NETALERT NEWSLETTER

It's time for action

ENSURING THE EFFECTIVENESS OF SAFETY NETS

June 2009

Terrain alert

check your altitude immediately

The crash of an A320 at Mont Saint-Odile in 1992 led to a recommendation by the Bureau d'Enquêtes et d'Analyses (BEA), the French government agency responsible for technical investigations of civil aviation accidents and incidents, for the "the design and implementation by the air traffic services of a ground-based system for detection of aircraft in dangerous proximity to the terrain". The recommendation was acted upon and led directly to the deployment of Minimum Safe Altitude Warning (MSAW) in French TMAs. This article looks at the deployment of MSAW by DSNA, drawing on lessons learned, and with particular emphasis on how each system is tuned and deployed.

WELCOME

This is a 'bumper' edition of NET*ALERT*, the safety nets newsletter for people working in airlines, air traffic control centres, and the organisations that support them.

In addition to our lead article, UK NATS provides up-to-date information on their 'CAIT' tool which alerts controllers when aircraft unintentionally enter controlled airspace. We also profile newly released (or updated) tools, specifications and guidance material from EUROCONTROL, developed in close association with all our Stakeholders and designed to enhance safety and the effectiveness of safety nets.

The Safety Nets Guide and companion CD distributed with this newsletter contains a wealth of information and documentation on STCA, MSAW, APM and APW as well as the new Awareness Package (profiled in an earlier edition of NET*ALERT*). Please contact us if you would like to receive further copies.

INSIDE

MSAW – a quick recap

Controlled Flight Into Terrain (CFIT) describes an accident in which the aircraft, under the flight crew's control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely flight crew awareness to prevent the event. CFIT accounts for approximately 50% of fatal aircraft accidents worldwide.

MSAW is designed to prevent CFITs by using the aircraft speed, horizontal position and vertical position to extrapolate its trajectory and anticipate a potential conflict with terrain. If at any point along the trajectory the height of the aircraft above the terrain becomes less than a safety margin, MSAW generates an alert. The DSNA MSAW makes two predictions in the vertical plane for eligible tracks, either of which can generate an alert:

- A linear extrapolation of the aircraft trajectory which gives good alerting performance for high rates of descent.
- A prediction with a 'level-off' assumption which is good for reducing the number of nuisance alerts for aircraft with low rates of descent who level off above the terrain.

Warning time prediction – the reaction loop

For MSAW to be effective, it must provide alerts in sufficient time for any potential conflict to be resolved. The French MSAW system has a minimum warning time of 30 seconds plus a track update of 4 to 8 seconds. This takes account of the factors below and assumes the controller makes a reflex action in the event of an MSAW alert:

- Controller reaction: 3 seconds
- Transmission of alert: 9 seconds
- Pilot reaction time: 3 seconds
- Aircraft reaction time: 15 seconds
- RDPS update period: 4 or 8 seconds

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Terrain alert
continued

MSAW deployment by DSNA

In French airspace MSAW alerts take place for flights under flight information services and are only transmitted to aircraft flying under Instrument Flight Rules (IFR) in contact with ATC and with a valid Mode A/C code. Exceptions do exist, such as when an IFR flight is circling to land or making a visual approach in daylight.

Sylvestre De Oliveira Costa of DSNA explains that the DSNA MSAW includes an integrated Approach Path Monitor (APM): *"A classification of CFITs in 1991 found that 87% of CFITs occurred during approach or take-off, with around 50% taking place on final approach or landing. Therefore, from the very beginning, it was decided that the DSNA MSAW would have an integrated APM. The first MSAW was installed at Lyon in 1997 and to date it is operational at 12 airports. Another system will soon be operational and implementation activities are planned for a further four systems during 2009/2010. Installation is very effort intensive, with each implementation typically taking more than two years".* Each step in the deployment is summarised in the table and expanded upon in the following sections.

Step	Purpose
Initial tuning	Prepare MSAW for off-line on-site testing by setting up initial parameters, inhibiting alerts for normal landings and establishing inhibition areas.
Out-of-room evaluation	Live traffic fed into an offline MSAW to refine the initial parameters to achieve an acceptable level of undesirable alerts.
In-room evaluation	MSAW alerts broadcast to the controller but not relayed to the pilot. Successful evaluation leads to operational use.

