis of equipage, hence ASAS Self-Separation (SSEP) is proposed in mixed equipage airspace for the timeframe 2025+. It appears essential to grasp the opportunity presented by SESAR to make significant steps towards the widespread implementation of ASAS techniques. Co-ordination must be assured with NextGen, those working on Oceanic applications and ICAO to ensure that the result is a simple, homogeneous set of ASAS techniques contributing significantly towards ATM safety and performance.

Key issues in the presentation

- Taking advantage of the opportunities offered by SESAR
- Accelerating the development of advanced ASAS techniques
- Participation in SESAR validation activities (JU) which will deliver evidence of ASAS performance
- Widespread co-ordination to ensure a consistent global development of ASAS

8.5 Issues from chaired discussions

Frank Alexander (North West Airlines)	**Q.** In SESAR strategies, ATM cost should be half, have you included the cost of a/c equipage?
Susanne Reed (SESAR)	**A**. It has not been included.
Frank	**Q** In SESAR you have addressed trajectory and cruise climb, did you address also CDA? Is descent separated from the whole trajectory?
Andy Barff (SESAR)	We wish to get as close as possible to the desired trajectory, and that could include CDA.
Frank	In your slide of equipage levels, you appeared to ignore the retrofit problem.
Andy (SESAR)	**A**. In SESAR we talk about not excluding anyone on equipage basis. Well, we tried that for RVSM and it went by the board. We need research to identify where we need to insist on equipage. NextGen says there must be performance based airspace. SESAR has a different approach. However, at end of day, users require an overall level of equipage. If equipage is required, then it will happen. Hopefully the research will show what to do with the level of performance.
Frank	Mandates are ok, but need a good, robust case.
Andy	**A**. Evidence of the benefit is needed before mandate.
Frank	**Q** There seems to be a lot of concern in improving runway throughput, but SESAR says nothing about runway occupancy.
Andy	**A**. Nothing to do with ASAS. Lots of work is going on, the presentation focus simply on ASAS.
Frank	**Q**. PR-NAV will give nothing in context of Closely Spaced Runways. The accuracies required exceed those offered by PR-NAV.
Andy	**A**. SESAR underlines the need to fly trajectories precisely, ASAS may help in this task and provide additional safeguard to RNP.
Tonea Dragos (EUROCONTROL HQ)	**Q**. Happy to hear about mixed mode operations. When can we expect the research to tell us something about mixed mode operations?
Andy	**A**. You know we have started the EPISODE 3 project that might not address self-separation because it is too far off, however, we at least have the chance now to get the evidence we all want. JU will have more opportunities.
Dragos	**Q**. AP23 is looking at this, and we hope that JU will take on board AP23 deliverable.
Andy	**A**. ASAS will survive only from the results of the research activities.
Tony Henley	I am concerned with the SESAR language about if ASAS will “survive” or not given that a

(BAE Systems)	lot of money has already been spent on its research. This is in contrast to NextGen.
Ken Jones (NASA)	**Q**. There has been a lot of talk on how ASAS can be used in the future. What progress should we make now? It is important also to define requirements. Will we still use ADS-B in 2025?
Douglas Arbuckle (JPDO NASA)	**A**. Do you need the functionality – yes. How do you provide the functionality? The problem we talk a lot about ASAS but we haven't defined a clear pattern and for sure we need to define standards.
Andy	We try to concentrate on independent technology, in future we could imagine SWIM (System Wide Information Management) overcoming technologies issues
David Wing (NASA Res. Centre)	**Q**. SSEP is only seen in low density airspace, do we have the capacity to apply that in high density airspace?
Andy	**A**. For high density areas ANSPs convey that new airway layouts will meet the increasing capacity, while the ASAS community failed to persuade the majority that ASAS will offer more than 3D route structures in high density airspace.
David	**Q**. [There is] no disagreement in highest density terminal airspace. The question is, what do we need to show? What is the evidence that is required?
Doug	**A**. [The] ASAS community should tell us what kind of evidence is needed in order to demonstrate the ASAS capabilities in high density environments.
Ken Carpenter (QinetiQ)	The value of ASEP is that it enables and allows the conflict to be resolved while adhering more closely to the approved and agreed trajectory than is possible using ground based conflict resolution.

C.Session 3: FLYSAFE

9 Introduction

This session was chaired by **Marc Fabreguettes** (THALES Avionics) and **Wim Huson** (Use2Aces), with **Fraser McGibbon** (BAE Systems) as the secretary.

This session gave a broad overview of the FLYSAFE project, and described the airborne Next Generation Integrated Surveillance System (NG-ISS). The NGISS is enhanced by a number of ground-based advanced Weather Information Management Systems (WIMS). The impact of weather on specific ASAS applications was discussed, focussing on ASPA-S&M and ATSA-SURF applications. Finally, some of the FLYSAFE Traffic Part Task Evaluation results were presented.

10 Review of the briefings

10.1 FLYSAFE Overview: Marc Fabreguettes (THALES Avionics)

Brief description

Air traffic is expected to triple world-wide within the next 20 years. With the existing onboard and ground systems, this may lead to an increase in aircraft accidents. As safety of flight depends to a large extent on flight crew actions, it is essential that crew members are supplied with reliable information that can be used at all times. FLYSAFE is developing the required new systems allowing the crew to make the right decision to avoid conflicts caused by weather, traffic and terrain.

FLYSAFE focuses particularly on the following areas identified as the main types of accidents around the world: loss of control, controlled flight into terrain, and approach and landing accidents. It addresses three types of threats: adverse weather conditions, traffic hazards and terrain hazards. For each of these it develops new systems and functions, notably improved situation awareness, advance warning, alert prioritisation, and enhanced human-machine interface.

The three main types of hazard sources for aviation (adverse atmospheric conditions, traffic and terrain) have led to the creation of three project branches, with a fourth branch dedicated to the development of the Next Generation Integrated Surveillance System (NG-ISS) itself with the integration of the design solutions.

- “Atmospheric hazards” will develop means to increase the awareness and fidelity on board aircraft with regard to all major sources of atmospheric hazards: Weather Information Management Systems (WIMS) (wake vortex, windshear, clear air turbulence, icing, and thunderstorm).
- “Traffic hazards” will develop means to increase the crew traffic situation awareness and provide them with early information on potential traffic hazards along the flight path.
- “Terrain information management” will develop means to increase the crew’s terrain and obstacle situation awareness and provide them with information on terrain and obstacle hazards along the flight path and functionalities that enable the crew to avoid conflict with terrain and obstacles.

As part of the NG ISS, innovative system functions will be developed, notably:

- Strategic data consolidation to anticipate any identified strategic risks related to atmospheric phenomena, traffic and terrain, along the planned flight path of the aircraft. This function is to reduce the number of tactical alerts generated inside the cockpit by anticipating those threats and advising the crew where replanning is required.
- Tactical alert management to help the crew manage all alerts generated by the "safety net" functions, such as TCAS, TAWS, and windshear (i.e. for those situations where an immediate response is required).

