ASAS-TN2.5

Report of the Rome Workshop
12-13th November 2008

"Towards an ASAS-Global Network: Next Steps"

Version 0.6, 9th December 2008

1 What is the ASAS-TN2.5?

ASAS-TN2.5 is a stand-alone event, following on from the work of its predecessor projects ASAS-TN (Airborne Separation Assistance System Thematic Network) and ASAS-TN2. ASAS-TN (2 year duration) and ASAS-TN2 (3 year duration) were projects that were primarily a communication activity and were sponsored by the European Commission (DG Research).

The TN2.5 Workshop has been funded by EUROCONTROL, organised with the co-operation of the FAA, and with the local support of ENAV and the former TN consortium members. The workshop is intended to maintain the momentum built by the ASAS-TN projects towards the development of future work in this domain.

The working title for this future work is the **ASAS Global Network** (ASAS-GN0 and its objective may be summarised thus:

The main objective of the ASAS Global Network is, through international cooperation, to accelerate the global implementation of ASAS applications throughout the world, in order to increase airspace capacity, safety and flight efficiency.

2 ASAS-TN2.5 Workshop

2.1 Format of the workshop

Day 1 consisted of an introductory session and update of the progress and status of worldwide ADS-B/ASAS implementation including SESAR, NextGen, trials results and Implementation plans.

Day 2 consisted of a session describing the work of the FAA/EUROCONTROL Action Plan 23 (AP23) in relation to Airborne Separation and Self-Separation. There was session that reported on relevant activities in the unmanned aircraft domain.

2.2 Day 1: Wednesday 12th November 2008:

- Host welcome (Nadio di Rienzo, ENAV)
- Workshop Chairman (Phil Hogge, ASAS-TN2.5)

Session 1: progress and status of implementation and standardisation
Chair: Phil Hogge (ASAS-TN2.5) Secretary: Bill Booth (EEC)

Session 1 reported on SESAR and NextGen and compares and contrasts their developing concepts. There were also be reports on developments and implementation plans for ADS-B in Europe, Australia and Japan.

- ASAS-TN2.5: Introduction and overview: Phil Hogge (ASAS TN2.5)
- SESAR and ASAS Opportunity: (EUROCONTROL EEC)
- NextGen Report: Doug Arbuckle (FAA)
- SESAR/NextGen Montreal: Lex Hendriks (EUROCONTROL HQ)
- *Discussions*

- European ADS-B activities: Alex Wandels (EUROCONTROL HQ)
- US ADS-B Programme: Vinny Capezzuto (FAA)
- Japanese activities: Shigeru Ozeki (ENRI - Electronic Navigation Research Institute)
- *Discussions*

Session 2: Results and business plans
Chair: Cedric d'Silva (Thales Avionics) Secretary: Giorgio Matrella (ENAV)

Session 2 provided reports on global ASAS activities, concentrating on the results of UPS's implementation at Louisville and their business case, KDC at Schiphol, the use of ASAS by LFV at Arlanda. It also covered recent results from the CRISTAL-ITP Project and the work being done on ITP in the USA.

- UPS Practical Experiences of Pilots and Controllers and their business case, Wes Stoops, (FAA)Randy Bone (Mitre)
- ASAS activities for Schiphol: Nico de Gelder (NLR)
- ASAS Operations at Arlanda: Jan Bengtsson (LFV)
- *Discussions*
- In Trail Procedure: Ken Jones (FAA)
- CRISTAL-In Trail Procedure: Johan Martensson (EUROCONTROL HQ)
- *Discussions*

2.3 Day 2: Thursday 13th November 2008:

Session 3: FAA/EUROCONTROL Action Plan 23: Airborne Separation and Self Separation
Chairs: Dragos Tonea (EUROCONTROL HQ) and Roberta Massiah (FAA)

Session 3, led by the FAA/EUROCONTROL Action Plan 23 team, reported on developing concepts of airborne separation and self separation. This was be followed by reports on recent work by NASA on flight deck functionality and the work of the iFLY consortium on self separation.

- General introduction to AP23 by the chairs
- ASAS Concept of Operations: Ken Carpenter (QinetiQ)
- Consideration of future ASAS applications: Brian Baxley (NASA) and Ben Stanley (Helios)
- *Discussions*
- NASA ASAS activities: Robert Vivona (L-3 Communications/NASA)
- “iFly: ASAS Self Separation – Airborne Perspective”: Petr Casek and Rosa Weber (Honeywell)
- ASAS issues identified: Jean-marc Loscos (DSNA)
- *Discussions*

Session 4: Unmanned aircraft and the issue of autonomous flight
Chairs: Nico de Gelder (NLR) and Chris Shaw (EUROCONTROL EEC)

Session 4 examined Unmanned Aircraft Systems (UAS) operations, technologies and autonomous flight.

- Project Outcast – UAS Sense and avoid: Michiel Selier (NLR)
- UAS flights in civil airspace based on ADS-B: Edward Falkov (GosNIIAS)
- *Discussions*

Concluding Remarks: Vinny Capezzuto (FAA) and Phil Hogge (ASAS-TN2.5)

A.Session 1: Global ADS-B Activities

3 Review of the briefings

3.1 ASAS-TN2.5; Introduction and Overview (Phil Hogge, ASAS-TN2.5)

Brief description

Phil Hogge welcomed delegates to the Workshop and explained that this was an interim Workshop sponsored by EUROCONTROL in cooperation with the FAA and supported by ENAV. It was designed to maintain the momentum between the European Commission sponsored ASAS-TN2 and the proposed joint FAA/EUROCONTROL ASAS Global Network that would follow on from it.

