October 2012 I N°15

NETALERT Newsletter
Stay tuned

Ensuring the effectiveness of Safety Nets

WELCOME

Over the summer runway safety nets have been added to the portfolio of SPIN and the safety nets team. So for this autumn newsletter the lead article introduces runway safety nets and presents recently published data on runway incursions.

In our second article we look at a real-life incident where STCA did not work as intended. The article highlights the importance of the STCA cycle time in quickly identifying conflicts and suggests possible actions for ANSPs.

Still on the subject of STCA, we briefly explain how, in predicting potential conflicts, STCA is able to take account of the most likely trajectory of an aircraft but at the same time not ignore the possibility of other trajectories being followed. The so-called multi-hypothesis concept has been used for many years in the horizontal dimension, but more recently has been applied in the vertical dimension.

Finally we update readers on safety nets activities at ICAO and SESAR and, for the latter, start to highlight some of the work planned for 2013.

If you have questions about any of the articles featured please do get in touch. We welcome all feedback!

Runway safety nets

Runway incursions counted in the top 5 ATM related incidents in the latest EASA Annual Safety Review, and until recently their reported frequency was rising. With work on runway safety in EUROCONTROL recently moving from the Airport Unit to the Safety Unit, runway safety nets have been added to the portfolio of SPIN and the safety nets team. So in this article, we provide our first introduction for NETALERT readers to runway safety nets – the last line of defence on the airport surface.

Runway incursions

Runway operations are the one occasion where aircraft operating at high speed, either landing or taking off, are in close proximity to other aircraft and vehicles. Consequently, when incidents occur there is a high risk of serious damage and loss of life. Runway safety nets represent just one way of preventing runway incursions. Before safety nets are used, a number of other strategies can be employed to prevent runway incursions taking place. (see text box below.)

Runway safety nets

Runway safety nets are used to alert controllers to conflicts on the runway surface, either by aircraft or ground vehicles. In Europe runway safety nets for controllers are provided through A-SMGCS (Advanced

Some ways of preventing runway incursions

- *establishing Local Runway Safety Teams to identify runway hotspots and develop risk mitigation strategies;*
- *the flight crew maintaining situational awareness of their own location in relation to active runways, and that of other aircraft and vehicles relative to active runways;*
- *the use of appropriate R/T phraseology – and a focus on improved communications between flight crew, ATC and ground personnel;*
- *use of ICAO standard taxiway surface markings, signs and lighting.*

Information on these and other preventative methods can be found in the European Action Plan for the Prevention of Runway Incursions (April 2011 update) on the EUROCONTROL website.

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Runway safety nets last line of defence on the airport surface

continued

Surface Movement Guidance & Control System) Level 2. This can also provide alerts of incursions into temporarily or permanently restricted areas such as closed taxiways or Instrument Landing System (ILS) critical areas. In the United States similar systems are used, for example Airport Movement Area Safety System (AMASS) and Airport Surface Detection Equipment, Model X (ASDE-X).

There are also runway safety nets for pilots. Newer aircraft are being fitted with a Runway Awareness and Advisory System (RAAS), a software upgrade to later-model Enhanced Ground Proximity Warning Systems, which provides flight crews with information on the aircraft's position relative to an airport's runway. Also, technology such as Runway Status Lights (RWSL), which uses airport lighting to warn pilots and vehicle drivers of potentially unsafe situations, has been trialled.

Runway safety nets in A-SMGCS Level 2

Safety nets in A-SMGCS Level 2 detect conflicts on the runway surface. In simple terms this is achieved by defining a protected area around the runways, and defining the scenarios and rules under which alerts will be provided to controllers. The alerting parameters and dimensions of the protected area need to be set to avoid unwanted nuisance alerts but also allow enough time for controllers to react to and resolve critical alerts.

