JURG
ASAS/Airline Event

8 October 2007 at the NLR facilities in Amsterdam
organised by the ASAS Thematic Network

Background

The ASAS TN exists to promote understanding of ASAS and thus expedite its implementation. It holds Workshops at six-monthly intervals. Unfortunately, experience has shown that it is difficult for airline operators to attend these Workshops, and so it was decided to hold this one day briefing event in conjunction with a scheduled meeting of the IATA/AEA Joint User Requirements Group.

The purpose of this event was to explain in high level terms what ASAS is, how it could be used in the SESAR 4D trajectory environment, probable timescales for implementation, and to concentrate on potential benefits.

NLR's GRACE simulator was used to allow delegates to fly three ASAS scenarios.

The original agenda is shown in Appendix 1. Unfortunately, problems with flights (two cancelled flights) prevented one of the speakers from attending, and the agenda was attenuated.

Attendees are listed in Appendix 2

Presentations

- Phil Hogge welcomed the attendees and outlined the agenda and the purpose of the event.
- Nico de Gelder welcomed the attendees to NLR and introduced the GRACE simulations.
- Andy Barff and Phil Hogge introduced the SESAR CONOPS, describing the role of ASAS in a Trajectory Management environment.
- Bob Hilb described UPS operations at Louisville and the use of ASAS.
- Christophe Hamel introduced the SafeRoute™ avionics used by UPS, and the ACSS approach to creating business cases for customers wishing to use ASAS.
- Chris Shaw outlined simulations of the use of ASAS in airborne spacing merge and remain behind in TMAs (Eurocontrol/DSNA) and traffic situational awareness for oceanic step climbs (ASSTAR).

The attendees were also able to use GRACE to fly the following simulations:

- Spacing in Terminal Airspace
- In Trail Follow in Oceanic Airspace
- Self Separation in En-Route Airspace

Summaries of the presentations are in Appendix 3.

During and after the meeting the airlines discussed their on-going feasibility studies with regard to the use of ASAS applications in Europe. Brief details of those which are engaged in such studies or may be considering trials in the near future are included in a postscript which can be found in this report immediately after the conclusions.

Conclusions

The main messages emerging from the presentations and discussions are summarised below. The meeting itself made no attempt to draw any specific conclusions but did promote a number of useful one to one discussions.

1. Significant changes are being planned in the way that ATM is carried out: System Wide Information Management (SWIM), Trajectory Management; Business Trajectories (RBT). ASAS is part of these changes, and symbiotic with the broad thrust of all the three changes; it should not be viewed in isolation.
2. In this context, there are many circumstances where ASAS offers some distinct advantage. Very often there are other ways to achieve the same advantage, but the availability of ASAS makes it a good route forward.
3. ASAS is being introduced gradually into operational service because it offers tangible benefits.
4. It is perfectly possible to argue a cost benefit case for ASAS, but it must be done for each operator individually and be based on the way in which that operator will be able to use the system. The investment seems to be typically repaid within about two years.
5. The ASAS demonstrations in the GRACE flight simulator were very powerful in conveying the operations of several airborne surveillance applications.

Postscript

Current and Proposed Airline use of ASAS in Europe

KLM at Amsterdam

KLM will start a feasibility study into the use of ASAS applications at Amsterdam. This is being done in conjunction with Knowledge Development Center (KDC) partners LVNL (the Dutch ANSP) and Amsterdam Schiphol Airport. The intention is to determine whether the Sequencing and Merging (ASAS-S&M) application, together with improved situational awareness from the CDTI both in the air and on the ground (ATSA-VSA and ATSA-SURF), could facilitate Continuous Descent Approaches (CDAs) that would bring environmental benefits in terms of reduced noise and reduced emissions, improve flight efficiency and increase capacity, and also help to optimise airport and terminal operations.

This study starts with an analysis of which scenarios and ASAS applications could be beneficial, potentially followed by operational trials. To support operational trials the airline will consider hosting applicable ASAS functions developed by ACSS on the Boeing Class III Electronic Flight Bags already fitted to their Boeing 777s.

