ASAS Thematic Network 2

Report of the Fourth Workshop
23-25th April 2007, Amsterdam

"ASAS: a reality check"

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1 Introduction

The Fourth ASAS (Airborne Separation Assistance System) Thematic Network 2 (ASAS-TN2) Workshop: ”ASAS: A Reality Check” was held from the 23rd to 25th April 2007 at NLR Amsterdam.

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

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

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

2 What is the ASAS-TN?

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

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

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

The ASAS-TN projects objective:

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

The work of the ASAS-TN2 is threefold:

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

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

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

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

3 Fourth ASAS-TN2 workshop

3.1 Format of the workshop

Day 1 consisted of a session describing the progress and status with regard to ASAS implementation and standardisation. The previous workshops have shown that ASAS applications are no longer handled in isolation but are well integrated within ATM. In addition the ASAS Concept Of Use, USA and EUROCONTROL joint working in AP23, and the ASAS-TN2 Maturity Assessment were presented.

Day 2 consisted of two sessions; the first described how ASAS fits within the SESAR and NextGen concepts. This was followed by a session providing updates on activities relating to ASAS Sequencing Validation.

Day 3 addressed ASAS Package 2 applications and next steps in ASAS. This session was followed by concluding discussions for the whole event.

3.2 Day 1 – 23 rd April 2007:

3.2.1 Session 0 - Introduction

- **Fred Abbink,** (NLR)

Fred gave a welcome on behalf of NLR, describing the work of NLR and the importance of new concepts to meet future requirements in terms of traffic demand, efficiency and the environment. He foresaw ASAS as a tool to enable highly regimented aircraft, with the controller speaking to fewer aircraft.

- **Eric Hoffman,** (EUROCONTROL EEC)

Eric gave a presentation on behalf of Jean-Luc Marchand (European Commission DG: Research) emphasising the importance of SESAR.

- **Phil Hogge**, (ASAS-TN2)

Phil Hogge welcomed delegates to the workshop, reminded them of the ASAS-TN2 objective and highlighted some of the issues to be considered during the event. These were:

(1) that delegates needed to ask themselves whether they were really satisfied with the progress and current maturity of ASAS applications as expressed in WP3;

(2) the need to extend the RFG's work into Package 2 and beyond;

(3) to consider whether the ADS-B implementation programme in Europe was adequate and whether ADS-B is up to the requirements for ASAS; and

(4) to consider whether it was time to think of new airborne separation standards.

He then emphasised the importance of the two major ATM projects; SESAR and NextGen. Both Concepts of Operations described ASAS applications (spacing, sequencing and merging, and cooperative separation) and included self-separation in the 2020+ timeframe. He was concerned that, even though SESAR included these applications, there were many from outside the ASAS community who were less than convinced of the viability of ASAS. We needed to set ourselves a demanding goal and to strengthen the dialogue with SESAR.

All delegates were encouraged to visit the NLR GRACE simulation and to experience for themselves how self-separation other applications could be used.

A.Session 1 Progress and status of implementation and standardisation

4 Introduction

This session was co-chaired by **Tony Henley** (BAE Systems) and **Christos Rekkas** (EUROCONTROL HQ) with **Chris Shaw** (EUROCONTROL EEC) as the secretary.

This session reported on what has happened in the ASAS domain since the last workshop six months ago. It provided an update on global ASAS activities, including the European ADS-B implementation and validation programme, CASCADE.

- CASCADE Progress Report: Christos Rekkas (EUROCONTROL HQ)
- FAA ADS-B Program: Vinny Capezzuto (FAA)
- RFG Status: Jorg Steinleitner (EUROCONTROL HQ)
- AP22 / GATI: Jose Roca (EUROCONTROL HQ)
- ASAS Concept of Use: Dragos Tonea (EUROCONTROL HQ)
- WP3 Maturity Assessment: Chris Shaw (EUROCONTROL EEC)

5 Review of the briefings

5.1 CASCADE Christos Rekkas (EUROCONTROL HQ)

Brief description

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

The ADS-B standardisation work is driven by the Requirements Focus Group (with principal membership from EUROCONTROL, FAA, EUROCAE, RTCA and additional participation from Australia and Japan). The first major milestone has been achieved with the publication of the ADS-B standard for Non-Radar Airspace.

Regarding validation, the CRISTAL partnerships accelerate the progress from validation to implementation and generate wide stakeholder involvement. The CRISTALs have one clear objective: to perform trials in partnership with stakeholders in local sites of Europe (“pocket areas”) where the surveillance service can be improved. These pocket areas will be the basis for a subsequent wider implementation. 14 ANSPs are currently involved. In parallel, the pioneer airline project currently involves 11 airlines and more than 200 aircraft, while targeting 20 airlines and 300 aircraft by mid-2007. The objective is Airworthiness Approval by 2007-2008, based on EASA material which will be available by October 2007.

The first implementation sites will be: the Netherlands (N. Sea by 2009); Sweden (Kiruna by 2008, and Ostgota by 2009). They will be followed by several Mediterranean ANSPs (7 of them will take an implementation decision by 2008-09) and DFS, Germany, intends to include ADS-B in its Surveillance Strategy (target date 2015).

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

Key issues in the presentation

- Implementation of ADS-B in Europe has started: The first implementation sites in Europe are known. 20 airlines with more than 300 aircraft will be ADS-B pioneers.
- Support the Requirements Focus Group in the preparation of harmonised, globally interoperable standards, following the delivery of ADS-B NRA standard
- Participate in the consultation process for the Surveillance Implementing Rule which includes ADS-B.

5.2 FAA ADS-B Program Vinny Capezzuto (FAA)

Brief description

Air Traffic Control (ATC) surveillance and aircraft separation services are currently provided through the use of Primary and Secondary Surveillance Radar systems in the US National Airspace System (NAS). In the Next Generation Air Transportation System timeframe, demand for air transportation and other airspace services is expected to grow significantly from today's levels in terms of passenger volume, amount of cargo shipped, and overall number of flights. With respect to air traffic, changes will occur not only in the number of flights but also in the characteristics of those flights. The current surveillance infrastructure cannot accommodate the projected capacity demands of the future. Simply stated, ground-based radar systems, additional sectors, and personnel cannot accommodate the NAS in a cost effective manner. Thus, a more efficient and affordable solution is needed to accommodate projected capacity demands that generates value. The Federal Aviation Administration (FAA) considers Automatic Dependent Surveillance-Broadcast (ADS-B) with Traffic Information Services-Broadcast (TIS-B) and Flight Information Services-Broadcast (FIS-B) a viable technology solution within the investment portfolio aimed at meeting the challenges of the future. Advancements in surveillance techniques, satellite-based navigation technologies, avionics, and communication data links have combined to offer an opportunity to use ADS-B as a surveillance source and to broadcast aeronautical information. Advancements in aircraft capabilities will allow for reduced separation and support the transition from rules-based operations to performance-based operations. In the future, controller workload will no longer be a limiting factor because of advancements in automation tools, which will provide expanded information supporting improved decision-making capabilities based on improved surveillance. In addition, the transition of separation responsibility from the controller to the flight crew in some areas will allow controllers to focus on overall flow management instead of individual flight management.

Key issues in the presentation

- The development of a viable program strategy that accounts for the airspace user perspective while harmonizing standards and operational aspects globally is imperative for successful implementation.
- Challenges of overcoming institutionalized practices within the FAA, development of sound business cases and managing the proliferation of the various airborne applications are met through the governance structure design, focused on inputs from the aviation industry, air traffic organization service units and safety regulators.
- While the program faces many risks, the potential rewards coupled with the impending growth of air traffic clearly supports this large scale infrastructure investment. The main question is "Can we afford not to do it?"

5.3 RFG Status Jörg Steinleitner (EUROCONTROL HQ)

Brief description

The presentation reported on the progress and status of the implementation and standardisation work being performed by the ADS-B Requirements Focus Group (RFG). The RFG is formed of a

group of experts primarily from EUROCONTROL, FAA, EUROCAE and RTCA, with additional participation from Australia and Japan.

The presentation began with a reminder of the scope, objectives and key stakeholders of the RFG activities. The RFG methodology is an interconnected process involving application definition and development of safety, performance and interoperability requirements.

It was remarked that the RFG has broken new ground for generating standards with regard to the overall approach to the work and in consensus building. The RFG has brought together a broad spectrum of backgrounds and skills.

A status report for the ADS-B-NRA, ADS-B-RAD, ATSA-VSA and ATSA-ITP applications was given. It was reported that EUROCAE and RTCA have now published safety, performance and interoperability requirements for ADS-B-NRA (document references ED-126 and DO-303, respectively). This document will provide the blueprint for other applications.

A summary of high level RFG planning was also provided. By mid 2008, it is planned to publish safety, performance and interoperability requirements documents for the ADS-B-RAD, ATSA-ITP and ATSA-VSA applications. By mid to late 2009, it is planned to publish ADS-B-APT, ATSA-AIRB and ATSA-SURF.

Work on ASPA-S&M is also due to recommence with the OSED being updated in early 2008 to reflect progress made in the Flight Deck-based Merging and Spacing (FDMS) application.

Finally, links to overall ADS-B standardisation were captured and a summary of forthcoming RFG meetings was provided.