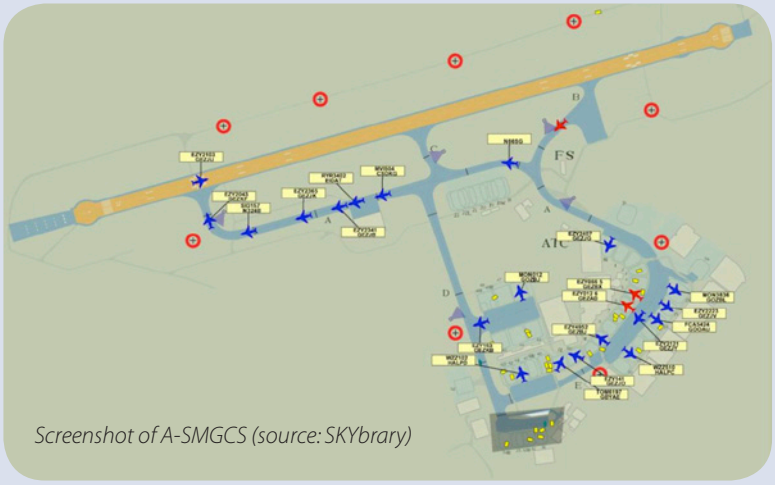
Some examples of scenarios under which an alert could be provided are shown on page 3. In practice, the exact list of scenarios will be airport specific and influenced by the layout, for example the number of runways and their orientation with respect to one another, and local ATC procedures. Additionally, the protected area could also be sized differently for different weather conditions, such as low visibility procedures, so the protected area used by the runway safety net could change during a day's operations.

An example often used to highlight how local ATC procedures influence runway safety nets is multiple line-ups for departures. In order to increase the departure rate, some airports allow two or more departing aircraft to line-up at the same time on the same runway. At such an airport, two departures lined up on the runway at the same time are not considered as a conflict situation and the runway safety net should not issue an alert. At other airports where multiple line-ups are not in operation, this same scenario would generate an alert.

By connecting the surveillance system to electronic flight strips, the A-SMGCS level 2 should provide controllers with earlier alarms as the system will know if an aircraft/vehicle has received a permission to enter the runway. It will also warn about conflicting clearances (e.g. line-up and landing clearances on the same runway at the same time).

More about A-SMGCS

A-SMGCS is a system "providing routing, guidance and surveillance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required level of safety" (ICAO Doc 9830 A-SMGCS Manual).



Screenshot of A-SMGCS (source: SKYbrary)

EUROCONTROL has defined four levels of A-SMGCS with each one offering more functionality. In brief:

- Level 1: the controller is given the position and identity of aircraft and transponder equipped vehicles on the manoeuvring area. Having position and identity is an important advance over a traditional Surface Movement Radar (SMR) which only provides position.
- Level 2: A-SMGCS Level 1 plus safety nets that alert the controller to potential conflicts on the runway between aircraft or aircraft and vehicles. Alerts can also be provided for incursions into temporarily or permanently restricted areas.

Levels 3 and 4, originally defined in 2003 and still requiring further validation, include functions such as different levels of conflict detection, planning and guidance as well as conflict resolution in Level 4.

Surveillance challenges

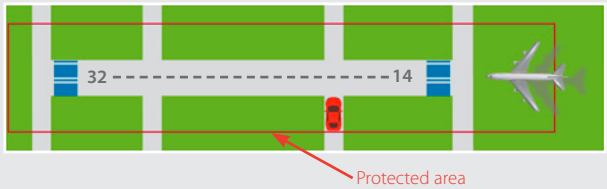
Surveillance is another challenge in introducing runway safety nets, as the performance of the alerting function is very dependent on the quality of the surveillance information it receives.

A-SMGCS uses two surveillance sources, a non-cooperative source and a cooperative source. The non-cooperative source consists of one or more SMRs and provides position information (plots) for all aircraft and vehicles, while the cooperative source provides position information and identification for aircraft and vehicles with an operating transponder/locator (multilateration is commonly used for the cooperative source). The combination of non-cooperative and

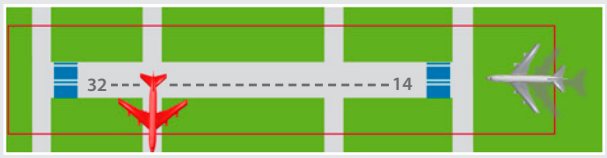
Runway safety nets last line of defence on the airport surface

continued

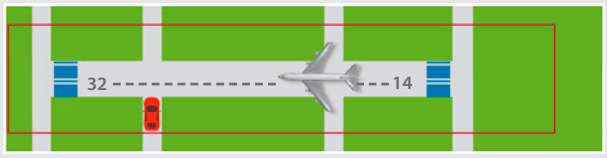
High-level examples of runway safety net alerting scenarios