This work will be placed on the Dutch research agenda defined by the KDC in conjunction with the government.

UPS at Cologne

After its Worldport Hub in Louisville, Kentucky, UPS is exploring the feasibility of making its European Hub in Cologne, Germany the second implementation of NextGen CDAs[1] using ASAS. UPS has had preliminary discussions with the DFS toward that goal.

At Louisville UPS is implementing NextGen CDAs (optimal 4D operations) in a series of incremental steps. The third step is to have multiple arrival fixes and dual arrival runways using a 2nd generation SafeRoute Merging and Spacing (M&S) system on their aircraft. At that point UPS will be ready to start a similar incremental process at Cologne.

UPS feels that an initial implementation with the last few arrivals to its night time hub would be possible with only minor changes to AMAN and equipage of M&S on only the UPS aircraft. A RNAV, possibly a RNP, CDA would have to built from multiple directions with multiple merge points. If cross border surveillance integration and metering is not initially practical, then the CDAs may have to begin below cruise altitudes.

For full implementation at Cologne, there would have to be agreements with various ATC service providers to implement metering into Cologne for all aircraft. A schedule would have to be built to the runway and speeds sent to the aircraft as far as 700 kms from Cologne for the initial setup of M&S. In addition, UPS' service partner airlines flying into Cologne would need to be equipped with M&S. A few unequipped aircraft could be handled by the controller by having the arrival manager add additional spacing buffers around those aircraft.

Since many of the aircraft flying into Cologne are already doing ADS-B Out, the SAMM (ATSA-SURF) application of SafeRoute will be fairly effective immediately. To take advantage of CAVS (ATSA-VSA) will require approval for visual approaches.

Further discussions with the DFS will occur in Cologne early next year.

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[1] *Current CDAs will normally result in a capacity loss (for near idle descents to final) or only minimal environmental benefits (for CDAs that still involve vectoring to final). NextGen CDAs (near idle descents to final with no vectoring) require aircraft based M&S (4D operations) and actually increase airport capacity while maximizing operational and environmental benefits.*

SAS at Arlanda

SAS has taken part in the NUP2+ activities, which have started validation of ADS-B applications over VDL4 on the airport surface showing aircraft own position on the CDTI. Equipped vehicles are also shown. Both equipped aircraft and non-equipped aircraft are shown as well. Non-equipped aircraft are shown as TIS-B targets. The applications are:

- RWY incursion CDTI alerts to aircraft, equipped vehicles and tower.
- Route deviation alerts to aircraft and tower if aircraft violate cleared taxi routing (deviation, crossing stop bars etc).
- Taxi route service over datalink with graphic map presentation (dashed-solid lines, stopbars etc.).

The plan was to install 4 aircraft with Electronic Flight Bags (EFBs) and Rockwell Collins VMMR VDL 4 radio. However, due to delays, only one aircraft has been equipped so far, and the authorities have not approved the installation yet. Approval is expected in December 2007.

So far only one trial has been made, on an exemption basis, with positive results re algorithms, procedures etc. The plan now is to validate the ADS-B point to point on one aircraft with RC VMMR only. Pending SAS internal decisions, the four aircraft might be equipped next year with EFB + VDL 4 RC VMMR. If this happens, the intention is to validate further.

In the longer term, SAS hope to contribute further to the development of the use of ADS-B and ASAS to increase flight safety and possibly to maintain capacity in low visibility operations.

Appendix 1

JURG
ASAS/Airline Event

8 October 2007 at the NLR facilities in Amsterdam
organised by the ASAS Thematic Network

Purpose

The purpose of this event is to explain in high level terms what ASAS is, how it could be used in the SESAR 4D trajectory environment, probable timescales for implementation, and to concentrate on potential benefits.

NLR's GRACE simulator will be used to allow delegates to fly three ASAS scenarios.