The main themes are:-

- To give an update on progress since the Paris Seminar in April.
- To encourage joint development of current and future ASAS applications.
- To encourage a convergence of thinking in SESAR and NextGen.
- To see what can be learnt from the growing use of UAVs.
- To keep up the pressure.

We need to continue to capitalise on the various successes of recent years such as the growing number of ADS-B implementation programmes around the world; the successful trial of the ITP procedures in the Reykjavik FIR; UPS's growing fleet of SafeRoute equipped aircraft; the very recent agreement of the FAA to fund the fitment of this equipment to 20 Airbus A330s of US Airways to investigate ATSA-SURF at Philadelphia.

We also need to support the work of AP23 on the ASAS Package 2 definitions, and the RFG's standardisation work.

Phil emphasised that, although the SESAR work programme included the necessary ASAS validation activities, it would be necessary to ensure that they actually happened.

There was general agreement that the ASAS-TN had been a success, therefore it has been decided to hold an ASAS Global Network Workshop in the USA in Spring 2009. This also provided an opportunity to seek ideas for improvement, a questionnaire to this effect would be issued with the Report. The proposed Objective for the Global Network is:-

> **Through international cooperation, to accelerate the global implementation of ASAS applications throughout the world, in order to increase airspace capacity, safety and flight efficiency.**

This objective is very similar to that of the original Thematic Network but has a much greater emphasis on international cooperation and global implementation. It also includes flight efficiency to reflect the growing importance of reducing fuel burn and environmental emissions.

3.2 SESAR and ASAS Opportunity (EUROCONTROL EEC)

Brief description

The objectives of SESAR are to eliminate the fragmented approach to ATM, transform the European ATM system and synchronise the plans and actions of the different partners and federate resources.

SESAR is structured in three major phases:

- Definition Phase (2005-2008 – complete with delivery of the ATM Master Plan)
- Completed Development Phase (2008-2013 – under management of the SESAR JU)
- Started Deployment Phase (2014-2020 – implement the results of the Development Phase)

To manage the development phase a legal entity was created, under European Community law, on 27th of February 2007: The SESAR Joint Undertaking (JU). The aim of the Joint Undertaking is to ensure the modernisation of the European air traffic management system by federating research & development efforts in the Community. As such, it will organise and coordinate the development activities of the SESAR project, in accordance with the ATM Master Plan.

Bob explained the structure of the SESAR JU and how it is structured around the Concept. For the audience he highlighted the ASAS applications that are described in the Concept thus:-

Service Level 0 & 1 (to 2012)

- ATSAW in flight and on the surface
- ATSA: ITP and ATSA: VSA
- Manual ASAS S&M

Service Level 2 & 3

- ASPA: S&M (2015)
- ASEP: ITP (2020)

Service Level 4& 5 (2020+)

- ASEP: C&P
- ASEP: Self-Sep

Bob emphasized the identification of “Quick Wins”. This is explicitly stated in the following quotes – “The SESAR JU is encouraged to “to identify, at an early stage, existing and validated technical solutions that can serve as a basis for early deployment to secure early benefits.” (EC Council Communication October 2008).

For ASAS the following opportunities for work towards quick wins are identified.

- ATSA: ITP Trials
- ATSA: ITP & ASEP – ITP (Oceanic in trail procedures)
- ASEP: Cooperative Separation
- ASEP: Self Separation in Mixed Mode
- ASEP: Separation Task in En Route Trajectory based environment
- ASEP: Compatibility between 4D Contract and ASAS Self Separation
- ASPA: S&M
- ASAS Airport related separation minima (Setting targets for possible reductions in selected separations based upon enablers and technological improvements such as RNP, RSP, ASAS, etc.)

In summary:

- Identify quick wins
- Ensure ASAS compatibility & co-existence of concepts elements e.g. Trajectory Based Operations
- Cost & Benefit analysis – particularly in the current economic climate
- Ensure global interoperability of ASAS applications
- Is there a killer application?

3.3 NextGen report (Doug Arbuckle, FAA)

Brief Description

Doug described how NextGen is being managed across two US bodies.

Joint Planning and Development Office (JPDO)

Coordinates across US Government, addressing cross-agency needs, issues, and concerns. It Includes system users and manufacturers. There are nine Government/Industry working groups. The JPDO defined the "*NextGen Vision* and *Concept of Operations for 2025" and is responsible for the long-term NextGen vision, Enterprise Architecture, and Integrated Work Plan.*

FAA's Integration & Implementation Office

Integrates and *manages* FAA work required to implement operational capabilities, including: Research; Technical requirements; ATC equipment; Aircraft avionics requirements; Airspace redesign; Procedures; Rulemaking; and Certification

The presentation gave an overview of the relevant Operational Improvements, enablers and pathways, in the context of the NextGen Planning Framework for ADS-B and RNP. The focus of the presentation was on the pathways for the ADS-B elements in the Framework.

The following definitions were given:

Operational Improvements (OIs) are planning elements that describe results of initial realization of a specific NextGen operating capability or an improved level of performance at a defined time

Enablers are planning elements that describe results of initial realization of a functional component of NextGen.

The pathways, or NextGen OI groups, described as relevant to ASAS/ADS-B activities were derived from the "emergent structure" of the OI dependencies contained within the IWP, and were presented on charts with the following titles:

- Separation
- Arrivals
- Corridors
- Surface Operations and Tower

Doug described the FAA's NextGen planning framework, based on the NAS Architecture and including operational capabilities categorized by Solution Sets. He concluded by provided URLs to reference material on JPDO and FAA web sites, where interested individuals could look for more detailed information

3.4 SESAR/NextGen Montreal (Lex Hendriks, EUROCONTROL HQ)

Brief description

ICAO Forum on Integration and Harmonisation of NextGen and SESAR into the Global ATM Framework was held in Montreal on 8-10th September 2008.