***Example 1**: Aircraft or vehicle on the protected area when an arriving aircraft is a certain time from the threshold*



***Example 2**: Preceding arriving aircraft which has not cleared the protected area when an arriving aircraft is a certain time from the threshold*



***Example 3**: Aircraft or vehicle on the protected area and not behind a departing aircraft*

cooperative ensures a surveillance picture of the entire airport surface and all aircraft and vehicles, regardless of whether they are equipped with a transponder/locator.

Experience has shown that alerts generated by false plots from the SMR can be a significant source of unwanted alerts for runway safety nets. Sources of false alerts can include precipitation and radar reflections due to aircraft, vehicles and buildings on the airport surface. Efforts to eliminate these types of alert typically include modifications to the surveillance processing. However, in some cases the solution has been to introduce an additional SMR to provide extra surveillance coverage.

Runway safety nets and SESAR

Runway safety nets are included in SESAR Work Package 12 (airport systems). Project 12.3.2 (Enhanced Surface Safety Nets) plans to provide enhancements, for example by validating new algorithms for a complex future airport/TMA environment, and use datalink to uplink information and alerts to pilots and vehicle drivers of conflicts detected on the movement area by an enhanced A-SMGCS.

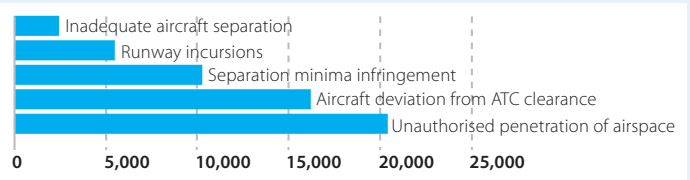
Also sub-work package 12.5 (Controller Working Position – including ground safety nets) has a project 12.5.2 (airport safety nets and wind-shear detection and alert for controllers) which intends to define and validate the HMI presentation of conflict alerts and resolution advisories to controllers.

Additional information:

- A-SMGCS: EUROCONTROL A-SMGSC website (www.eurocontrol.int/articles/a-smgcs)
- SKYbrary: Runway incursions (www.skybrary.aero/index.php/Runway_Incursion)
- European Action Plan on the prevention of runway incursions (http://www.skybrary.aero/bookshelf/books/151.pdf)
- ICAO: Doc 9870: Manual on the Prevention of Runway Incursions (2007) (http://www.skybrary.aero/bookshelf/books/482.pdf)

Runway incursions in Europe

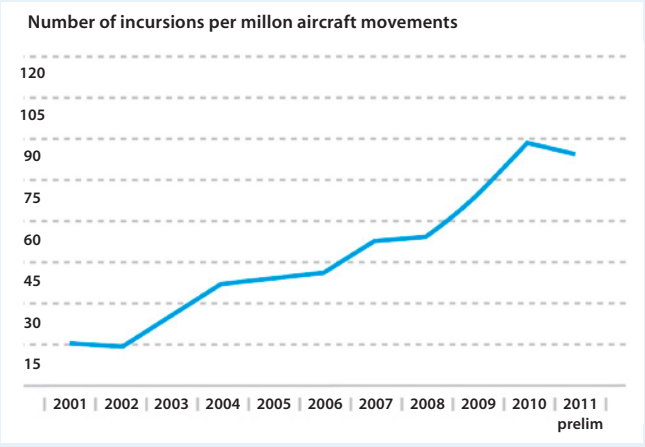
How frequent are runway incursions and how does this compare to other types of ATM related incidents? This information was published in the EASA Annual Safety Review for 2011 which analysed mandatory safety data reported to EUROCONTROL. As shown in the graph below, between 2005 and 2011 runway incursions were in the top 5 ATM related incidents for EASA Member States.



Incident categories of ATM related incidents (2005-2011) - EASA Member States [1,2]

1 An incident can be included in more than one category (e.g. a runway incursion can also be categorised as a deviation from ATC clearances)
2 Only a fraction of ATM incidents have an ATM contribution in the chain of events.

