Airborne Separation Assistance System Thematic Network 2 (ASAS TN2)

Report of the First Workshop
26th - 28th September 2005, Malmö, Sweden
Implementing ASAS

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Conclusions drawn from the workshop

- Position ASAS in the SESAME (Single European Sky Implementation Programme) Master plan.
- ASAS stakeholders must show empirical evidence to support implementation decisions
- ASAS is not stand alone - it is recognised as an integrated part of the Air Traffic Management (ATM) system.
- The RFG (Requirements Focus Group) is successful - it should be continued and strongly supported by the international community.
- We are in an ADS-B (Automatic Dependent Surveillance – Broadcast) - Out rich environment. Beware it is a non-certified environment
- The Airbus/Boeing common view & road map on ADS-B, leading to advanced ASAS applications is a major milestone.
- Need to involve the military because they have ASAS-like experience, airspace is shared and UAVs (Unmanned Aerial Vehicle) need to be accommodated.
- Differences in terminology and definitions are causing confusion and need to be addressed.

ASAS-TN2 Recommendations

The following recommendations are derived by the ASAS-TN2 Consortium on the basis of the proceedings:

- Validation programs should be aligned with the RFG with the goal of validating the RFG outputs and the RFG process should be used for Package 2 & 3 (Ground surveillance (GS) and airborne surveillance applications (AS)) when appropriate. RFG outputs should be positioned into SESAME.
- Links with ICAO (International Civil Aviation Organisation) need to be strengthened. National representatives to ICAO should be encouraged to take note of RFG outputs.
- Packages 2 & 3 require a coordinated research programme now in order to define the road map for development
- EUROCONTROL the European organisation for the safety of air navigation (and the FAA – Federal Aviation Authority) needs to work with stakeholders to actively identify and eradicate differences in terminology and definitions

1. Introduction

The First ASAS (Airborne Separation Assistance System) Thematic Network 2 (ASAS-TN2) Workshop **Implementing ASAS** was held from the 26th to 28th September 2005 at the Savoy Hotel, Malmö (Sweden).

This workshop is the first of five ASAS–TN2 Workshops. This workshop was focused on ASAS applications and their operational impact and evolution.

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

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

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

2. What is the ASAS-TN2?

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

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

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

The ASAS-TN2 projects objective:

The main objective of the ASAS Thematic Network 2 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 Experimental Centre (EEC) that includes BAE Systems (Rochester, England), ENAV (Italian company for air navigation services), LFV (Civil Aviation Authority, Sweden), NLR (National Aerospace Laboratory, the Netherlands), Thales ATM and Thales Avionics (France).

In addition to the above organisations, the ASAS-TN2 involves a very wide range of organisations (e.g. ATM stakeholders, Universities) including pilot and controller professional associations (Air Traffic Controllers European Union Co-ordination (ATCEUC), International Federation of Air Traffic Controller’s Association (IFATCA), International Federation of Air Line Pilot’s Associations (IFALPA) and ECA (European Cockpit Association)).

3. First ASAS-TN2 workshop

3.1. Format of the workshop

Day 1 consisted of an introductory session describing the work of the ASAS-TN2, the purpose of the workshop and an overview of ASAS activities followed by a series of keynote presentations examining the overall ASAS issues from a variety of perspectives.

Day 2 consisted of two sessions. In each of these sessions selected presentations addressed the subject area with a view to raising the key issues. In each session, the presentations were followed by a chaired discussion session. Session 2 focused on the progress in ASAS application development and validation. Session 3 was a report from the NUPII (North European ADS-B Update Project).

Day 3 addressed implementation issues and future ASAS packages and the longer-term research and development aspects. The final session addressed the ASAS-TN2 approach to reporting on ASAS application maturity followed by concluding discussions.

3.2. Day 1 – 26th September 2005

3.2.1. Welcomes

- **Phil Hogge -** Event Chairman, Former director of infrastructure in Europe for International Air Transport Association (IATA)

Phil Hogge welcomed the participants on behalf of the ASAS-TN2. He started by emphasising that while the overall objective of the ASAS-TN2 remained the same as in ASAS-TN1, the aim now was to continue sharing information and to extend the scope to encompass Packages 1 and 2.

Whereas previous workshops had had parallel sessions, this one, by popular demand, would have four consecutive sessions and some demonstrations on Tuesday evening. This meant that the workshop itself would be very busy with relatively little time for questions and discussions. The Chairman asked delegates for their understanding while he tried to ensure that the event kept to time.

- **Michael Standar**, LFV - Manager ANS Support & Development

Michael Standar welcomed the participants on behalf of LFV. He highlighted the drivers for change including the demand for increased capacity, improved efficiency, cost reduction and environmental issues… He also referred to the institutional changes for ANSPs (Air Navigation Service Providers) that may shift from being National ANSPs to Regional ANSPs to potentially European wide service provision. He identified ATM performance as being an en-route to en-route issue with airports as the bottleneck. ASAS, as shown in the NUP work, can provide better turn around times. There is one ATM concept but many enablers of which ASAS is one. We should be finding the best way of performing tasks and redistributing these to the airspace user. ASAS enables many of the sought after improvements in ATM as well as a greater situational awareness distributed to more users of the system.

  - Ensure the introduction of ASAS capabilities which provide measurable benefits for the investor.
  - Ensure a safe and timely introduction of ASAS
  - Ensure a safe and efficient growth potential in ASAS systems
  - Include ASAS in the overall ATM concept
  - Avoid extreme costs barriers

- **Bob Graham (EEC)** on behalf of **Chris North**, European Commission

Chris North was unable to join the workshop due to illness, but passed on a message of welcome and wishes for a successful workshop via Bob Graham

3.2.2. Setting the Scene

Overview of ASAS-TN2 – Bob Graham/Eric Hoffman (EEC)

Bob Graham described the format of the event, the purpose of the ASAS-TN2 and its history and origins.

This workshop is the first of a series of five within the TN2 work and is co-located with the NUP II project. Co-hosting with other projects is to be a feature of ASAS-TN2. The scope of the work is now Package 1, 2 and 3 (n.b. information on the Package approach can be found at www.asas-tn.org). The required work to realise ASAS should be globally structured, as we cannot spread the available resources too thinly.

Bob advocated that we should be aiming to <u>prove</u> and <u>quantify</u> the benefits of ASAS.

The ASAS-TN2 will deliver an ASAS application status report, originally titled Tableau De Bord, which will also contain a gap analysis identifying what still needs to be done. We shall analyse the work to date and critically evaluate the whole. This work will evolve to recommend research strategies and we will take this message to the European Commission.

European Commission Expectations – Bob Graham on behalf of Chris North (EC)

Bob Graham presented a message to the workshop on behalf of Chris North. The message was to speed up ADS-B implementation and its associated applications. Other concepts will not be able to solve all of the ATM challenges. He urged that implementation be speeded up, even if early steps were less ambitious than the later ones. He pointed out that EC has invested over several years but has witnessed things happening first in other regions of the world. We need to learn from the global experience. Some of the applications appear to be mature, especially Package 1. In conclusion:

- We need to show benefit to achieve implementation – area for focus?
- We need to accept some risk – use available technology (Mode-S Extended Squitter)?
- EC remains committed to ASAS
- Position ASAS in the SESAME Master plan.

NUP II Overview –Niclas Gustavsson (LFV)

Niclas Gustavsson gave an overview of the NUP2 cluster D activities that are to be reported individually in Session 3 of this workshop. He gave an overview of the origins of NUP from the NEAN (North European ADS-B Network) and NEAP (North European ADS-B Applications Project) programmes and outlined the work to be done in NUP 2+.

The objective of NUP Phase II is to deliver an extensive pre-operational platform for Europe supporting various ADS-B and Communication, Navigation and Surveillance (CNS) applications.

The progress of this work has been via a stepwise approach, starting with ADS-B out applications through to Air to Air (ASAS) applications. The scope of the NUP2 + work is to include ADS-B and 4D.

Niclas outlined the key lessons learnt as a result of the NUP2 work:

- Need to ensure benefits and transparency in the whole “food chain” – what’s in it for me?
- Need to reduce complexity in the implementation phase
- Unclear process towards final implementation for human users

- Balance between industry and institutional development
- Retrofit vs. Forward fit issues

ATA/Boeing joint position on ASAS – Stéphane Marché (Airbus) and John Brown (Boeing)

Boeing and ATA have agreed to cooperate in a number of areas of ATM, notably in interoperability issues. This is a working arrangement from a high-level (e.g. Congressional) down to where anti-trust issues would prevent any further collaboration.

They have identified several evolutionary areas to address and work in collaboration via Working Groups-

- RNP (Required Navigation Performance)
- GLS (Global Navigation Satellite System Landing System)
- 4D trajectory
- Communication
- ASAS

In addition they support the RFG, Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) ADS-B Task Force and ASAS-TN.

They have agreed a common position on ASAS, including development of a roadmap. ASAS shows great promise for use in an evolved ATM system. Ground system capabilities are evolving as a result of the availability of ADS-B out. This appears in the wake of European Mode S mandates and is provided on a non-interference basis.

Some key areas they have identified is the overlaps and gaps in standards and the differences in certification between the US and Europe. There is no certification on the performance of ADS-B out.

Current implementation plans are limited and the future is unclear, hence the need for a roadmap.

After the use of ADS-B out, the roadmap starts with retrieving data from other aircraft, to provide ATSAW - air traffic situation awareness (e.g. In trail procedure in oceanic airspace (ITP), Enhanced visual separation on approach (VSA), Enhanced traffic situational awareness on airport surface (SURF)). Based upon this experience other applications may be developed.

After ATSAW, Sequencing and Merging and Crossing and Passing applications are the next most likely candidates, but more work is required in terms of requirements and clear identification of benefits.

The ground applications after the use of ADS-B in non-radar airspace are likely to be using ADS-B out in addition to radar. The use of Aircraft Derived Data (ADD) via ADS-B is still to be defined and there is a range of possible complexity with ADD (i.e from simple to more complex ADD). The development of Precision Runway Monitoring is also seen as viable, but it may be in competition with multilateration techniques.

In conclusion they stated:

1. Air Traffic Alliance and Boeing share a common view on most aspects of ADS-B:
   - The benefits that can be obtained.
   - Issues that need to be addressed
   - A likely roadmap for progress

2. Airborne use of ADS-B will depend on:

- Integration into ATM system (including ground)
- Clear availability of operational benefits

3. Internationally harmonized standards are essential to global interoperability.

A. Session 1 ASAS in the global ATM Environment

1. Introduction

This session was chaired by **Tony Henley** (BAE Systems) with **Rob Ruigrok** (NLR) as the secretary.

- Five briefings presented in the session:
  - ICAO work on ASAS by Jean-Marc Loscos, Direction des Services de Navigation Aérienne (DSNA)
  - ASAS in OCD and C-ATM (Co-operative ATM) by Bob Graham, EEC
  - Perspective from C-ATM User Group by Billy Josefsson, LFV
  - Australia Upper Airspace Project (UAP) and Lower Airspace Project (LAP) by Bob Peake, Airservices Australia
  - Clustering ASAS Applications by Fraser McGibbon, BAE systems, England
- Chaired Discussions
- Wrap-up by Chairman.

2. Review of the briefings

2.1. Jean-Marc Loscos (DSNA)

Brief description

Jean-Marc Loscos, ICAO SCRSP (Surveillance and Conflict Resolution Systems Panel) member from France, presented the activities ongoing in ICAO on ASAS. ICAO develops SARPS (Standards And Recommended Performance) and guidance material. Historically, the ASAS work in ICAO was started by Francis Casaux, at that time within SICASP (Secondary Surveillance Radar Improvements and Collision Avoidance Panel)). The ASAS work in SICASP started by looking at "other uses of ACAS". An example of such use of ACAS was the "In Trail Climb" procedure in the Pacific. Although this procedure was not well accepted, it proved an operational need. ICAO assigned the task to SICASP to include ASAS related issues.

An overview of ICAO panels currently dealing with ASAS:

- SICASP/SCRSP: Develop, as necessary, ICAO provisions to meet the operational and technical requirements for an airborne separation assurance system (ASAS). (SICASP/6 Feb.97) ANB task CNS9701
- OPLINKP (Operational Data link Panel): worked on ADS-B applications (ADS-B NRA – Non Radar Airspace) and produced an ADS-B concept of use.
- SASP (Separation and Airspace Safety Panel): worked on separation minima based on ADS-B.
- ATMCP (ATM Concept Panel): worked on a global ATM operational concept for the years 2020 and onwards.

ANC (Air Navigation Conference)/11 in 2003 provided a major milestone. The ATM operational concept is accepted and endorsed:

- It introduces the "separator" as being "the airspace user". The flight crew will require airborne surveillance and assistance for spacing or separation, i.e., an ASAS.
- The ADS-B concept of use is endorsed and AS/GS package I is supported

- It introduces ADS-B surveillance including GS applications such as ADS-B-NRA, and AS applications such as Airborne Spacing Enhanced Sequencing and Merging (ASPA-S&M) and Air Traffic Situational Awareness on the airport surface (ATSA-SURF).

The ASAS circular, being produced by SCRSP, will provide acknowledgement of ASAS definitions, classification of applications and an update on applications under evaluations worldwide. ACAS is reaffirmed a last resort system independent from ground systems but impacting the ATM system.