The conclusion from comparing the SESAR and NextGen programmes was that they are in broad alignment and built on common tenets (e.g. with performance–driven goals, in an advanced automation and SWIM environment).

The work of the two programmes was examined in the context of ICAO. ICAO is the only common global framework, and facilitates harmonisation and interoperability through timely production of necessary SARPs.

Within this context SESAR/NextGen needs more ICAO material to ensure interoperability. The following key areas for work were highlighted:

- Common time reference
- New flight plan / flight object
- Information Management (data models, quality of service requirements, sharing rules, distribution process)
- 4D Trajectory exchange format
- Trajectory exchanges & “contracts” procedures
- D/L applications for trajectory data exchange
- New wake vortex separations based on time
- Procedures for delegation ATC/Pilots
- Time based separations
- UAS (sense & avoid: new rules & technologies)

The following recommendations to ICAO were identified.

ICAO will:-

- Need to move from standardizing “pieces” to “packages or groupings” of capabilities and procedures to deliver a specific level of operational capability and performance (with targets)
- Need to restructure itself to be responsive to demands
- Work with other international standards-making bodies
- Prioritize the supporting technical specifications to be addressed
- Work with SESAR JU and the US to review needs for standards
- Review structure & terms of reference of all ICAO Panels & Groups, and reset priorities
- Host periodic Future Aviation Systems Forums

A number of bilateral meetings were held on the sidelines of the Forum with relevant third countries to explore next steps for cooperation in the SESAR framework.

In summary:

- SESAR: a new dimension to European ATM & regional integration efforts
- SESAR is for all airspace users, global interoperability is a priority
- ICAO has an essential role for this
- Airspace users requirements should drive the process
- Cooperation SESAR/NextGen is essential and active
- Find common solutions

3.5 European ADS-B activities (Alex Wandels, EUROCONTROL HQ)

Brief description

The scope of the CASCADE programme covers ADS-B out and ADS-B in (limited to ATSAW) applications. The benefits are mainly a more efficient service for aircraft operators and savings in surveillance infrastructure. The trials have so far concentrated on ADS-B out. 18 pioneer airlines with more than 400 aircraft are heading for airworthiness approval of existing equipage and are exposed to pre-operational stations around Europe. Other trials include ITP and ATSA-SURF.

On the regulatory front, the SPI-I is published for formal consultation and the proposed dates for ADS-B equipage are 2012 for forward fit and 2015 for retrofit. The changes required to transponders/GNSS installations should generally be limited to software upgrades. It is important the ASAS-GN understands that this is the standard they will have to live with for at least 10 years after 2015. The path to get from concept to implementation is long and complex and should not be underestimated. The biggest challenge for ASAS-GN is to find locations where their applications have a chance of being implemented.

In summary

- ADS-B is happening.
- The base-line has been fixed
- ADS-B is being globally co-ordinated

3.6 US ADS-B Programme (Vinny Capezzuto, FAA)

Brief description:

The presentation described the US ADS-B programme dual track strategy for the ground infrastructure and necessary avionics. Progress and planning along each axis was described. The next steps in the deployment of ground infrastructure in the US were described. The current UPS operations in Louisville will be extended to Philadelphia.

- New ADS-B Operational at Louisville: (October 2009)
- New ADS-B Operational at Philadelphia (February 2010)
- New ADS-B, Weather and Communications Gulf of Mexico/ZHU (December 2009)
- Automatic Dependent Surveillance - Broadcast (ADS-B)
- In Alaska , Juneau key site New ADS-B Operational (April 2010) then Statewide Expansion of ADS-B with Communications & Weather

The September 2008 ARC report concluded with the statement that it emphasizes its support for ADS–B Out implementation in the NAS by 2020.

In its longer-term recommendations of the ARC were:

The FAA should develop and implement the requirements and operational procedures for 3 nm separation in all domestic en-route airspace based on ADS-B surveillance, before the ADS–B Out compliance date.

The NPRM is focused on ADS–B Out and attempts to establish the requirements of ADS–B Out equipment so that it is compatible with ADS–B In. The FAA, in partnership with industry, should define a strategy for ADS–B In by 2012, ensuring the strategy is compatible with ADS–B Out avionics. The FAA also should ensure this program defines how to proceed with ADS–B In beyond the voluntary equipage concept included in the NPRM.

On November 3 2008 the FAA announced awards of a total value of $9.3M to two vendors, ACSS and Honeywell.

3.7 Japanese activities (Shigeru Ozeki, ENRI)

Brief description:

The presentation focused on ADS-B and R&D activities in Airborne Surveillance in Japan. The special features of Japanese airspace were described.

The Japanese airspace provides some interesting challenges in terms of its weather systems, geography and volcanic activity. The airports tend to be near the shore with small and complex airspace, its international and domestic route structures are parallel and in-line with the islands.

The presentation included an overview of the relevant R&D activities in Japan and an over view of the perceived opportunities for Airborne Surveillance Applications (ASA) in Japanese airspace.

ASA will need to support the future traffic in Japanese airspace in order to increase the throughput of the airspace, especially in hub area and to improve aircraft fuel efficiency and to reduce flight time.

Possible higher throughput and fuel efficiency may be achieved by using ASA, for example:

- ASA in oceanic airspace (ITP)
- Gate-to-gate optimization including en-route (ITM)
- Less separation at crossing for less impact to trajectory(C&P)

- M&S without waiting circle for ATFM environment
- Less workload by task sharing with GSA (Cluster control & ITF)

ASA may also be employed to enhance safety, e.g.