The annual review also includes statistics on reported runway incursions per 1 million aircraft movements. The graph shows, with the exception of the preliminary data for 2011, an increasing trend in reported runway incursions. The report concludes that the increase is due to improved awareness through the publication of the European Action Plan for the Prevention of Runway Incursions and the change of the ICAO definition of a runway incursion which effectively enlarged the scope of occurrences included.



Rate of runway incursions by severity for 2001-2011 (incidents per 1 million aircraft movements) - EASA Member States

STCA
cycle time in the spotlight

An investigation report has recently been published into an airprox between two passenger aircraft. The report identified several contributory factors including the STCA system, which was not working as intended. A key learning point arising is that STCA cycle time is a crucial aspect of system configuration – not just look ahead time.

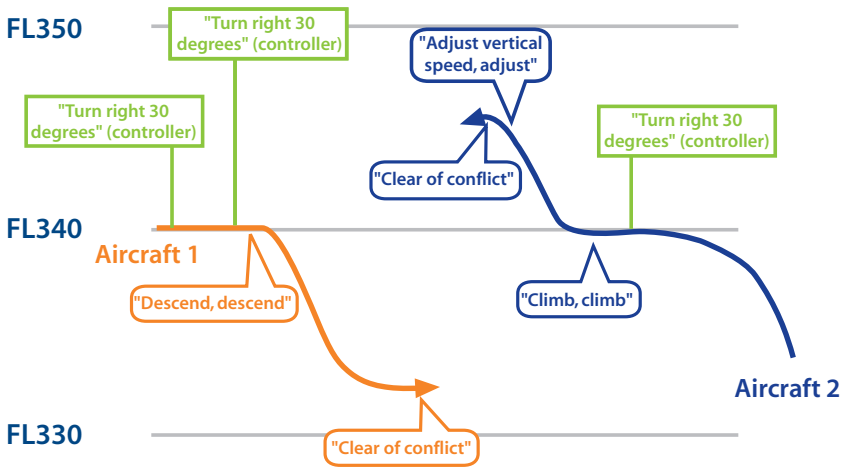
In this incident the risk of collision between the two aircraft was averted by both flight crews following their respective TCAS RAs in accordance with ICAO guidelines. The air traffic controller on duty only became aware of the conflict when the aircraft were approximately 9NM apart and before STCA alerted. He immediately instructed both aircraft to turn 30 degrees right. One aircraft followed the instruction, the other did not – most probably partly due to the timing of the instruction coinciding with the "descend" RA. The minimum horizontal distance between the aircraft was 2.7 NM.

STCA set up

At the time of the incident the STCA at the ACC was configured as follows:

Warning time: the system was required to provide a STCA 'predicted conflict' alert if the separation minima between aircraft

Overview of the airprox



The first aircraft (aircraft 1) checks in to the sector at FL340. The aircraft is heading north-west. Seven minutes later, the second aircraft (aircraft 2), flying on a southerly course checks in on the same frequency reporting it is climbing from FL320 to FL340. Both contacts are acknowledged by the controller, however aircraft 2 does not report reaching FL340.

Both aircraft are now at the same flight level on crossing courses. When the aircraft are separated horizontally by approximately 9 NM the controller identifies the conflict and immediately instructs aircraft 2 to make a 30 degree right turn, the instruction is acknowledged by the crew. The controller then also instructs aircraft 1 to make a 30 degree right turn, initially by using the callsign of an aircraft operated by the same company that was leaving the sector, but then corrects this. However, the crew of aircraft 1 do not respond.

Aircraft 2 contacts the controller to confirm the instruction to turn right. At the same time they receive a 'climb' TCAS RA. The controller again contacts aircraft 1 giving instructions for an immediate right turn; however it does not make the turn. It is not known whether the crew hears the instruction, but they receive a 'descend' RA which they follow, and report this to the controller.

Seven seconds after the crew of aircraft 2 receives the RA, the controller receives an STCA 'predicted conflict' warning to signify that the separation minima will be violated within the next 25 seconds. At this time the aircraft are separated horizontally by 5.9 NM. Four seconds later, with the aircraft separated horizontally by 4.9 NM, STCA gives a 'conflict alert' to warn that the separation minima have been violated.