ASAS is recognised as an enabler of elements of the ATM operational concept (information management, traffic synchronization, separation provision). RFG is instrumental for coordinated operational and technical requirements. SARPS have been proposed for ADS-B on 1090ES.

ICAO would like to define SARPs in a different way than before. Until today, SARPs have been technically oriented. ICAO intends to move away from the technical details, and instead wants to focus on required performance for communication, navigation and surveillance systems and for the total system. After Required Navigation Performance (RNP), Required Surveillance Performance (RSP) specifications for surveillance systems are being developed. These are at the level of the applications, from which the detailed technical level requirements will follow. RSP includes accuracy, availability, integrity, latency, update rate, continuity and coverage.

The next step is the production of an ASAS Concept of Use. The ASAS concept of use should provide a consolidated view of how **ASAS applications would be a component of the ATM system**.

Key issues in the presentation

- ASAS applications would be a component of the ATM system.
- ICAO assembly moves from technical SARPS to performance-based SARPS, including acknowledgement of industry work on standards. The requirement to ensure system interoperability will also fall to industry, leaving ICAO to concentrate on functionality.
- But, the challenge for ICAO is now as follows: how to ensure global interoperability of complex systems such as ASAS without dictating detailed or specific solutions to industry?
- Work progress in ICAO panels is heavily dependent on State expertise, contributions and resources. Everybody is welcome to participate!

2.2. Bob Graham (EUROCONTROL EEC)

Brief description

Bob began by stating that a Concept of Use would be good.

Eurocontrol has an Operational Concept Document which calls for:

'A collaborative and co-ordinated layered Planning framework for ATM operations in a gate-to-gate context based on the principles of Collaborative Decision Making and System Wide Information Management'

This calls for a coherent approach to task distribution but current work is focused on 'Bits' and is not well integrated.

The R&D roadmap which forms a core part of Single European Sky (SES) calls for an integrated concept of use with overall goals, ASAS fits into this with package 1 mapping onto the medium term deployment phase but it must be shown to be integrated

There is a call for Collaborative Decision Making (CDM) – this must apply between the controller and the pilot as well as between nodes on the ground

It is difficult to talk about in service dates, what is important is to introduce the packages that work when they are ready.

SESAME will incorporate the first parts of package 1

Co-operative ATM (C-ATM) had the role to integrate mature research into a coherent concept but it was quickly found that the research was not mature and the available elements were also very specific.

It became apparent that airlines (at least those that contributed) were not interested in capacity but rather in predictability.

ASAS can stand alone in special locations if it is useful and safe but we must be focusing on ASAS integrated with time-based traffic management, RNAV (Area Navigation), 4D, Environment requirements

Bob concluded with 5 key issues that must be addressed if ASAS is to become an integrated component of the future ATM system.

Key issues in the presentation

- Benefits – these must be demonstrated
- Buy in – it must be tested with users and their acceptance confirmed
- Implementation- must take note of work in USA and Australia
- Positioning- SESAME will go ahead – this is the right time for action
- Integration – must ensure that ASAS is integrated into the SESAME master Plan

2.3. Billy Josefsson (LFV)

Brief description

Billy Josefsson presented on behalf of the C-ATM User Group (UG) and the notion of ASAS within this group. The C-ATM User Group is not dedicated looking at ASAS, but at ATM in general. Within the European Commission 6th Framework programme C-ATM, the goal is to improve safety, use available capacity in all weather conditions, create additional capacity and manage uncertainty. Current research in ATM is being integrated in an overall gate-to-gate ATM concept, including ASAS, 4D and CDM. The ATM concept is foreseen for 2020, with initial deployment in 2012.

The C-ATM User Group (UG) comprises of Airlines, Service Providers and Airports, and was tasked to be independent in thinking and trying to set its own “agenda”. In the end, consolidated views and expectations of all major ATM partners were to be identified.

The C-ATM UG has produced a User Objectives Document (UOD), http://www.catmug.be/ containing consolidated user requirements, observations and issues based on a merged view from Airline, ANSP and Airport.

Main overall recommendations / requirements / issues in the UOD:

- Promote strategy that ensures meeting the schedule at gate **at destination**
- Airline Operational Control and Airport Operations Control should be integrated in the concept
- Common situational awareness ensures a clear view of the operation for all ATM partners

Main ASAS related recommendations / requirements / issues in the UOD:

- The concept should not necessarily require a ground infrastructure as it currently exists.
- Aircraft trajectories should be represented in both airborne and ground systems.
- ANSPs should have access to the aircraft’s intended high reliability 4D plan.

- Today's airborne situational awareness is limited to mental picture obtained from listening on the radio.
- ATM processes today, poor automation and information sharing as well as inefficient task and responsibility distribution, lead to unnecessarily high costs and fees.
- In the current system task allocation between air and ground cannot be optimised further.
- The system does not provide the flexibility required for efficient use of the aircraft fleet, airspace and ATM capacity.
- Separation minima and procedures do not fully reflect modern aircraft capabilities.
- Inability of the air transport industry to agree on strategy and required equipage

It should be noticed that the C-ATM UG did not specifically address ASAS, but the User Group requirements and statements map nicely to an environment where ASAS applications are an enabler.

The need for a group with a task similar to that of the C-ATM UG is acknowledged for future programs, e.g. SESAME:

- Increased understanding of each actors requirements & constraints
- Acceptance of each other's position and possibilities
- Collaborate to find out the best way forward
- Challenge is to keep this process going!

Key issues in the presentation

The concept of a User Group with representation from Airlines, ANSPs and Airports is key to converge to a commonly agreed ATM Operational Concept.

Although not focussed on ASAS, the C-ATM User Group provided requirements and issues that can be met or solved by including ASAS elements in the operational concept, not as stand-alone entities, but integrated.

2.4. Bob Peake (Airservices Australia)

Brief description

The Australian interest is initially more ADS-B -Out than ASAS, they have a large land mass with very restricted radar coverage and now a lot of long haul aircraft from Europe and elsewhere which, because of the European Modes S mandate are ADS-B out equipped. First target is to provide air traffic control (ATC) surveillance over a wider area with air to air applications to follow. They also have an interest in ITP climb and descent for the oceanic areas.

Airservices Australia has a 3 phase plan:

1. ADS-B operational trial,

2, ADS-B upper airspace project,

3. Atlas (lower airspace ADS-B surveillance with satellite navigation)

Phase 1

Operational trial in the Burnett Basin using partially overlapping radar and ADS-B coverage with the ground surveillance using, in order of preference: Radar, ADS-B, ADS-C (Contract), or flight plan data with different symbology assigned to each and smooth transitions between the data sources.

The regulator has approved 5 NM separation using ADS-B surveillance in the Burnett area. It is planned to expand the trial to include Boeing 737 and Airbus A320 aircraft. The ADS performance was assessed as good as or better than the radar.

Phase 2

The plan is to fit 28 ADS-B ground stations (co-located with existing VHF (Very High Frequency) communication sites) across the country to give full continental coverage. The expected benefits are:

Safety (no ATC surveillance coverage today)

Efficiency (able to allow more optimum altitudes)

Equipage will be optional but preferential flight levels will be awarded to those aircraft that are ADS-B capable. While some aircraft are already equipped there is at present a slow uptake by the regional aircraft.

Phase 3

ATLAS (Australian Transition to Aviation Satellite technology)

The plan is to introduce satellite navigation as sole means linked to ADS-B for surveillance -this will allow the removal (non replacement) of en-route radars and many of the existing Nav aids, leaving just a 'thin' network. This is being debated now at government level as it would probably entail the service provider paying for the equipage of the General Aviation (GA) fleet. An RFP (request for proposal) for low cost GA avionics has recently been issued.

Key issues in the presentation

Using ADS-B operationally – with initial regulatory approval

Plans for wide spread deployment – linked to aircraft equipage resulting from the European Mode S mandate

Providing a major drive towards full international acceptance of ADS-B-Out as an alternative to radar

2.5. Fraser McGibbon (BAE Systems)

Brief description

This presentation was prepared by Fraser McGibbon with Tony Henley (BAE Systems) and Pierre Gayraud (Thales Avionics).

Fraser McGibbon presented the ASAS-TN2 work in progress on clustering ASAS applications. Within ASAS-TN2, the goal is to cluster ASAS applications into homogeneous sets, which will enable the structuring of development and deployment plans to support ASAS-TN2 WP3 in which ASAS Application Maturity will be assessed.

PO-ASAS (Principles of Operation of ASAS) defines the following categories of airborne applications, with Packages definitions as defined by CARE-ASAS:

- Package 1:
    - Airborne Traffic Situational Awareness (ATSA)
    - Airborne Spacing (ASPA)
- Package 2:
    - Airborne Separation (ASEP)
- Package 3:
    - Airborne Self-separation (SSEP)

Ground surveillance (ADS-B) applications have been included in Package 1, Runway Incursion Alerting applications have been included in Package 2/3.

Airspace users through JAFTI (Joint User Requirements Group [JURG] ADS-B Fast Track Initiative) consider Package 1 applications as the first "building block" which will be the basis for further Packages, enabling high benefits. This position has been endorsed by EUROCONTROL, the FAA and ICAO.

The clustering was presented as table in the form of an Excel spreadsheet. Each application within the clustering has been characterised by the following criteria: airborne equipment, ground infrastructure, progress, airborne integrity, role, implications, near term benefit, decision makers, training and who invests.

Examples were given of how the clustering table can provide a useful decision making tool to allow airlines, ANSPs or airports to answer questions such as:

- What can I do with …?
- What do I need to do if I want to …?

Key issues in the presentation

The ASAS-TN2 proposed clustering is summarised as follows:

- Airborne Traffic Situational Awareness
- Airborne Spacing
- Ground Surveillance
- Airborne Separation
- Alerting for Runway Incursion
- Self Separation

These clusters will be used in ASAS-TN2 WP3 (ASAS Application Maturity).

The clustering table can also be used as a decision making tool.

3. Issues from chaired discussions

Clustering presentation

Jean-Claude Richard:

- Parameters in the clustering table were generally appreciated. Comment was that the one investing is not necessarily the one who gets benefits.

Answer Pierre Gayraud:

- But we have to identify this, so therefore it is included in the table.

Answer Tony Henley:

- It also depends on which level we address the benefits: European level (EU, capacity to support economic growth), specific airline level (competitive advantage), etc.
- It may therefore be appropriate to include high level global benefits in the table.

Answer Bob Peake:

- In the Australian scenario, any reduction in ATC costs are directly returned to the user as reduced charges. We expect a 3% reduction in fees, while still being able to subsidise GA equipment.

Stéphane Marché:

- How do we validate the table content?

Answer Tony Henley:

- It will be the challenge for the ASAS-TN2 team to fill the table and to find agreement with the ATM community (you!) on the content.

Answer Eric Hoffman:

- Actually, the table is a by-product. The goal was to cluster the ASAS applications sensibly, based on some criteria / parameters. This way we were able to group the applications in preparation for the ASAS-TN2 WP3 Application Maturity assessment. The content is at this moment not yet mature.

<u>C-ATM User Group presentation</u>

Tony Henley:

- C-ATM User Group appears to be negative on incentives, however Australia is planning to use incentives scheme. Comments please.

Answer Bob Peake:

- In the Australian case, the fees are regulated by a pricing formula which is discussed and agreed with the airlines. Any proposed ATM changes are offered as options, together with the relative increases / decreases in fees.
- When RVSM (Reduced Vertical Separation Minimum) was introduced, equipped aircraft received better / higher flight levels, so there was a precedent for those who invest to get benefits.

Bob Arnesen:

- In Australia there is the political will to switch off radars. Does the SESAME master plan address such a political decision?

Answer Jean-Claude Richard:

- SESAME includes all stakeholders. Any proposal like this should come from the stakeholder group(s) in SESAME.

Bob Darby:

- How did you involve operational people in the C-ATM User Groups?

Billy Josefsson:

- The user group was very successful and well supported with the right people at the right time, it is hoped that this momentum can be continued.

<u>ICAO presentation</u>

Pierre Gayraud:

- To implement ASAS we need ICAO documents. ICAO is to develop Required Surveillance Performance (RSP), but RFG does not develop RSP, it is developing Interoperability, Safety and Performances Requirements. Is there a discrepancy?

Answer Jean-Marc Loscos:

- ICAO is afraid of too rapid changes to specifications. For this reason ICAO intends to limit on performance requirements rather than on technical details/design.
- RFG is complement to what ICAO produces, since industry is part of RFG.
- RFG further has a mandate to send documents to ICAO.
- Ken Carpenter's task as chairman of the ICAO Subgroup on ASAS is to co-ordinate with RFG on content of RFG to ICAO level.

Heinz Frühwirth:

- Interoperability is the highest level ATM requirement. This has to be achieved.

Phil Hogge:

- How will the ASAS-TN2 feed into SESAME?

Answer Tony Henley:

- The global concept recognises ASAS. Unknowns are where, when, how and alternatives for ASAS. Enough people are involved in SESAME aware of capabilities of ASAS.

4. Concluding remarks

This session on ASAS in the global ATM Environment has shown that ASAS is fully recognised as an element in the global ATM system by ICAO, the European Commission, the stakeholders in the C-ATM User Group and by Airservices Australia.