Key issues in the presentation

- Safety, Performance and Interoperability requirements were published for the ADS-B-NRA application in December 2006. Certification of aircraft based on this standard is due to commence later in 2007.
- The RFG is a powerful example of effective international cooperation and has refined the methodology for generating standards.
- The RFG offers a wealth of “hands-on” experience to EUROCONTROL/FAA “Action Plan 23”.
- The ASPA-S&M OSED will be updated in early 2008 to reflect progress in the Flight Deck-based Merging and Spacing application.

5.4 AP22/GATI: Jose Roca (EUROCONTROL HQ)

Brief description

Interoperability and harmonization are key components of all activities supported under the FAA/EUROCONTROL Memorandum of cooperation. While there is a general understanding of harmonization and interoperability with respect to specifications, there is less knowledge of what these terms mean for operations, especially interoperability with respect to ATM and the movement of aircraft from one flow management region to another. Trials for Global Interoperability solutions are envisaged as the best means to address these operational interoperability problems. In December 2005 the NAM/EUR Interoperability Trials (AP22) were created to begin to clarify this situation and to -

a. Define and demonstrate technical, procedural and policy alternatives to improve global interoperability and the consistency of ATM services in handling flights.

b. Identify and demonstrate effective ways of communicating information, such as system-wide information management (SWIM) capabilities, to enable external flights entering a high-density homogenous area to be not only accommodated but also integrated more accurately and more in advance into the safe, efficient and effective use of capacity.

c. Identify concepts, and related procedures and policy issues, for enabling the strategic flow measures of a region to take effect across regional boundaries.

d. Provide a focusing program framework for the practical validation and implementation of emerging U.S. Joint Planning and Development Office (JPDO) and Single European Sky ATM Research (SESAR) system plans that relate to interoperability.

e. Evaluate the results of other Action Plan products with respect to these newly established interoperability strategies and requirements.

The presentation provided an overview of the main activities of AP22 in 2006 plus the results expected in 2007.

5.5 ASAS Concept of Use Dragos Tonea (EUROCONTROL HQ)

Brief description

The presentation focused on the development concerning ASAS Concept of Use in the context of SESAR and NextGen.

It started by identifying the common visions shared by SESAR and NextGen and moved to identify initiatives taken to continue development post-implementation programmes, such as CASCADE.

The most notable global initiative is the Common FAA-EUROCONTROL Action Plan 23. Its ToR's cover the development of ASAS Package 2 and the workplan identifies the steps necessary to get there.

One of the steps is the joint development of the CoU that supports both SESAR and NextGen.

EUROCONTROL's ADAS initiative has already developed a European document through a number of workshops and has proposed the document as input for the work. The document has been accepted and forms now the basis for future developments that include US views.

The same process and structure used to describe ASAS TMA operations in 2010, 2020 and 2030 will be used for the rest of the domains, identifying specific ASAS related aspects of the NAV, SUR, COM, airspace evolutions.

The end product will have to describe to the best extent possible the use of Package 2 applications identified through AP23 work and their relationship with various support systems in the environments described (e.g. TP based tools in TMA, SMAN, etc)

The CoU will cover airport, TMA, En-route and non-continental operations and will have to be eventually forwarded towards the appropriate ICAO structure.

5.6 WP3 Maturity Assessment Chris Shaw (EUROCONTROL EEC)

Brief description

A global maturity assessment of eighteen applications based on Automatic Dependent Surveillance Broadcast (ADS-B) has been updated for 2006-7 by the European Commission sponsored ASAS-TN2 project. The assessment has been conducted twice, once in 2006 and again in 2007 to monitor the rate of improvement.

A group of operational and technical ASAS specialists from industry, service providers, and research organisations, judged maturity based on a set of commonly agreed metrics and their experience in the field. For each application, maturity scores between 1 and 4 (±0.5) were assigned for each of the following metric types: (1) Operational concepts (2) Benefits and constraints, (3) Safety, (4) Procedures and human factors, (5) Systems, HMI and technology; and (6) Transition issues.

The maturity assessment was reviewed externally by selected peers in Europe, USA, and Australia. The results were summarised graphically, application by application, in a 'spider-web' format that allows easy comparisons to be made between different aspects of maturity within a particular application and between all applications.

Over the year from March 2006 to February 2007 the maturity scores of fifteen out of eighteen applications increased and one decreased. 'In-trail procedure' (Airborne separation category) had the greatest total score from 7.5 to 10 across four of the six maturity metrics.

5.7 Issues from chaired discussions

Q: Philippe Lievin (Rockwell Collins) – Asked about 1090 implementation in the US and the need for more precise information and if there is a risk mitigation plan in place?

Vinny Capezzuto (FAA) answered: Spectrum issues are a concern, particularly during transition while still maintaining radar. Need to control output (transmission) power (e.g. on vehicles). Vintage radars are optimised for local environment. Also need to consider the update rate (e.g. 1 second, 5 seconds?). We don't need to over interrogate. Also consider dual link solution with 1090 and UAT. For example, weather uplink is not possible with 1090.

Q: Cedric D'Silva (Thales Avionics) – Do we have robust enough ADS-B standards? Have CASCADE and the RFG gone far enough into standard development?

Jörg Steinleitner (EUROCONTROL HQ) questioned what was meant by robust. The RFG approach is top down driven, but also takes into account bottom up. Also need to consider back-up sources (e.g. back-up to GPS)?.

Cedric D'Silva – stated his question was more looking forward to future applications.

Vinny Capezzuto: FAA are looking at a back-up analysis (e.g. what if ADS-B out source not available?) Some form of radar will be left in. Not yet considered from an ADS-B in perspective. Availability, integrity and reliability figures are robust.

Jörg Steinleitner (EUROCONTROL HQ): The obvious answer is given by the requirements themselves.

Tony Henley (BAE Systems) to Christos Rekkas (EUROCONTROL HQ): In 2007, aircraft will be certified for ADS-B-NRA, but what will be certified?

Christos Rekkas: Airborne installation for NRA based on ED-126.

Q: (not really a question but a statement) Jean-Marc Loscos (DSNA and French member of ICAO ASP) –the need for procedures has been recognised. There is general agreement that ASAS/ADS-B requires standards. There exists a new airborne surveillance subgroup (ASP, former SCRSP).

Q: Bob Arnesen (ECA/IFALPA) - is 1090 going to be saturated?

Vinny Capezzuto: A lot of modelling has been done looking at stress on 1090 link e.g. Europe, LA basin and east coast US. It will peak 2010 to 2020 as airborne demand grows and all radars are still active – then it should decline – but long term we need something else but we don't know what yet.

But 1090 is not likely to support trajectory exchange << *AJH- post meeting comment- this is important and the opposite of what some airlines e.g. DLH expect-* >> The USA already has a second link (UAT) to help with capacity.

Christos Rekkas: in Europe, there was a 2001 study comparing different links. This was updated in 2005 and focussed on 1090. 1090 can support the initial "ADS-B out" and ADS-B in" applications in core Europe over the next 10 to 15 years. The worst year for RF will be around 2015. Sensitive applications are the "ADS-B-in" ones. Intent is not expected in core area in the 2015 timeframe. After 2015, with gradual radar replacement, the problem will be reduced because less interference from fewer radars.

Q: Christophe Hamel (ACSS) (to Vinny Capezzuto) - What applications have been selected and why? It does not look as if it was driven by economics.

Vinny Capezzuto: Essentially driven by what can be done with 1090 (260A). M&S is the last application in the block but should be possible from 2009. Stakeholder support is lacking and the FAA wants to expedite ideas from industry. Approach to have industry pulling not regulators pushing.

Christos Rekkas: In Europe, criteria for selection of applications is: 1) technical feasibility, 2) operational usefulness, 3) economics and 4) stakeholder support. There has been no stakeholder support for trials in Europe for S&M.

Q: Bernhard Wolfmayr (Austrocontrol) - Surveillance is going to be a mix of ADS-B and Radar, when are radars switched off?

Christos Rekkas: we will in the periphery of Europe – also radar will be reduced due to Multilateration. There will not be a big bang.

Bernhard Wolfmayr (Austrocontrol) - What assumptions has the FAA CBA made about radar retention?

Vinny Capezzuto: It assumes 50% of current radars remaining including those around key airports. The CBA is better if people equip earlier - that is one of our goals to accelerate equipage. The CBA also includes the situation awareness/enhance vision air to air applications. Business case for Colorado ski resorts where state shares cost.

Q: Phil Hogge (ASAS TN2): Is 1090 capable of supporting a scenario such as SSEP, while retaining a certain amount of radar?

Christos Rekkas: Critical element is the airspace density. Very marginal with current standards. Could be supported with, for example, 260B. OK for initial applications, even in 2025, but need to work on a future link to overcome capacity problems by 2025. With a reduction in radar, can handle more capacity due to spectrum availability.

Vinny Capezzuto: Hard to project! We don't think 1090 will support everything but design is performance centric not technology based. Will upgrade when ready and know what is needed.

Q: DFS – Frankfurt has the highest 1090 spectrum congestion in Europe – may be the world – it is manageable at the moment but being monitored closely (AJH - we should include a link to the ICAO Reports J-M Loscos can provide). More problems are expected if the military go ahead with their own version of TCAS on the same frequency**.**

Q: Rick Shay (NASA Langley) – NASA is conducting M&S simulations in a high noise environment and offered a paper for the September workshop in Toulouse.