Both aircraft follow their respective RAs until separated by 1,000 feet vertically and 'clear of conflict' at which point they are separated horizontally by 2.7 NM. The RAs on both aircraft last for approximately 40 seconds.

STCA cycle time in the spotlight

continued

were predicted to be violated within 25 seconds. (STCA 'conflict alerts' were given if the separation minima had already been violated).

Look ahead time: the system was set up with a look ahead time of 40 seconds (i.e. any aircraft pairs with a predicted violation of separation within 40 seconds were transferred into a STCA filter for monitoring by STCA).

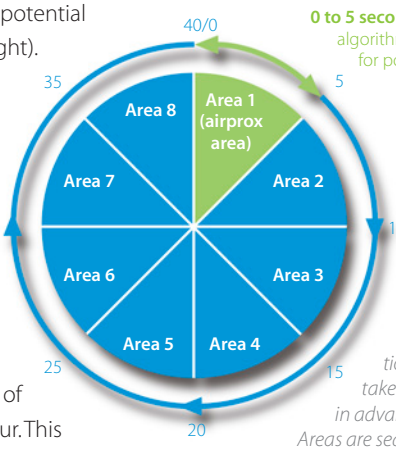
STCA search algorithm: The STCA search area had 6 sub-areas. The system took 5 seconds to search each of these areas for potential conflicts. Two of the sub-areas were TMAs and were searched twice in each cycle. This meant that it took 40 seconds to search all "8" areas (i.e. there was a 35 second period in every 40 seconds where the airprox area was not being searched for potential conflicts) (see diagram on the right).

Combined effect of STCA parameters

The combination of search algorithm, look ahead time and warning time raises the possibility that controllers could be provided with notifications of STCA alerts less than 25 seconds before a loss of separation was predicted to occur. This is shown in the simple example below which illustrates that assuming the speed, altitude and

STCA Cycle Time

Elapsed time (seconds)