Initial tuning

This stage establishes an initial set of MSAW parameters (for example prediction times and safety margins) for on-site testing. For the site in question, a sufficient sample of actual aircraft tracks on all active runways is recorded - typically 1 week for major airports (for example Orly) and up to 2 months for airports with low traffic density (for example Biarritz).

The collected data is processed by an MSAW test-bed (fast-time simulation) to establish a default configuration. Such a configuration causes an enormous number of undesirable MSAW alerts relating to aircraft carrying out normal operations - not only for all aircraft landing at the airport where the MSAW is to be installed, but also other airports within the TMA boundary. The number of undesirable alerts can be significantly reduced by:

- Establishing inhibition areas and inhibiting alerts caused by aircraft landing in normal operating conditions (see below for more information).
- Optimising parameters to maximise the warning time given by MSAW without increasing the number of undesirable alerts.

Out-of-room evaluation

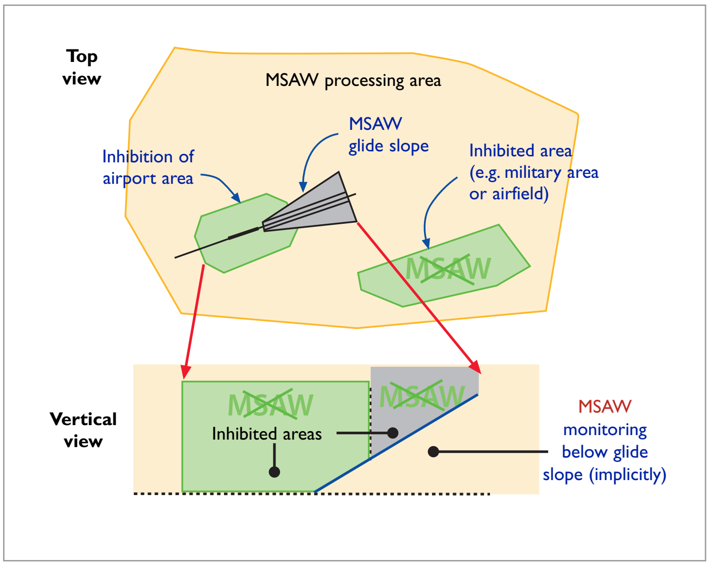
Once the initial parameters have been set, the MSAW is installed on-site for testing outside of the control room. To validate and further refine the initial parameters live traffic is fed through the MSAW, but not broadcast to the controller. Adjustments are made to capture the specifics of the site's operating configurations, something that cannot be achieved solely using the data collected for the initial tuning phase.

In-room evaluation

When the rate of undesirable alerts reaches the threshold of one alert per day, the parameters are considered to be satisfactory and the operational on-site testing can begin. In this phase MSAW alerts are broadcast to the controller but not relayed to the pilot as the system is not yet certified for operational use. At the end of the operational test period, the MSAW is approved and an Aeronautical Information Circular (AIC) is published, which stipulates that the system has been put into service at the airport.

Removing undesirable alerts through inhibition areas

MSAW has a defined processing area (e.g. the TMA horizontal boundaries) inside which alerts will be generated, and outside of which they are filtered. There may also be volumes within the processing area where alerts should not occur. Here, inhibited areas (polygons with a minimum and maximum altitude) are applied.



MSAW inhibited areas

Examples include:

- Parts of the TMA such as military areas or nearby airfields in which aircraft are not under the controller's responsibility.
- Glide slopes and areas surrounding the airport surface.

MSAW alerts clearly need to be suppressed for aircraft landing in normal operating conditions. A glide slope monitored by MSAW, above which alerts are inhibited, is determined with respect to the published glide slope in the following steps:

- **Step 1:** Recorded actual arrival tracks are played through the MSAW test-bed. No inhibition areas are applied around the published glide slope at this stage, causing all arriving aircraft to trigger MSAW alerts.

- **Step 2**: An 'MSAW glide slope' is established above which all unjustified alerts are inhibited. The glide slope typically starts a few tenths of a mile from the runway threshold and follows the published glide slope but with a marginally lower gradient (see diagram). This not only accounts for aircraft which may be below, but within the tolerance limits, of the published glide slope, but also the final segments of the approach path that are too close to the ground to transmit a timely alert.
- **Step 3**: Recorded arrival tracks are again played through the MSAW test-bed, but this time all alerts above the MSAW glide slope are inhibited. Where MSAW alerts still occur, it is determined whether they are valid or are alerts that should be inhibited. In the latter case, further refinements to the MSAW glide slope are made and checked using the MSAW test-bed.