Q: Wim Huson (USE2ACES) to Dragos (EUROCONTROL HQ) – Why start in the TMA?

Dragos Tonea - After considering the wider context and taking into account existing arrival management and trajectory prediction based tools.

Q: Mete Celktin (EUROCONTROL HQ): In the WP3 maturity assessment, were the planning issues, for example in ASPA-S&M, in order of prioritisation?

Chris Shaw (EUROCONTROL Experimental Centre): No prioritisation is intended in the order. It might be something to address in the next update.

Q: Wilfred Rouwhorst (NLR Flysafe): Why did airborne situation awareness maturity score go down?

Chris Shaw: Reviewer had pointed out that safety issues had been identified with mixed equipage. (For traceability the reviewer referred to a draft white paper on partial display issues circulated to RFG ASA SG, 23rd Dec 2006. The white paper discusses "idea that pilots start to rely too heavily on the traffic display and forget to look outside for aircraft" which is part of an excerpt from: "Assessment of Advanced Cockpit Displays for General Aviation Aircraft – The Capstone Program", Final Report, Office of Aerospace Medicine, Kevin W. Williams, Alan Yost, Jeff Holland, Robert R. Tyler, December 2002, (DOT/FAA/AM-02/21)]

B.Session 2 ASAS in future European and US ATM concepts

6 Introduction

This session was chaired by **Peter Howlett** (Thales Air Systems) with **Soren Wikerud** (LFV) as the secretary.

The first two presentations of this session provided an overview of the future concepts of operations developed by SESAR in Europe and NGATS / NextGen in the USA and highlighted the position of ASAS applications in these two major programmes.

The next four presentations provided some key results of recent validation projects addressing Sequencing & Merging applications (Flight Deck Merging and Spacing for the US presentation).

Six briefings were presented in the session:

- ASAS in SESAR Concept by Andy Barff (EUROCONTROL EEC)
- ASAS in NextGen by Roberta Massiah (FAA)
- G2G project: S&M by Marinella Leone (Deep Blue)
- MITRE: flight deck based M&S by Randy Bone (Mitre)
- NUP 2+: S&M and CPDLC by Fredrik Lindblom (LFV)
- Cristal and Paloma: S&M in Paris by Jean-Marc Loscos (DSNA)

The presentations were followed by Q&As and a joint debate session facilitated by Phil Hogge.

7 Review of the briefings

7.1 ASAS in SESAR Concept: Andy Barff (EUROCONTROL Experimental Centre)

Brief description

Andy Barff presented the key features of the future ATM concept of operations developed in the context of SESAR and the position and role of ASAS in this concept.

Key issues in the presentation

The challenging SESAR political goals include the need to triple capacity and increase safety by 10 times. There is also a requirement to reduce ANSP unit cost by 50%. In view of this, SESAR is considering some aggressive ATM changes to deliver the required performance. Among the main aspects under consideration are ASAS applications with their potential to reduce controller workload and allow the most efficient trajectory to be flown.

The SESAR concept is based on precision trajectories which are widely shared throughout the ATM planning process and during flight itself. An initial version of the SESAR concept is about to be delivered. Its main aspects affecting those interested in ASAS are as follows:

- Trajectory based operations where a degree of prior deconfliction takes place. The Reference Business Trajectory which the “user agrees to fly and the ANSP agrees to facilitate” will be cleared in segments, using Precision Trajectory Clearances and/or ASAS Applications.
- Trajectory Management Requirements which set the “delta” change that will trigger trajectory sharing to assure consistent, accurate data availability.
- ATM Capability Levels describe the aircraft and ground system capabilities expected in various timescales.

- ASAS Separation applications are expected to be deployed from 2020 with Self-Separation beyond 2025.
- No segregation will be applied based on aircraft capability; therefore ASAS applications will be integrated in mixed operations which will include 3D and 4D Precision Clearances.
- One of the proposed separation modes is the 3D Co-operative clearance which combines a 3D trajectory to be flown along which aircraft will maintain their own separation from other aircraft on compatible 3D clearances.

SESAR therefore has high expectations of ASAS applications. During the SESAR Joint Undertaking research activities will be conducted during which ASAS application will be assessed in depth to assure that they will deliver the necessary performance.

SESAR describes an environment in which ASAS is an integral element. It sets a very ambitious timescale: ASAS Separation applications using new airborne separation minima deployed by 2020. The ASAS community is faced with an unprecedented opportunity but also a great challenge – can ASAS deliver?

7.2 ASAS in NextGen: Roberta Massiah (FAA)

Brief description

Roberta Massiah presented some of the highlights and strategic goals of NextGen, and the position and role of ASAS in NextGen.

Key issues in the presentation

The goals for NextGen focus on significantly increasing the safety, security, and capacity of air transportation operations. These benefits are achieved through a combination of new procedures and advances in technology deployed to manage passenger, air cargo, general aviation (GA), and air traffic operations. Advancements in aircraft capabilities allow for reduced separation and support the transition from rules-based operations to performance-based operations. Controller workload is no longer a limiting factor because of tools and automation, which provide expanded information and improved decision-making capabilities. In addition, the delegation of separation responsibility from the controller to the flight crew in some areas allows controllers to focus on overall flow management instead of individual flight management. Increased levels of service and dynamic resource management will enable the NextGen to meet demand rather than constrain demand to meet available resources.

The FAA's ADS-B program is one of the key enabling technology programs in the near term investment portfolio, chartered to deploy an initial set of advisory airborne applications. These initial air-to-air applications provide the safety foundation in which the high value future airborne applications will be built upon. The challenge is deciding on how to use current resources to deploy the initial set of applications, while simultaneously looking forward and wisely investing in future applications. Prioritization of the various future air-to-air applications will help focus critical resources towards developing and deploying these applications to ensure the innovations developed are effectively applied to produce value for the airspace users.

7.3 G2G project: S&M: Marinella Leone (Deep Blue)

Brief description

Marinella Leone presented the main validation results obtained by the “Gate-To-Gate” (G2G) project in relation to ASPA S&M. The G2G project ended in October 2006.

Key issues in the presentation

The presentation highlighted the main outcome of the ASPA S&M activities carried out in the context of the G2G project. This presentation included a reminder of the focus and objectives of G2G, the extent of validation obtained on ASPA S&M, the results of the experiments, plus some recommendations and conclusions.

The objective of the G2G project was to focus on possible R&D solutions to improve the ATM to be implemented from gate to gate in 2010+. ASPA S&M was identified as a possible improvement for arrival management in TMA. The interest of the project was to evaluate the ASPA S&M application in different operational environments (Paris and Rome, with a small scale experiment run on a Naples APP, which represents a smaller approach area), with the support of different tools (e.g. AMAN, D/L, SYSCO). Several experiments were planned in 2001 and run from 2005 to 2006 in ENAV, DSNA and EEC. The results of the experiments addressed and covered the following areas of interest: user Acceptability, Operability, Applicability They also addressed capacity, efficiency and safety, though in a less rigorous fashion.

As for ASPA S&M concept applicability, there was globally a significant use of ASAS chains both in TMA and in the extended part of the TMA. Its usage was high in dense traffic situations.

This is a very positive result taking into account that the ASPA S&M application was not mandatory and controllers were requested to apply it only where and when they considered it would have been helpful. Moreover, ASPA S&M is more easily applied where AMAN and D/L are implemented. The chosen ASAS sequence was likely to be the AMAN runway sequence.

User acceptability differs depending on scenarios and application development from a procedural and technical point of view. Despite some initial reluctance, confidence was found to improve with practice, thus reducing the initial feeling of complexity. In some cases, an increased ATCO availability was demonstrated as ASPA S&M balances and reduces EXC instructional workload (especially in the approach phase) and EXC monitoring workload (in large spacing conditions). HMIs were considered usable despite some suggestions for improvement collected in different degrees according to the maturity of the adopted HMIs.

As for the benefits it was noted that more regular, predictable and efficient spacing is possible when ASPA S&M is used. As for the user acceptability of the transition phase, it was observed that controllers managed mixed traffic in an easy way and no decreases in performances were measured.

ASPA S&M requests well-defined procedures and supporting functions to work properly, so it is recommended to optimize procedures, work on system requirements and suitable airspace characteristics.

In conclusion, G2G partners (mainly ANSPs) forecast ASPA S&M implementation beyond 2015 time horizon.

7.4 Mitre: flight deck based M&S: Randy Bone (Mitre)

Brief description

Randy Bone presented key results obtained recently in simulations related to Flight Deck Merging and Spacing (FDMS).

Key issues in the presentation

In an effort to reduce aircraft manoeuvring, fuel burn, and controller workload, the Federal Aviation Administration (FAA) is developing an Automatic Dependent Surveillance-Broadcast (ADS-B) concept termed Merging and Spacing (M&S). M&S has two phases: a strategic set-up by a ground operator (called Airline Based En-route Sequencing and Spacing (ABESS)) followed by tactical Flight Deck-Based M&S (FDMS). FDMS starts in the en route environment and ends on final approach. FDMS utilizes ADS-B for more active flight crew participation in achieving a desired spacing interval. The main objective of FDMS is to achieve consistent, low variance spacing between aircraft pairs at the entry to an arrival procedure (e.g., Continuous Descent Arrival (CDA)) and along approach through minor flight deck originated speed adjustments. FDMS is similar to past or on-going work on spacing concepts in the United States and Europe.