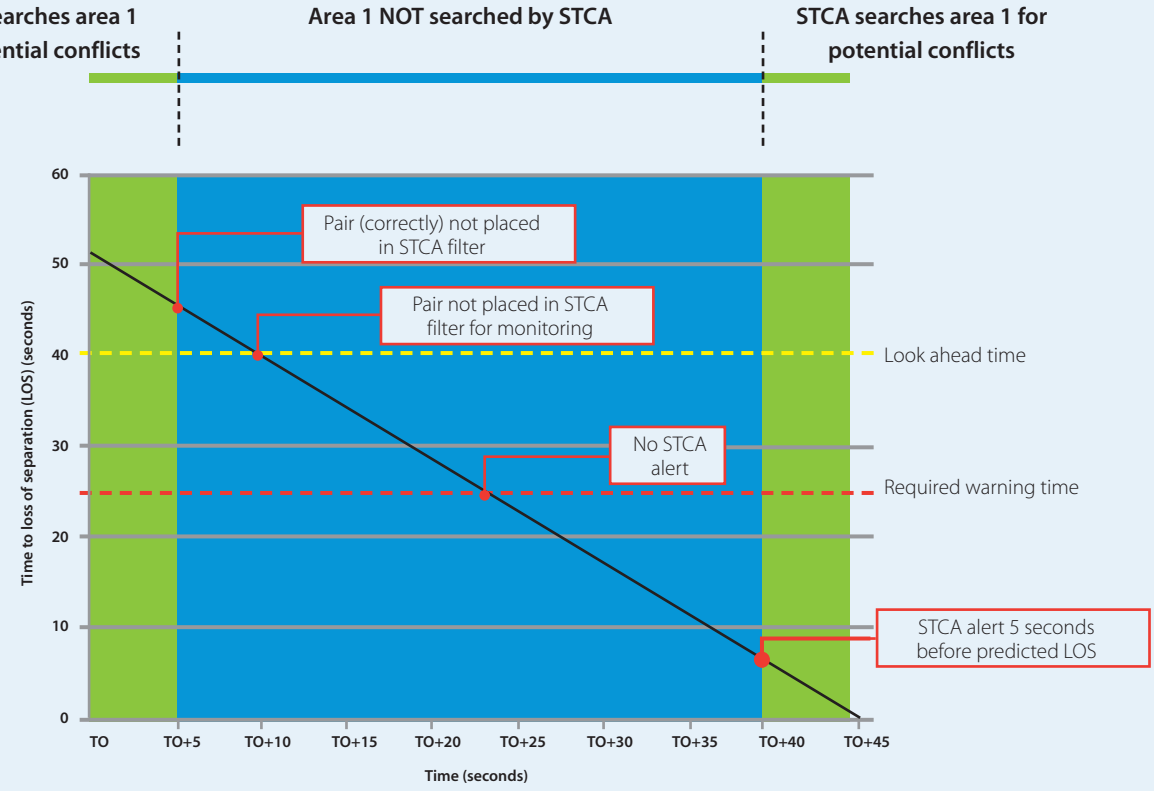


0 to 5 seconds: STCA search algorithm searches area 1 for potential conflicts

0 to 40 seconds: STCA search algorithm is NOT searching area 1 for potential conflicts

At the time of the incident STCA searches 8 areas for potential violations of separation that are predicted to take place up to 40 seconds in advance (look ahead time). Areas are searched one at a time. Each search takes 5 seconds.

Combined effect of STCA parameters – a simple example



■ **T0 to T0+5:** Area 1 is searched. The two aircraft in question are predicted to have a loss of separation in 45 seconds at the end of the search. As this is greater than the 40 second look ahead time the pairs are (correctly) not placed into the STCA filter.

■ **T0+5 to T0+40:** During this time STCA is not searching area 1. However:

- At T0+10 the aircraft are predicted to violate the separation minima within 40 seconds. However as area 1 is not being searched by STCA the aircraft would not be added to the filter for monitoring.
- At T0+23 the separation minima between aircraft are predicted to be violated in 25 seconds. However as the pair have not been transferred to the filter for monitoring by STCA, no alert is provided to the controller.

■ **T0+40:** STCA starts to search area 1 again. The aircraft are found to be 5 seconds away from a loss of separation so an alert is given to the controller.

STCA cycle time in the spotlight
continued

heading of both aircraft remained constant, the controller would not be provided with an alert until 5 seconds before the loss of separation was predicted to occur (i.e. the 25 second warning time requirement is not met).

System changes

One STCA action arising from the incident was that the 'look ahead' or 'predicted ahead' time for the STCA system involved was increased from 40 seconds to 70 seconds. However, with a 40 second cycle time still in place, this measure is only adequate in situations where both aircraft do not manoeuvre during the cycle time.

The effect of heading changes on conflict timing was clearly demonstrated in the incident investigation report (see Convergence Point Analysis text box opposite) and similar effects occur in both horizontal and vertical speed changes. Therefore, cycle time is the real problem to solve.

Learning points from the incident

- **Check your STCA system configuration** – particularly look at cycle time (also known as Course Filter interval or Search Algorithm interval). The cycle time should be in the region of 5 seconds – not 40 seconds as in this incident.

- **Look also at how search areas are defined.** In this incident, TMA areas were searched more frequently than ACC areas – leaving the ACC area in question particularly vulnerable.

- **Warning time is variable depending on your operational environment.** In this incident the warning time target was 25 seconds, but in reality the controller had only 5-9 seconds warning. Run some tests (ideally using reference scenarios) and monitor the impact on warning time – particularly for 'predicted conflict' messages. Are you getting predicted conflicts before the actual conflict message? If not, your cycle time may be too long.

- **If you are dealing with a legacy STCA system, check the system capacities** and limitations and whether simple system upgrades are available.

STCA cycle time & coarse filter

STCA processing occurs periodically. This may be a regular cycle time (e.g. 4 seconds) driven by system track updates, or driven by a surveillance update of the system track.

On each STCA cycle all system tracks in the STCA search area are introduced to the coarse filter. The purpose of the coarse filter is to find pairs of system tracks that are of potential concern and that require further processing.

The coarse filter takes the current system track vectors and calculates whether the aircraft could potentially come into conflict within a certain prediction time. For a track pair to pass the coarse filter, a potential conflict must be detected in both the lateral and the vertical dimensions, although the lateral and vertical conflicts do not necessarily have to occur at the same time.