SESAME is tasked to ensure that ASAS will be integrated into the SESAME Master Plan. It is however emphasised that ASAS elements should be included in the operational concept, not as stand-alone entities, but integrated.

The ASAS-TN2 team has proposed a clustering of ASAS/ADS-B applications to further assist the implementation of ASAS:

- Airborne Traffic Situational Awareness
- Airborne Spacing
- Ground Surveillance
- Airborne Separation
- Alerting for Runway Incursion
- Self Separation

B. Session 2 – Progress in ASAS application

5. Introduction

This session was chaired by **Pierre Gayraud** from Thales Avionics with **Peter Howlett** from Thales ATM as the secretary.

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

- Six briefings presented in the session:
  - CASCADE (Cooperative air traffic services through surveillance and communications applications deployed in European Civil Aviation Conference) overview by Alex Wandels, EUROCONTROL Headquarters (HQ)
  - CASCADE CRISTALS (Co-opeRative ValidatIon of Surveillance Techniques and AppLications of Package I) by Christos Rekkas, EUROCONTROL HQ
  - Overview of RFG activities by Jorg Steinleitner, EUROCONTROL HQ
  - RFG NRA by Jorg Steinleitner
  - RFG S&M by Ben Stanley, Helios, England
  - RFG ITP by Tom Graff, National Institute for Aerospace (NIA) for NASA (National Aeronautics and Space Administration)

5.1. Introduction by the session leader

The session leader first presented the objectives of the session. The purpose is to make a status of progress made in the development and validation of ASAS applications. The R&D phase of a number of ASAS applications can now be considered to have been successfully completed and we have moved into the application development and validation phase.

The development and validation phase is the phase where all necessary material is being prepared allowing then to launch deployments with the final goal of entry into service.

The achievements at the end of this phase should be:

- A dedicated operational concept has been validated and agreed; and
- Applications are technically defined and validated; and
- Standards are established (technical, operational) with performance allocated to each element (Aircraft, Aircraft operators, ANSPs, airports); and
- Approval regulations and means of compliance documents are ready

As the last point will not be addressed by the presentations it has been mentioned by the session leader that there is currently an activity within EASA (European Aviation Safety Agency)/JAA (Joint Aviation Authority) aiming at developing guidance material for the certification of Mode S Transponder Systems for ADS-B out.

6. Review of the briefings

6.1. Alex Wandels (EUROCONTROL HQ)

Brief description

The presentation was given by Alex Wandels, CASCADE Programme Manager (EUROCONTROL Headquarters).

The CASCADE program builds on the European programs Link 2000+ (CPDLC – Controller Pilot Data Link Communication) and Mode S Extended surveillance. CASCADE's objective is to coordinate the introduction of new CPDLC services over and above the services deployed by Link 2000+ and initial ADS-B services. These services will be defined in the context of existing technologies: VDL Mode 2 and ATN for CPDLC and Mode S 1090 Extended Squitter.

The program is organised into two streams:

- Stream 1 (deployments from 2008): with respect to ASAS applications it includes Ground Surveillance Applications: ADS-B NRA (Non Radar environment) and ADS-RAD (Radar environment).

  Two other ASAS applications are envisaged but not yet decided due to a lack of demand: Ground Surveillance on the Airport surface (ADS-B-APT) and Airborne Derived Data (ADS-B-ADD).
  On-board the aircraft, all these applications require only ADS-B-out. As many aircraft are already equipped, the investment is marginal.

- Stream 2.

  The ASAS applications to be deployed from 2011 are:
  - Air Traffic Situational awareness on the airport surface (ATSA-SURF)
  - Airborne traffic situational awareness (ATSA-AIRB)
  - Visual separation on approach (ATSA-VSA)
  - Enhanced Sequencing & Merging (ASPA-S&M).

The benefits expected from these ADS-B deployments are to provide quality surveillance services in a cost effective way, to improve situational awareness in the cockpit, to create opportunities to delegate some ATC tasks to pilots and also the opportunity to provide situational awareness to airline operations centres.

The CASCADE programme provides the European infrastructure to coordinate the requirement and standard development, their validation (further described in the CASCADE CRISTALS presentation below) and the technical feasibility up to implementation.

Key issues in the presentation

- There is a European program structuring the ASAS application development and validation phase
- It covers 8 of the 10 Package I applications
- There is a deployment plan with the short-term ASAS application, requiring marginal investment, from 2008.

6.2. Christos Rekkas (EUROCONTROL HQ)

Brief description

Christos Rekkas, CASCADE Deputy Programme Manager, EUROCONTROL presented the current validation activity within the CASCADE Programme.

The approach for validation is to establish partnership with the local stakeholders to perform validations on site (CRISTAL Projects). Doing so will guarantee that the validation activities are performed in environment where the need exists and that it will be integrated in operational systems. Pilots and controllers are involved where possible.

Validation activities are currently in progress for the ADS-B NRA, ADS-B RAD and ATSA-S&M applications. Linked to the growing number of ADS-B-out equipped aircraft, a monitoring of the broadcast data is currently performed in different sites in Europe in order to assess their quality.

Emphasis is presently on the Ground Surveillance applications. Pre-operational trials for some of the Ground Surveillance applications (e.g. NRA, RAD) are expected from 2006-07 onwards. Operational use of Ground Surveillance could be expected to start from 2008-09 onwards, depending on the local plans. Then the effort will shift to ATSA applications.

Key issues in the presentation

- A significant validation programme is established in Europe to support the development of the ASAS applications

6.3. Jörg Steinleitner (EUROCONTROL HQ)

Brief description

The presentation was given by Jorg Steinleitner, CASACADE Programme and European Co-Chair of the RFG

The RFG is a pragmatic international working arrangement involving EUROCAE (European Organization for Civil Aviation Electronic Equipment), RTCA (Radio Technical Commission for Aeronautics), Eurocontrol, FAA, Australia, Japan. RFG's main objective is to define the requirements for a first package of “ADS-B out” and “ADS-B in” applications. The documents to be produced are Operational Services and Environment Descriptions (OSEDs), Safety & Performance Requirements (SPR) and Interoperability Requirements (INTEROP). When completed, SPR & INTEROP documents will be handed over to EUROCAE WG51/RTCA SC-186 in order to derive means of compliance for airworthiness & operational approval and as an input to Minimum Aviation System Performance Standards (MASPS) and Minimum Operational Performance Standards (MOPS) (or updates of existing material). The RFG also provides material to and liaises with ICAO (SASP, OPLINK, SCRSP panels).

RFG is now clearly implementation oriented and currently developing material for 9 Package 1 applications of which 2 are "fast-tracked": ADS-B-NRA and ASPA-S&M.

Key issues in the presentation

- RFG is now well recognised and “steaming” ahead; it is well established within overall standardisation context and providing key deliverables for initial ADS-B implementations.
- Work on the “Fast-track” applications is laying the foundation for the next applications.
- Work is well under way with completion expected in the summer of 2006. ADS-B-NRA SPR and INTEROP are almost complete and due to be handed over to EUROCAE/RTCA very shortly.
- ASPA-S&M requires further validation & harmonisation with UPS cargo airline Merging & Spacing implementation activities.

6.4. RFG – NRA - presented by Jörg Steinleitner (Eurocontrol HQ)

Brief description

A status of RFG activities on ADS-B in Non Radar Airspace (ADS-B-NRA) was presented. As in all other applications considered by the RFG, work on ADS-B-NRA is organised in three sub-groups: Application Definition (AD, developing the OSED), Safety & Performance Requirements (SPR), Interoperability Requirements (INTEROP).

The AD released its proposed Final “Operational Service and Environment Definition” document (OSED) end of August (version 1.3) for approval by the CASCADE Operational Focus Group. All issues raised so far have been resolved in OSED version 1.3 with the exception of one remaining issue concerning “manual de-selection of baro altitude transmission” which is currently being addressed and will lead to an update.

A strong link has been established with the ICAO OPLINKP panel who have agreed with future changes to document 4444 PANS-ATM in line with this OSED.

The SPR sub group focuses on Operational Performance Assessment (OPA) and Operational Safety Assessment (OSA). The OPA identified radar baseline requirements and derived corresponding ADS-B requirements, e.g. integrity, accuracy. Strong international coordination has enabled full convergence on the major issues. A complementary Safety Assessment including an ASOR (Allocation of Safety Objectives and Requirements) enabled consolidation of the SPR. SPR version 1.0 release is under preparation for approval at RFG/7.

The INTEROP sub-group defined minimum functional & technical requirements with link-specific requirements established in an annex for 1090 ES.

Final editorial changes are now in progress targeting submission to EUROCAE WG51/RTCA SC-186 in November 2005 and approval in February 2006.

All ADS-B-NRA related RFG material will be forwarded to ICAO SASP.

Key issues in the presentation

- The OSED, SPR and INTEROP are close to completion and will be submitted to EUROCAE WG51/RTCA SC-186 very shortly.
- Close liaison has started with relevant ICAO panels

6.5. Ben Stanley (Helios)

Brief description

The presentation was given by Ben Stanley, European Co-leader of the RFG S&M Task Force

A status of RFG activities on Sequencing & Merging (ASPA-S&M) was presented. A quite mature Operational Service and Environment Description (OSED) is now available. Convergence on almost all main issues has been obtained while work is continuing on clarifying operational requirements, including unambiguous measurement of spacing value and the relationship of ASAS with the surrounding environment. An update currently in progress will incorporate initial OSA and OPA findings.

The safety assessment was conducted according to ED-78A / DO-264 in full collaboration between US and Europe. New mitigation procedures were proposed (to be included in OSED as exceptions). The OHA (operational hazard assessment) is almost complete while ASOR work on-going.

ED78A was found to be a good basis for assessment, but requires careful use by experts and a proper understanding of inter-relationship between Communication, Navigation and Surveillance functions. Some differences between US and Europe in applying methodologies had to be resolved.

Key issues in the presentation

- ASPA-S&M was chosen as a fast track application despite being one the most challenging Package 1 applications. There was a learning process and differences to be resolved for this fast-track application that will benefit the following applications.
- OSA is almost complete and is to be validated shortly.
- OPA is being re-drafted – material should be complete by late 2005
- INTEROP work is to start on completion of mature OSED and SPR

6.6. Tom Graff (NIA for NASA)

Brief description

The presentation prepared by Ken Jones (NASA) and Tom Graff has been given by Tom Graff (consultant for NASA).

The context of operations where there is a need for in-trail procedures has been explained with examples in the North Atlantic Organized Track System, The South Pacific Oceanic Region and Oceanic Non-Radar Airspaces. The objective is to allow aircraft to climb to more efficient altitudes.

An attempt was made in the 1990's to solve this issue based on TCAS (Traffic Alert and Collision Avoidance System) but it has been rarely used and this solution was questionable from the safety point of view.

Now RFG is defining a procedure based on Airborne Traffic Situational Awareness (ATSA). On-board system is used to provide information to ATC: target aircraft flight ID, ground speed and range information. They are obtained via ADS-B-in without explicit communication with target aircraft.

The ATSA-ITP application has a great potential for fuel saving and should present a good return on investment for airlines. In addition it provides more flexible operations in oceanic areas.

RFG is developing the Operational and Service Environment Description (OSED). Approximately 40 international participants contributed to the development of the document. Two international workshops have been held to address substantive issues.

RFG is now starting the Operational Hazard Assessment (OHA) with the view to establish Safety and Performance Requirements (SPR) and INTEROP standards.

As implementation by the States, requires ICAO involvement to introduce ATSA-ITP standards and separation criteria in the ICAO documents, contacts with ICAO have been established by RFG.

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

- ATSA-ITP offers a solution to the lack of flexibility in oceanic area to use efficient flight levels,
- Airlines who decide to equip their aircraft will immediately take benefit (provided surrounding aircraft are largely ADS-B equipped).
- RFG, gathering a large panel of competence, is progressing well on this application.
- Global interoperability is necessary
- Implementation by the States requires ICAO involvement.

7. Issues from chaired discussions

IFALPA expressed three concerns:

Q: How is safety ensured in flight trials. They have seen operational trials where safety was marginal.

A: *(A. Wandels) before any trials are undertaken, a safety case is submitted to local authorities. Judging by the case of CPDLC trials, trials are at least as safe as regular operations.*

Q: There is no consistent use of selected altitude. So far operationally and technically and the selected altitude parameter is not usable until standardised.

A: *(C. Rekkas/M. Watson) what happens if mode S is going to be transferred to ADS-B?. The solution adopted in UK for mode S is likely to be adopted for ADS-B.*

Q: There are concerns about developing E-TIBA (Enhanced Traffic Information Broadcast by Aircraft) procedures which are considered to be workaround procedures to mitigate deficiencies of the ATC service. IFALPA advocate rectifying the deficiency rather than developing workarounds.

A: *(J. Steinleitner) acknowledged concern but working on E-TIBA all the same. There is a workshop in two weeks where IFALPA is more than welcome to participate.*

SAS noted that ADS-B-ADD had been referred to as the "funny bird" in one of the presentations. Since Airbus and Boeing seem to be reluctant as well, is there any value in continuing work on ADD?