Finally, the validation of the complete system, and proof of concept, with both ground and onboard components, will be provided by a set of simulator and flight tests, involving a representative group of pilots.

The FLYSAFE consortium groups 36 partners from 14 EU countries and Russia. Universities, research centres, national meteorological bodies, equipment manufacturers and airframe manufacturers all contribute to the development and evaluation of the programme outputs.

The FLYSAFE programme started in February 2005 and will end in June 2009. Major developments are nearly finished and successive integration tasks on two test platforms will start shortly. Finally two campaigns of flight tests will specifically focus on evaluation of the FLYSAFE WIMS.

10.2 Impact of Icing and Turbulence on Safe Separation: Andrew Mirza (UK Met Office)

<u>Brief description</u>

Icing and turbulence are known hazards to the safe and efficient conduct of a flight. Icing affects aerodynamic performance and turbulence affects the health and safety of cabin crew and passengers. Both atmospheric phenomena could cause unplanned changes to vertical and horizontal position to avoid these hazards; hence to possible reductions in minimal separations in controlled airspace.

With the predicted global increase in air traffic movements, the adverse impact upon surrounding traffic caused by changes in vertical or horizontal position of one aircraft may become more common. Similarly, with higher traffic density it is possible that terrain and atmospheric conditions combined may limit further options available to flight crew to escape from any adverse conditions affecting their flight path.

Within FLYSAFE, knowledge of the current and future states of the atmosphere is considered desirable as a means to mitigate unplanned changes to the flight path, especially with respect to adverse weather conditions. Up-linking the most up-to-date and most relevant weather information could enable the flight crew to make more informed decisions regarding their current and future flight path. Such decisions, or changes to the intended flight path could be made before the aircraft leaves the ground. The aircraft only requires a subset of weather data, however provision of the master data to all interested users like ANSP's and AOC's could enable for more collaborative decisions that affect air traffic movements in anticipation of changes in the atmospheric state.

Centres for national meteorological services and meteorological research are collaborating within FLYSAFE to develop the means for generating and delivering the most up-to-date information regarding the current and future states of the atmosphere: with respect to identified hazards for aviation (icing, turbulence, thunderstorms and wake vortices); at variable spatial resolutions (1km to 40km) and time horizons (minutes, hours, or days ahead).

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

- Two scenarios were considered in which aircraft separation changes unexpectedly:
    - Vertically, due to clear air turbulence;
    - Horizontally and vertically, due to in-flight icing.
- Greater awareness of the 4D evolution of the atmosphere could provide better management of aircraft movements so as to maintain safe separation whilst avoiding hazardous volumes of space.
- FLYSAFE's vision of greater situation awareness could support this by:
    - Up-linking more frequently data indicating the spatial extent, evolution and intensity of areas of adverse atmospheric conditions;
    - Customising the requests for data to the intended flight path of each aircraft;
    - Providing forecasts of the state of the atmosphere, flight crew would have sufficient time to plan their actions thus reducing unexpected changes in vertical/horizontal separations.

10.3 On-board Wake Prediction & Alerting System: Andreas Reinke (Airbus Deutschland)

Brief description

Wake vortices have been a known danger to safe and efficient air transport for many years, and they are the reason for dedicated ICAO aircraft separation minima during take-off and approach. The low number of serious incidents indicates that these current standards are safe, although they do not completely prevent serious incidents during unfavourable conditions. In addition, the lack of wake turbulence separations during cruise flight leaves room for wake-induced upsets under specific conditions (e.g. climb/descent with small separation, low turbulence and adverse wind condition).

The number of such events could increase in line with the forecast increase in air traffic movements. Considering also the growing range of aircraft sizes (including the introduction of Very Light Jets), advanced technologies to assure the safety of flight operations are constantly being evaluated.

New airborne wake encounter prevention systems are being evaluated in the context of the FLYSAFE project. Such systems require validated sensors and models to inform the crews about potential severe wake encounters during all phases of flight. Model-based wake prediction could rely on the emerging ADS-B technology, improved knowledge of atmospheric parameters on wake vortex behaviour and should be seen in the context of integrated surveillance functions, possibly including ASAS applications.

The FLYSAFE objective is to demonstrate the functionality and applicability of an airborne Wake Encounter Prevention System (WEPS) as part of the Next Generation Integrated Surveillance System (NG-ISS)

Key issues in the presentation

- Severe wake encounters are rare but can occur under very specific conditions.
- Wake encounter prevention functions may become operationally feasible and contribute to enhance safety and capacity.
- Availability of mature and capable sensors as well as necessary data link is uncertain.
- Wake encounter prevention must be regarded as part of wider surveillance function and is likely to interact with ASAS.

10.4 Experiments on the Impact of Wind on ASPA-S&M Manoeuvres: Stephen Broatch (BAE Systems)

Brief description

ASPA-S&M (Airborne Spacing – Sequencing and Merging) is part of the “Traffic” functionality of the Next Generation Integrated Surveillance System (NG-ISS) being developed by FLYSAFE. Automatic execution of the S&M manoeuvre via the FMS and autopilot has been developed and the speed control mechanisms have been updated to take this into account. The ASPA-S&M algorithms used in FLYSAFE are based on those developed by the Requirements Focus Group (RFG) which currently do not make any specific provision for the effect of wind.

In order to determine the sensitivity of different S&M manoeuvres to the effect of steady air flows, a number of experiments have been performed. When comparing time and distance spacing manoeuvres, different responses to wind effects can be expected, based on the way that the respective spacings are defined.

A test scenario was developed, containing a route with turns into and away from a steady wind. This route was then used for Remain Behind manoeuvres with distance and time spacings in wind speeds of 0, 50, 100 and 150 knots.

These experiments show that time spacing manoeuvres are not sensitive to different wind speeds, although the initial capture period is altered, because of the own-ship’s ability to achieve the specified spacing value behind the target aircraft. However, distance spacing manoeuvres are sensitive to wind speeds over 50 knots, to the extent that the specified spacing is only just maintained at 100 knots and the manoeuvre cannot be maintained at 150 knots, in which case an automatic manoeuvre termination is generated.

One particular implication of these results is that time spacings must be selected carefully to ensure that legal safe-separation rules, which are defined in terms of distances between aircraft, are not inadvertently infringed during time spacing S&M manoeuvres in real-world wind conditions.

Key issues in the presentation

- Distance spacing is more sensitive to wind than time spacing.
- Wind impact is seen in the severity of the speed adjustments required to maintain distance spacing.
- Speed demands can exceed actual aircraft performance, potentially leading to manoeuvre termination.
- Wind of 150 knots resulted in manoeuvre termination for distance spacing, whereas time spacing was stable.
- ATC time spacing instructions must respect wind effects to ensure separation limits are not infringed at turns into wind.