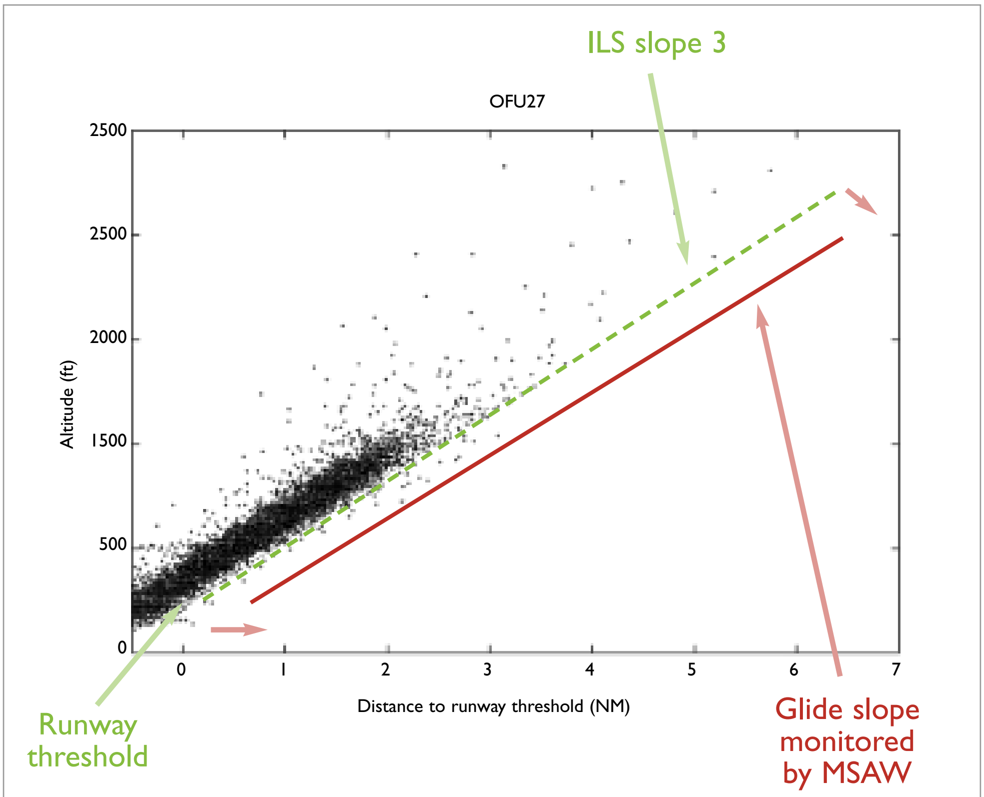
When the DSNA system first came into operation - only precision approaches (for example ILS approaches) were monitored by the MSAW glide slope. However, as Sylvestre De Oliveira Costa explains, this is not the case today: *"In some cases, the MSAW glide slope defined for precision approaches can also be used for non-precision approaches. In other cases, different MSAW glide slopes are needed for each type of approach. In the latter case, the shift supervisor is able to switch from one MSAW configuration to another according to the approach procedure being flown."*

Continuous improvement

The deployment of several MSAWs over time has allowed DSNA to implement numerous improvements to their system. These include:

- Shape of inhibition areas: to best meet local requirements, any shape of inhibition area can be specified.
- Glide slopes: specifying different gradient glide slopes for different runway directions.
- Multiple configurations: for a given airport, multiple MSAW configurations (processing area, inhibition areas, glide slopes etc) can be specified to account for different procedures and modes of operation. The desired configuration is activated by the shift supervisor using a touch screen in the control tower.
- Filtering criteria within inhibition areas: criteria can be specified which need to be fulfilled before an alert is suppressed inside an inhibition area (for example Mode A code and the departure/destination airfield).
- 'Reduced warning time' areas: short duration, undesirable, alerts have been experienced in some instances (for example where aircraft level off before interception of the glide slope). As a mitigation, it is possible to specify areas where MSAW applies a shorter warning time.
- Correlation with flight plans: if available, MSAW uses flight plan information, such as arrival and departure information, to make a more accurate alert calculation. For example, if a flight penetrates the inhibition volume of an airport, but its flight plan shows that it has not taken-off from or will not land at that airport, MSAW alerts for this aircraft will not be suppressed.
- Manual inhibition: ATCO's are able to manually inhibit MSAW alerts for individual flights. Manual inhibition is used when the controller clears a pilot to fly a visual approach for landing. It is also used for VFR flights which are considered as IFR flights by MSAW due to the allocation of a Mode A code by a border control centre.