A: *(A. Wandels) acknowledged that this is a real issue. The idea of using Aircraft derived data transmitted by ADS-B was identified long ago but so far there are no clearly expressed requirements. ADD is to be used to enhance controller position (Controller Access Parameters – CAP) and to enhance ATC tools but there are still no clear endorsed requirements. Hope to see some clear requirements. C. Rekkas added that Mode S already covers some of this. Market for ADS-B ADD would be in the periphery outside mode S areas.*

Q: (B. Arnesen, European Cockpit association) Generation of position info. GPS (Global Positioning System) based, IRS (Inertial Reference System), based, FMS (Flight Management System) VOR (VHF Omni-directional Radio Range) /DME (Distance Measuring Equipment) generated. What is going to be the standard? Need good qualified positional data.

A: *(J. Steinleitner) quality indicators are required, e.g. Accuracy, update rate, integrity requirements. Anything that meets them will be usable. The most likely is GPS but not necessarily. ADS-B messages will be transmitted with quality indicators. Ground systems then decide how data can and will be used. Will it be defined through certification?. Different schemes may be envisaged.*

Q: (J. Brown, Boeing) – had proposed to add Precision Runway Monitoring to the RFG list of applications. What is the status?

A: *(J. Steinleitner) RFG is willing to include it if there is enough support but Cascade is more reserved because outside Package 1. The subject is on the agenda for RFG/7.*

S. Marché (Airbus) thanked the other participants in the ITP group of RFG for the quality of their comments to the ITP procedure. Pointed out that the 15nm separation is only at the crossing altitude. Normal separation is maintained through the rest of the flight. Suggested that a new set of CPDLC messages for ITP might be required. Will need to forward this to communication working groups. The procedure is still to be assessed by separation panels. Actions towards SASP and ICAO regional panels. T. Graff (NIA/NASA) indicated that this has started with ATMG (ATM Group) for North Atlantic.

Q: (M. Agelii – SAS (Scandinavian Airlines)) asked whether any consideration had been given to providing benefits for the first equipped?

A: *(T. Graff) Benefits will outweigh the costs anyway and the first equipped will get benefits immediately, as soon as the others have ADS-B out which is happening very fast. He sees no real need for incentives except maybe for the first certification.*

Q: (M. Watson - NATS): fuel savings figures shown in the figures seem to be a little out of date. Could we use more recent figures?

A: *(T. Graff): Yes it would be good but detailed carrier data including e.g. MGTOW (Maximum Gross Take Off Weight) are needed, which are hard to obtain. Acknowledge that the $160,000 saving figure is probably conservative.*

Q: (J.M. Loscos - DSNA) on ASPA-S&M. Sequencing & Merging procedures tend to be used in different ways depending on the specifics of the TMA (Terminal control area)/approach, this requires close coordination with local actors. How does this fit with the RFG work which describes generic procedures?

A: *(B. Stanley) It is recognised that the RFG defines generic S&M. Individual variants will have significant impact on benefits that can be obtained locally. In particular, approaches may need to be redesigned to reap the benefits of S&M. This still needs to be done. E. Hoffman: we need to confront generic view developed by RFG with local cases. RFG willing to check that RFG work is applicable*

Q: (A Barff – Eurocontrol EEC): The benefits of ITP seem to be obvious but are we really honest when we say it's ATSAW? Isn't this rather a new separation standard that will then get applied elsewhere and often?

A: *(T. Graff) No, it's a new way of applying an existing standard. If it's set up correctly, believe it's safe. We need to try it out. However we'll need to look at controller workload if it's used frequently.*

8. Concluding remarks

After discussion at the ICAO 11th Air Navigation Conference of the ASAS Package concept and recommendation to start deployment with Package I applications, the presentations and discussions during the session show that at least 8 of the Package I applications are well advanced and an important momentum has been given. It relies mainly on the Requirement Focus Group activity bringing together experts from different disciplines and from a number of countries. When establishing standards for new operations in aviation, a validation process involving a number of European states and other countries (United States, Japan, Australia…) is necessary to support this activity.

The RFG work clearly appears to be moving in this direction towards concrete definitions and beginning to address approval steps.

C. Session 3 – NUP II

1. Introduction

This session was chaired by **Billy Josefsson** from LFV with **Eric Hoffman** from EUROCONTROL EEC as the secretary.

Four briefings presented in the session (15 minutes each presentation):

- TT (Tiger Team) ITS Arlanda - Michael Agelii (SAS) and Anders Nyberg (LFV)
- TT ADD by Nick McFarlane (Helios), Billy Josefsson (LFV) and Costas Tamvaclis (EEC)
- TT Reijkavik ITP by Brynjar Arnarsson (Tern systems, Iceland)
- TT Frankfurt Airborne Approach Spacing and Extended Visual Acquisition by Oliver Reitenbach (DFS – German air navigation services) and Matthias Groth (DLH – Lufthansa airlines)
- Airbus NUP II activities – Stéphane Marché
- TT COOPATS (Co-operative Air Traffic Services) – Karim Zeghal

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2. Review of the briefings

Note that issues raised in each briefing are listed in the order that they were identified. For the sake of brevity, they were not repeated if raised again in subsequent briefings.

2.1. Michael Agelii (SAS) and Anders Nyberg (LFV)

Brief description

A simulation addressing the approach to Stockholm Arlanda was performed in October 2004. The application evaluated was “in trail spacing”. The set up of the scenarios, methods, phraseology and human machine interaction was based on previous in trail separation activities i.e. NUP I Flight Deck (SAS) and ATC simulation (LFV). Six pilots (SAS Group), 4 pseudo pilots and 4 ATCOs (LFV Group) worked together to evaluate the “in trail spacing” characteristics. Methodology used was the concept of spacing reference point (SRP) set to the threshold of the actual runway. ATCO assigned each aircraft a leader and an associated spacing time. Each aircraft FMS calculated its distance to SRP via an assigned STAR. That distance was broadcast in the ADS-B message. The trailer aircraft then compared its own distance to SRP with that of the leader aircraft. The difference was defined as the spacing distance. The spacing distance was then converted to spacing time by dividing the spacing distance with the trailer groundspeed. The trailer (follower) aircraft was executing the spacing and the ATCO was responsible for the separation. The alert and warning algorithm was identical between cockpit and the ground system.

The spacing algorithm was considered as robust and worked well in both turns and merging scenarios. {However, it should be noted that when the simulation required a 60 second spacing, the ATCOs were unable to consistently maintain the spacing although the simulation showed that the pilot could maintain the required spacing values}. Initial findings were that spacing/merging has to be initiated early, 80-100 NM from threshold and a need for a multi sector planner (MSP) function was identified as necessary. Further, considerably less load on the radio telecommunication (R/T) and consequently decreased air traffic controller (ATCO) workload. It was concluded that the pilots in this trial were able to maintain high precision spacing with a reasonable amount of increased workload.

In order to support the SRP methodology the aircraft distance to the SRP has to be included in the ADS B message. Further four TCPs (trajectory change point) were distributed in the ADS B network.

In the last run of the simulation a ground system failure was simulated and the 25 aircraft currently under approach had just got their spacing instruction before the failure. However, the algorithm stood the test and the aircraft landed with the anticipated 60 seconds separation at runway threshold.

Key issues in the presentation

➔ ITS works! Airspace, algorithm and phraseology must play together

2.2. Nick McFarlane (HELIOS), Billy Josefsson (LFV) and Costas Tamvaclis (EUROCONTROL EEC)

Brief description

ADD (Aircraft Derived Data) is a surveillance application in which avionics data are transmitted from the aircraft to the ground and possibly to other aircraft.

ICAO adopted 7 conceptual changes at ANConf (Air Navigation Conference) 2003 where 4 out of 7 conceptual changes are strongly linked to ADD. These are; traffic synchronization, demand and capacity balancing, conflict management, and airspace user operations. The general benefits are to be found in a more accurate profile for climb, descent and direct turns but also more accurate ETAs (Estimated Time of Arrival).

Parameters subject for transmit are aircraft identification/equipage/equipment status, aircraft configuration such as flap settings, de-icing etc. Other parameters comprise current state, 3-D position including bank-angle, ground/airspeed vectors, meteo, weight etc. Further pilot 'set' parameters or targets (short term intent), selected altitude, heading, airspeed and next waypoints and avionics flight path data/calculations and last intermediate waypoints and ETAs can be subject for transmitting.

The supplied data may be displayed to the Air Traffic Controller, and/or used in ground processing functions like airline operational control, airport services, follow up and ATC decision support tools.

For the validation of ADD the evaluation of "environmentally friendly" RNAV approach procedures at Stockholm-Arlanda Airport was selected. The proposed RNAV approach set high demands on sequencing and monitoring tools that should benefit from high accuracy trajectory predictions (TP) that are available in the aircrafts avionics. Hypothesis is that TP accuracy could be improved significantly with ADD.

Key issues in the presentation

➔ ADD is a broad application and all the users and applications are not yet defined.

➔ The integration into the ATC system might be cumbersome whilst the inclusion of high quality data in CDM and SWIM applications that are to be used by airlines, airport and ANSPs as a basis for collaboration in terms of prioritization, resource allocation and follow up on operations.

2.3. Brynjar Arnarsson (Tern systems)

Brief description

The work with ITP started already under the NUP I project around 1999 and was then pursued as a separation application. The objective with ITP was to establish a procedure to allow aircraft to shift to a more optimal flight level in the transatlantic phase i.e. non-radar environment. The procedure should be performed based on ATSAW enabled by ADS B in and out. The ITP application was aligned to PO-ASAS practices and considered as a spacing application.

In December 2004 an ITP simulation was performed with three scenarios, base line, all aircraft equipped and 80% aircraft equipped. A real traffic sample was used. Pilots requested changes in flight level and the ATCO evaluated if it was possible depending on equipage and traffic. CPDLC and or voice were used for communication. ADS C reports were used to report on flight-levels during ITP procedure.

The ATCOs were positive towards ITP. Main results point out that responsibility between air – ground during the ITP is the main issue that needs further clarification. Workload increases with the introduction of ITP but not significantly. The ATCOs managed 1-3 ITP contracts simultaneously. Further it was reported as easy to adjust to the new procedures. The phraseology needs to be adjusted.

A feasibility study addressing the possibilities and benefits by integrating the ITP in the FMS was performed. The conclusion was that significant modifications in the FMS were not worth the effort.

The ITP was accepted by ATCOs and 80% equipage was acceptable.

The ITP was adopted and harmonized by RFG, an approved safety case has also been delivered.

Key issues in the presentation

- ➔ ITP as a spacing application meets the users need and is feasible and can with little effort be integrated in the ATM system
- ➔ Classification i.e. downgrading of ITP……

2.4. Oliver Reitenbach (DFS) and Matthias Groth (DLH)

Brief description

The aim of the work reported was to obtain feedback from pilots and controllers on two spacing applications of potential relevance for future Frankfurt operations. The focus was put on acceptance by actors – pilots and controllers – rather than going into details and specifics. The technique selected to elicit such feedback was to perform “simulation workshop”, i.e. small series of simulation session from which participant can provide subjective feedback.

The first application of interest was Extended Visual Acquisition (EVA) equivalent to the RFG ATSA VSA. The modelled Frankfurt approach consists of 2 Pick Up controllers – North and South – streaming traffic to a Feeder controller performing the final integration on the extended runway centrelines for the 2 parallel and dependant runways. EVA introduces no changes to current tasks to the controllers. Visual approaches are currently extensively used in Frankfurt. EVA is expected to aid the flight crew to establish and maintain visual contact with the designated traffic. The relative distance bearing information exchanged between ATC and flight crew in current operations is replaced by the spelled out call sign. It is worth noting that tentative phraseology proposed by RFG VSA consisting of both call sign and distance & bearing is deemed unacceptably loading the frequency – leading to workload concerns. Overall and subjectively, EVA seems well accepted provided the identification of the target aircraft is kept simple. Third party/target aircraft identification requires further works – and standardisation. The simultaneous usage by controllers of EVA and of “conventional” visual following approaches seems to be feasible.

The second application investigated was Airborne Approach Spacing (AAS). The same environment – Frankfurt approach – as for EVA was considered. However, with AAS, the pick up controllers have a new task to create sequences of aircraft while the feeder will be able then to handle these sequences. The feeder is not expected to create new sequences. Both distance and time-based spacing were considered. During AAS operation, the trailing aircraft follows the track of the leading aircraft until ILS when he switches to its own navigation mode – as he may be landing to the parallel runway. The AAS instructions imply also automatically tracking of the altitude changes of the leading aircraft. While AAS is designed as including 3 phases: initiation (“expect”), identification and the actual instruction, the first phase appears to be hardly used. Pick-Up Controllers report that the creation of sequences leads to a high workload due both to voice communication and the required vectoring to establish the sequence. The Feeder Controllers report being able to control the first aircraft of each sequence. The required monitoring of aircraft within each sequence is very limited except for the very last one which has to be watched carefully. Overall, the more aircraft in sequence, the higher the benefits in workload reduction. But controllers expressed concerns on loss of flexibility in that case. It was further noted that distance based spacing leads to uneconomic speeds while though very much preferable, time based spacing can lead to larger inter aircraft spacing and hence waste of airspace. Overall, based on the subjective feedback received, the additional communication workload and loss of flexibility introduced by AAS do not appear to be balanced by the gains in managing aircraft sequences in the investigated environment.