- Basic improvements of situation awareness (ATSA)
- Possible improvements with graphic HMI for ASA with CDTI & CPDLC
- ATM compatible ACAS as another layer for safety-net

There are many R&D activities in Japan in terms of hardware, fast-time simulations and flight trials to support these ATM Improvements.

<u>In summary</u>:

"Japan is ready to work proactively with others in expectation of ICAO's leadership" (JCAB)

"Japan is undergoing a development phase of Long-term Roadmap of Future Air Traffic Systems in 2025 to complete in 2010" (JCAB)

R&D activities are underway in Japan to prepare for ASA for domestic special mission and for global ATM implementation

B.Session 2: Results and business plans

4 Review of the briefings

4.1 UPS practical experiences of pilots and controllers and their business case (Wes Stoops, FAA and Randy Bone, Mitre)

Brief description

Flight Deck-based Merging and Spacing (FDMS) during Continuous Descent Arrival (CDA) operations have been conducted on a limited basis during UPS flights.

Current Implementation status:

- UPS has five Boeing 757 aircraft equipped with Aviation Communication & Surveillance Systems (ACSS) Cockpit Display of Traffic Information (CDTI) hosted on class III Electronic Flight Bag (EFB) for FDMS and new display (ADS-B Guidance Display) with the Co-space derived algorithm
- UPS Boeing 767 are certified but not yet operationally approved for FDMS
- UPS has 107 of its Boeing 757 and 767 aircraft transmitting ADS-B
- UPS conducting FDMS about once a week due to limited number of aircraft and limited number of trained pilots (since January 2008)

Expected benefits include consistent, low variance spacing between paired aircraft at the entry to an arrival procedure (e.g., CDA) and on final approach. UPS has realized the following benefits during CDA conduct.

- 30% reduction in noise (up to 6 dB)
- 34% reduction in nitrous oxide (NOx) emissions
- 250 to 465 pounds less fuel burn per flight

The on-going flights facilitate data collection on spacing performance and support the validation of operational, safety, and performance requirements. Observations have occurred both in the flight deck and with Air Traffic Control (ATC). Flight crews have generally reported positive feedback on the operation. The following bullets summarize the initial impressions of the flight deck operations.

- Initiation method (datalink) acceptable
- Flight crews following appropriate phraseology and it appears to be sufficient
- Non-normal situations are sufficiently resolved
  - o Visual approach and visual separation issuance during final portions of the arrival if spacing issue
- Current flight crew coordination procedures are sufficient
- CDTI is a useful tool

ATC reactions have generally been positive in both the en route and terminal environments. For example, workload reductions are expected through reduced communications and the flight crew maintaining the spacing interval. In the terminal environment, some challenges (not directly related to the pair-wise spacing task) have arisen, e.g., the integration of spacing and non-spacing aircraft.

In Summary

The next steps in the FDMS effort include waiting upon the equipage of UPS Boeing 767 aircraft with FDMS avionics, continued examination of algorithm performance and speed quantization, as well as the conduct of a focused field test. On-going efforts are also expected to support the development of the Enhanced Sequencing and Merging (S&M) application within the Requirements Focus Group (RFG). Finally, future activities include the conduct of further analyses on and definition of future implementations and the expansion to additional locations.

4.2 ASAS activities for Schiphol (Nico de Gelder, NLR)

Brief description

To investigate which surveillance applications might be beneficial for operations at Schiphol the Knowledge and Development Centre (KDC) has set up the KDC project "Airborne Separation Assistance System (ASAS)". In this study the requirements and desires of Dutch aerospace sector are matched to the possibilities offered by ADS-B and ASAS. The focus is mainly on Airborne Surveillance Applications. This study is seen as a first step towards the long term objective: to set-up and execute an ASAS strategy that is to implement selected airborne and/or ground surveillance applications in the daily operations of Amsterdam Airport Schiphol. The expected project result of the 2008 study is a shortlist of applications ready for implementation or having good potential but requiring further design and development or research.

The challenges of flight operations at Schiphol were explained, and the approach and scope of the KDC ASAS study to see if these challenges could be met with the use of ASAS were given. One example of the Schiphol concept evolution "High Capacity CDA operations" and associated airborne surveillance application Merging & Spacing (ASPA-M&S) were presented in more detail. It was concluded that ASPA-M&S is an enabler for high capacity CDAs provided that a) lower distance-based (or preferably time-based) separation minima are introduced for approach & landing operations at Schiphol and b) APSA-M&S actually delivers the spacing performance, as demonstrated in R&D, in the Schiphol environment.

In summary

- The KDC ASAS study recommended to pursue:
  - an internationally agreed mandatory implementation for ATSA-SURF and ATSA-AIRB
  - design and development at Amsterdam Airport Schiphol of ASPA-M&S
  - applied research into Closely Spaced Parallel Approaches (ASEP/ATSA-CSPA), Closely Spaced Landings in low visibility (ASEP-CSL), Taxiing on the airport surface in low visibility (ASEP-SURF)
- In the implementation phase one of the main questions is how to reach the required levels of equipage (particularly the high ones) before starting the intended operation on a daily basis and getting the benefits. This topic should globally get high(er) priority.

4.3 ASAS Operations at Arlanda (Jan Bengtsson, LFV)

Brief Description

Arlanda Surface live operational trial was undertaken at Arlanda Airport in Stockholm in September 2007 with participation of LFV, SAS, Rockwell Collins France, AVTECH and SAAB. New presentation equipment in aircraft, VMMR and Electronic Flight Bag (EFB); vehicle, LCD display with moving map; and tower with a surveillance display, all showing surrounding traffic and alerts.