This presentation focused on FDMS and presented the subjective and objective results of three human-in-the-loop simulations. The simulations examined FDMS from pilot and air traffic controller perspectives. The simulations are part of the FDMS development and maturation process, and were designed to examine the impact of FDMS on: traffic efficiency, voice communications load, safety, workload, information requirements, and situation awareness. The simulations examined nominal and non-nominal (e.g., overtake, incorrect traffic to follow identification, suspension of

FDMS). Results indicated general acceptability and improvements over current-day operations under nominal and non-nominal conditions. Results also indicated that further clarification of pilot and air traffic control roles and responsibilities is necessary. These results will be used to further refine the concept as the application moves forward in the operational approval activities.

7.5 NUP 2+: S&M and CPDLC: Fredrik Lindblom (LFV)

Brief description

Fredrik Lindblom presented NUP 2+ and key results from different areas and ongoing projects run by LFV i.e. A-SMGCS, CDM, A-CDA, CPDLC and findings and results from trials and LFV's ambitions for the future.

Key issues in the presentation

- The NUP2+ project (North European ADS-B Network Update Programme, Phase II+) is supported and financed by the European Commission. The project focuses on applications that have potential to make the airport operations more effective. The usage of 4D Trajectory and ADS-B data are key-elements in the application that are validated through Real Time Simulations and Live Trials. The project started in mid 2004 and will end by late 2007.
- The applications that are validated through either simulations and live trials or both are A-CDA, CDM, and A-SMGCS. As part of the presentation CPDLC results are also included but this is an activity done in NUP II and cooperative work with EUROCONTROL.
- The A-CDA application is today being performed on a day-to-day basis at Arlanda Airport in order to gain operational experience with new procedures and methods and also to be able to validate FMS 4D Trajectories. 19 Boeing 737NG from SAS are used in the trials.
- The CDM application is used by Airport, Airline OP, and Ground Handling to increase the predictability. The basis of the application is sharing aircraft arrival times (FMS ETA/RTA) among the interested parties. So far the trials show good results and predictability has increased.
- The A-SMGCS application includes Situational Awareness, Runway Incursion and Routing. So far only Real Time Simulations have been done but the results show a great potential for both pilots and controllers in terms of increased safety and awareness when taxiing on the airport surface. Live trials will be performed in June, August and September to verify the simulation results. In the Live Trials 4 SAS Boeing 737 will be used. To support the applications aircraft will be equipped with Electronic Flight Bags and a VHF Multimode Radio capable of both data link and ADS-B IN/OUT.
- The CPDLC simulation focused on using CPDLC (data link) for ITS. The results revealed that the use of data link could have good potential. The HMI developed for both pilots and controllers to support the application was appreciated.

7.6 Cristal and Paloma: S&M in Paris: Jean-Marc Loscos (DSNA)

Brief description

Jean-Marc Loscos presented the main validation results of two projects conducted by DSNA in 2006 on the introduction of ASPA-S&M procedures for the arrivals at Paris airports

Key issues in the presentation

- The two projects, namely CRISTAL PARIS using Fast Time Simulations and PALOMA using Real Time Simulations, presented several common points which supported the following conclusions:
  - ASPA-S&M could be implemented in the current Paris Airspace, without requiring the modification of the airspace subject to a minimum equipage of 70% by airlines.

- The procedure would complement the current use of the arrival manager satisfactorily, using time spacing values which need to be adjusted to the traffic.
- The ASPA procedure can be initiated in the existing airspace with some limited difficulties
- ASAS instructions are useful (heading then merge, remain, merge) when traffic is high.
- ASPA-S&M works efficiently at peak hours and reduces the number of instructions in TMA with an increase of the regularity. Gains can be 20s / 2.1NM per aircraft on one hour for CDG.

For more information, CRISTAL PARIS reports are available upon request.

- It is not easy to implement in the TMA because of the positioning of merging points to support the procedure. The relative spacing values at each IAF are also difficult to optimize since it varies with the traffic and the peak hours. Controllers still express doubts on the usefulness even if the use of data link was seen as a facilitator for acceptability.
- It was possible to address other topics such as:
  - Use of Data link for target selection and for monitoring: according to ATCO, data link is essential for target selection and useful for spacing monitoring.
  - Reduction of number of instructions: when ASAS works it works well with an important reduction in number of instructions after ASAS links are established.
  - Regularity: with ASAS, a peak at 90sec between arrivals clearly indicates an increased regularity between arrivals.

  The reports of the real time simulations will be available in July 07.

Issues from chaired discussions

Q&As just after Part 1 presentations

Q: Dragos Tonea (EUROCONTROL HQ) to Andy you mentioned different notions of separation, can you elaborate on that?

Andy Barff (EUROCONTROL EEC): it has been suggested that there would be 2 types of ASAS separation: one for a situation involving designated aircraft (separation applications), one for a period of time (self-separation against all other aircraft). For separation, you could imagine a kind of tube with 2 or 3 aircraft, and one (or possibly several, although PO-ASAS says only one) aircraft interfering. This is under discussion and scenarios will be developed over the next months.

Ken Carpenter (QinetiQ) pointed out that the original definition of PO-ASAS separation didn't specify that the manoeuvres were against a single aircraft. It was more open than subsequent debates, which narrowed it to a single aircraft.

Q: Christophe Hamel (ACSS) to Andy: Seem to address only forward fit and ignoring retrofit. Could you elaborate?

A: Andy Barff: The concept team is trying to keep away from technology and stay at the concept level, leaving it to the technical people to draw up solutions.

Q to Roberta Massiah (FAA): In your cost benefit analysis, are you considering savings or crew, optimizing your flight, fuel time, linked to M&S applications, etc.

Vinny Cappezuto (FAA): CBA includes Direct Operating Costs, which includes flight time, crew savings, etc.

Q: Maurizio Smanio (Italian Air Force) to Andy Barff: Have there been any studies on ADS-B for military aircraft, particularly fighters?

A: Andy Barff: There has been considerable involvement of the military in SESAR, in particular through EUROCONTROL EURAMID / DCMAC. The military have gone a long way and have now accepted to share a trajectory rather than reserving airspace. However they have rejected ASAS self-separating from other aircraft. ADS-B equipage is critical. ACSS say they have solutions available for military aircraft.

Debate at the end of the session

Q: Christophe Hamel (ACSS) - to J.M Loscos (DSNA): What were your assumptions on data link equipage?

A: J M Loscos - VDL-2

Q: Marian Schuver van Blanken (LVNL): Can you elaborate on human factors and foreseen changes to the role of the controller. What happens to conflict solving during ASAS?

A: Andy Barff: SESAR introduces the biggest changes. This was discussed recently with IFATCA, who agree that there will be increased reliance on automation but stress the importance of providing proper assistance to controllers in the event of a failure of the automation functions. The path to automation will be long; this must not be underestimated.

A move from tactical ATC to a more strategic handling of traffic aided by automation would benefit from appropriate monitoring functions.

Marinella Leone (Deep Blue): Adequate practice & training are essential for a successful transition. ASAS and future concepts might require different skills than current ATC.

Q: Mete Celestin (EUROCONTROL HQ): What is the impact of ASPA S&M on controller workload?

After some discussion, all three presenters confirmed that the results show a reduction of controller workload, at least in approach. Less obvious in en-route.

For FDMS (UPS procedures), controller workload is reduced but the situation is a little different as instructions are directly issued by AOC.

Q: Philippe Liévin (Rockwell Collins) to Fredrik Lindblom (LFV)

What CPDLC message types were used in the NUP2 evaluation of CPDLC for ASAS? Link 2000+ or specific messages?

Fredrik Lindblom: I don't know

Dragos Tonea: Will need new messages to support ASAS procedures anyway. These will have to be standardised.

Q: Phil Hogge (ASAS TN2) to Andy Barff and Roberta Massiah - What should we – the ASAS community – be doing to support SESAR, to help them to take benefit of our work and of the potential of ASAS?

A: Andy Barff: ASAS is a powerful tool to reduce controller workload and can deliver. SESAR is a great opportunity for a quantum leap. ASAS has its foot in the door of SESAR but we must prepare ourselves to get involved in the development phase and JU.

User Preferred Trajectories are by essence close to the optimum profile, i.e. we should assume that UPTs include CDA, optimum climb and cruise.

Q: Christophe Hamel (ACSS): are NextGen and SESAR coordinated?

A: Andy Barff: The two projects are converging, their timescales are similar and there are exchanges between the two projects.

Q: Cedric D'Silva (Thales Avionics): Is it clear what separation is and what the requirements are on precision, RNP capabilities, intents?

A: Andy Barff: Availability of precise intents will improve the predictability. Regarding the flexibility of trajectory based operations such as envisaged by SESAR: scenarios have been developed that show that some flexibility remains to support individual requests/changes on the day of operations.

There will be new separation modes coupled with automation. Maybe no longer distance based. Possibly time based? Precise trajectories feed the automation and will provide solutions with the new separation modes. It is starting to become clear.