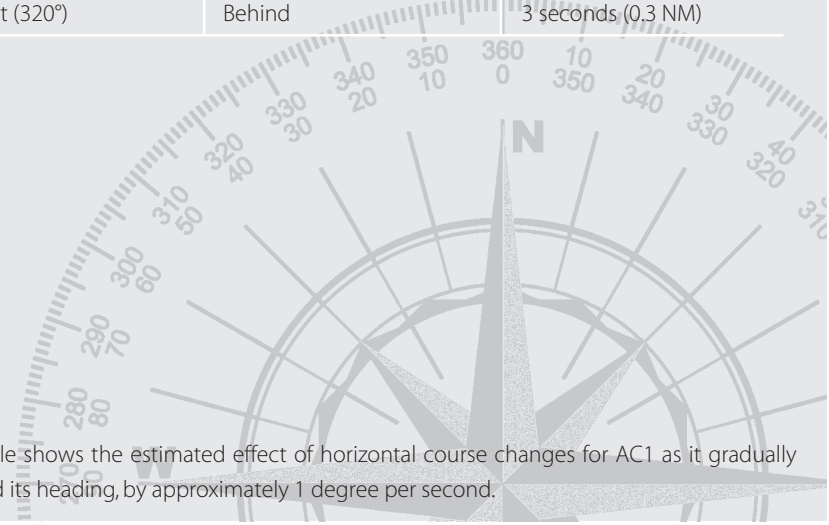
Pairs of system tracks that are not predicted to come into conflict are eliminated at this stage, and hence much unnecessary processing is avoided – particularly critical in the past when computers were less powerful.

Tracks for which a potential conflict could occur are subject to further processing by the fine filters (for example linear prediction or turning filters). Subject to processing against the parameters used by the fine filters, an alert for these tracks may or may not be generated.

Convergence point analysis

As part of the investigation, the convergence point of the two aircraft, where one aircraft (AC1) changes its heading and the other (AC2) does not, was analysed. This was done to assess what the change in heading would mean if TCAS had not been active, and if the aircraft had not changed altitudes. The conclusions show that because only one aircraft followed the heading instruction, from the horizontal perspective it actually brought the aircraft closer together.

AC1 magnetic heading changes in degrees	AC1 will pass in front of or behind AC2	AC2 time and distance to the convergence point
No course change (305°)	Front	20 seconds (2 NM)
7° right (312°)	Front	11 seconds (1.1 NM)
12° right (317°)	Front	3 seconds (0.3 NM)
13° right (318°)	Front	1 second (0.1 NM)
15° right (320°)	Behind	3 seconds (0.3 NM)



The table shows the estimated effect of horizontal course changes for AC1 as it gradually changed its heading, by approximately 1 degree per second.

Multi-hypothesis
predicting STCA alerts in the vertical dimension

Multi-hypothesis is about taking account of the most likely trajectory of an aircraft but not ignoring the possibility of other trajectories being followed. Below we explain how it can be applied in the vertical dimension.

Is multi-hypothesis new?

The concept itself is not new and the technique has been employed in the horizontal prediction elements of STCA systems at least since the late 1980s. For example, if one aircraft starts to manoeuvre towards another the linear (straight-ahead) prediction filter can be slow to provide an STCA alert. Therefore, in addition to the usual linear prediction, some STCA systems simultaneously use some form of turning prediction which activates when an aircraft is detected as turning by the tracker. This is multi-hypothesis (for further information on turning predictions see the 'STCA in the TMA' article in NET*ALERT* 12).

More recently, multi-hypothesis is also used in the vertical dimension. In this dimension, multi-hypothesis is very powerful. It allows ANSPs to significantly reduce the STCA nuisance alert rate by using the Cleared Flight Level (CFL), yet still gives some degree of level-bust protection.

Using CFL to reduce nuisance alerts in the vertical dimension

Many STCA systems provide the option to use the CFL when it is input by the controller. In configuring the basic STCA parameters, the ANSP often has a choice either to use the CFL, or to ignore the CFL.