The trial used the whole manoeuvring area at Arlanda for the validated services; routing and route deviation detection services and one of the runways for runway incursion detection service scenarios. Two SAS flight crews altered in cockpit of a NG B738, two vehicle drivers manned two vehicles and a controller manned the tower.

- Description of Runway Incursion Detection
- Description of Routing and Clearance Deviation Detection
- Examples of traffic displays in control tower
- Examples of EFB display in aircraft
- Equipment in aircraft and the ground infrastructure at Arlanda airport
- Result and recommendations
- Summary of results/recommendations
- Pilots, controllers and vehicle drivers agreed that the applications will enhance Safety
- The live trial was to short to produce valid data
- A new experiment should be carried out with a more mature system including a working point-to-point system and a stable display on the EFB when the aircraft is standing still

For more information about the project visit http://www.nup.nu/nup2plus/

4.4 In Trail Procedure, (Ken Jones, FAA)

Brief description

The presentation covers the FAA plans for the development and implementation of ADS-B In-Trail Procedures with the goal of conducting an operational evaluation of ADS-B ITP in selected revenue service. The presentation includes an overview of ADS-B ITP, a discussion of the recently approved standards and covers some of the research that has been conducted in support of the development of ADS-B ITP. The presentation also includes material in support of the FAA's plan for conducting operational flight trials on revenue flights operating on South Pacific routes.

Highlights of the presentation include a discussion of:

- Approved ADS-B ITP standards
- Research results in support of ADS-B ITP
- Business case results for ADS-B ITP for flights in the South Pacific
- High level overview of FAA operational evaluation flight trials

In summary:

- ITP is cost beneficial to airlines in the Pacific
- ITP using certified DO-260 signal produces an early payback in the SOPAC
- An equipped 747-400 with a and certified ADS-B ITP system will received immediate benefit in the SOPAC and be ready for use in other areas when authorized
- Cockpit implementation specifics – (EFB for FAA ITP)

4.5 CRISTAL In-Trail Procedure (Johan Martensson, EUROCONTROL HQ)

Brief description

CRISTAL ITP is working towards implementation of the ATSA ITP procedure in the North Atlantic airspace. The ATSA ITP procedure is expected to provide improved flight economy and reduced carbon dioxide emissions whilst maintaining safety and comfort.

The standardization of the ATSA-ITP procedure is progressing both on industry standards and ICAO material. The ATSA-ITP Safety and Performance and Interoperability (SPR/INTEROP) standard was published on the 19th of June 2008. An ad-hoc working group is formed to produce a CPDLC provisions for ITP. The ICAO SASP has approved the SPR ATSA ITP procedure, with some limitations, and based on this produced a draft PANS-ATM (Doc4444) amendment, which also includes proposals for voice and CPDLC communication. The Air Navigation Commission will now process the PANS-ATM amendment further. NAT groups have also been involved in the standardization and implementation work. OPLINK is also expected to be involved in the communications provisions.

CRISTAL ITP have completed a number of validation activities of the ATSA-ITP procedure. The project ran a series of simulation sessions involving controller and flight crew. The simulations were run using the Airbus A320 simulator as well as Shanwick (NATS) and Reykjavik (ISAVIA) controller training facilities. CRISTAL ITP also performed the world’s first flight trial of the ATSA-ITP procedure. Further, the project carried out a benefit analysis of the ITP procedure in the North Atlantic. The project is also currently preparing for a revenue aircraft trial phase of the ATSA-ITP procedure.

The CRISTAL ITP results showed that the ATSA-ITP procedure is feasible in the North Atlantic airspace and the procedure was found acceptable by both controller and flight crew participating in the project. The flight crew HMI, a prototype, was found supportive in assessment and communication tasks. It was also identified that a graphical display (CDTI) is preferred. The controller HMI, identical to the one currently used today in Reykjavik and Shanwick, was found acceptable to support the ITP procedure. However, some Improvement suggestions were given. Technical performance results are currently being consolidated in the project and will be made public in the final report.

CRISTAL ITP (in conjunction with ICAO SASP) produced a recommendation for the ITP communications, both using voice and CPDLC, examples were given.

The benefit analysis carried out by the project indicates that the ITP procedure has the capability to save up to 1% of fuel burn for the Atlantic fleet. Specific scenarios for fuel burn and cost savings were presented.

The CRISTAL ITP project is currently consolidating the technical results into a final report. A second step has been taken and the project is currently working on revenue aircraft trial preparation. In this work possible trial areas have been identified, 5 possible areas were listed described.

In summary:

CRISTAL ITP – An important step towards ATSA-ITP implementation

ITP procedure feasible for NAT

- Controller and flight crew acceptance

Technical systems are able to support ITP

- Human Machine Interaction
- Technical performance

ITP is capable of saving ~ 1% Fuel burn reduction

- Saving € 108 million (€ 124k per aircraft) annually and
- Reducing carbon dioxide emissions with 344 000 tonnes annually
- Preparation for revenue aircraft trials ongoing
- Moving towards implementation

C.Session 3: FAA/EUROCONTROL Action Plan 23

5 Review of the briefings

5.1 General introduction to AP23 (Dragos Tonea, EUROCONTROL and Roberta Massiah, FAA)

Brief description

AP23 – Operational Scope

The operational scope of AP23 is focused on the longer term airborne surveillance (AS) and ground surveillance (GS) applications of common interest between FAA and EUROCONTROL, beyond those already covered by the RFG (ASAS Package 1).