Q: Bob Arnesen (ECA/IFALPA) to Randy Bone (Mitre): What is the information displayed on the AGD for merging & sequencing?

A: Randy Bone: It is just speed commands, not heading information.

Q: Evangelos Malikoutis (Technological Institute of Piraeus): As a controller, I would love to have ASAS equipment in front of me (with the same presentation as the pilot) to help select aircraft pairs and the same presentation as the pilot has.

A: Andy Barff: Agrees that it would be good for the controller to have some way to see what the pilot will be doing.

Q: Werner Langhans (Austrocontrol): Could we use DME/DME onboard the aircraft to cross-check the GPS information used for ADS-B? This would be similar to what ground surveillance does i.e. when Multilateration is compared with ADS-B. ADS-B should not necessarily be used as the preferred source of surveillance data.

A: Vinny Capezzuto (FAA): Interesting proposition but not applicable to GA as they do not have such DME/DME triangulation capabilities + there is a cost/benefit issue. Is it worth it?

Suggestion Bob Arnesen: Do not use the term Free Flight as it is confusing and conveys the wrong messages. We should use the term Autonomous Flight Management.

Closing Comments: Phil Hogge (ASAS TN2): SESAR and NextGen are tremendous opportunities to get things going in the right direction. They have about the same timeframe and there is a great potential to agree on interoperable solutions for the future.We must not miss this opportunity.

8 Concluding remarks

Phil Hogge reminded delegates of the importance of SESAR and NextGen. These two major ATM projects, one on each side of the Atlantic, cover the most densely utilised airspace in the world and provide a unique opportunity in which to gain acceptance of ASAS. Both have draft Concepts of Operations which combine 4D trajectory management with the use of ASAS applications, and both have similar time horizons.

The ASAS community must seize this opportunity with the utmost urgency and prove that the ASAS applications can bring the required benefits. They must brief everyone in their organisations having an interest in ATM, and all those involved in SESAR Tasks, to ensure that they have a good understanding of the potential of ASAS and can work towards the inclusion of ASAS applications in the SESAR ATM Master Plan.

C. Session 3: ASSTAR User Forum

9 Introduction

This session was chaired by Jean-Marc Loscos (DSNA) with Nico de Gelder (NLR) as secretary.

The session reported the latest results from projects, made recommendations and highlighted the lessons learnt from the ASSTAR programme (Advanced Safe Separation Technologies and Algorithms). Five briefings were delivered during the session:

- Overview of ASSTAR & Forum objectives: Jean-Marc Loscos (DSNA)
- Airborne separation applications: Craig Foster (NATS)
- Feasibility, benefits & safety of the oceanic applications: Bart Klein Obbink (NLR)
- ASEP-C&P findings: John Anderson (University of Glasgow)
- Airborne hardware implementation & installations: Philippe Salmon (Thales Avionics)

10 Review of the briefings

10.1 Overview of ASSTAR Jean-Marc Loscos (DSNA)

Brief description

ASSTAR is a FP6 project sponsored by the EC-DG RTD which started in January 2005 and will end in November 07

One year ago in Rome, the ASSTAR consortium presented the approach, methods and feedback from the audience, including critiques.

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

Research objectives are related to ASAS manoeuvre design and execution, definition of supporting procedures, system architecture, benefits and safety results, and the impact on regulations.

All the applications belong to the airborne separation category according to PO-ASAS classification. The main principle is the delegation of responsibility from the controller to the flight crew to execute a crossing manoeuvre with respect to one designated target aircraft, while the controller remains responsible for the separation with respect to the other aircraft in the sector.

Another essential element is the determination of the performance of airborne separation which will be based on airborne surveillance and airborne navigation. Safety studies are required before promoting any reduction in the current ATC separation minima.

Jean-Marc introduced the ASSTAR topics for the afternoon session:

- Definition of the procedures (Applicability conditions, phraseology)
- Operational benefits (safety, capacity, workload and task sharing)
- Airborne systems requirements (algorithms, architecture)

He also stated that further results will be presented at ASSTAR User Workshop #5, 27th June 2007. This last workshop will be focussed on the ASSTAR contributions to SESAR.

10.2 Airborne Separation Applications Craig Foster (NATS)

Brief description

The presentation focused on introducing the airborne separation concepts which where investigated in the ASSTAR project.

The presentation described the two operational concepts of airborne separation and airborne self-separation, focusing on the level of delegation of responsibility. The radar airspace ASEP-LC&P application was described with diagrams illustrating the application.

A brief introduction to the oceanic environment was given. This included discussion of the limitations imposed by the lack of radar coverage and poor voice communications and how this affects the method of control, separation standards and systems used.

The ASEP-ITP and ASEP-ITF applications were described with the use of animations to simulate the various steps in establishing and executing the applications. The SSEP-FFT application was also briefly discussed.

The motivation for the new ASEP-ITM application was presented and the programme of work for WP-8 was elaborated.

A short statement on the commonalities of the applications was given which emphasised the need for high ADS-B out equipage and that the applications all present similar issues to ATC: delegation of responsibility, transition and interfacing with managed airspace.

NATS also presented the opinion that the complexity of the communications exchanges to set up the applications would require them to be undertaken only in a data-link environment. Finally, an ANSP operational perspective was given by NATS which highlighted the need to understand a number of issues with these ASAS applications. These included the capacity effects of free-flight (autonomous aircraft operation) tracks, the control of adjacent tracks in the event of non-nominal situations on the free-flight track, how traffic is to be managed at the domestic airspace interface and the need for a harmonised approach with adjacent control centres.

10.3 Feasibility, Benefits and Safety of Oceanic Applications Bart Obbink (NLR)

Brief description

The presentation provided a succinct summary of the feasibility, benefits and safety implications that arise from the use of ASAS applications in the Oceanic NAT. The applications under investigation were ASEP-ITP, ASEP-ITF, and SSEP-FFT. Two real time simulations with different emphases were conducted, both used adapted (optimised) real traffic flow data as a baseline. The first simulation run in winter 2006 was focused on the pilot's perspective. ASEP-ITF and SSEP-FFT were tested in normal and rare-normal conditions. The second simulation, run in spring of 2007, re-examined ASEP-ITF and SSEP-FFT but also included the ATCo perspective. The scope of scenarios was broadened to include failure conditions.

Safety assessments were conducted using qualitative (OHA according to ED-78a) and quantitative (based on material from RFG, MFF) methodologies. It was highlighted that both approaches are, ultimately, limited as they focus predominantly on the safety-critical issues.

Key issues from presentation

- ASEP-ITP Safety: There is a reduced severity of "Execution of manoeuvre[s] not compliant with criteria". A new hazard class was identified, "incorrect termination of manoeuvre". The collision risk was found to be reduced in the nominal case by up to three orders of magnitude. In the case of non-nominal scenarios air crew monitoring was found to be beneficial.

- ASEP-ITP Benefits: ASEP-ITP and ASEP-ITF benefits were found to be comparable. No significant benefit was found for double climbs in NAT OTS.

- ASEP-ITF Feasibility: Flight Crew acceptance is high, safety was not compromised. There are some minor revisions and additions needed for the HMI, namely target Mach Number.

- ASEP-ITF Benefits: The benefits are still disputed, but appear to be near the maximum attainable. There is a slight positive correlation of benefit with increasing traffic density.
- SSEP-FFT Feasibility: As with previous applications, flight crew acceptance was found to be high, and safety was never compromised. In addition to a need for target Mach Number display, target altitude, offset tracks, and intention information were identified as useful.
- SSEP-FFT Benefits: According to simulations, FFT benefits are comparable to those for ITF. Fuel usage, delay and predictability are near the maximum attainable.
- SSEP-FFT Safety: Off-set tracks are needed, conflict detection and resolution algorithms need to be enhanced, and a large sensitivity to the aircraft performance envelope was found.

10.4 ASEP-C&P Thierry Miquel, Philippe Louyot (DSNA), John Anderson, Colin Goodchild (University of Glasgow)

Brief description

The presentation focused on the findings of fast-time simulation results for ASEP-LC&P applications in radar airspace. A review of the intended operational procedures for ASEP-LC&P applications was provided along with a number of accompanying screenshots of a preliminary cockpit display of traffic information (CDTI) providing enhanced ASAS functionality.

Two well-established conflict resolution manoeuvre classes were presented: a turning point manoeuvre which may be implemented through the autopilot lateral mode; and an offset manoeuvre which may be compatible with Flight Management System (FMS) functionality. The main thread of the presentation was the analysis of the sensitivity of the two resolution manoeuvre classes to navigation errors while attempting to maintain a prescribed minimum lateral separation. The assessment was conducted using a set of radar encounters which were modified and simulated by means of a point-mass dynamic aircraft model incorporating autopilot and navigation functionalities. Two metrics were used to assess the performance of each of the two resolution manoeuvre classes, namely; minimum lateral separation achieved, and maximum cross-track deviation.

The main findings of the simulations concluded that (a) turning point manoeuvres perform better than offset manoeuvres in terms of achieving the prescribed separation, but generally result in a greater cross-track deviation (b) navigation errors (either from the own-ship or target aircraft) significantly increase the number of unresolved conflicts by the airborne system and (c) a static manoeuvre envelope may not be adequate to take advantage of lateral crossing manoeuvre opportunities. These results indicate that close links should exist between future airborne separation standards and navigation performance, and that the use of dynamic manoeuvre envelopes should be explored further.