Setting up an MSAW glide slope



Conclusion

Sylvestre De Oliveira Costa summarises: *"While the implementation of MSAW by DSNA has been very effort intensive, our hard work has paid off. The system is well accepted by controllers as it has helped them manage some critical situations. DSNA's experience has meant that we've continually managed to improve the system to both meet local needs and reduce the number of undesirable alerts".*

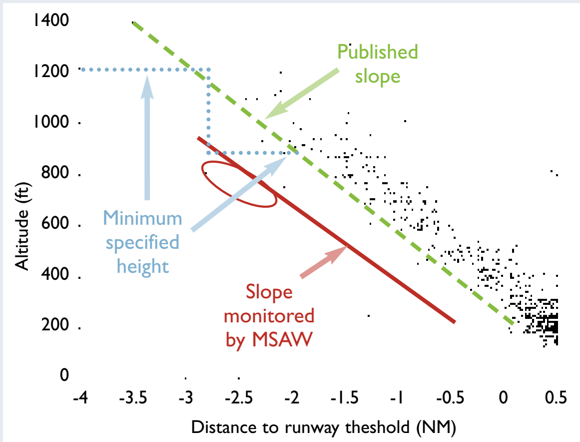
This article has been produced with the kind support of DSNA.
Further information on the DSNA MSAW system can be found in the May 2004 edition of Revue Technique.
http://www.dsna-dti.aviation-civile.gouv.fr/actualites/revuesgb/revue66gb/66pgarticle1gb/fr66art1gb.html

MSAW

Preventing accidents

It has been proven on many occasions that MSAW/APM can help to prevent incidents – either because a MSAW/APM has been installed and has provided a timely alert, or because subsequent investigations have shown that MSAW/APM would have provided a warning before the incident took place. Below we look at three such incidents.

Orly 1997: The pilot of an MD-83 inadvertently descended below the published glide slope. The pilot corrected the mistake and initiated a go-around at 67 feet. A replay of the event using an MSAW/APM test-bed revealed that an alert would have been generated 32 seconds before the aircraft pulled up. The installation of MSAW at Orly was decided upon soon after the incident.

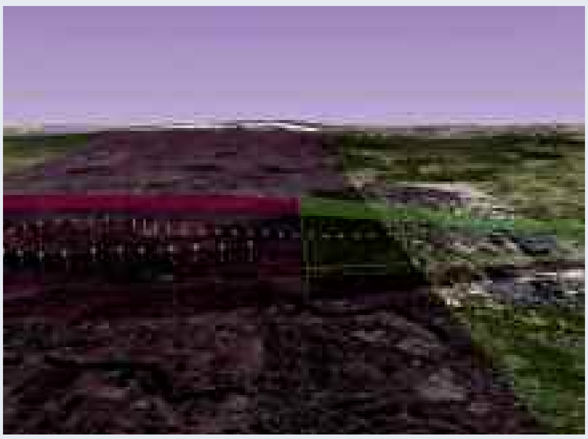


Recreation of the Orly incident using an MSAW/APM test-bed

Dublin 2007: Due to maintenance on the main runway, an MD-83 was cleared for a non-precision approach to the secondary runway. The flight crew misidentified the lights on the top of a nearby building with the runway approach lighting system and began to deviate left of the approach course. The aircraft continued to descend below the Minimum Descent Altitude (MDA) without proper visual identification of the runway in use. At 1.3 miles from touchdown the radar controller observed an MSAW warning on his radar screen and advised the tower controller of the deviation in order to initiate a go-around. In this instance the tower controller had already instructed the pilot to go-round. The go-around was initiated 520 meters away from the building and 200 feet above it.

View of the RWY 34 approach at 5.5 NM to touchdown (circled right) and lights on top of a nearby building (circled left)

Yerevan 2008: A large passenger jet reached the final approach fix 1,275 feet below the planned altitude for a 3 degree glide slope. The descent continued and a climb was only initiated at approximately 6.5NM from the runway threshold when the aircraft was 865 feet above the airport elevation. A recreation of the event by EUROCONTROL demonstrated that if an APM had been implemented, the aircraft would have penetrated the APM surface 7.5NM from the runway threshold at a height of 3,844 feet. The Armenian ANSP, ARMATSA, is investigating either modifying the existing MSAW which is not currently configured for approach or implementing a separate APM system.