5.2 Operational role of airborne surveillance in separating traffic (Ken Carpenter,QinetiQ)

Brief description

This AP23 deliverable, D3, is a concept document that aims to provide an overview of the concept of airborne separation and the operational use of ASAS (airborne separation and self-separation applications), in the context of the potential evolution of ATM within different timeframes: 2010 / 2020 / 2030. The document of two parts: Part 1 – Concept and Part 2 Operational Use.

A stable version of D3 will be delivered this year, and submitted the ASP Working Group of the Whole in December.

SESAR and NextGen discuss the use of ASAS in TM environment and emphasise new ASAS-based separation modes. D3 considers these new SESAR and NextGen operational concepts and improvements, and discusses airborne separation and self-separation in different environments (terminal areas, en-route, procedural airspace and surface).

Airborne separation and TM are complementary concepts, each enhanced by the other.

"The operational role of airborne surveillance in separating traffic"
can now be downloaded from:
www.icao.int/anb/panels/scrsp/indexp.html
by clicking on "Information/Documents"

5.3 Draft proposal for a second set of GS/AS applications (Brian Baxley, NASA and Ben Stanley, Helios)

Brief Description

This AP23 deliverable, D4, is a draft proposal for advanced Application Elements and ASAS Functions:

Application Elements are basic ASAS-enabled (operational) capabilities of the subject aircraft that cannot easily be subdivided further into more basic elements.

ASAS Functions are the processes, calculations, and monitoring tasks that must be supplied by the ASAS avionics system to enable application elements.

Application elements and ASAS functions are used to streamline standardization process.

Currently, D4 does not propose a firm set of ''Package 2'' applications. It describes a method to be followed to build an ASAS application: an application encompasses a set of Application Elements and ASAS Functions together with applicable Environment.

When completed, D4 will highlight key applications that will enable all the required elements and functions to be analysed have in the most demanding context, in order to derive ASAS requirements that will be robust on the longer SESAR and NextGen timescales.

Cost benefit analysis should be performed by stakeholders for their own circumstances and operational environment.

Two examples were provided to demonstrate how applications can be constructed using application elements and ASAS functions:

- ASEP M&S
- SSEP in airborne trajectory environment

5.4 NASA ASAS activities (Roberta Vivona, L-3 Communications/NASA)

Brief description

The presentation described specific research undertaken by NASA in support of NextGen and SESAR concepts that include Decision support for Airborne Trajectory Management and Self Separation.

It mapped the ASAS elements and functions outlined in D4 (Conflict Management, Maneuver without Conflict, Compute Conflict-Free User-Preferred Trajectory) to the capabilities in AOP (Autonomous Operations Planner).

Two AOP experimental performances were presented:

- Experiment 1 – Lateral only, Random routes, All autonomous,
- Experiment 2 – Lateral only, Random routes, All autonomous and Pilot Delay and a demonstration of lateral intent based Conflict Resolution.

5.5 iFly: ASAS self separation – airborne perspective (Petr Casek and Rosa Weber, Honeywell)

Brief description

The presentation highlighted the airborne architecture that the iFly project uses to investigate their operational concept. It was observed that the iFly ConOps is consistent with the AP23 concept presented in D3.

The project will provide safety and performance analyses following both TOPAZ and ED78A methodologies.

5.6 D5 – Paper on issues surrounding airborne separation (Jean-Marc Loscos, DSNA)

This talk outlined some of the fundamental issues that are still under investigation with respect to the use of airborne surveillance. The AP23 deliverable, D5, once completed, will provide a list of topics that must be investigated as a priority. It is not the intention to provide solutions to the problems identified but rather to indicate work that is required to provide solutions.

The topics covered in the talk included:

- ATCO – Flight crew roles and responsibilities
- Transition towards ASEP and SSEP
- Transfer of separation responsibility
- Airborne Separation Minima Values
- Regulatory Aspects and Safety Case
- Operational Benefits

D.Session 4: Unmanned aircraft and the issue of autonomous flight

6 Review of the briefings

The aim of this session was to examine Unmanned Aircraft Systems (UAS) operations, technologies and autonomous flight. The chairman reminded the audience that the previous ASAS-TN2 session on UAVs was two years ago in Glasgow where presentations were given by BAE systems (UK), LFV (Sweden) and Thales Aerospace (France). The main conclusions from that September 2006 workshop were:

Military requirements for the use of airspace are now evolving (e.g. UAVs) and these must be taken into account when introducing new ASAS/ADS-B applications.

Increasing numbers of commercial and military UAVs of varying size and capability require access to controlled airspace. ASAS/ADS-B will contribute to achieving this.

Sense and avoid, once approved by the regulator for UAVs, is likely to be used to enhance the safety of manned civil operations.