10.5 Airborne Hardware Implementation and Installation Philippe Salmon (Thales Avionics)

Brief description

ASAS-SEP applications are expected to be one of the solutions that will enable the increase of air traffic density that is foreseen in the future. Since these applications rely on a new sharing of tasks and responsibilities between the ground-based controller and the airborne crew, using ADS-B technologies and systems implementation, safety considerations must be carefully analyzed in order to establish the appropriate requirements that will apply to the system design.

As a key principle, ASAS-SEP concept of operations states that ATC will delegate to a "clearance aircraft" the responsibility to ensure separation with designated "target aircraft", within a space and time envelope. The initiative of such a delegation remains with ATC, and must be accepted by the "clearance aircraft", while the "target aircraft" does not have an active participation in the manoeuvre.

The essential safety considerations expected to drive systems implementation are that ATC does not monitor the "clearance" and "target" aircraft trajectories during the manoeuvre. ATC however remains responsible for ensuring separation with surrounding traffic.

The main consequence of this approach is that the safety case is entirely supported by the airborne systems, requiring a high level of safety and performance for all of the components involved. A second consequence is that during the manoeuvre, conditions shall be maintained that allow a possible reversion to ATC control in case of abnormal situation.

Key issues from presentation

- The position information for the "clearance" and "target" aircraft must have a high level of integrity and continuity. This can be achieved either by an intrinsically high quality positioning source, or by combination of a less reliable source with independent monitoring. The latter will require a robust ADS-B datalink for ensuring the continuity of data.
- The "clearance" aircraft trajectory shall be managed consistently with the usual trajectory management system of the aircraft. Moreover, this trajectory must be such that it allows possible reversion of control to ATC, therefore it needs to be predictable, and possibly transmitted to the ground.
- The ASAS-SEP function shall provide the crew with appropriate means for monitoring the manoeuvre and maintaining the elaborated trajectory.
- The ground / air datalink that supports exchanges between ATC and airborne crew shall be suitable for ensuring the integrity of the numerous and critical data that have to be exchanged during the initiation phase of the manoeuvre.
- The maturity of the current standardisation for ASAS-SEP applications is insufficient, so further work must be done to analyse, quantify and allocate integrity requirements. ASAS-SEP procedures must also be defined and be subject to standardisation.

Issues from chaired discussions

Q1 - Tom Graff (NASA): NASA did a lot of research in the same areas as ASSTAR, with slightly different results. Tom volunteered to make a presentation at the next ASAS-TN2 workshop. There is also a study with Australian controllers currently under review, which can probably be passed to the ASAS-TN2.

A1 - Bart Obbink (NLR): ASSTAR simulations have indicated that there is an apparent issue with the benefits provided by ITP, as they are very limited when compared to the “current” scenario used as a reference. Bart explained that the ‘current’ operations mentioned in the presentation are partially optimised, i.e. simulated pilots always ask for step climbs when the need arises and controllers always grant step climbs when they are possible within current separation standards (10 minutes).

However, in actual operations, pilots miss some opportunities for step climbs, as indicated in previous NATS studies. The increased awareness of surrounding traffic afforded by the CDTI should result in more requests for step climbs. Consequently, additional benefits beyond those modelled can be expected from the introduction of ATSA-ITP.

Tom Graff (NASA): His personal explanation for missed step climb opportunities, as a pilot, is that generally pilots do not ask for a step climb because they expect ATC to suggest a climb to them. If ATC does not, pilots guess, maybe erroneously, there must be a good reason for this.

Moreover, Tom stated that currently 10 percent of the transatlantic flights request an altitude change and 5 percent will actually get it, and everyone needs at least one step climb over the Atlantic. The point is that everyone will request a climb when they know when to request it (“informed requests”), this is part of ATSA-ITP. The actual ITP climbs are the icing on the cake.

Q2 - Evangelos Malikoutis (TEI-Piraeus) stated that ASAS separation and radar separation are two totally different kinds of separation. Consequently, ASAS separation can be associated with new procedures, new rules, etc. This implies that ASAS separation will need new regulation, new rules and new procedures at the ICAO level.

He then asked why the separation criteria are always reduced for airborne separation. What happens if things go wrong, e.g. separation is 3 NM instead of 5 NM, and the flight crew aborts the manoeuvre and

gives responsibility for separation back to the controller. A controller faced with this situation is unlikely to want to resume responsibility for separation.

A2 - Philippe Salmon (Thales Avionics): answered that at the moment there is no evidence that airborne separation could lead to reduced separation minima. It is necessary to further discuss this issue in order to finally come up with agreed new separation criteria. Therefore, he agrees that new procedures are required. The new capability provided by ASAS means that the separation minima could be revised. And of course one of the most critical issues is the non-normal abortion of an airborne separation manoeuvre. New standards are probably required to address the issue of responsibility transfer in cases where the controller is unable to take over separation responsibility.

Jean-Marc Loscos (DSNA): stated that the objective of the ASSTAR project is to research the viability of ASAS procedures in the current environment. Reduction of separation minima should not be an objective of ASAS in radar environment.

However, airborne surveillance and ASAS will provide something new and provides information to the flight deck that pilots don't have today. Because ADS-B provides flight deck updates every second, it greatly reduces the current data lag inherent in the current process.

In addition, the fast time simulation in ASSTAR WP2 showed that it may still be too early to envisage a reduction in separation minima. This should however be investigated at ICAO level. It may be that the most appropriate expression of ASAS separation is in terms of time rather than distance, this would not be compatible with radar separations.

Bart Obbink (NLR): mentioned two additional considerations.

Firstly, separation minima were originally conceived due to inaccuracies in navigation systems. Since then much progresses has been made and ATCOs now consider separation minima as a safety margin or a buffer. Secondly, a great advantage of the distribution of tasks over many actors may be increased situational awareness.

Evangelos Malikoutis (TEI-Piraeus): Referring to the abort procedure, Evangelos pointed out that the airborne and radar separation minima must be compatible, even identical.

Q3 - Philippe Ducos (ATR France): We are introducing TCAS modifications, EFB class-3 equipment, and even own navigation related functions on EFB class-2 equipment. Is there a group trying to unify the hardware implementations?

A3: Philippe Salmon (Thales Avionics): We are currently far from a unified solution (ARINC Standards). Many architectural solutions are possible, and we are certainly not yet in a position where we have one solution in mind.

David Bowen (EUROCAE): explained that certification process is usually done in batches. A first set of requirements, technical specification and applications is being standardised, there will be updates as things move forward.

Q4 - Bob Arnesen (ECA/IFALPA): With reference to the ASEP-LC&P application in a radar environment, Bob expressed his concerns about the complexity of such a procedure. Irrespective of whether R/T or CPDLC are used, the amount of required communications is still too high compared to current operations.

Also, is an aircraft being the target of an ASAS manoeuvre informed or not of this situation?

A4 - John Anderson (University of Glasgow): Informing the target that he is under an ASAS manoeuvre is a possibility.

Bob Arnesen: The aircraft that has on-board ADS-B In, ADS-B Out and C&P functions has to manoeuvre, resulting in 2 minutes extra flying time. The aircraft that only has ADS-B Out can continue straight on. It seems to be nonsensical that the ASAS-equipped aircraft performs a manoeuvre to deviate from his planned trajectory, while the unequipped aircraft does not change. Companies that have made investments in ASAS are penalised. There could be other means of solving these crossing and passing situations.

Ken Carpenter (QinetiQ): opined that equipped aircraft would not be punished. The procedure would not be used were there not a benefit in terms of adhering to trajectory.

It is important to recognise that the equipped aircraft does not disrupt his trajectory because of the ASAS manoeuvre; rather, a manoeuvre is required because of the conflict. He would have to do something anyway. If this were not the case then a crossing & passing manoeuvre would not be required.

Informing the target of his status in the ASAS manoeuvre is an additional transaction on RT and thus would increase the load.

Q5 - David Bowen (EUROCAE): On the issue of having an independent source monitoring the broadcasted position, what is the solution that THAV have in mind? What is the impact of the required robustness of ADS-B on existing implementations?

A5 - Philippe Salmon (Thales Avionics): An independent monitoring source will not be easy to find, particularly in oceanic airspace. Consequently, the emphasis is currently on the integrity of the data source, but the issue is still open. Regarding the question on the robustness of the supporting data-link, it is clear that it must not fail during the execution of a manoeuvre. However, there are currently no figures for the required integrity and consequently, no idea if existing equipment would be impacted.

Q6 - Wilfred Rouwhorst (NLR): The SESAR timescales are 2020/2025. What are the aspects blocking an earlier implementation?

(The question and answer were deferred until the following day as, strictly, they relate to SESAR)

THAV's presentation on ASSTAR work indicated requirements on trajectory management. SESAR is developing concepts focused on trajectory management. How do these two points interact?

A6 - Craig Foster (NATS): said that a new MTCD is being developed by NATS and should be operational by 2009. However it falls outside of the ASSTAR timeframe and will not be considered in the project.