Key issues in the presentation

- ➔ Third party identification
- ➔ Airspace (re-) design
- ➔ Controller roles
- ➔ RFG variants

2.5. Stéphane Marché (Airbus)

Brief description

A video showcasing Airbus activities on Air Traffic Situation Awareness was shown. After an introduction re-stating the challenges that ATM will have to face in the near future, it provides a high level non-technical introduction to ADS-B. It moves on to successively describe pedagogically from an operational and flight deck perspective a number of ATSAW applications as well as their anticipated benefits. These are all covered by RFG, specifically Enhanced Airborne Situation Awareness, Successive Visual Approaches, Oceanic In Trail Procedures and Airport Situation Awareness. Bob Hilb is on record stating that through the use of CDTI (Cockpit Display of Traffic Information) at UPS (United Parcel Service), they have been able to increase by 20% the usage of visual approaches. The video includes numerous screen shots of the Airbus proposed CDTI implementation as prototyped in their integration simulator. ATSAW/CDTI is seen by Airbus as a stepping stone towards more ambitious ASAS applications.

Key issues in the presentation

- ➔ Justifying airline investment
- ➔ Reaching out to, informing airlines
- ➔ Moving from R&D towards implementation
- ➔ Situation awareness – over expectations and potential for abuse

2.6. Karim Zeghal (EUROCONTROL EEC)

Brief description

Airborne spacing involves a new allocation of tasks between controller and flight crew envisaged as one possible option to enhance the management of arrival flows of aircraft. It relies on the ability of the controller to task the flight crew to maintain a given spacing with respect to the preceding aircraft. The motivation is neither to transfer problems nor to give more freedom to the flight crew, but to identify a more effective task distribution beneficial to all parties without modifying responsibility for separation provision. Air-to-air surveillance along with cockpit automation is required. No significant change on ground systems is initially required.

The work performed so far at the EUROCONTROL Experimental Centre allowed developing and refining a set of spacing instructions for sequencing and merging arrival flows of aircraft. To gradually assess their operational feasibility, potential benefits and limits, two streams of air and ground experiments are conducted . The previous ground experiments highlighted a positive impact on controller activity (increased availability, more anticipation) and on control effectiveness (inter aircraft spacing at the sector exit point more regular). However, even if the complete arrival phase was considered, en-route and terminal areas were studied separately. The interaction between en-route and terminal areas when using spacing instruction and a sequencing tool (suggesting sequence order and delays) had to be investigated.

An experiment simulating two en-route sectors and two approach positions was conducted. The positive feedback previously obtained on spacing instructions was confirmed. As expected, the sequencing tool allowed smoothing flows, which ensured the capacity in the terminal area was not exceeded. In en-route, spacing instructions and sequencing tool, used as two distinct tools operating at different time scales, were found to be compatible and complementary. In the terminal area, spacing instructions benefited from the proposed sequence order displayed on the sequencing tool. The number of heading and speed instructions was reduced, slightly in en-route and drastically in the terminal area. Their geographical distribution suggests an increased anticipation in the terminal area (relief from late vectoring and earlier flow integration). Receiving aircraft under airborne spacing in the terminal area was preferred, as transfer conditions remained more stable. In case an airborne spacing had to be cancelled (to integrate aircraft from the other flow), the required coordination fitted in with current practices. In the terminal area, the inter aircraft spacing on final was more regular, trajectories were straighter with no dispersion below 4,000ft and aircraft remained under lateral navigation mode (as opposed to open vectors). All the results are consistent with those obtained from the previous experiments: same positive impact in the terminal area and reduced positive impact in en-route due to fewer arrivals per sector (offering fewer opportunities to use spacing instructions). In addition, an in depth analysis of the impact on throughput at the final approach fix showed an average increased delivery rate of 2 aircraft for a reference period of 45 minutes as well as a reduction of the variance of the achieved instantaneous rate.

In conclusion, spacing instructions and a sequencing tool can be jointly used in en-route and in terminal areas, with high benefits particularly in terminal areas. The next proposed steps will consist in assessing benefits in more complex environments (e.g. mixed equipage, non specialised runway, additional entry point, holding patterns) and with new capabilities (e.g. data-link).

Key issues in the presentation

- ➔ Incremental approach for validation, volume of research required and associated duration: the results presented are the outcome of a continuous stream of studies initiated more than 3 years ago.
- ➔ Understanding current practices and the roots of their induced limitations
- ➔ Amount of training required – even for experiments – so as to be able to collect stable and "mature" data and draw meaningful conclusions.
- ➔ Willingness to reconsider some current working practices
- ➔ Importance of airspace and route network design.

3. Issues from chaired discussions

➔ Potential misuse of CDTI.

In current operations, during visual following operations if the flight crew loses visual contact the manoeuvre has to be interrupted/cancelled. The same is expected to be valid for EVA (Enhanced Visual Acquisition) /VSA operations. Concerns were expressed by various members of the audience that the availability of a CDTI on flight deck may unacceptably delay the flight crew acknowledgement of a loss of visual contact – the anticipated basis of the certification of the CDTIs would not allow for safe operations in such cases. The case of radar induced maritime collision was highlighted. It was also remarked that a more demanding certification basis – allowing for loss of visual contact – may be required to unlock significant benefits.

➔ Required level of automation assistance.

The design of AAS instructions requires the trailing aircraft to mirror the leading aircraft vertical profile. Pilots in the audience noted that it would be potentially a very demanding task workload wise and hence could require significant automation support.

➔ Quantification of benefits

The discussion strayed away on specific target inter aircraft time spacing. While some values reported upon seemed to be quite ambitious compared to typical today's practices (60 seconds for ITS Arlanda), it was concluded that the benefits come actually from reducing the gap between the targeted values and the achieved ones (which by nature tend to be on the conservative side). Furthermore, there is a need to move further from operational performance improvement to (financial) quantification of benefits.

➔ Reconsidering current practices

IFALPA expressed concerns on perpetuating current very inefficient procedures and simply trying to tag upon new ASAS instructions. The approach of TT Coopats (CoSpace) which appears to have performed an almost clean sheet redesign of the airspace should be encouraged. Such redesign could even have benefits by itself.

4. Concluding remarks

- In spite of general criticism of big ATM R&D projects like NUP II the conclusion was that NUP II delivers to the ATM community things like OSEDs to RFG. The meeting also noted the progress and the similarity between the ITS, AAS and the CoSpace in methodology and result. Nevertheless there is a need for harmonisation of procedures, phraseology and refinement of algorithms.

D. Session 4 – Implementation, Planning and Future Packages

1. Introduction

This session was chaired by **Giorgio Matrella** from ENAV with **Soren Wikerud** from LFV as the secretary.

- Eight briefings presented in the session:
    - ASAS and SESAME by Jean-Claude Richard, Air Transport Alliance (ATA)
    - Operator specific Cost Benefit Modelling for ASAS applications by Terry Johnson, BAE systems, England
    - Joint LFV, DFS, AENA (Spanish Airports and Air Navigation Authority), ENAV ANSP paper by Matthias Poppe, DFS
    - Mediterranean Free Flight (MFF) Flight trials report by Gennaro Graziano, SICTA (Sistemi Innovativi per il Controllo del Traffico Aereo), Italy
    - Joint Planning and Development Office (JPDO) and ASAS by Diana Liang, FAA
    - Lufthansa views on future ASAS applications by Matthias Groth, Lufthansa
    - NASA and ASAS by Tom Graff, NIA/NASA
    - ASSTAR (Advanced Safe Separation Technologies and Algorithms) – Chris Rossiter, BAE systems, England

- Discussion (1 hour and 30 minutes planned for discussion), and
- Wrap-up by Chairman.

2. Review of the briefings

Note that issues raised in each briefing are listed in the order that they were in the programme. For the sake of brevity, they were not repeated if raised again in subsequent briefings.

The chairman introduced the session and gave a short overview of the coming presentations.

It was made a brief introduction related to the scope of the session taking as reference the ASAS-TN2 scope and the activity performed in the framework of the previous ASAS-TN WP3 “Towards an ASAS Implementation strategy” document. The introduction focused on how the consortium collected information from workshops, ASAS-TN members, Standards and Project Document, in order to define the above mentioned “Towards an ASAS Implementation strategy” document. All the defined recommendations were reported in order to define guidelines for an early implementation of Package 1. Scope of this session is to find out the way forward and report all ASAS activities performed since the last ASAS-TN Seminar.

2.1. Jean-Claude Richard (ATA)

Brief description
SESAME is an activity that is supporting the operational implementation of the SES initiative.
As such, SESAME is divided into two phases:

- A definition phase, from 2006 to 2008
- An implementation phase, from 2008 to 2015 and 2020 and beyond.

The major goal of the definition phase is to set up an ATM master plan reflecting the needs and the solutions of the European Air Transport (airspace users, ANSPs, Airports, Supply Industry). This ATM master plan will define not only the preferred mix of solutions (including ASAS), but also the appropriate set of R&D activity necessary to feed them and the regulatory process that is deemed to be necessary (key decisions and funding, planning, mandates, certifications) from everyone (EC-bodies, ICAO, Member States)

The specificity of the SESAME definition phase is the full involvement of every actor of the Air Transport value chain. All these actors are committed at every step of the definition process in order to ensure the overall buy-in of the Definition Phase that has never been achieved until now, and which is a necessary prerequisite for the success of the SES initiative.

Key issues in the presentation:

- SESAME is an activity that is supporting the operational implementation of the SES initiative.
- SESAME is user and customer driven activity.
- The major goal of the definition phase is to set up an ATM master plan reflecting the needs and the solutions of the European Air Transport (airspace users, ANSPs, Airports, Supply Industry).
- All existing projects will feed the process. Global harmonisation is one key.
- Tangible benefit and buy-in as a mechanism and a pre-requisite.
- The specificity of the SESAME definition phase is the full involvement of every actor of the Air Transport value chain.

2.2. Terry Johnson (BAE Systems)

Brief description

This presentation considered three different approaches to cost benefit evaluation:

- General Cost Benefit Models (Example: EMOSIA - European Model for ATM Strategic Investment Analysis (Eurocontrol))
- Particular Cost Benefit Models (Example: ATOBIA (Air Transport Operators Benefit Incentive Analysis) Model (BAE Systems))
- Specialised Cost Benefit Models (Example: Hub Model (BAE Systems))

For the General Cost Benefit Model a top-down high level analysis for broad classes of stakeholder is undertaken by the following steps:

1. Determine an aggregate description of stakeholder operations
2. Derive aggregate estimates of costs and benefits
3. Evaluate the business case for the combined set of stakeholders

The highlighted advantages for this approach are that it provides a broad view of the business case viability, and that it is simple to adapt, being compact and not over complicated. Moreover, a wide area analysis can minimise any geographic boundary problems and the generic approach allows the use of standard methods and standard values.

The disadvantage is that only broad costs and benefits can be modelled. Competitive advantage will average out over a set of stakeholders, and the use of average values can mask wide variations, which are not amenable to all mathematical calculations. Sensitivity analysis can only be applied at the aggregate level.

For the Particular Cost Benefit Models, bottom up analyses for individual stakeholder operations can be undertaken by the following steps:

1. Establish a description of a particular stakeholder operation
2. Derive specific estimates of costs and benefits
3. Evaluate business case for the particular stakeholder

The highlighted advantages for this approach are that specific stakeholder characteristics can be modelled and the business case can be addressed. Competitive advantage can be modelled and common benefits can be discounted where appropriate. Modelling assumptions are more transparent and can identify specific investment cases.

The disadvantage is a less compact, less flexible and over- detailed analysis. Detailed data may not be available and may not be of good quality. Detailed characteristics may be less stable over time and model capacity may limit modelling capability.

For the Specialised Cost Benefit Model a purpose analysis tailored for specific scenarios is undertaken by the following steps:

1. Identify a scenario that can be modelled as a standalone operation
2. Derive estimates of costs and benefits from the scenario characteristics
3. Evaluate the business case for the particular scenario

The highlighted advantages are that good compact models are achieved where appropriate which address high value and specific scenarios where these exist and identify useful investment opportunities.

The disadvantage is very specific models and limited applicability.

Cost Benefit Models were presented for a Passenger Hub and for an Airline Operator as illustrations of Specialised and Particular models, respectively. Example calculations were presented for each and sensitivity issues were discussed.

Key issues in the presentation

• General cost benefit models for Investment evaluation can be defined with a methodology based on top down high-level analysis for stakeholders.

• Specific models can be derived, with more specific stakeholder characteristic.

• A specialised model, tailored for scenarios, can help.

• In the examples ASAS benefits are considered in terms of fuel consumption, maintenance, arrivals predictability, contingency time (more resilience to delays).

2.3. Matthias Poppe (DFS)

Brief description

This presentation reports ANSPs strategic ASAS objectives and expectations and the relative common position referred to the Spanish, Italian, German and Swedish ANSP.

It has been recognised an increase in traffic volume which ANSPs cannot handle. The predicted growth needs a paradigm change.

First of all history lessons learned indicates a need for an ASAS strategy approach.

AENA defined the following strategic objectives in ASAS:

- To identify the possible benefits (and costs) and general implications.
- To identify clear Spanish scenarios where ASAS could provide benefits.
- To carry out tests focussed on these scenarios.
- To implement and improve current services.