09.00 – 10.00 GRACE simulator sessions for early volunteers

- 09.00-09.30 (4 people)
- 09.30-10.00 (4 people)

10.00 – 10.30 Coffee and arrival

10.30 – 11.00 Introduction Phil Hogge & Nico de Gelder (NLR)

- Welcome
- Why ASAS?
- What it is
- Overview of use
- Briefing on GRACE Simulations

11.00 – 11.30 4D and ASAS Andy Barff (EEC and ConOps Drafting Group)

- The SESAR 4D environment
- A phased approach (simple applications first)
- ASAS S&M in the TMA
- ASAS Separation in en-route airspace
- ASAS Self Separation in en-route airspace
- ASAS on closely spaced runways

11.30 – 12.00 UPS at Louisville Bob Hilb (UPS)

- Number of a/c fitted
- Overview of equipment fit
- How it is used
- Practical results
- Costs and Benefits

12.00-12.30 Equipment being used by UPS Christophe Hamel (ACSS)

- Applications being used
- Certification and operational approval status
- Safety benefits on airport surface from a map and traffic displays
- Economic benefits from Merging, Spacing and CDAs
- Building individual business cases

12.30 -13.30 Buffet Lunch

Appendix 1

13.30-14.00 Airbus plans for ADS-B and ASAS Stephane Marche (Airbus)

- Status of ADS-B and ASAS
- Strategy for certification and implementation
- Expected benefits

14.00 – 14.30 Summary of Simulations Chris Shaw (EEC)

- CoSpace S&M in TMA
- CRISTAL PARIS results
- Mixed equipage
- MITRE support to UPS
- MFF Gate-to-gate
- Benefits (workload, fuel, R/W capacity)

14.30 – 16.00 GRACE simulator sessions in groups of 4 people (30 mins in control room followed by 30 mins in simulator) – this will allow 12 people to fly the simulator, plus more in the control room.

Scenarios:- Spacing and Merging in TMA
In Trail Follow in oceanic airspace
Self Separation in en-route airspace

During these simulator session, JURG members will have the opportunity to discuss with the presenters issues arising from their presentations.

Additional simulator sessions can also be arranged for the next day to take place during the airline JURG meeting.

16.00 – 17.30 Discussion

End

Appendix 2

List of Attendees

Araceli	Cal	AEA
Edwin	Kleiboer	KLM
Ton	van der Veldt	IATA
Andy	Shand	NATS
Jean-Marc	Bara	AIR FRANCE
Göran	Carlsson	SAS
Jan	Eriksson	SAS
Jürgen	Lauterbach	LH
Pedro	Vicente Azua	EBAA
Val	Eggers	INTEGRA
Mário	Araújo	TAP
Phil	Hogge	ASAS-TN2
Ken	Carpenter	QinetiQ
Bob	Hilb	UPS
Christophe	Hamel	ACSS
Chris	Shaw	EUROCONTROL EEC
Andy	Barff	EUROCONTROL EEC
Bill	Booth	EUROCONTROL EEC
Jos	Nollet	DGTL
Rob	Ruigrok	NLR
Nico	de Gelder	NLR
Martin	Joosse	NLR

Appendix 3

4D Trajectories and ASAS in the SESAR CONOPS
Andy Barff (Eurocontrol) and Phil Hogge (ASAS-TN)

The SESAR ATM environment is based on a number of key elements:- a System Wide Information Management network in which the aircraft is a node in the system; a collaborative process of Network Management; the management of precision 4D Trajectories; and new Separation Modes to support Conflict Management and Separation. A precise 4D trajectory for each flight will be collaboratively agreed prior to departure. Processes are described through which the agreed trajectory will be authorised, revised and updated.

All information required to manage the network is shared within SWIM network so that all parties van make decisions in the light of accurate up-to-date information. The results of their decisions are then shared back into the network so that other parties can in turn make their decisions based on this new information.

Both before and during flight the aim is for the 'owner' of the trajectory to use collaborative processes to modify the trajectory as needed to conform to known constraints. Normally it is the 'owner' (the airspace user) will do this because he knows how best to do this in an efficient manner, but this does no prevent controllers and pilots from making time critical changes when required.