10.5 ATSA-SURF – Enhanced Situation Awareness Under Adverse Weather Conditions: Claudia Fusai (Deep Blue) and Christoph Vernaleken (Technische Universität Darmstadt)

Brief description

Surface Movement is one of the most challenging phases of flight. Night or degraded visibility conditions (e.g. with airport markings obscured by snow and at airports not familiar to the flight crew) may cause excessive workload and increase the risk of disorientation while taxiing an aircraft. This does not only impair the efficiency of surface operations, which is important in view of growing air traffic, but can also lead to serious incidents and accidents, of which runway incursions (i.e. the incorrect presence of an aircraft on a runway) are most safety-critical.

FLYSAFE proposes solutions to enhance airport situational and traffic awareness to help flight crews overcome the problems they currently meet on the airport surface, both in good and low visibility conditions.

On the airport surface, pilots refer to two different kinds of awareness: global and local awareness. Global awareness is used to maintain ownship positional awareness relative to the gate and other airport features. Without global visual navigational references incorrect taxi turns are more likely and complete disorientation is possible. Local awareness refers to an immediate area of a route: the centreline and lights, the taxiway edges, the edge lighting, and taxiway signage.

Even if pilots have means to orientate themselves on the airport surface, sometimes they still may end up in error. Errors are the product of many concurrent events: deficiencies in the visual airport surface environment (non standard markings, markings obstructed by high grass, etc.), ineffective communications between controllers and crews, last minute taxi route changes, or high workload. Errors are more likely to happen in low visibility conditions, when global awareness is strongly affected and local awareness is degraded.

Over the past decade, the electronic airport moving map display has evolved both in research and industry, and is now widely accepted as the core technology to increase the flight crew's situational awareness in terms of position on the airport surface. Building on the foundation of an airport moving map, the FLYSAFE system proposes a Surface Movement Awareness and Alerting System (SMAAS) that includes the following additional features:

- Visualisation of taxiing instructions;
- Visualisation of the active runway;
- Visualisation and alerting system for closed runways;

- Display of traffic on or close to the airport surface, such as landing and departing traffic;
- Traffic alerting system referred to taxiing traffic conflict and runway incursion.

Key issues in the presentation

- Flight crews use different means for orientation on the airport surface, but sometimes pilots still experience difficulties during taxiing.
- Taxiing difficulties are more frequent in low visibility conditions due to the lack of global visual references and degraded local visual cues.
- With respect to NOTAM information, the advent of airport moving map technology adds a disparity in the conspicuousness of information, resulting in the danger that a runway that is displayed without any closure markings on the airport moving map might be perceived as open even if contrary NOTAM information exists on paper elsewhere in the cockpit. In other words, the unrestricted runway presentation of the same RWY on the airport moving map might have a stronger influence on the mental model of the airport that the crew builds. This calls for an integrated representation of PIB/NOTAM and airport moving map information.
- Human attention is limited and particularly when people are deeply involved in a task, there is a high risk of overlooking some information. Alerts draw the attention in the event that some important information goes unnoticed.
- The alerting concept developed must be integrated with an aircraft's general flight warning philosophy, wherever possible.

Afterword

During the presentation, the audience was shown a short video clip of a group of six people, three dressed in black and three in white, each team passing a ball between each other. Half of the audience was asked to count the total number of passes between the white team and the other half of the audience was asked to count the number of "bouncing" passes between the white team.

Mid way during the clip, a gorilla walks through the group, waves at the camera, then exits. The purpose of this was to demonstrate that if you are told to focus on a particular task, you can fail to see other significant events. It was interesting to note that only very few members of the audience appeared to spot the gorilla (or at least admitted to it!).

10.6 Panel session, discussion and feedback

Frank Alexander (Northwest Airlines)	Regarding the runway moving map display, what are the ADS-B-in requirements and costs? There seems to be a reliance on ADS-B. Also, it was requested to stop putting everything in the FMS (e.g. weight problems).
Christoph Vernaleken (TUD)	In FLYSAFE, ADS-B-in is addressed from human factors and functional perspectives. The project has studied what is feasible, and whether these alerts are desirable and useful from flight crew perspective. ADS-B-in is identified as a candidate but we are not limited to this technology. Could also look at TIS-B and maybe future technologies in 10 to 15 years. We are aware of issues with regard to the traffic datalink with respect to high level warnings, but we are sure it is very important to add these functions. Number of airport surface incidents in the US this year is worrying. FLYSAFE is far from putting something on an aircraft but the requirements need to be studied in detail. With regard to the FMS, what FLYSAFE is proposing to add to the system is is small considering advancing solid state technology and the general increase in computing power.

Wim Huson (Use2Aces / FLYSAFE)	Reminded the audience that the FLYSAFE time frame is to 2020 and these functions will not be add-ons to existing FMS technology introduced 25 years ago.
Frank Alexander	Everything safety related is very important to operators. It is the airlines who have to foot the bill so where these functions reside is very important. Frequently, people use the term "it's only software" but this is also expensive. Other ways of achieving the same objective should be explored (e.g. is on the aircraft always the best solution?).
Tom Graff (NASA)	Is there a regulatory issue? As pilots do make wrong turns today, must we wait until 2025 for a solution? Graphics requirements are such that we are not going to put moving maps on Navigation Displays. Should consider an EFB solution.
Lars Lindberg (AVTECH)	I would like to remind people of the Milan Linate accident where SAS colleagues were lost. Trials will soon be taking place in Stockholm to demonstrate some of these capabilities. I also do not consider that everything must go into the FMS. Agree that it will take too long with an ND solution. Has FLYSAFE looked at the feasibility of an EFB?
Christoph Vernaleken	Airport moving map on an EFB is not part of current studies but is in the concept mainly to address retrofit. The FLYSAFE philosophy is to use the ND as future line fit option. Recognised that retrofit to older airframes may not be possible. The current evaluation at TUD is looking at an ND solution as this is the superior solution from a conceptual point of view. It is still to be decided what solution will prevail which would be adapted to economic constraints.
Phil Hogge	Recognised this is an important issue. An FMS upgrade is expensive and this needs to be balanced with the speed of bringing in an initial solution (e.g. EFB).
Christoph Vernaleken	Agreed with this statement.
Vinny Capezzuto (FAA)	We should be considering a bundle of capabilities. If we consider a whole spectrum of applications, it becomes affordable. It is hard to quantify (cost) random events and it is challenging to find a solution for everyone. On the ground, all obstacles and vehicles need to be equipped. We can't get any more safety benefits from what we have today and it's time to put something in the cockpit.
Tony Henley (BAE Systems)	Raised the point that from a Human Factors point of view, how good is it if you only have some traffic and not all of it, and how would this affect providing advisories to the pilot.
Pierre Gayraud (Thales Avionics)	Referred to the ACSS presentation which will be given in session 4.
Doug Arbuckle (JPDO)	This is a good set of functions, but US regulators are concerned with putting too much on an EFB. Is there scope for a study into the pros and cons of different solutions (EFB, ND, and so on). Pointed out that we in the research community often want everything, but we need to remember to analyse the pieces.
Christoph Vernaleken	This is something we will look into. Regarding further the FMS issue, we're not planning on putting all functions into the FMS, but to extract some data and we are looking into using the MCDU as an interface to some functions, for example NOTAM upload. Recognised that complex solutions may have certification problems.
Mel Rees (EUROCONTROL HQ)	For timescales of 2020, SESAR has identified IEEE 802.16 as a future ground based communications system which provides high data uploads for FMS loading at the gate. This could be considered.