Q7 - Werner Langhans or Martin Stieber (Austrocontrol): Independent validation of aircraft position is possible today, using multilateration. Why would something similar not be possible with ADS-B?

A7 - Philippe Salmon (THAV): Agreed, but only for monitoring of the aircraft position by itself. What is still missing is the monitoring of the target aircraft position.

Werner Langhans or Martin Stieber (Austrocontrol): The priority has been set on ADS-B data. Would it be possible to do an independent monitoring inside the aircraft, possibly through DME/DME updates?

David Bowen (EUROCAE): In radar environment, it would be possible to use ADS-B ground stations for an independent monitoring of aircraft positioning. Therefore, the issue is most critical in Non Radar Airspace.

Vinny Capezzuto (FAA): The DME/DME solution de facto excludes general aviation. In addition, multilateration is a possibility to address the positioning monitoring issue in terms of technology, but would the ensuing costs be justified?

Q8- Bob Arnesen (ECA/IFALPA): The term "Free Flight" (FFT) is a misnomer and we should move away from it as it sends a wrong message. The related concept would be better described as the autonomous management of an aircraft trajectory (cf. SESAR). He therefore suggests replacing "Free Flight" with "Autonomous Flight Management".

A8 - Phil Hogge (ASAS-TN2): This is a fair proposition. It is not free at all; it is about minimum deviations from the operational flight plan/trajectory of the (airline) company.

D. Session 4: Beyond the clean lab environments

11 Introduction

This session was chaired by **Pierre Gayraud** (Thales Avionics) with **Giorgio Matrella** (ENAV) as the secretary.

The session chairman introduced Session 4 objectives and explained that ASAS needs additional aspects to be investigated in order to meet a fully operational status. Among them (and not limited to): certification conditions, methodologies finalisation, degraded mode analysis, and security issues.

Five briefings were presented in the session:

- Airborne Separation Assistance Systems (ASAS) Airworthiness Certification: by Friedhelm Runge (EASA);
- EUROCAE ASAS Standards: “From concept to equipment”: by Dave Bowen (EUROCAE);
- Data Links, a Meeting Point for ATM Security: by François Cervo (EUROCONTROL HQ);
- Airborne spacing in the terminal area: A study of non-nominal situations: by Karim Zeghal (EEC)
- Environmentally Friendly Airport Systems (EFAS): by Thierry Narnio (Thales Air Systems) and Zeshan Kurd (NATS)

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

12 Review of the briefings

12.1 ASAS Airworthiness Certification Friedhelm Runge (EASA)

Brief description

The European Aviation Safety Agency (EASA) is tasked for the rulemaking in the area of aircraft design, production and maintenance and performs the certification task. It is also responsible for the formal approval of aircraft (certification).

EASA guidance in certification material for a specific application (e.g. ASAS) is developed in the rulemaking process. This process starts with a task-planning phase. Later the development task is performed and leads to a Notice of Proposed Amendment (NPA). The proposed Amendment is opened for comments for a period of three months. A comment response document has to be compiled which will be made available for a further two months prior to publication of the final decisions. After finalisation, the material is uniformly used for certification. Concerning the use of ADS-B for separation in a non-radar environment (ADS-B NRA), the corresponding NPA is currently being processed and should be adopted before the end of 2007.

The first step in the certification process is the description of the intended functions. Then the requirements to perform a safe flight are assessed. It has to be demonstrated that equipment required for type certification or by operating rules, or whose improper functioning would reduce safety, and will perform as intended under normal operating and environmental conditions.

The differences between the Test Phase and Operational Phase installations were highlighted because they lead to different certification approaches. For the Test Phase, it only has to be demonstrated that the equipment does not interfere with existing aircraft systems. For the Operational Phase the intended function has to be demonstrated. Furthermore, requirements may be stipulated that concern interactions with other aircraft, either in the air or on the ground.

ASAS applications involve and impact on many different parties. Therefore, to ensure the intended functionality, requirements for communication between parties must be clearly defined. This can not be handled by EASA alone and a coordinated approach is needed. As a minimum the intended function and the interaction with others outside the dedicated aircraft must be explicitly defined.

For example, the requirements for ADS-B NRA having been defined for the specific operation in airspace, they have to be assessed and documented for the aircraft during certification. As a consequence the aircraft can be used for such type of operation in that airspace. Other use of ADS-B related functions have to be assessed in a similar way before certification can be granted.

Key issues in the presentation

- The definition of the intended function and the interaction with others outside the dedicated aircraft must be made explicit;
- The requirements for the use of ADS-B for separation in a non radar environment have been defined for the specific operation in that airspace;
- Other uses of ADS-B related functions have to be assessed individually and in a similar way before certification can be granted,
- Rulemaking is a long process.

12.2 EUROCAE ASAS Standards Dave Bowen (EUROCAE)

Brief description

The presentation covered the end to end process required to move from the “Idea” of ASAS to a viable system with installed equipment and approved procedures. It does not however cover the regulatory element but simply the development of material (technical and operational) which will support the regulation.

According to the EUROCAE ED78A methodology, the process is broken down into three main phases; Concept development, Requirements Engineering and Technical Specification development.

The first step is to take the overall ASAS concept and develop this into specific applications within a defined operational concept. This should result in OSEDs (Operational Service and Environment Descriptions) on an application basis.

The next phase, and perhaps the most critical, is the analysis process which identifies requirements, at both an operational level and system level to achieve the ASAS application, or set of applications, in question. This step results in Safety and Performance Requirements (SPR), and an Interoperability document which begins to map the requirements to technical enablers.

The final step (on this axis) is the System Level Specification, which could be thought of as an ASAS, or even ADS-B, architecture (MASPS), together with detailed technical specification for the individual component equipments (MOPS) which make up the system (transceiver, display etc).

The need to meet the standardisation aspects of the Single European Sky Interoperability Regulation (Community Specifications), in parallel with the established EASA processes, was also outlined.

Key issues in the presentation

- The full end to end process is required for successful ASAS implementation,
- The process requires the coordination of various organisations as the key responsibility evolves through the process. EUROCAE involvement in Architecture and Equipment specs must be preceded by cooperative work between EUROCONTROL and EUROCAE, and EUROCONTROL and EC coordinated research for initial concept development is a prerequisite for this,
- The participation of industry, ANSPs, pilots and controllers is essential with the emphasis being on operational inputs in the beginning, moving to engineering at the end. The process is labour intensive, although lessons learnt from early application development should result in more efficient future developments.

- Although initial applications have been developed through the RFG (joint EUROCAE/EUROCONTROL, RTCA/FAA initiative) all future developments should be aligned with SESAR. This will also ensure industry buy-in and sufficient resourcing for the development cycle.

12.3 Data links a meeting point for ATM Security François Cervo (EUROCONTROL HQ)

Brief description

The presentation gave an overview of ATM Security by providing definition, scope, objectives, and describing the ATM security management process within Europe.

The objective of Aviation Security is the safeguarding of civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human resources.

The different phases, requiring different types of measures, were described: identification and prevention of threat, reaction, and contingency measures. The institutional mechanisms in Europe were presented.

In the end, the airspace and ATM system (people, infrastructure and data) should be trusted by the national governments and by the public that they are secure and well protected from any unlawful activities that could potentially cause disruption to civil air transport.

The briefing also addressed the security issues related to data links. The military experience shows that circulation of data through data-link could represent a security threat but may also have a mitigation role and help in the recovery phase, providing information redundancy. Military examples were given where redundant data links are operating with no security overhead.

Key issues in the presentation

- ATM security should be considered as an integral part of ATM system and taken into account in the early stages of research and investigations programs;
- Data link in ATM could represent a security threat, but it may also have a positive role bringing information redundancies;
- Since the distinction between civil and defence activity in terms of tasks and challenges to be carried out is narrowing, crossover between civil and military technologies such as data link should be consider to improve security levels,
- Civil military cooperation could envisage a better ATM security system cost efficiency such as the one related to infrastructure.

12.4 Airborne Spacing in the Terminal Area Karim Zeghal (EUROCONTROL EEC)

Brief description

A series of small-scale controller experiments have been conducted to investigate two aspects:

- the handling of non-nominal situations involving the use of airborne spacing in terminal area;
- the benefits of using the route structure defined for airborne spacing in the terminal area, with no airborne spacing equipped aircraft.

The non-nominal situations considered were: mixed equipage, holding patterns and typical unexpected events (go-around, emergency, radio failure, spacing instructions not correctly executed).

Handling mixed equipage and holding patterns was found to be feasible. Recovering from the unexpected events was found to be easier than anticipated and was evaluated as being similar to recovery in today's operations.

Using the route structure without airborne spacing, heading instructions were no longer used and aircraft remained on lateral navigation mode. Even under high traffic load, the inter-aircraft spacing on final approach was as accurate as it is today, while descent profiles were improved. The flow of traffic was more orderly with a contained and predefined dispersion of trajectories.

The route structure is a prerequisite for airborne spacing, and its use (without airborne spacing) could be seen as a preliminary step to prepare for the implementation of airborne spacing. It could also be seen as a transition towards the systematic use of area navigation, or as a sound foundation to support further developments (e.g. continuous descent, target time of arrival).