EUROCONTROL recreation of the event assuming APM was implemented. Key: Green plane - nominal glide slope, red plane - recommended protection floor, green dots - successive aircraft positions (radar plots), white vertical lines - aircraft height above the protection floor (no line represents the aircraft being below the protection floor).

APW in action:

NATS Controlled Airspace Infringement Tool (CAIT)

Area Proximity Warning (APW) is a ground-based safety net which warns the controller about the unauthorised penetration of protected airspace (such as controlled airspace or restricted areas). In this article we look at a real-life application of APW, the NATS Controlled Airspace Infringement Tool (CAIT) which was deployed in London terminal control airspace in Spring 2008.

Alistair Sloan, NATS safety nets manager, explains the rationale for implementing CAIT. *"All pilots must obtain ATC clearance to enter controlled airspace (CAS), however evidence gathered by NATS shows that pilots have entered controlled airspace without clearances. This can pose a risk to commercial aircraft, particularly in a high-density traffic environment such as London terminal control".*

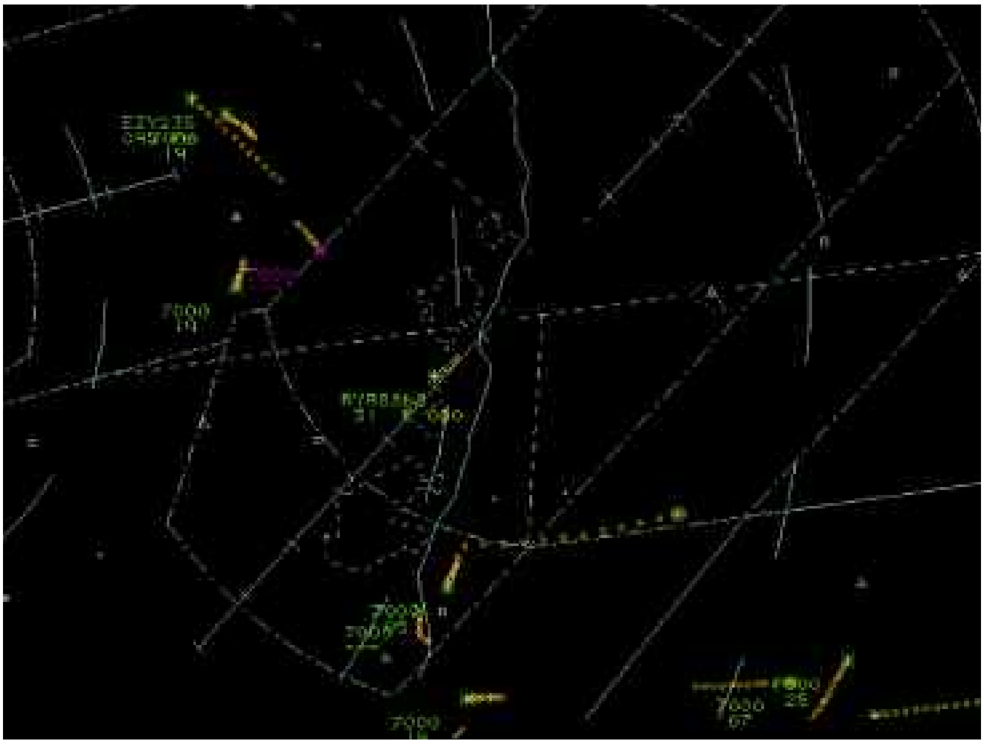
CAIT is designed to draw the controller's attention to those aircraft, which may have unintentionally penetrated controlled airspace.

CAIT identifies the infringing aircraft and turns its trace from green to magenta as it crosses the lateral or vertical boundary of controlled airspace (see image below). It was designed in close cooperation with operational controllers from London terminal control. This not only ensured acceptance of the tool and HMI, but also that CAIT did not alter controllers' responsibilities for avoiding and reporting controlled airspace infringements.