Project Outcast – UAS detect and avoid - , Michiel Selier (NLR)

Outcast was a National Technology Project (NTP) for the Netherlands Ministry of Defense department of research and development. It ran from April 2004 to 2007. The objective was to find a 'detect and avoid' solution for military UAVs (Medium-Altitude Long-Endurance - MALE) flying peacetime missions in civil airspace from 2010. Focus was on a short term solution based on existing technologies: TCAS/Mode S enhanced with an Electro-Optical Infrared Camera as payload to improve intruder bearing, category and intent information. Thirty three flight tests were performed using the NLR Cessna Citation research aircraft emulating a MALE UAV against intruders such as a Pilatus PC7 (general aviation), Fokker 50 (transport) and F-16 (Fighter). The human pilot and human payload operator who would normally be based on the ground were on-board the Cessna for the purpose of the trials so there were no data-link issues. Detection times before Closest Point of Approach were above 210 seconds for Fokker 50 and 158 seconds for Pilatus PC7 but went as low as 50 seconds for the F-16. TCAS display of bearing information was confirmed to be unsuitable for separation provision. The camera gave more insight into intruder maneuvering but interpretation was not trivial and sometimes led to wrong aircraft being identified. For minimum separations of 0.5 NM horizontally and 500 feet vertically, there were 5 separation violations out of 44 encounters which triggered corresponding TCAS Traffic and Resolution Advisories. Conclusions for working groups on regulations and standards were to:

- Ensure compatibility with TCAS and pilot comfort
- Requirements should support Situational Awareness (not just 'detect')
- Structured safety assessment of Detect & Avoid requirements is needed

UAS flights in civil airspace based on ADS-B, Edward Falkov (GosNIIAS, Moscow)

The approach was that UAS should behave like other airspace users when in civil airspace and must not adversely impact air traffic management. ADS-B proposed for UAS surveillance in civil airspace by ATC staff and airspace users. UAS that cannot afford 3-5 kg payload for ADS-B should operate in segregated airspace. VHF Data Link (VDL) – Mode 2 and VDL - Mode 4 might be considered as data links for command and control of UAS. Russia's industry has developed UAS e.g. take-off weight of 350 kg, 1 turbojet, speed of 700 km/h, height of 9 km. Flight tests were carried out using surveillance based on ADS-B VDL-Mode 4 and control/command based on Controller Pilot Data Link Communication VDL Mode 4 transponders in accordance with ICAO SARPs and Manual, EUROCAE ED108A and ETSI European Norms EN 301.842 and 302.842. The equipment is under certification by both Air Force and Interstate Aviation Committee (civil aviation). The pilot-in-command of the UAV had a display of traffic (current and predicted due to knowing of trajectory change points) fed by ADS-B or TIS-B, status of all onboard systems diagnostics including and the full list of all sent by PiC's commands, their recording and confirming receipts. ATC controller had display of manned and unmanned aircraft. Aim to provide pilot-in-command of UAS with same capability displays as those of civilian flight crew hence requirement for appropriate quality data link. Flight tests confirmed capability of VDL Mode 4 to manage UAS flights in civil airspace. Given data link issues to be solved like frequency allocation, an alternative title to presentation was offered in conclusion: "UAS flights in civil airspace staying within existing arrangements". Additionally the speaker concluded "To solve the problem to provide UAS flights in civil airspaces alternatives for countries where VDL-4 is not accepted yet or forever are suggested: either to continue to ignore VDL-4 and to look for other capabilities (there is no solution for that yet) or to implement VDL-4 ground and airborne parts for managing only UAS flights in civil airspace; coupling of existing airspace facility and VDL-4 ground unit could be done very easily."

7 Concluding remarks: Vinny Capezzuto (FAA) Phil Hogge (ASAS-TN2)

Phil Hogge (ASAS-TN2) started his summary of the Workshop by reminding delegates of the good work that was being done and the continuing need to implement ADS-B, to support the work of AP23 and the RFG, and to ensure that the necessary ASAS validation work was completed within the SESAR work programme.

Ideally, the SESAR and NextGen programmes should be combined, but at the very least there should be a determined effort to formalise working arrangements between them at all levels to achieve common goals, common developments and common models for the safety case for Airborne Separation. In the current economic climate every effort should be made to reap benefits from economies of scale and combined action.

The standardisation of definitions, procedures and aircraft equipment was most important. A very good example of what could be done was demonstrated by the ITP work that has been done in the Pacific and the N. Atlantic where the ICAO SASP was used as the forum for this.

There were many concrete implementation plans for ADS-B (e.g. in Australia, Canada, Europe, Russia and the USA) but what about the developing plans in Japan, the business plans in SE Asia, and the opportunities in China, Latin America and Africa? ADS-B implementations could provide a cost effective substitute for radar in these areas and provide a platform for the future use of ASAS.

We should also concentrate on 'quick wins'. There are the ADS-B opportunities mentioned above, but there were also opportunities to implement the suite of 'early' ASAS applications:- ATSA-VSA; ATSA-SURF; ASPA-S&M; ATSA-ITP. Each of these showed potential benefits, each on its own might not have a viable business case, but together they probably could.

UPS is convinced that this is the case for FDMS; CDAs; CAVs and SAMM. But these are certificated for local use at Louisville. They now need to be migrated elsewhere. As a first stage the FAA is funding fitment to 20 A330s of US Airways to be used at Philadelphia to develop Operational Performance Assessments and Operational Safety Assessments specifically for ATSA-SURF and Conflict Alerting and Indication. UPS want to use this same equipment in Cologne, but this will need the use of an AMAN and, even more crucially the cooperation of several ANSPs.

A particularly noteworthy piece of work has just been completed by AP23. This has produced a common reference of ASAS operational elements and functions that allows the development of future ASAS applications. It includes a portfolio of definitions, a portfolio of ASAS application elements, a portfolio of ASAS functions, all of which provide a set of building blocks to assist the work on system design, validations, safety cases and certification.

8 The ASAS Global Network: Vinny Capezzuto (FAA)

Vinny Capezzuto emphasized the "value" of the ASAS TN 2.5 workshop. He noted that increased awareness of airborne applications have been globally realized through true trials that was clearly presented at this workshop. ITP and FDMS trials have produced avionics, certification knowledge, actual operational results and new issues to surmount. The ASAS community is growing strong with ideas going from "paper napkin designs" to avionics installed and operating in revenue generating aircraft.