	Also encouraged consideration of an alternative to ADS-B for the additional information that will be required. Also pointed out that ACAS is turned off until entering the active runway so might not be useful for checking on taxiway.
Bob Darby (EUROCONTROL HQ)	As we are in the process of writing rules for applications that will become operationally live in 2 to 3 years, there will be no possibility to change the ADS-B datalink before the 2015 timescale. We need to respect what is going to be used in the short timescale. Commented that some of the FLYSAFE traffic weather terrain elements are also in the CAPSTONE programme and wondered if FLYSAFE has taken anything from CAPSTONE and what could FLYSAFE add. *(No member of the FLYSAFE team was able to respond on CAPSTONE.)* Also acknowledged that the experiments into the effects of wind of S&M showed that time based spacing had advantages over distance based.
Alan Groskreutz (AENA)	Spoke in favour of time based separation. A lot of times this new way of looking at separation might increase capacity, but only by helping realise unused capacity.
Phil Hogge	What about using a separation application on the ground?
Andy Barff (EUROCONTROL EEC)	Integrity of traffic data is the critical issue. Once this is achieved, then we need to consider the problems in how to go from assisting visual separation to using the cockpit display for ground movement. The safety driver is significant and we might need to wait a while until there is a means of providing high integrity data. In Europe the focus has been on A-SMGCS for controllers but we need this surveillance data on displays in cockpit. Can we do this rapidly as the benefits seem great?
Jean-Pierre Magny (FAST)	Different types of aircraft mix create problems for spacing. Recommended to do simulations involving various types of aircraft.
Tom Graff	The number of surface accidents caused by (collisions with) other traffic is probably smaller than those caused by being in the wrong place (i.e. disorientation). It is more complex to display other traffic so this should not delay the introduction of moving map displays.
Christoph Vernaleken	Fully supported the comment. There is encouragement in FLYSAFE for a moving map technology and this should not necessarily be part of a set. There needs to be a packaged approach and a stepwise integration of technologies, beginning with an airport moving map, and a movement on to using the traffic data only when the data are good enough.
Vinny Capezzuto	We have considered integrity but what about accuracy? Current accuracy (90m is considered good) is such that it could mean you are on a runway instead of a taxiway. Therefore, this information should be advisory to the pilot. Also need to make sure this is not too expensive.
Lars Lindberg	Some studies (FAA / Transport Canada) have shown that for a 20% increase in traffic, there could be a 140% increase in runway incursions *(figures confirmed on page 9 section 9.5 of "Report on Runway Incursions"[1] from the Canadian Department of national Defence, directorate of Flight Safety – see footnote for link to this document)*.

[1] At the time of writing a full version of the "Runway Incursions" report can be downloaded from this link - aerohabitat.org/link/2006/22-04-2006%20-%20Runway_Incursions_Canada%202000%20-%202004%20(0.5MB).pdf

Vinny Capezzuto	Could not confirm the figures but agreed that it is not a linear relationship.
Wim Huson	What kind of timescale do we envisage if we need to think about weather information availability? Will there be any cost involved for the airlines?
Andrew Mirza (UK Met Office)	The timescales for development of weather products from FLYSAFE are aligned to the SWIM network being developed by EUROCONTROL, but whether the data will be available through what is in FLYSAFE or what is from EUROCONTROL is unclear. In terms of cost, this is not known. In FLYSAFE, there is a network of ground weather processors and equipment needed to store the data, and aircraft need avionics to access the data. Meteorological suppliers need equipment to supply the data. FLYSAFE is trying to keep development running in parallel with EUROCONTROL.
Wim Huson	Will weather updates be available earlier for the ground than the air?
Andrew Mirza	Yes, standard web browsers could be used to access the data.
Marc Fabreguettes (Thales Avionics)	FLYSAFE is a research project and is working on upstream solutions to limited problems which might find their place in future standards. With regard to WIMS (Weather Information Management Systems), when FLYSAFE ends in 2009, if important for the safety of flight, we will need to set up a different structure. This will be up to some of the FLYSAFE weather partners.
Bob Darby	There have been OTIS trials based on CPDLC and these have been well accepted by the pilots involved. Hence, there is already a means to provide the data.
Andy Barff	If UPS are using a traffic display for M&S, are they going to switch off the moving map display when they get onto the ground?
Tony Henley	Understands that they don't plan to, but there is a different symbol set for vehicles on the ground. Also, the present information is useful and powerful, but we have to be careful how it is used. We should not start to use it to move around the airfield at high speed.
Phil Hogge	We should separate what is an ATSAW function and perhaps a future one like ASEP-SURF.
Vinny Capezzuto	For the ACSS equipment, Philadelphia provides an environment to see how this works out in practice. RTCA is defining what the conflict detection tools should look like. At present, this is only on 1090 but it is hoped to use multilateration and transmit this out as TIS-B. However, there is the issue of false targets, but these are all experiments to learn from.
Christoph Vernaleken	FLYSAFE is looking at what needs to be equipped. The current policy assumed is that all aircraft and vehicles on manoeuvring areas should be equipped. However, baggage trucks, for example, are not a threat in the places that matter and could mean displays become cluttered.
Vinny Capezzuto	The FAA spectrum office will not allow more than 200 vehicles to be equipped. A draft AC has been issued on the subject. Interference with SSR, overhead TCAS and MLAT are concerns. The use of a different link is another possibility (e.g. MLS band for tugs). The power levels and quantity of emitters on the surface needs to be defined.
Lars Lindberg	Regarding navigation accuracy on the ground, we need another decimal. However,

	this will lengthen the message so we would have to consider ways to reduce the message size. For example, in Stockholm, higher resolution is used for ground vehicles but certain assumptions can be made (e.g. for incoming aircraft, they will land on the runway).
James Hanson (Helios)	Are there any thoughts about alignment of algorithms for alerting controllers and those for alerting pilots? It would be concerning if there are differences.
Christoph Vernaleken	We first need to look at trigger conditions, e.g. what constitutes a runway incursion? This should be standardised between air and ground. Something to be addressed is the availability and integrity of data. The algorithms may not necessarily be the same or identical. For example, consider the case that one aircraft aborts its take off and remains on the runway surface while another aircraft lines up. A condition for an alert would occur when the aircraft lining up commences take-off. But how can you detect its intention to take off? From a ground surveillance point of view, use of a speed threshold is possible. By contract, on board the aircraft, there are a number of systems that can give information much earlier, even before the aircraft starts to roll. This would not be available in a purely ground system. Operation in other parts of the world, or regional airports which are not as well equipped must also be considered. It is a complex task to make an onboard system capable of operating stand alone where there is no supporting ground infrastructure. Interoperability with other regions is another important issue.
David Zammit-Mangion (University of Cranfield)	With regard to non-commonality of air and ground algorithms, there are issues such as common mode errors. The concept of conflict detection is different on ground and in the air. I don't foresee a concern over different methods for alerting.
Tony Henley	Will new technology for wake vortex detection change the picture much?
Andreas Reinke (Airbus)	Yes, there are models for wake vortex prediction based on airborne or ground systems, or a combination of both.
Tony Henley	Can it be done on a day by day dynamic basis (e.g. separation changes on a daily basis)?
Andreas Reinke	There are already some solutions at Frankfurt Airport, e.g. good forecast horizon times. What does not exist is a global accepted standard to get it implemented right away.
Frank Alexander	We also need to consider where the application belongs, whether on the ground or in the air, to avoid duplicating cost and equipment.
Andreas Reinke	Agreed.