Furthermore a set of ongoing ASAS related activities were provided by AENA.

Currently ENAV is pursuing the following short-term ASAS priorities:

- ASAS Spacing Package 1.

- Integration of ASAS with other Decision Support Tool (i.e. AMAN – Arrival Manager) – ASAS as a non-Stand Alone tool.
- Use of ADS-B Data Link capabilities.

ENAV ASAS and ADS-B priorities have opened new interesting possibilities for improvements in ATM sensitive areas in terms of:

- Predictability
- Bottle neck avoidance
- Capacity and safety increasing
- ANSPs and Users costs
- Technology update
- More efficient development of operational procedures

In DFS view:

- Package 1 is on the right track.
- A leading application is required to stress early implementation (e.g. ADS-B Initiated Flight Level Changes ATSA-AIFLC in oceanic airspace).
- Implementation of high-density airspace application potentially can be a following step.
- International harmonisation is an important issue to ensure compatible applications of ASAS functionality.

In LFV priorities, “On Time, First Served” will act as a general principle for the Nordic region, thus improving the predictability in the ATM network in a stepwise manner. Provision of most accurate information to increase network efficiency must be addressed with ASAS and Separation assurance will be the task of the best placed actor to perform it. In some airspace, this may be the flight crew; in others, the controller will retain responsibility.

Common position was expressed in terms of the following needed activities:

- Work on standardisation of procedures/applications (ground and air side);
- Work on ground side issues: standardisation/certification of equipment and procedures (for the aimed use!);
- Positioning of ASAS Applications integrated in the European ATM Concept;
- Some coherent and common decisions taken at a given point.

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

- ADS-B can act as a complement to radar (low level airspace, additional parameters)
- ADS-B stations can provide additional services (TIS-B (Traffic Information – Broadcast), FIS-B (Flight Information – Broadcast))
- ASAS operations → Improved operations.

  Example: sequencing and merging around the TMAs in specific scenarios
- ADS-B stations respect more the environment → Ecology
- ADS-B stations → lower Costs
- By introducing ASAS components in the ATM network, AENA, DFS, ENAV and LFV believes an ANSP should be able to:
  - provide a better ATM service

- reduce ATM and Users cost

2.4. **Gennaro Graziano** (SICTA)

Brief description

This presentation reported the first draft results of the MFF Flight Trials performed this year together with the layout structure of the experimental design.

The MFF presentation objective was to present the organisation structure and the technical infrastructure used during flight trials, and to provide first results of the MFF flight trials based on pilots and ATCOs feedback.

It provided an outline of the MFF Project and its applications, the role of Flight Trials in MFF Validation, Flight Trials Rules and Organisation, Flight Trials Validation Platform, CDTI and Airborne architecture, Flight Trials execution phases and initial results.

The following ASAS applications were addressed:

- Air Traffic Situation Awareness
- ASAS Spacing
  - Remain Behind, Heading then Remain Behind
  - Merge Behind, Heading then Merge Behind
- ASAS Separation
  - Lateral separation (Pass behind, Pass abeam)
  - Longitudinal separation (Remain behind, Merge behind)
- Airborne Self Separation

During ASAS Spacing / Separation pilots and ATCOs feedback highlighted that allocation of responsibility and tasks between ATC and aircrew were acceptable. Pilots Workload increased due to the required attention for the CDTI, aural warning and avionic integration system might reduce workload. Phraseology showed to be long and complex and induced an increase of the perceived workload, CPDLC might overcome this problem. Pilot expressed that the ASAS Spacing algorithm should take into account aircraft performance and passengers comfort, while ATCOs expressed the need to have ADS-B Intent information. Further investigation of the tolerance in the delegation parameters should be addressed.

ASAS Self Separation was positively accepted by Pilots due to no R/T, less workload and more flight efficiency. Workload was within tolerable limits. No peaks were experienced, even if it should be assessed in a more realistic environment with more traffic and more complex geometries. Pilots stated that Airborne Self Separation would benefit from having a fully integrated system coupled to the aircraft FMS and autopilot.

Key issues in the presentation

- ASAS Spacing / Separation operations increase pilot workload, but within acceptable limits; required attention for the CDTI/ASSAP Airborne Surveillance and Separation Assistance Processing was considered high. Further improvements on the CDTI/ASSAP (e.g. aural warnings) and its integration with avionic systems will reduce pilot workload.
- Pilots and ATCOs found the phraseology long and complicated and inducing an increase of the perceived workload. The communication overhead should be reduced.
- The concept of tolerance should be included for the delegation parameters.
- ATCOs expressed the need to have ADS-B Intent information;
- During Flight Trials pilots positively accepted Self-Separation because of several positive effects (no R/T, more flight efficiency, low workload).
- Airborne Self Separation would benefit from having a fully integrated system coupled to the aircraft FMS and autopilot.

2.5. Diana Liang (FAA)

Brief description

FAA provided a high level description of the FAA and JPDO ASAS activities as envisaged in the next generation Air Transport System (NGATS) roadmap development.

JPDO (Joint Planning and Development Office) was established by the Vision 100 – Century of Aviation Reauthorization Act. It Consists of: Department of Transport (DOT), FAA, NASA, Department of Homeland Security (DHS), Department of Defence (DOD), Department of Commerce (DOC), National Oceanic & Atmospheric Administration (NOAA), Office of Science and Technology (OST) and its objective is to transform the US transportation system to meet future needs.

NGATS (Next Generation Air Transport System Concepts) is a mix of user-oriented concepts for System wide transformation. An environmentally compatible global harmonisation is envisaged to enable continued growth.

NGATS key capabilities can be grouped into:

- Net-Enabled Information Access
- Performance-Based Services
- Weather-Assimilated Decision Making
- Layered, Adaptive Security
- Broad-Area Precision Navigation
- Trajectory-Based Aircraft Operations
- “Equivalent Visual” Operations
- “Super Density” Operations

Concerning the FAA and JPDO ASAS activities, Surveillance, En-Route, Terminal and Surface applications can be detailed.

Surveillance activities, also with industrial collaborations, affect both low (Capstone) and high density airspace with a different timeframe. As a matter of fact, primary means were defined in terms of Timeframe, Support Activities and Benefits. For the En-Route the following applications are being experienced:

- See and Avoid,
- Delegated Pair wise Separation Operations,
- Airborne Separation in Specified Airspace
- “VFR like” Autonomy Operation (2020)

Terminal application is currently addressing High Density Airspace activities (In Trail Spacing, Spacing and Merging) and Low Density Airspace activities (Low Visibility Approaches, Self Separation in non-Towered, Non-Radar Airports). The benefits identified are enhancement in efficiency and capacity.

Surface applications currently addressed under the ASAS domain are Traffic Situational Awareness on Airport Surface, Taxi Route Situational Awareness, Surface Conflict Detection and Alerting (2009+), Virtual Tower – See and Avoid. The benefits identified are in terms of efficiency and situational awareness.

Key issues in the presentation

- NGATS (Next Generation Air Transport System Concepts) is a mix of user oriented concepts for System wide transformation

- An environmentally compatible global harmonisation is envisaged to enable continued growth
- Surveillance activities, also with industrial collaborations, affect both low (Capstone) and high density airspace with a different timeframe.
- Primary means were defined in terms of Timeframe, Support Activities and Benefits.
- Terminal application is currently addressing High Density Airspace activities (In Trail Spacing, Spacing and Merging) and Low Density Airspace activities (Low Visibility Approaches, Self Separation in non-Towered, Non-Radar Airports). The benefits identified are enhancement in efficiency and capacity.

Surface applications currently addressed under the ASAS domain are Traffic Situational Awareness on Airport Surface, Taxi Route Situational Awareness, Surface Conflict Detection and Alerting (2009+), Virtual Tower – See and Avoid. The benefits identified are in terms of efficiency and situational awareness.

2.6. Matthias Groth (DLH)

Brief description

The presentation showed DLH expectation on future ASAS Applications, crossing and passing.
The following ASAS-Applications Goals & Conditions have been identified in order:

- To increase airspace safety and traffic capacity
  - More movements per air traffic controller per sector should be accommodated while preserving the required minimum separation
  - The increased number of movements should be handled by ATC without degradation of service quality
- To redistribute sub-tasks between ATC and flight crew
  - New work share for separation of aircraft and merging of target trajectories
- To Improve ATC availability
  - Reduction of air traffic controller workload

The need to be as close as possible to the original track is the general DLH requirement for all C&P (Enhanced Crossing and Passing) applications.

Other requirements expressed to correctly perform C&P applications, is to have available intent data now, in order to better define and not guessing future a/c trajectories.
This will allow:

- To increase the benefit of ASAS applications;
- To efficiently monitor C&P procedures (How should ATC monitor a C&P procedure without knowing where trailer can turn back on course);
- To delegate responsibilities for subtasks to flight crews;
- To enhance traffic situation awareness for flight crews and controllers;
- Enables new and automated monitoring functions to improve safety and controller availability.

Key issues in the presentation

- Avoid implementing ADS-B simply as an additional feature to conventional ground centred ATC procedures (from first Package I applications on).
- Develop new procedures, which fully exploit the potential benefit of ADS-B and modern onboard navigation capabilities.
- Re-distribute separation responsibilities between pilot and ATCO by law.

2.7. Tom Graff (NIA / NASA)

Brief description

NASA has a long-term view for a distributed approach to ATM. ("Capacity takes flight" video).

NASA ASAS R&D concepts can be detailed as:

- En-Route
  - Autonomous Flight Management
- Terminal
  - Airborne Precision Spacing (Phased Approach)
  - Trajectory Oriented Operations with Limited Delegation
- Oceanic
  - In-Trail Procedures (Phased Approach)

Moreover, National Air Space (NAS) will be required to handle two to three times more traffic than today's system.

- Proposed solutions include greater delegation of appropriate air traffic management responsibilities to the flight deck of appropriately equipped aircraft.
- Airborne Separation Assistance Systems (ASAS) are an essential component in a "Transformed NAS"

ASAS will be implemented only after:

- Technical and operational challenges are addressed
- ASAS is proven to be safe
- Operational experience with ASAS is gained

NASA defined a new class of en route operation: AFR (Autonomous Flight Rules). AFR flight crews require decision-support automation to perform the extra tasks associated with autonomous flight. To meet this need, has been developed a sophisticated software prototype called AOP (Autonomous Operations Planner). Significant effort was put into its design to meet human factors requirements, flight deck display and alerting conventions, and avionics architecture integration. AOP was specifically designed to investigate the most difficult capacity-constrained traffic environments known, based on NASA's extensive experience with CTAS (Center Terminal Radar Approach Control Automation System). These environments, characterized by mixes of overflights and descending aircraft that are subject to metering constraints during capacity-saturated arrival rushes, were chosen specifically to test the limits of concept feasibility. AOP's level of capability is unique in the world. Airline pilots have tested its capabilities in several simulation experiments, and have contributed greatly to its refinement.

Key issues in the presentation

- NASA is conducting R&D across all levels of ASAS.
  - Started with a vision of a mature ASAS implementation.
  - Studied ASAS implementations in Enroute, Terminal, and Oceanic operations.
  - Developed frameworks for phased implementations in each domain
- ASAS will be implemented only after:
  - Technical and operational challenges are addressed
  - ASAS is proven to be safe
  - Operational experience with ASAS is gained

- R&D must be driven by requirements of mature ASAS concepts capable of 2-3 times capacity
- Implementations must be phased in small increments to gain operational experience.

2.8. Chris Rossiter (BAE Systems)

Brief description

ASSTAR is a Specific Targeted REsearch Project (STREP) sponsored by The European Commission – Directorate General RTD - within the 6th Framework Programme.

Project objectives are:

- Establish a number of well-defined ASAS Package 2/3 applications;
- Reach a common endorsement between the airlines and ANSPs of the proposed applications;
- Regular project user workshops are planned to ensure the involvement of key users at the detailed level;
- Public User Forums to achieve wider dissemination and elicit responses from a broad representation of the Air Transport community;

The following scenario and application priorities were defined:

- Radar Environment
  - Airborne Separation Lateral Crossing Application (ASEP-LC&P)
    - Pass Behind (Co-altitude and descending/climbing)
    - Pass In-front
  - Airborne Separation Vertical Crossing Application (ASEP-VC&P)
    - Pass Above/Below

- Non-Radar Environment
  - Airborne Separation Enhanced Flight Level Change Procedure (ASEP-FLC)
  - Airborne Self-Separation on an OTS (SSEP-OTS)
  - Airborne Separation In Trail Follow (ASEP-ITF)

For each scenario and application, impacts on roles and procedures have been defined.

Key issues in the presentation

- Establish a number of well-defined ASAS Package 2/3 applications
- Reach a common endorsement between the airlines and ANSPs of the proposed applications
- Regular project user workshops are planned to ensure the involvement of key users at the detailed level
- Public User Forums to achieve wider dissemination and elicit responses from a broad representation of the Air Transport community

3. Issues from chaired discussions

FAA was requested to tell if they plan any mandate on ADS-B initial development. They stated no mandates are actually foreseen. Moreover, FAA was asked if CPDLC was missing from JPDO plan. A concept CPDLC development is foreseen in 2006. It was remarked that in the ANSP paper other ANSPs was not taken in account except for AENA, DFS, ENAV and LFV. AENA explained its short-term views on ASAS implementation taking into account S&M in Mallorca Terminal Environment with the support of Air Berlin Fleet, 18/20 aircraft VDL Mode4 equipped, using the Mallorca Airport as a hub. DSNA state its strategic view mostly expressed via CASCADE and CRISTAL projects (i.e. Med – ADS-B NRA (Corsica, La Réunion & New Caledonia); S&M for Paris), and the importance of Data Link features for S&M operations. Airborne separation will be addressed in the framework of the ASSTAR Project.