Key issues in the presentation

- The non-nominal situations in ASPA S&M were found to be manageable by today's operations;
- Traffic flow in ASPA S&M was found to be more orderly with a contained and predefined dispersion of trajectories helping the management of non-nominal situations;
- The redefinition of route structure (e.g. P-RNAV) besides helping the introduction of ASPA applications could support further concepts as continuous descent and target time of arrival.

12.5 Environmentally Friendly Airport Systems (EFAS) Thierry Narnio (Thales Air Systems) and Zeshan Kurd (NATS)

Brief description

All forecasts predict a huge growth of UK air traffic in the next 20 years. This is expected to have a major environmental impact at, and around the airports. Environmental impact such as noise and engine emissions, if not addressed, will lead to unsustainable growth, and ultimately constrain the development of airports.

The EFAS consortium was formed with BAES, Helios, Manchester Metropolitan University, Longhborough University, QinetiQ, NATS, SELEX-SI and Thales to:

- Identify candidate ATM technologies and system that can reduce the environmental impact of growth in air traffic.
- Evaluate the efficacy of these solutions using an Airport Synthetic Environment Simulation tool.

The assessment of the solutions will include:

- Analysis of environmental Key Performance Indicators KPIS;
- Cost benefit analysis;
- Safety assessment.

All leading to the selection of the most beneficial solution(s).

At this point in the programme, one of the solutions being investigated is CDA+ASAS+AMAN, and a preliminary Hazard Identification (HAZID) has been performed by NATS.

Some safety concerns, identified as a result of ASAS and AMAN failures are given below:

- Reduced predictability of aircraft manoeuvres;
- Loss of separation and monitoring;
- Increased ATCO workload;
- Incremental concertina errors;
- Incorrect sequencing.

Key issues in the presentation

- Environmental issues could benefit from the introduction of CDA and ASAS concepts (in conjunction with AMAN) that could satisfy the best trajectory profile reducing pollution and noise emission;
- A side effect is that ASAS could help to mitigate AMAN failures (no time available) for simple geometries.

Issues from chaired discussions

12.6 Debate

Q: LVNL Asked if there is any loss of expertise due to automation features developed for ASPA.

A: Karim Zeghal (EEC) answered that when ASPA is introduced we will face the same situation of what happened when automation was introduced in the cockpit.

Q: David Bowen (EUROCAE) asked about the relationship between AMAN and ASPA concepts.

A: Zeshan Kurd (NATS) and Karim Zeghal agreed that AMAN is used for the initial phase set-up of the arrival aircraft sequencing list, while ASPA is used in a second phase in order to obtain spacing. Along all the feasibility and validation studies ASPA has been demonstrated to be compatible with AMAN. On the other hand there is a clear point that in term of safety ASPA could help to resolve an AMAN failure.

Q: John Brown (Boeing) asked about the sources of the vertical profiles showed in the EFAS presentation since he thought that they seem difficult to fly (continuously change speed and altitudes). He raised the point that this is further compounded by the fact that optimal CDAs are aircraft specific, and so questioned whether the CDA shown was generated from a specific airframe, or was a generic CDA.

A: Zeshan Kurd answered that data have been gathered from different sources.

Q: Wilfred Rouwhorst (NLR) asked if there were any plans to investigate non-nominal situations further.

A: Karim Zeghal answered that presently no plans for further non-nominal investigations are foreseen.

Q: Cedric D'Silva (THALES Avionics) asked if mixed equipage aircraft has been considered in CDA environment in EFAS research.

A: Zeshan Kurd answered that at this stage it was assumed that all aircraft were equipped; nevertheless CDA is expected to rely heavily on ASPA concepts.

On this subject Jean-Marc Loscos (DSNA) commented that the results mentioned by Karim in the non-nominal situations study regarding mixed-equipage aircraft are consistent with the CRISTAL Paris study findings. The minimum 70% equipage rate that has been given during S&M session, does not represent a firm threshold, since it comes from the simulation of future congested environments. In any case it is expected that benefits will correlate with equipage.

Q: Marinella Leone (Deep Blue) asked if bad weather conditions were considered in the non-nominal situations study.

A: Karim Zeghal said that it was difficult to quantify and measure bad weather conditions and for this reason they were not able to simulate them, while strong wind conditions were simulated and evaluated.

Q: Claudio Vaccaro (SICTA) asked if the ATC ground organisation has to be modified in order to support ASPA.

A: Karim Zeghal answered that no changes have been required since the simulation was based on the current organizational structure.

Q: Wilfred Rouwhorst (NLR) asked how SESAR defined the ASEP implementation timeframe.

A: Andy Barff answered that in SESAR users desired ASEP by 2020, industry thought this too ambitious. Since users were pushing, industry has come back and said it may be feasible by 2020.

Q: Giorgio Matrella (ENAV) asked if Security issues were properly addressed by the aviation community and what work could stakeholders do to better address security requirements.

A: François Cervo (EUROCONTROL HQ) answered that security needs to be clearly understood by all stakeholders of the aviation community. Political levels should be well aware of this sensitive issue already. In the SESAR framework security is addressed, but there is still room for

improvement. If security is coordinated between aviation concepts and technologies, stakeholders should profit, and this may reduce future security implementation costs.

13 Concluding remarks

Session 4 has illustrated some of the numerous subjects which have to be addressed along the way leading to the entry into service of new concepts and technologies. The briefings and discussion have shown no blocking point for ASAS, on the contrary they have identified positive aspects:

- The aircraft certification process is suitable for the ASAS certification and the first step is the development of a Notice of Proposed Amendment (NPA) on ADS-B NRA during 2007;
- The end-to-end methodology to support the development of standards has been used for ASAS as a pioneer application and has been proven,
- Security is a global concern for ATM. ASAS raises no specific issue;
- Non-nominal situations have been analysed for at least one application, and show no significant difference with respect to the current operations. Benefits can also be achieved with mixed equipage;
- Environmental constraints which represent growing constraints for ATM could be an opportunity for ASAS.

14 Demonstrations

During the workshop NLR arranged visits to their GRACE simulation; 75 delegates took part. The GRACE simulation has been used to develop and evaluate a range of ASAS applications. Delegates were shown and were able to fly Sequencing & Merging (ASPA-S&M), Crossing & Passing (ASEP-LC&P), oceanic In Trail Follow (ASEP-ITF), Self Separation in segregated free flight airspace (SSEP-FFAS) and Self Separation in an organised track system (SSEP-FFT).

15 Conclusions from the Workshop

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

- Good progress has been made since the first ASAS TN1 workshop in Rome in April 2003. There has been a wide range of successful R&D programmes and, recently two important milestones have been achieved:- (1) the second Maturity Assessment of ASAS Applications which shows significant advances, and (2) the publication by EUROCAE and RTCA of the ADS-B-NRA standards in ED-126 and DO-303.

- ASAS applications are now included in the SESAR draft Concept of Operations. The Glasgow workshop had been concerned that these were not being taken sufficiently seriously by the SESAR working groups. There was now a unique opportunity to integrate ASAS into the new ATM system, but the ASAS community needed to work hard to prove that ASAS could achieve what is promised.

- It is most important to maintain continuity of a number of activities:- (1) the RFG standardisation work; (2) pre-operational trials; (3) working with partners in the US, Australia and Asia to ensure global applicability; (4) defining benefits and translating these into financial terms; (5) interacting with the appropriate SESAR working groups.

- In many areas good work is in progress. In particular:- (1) the further refinement of sequencing and merging showing that benefits could be derived in complex TMAs, with mixed equipage and in non-nominal situations; (2) new work on Package 2 applications; and (3) simulations of self-separation.

- Amongst other considerations:- (1) it was inappropriate to continue to refer to Free Flight, it would be better to refer to Autonomous Flight Management; (2) approval for airborne separation standards would be needed in each continent; and (3) there were concerns over 1090MHz saturation in the 2015- 2020 timeframe.

- Regarding the political capacity goal that has been set for SESAR, it should be noted that the FAA has concluded that, if only 2% of passengers switched to VLJs, the result would be a tripling of the number of movements.

- The SESAR Concept of Operations includes military requirements and a more flexible use of airspace. In addition, ATM security will need to be addressed within an open information architecture.

- This was the first ASAS workshop at which there have been presentations from EASA and EUROCAE. The process from R&D, to RFG preparation, to EUROCAE standards, and then to EASA certification is clear, but no-one should underestimate the length of time it will take and the difficulty of certificating some of the more complex applications.

He finished by thanking all those from NLR who had organised the workshop so well.

16 ASAS-TN2 Recommendations/Actions

The emerging concepts of operations in both SESAR and NEXTGEN feature the use of ASAS applications. In order to ensure that both these programs exploit ASAS to full advantage, the ASAS-TN recommend the following;

a. More effort is required urgently to describe concepts for the use of ASAS in a 4D environment in accordance with SESAR/Nextgen timescales.

b. Need to identify those applications that need to be fast-tracked to meet the above timescales

c. These concepts and priorities must be conveyed to the major stakeholders urgently in anticipation of SESAR master plan (D5)

The above issues are urgent within a timescale of a few months. There are other urgencies with regard to standardisation and development over the next few years.

d. In order to provide a high-level of equipage to support the use of ASAS on SESAR/Nextgen timescales work on the standardisation and development of the concepts described in (a) need to commence now.

17 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-TN; and

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

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