10.7 Conclusions from Panel Session and Closing Remarks

Conclusions from the panel session and closing remarks were given by Wim Huson of Use2Aces, a partner in the FLYSAFE project. Wim is leader of the FLYSAFE External Experts Advisory Group.

It was noted that there is only one ANSP, Austrocontrol, among the FLYSAFE partners. It would be desirable for FLYSAFE to obtain the input of more people with an ATC background both for developing specifications and to participate in the External Experts Advisory Group. This would help provide a more global point of view for integration of ATC concepts.

FLYSAFE is carrying out research towards implementation in the 2020 timeframe. Some general reactions from the audience indicated that certain results would be attractive to the aviation community somewhere between now and 2020. However, FLYSAFE results must be seen as building blocks to be used for future policy decisions. The aim of FLYSAFE is to develop technological enablers, thus it is too early to consider business cases for future implementations.

It was also stated that the FLYSAFE project group will disband after 2009 and it will be up to commercial partners to follow up the results of the project.

One of the main issues identified during the discussion was how airport moving maps are seen as a first step to improve safety during taxi and runway operations. As such, it was expressed that it would be desirable for moving maps to be made available as soon as possible without waiting for a possibly more complete solution (e.g. with traffic information) which would be expected to be introduced later.

Concerns were voiced about overloading the Navigation Display (ND) with too much traffic related information. This is a view which is shared by FLYSAFE. However, in the FLYSAFE long term vision, the proposed solution to display additional traffic functions is not to use an Electronic Flight Bag (EFB) but rather to use prioritised, pilot-selectable display options.

Similarly, the possibility of overloading the FMS was mentioned. Again, this is a view which is shared by FLYSAFE. However, in the FLYSAFE long term vision, the solution lies with enhanced FMS performance.

It was also reported that Weather Information Management Systems (WIMS) data (both forecast and nowcast) will be available to ATC centers and AOCs, and uplinked to aircraft. While uplink to aircraft might take longer to implement, WIMS information will be available to ANSPs before 2020 (perhaps via SWIM), which will benefit flight crews as ATC will be able to divert them around areas of bad weather.

Other major issues brought up included datalink bandwidth and end-user costs, as well as position accuracy and integrity. Finally, there was general consensus that time based separation is strongly preferable to distance based separation.

D.Session 4: Ground and Airborne Industry Progress

11 Introduction

This session was chaired by **Pierre Gayraud** (Thales Avionics) with **Tony Henley** (BAE Systems) as the secretary.

The session chairman introduced Session 4. The scope covers all air and ground equipment supporting ASAS.

The objective is to allow Airframe manufacturers, Avionics manufacturers and Ground equipment manufacturers to present their views, the lessons learnt from current development and deployments, their expectations and their vision of the future.

Seven briefings were presented in the session:

- Boeing ADS-B strategy: by John Brown (Boeing);
- Airbus status on ADS-B: by Christophe Maily (Airbus);
- ATSAW Development and Validation Status: by Béatrice Raynaud (Egis Avia) in the name of Airbus and Frédéric Legrand (DSNA);
- SafeRoute: Christophe Hamel (ACSS);
- ASSTAR findings: Aircraft Equipage for ASEP: by Cédric D’Silva (Thales Avionics) in the name of the ASSTAR consortium;
- Ground ASAS equipment: by Michel Procoudine-Gorsky (Thales Air Systems);
- ADS-B avionics for General Aviation: Aircraft Equipage for ASEP: by Ronny Friebel (EUROTELEMATIK).

They were followed by a discussion facilitated by Phil Hogge (ASAS-TN2)

12 Review of the briefings

12.1 Boeing ADS-B strategy: John Brown (Boeing)

Brief description

Boeing developed a high-level surveillance strategy, and presented it at various industry events during the spring of 2006. Since that time, the company has been working on the details in a number of areas, and responding to announcements by Air Traffic Service Providers and regulators, and enquiries by customers as they occur. The presentation reviewed the issues that were raised as the strategy was being developed, and considered how much progress had been made since. The presentation went on to consider the various factors that are affecting the more detailed development of the strategy.

Safety is always a concern, and the industry must ensure that the effects of ADS-B are, at worst, neutral. However, consideration of the various ASAS applications indicates that the functions could contribute very positively. Customer demand is always a factor when investing in new functions, but although pioneers like UPS and CASCADE are showing the way, there are still significant doubts about an operator's ability to achieve a realistic return on investment.

The business case must be supported by operational benefits or by other incentives. Existing equipage appears set to be used in Europe, Australia and Canada, but system requirements are still evolving and details of the benefits that ASAS will provide in SESAR and NextGen are not sufficiently defined to apply them to a business case for equipage. A number of mandates are being considered, reducing developmental investment risk, but the mandates will span a number of years and the requirements emerging are not fully consistent. Even in those areas where current equipage will meet requirements, the systems must be recertified to remove restrictions on use of the data transmitted. It is not yet clear how far current standards will allow us to progress with implementation of more advanced operational applications. Boeing is working to define the most economical way to implement ASAS applications across a wide range of dissimilar display and control systems. As UPS has shown, one possible approach is the Class 3 Electronic Flight Bag. The industry is also considering use of a Class 2 EFB, and Boeing waits with interest to see the outcome. ADS-B's relationship to TCAS/ACAS both from the point of view of presentation of both functions on the flight deck and from use of ADS-B data for the ACAS function still needs to be resolved.

Key issues in the presentation

- From this description, the key issues continue to be the ability of the ATM system to deliver the scale of benefits that make the case for widespread equipage with ASAS, and the range of standards and requirements that have emerged.

12.2 Airbus status on ADS-B: Christophe Maily (Airbus)

Brief description

The objective of the presentation is to update the Workshop on the status of Airbus ADS-B development.

Christophe reminded the workshop of the ultimate objective of Airbus: provide ADS-B In and ADS-B Out solutions for the whole fly-by-wire Airbus family.

To achieve this, a step-by-step approach has been established.

Step 1 : ADS-B Out

Certification is achieved on A380 for use of ADS-B in Non Radar Airspace operations (ED-126/DO-303). Certification activity is ongoing for A320, A330 and A340 aircraft with a target date of end 2007.