Vinny paid tribute to the EC foresight for sponsoring these workshops over the past 5 years and indicated a joint EUROCONTROL / FAA undertaking will ensure the investment to date is fully realized. Under an existing EUROCONTROL / FAA memorandum of cooperation, these entities will continue ASAS Global Network (ASAS-GN) workshops with our first meeting being held in Chicago around the May 2009 timeframe in alignment with the RFG meeting cycle. The intent is to conduct a bi-annual workshop that alternates between the US and Europe. Vinny concluded his remarks with encouragement to the ASAS community for their continued support and engagement.

9 ASAS-TN2 Conclusions and Recommendations

Overall Workshop Conclusions

1. The ASAS-TN workshops have successfully met the expectations of the European Commission, EUROCONTROL and workshop delegates. Knowledge has been shared, standardisation accelerated, implementations supported and ASAS applications embedded in SESAR and NextGen. I view of this the FAA and EUROCONTROL have decided to set up a series of ASAS Global Network workshops alternating between the USA and Europe with the following objective:-

   Through international cooperation, to accelerate the global implementation of ASAS applications throughout the world, in order to increase airspace capacity, safety and flight efficiency.

2. In view of the growing economic pressures facing all areas of the aviation industry there is an increased need to accelerate and coordinate activities with respect to research and validation so as to achieve the maximum economies of scale and to avoid wasting resources. It is also considered necessary to harmonise actions such as the timing of implementations and to improve standardisation. Therefore SESAR and NextGen should formalise working arrangements to achieve:-
   - A set of harmonised goals and timescales;
   - The common development of Data Communications, RNP, ADS-B and ASAS;
   - Common models for the safety cases for Airborne Separation minima;
   - And extend this to other parts of the world.

3. There are several examples that show the advantages of common working. One of these is the work that has been done to develop the criteria and procedures for ITP applications on oceanic routes in the Pacific and North Atlantic. The groups involved, while still working separately, have ensured that they have shared information at all stages and have used the ICAO SASP and the RFG to ensure the early standardisation of:-
   - The definitions;
   - The procedures to be used;
   - The aircraft equipment.

4. Another good example of joint working is the first set of results from Action Plan 23 where they have produced a common reference of ASAS operational elements and functions that allows the development of future ASAS applications. This includes:-
   - A portfolio of definitions;
   - A portfolio of ASAS application elements;
   - A portfolio of ASAS function.

   The purpose of these is to provide a set of building blocks which will assist system design, validation activities, safety cases and certification. The use of these agreed building blocks and continued joint working will prevent unnecessary divergence and differences while still allowing specific implementations in different operating environments.

5. There are many concrete and emerging ADS-B implementation plans that need to be used as the foundation for the future use of ASAS. Good examples of definite implementation programmes exist in Australia, Canada, Europe and the USA (as described in previous and current ASAS-TN reports) and there is good coordination between them. Plans are also being developed in Japan, Russia and SE Asia. It is recommended that;-
   - In other areas of the world, such as in China, Latin America and Africa, similar implementation plans should be developed as quickly as possible and coordinated with other areas in the world;
   - The agreed baseline is to use the DO260A change 3 standard for ADS-B, which will be fitted to all future Airbus aircraft as of 2009, it is necessary to continue to take advantage of the DO260 standard equipment that has already been fitted so as to enable the use of ADS-B-NRA and ITP.

6. SESAR has expressed an interest in 'quick wins'. On a global basis several proposals can be advocated for the early use of ADS-B and ASAS applications:-
   - Implement ADS-B-NRA and ADS-B-RAD where it can be shown to provide an economic advantage. A good example is the introduction by NavCanada of ADS-B-NRA in the Hudson Bay area to reduce separation minima so as to increase airspace capacity and introduce more economical routes;
   - Develop and implement the 'early' ASAS applications (e.g. ATSA-VSA, ATSA-SURF, ASPA-S&M and ATSA-ITP);
   - Identify locations where these could be used so as to promote business cases for equipping aircraft.

7. A number of manufacturers have either certificated 'early' ASAS applications (e.g. ACSS with FDMS, CDA, CAVS and SAMM) or are about to (e.g. Honeywell and ACSS with ITP). The development of ASAS applications and their use should be encouraged so as achieve more 'quick wins' in as many working environments as possible.
8. A good example these quick wins is where UPS, together with ACSS, MITRE and the FAA, have brought to maturity a suite of 'early' ASAS applications (FDMS, CDA, CAVS and SAMM) which are being used at Louisville. However, these are still certified for local use only and need to be migrated to other areas. The FAA is funding fitment of this equipment to 20 Airbus A330s belonging to US Airways for use at Philadelphia so as to develop:-
   - Operational Performance Assessments and;
   - Operational Safety Assessments for:-
   - ATSA-SURF Conflict Alerting and Indication with a view to using it to reduce the risk of runway incursion type incidents. It is known that UPS also want to conduct trials of these applications at Cologne. Regulatory authorities, ANSPs and airports should assist where ever possible to assist in spreading the use of such ASAS applications.

9. Recognising that many countries either have ADS-B implementation plans in progress or are developing such plans, it is recommended that they are encouraged to share information through the new ASAS Global Network so as to:-
   - Stimulate early implementation of ADS-B wherever it can offer an economic advantage;
   - Find opportunities for the early use of the ASAS application that are reaching maturity (e.g. ATSA-VSA, ATSA-SURF, ASPA-S&M and ATS-ITP);
   - Promote global interoperability of ASAS;

- Take advantage of the growing body of information that is rapidly becoming available;
- Positively encourage participants from all areas of the world to join the Global Network.

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