Although CAIT does not prevent the unauthorised penetration of controlled airspace, it quickly brings the infringement to the attention of the controller, allowing timely remedial action to be taken if required. Therefore, the tool enhances safety by improving the controller's awareness, giving him more time to take appropriate action to avoid a potential loss of separation, thus minimising the risk posed by the infringement.

CAIT relies upon the unknown aircraft carrying a transponder with or without altitude reporting to provide an alert. CAIT will check its position relative to the boundaries and base altitude of controlled airspace. If an aircraft with a Mode A code also has Mode C, then the tool will check its vertical position relative to any adapted airspace in control and terminal manoeuvring areas (CTA and TMA). If the aircraft has no Mode C then the tool will only check its position relative to controlled airspace that exists from the ground level upwards (i.e. Control zones). Moreover, if the unknown aircraft is equipped with a Mode S transponder then CAIT can provide the controller with additional information on the intruder to both resolve the incident and assist in post-incident analysis.

NATS CAIT HMI



Alistair Sloan concludes: *"CAIT is a relatively simple tool, which has been easy to implement and requires minimal controller training. Controllers are aware that they cannot totally rely on CAIT to identify a controlled airspace infringement and that they still need to be vigilant. However, deployment in the UK has demonstrated that this tool strengthens the safe delivery of the Air Traffic Service within controlled airspace. Overall, operational experience to date indicates that the performance of the tool is exceeding expectations".*

This article has been produced with kind permission from NATS referencing an article by Bill Casey and Adrian Price for the Autumn/Winter (2008/09) edition of the Guild of Air Traffic Control Officers (GATCO) Transmit publication.

Low cost and ready now

Data monitoring tool proves its worth

Gathering, analysing and exchanging data on aviation incidents or events forms a valuable part of an ATM safety management system. Given the large volume of data involved, an automatic data monitoring tool is essential. One such tool is the ATM Safety Monitoring Tool (ASMT) which is available on a low-cost laptop from EUROCONTROL.

What the tool does

ASMT provides automatic monitoring and recording of safety-related events using operational data and contains a powerful database supporting data gathering, consolidation and off-line analysis.

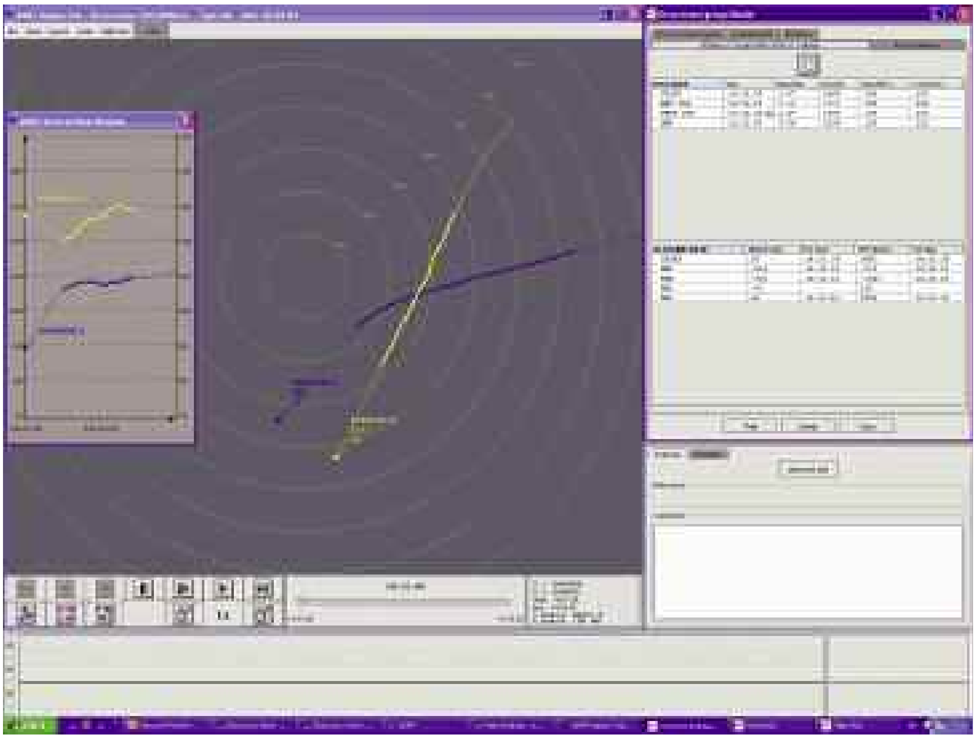
ASMT in practice

ASMT was recently used successfully to process recorded Mode S radar data for TCAS advisories. A sample 24-hour recording from 9 radars was processed and all TCAS RA downlink messages were extracted in one and a half hours and inserted into the database for analysis.