Step 2 : ATSAW (Air Traffic Situational Awareness)

Solutions are ready for A320, A330, A340 and A380 aircraft. Development has started with a target date for certification on A320, A330 and A340 of 2009. Flight tests have started on A320 flight test aircraft with very good feedbacks from pilots.

ATSAW will provide short term benefits, for example to detect climb opportunities and obtain better flight levels over oceans, without change in controller / pilot roles and responsibilities. With In Trail Procedures (ITP) additional benefits will be gained but will require a new procedure.

Step 3 : ASAS Spacing

An initial technical definition is ready for A320, A330, A340 aircraft for Sequencing & Merging. It is an automated function with a coupling to the autopilot. Only a software change will be necessary with respect to ATSAW. The benefits are linked to the use of CDA for noise and fuel reduction, mainly on secondary airports. The target is 2013 which corresponds to the mid term timeframe of SESAR where ASAS Spacing is introduced. The main constraint is not on the aircraft but airspace changes and ground system updates are needed.

Step 4 : ASAS Separation

This is an essential element of future concepts (NextGen, SESAR) for which operational definitions must be refined. Airbus does not see ASAS Separation before 2020.

As a conclusion,

A380 is the first aircraft certified for Non Radar Airspace operations (ED-126/DO-303). Airbus is in the process of developing Step 1 and Step 2 for the entire fly by wire family.

Key issues in the presentation

For further steps, airspace, procedural and ground system changes are pre-requisites. The benefits will be obtained if all stakeholders move in the same direction in the same timeframe. To meet their long-term objectives, SESAR and NextGen should coordinate ATM actors' developments to ensure economic viability of future ASAS developments

12.3 ATSAW Development and Air Ground Operational Validation Status: Béatrice Raynaud (DSNA) and Frédéric Legrand (DSNA)

Brief description

This presentation gives an overview of the CRISTAL-ATSAW project conducted by a consortium of three organisations, i.e. Airbus, DSNA and Egis Avia (formerly Sofréavia), in partnership with the EUROCONTROL CASCADE programme.

The project aim is to progress with the validation of ATSAW applications and to support the path for an early implementation of Airborne Surveillance applications enabled by ADS-B.

The project addresses three ATSAW applications from of ADS-B Package I applications, i.e. the;

- "enhanced Visual Separation on Approach (ATSA-VSA)" application,
- "enhanced Traffic Situational Awareness on the Airport Surface (ATSA-SURF)" application, and
- "enhanced Traffic Situational Awareness during Flight Operations (ATSA-AIRB)" application.

The presentation provides an insight into the results of the CRISTAL ATSAW validation activities, which consisted of:

- a set of real-time simulations conducted at either Airbus or DSNA premises, and
- a specific investigation of the airborne traffic filtering functionality.

The CRISTAL-ATSAW final report will be released in October 2007.

Key issues in the presentation

The joint DSNA and Airbus activity on airborne traffic filtering methods evaluated the acceptability and appropriateness of the baseline traffic filtering function (derived from current TCAS implementation in Airbus aircraft) and investigated areas of improvement whilst taking into account technical feasibility constraints.

The Airbus real time experiments consisted of operational evaluations of traffic display in the cockpit for the ATSA-VSA ATSA-SURF, and ATSA-AIRB applications. For each ATSAW application, the experiment evaluated four major topics:

- Operational benefits of ADS-B traffic display;
- Evaluation of ADS-B traffic display;
- Impact on pilot tasks and global integration; and
- Evaluation of new phraseology.

The DSNA real-time simulations consisted in an operational evaluation of the ATSA-AIRB application from an ATC and pilot/controller cooperation perspectives addressing four major topics:

- Evaluation of new phraseology for traffic information;
- Impact of ATSA-AIRB on controller tasks and global integration;
- Impact of ATSA-AIRB on controller / flight crew cooperation; and

- Impact of ATSA-AIRB on safety of flight operations.

Conclusions on the feasibility and potential benefits of the evaluated ATSAW applications are currently being developed inside the project, whose final results are expected by October 2007. The general feedback from the project is that:

- ATSAW is considered positively by both controllers and pilots;
- Pilots and controllers see an interest in sharing information about the identification of relevant aircraft, but have divided opinions on the evaluated new phraseology (that used the spelt identification);
- Training and clear pilot procedures should be established to avoid abusive use;
- The filtering logic based on proximity is acceptable considering a variety of traffic situations. The filter would be optimized in some traffic situations by combining a convergence criterion.

12.4 SafeRoute: Christophe Hamel (ACSS)

Brief description

SafeRoute™ is a Portfolio of airborne surveillance applications (ASAS) utilizing Automatic Dependent Surveillance – Broadcast (ADS-B), Traffic Information Service – Broadcast (TIS-B) and Cockpit Display of Traffic Information (CDTI) technology to improve the safety and efficiency of flight operations.

SafeRoute™ airborne surveillance applications include:

- Surface Area Movement Management (SAMM)
  Aids in the prevention of runway incursions and can be used for asset management purposes bringing efficiency benefits
- CDTI Assisted Visual Separation (CAVS)
  Is an airborne separation application providing flight crews with an enhanced means of ensuring separation from designated traffic rather than relying solely on out-the-window tracking when visual separation procedures are in use.
- Enhanced Traffic Situational Awareness during Flight Operations
  Provides, during flight operations, flight crews with a display of nearby traffic information (aircraft identifier, position, altitude, velocity and orientation) relative to own-ship data. Supplements the flight crew normal out-the-window visual scan, as well as verbal traffic information provided either by controllers or other flight crews to better understand the traffic situation.
- Merging and Spacing (M&S)
  Improves the predictability and stability in the flow of traffic for optimum use of an airport runway. Eliminates aircraft vectoring at low altitudes.

SafeRoute™ applications are functionally equivalent to the airborne surveillance applications defined by the Requirements Focus Group (RFG).

Within the industry, ACSS has actively promoted and developed the required aircraft surveillance infrastructure enabling applications development and implementation.

By making this technological leap, ACSS expects to accelerate the deployment of ADS-B based application in various regions of the world. In this respect, ACSS is promoting pocket trials, various standardization activities and has also been selected by ITT as part of the contract award for ADS-B services for the NAS to provide expertise on the airborne side.

Today’s ACSS FAA approved ADS-B IN applications offer incremental and direct Safety and Efficiency benefits to the Users. SafeRoute also help address the environmental issue

Key issues in the presentation

- SafeRoute™ is available to support situational awareness on the airport surface and in flight, CDTI assisted visual separation and Merging and Spacing.

12.5 ASSTAR findings: Aircraft Equipage for Airborne SEParation applications: Cédric, D'Silva (Thales Avionics)

Brief description

The ASSTAR (Advanced Safe Separation Technologies and AlgoRithms) 6th Framework R&D Project, led by DSNA with several partners, focuses on Package II ASAS applications. In particular the Airborne separation applications, targeted as Package 2 include Crossing & Passing, In Trail Procedure, In Trail Follow, In Trail Merge.