MTCD (Medium Term Conflict Detection) and data-links have been addressed by the audience as facilitators for future increasing capacity, to be developed together with ASAS ADS-B applications. DFS believes that current ASAS applications may not bring capacity benefits in high density airspace (European Core Area) before 2015.

Intent data may increase ATCOs awareness. In any case it should be noted that during a separation application that information will not guarantee a recovery procedure from the ATCO if the airborne system may fail. DLH states that separation application should be anticipated by a detailed hazard assessment.

No low cost airlines were remarked to be represented in SESAME. SESAME is anyway structured in order to disseminate information to all the stakeholders. As a matter of fact, ADA is in SESAME and represents Airlines, also low cost ones.

The need for flight deck and controller to have the same picture of the traffic situation was questioned. It was suggested that Air and Ground may not need to have the same picture, since ATSAW applications may have negative effect on pilot-controller relations, as they are doing different jobs. A Common picture could be a driver for the future, where the controller manages the traffic flows, and control many tasks be delegated to the airborne component.

4. Concluding remarks

- FAA is not yet planning any mandate on ADS-B.
- MTCD and data-links may be seen as facilitators for future increasing capacity, to be developed together with ASAS ADS-B applications.
- DFS states that ASAS implementation is foreseen for 2015 and beyond.
- DSNA states its strategic view mostly expressed via CASCADE and CRISTAL projects (i.e. Med – ADS-B NRA (Corsica, La Réunion & New Caledonia); S&M for Paris), and the importance of Data Link features for S&M operations. Airborne separation will be addressed in the framework of the ASSTAR Project.
- Air and ground may not need to have the same picture, since ATSAW applications may have negative effect on pilot-controller relations, as they are doing different jobs. Common picture may be a requirement for the future, where there are fundamental changes of the roles and task distribution between airborne and ground components of the ATM system.
- Intent data may increase ATCOs awareness. In any case it should be noted that during an airborne separation application that information will not guarantee a recovery procedure from the ATCO if the airborne system may fail. DLH states that separation application should be anticipated by a detailed hazard assessment.
- SESAME is structured in order to disseminate information to all the stakeholders. As a matter of fact, ADA is in SESAME and represents Airlines, low cost ones also.

E. ASAS maturity and workshop conclusions

1. ASAS-TN2 Application Maturity (Eric Hoffman, EEC)

Eric Hoffman presented the approach to the ASAS-TN2 ASAS application maturity work. This outlined the approach to the work with some worked examples that the ASAS-TN2 consortium had already prepared. The approach is based on the EMERALD (Emerging Research Technology Development Activities of Relevance to ATM concept Definition) plan (www.cordis.lu) and the industry technology maturity levels. The approach is not to re-invent the wheel but to produce a lightweight and accessible summary of the level of maturity of ASAS applications in a few pages. In order to perform an analysis with the available resources in an accessible way, it was considered that we could not address each ASAS application individually and that an analysis at the level of the Packages was too high level. Therefore the clusters outlined in session 1 of this workshop were analysed.

In addition to organising workshops to exchange information on ADS-B/ASAS related activities, the ASAS-TN2 tasks also include specifically the following:

- Reviewing R&D work on ASAS/ADS-B applications including validation/safety/human factors work – in particular work performed in ASAS-related projects;
- Reviewing the development of operational standards at the ICAO and European levels;
- Reviewing the development of technical standards;
- Reviewing of the achievement of early implementations; and
- Developing guidelines and recommendations to accelerate implementation of ASAS/ADS-B applications

More specifically, it is foreseen to produce a yearly assessment of the advancements of ADS-B/ASAS towards implementation in a very concise format – typically a few A4 sheets and if possible in graphical format.

An initial analysis of the needs has led to the conclusion that reporting at the "Package" level would be of very limited usefulness because of the intrinsic diversity of the applications. At the other extreme, reporting the maturity at the individual application level would miss the conciseness objective. The notion of application cluster has been found useful and of appropriate granularity.

The proposed Application Clusters and associated "champions" within the consortium are the following:

- ADS-B Surveillance Thales ATM
- Situation Awareness Thales Avionics
- Runway applications LFV
- Spacing ENAV
- Separation BAE Systems
- Self-Separation NLR

The EMERALD methodology and associated taxonomy will be used as a basis to capture the maturity of the clusters. It is proposed to reuse the "dimensions" verbatim but to enhance the maturity scales and use classical industry maturity levels so at capture better the later steps towards implementation.

The EMERALD domains and associated partners responsible to ensure consistency across the application clusters are:

- Operational Concepts LFV
- Benefits & Constraints BAE Systems
- Safety Assessment NLR
- ASAS Operations and Human Factor IFATCA

o ASAS Design and Airborne HMI	THAV (Thales Avionics)
o Transition Issues	TATM (Thales ATM) & ENAV

Industry maturity levels	**RTD plan phases**
1 - Basic principles identified and reported on	User Requirement/Concept Phase
2 - Technology capability understood	User Requirement Analysis/Feasibility Phase
3 - Elements / sub-element feasibility demonstrated	Functional Requirements/Feasibility Phase
4 - Component feasibility demonstrated	ASAS Development for Prototyping Phase
5 - Major component capability demonstrated in a representative environment	
6 - Integrated component capability demonstrated in a representative environment	Experimentation and Validation Phase
7 - Principles ground or flight demonstrated / validated modeling capability in a representative environment	
8 - Flown or operated in an operational environment and production capability demonstrated	Operational Implementation
9 - Fully qualified capability	

The projects, programmes and activities foreseen to be reviewed are the following:

NUP2, NUP2+, MA-AFAS (More Autonomous Aircraft in the Future ATM System), G2G (Gate to Gate), MFF, SEAP (Large Scale European ADS Pre-implementation Programme), SAFEFLIGHT 21, Capstone, C-ATM, ISAWARE II (Increasing Safety through collision Avoidance WARning integration), CASCADE Stream 1&2/Cristals, RFG, Asia Pacific/Australia implementations, CARE/ASAS, INTENT, FALBALA (First Assessment of the operational Limitations, Benefits & Applicability for a List of package I AS applications), COSPACE, AATT (Advanced Air Transportation Technologies)/DAG-TM (Distributed Air Ground – Traffic Management), NLR/NASA Free Flight, FlySAFE, HILAS (Human Integration in the Lifecycle of Aviation Systems), EMERTA (Emerging Technologies and Opportunities for ATM), EMERALD, ASSTAR,…

The list is not in any way exhaustive and will be updated during the course of ASAS-TN2.

The way forward:

A very first draft of the assessment has been performed and suggests that the proposed approach is viable. The next steps consist in further collecting feedback, ensuring consistency of maturity assessment across clusters and dimensions. A first mature draft is expected to be available for review by end of the year leading to a first release at the second workshop in April 2006. Annual updates will follow.

2. Issues from panel discussions

Tom Graff: In the NASA self-separation concept there were no fall back procedures for ATC to take over, they couldn't. If one aircraft became unable to operate autonomously, it was merely treated as one more aircraft that had to be added to those under ground based ATC.

Anthony Smoker: whilst instinctively a controller would not like this, he suspected there would be many ways that pilots and controllers would find to use the equipment that have not been thought of yet. It was a long way in the future.

John Brown asked Tom about the spacing issue, as he had shown improvements in spacing. Controllers, for example at Heathrow are already delivering optimum spacing – would there be a world standard definition of spacing.

Tom replied that he actually meant that the system reduces that variability in spacing bringing it all around the 90 secs mark

Eric Hoffman: We want to do more than Package 1 the question is when, where and how. When do we expect Package 3, that is the big question?

Bob Peake: NRA is going ahead, therefore there is big demand for ADS-B-OUT. He felt that ITP in oceanic areas would attract operators and give immediate benefits to those that fitted ADS-B-IN. This was probably where ASAS would start.

Stéphane Marché: said it would be necessary to clean up some airspace before S&M could be used, it would be necessary to make small steps both in the air and on the ground.

Jean-Claude Richard: had noticed that during the workshop and in the various pieces of work there was a lot of confusing vocabulary, similar applications, procedures, etc. being described differently. He made a plea to make a great effort to agree on a common vocabulary.

Phil Hogge: strongly agreed, this was an existing problem with a significant number of long established procedures, especially between the US and Europe.

Anthony Smoker: was concerned about the way people were applying the term situational awareness. The term has a specific definition and is a psychological construct. Its misuse could be misleading: are all the actors in ASAS actually refefing to the same thing? It is essential that there are no misconceptions or false expections because of the misuse of the terminology. It is apparent that in order to maximise (or optimise) the value of ASAS there will be a need to change the operational environment, in some cases quite fundamentally. It is time to consider the human performance aspects of ASAS on the air and ground components, in greater detail..

Bob Darby: When we started to work on Package 1 we envisaged the need for Packages 2 & 3 because we didn't think there would be sufficient benefit from Package 1. Do we still need Packages 2 & 3 to justify Package 1?

Eric Hoffman: asked can we go from spacing to separation? We need a continuous evolution to Packages 2 & 3.

Tony Henley: I think we have a problem transitioning from Package 1 to Packages 2 & 3.

Bob Arnesen: pointed that all the trials so far had been done in very favourable conditions, it would be necessary to do some with more variables:- bad weather, thunderstorms, tired pilots (they make mistakes), problems on board (say with passengers, etc.). Some of the trials showed an increase in pilot workload, albeit small. He agreed with what had been said on phraseology. NRA in the upper airspace was no problem, but what about the lower airspace with GA and VFR traffic? He was concerned about the airspace classification. Most Cost Benefit Analyses (CBA)s looked at fuel savings but there were other benefits, preventing R/W incursions, therefore safety. He was concerned about the integrity of the navigation information being broadcast by ADS-B. He was concerned about encryption of the data, who would have access to the data, who owns it? However, Package 1 has good potential.

Phil Hogge agreed with the problems of pilots making mistakes when tired and with other real life problems on board such as passenger problems which distract pilots from the primary task of flying the aircraft.

Mick van Gool: pointed out that we tended to look only at the civil issues, we were ignoring the military.

Jean-Claude Richard: replied pointing out that SESAME would involve the military.

Eric Hoffman: agreed that we would need a session with the military in ASAS-TN2. He took an action to ensure their involvement in a session in a future workshop.

Bob Peake: said that they had detected military DF19 signals in remote areas of Australia. With ADS-B it would be possible to cover a large area of airspace which wasn't under surveillance before. This would be good to help identify friendly targets.

Bob Darby: pointed out that the military already had capabilities similar to ASAS and added that EUROCONTROL had carried out a study on the use of a variation of military Link16 technology for use in civil ADS-B.

François Cervo: said again that it would be very important to bring in the military, they were like a big airline (9000 aircraft in Europe) with other constraints such as defence and costs. This community is using ADS-B and other data-link networks. He also added that security issues should be addressed within ASAS-TN.

3. Summary of the workshop concluding remarks

Phil Hogge summarised by briefly recalling progress since the ASAS-TN started, emphasising the main EC DG TREN (Department of Transport and Energy) messages to the delegates and outlining key issues raised during the Workshop. The latter were in no particular order and neither were they complete. The ASAS Team would be meeting immediately after the Workshop when they would review all the key issues to include them in the Report, and delegates would have ample opportunity to review them before the Final Report was posted on the web.

Regarding progress, ASAS had come a long way since the Thematic Network started in 2003. The RFG had worked very successfully on the Package 1 ASAS applications and the first of these (ADS-B NRA) is just about to be proposed for publication via RTCA and EUROCAE. The major airframe manufacturers were both working on ASAS as a part of the ATM packages in their respective aircraft and had developed a common view and roadmap. And most of the delegates present had worked, and were working, on simulations, trials and demonstrations of the many applications and systems in Package 1. ASAS was now respectable!

DG TREN had emphasised that the EC remained committed to ASAS and advised the ASAS community to work hard to ensure that ASAS took its proper place in SESAME work. The ASAS community also needed to focus on areas where it was possible to show benefits to achieve implementation.

Key issues from the Workshop were:-

- ASAS was not a stand-alone system. It was an integrated part of the overall ATM system.
- The RFG process was very successful and was feeding proposed standards into RTCA/EUROCAE and then into ICAO.
- The work in NUP and other programmes had started before the RFG was set up. This work needed to be updated to reflect RFG outputs so as to ensure consistency.
- Validation of the ASAS components had to become an integrated element of ATM development.
- It is essential that SESAME takes into account RFG outputs on ASAS.
- A rich ADS-B-OUT environment was becoming a reality. UK NATS had showed that 50% of aircraft passing through the London area were ADS-B-OUT equipped, and 90% of these were giving good data. ADS-B-OUT equipage was increasing at 2% per month. NRA applications should become operational as soon as possible in Scandinavia, Ireland, Spain/Canaries and the Mediterranean area to assist ANSPs in areas at the edge of radar coverage. ADS-B-OUT was likely soon to be mandated in Australia, thus most aircraft operating in the Pacific would have ADS-B-OUT. An immediate benefit could be achieved for long-range operations by fitting

ADS-B-IN to enable ITP. These same aircraft were likely also to be operating in the North Atlantic, therefore ITP could take place there as well. In both cases early and substantial benefits would be achieved by those who fitted. It was essential that the equipment used for these oceanic operations also would be able to support S&M in the TMA. Cost benefit studies should be used to drive this common equipage and work was needed towards implementation decision making.