SESAR foresees a series of ATM Capability Levels to assure the linear development of both air and ground ATM components. ATM Capability Level 2 (ATM-2) in 2013 includes ADS-B-IN permitting CDTI based Situational Awareness (ATSA) and Spacing (ASPA) applications. The key SESAR implementation date of 2020 (ATM-3) is characterised by the inclusion of ASAS Separation (ASEP) and 3D VNAV capabilities, whilst ASAS Self-Separation (SSEP) is included in ATM-4 for 2025+.

The use of precision 4D trajectories is expected to have a number of benefits:- primarily by making more efficient use of the available airspace through the reduction of uncertainty; but also by being able to provide controller support tools with precise data. The reduction of uncertainty will reduce the volume of tactical interventions required to ensure separation, and the use of precision data by controller support tools will permit a much higher degree of automation support controllers. Both these aspects will help to reduce controller task-load the main capacity constraint in the ATM system today.

The SESAR concept provides multiple opportunities for ASAS to contribute fully towards the ambitious SESAR performance targets. Primarily ASAS is expected to deliver safety performance in the airport environment, contributing greatly towards the SESAR objective of eliminating collisions on the ground. Airport capacity will benefit from the advantages of ASPA techniques associated with time based spacing, maximising runway throughput, and then, from 2020, ASEP applications may contribute to airport surface and closely spaced parallel runway operations in low visibility.

Airspace capacity will be further enhanced by the reduction of controller task-load per flight permitted by the delegation of separation and other tasks to the flight crew. ASAS techniques will enable aircraft to fly closer to their optimum trajectory therefore enhancing efficiency. Finally SESAR proposes that airspace should not be segregated on the basis of equipage, hence ASAS Self-Separation (SSEP) is proposed in mixed equipage airspace for the timeframe 2025+. It appears essential to grasp the opportunity presented by SESAR to make significant steps towards the widespread implementation of ASAS techniques.

It will also be important to ensure co-ordination with NextGen in the US. Those working in Europe and the US on continental and oceanic airspace applications should collaborate in order to ensure that the result is a simple, homogeneous set of ASAS techniques contributing significantly towards ATM safety and performance.

Appendix 3

UPS Gate-to-Gate Operations at Louisville: Bob Hilb (UPS)

Background

Every concept for modernization of aviation recognizes the importance of adding *predictability* to operations, especially into high density airports. However, in current operations, limits to air traffic surveillance and a lack of tools for predictable delivery of aircraft arrivals to the landing runway reduce capacity and efficiency and make predictable operations difficult and impractical. Technologies now exist that can dramatically increase capacity and efficiency while reducing noise and emissions by delivering aircraft to the landing runway within seconds of a desired time. With these emerging technologies, a real-time schedule that can actually be achieved can be built for each runway of any airport.

The key to predictable operations is to have accurate surveillance of all inbound aircraft and to have the ability to control these aircraft to this real-time schedule. This inbound arrival schedule must look far enough in the future to ensure arrival demand does not exceed runway capacity. This includes aircraft both “pre-block”-out, taxiing, and those close enough to the arrival airport to affect that demand. UPS and the FAA are installing the necessary technology to implement such a system at the Louisville International Airport, Louisville, Kentucky (KSDF). This implementation will lead the way for NAS and world-wide use.

Concept

This system will utilize ADS-B surveillance, a Surface Management System (SMS), and a scheduling and sequencing system. UPS will initially use a MITRE and NASA developed Airline Based En Route Sequencing and Spacing (ABESS) tool to allow total scheduling of all aircraft inbound to KSDF. The ABESS system will build a schedule of all inbound aircraft within a defined time horizon and send airspeeds to-be-flown to each aircraft, via the ACARS data link, to maintain that schedule. The schedule is built to optimize runway utilization and uses information such as arrival fix, parking spot location, wake category and slots for any departing aircraft. Once the aircraft are within ADS-B range of one another, tactical merging and spacing by each aircraft will commence to achieve the fine tuned intervals to the landing runway. Scheduling and controlling aircraft to a specified time in the future is known as 4-dimensional (4D) flight operations.