The ASAS SEParation Operational Principle is to delegate the separation manoeuvre and responsibility to a given clearance aircraft. The resulting separation manoeuvre is deemed more efficient (as it is an optimally calculated on-board aircraft, with frequently updated air-air broadcast navigation data).

The ASAS Separation delegation provides its benefits through optimised manoeuvres within regulatory separation in radar airspace; in procedural airspace better accuracy would allow near radar separation minima. Additionally it will reduce the ATCO workload: ATCO action will only be required for a short period well in advance of a possible conflict, the remainder of the conflict resolution being entirely performed by the aircraft. It was indicated that this induces an advantage of higher efficiency than current practices where instructions are anticipated, margins are taken, and the ATCO workload is consumed by constant monitoring of the manoeuvres).

The dimensioning hazard from the Safety analysis is risk of collision. If the ATC monitoring loop using independent surveillance is no longer performed, then reliance on air-air aircraft dependant broadcast navigation data, even if monitored at the on-board level, will be at stringent performance levels.

At the implementation level, ASSTAR has analysed several implementation alternatives (documentation can be found at the ASSTAR website: www.asstar.org). The key findings on equipage being:

- Extremely high confidence in navigation position integrity and continuity. Stringent requirements expected for clearance aircraft and target aircraft, which could be relaxed with a ground monitoring/alerting control loop with independent position data
- High continuity ADS-B datalink (data integrity over the link is easily ensured through protocol techniques).
- Regarding features that are specific to the cockpit no particular findings are relevant. They are expected to be integrated into future cockpit and avionics designs.

Main conclusions are that:

- ASAS-SEP will be driven by future standardisation; safety analysis and resulting allocations will be of paramount importance in system design options. Activities need to be launched to pursue this (inter alia: Stringent Navigation Integrity vs. Ground Monitoring against independent data, High continuity broadcast datalink)
- The use of Datalink (e.g. CPDLC) is recommended for ASEP applications:

Key issues in the presentation

- ATC monitoring loop in current system contributes to high integrity, by enabling a response to discrepancies and blunders
- Strong reliance on air-air broadcast navigation (navigation integrity, broadcast data continuity) data while executing the manoeuvre, both clearance and target aircraft navigation data integrity is of paramount importance.
- To meet safety expectations:
  - Either ASAS is entirely dependent on the on-board ASEP implementation, with stringent performance requirements placed on aircraft

- Alternatively, if an air-ground system architecture is used, including monitoring using independent data, the requirements can be spread between the aircraft and the ground components.

12.6 Ground ASAS equipment: Michel Procoudine-Gorsky (Thales Air Systems)

Brief description

While ASAS is considered as a key enabler in future generation ATM systems, Ground Surveillance Applications are the forerunners of ADS-B implementation, in particular ADS-B NRA which is generally considered as the simple case of implementation.

The presentation shows that even in this case there is a significant impact on the automation system. In the scope of ASAS standardisation, the current definition works do not address the requirements on automation systems in detail, only through high-level operational requirements or recommendations. But the controller will certainly need tools to support the implementation of ASAS applications, especially when safety and performance improvements are sought.

As a conclusion it is therefore recommended to address the topic of requirements on automation systems to ensure a timely implementation of ASAS.

Key issues in the presentation

- ADS-B NRA requires additional hardware and software on the ground (ADS-B processing chain, ADS-B Front Processor, ADS-B Data Processing, RAIM Outage prediction). Some software has to be modified (Safety Nets Manager, Controller Working Position).

- Existing alert functionality may be enhanced (Short Term Conflict Alert, Cleared Level Monitoring, Route Adherence Monitoring, Minimum Safe Altitude Warning and Danger Area Infringement Warning) and new alerts may be defined: inconsistency between data from various surveillance sources or between surveillance data and flight plan data.

- The solution to integrate new surveillance means may differ depending on the capabilities and age of the ATM system.

- Up to now, operational requirements have not been clearly transformed into technical requirements in the SPR/INTEROP process. They are limited to the ground stations and capabilities of modern automation systems are not considered (in term of contribution to performance, safety)

12.7 ADS-B avionics for General Aviation: Ronny Friebel (EUROTELEMATIK)

Brief description

The market for ADS-B avionics for General Aviation (GA) currently experiences a growth due to the strengthened demand for Mode-S transponders, as carriage is prescribed by regulations. With this installation being mandatory, the market for ADS-B applications in GA is opened. Several manufacturers offer Mode-S transponders, some of which are ADS-B out capable.

Euro Telematik's CDTI has been used and evaluated in several research projects. It comprises a traffic information display, a moving map, terrain indication and also enables the pilot to communicate with ground operations using a standard message set or free text messages.

Together with a Mode-S transponder (Filser) and receiver (Selex) the CDTI-2000 forms a low cost ADS-B In/Out solution for General Aviation.

Key issues in the presentation

General Aviation covers a wide range of aircraft types, where air vehicles will not always have the necessary power supply to enable the operation of a transponder or other avionic electronics.

Currently there is no need for ASAS installations for the majority of GA users.

12.8 Issues from chaired discussions

Jean-Marc Loscos (DSNA)	We heard from John that there is no guarantee that today's ADS-B will support ASAS, but Christophe seemed more bullish. Please elaborate. What is the requirement for ADS-B, which standard ED102 /DO260 or DO260A or 260A change 1, 2 or 3 is required for which application?
John Brown (Boeing)	I hope that we can use one of the ADS-Out variants. We need to see what we can achieve with that, rather than define a requirement for each application, but I am not sure RFG is doing that. If we don't, we will have many different requirements for ADS-B-Out. More important is agreement on the navigation source and quality
Christophe Maily (Airbus)	Agree. It is not the messaged structure but the sources of navigation data that is important. What is sufficient? Is GPS OK? Multipath on the ground is a concern. The choice between DO260/260A is not a big issue. If we need to change from current standards we will (i.e. if 260B is specified) upgrade to it, but not until we know benefits.
Christophe Hamel (ACSS)	DO260A will cover all our needs, but we may need higher integrity for future applications (e.g. CSPA (closely spaced parallel approaches).
Bob Darby (EUROCONTROL HQ)	It was said that the business case might be helped by mandates. However the EUROCONTROL view is to allow ANSPs to make the decision on their ground equipage. Europe is preparing the Surveillance Performance and Interoperability Requirements Implementing Rule which will require that airlines carry a transponder that will support radar, Multilateration and ADS-B-Out. The aim is to future-proof the aircraft equipage against foreseeable changes in the ground surveillance environment. However, the precise details of what will be in the rule and which standards will be referenced are still being developed. The SPI IR is ground focused and does not support the air-to-air applications. However equipage according to current standards (DO-260 / 260A + changes) should support a package of near term applications, as we heard in the first session. Therefore calling on these standards in the SPI IR should help ensure wider and more consistent aircraft equipage which would also strengthen the business case for the near term air-to-air applications. Therefore the Surveillance Strategy and the SPI IR between them should give a firm basis for both ASAS and ground surveillance for many years to come.
John Brown	Yes, we can develop a specification to cover the future but only if we knew what the future requirements will be, specifically what will be the required integrity level.
Frank Alexander (NW Airlines)	We are obsessed with technology. We have to reach a point where we say one technology is enough for 20 years and freeze it, and see how far it will take us.
Christian Cantaloube (Thales Avionics)	Could you expand on the abusive use of ADS-B that Frédéric mentioned?
Béatrice Raynaud (DSNA)	Yes, when we provide more information, it can be found that there are (e.g.) too many requests to ATC trying to understand what is going on. However, the flight crew still don't have full picture and cannot know the ATC strategy completely and can misunderstand it. This has been seen with TCAS. We need training to avoid this and then it should not be a