ASMT monitors and collects radar track data, flight plans and system alerts messages, gathering all relevant information for each occurrence and storing this in the database for further analysis by operational experts. It can either be connected to a live radar feed, or can process recorded radar data offline. ASMT can also combine data from different sources and locations.

The current version includes six detection modules which automatically record:

- Proximity events - infringements of minimum separations between aircraft;
- Short Term Conflict Alerts;
- Area Proximity Warning alerts for predicted infringement of segregated airspace;
- Mode S downlink messages of ACAS Resolution Advisory;
- Altitude Deviation - detection of aircraft which do not comply with the cleared flight level;
- Airspace Penetration - detection of unauthorised penetrations of a segregated airspace.



ASMT ACAS RA Detection Module Replay

The key details of all recorded safety events (e.g. time of event, altitude, flight details etc) can be displayed in a list and replayed for further examination.

How can it be used?

The primary objective of ASMT is to enhance safety and in particular safety monitoring. ASMT helps you collect and analyse a wider set of occurrences than would be possible through human reporting. It provides uniform, integral data collection very efficiently. The analysis focuses on structural problems (airspace/route structure, hotspots, procedures, ATM system performance).

ASMT cannot and should not replace human reporting but it is a valuable tool for enhancing safety knowledge locally and at a pan-European level. It can also be used for training and in simulations and studies. It allows safety analysis findings to be exchanged within the ATM community – occurrences can be made anonymous for outcome sharing.

The tool can help operations staff to determine causes of individual safety occurrences, and aid development of local procedures, airspace design and techniques by identifying potential risks due, for example, to changing traffic patterns.

It can also be used for training and in simulations such as real-time simulations and studies. It allows safety analysis findings to be exchanged within the ATM community – occurrences can be made anonymous for outcome sharing. Since the benefits of participation and data sharing are community wide, EUROCONTROL can offer low cost licences for ANSPs who join the ASMT user group.

For more information, and to organise a demonstration, contact Frederic Lieutaud at Frederic.LIEUTAUD@eurocontrol.int

Major milestone achieved

Final specifications and guidance material released

A major milestone has been achieved in ongoing efforts to ensure the effectiveness of ground-based safety nets with the release of anticipated specifications and supporting guidance material relating to Minimum Safe Altitude Warning (MSAW), Approach Path Monitor (APM) and Area Proximity Warning (APW). The previously released materials for Short Term Conflict Alert (STCA) have also been updated.

"This is the culmination of 4 years' work, involving some 25 stakeholders and has been a true 'community effort'. The SPIN (Safety nets Performance Improvement Network) Sub-Group pioneered the development process in its work on STCA and has successfully applied it to the remaining ground-based safety nets." said SPIN chairman Stan Drozdowski.

"We wish to take this opportunity to thank everyone who has contributed. Like STCA the specifications are now subject to ENPRM, the EUROCONTROL Notice of Proposed Rule Making, which should be complete by the end of this year. The materials are intended to facilitate and support implementation of MSAW, APM and APW, where applicable, by December 2013."

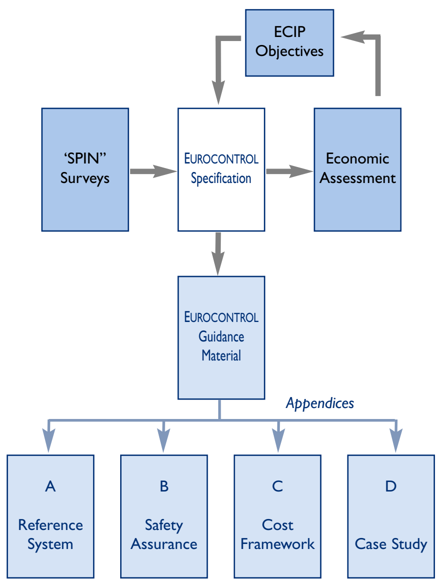
For ease of access all the materials, along with a number of other published documents, have been packaged together on one CD, and the Safety Nets team has developed an accompanying guide explaining what is on the CD and the background to its development.