For those aircraft not yet airborne but within the relevant time horizon, SMS will predict when an aircraft will be ready to pushback and take-off using various airline operations center (AOC) inputs (e.g., crew on board, mechanically ready, percentage loaded, etc.). ADS-B surface surveillance will then detect the actual block-out event and monitor the aircraft’s movement. SMS will know, real-time, the active runway configuration and will be able to accurately predict when the aircraft will be ready for take-off. SMS continuously provides the predicted take-off time to ABESS so it can schedule a slot in the arrival stream and to manage / control take-off time to achieve the slot, as necessary.

SMS will also be able to use the output from ABESS and ADS-B surveillance to predict gate arrival times and will be available to highlight potential gate conflicts. In addition, all the resources needed to expedite the departure of conflicting aircraft and handle the arriving aircraft can be more efficiently managed.

Note: For passenger operations, the AOC will be better prepared to better handle potential misconnects, and other operational issues creating opportunities for greatly enhanced customer service.

UPS will use the ADS-B Merging and Spacing (M&S) application to deliver aircraft to the runway within a few of seconds of schedule. The system is now highly predictable except in the most extreme weather conditions. Because arrival and departure streams can be finely managed, schedules can now be made highly predictable, and efficiency and capacity can be greatly increased. Time based spacing enables the use of dynamic wake turbulence separation based on actual aircraft weights and wind conditions, another factor in increasing capacity.

Using the ABESS system and ADS-B enables the use of Continuous Descent Arrivals (CDA); users will be able to reduce block times, fuel burn, emissions, and noise while increasing capacity, payloads, safety, and management oversight. Additional benefits include decreases in service personnel and infrastructure and lower crew and maintenance costs. From an air traffic service provider perspective, these capabilities can dramatically decrease infrastructure costs and increase air traffic management productivity which will ultimately result in much lower costs.

Status of Required Capabilities for KSDF Implementation

ADS-B "out" will be operational on all UPS aircraft by the end of 2007. In conjunction with the FAA's installation of ADS-B ground stations, the appropriate UPS airports should have all the necessary ground infrastructure by late 2009. UPS is also installing an updated ADS-B CDTI system with Merging and Spacing (M&S) capability in its Boeing 757, 767, and 747-400 fleets. These installations will be complete by early of 2009. Current UPS planning calls for their Airbus A-300 and Boeing MD-11 fleets to be completed by the fall of 2009.

UPS has submitted the first four RNAV/CDA arrival procedures to the FAA, for processing in the 18-step required FAA approval process. UPS received initial operational approval for these arrivals in August 2007. UPS has implemented CDAs for its last 10 or so late-night arrivals from the west into KSDF. Initially, in-trail spacing will be accomplished during en route cruise by controllers placing each aircraft approximately 20 miles in-trail with each other. When the ABESS system is available in early 2008, it will serve to "pre-condition" these spacings, thus further reducing controller workload.

The ABESS tool had its first "live" test in May, 2006. The integration of ADS-B surveillance will be tested in late 2007. It is expected that the accuracy of ABESS will increase significantly when the enhanced surveillance capability and intent data from ADS-B becomes widely available with the FAA's deployment of ground stations. A connection to the SMS to take advantage of predicted take-off times for pre-departure and taxiing aircraft destined for KSDF will then be needed.