- There were many areas of ASAS activity:- NUP and MFF programmes; the RFG, RTCA, EUROCAE and ICAO; also in the USA, Europe, Australia and Japan; and by Airbus and Boeing. It was essential that all this work, including the common view and roadmap developed by Airbus and Boeing converged and became coherent.
- Situational awareness was mentioned by many speakers, probably with many different interpretations of what it meant and sometimes with no real human factors knowledge. For reasons of safety and workload ATSAW applications should only be used with procedures.
- ASAS introduction should be kept simple and made to work for the human operators.
- An ASAS-TN2 event should be arranged to include military input, since the military operated a large number of aircraft, the airspace often needed to be shared and they had ADS-B experience.
- Packages 2 & 3 need a coordinated research programme now.

The next Workshop will be in Rome on 3-5 April 2006 and will be linked with MFF and ASSTAR, it will be highly focussed on Packages 2 & 3.

4. Conclusions drawn from the workshop

- Position ASAS in the SESAME Master plan.
- ASAS stakeholders must show empirical evidence to support implementation decisions
- ASAS is not stand alone - it is recognised as an integrated part of the ATM system.
- The RFG is successful - it should be continued and strongly supported by the international community.
- We are in an ADS-B-OUT rich environment. Beware it is a non-certified environment
- The Airbus/Boeing common view & road map on ADS-B, leading to advanced ASAS applications is a major milestone.
- Need to involve the military because they have ASAS-like experience, airspace is shared and UAVs need to be accommodated.
- Differences in terminology and definitions are causing confusion and need to be addressed.

5. ASAS-TN2 Recommendations

The following recommendations are derived by the ASAS-TN2 Consortium on the basis of the proceedings:

- Validation programs should be aligned with the RFG with the goal of validating the RFG outputs and the RFG process should be used for Package 2 & 3 when appropriate. RFG outputs should be positioned into SESAME.
- Links with ICAO need to be strengthened. National representatives to ICAO should be encouraged to take note of RFG outputs.

- Packages 2 & 3 require a coordinated research programme now in order to define the road map for development
- EUROCONTROL (and the FAA) needs to work with stakeholders to actively identify and eradicate differences in terminology and definitions.

6. Dissemination

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

http://www.asas-tn.org

The key messages and conclusions of the workshop will be:

(1) Delivered to the European Commission;

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

(3) Provide an input to the ASAS-TN2 Work Package 3 ASAS application maturity work

7. List of attendees

Last Name	First name	Organisation
Martinez	Anselmo	AENA
Ohlson	Robert	Aerotech Telub
Richard	Jean-Claude	Air Traffic alliance
Marché	Stéphane	Airbus
Peake	Bob	Airservices Australia
Paradell	Antonio	ATOS Origin
Ahl	Per	AVTECH
Henley	Tony	BAE Systems
Johnson	Terry	BAE Systems
McGibbon	Fraser	BAE Systems
Rossiter	Chris	BAE Systems
Watters	Richard	BAE Systems
Brown	John	Boeing Commercial Airplanes
Loscos	Jean-Marc	DSNA
Miquel	Thierry	DSNA
Hogge	Phil	Consultant
Fusai	Claudia	Deep Blue
Leone	Marinella	Deep Blue
Reitenbach	Oliver	DFS Deutsche Flugsicherung GmbH
Poppe	Matthias	DFS Deutsche Flugsicherung GmbH
Savy	Christine	DGAC
Czerlitzki	Bernhard	DLR
Kohrs	Ralf	DLR
Arnesen	Bob	ECA/IFALPA
Cantoni	Cristiano	ENAV
Matrella	Giorgio	ENAV
Romahn	Stephan	Euro Telematik AG
Barff	Andy	EUROCONTROL EEC
Boursier	Ludovic	EUROCONTROL EEC
Graham	Bob	EUROCONTROL EEC
Hoffman	Eric	EUROCONTROL EEC
Lachiver	Catherine	EUROCONTROL EEC
Tamvaclis	Costas	EUROCONTROL EEC
Vergne	Francois	EUROCONTROL EEC
Zeghal	Karim	EUROCONTROL EEC
Darby	Bob	EUROCONTROL HQ
Petricel	Bogdan	EUROCONTROL HQ
Rekkas	Christos	EUROCONTROL HQ
Steinleitner	Jörg	EUROCONTROL HQ
Van Gool	Mick	EUROCONTROL HQ
Wandels	Alex	EUROCONTROL HQ
Cervo	François	EUROCONTROL HQ
Frühwirth	Heinz	European Cockpit Association, ECA
Liang	Diana	FAA
McFarlane	Nick	HELIOS TECHNOLOGY LTD
Stanley	Ben	HELIOS TECHNOLOGY LTD
Smoker	Anthony	IFATCA
García Medina	Mónica	Isdefe
Barchéus	Fredrik	KTH - Human Factors Engineering
Adamsson	Lennart	LFV
Bivrén	Maj-Lis	LFV
Danielsson	Lars	LFV

Ericson	Tomy	LFV
Gustavsson	Niclas	LFV
Håkansson	Lars	LFV
Johnsson	Larry	LFV
Josefsson	Billy	LFV
Kjellander Holtzrin	Carin	LFV
Linge	Anne-Lovise	LFV
Manning	Ann-Louise	LFV
Matsson	Yvonne	LFV
Nyberg	Anders	LFV
Schack	Ulf	LFV
Sgorcea	Roland	LFV
Standar	Michael	LFV
Ternov	Sven	LFV
Westermark	Håkan	LFV
Wikerud	Sören	LFV
Groth	Matthias	Lufthansa
Riedelsheimer	Hans-Joachim	Lufthansa
Graff	Tom	National Institute of Aeronautics
Watson	Mark	NATS
Ruigrok	Rob	NLR
Balen	Rafael	PAGE Telecom
Booth	Bill	Qinetiq
Mårtensson	Lena	Royal Institute of Technology
Agdal	Niels Peter	RTX Products
Laursen	Finn	RTX Products
Agelii	Michael	SAS GROUP
Gabatel	Gianluca	SELEX COMMUNICATIONS
Vaccaro	Claudio	SICTA
Ciaburri	Mario	SICTA
Graziano	Gennaro	SICTA
Béron	Florent	Skyguide
Freitas	José	Skysoft Portugal S.A
Kouros	Pavlos	Technological Educational Institute of Piraeus
Gudmundsdottir	Silja	Tern Systems Inc
Arnarsson	Brynjar	TERNs
Howlett	Peter	Thales ATM
Gayraud	Pierre	Thales Avionics
Shafaat	Taji	The Boeing Company
Anderson	John	University of Glasgow
Goodchild	Colin	University of Glasgow

8. Acronyms

Acronym	**Definition**
AAS	Airborne Approach Spacing
AATT	Advanced Air Transportation Technologies
ADD	Aircraft Derived Data
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	ADS – Contract
AENA	Spanish Airports and Air Navigation Authority
AFR	Autonomous Flight Rules
ANC	Air Navigation Conference

ANSP	Air Navigation Service Providers
AOP	Autonomous Operations Planner
APANPIRG	Asia Pacific Air Navigation Planning and Implementation Regional Group
AS	Airborne Surveillance
ASAS	Airborne Separation Assistance Systems
ASAS TN2	ASAS Thematic Network 2
ASEP	Airborne Separation
ASPA-S&M	Airborne Spacing Enhanced Sequencing and Merging
ASSAP	Airborne Surveillance and Separation Assistance Processing
ASSTAR	Advanced Safe Separation Technologies and Algorithms
ATA	Air Transport Alliance
ATCEUC	Air Traffic Controllers European Union Co-ordination
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATMCP	ATM Concept Panel
ATMG	ATM Group
ATOBIA	Air Transport Operators Benefit Incentive Analysis
ATSAW	Air traffic situation awareness
CARE	Co-Operative Actions of Research and development in EUROCONTROL
CASCADE	Cooperative air traffic services through surveillance and communications applications deployed in European Civil Aviation Conference
C-ATM	Co-operative ATM
CBA	Cost Benefit Analysis
C&P	Enhanced Crossing and Passing
CDM	Collaborative Decision Making
CDTI	Cockpit Display of Traffic Information
CNS	Communication, Navigation and Surveillance
COOPATS	Co-operative Air Traffic Services
CPDLC	Controller Pilot Data Link Communication
CRISTALS	Co-opeRative ValidatIon of Surveillance Techniques and AppLications of Package I
CTAS	Center Terminal Radar Approach Control Automation System
DAG-TM	Distributed Air Ground – Traffic Management
DFS	German air navigation services
DG TREN	Department of Transport and Energy
DHS	Department of Homeland Security
DME	Distance Measuring Equipment
DOD	Department of Defence
DOT	Department of Transport

DSNA	Direction des Services de Navigation Aérienne
EASA	European Aviation Safety Agency
EC	European Commission
ECA	European Cockpit Association
EEC	EUROCONTROL Experimental Centre
EMERALD	Emerging Research Technology Development Activities of Relevance to ATM concept Definition
EMERTA	Emerging Technologies and Opportunities for ATM
EMOSIA	European Model for ATM Strategic Investment Analysis
ENAV	Italian company for air navigation services
E-TIBA	Enhanced Traffic Information Broadcast by Aircraft
EUROCAE	European Organization for Civil Aviation Electronic Equipment
EUROCONTROL	European organisation for the safety of air navigation
EVA	Extended Visual Acquisition
FAA	Federal Aviation Authority
FALBALA	First Assessment of the operational Limitations, Benefits & Applicability for a List of package I AS applications
FIS-B	Flight Information – Broadcast
FMS	Flight Management System
G2G	Gate to Gate
GA	General Aviation
GLS	Global Navigation Satellite System Landing System
GS	Ground Surveillance
HILAS	Human Integration in the Lifecycle of Aviation Systems
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFALPA	International Federation of Air Line Pilot's Associations
IFATCA	International Federation of Air Traffic Controller's Association
IRS	Inertial Reference System
ISAWARE	Increasing Safety through collision Avoidance WARning integration
ITP	In trail procedure in oceanic airspace
JAA	Joint Aviation Authority
JAFTI	JURG ADS-B Fast Track Initiative
JPDO	Joint Planning and Development Office
JURG	Joint User Requirements Group
LAP	Lower Airspace Project
LFV	Swedish Civil Aviation Authority
MA-AFAS	More Autonomous Aircraft in the Future ATM System
MASPS	Minimum Aviation System Performance Standards
MFF	Mediterranean Free Flight

MOPS	Minimum Operational Performance Standards
MGTOW	Maximum Gross Take Off Weight
MTCD	Medium Term Conflict Detection
NASA	National Aeronautics and Space Administration
NEAN	North European ADS-B Network
NEAP	North European ADS-B Applications Project
NGATS	Next Generation Air Transport System
NIA	National Institute for Aerospace
NLR	National Aerospace Laboratory, the Netherlands
NOAA	National Oceanic & Atmospheric Administration
NRA	Non Radar Airspace
NUP	North European ADS-B Update Project
OHA	Operational hazard assessment
OPA	Operational Performance Assessment
OPLINKP	Operational Data link Panel
OSA	Operational Safety Assessment
OSED	Operational Services and Environment Descriptions
OST	Office of Science and Technology
PO-ASAS	Principles of Operation of ASAS
RFG	Requirements Focus Group
RFP	Request for proposal
RNAV	Area Navigation
RNP	Required Navigation Performance
RSP	Required Surveillance Performance
RTCA	Radio Technical Commission for Aeronautics
RVSM	Reduced Vertical Separation Minimum
SARP	Standards And Recommended Performance
SAS	Scandinavian Airlines
SASP	Separation and Airspace Safety Panel
SCRSP	Surveillance and Conflict Resolution Systems Panel
SEAP	Large Scale European ADS Pre-implementation Programme
SES	Single European Sky
SESAME	Single European Sky Implementation Programme
SICASP	Secondary Surveillance Radar Improvements and Collision Avoidance Panel
SICTA	Sistemi Innovativi per il Controllo del Traffico Aereo
SPR	Safety & Performance Requirements
STREP	Specific Targeted REsearch Project
SURF	Enhanced traffic situational awareness on airport surface
TCAS	Traffic Alert and Collision Avoidance System

THAV	Thales Avionics
TIS-B	Traffic Information – Broadcast
TMA	Terminal control area
TP	Trajectory Prediction
TT	Tiger Team
UAP	Upper Airspace Project
UAV	Unmanned Aerial Vehicle
UPS	United Parcel Service
UG	User Group
UOD	User Objectives Document
VHF	Very High Frequency
VOR	VHF Omni-directional Radio Range
VSA	Enhanced visual separation on approach