	show stopper.
Jean- Pierre Magny (FAST)	With respect to non-flying vehicles on the airport, the FAA says that they cannot broadcast their position on the same frequency that aircraft use but is there a plan for tracking these vehicles? There is risk of collision with these?
John Brown	Vinny Capezzuto said that there will be a maximum of 200 vehicles on the ground which will be reported to aircraft and expects no more that 20 on the screen at any one time. Low speed collisions with baggage trucks will not be prevented by this technology.
Christoph Vernaleken (Technische Universität Daarmstad)	How will the spacing in S&M be automated?
Christophe Hamel	For SafeRoute there is currently no integration with FMS. Controller provides verbal spacing time e.g. 80 seconds. Pilot enters this, then system provides speed cues. The distance is a consequence of the time spacing. [Airbus have an integrated approach using the autopilot]
Mel Rees (EUROCONTROL HQ)	Business case is very important, you [ACSS] have done a lot of work in this area and you have a price for the equipment. Could your cost benefit analysis (CBA) studies be released to others?
Christophe Hamel	There are different answers. What is the best price for selling? We have used studies based on Mitre work (and others) on benefits analysis etc. But in order to respond to price/benefit requests from airlines we need to work with them to first develop an operational concept. This is different at different locations. We are talking with British Airways about an operational concept for Heathrow where they control 40% of the traffic but for M&S to be effective it looks as if we would need 80% equipage. We could provide the generic CBA tools but airline need to tailor them to the specific locations and operational scenarios. We end up developing a unique case for each airline and location. We have experts looking at procedures at a range of airports. We have done some work on S&M at Paris but have been given the constraint of not changing the airspace. This leads to the requirement for 75% equipage in order to give benefit but this would be much lower if it was allowed to change the airspace For airlines that dominate a Hub the case is much easier e.g. Air Berlin which controls 100% of traffic at its Hub, and some middle east airports where just two airlines control 90% of the traffic. The case is easier for ATSA-SURF [but based on accident reduction], and CAVS is not too difficult.
Lars Lindberg (AVTECH)	4D and ASAS are in Competition! Both have potential for benefits. ACSS and UPS have made a great step forward (with their certified equipment) however, South West airlines are doing it a different way and plan to equip lots of aircraft. We have healthy competition!
Christophe Hamel	I don't see it as a competition The UPS system is just SafeRoute 1. There will be more integrated systems with greater predictability in the future which will combine the approaches. SafeRoute 1 is for retrofit. For forward fit there will be a much more integrated solution.

13 Concluding remarks: Phil Hogge (ASAS-TN2)

Phil Hogge (ASAS-TN2) summarised some of the main points of the workshop as follows:-

- Time is very short, we only have until the end of October to get the main ASAS development and implementation steps into the appropriate SESAR D4 documents. If this is not done there is a danger that they will not be included in the European ATM roadmap and may not receive the appropriate funding.
- The SESAR and NextGen Concepts of Operations have many similarities with regard to the use of ASAS in a 4D trajectory environment. In order that these two projects remain in step, and to utilize best the available resources, a strategy should be developed for validation and implementation that builds on shared results.
- The ASAS-TN2 comes to an end in April 2008. The ASAS community should consider setting up an 'ASAS Group of Experts' to co-ordinate continued input into the SESAR Joint Undertaking.
- We must acknowledge that a number of applications are simple and can give benefit in the short term (ATSA-SURF, ASPA-S&M, ITP, etc). A structure similar to that in the CASCADE/CRISTAL project could be used so that pioneer airlines could use these applications in specific locations.
- In the longer term, we should focus now on those applications which will take time to develop and which it is expected will give significant benefits. SSEP is the prime example. Therefore, we should support the experts who are trying to quantify benefits, we should define now the requirements for the most demanding applications, and we should use these to develop the technologies which will give the required integrity levels.
- Finally, airspace users and ANSPs cannot afford frequent upgrades. A plan should be developed outlining a minimum number of system upgrades which will support the emerging ASAS applications.

14 Conclusions from the Workshop

Short-Term Implementation

- Both SESAR and NextGen anticipate that 4-D and ASAS are totally synergetic. If SESAR is to meet its objective, ASAS must be positioned correctly within SESAR D4. If this is not achieved then ASAS will not be included in the European ATM roadmap.
- A number of potential short-term applications with identified benefits were discussed at the Workshop (ATSA-SURF, ASPA-S&M, ATSA-ITP).
- Presentations concerning the use of ASAS (by adding traffic and alerts to a moving map) in surface operations indicated that several distinct levels of capability and consequential benefits exist e.g.
    - map only,
    - moving map and own position (and taxi route when available),
    - moving map, own position and traffic (and taxi route when available)
    - moving map, own position, traffic and alerts (and taxi route when available)

Medium / Long-Term Implementation

- Coordination between SESAR and NextGen, with regard to validation and implementation, needs to be assured for efficient use of resources and global interoperability.

- If the high capability level applications of ASAS envisaged in SESAR and NextGen (separation and self-separation) are to be implemented as planned, development of the necessary requirements and technological solutions needs to start now.

Industry

- Industry recognizes the need to minimize the costs to airspace users and ANSPs of multiple system upgrades. This can be achieved by clustering applications and defining and developing the long-term applications immediately.

15 ASAS-TN2 Recommendations/Actions

Short-Term implementation

- The ASAS-TN2 team recommends that the short-term development of appropriate ASAS applications receives the necessary funding.
- The ASAS-TN2 team recommends that the short-term ASAS applications (ATSA-SURF, ASPA-S&M, ATSA-ITP) should be included in SESAR D4 IP1.
- Ways should be found to enable pioneer airlines to implement S&M and ATSA-SURF. A project similar to the CASCADE/CRISTAL projects is needed to enable pioneer airlines to use these applications in specific locations in Europe.
- The ASAS-TN2 team recommends that for ATSA-SURF the different levels of capability are defined, together with the associated operational and safety benefits.

Medium / Long-Term implementation

- The ASAS-TN2 team recommends that the definition of the requirements for the high capability level ASAS applications (separation and self-separation) starts now in order to ensure that the appropriate technology will be available on time.

Industry

- Develop a plan for a minimum number of avionics upgrades to support the progressive introduction of ASAS applications.
- The SESAR JU should ensure that sufficient funding is made available to develop high capability level ASAS applications.

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