The UPS SMS system became operational in May, 2006. It has a basic departure prediction function for all UPS aircraft departing KSDF. It can be upgraded to provide predication capability at all UPS-served airports with aircraft destined for KSDF. More advanced algorithms for departure prediction would enhance its accuracy

Additional Benefits

Additional benefits that are also enabled with the gate-to-gate concept are:

- departure sequence optimization by SMS, based on the aircraft's parking location, assigned runway, runway queues, wake vortex category, and planned initial departure fix
- a very significant reduction in infrastructure costs by allowing the phase-out and removal of secondary radar and multilateration because of ADS-B equipage
- extension of visual operations into marginal VFR conditions -- possibly even IMC -- with the CDTI Assisted Visual Separation (CAVS) application
- the ability to move to dynamic, time-based wake turbulence separation to further increase capacity

Status of Required Capabilities for NAS Wide Implementation

The FAA has awarded a contract to deploy an ADS-B ground infrastructure and plans a mandate ADS-B "Out" equipage for all aircraft flying in most airspace. Equipage of ADS-B "In" will be benefits driven.

Scheduling to a runway using a CDA would require all aircraft to be 4D capable. For any airport with multiple arrival runways when equipage levels reach a specified level, one or more runways could be designated as a CDA/4D arrival runway. Typically, at major airline hubs, if the dominant airline equips, then gate-to-gate operations can begin.

Airlines that equip with M&S and install SMS systems can have a significant competitive advantage in fuel savings, reduced flight times, schedule reliability, and customer service. Additionally, participating airlines will gain a benefit at airports where they are not the dominant player. As the percentage of ADS-B "Out" increases, the frequency that M&S aircraft will have another aircraft to follow increases, thus decreasing their overall distance flown at fuel inefficient low altitudes in the terminal area.

Ultimately, to support a wider implementation, ABESS will need to move from just an AOC function to an Air Traffic Management function. NASA and the FAA have started the process of updating the Center-TRACON Automation System (CTAS) Traffic Management Advisor (TMA) which will soon be installed at all FAA Centers.

The System Wide Information Management (SWIM) system would be an excellent choice to provide ADS-B surveillance data to ABESS and SMS, and to allow ABESS and SMS to share data. To further expand SMS potential, SMS should also be deployed in Air Traffic Control Towers to produce maximum benefit.

As mentioned previously, the functionality of ABESS and SMS will also need to be upgraded. However, both will provide benefits to the FAA and users before CDA/4D operations become widespread. ABESS can be used to schedule aircraft to an arrival fix reducing vectoring, holding, thus reducing controller workload. SMS can improve departure operations and enhance airline operations through visibility of ground operations. Notably, both systems improve as ADS-B deployment increases.

Summary

All the prerequisite technologies needed to move aviation from its current by-and-large, open-loop system to a closed-loop system, with all the inherent benefits, is now available.

The concepts have been discussed for years and the technology is now ready for implementation.

KSDF and UPS offer a unique location to evaluate these concepts along with a path to begin step-wise deployment.

Aviation does not have to wait 20 years to gain the majority of benefits; they are available in the near term!

Appendix 3

SafeRoute™ Description and Capabilities: Christophe Hamel (ACSS)

SafeRoute™ is a Portfolio of in cockpit surveillance applications utilizing Automatic Dependent Surveillance – Broadcast In (ADS-B IN), Traffic Information Service – Broadcast (TIS-B) and Cockpit Display of Traffic Information (CDTI) technology to significantly improve Safety and Efficiency of flight operations. As a result it also helps address the environmental issues.

SafeRoute™ airborne surveillance applications include:

- Surface Area Movement Management (SAMM)

  Aids in the prevention of runway incursions and can be used for asset management purposes bringing efficiency benefits

- CDTI Assisted Visual Separation (CAVS)

  Is an airborne separation application providing flight crews with an enhanced means of ensuring separation from designated traffic rather than relying solely on out-the-window tracking when visual/marginal separation procedures are in use.

- Enhanced Traffic Situational Awareness during Flight Operations

  Provides, during flight operations, flight crews with a display of nearby traffic information (aircraft identifier, position, altitude, velocity and orientation) relative to own-ship data. Supplements the flight crew normal out-the-window visual scan, as well as verbal traffic information provided either by controllers or other flight crews to better understand the traffic situation

- Merging and Spacing (M&S)

  Improves the predictability and stability in the flow of traffic for optimum use of an airport runway. Eliminates aircraft vectoring at low altitudes. It also enables the use of CDA (Constant Descent Approaches) in dense traffic.