In the Guide

The Guide is a 20 page document which accompanies the CD and provides highlights of the CD contents, explanations of terms and acronyms. It explains briefly the need for safety nets, introduces the individual safety nets covered by the specifications as well as the type of mandates in place. It tells the story of why specifications have been developed, and the issues they are seeking to address. The Guide also explains the need for clear policies, organisational focus and planning with regard to safety nets – as well as providing an update on how safety nets fit into the SESAR programme.

On the CD

The CD sits at the back of the Guide and contains the complete document hierarchy (specifications, case studies, safety cases, economic assessments and more) for each safety net (STCA, APW, MSAW and APM). It also includes selected presentations, articles and policy documents as well as useful web resources. Finally, the CD contains the Awareness Package – a newly launched e-learning tool about safety nets and how to ensure their effectiveness. It can be used for individual learning and to support classroom teaching.



Documentation packages for each ground-based safety net. All contained on the CD.

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Major milestone achieved

continued

IANS welcomes Safety Nets Awareness Package

EUROCONTROL's training institute at Luxembourg has welcomed the Safety Nets Awareness Package and made it available to the aviation community via its e-learning zone **(http://elearning.eurocontrol.int/)**.

The Package also features as recommended background preparation for the 5-day course: "**Understanding the Data Processing Chain in ATM" taking place 7-11 September and 2-6 November 2009.** The course provides a basic foundation knowledge and understanding of the principles used in ATM data processing (FDPS, SDPS and added value safety net functions like STCA, or the controller support tool MTCD) and an overview of their use in ATM operations. The course describes the core functions associated with flight plan processing and the advanced functions offered by a state-of-the-art flight data processing system. As for the Surveillance Data Processing, besides the classical surveillance techniques there is a strong emphasis on the most recent techniques like Mode S, ADS-B and Multilateration.

Says Svetlana Ceca Bunjevac, ATM Training Expert at IANS: *"This package is great background reading for many students, including those following "Ab Initio Training for ATC". It is not a mandatory part of their studies but is highly relevant and is presented in an accessible way. We are also looking at the options for extending its use to other courses or classroom situations here at the Institute".*

The Safety Nets team will keep you posted on other feedback and how the material is being used for classroom training in future issues of NET*ALERT*.

WORKSHOP INVITATION

DIARY DATE

RA Downlink: *Finding Common Ground*

27 October, Berlin

Notification of ACAS II Resolution Advisories (RA) to controllers as they occur has been contemplated for many years. In Europe the Überlingen mid-air collision gave additional impetus for a number of organisations to implement what ususally is referred to as RA Downlink. With the increasing operational use of Mode S, at least one enabling technology is readily available in a number of States. To avoid proliferation of concepts of use, it is now urgently needed to find common ground for use of RA Downlink in Europe.

- **ACAS II demystified:** How ACAS II works and how it behaves in European airspace
- **ACAS II encounters of the first, second and third kind:** When and how ACAS might interact with ATC
- **RA Downlink:** Magic bullet or yet another complication?
- **Key elements of future-proof RA Downlink:** The do's and don'ts to avoid new issues
- **Further steps:** What is now needed at local, European and international level?

Invited: *Operational, technical, safety, procedures, regulation experts and managers involved in planning or implementing RA Downlink as well as representatives of Stakeholder groups that may be impacted by RA Downlink*

Registration: *Announcement and link to registration page will be on the safety nets website (www.eurocontrol.int/safety-nets) by the end of June.*

In Brief

- **Spreading awareness:** the Safety Nets team has been partnering with a number of ANSPs to share knowledge and experience of ground-based safety nets in a series of seminars. On 16 April the team travelled to Armenia together with Sakaeronavigatsia the Georgian ANSP. On 21 April they were in Albania together with DFS from Germany, and by the time NET*ALERT* is published, they will have also held seminars in Ireland and Malta, the latter together with Sakaeronavigatsia. Each seminar is different to meet the needs of the local ANSP, but has some common features. To find out more and discuss your needs please contact safety-nets@eurocontrol.int

- **RA Downlink operational:** the ANS of the Czech Republic has successfully introduced a filter to remove erroneous messages from RA Downlink. Their application to begin operations was approved by the Czech NSA.

- **SPIN meeting:** the next meeting of the SPIN Sub-Group takes place in Bulgaria on 15-16 September. On the agenda will be the preparation of the RA Downlink Workshop. If you are interested in joining please contact the Safety Nets team.

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