SafeRoute™ applications are functionally equivalent to the airborne surveillance applications defined by a joint RTCA and EUROCAE group called the Requirements Focus Group (RFG). The RFG is an international group consisting of members from the EUROCAE, EUROCONTROL, RTCA, FAA and other interested parties that develop operational concepts and minimum safety and performance requirements for initial Airborne Surveillance (AS) applications.
Within the industry, ACSS has actively promoted and developed the required aircraft surveillance infrastructure that enables further deployment of ADS-B applications. In fact, ACSS has developed and certified the first ever ADS-B IN military and civil applications that are expected to bring direct and significant benefits to Users.

Having achieved this technological leap, ACSS expects to accelerate the deployment of ADS-B based applications in various regions of the world. ACSS is notably promoting pocket trials in Europe as well as international standardization activities.

ACSS has also been selected by ITT as part of the contract award for ADS-B services deployment in the NAS to provide expertise for the airborne side. Finally, ACSS is in the process of supplying major OEM's and Users with the SafeRoute technology in the Air Transport, Regional, Business and Military markets.

For More details please contact
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Appendix 3

Summary of Simulations: Chris Shaw (Eurocontrol EEC)

Since the invention of ADS-B in the 1980s there have been thousands of man years of ASAS research on both sides of the Atlantic. In 2007 nearly three quarters of flights in Europe are ADS-B equipped and although not certified for use yet the US and Europe have identified over eighty potential ASAS applications.

Several of these have been investigated for feasibility and benefits. Two applications with simulation results indicating short term benefits are

(1) airborne spacing merge and remain behind, and

(2) airborne traffic situational awareness for oceanic steps climbs. The following are summaries of results from some European projects:

Airborne spacing merge and remain behind instructions could enable controllers to ask an aircraft to achieve a desired spacing behind a target aircraft on a converging route by a given waypoint (merge behind), and if necessary maintain the spacing beyond the waypoint along the same route (remain behind).

Real-time simulations involving controllers and pilots from several different countries in Europe and US over the last decade show this application to be feasible and beneficial to both air navigation service provider and airlines.

The variability in aircraft spacing at the final approach fix is significantly reduced allowing a couple of movements an hour more at peak times in busy airports like Paris Orly.
Lateral tracks are more orderly with significantly less dispersion and a single point of convergence (Eurocontrol CoSpace 1999-2006). Simulations at Paris Charles de Gaulle indicate significant average gains in time per aircraft for equipage rates above 70% (Eurocontrol/DSNA).

Unlike today, this ASAS application assumes aircraft are merged at a single common point (point merging). Simulations indicate that point merging as an intermediate enabling step before ASAS could already start to give potential benefits:

(a) lateral navigation remains engaged

(b) heading vectors replaced by a single direct to instruction

(c) significant reduction in radio occupancy

(d) distance to go is fixed early enabling continuous descent profiles from point of issuing ‘direct to waypoint’ i.e. significant reductions in fuel consumption (Eurocontrol point merge studies 2005-7).

Airborne traffic situational awareness oceanic step climbs. Today aircraft fly parallel tracks over the North Atlantic with a typical minimum separation of 10 minutes. Most of the area is outside the range of VHF radio communication and radar surveillance so ATC issue strategic clearances, and surveillance is by pilots reporting position over short wave radio every half an hour or so.

Strategic clearances limit the flexibility of aircraft for achieving optimum flight profiles with an average of 0.2 step climbs per flight recorded. Simulations of the North Atlantic track system in both directions between 35 and 40,000 feet indicate the number of step climbs could be 2 or more if flight crew of climbing aircraft had a cockpit display of traffic information.

Cost benefit analysis per aircraft indicates a strong business case with cost of equipment of the order of 50,000 euros (retro or forward fit) being recouped within the first year and maintenance costs less than 2,000 euros per year (retro or forward fit). (ASSTAR European Commission consortium 2005-2007)