In STCA, many nuisance alerts may be generated when aircraft are converging vertically, but are in fact cleared to different safely separated flight levels. Therefore, the advantage of using the CFL in STCA is that STCA can take the cleared levels into account, recognise that there is no actual conflict when the aircraft are safely cleared, and thereby reduce the nuisance alert rate quite significantly (see Figure 1). Conflicts that might exist at the CFL are detected early but conflicts that might exist (in this example of a descending aircraft) below the CFL are only detected after the CFL is busted. Dependent on the vertical rate, the remaining time to resolve the conflict may be very limited and TCAS may already have issued an RA.

Not using CFL to predict level busts

For STCA systems that don't use the CFL (see Figure 2), the late alert in the case of level bust is no longer an issue. However, a high nuisance alert rate will either have to be tolerated or the STCA parameters reduced so that the general warning time provided to the controllers is not as long as one would really wish.

Multi-hypothesis – best of both worlds

In systems where multi-hypothesis can be used in the vertical dimension, STCA can make two vertical predictions where it would previously have made just one (see Figure 3).

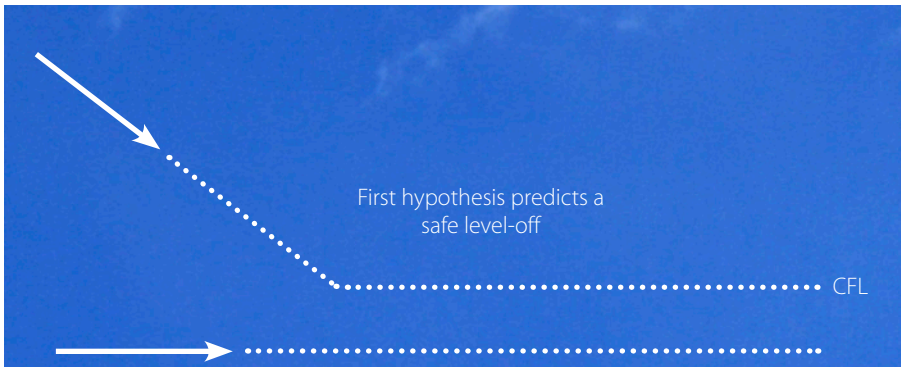


Figure 1: Vertical Prediction using CFL (First hypothesis)

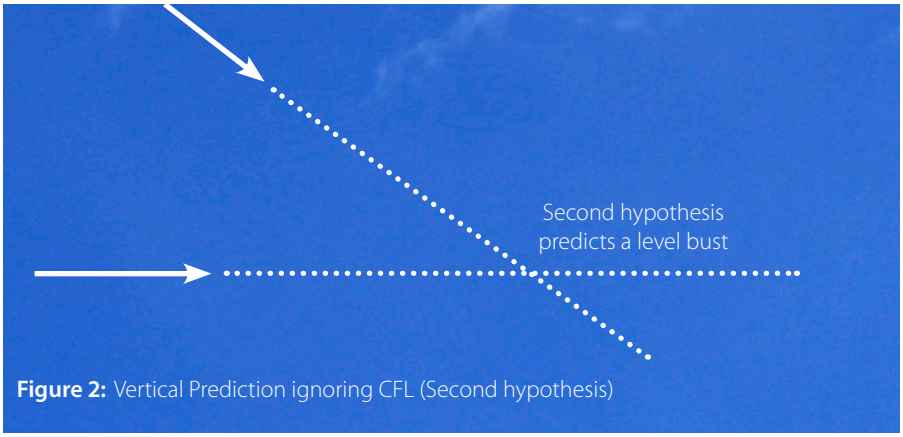


Figure 2: Vertical Prediction ignoring CFL (Second hypothesis)

Multi-hypothesis
predicting STCA alerts in the vertical dimension
continued

■ Using CFL to reduce nuisance alerts in the vertical dimension: The first vertical prediction assumes that the CFL will be adhered to. Because this is a more likely outcome, the ANSP can afford to set the horizontal parameters wider to obtain optimal protection.

■ Predicting level busts: The second vertical prediction ignores any input CFL. It is a back-up hypothesis which protects against level-busts. The likelihood of a level bust is quite small and the consequence of using wide STCA parameters would be a large nuisance alert rate. Therefore the ANSP must set reduced STCA parameters for this hypothesis. The key points are that the ANSP must set narrower/smaller parameters for the hypothesis that ignores the CFL, and must also accept the fact that it will therefore only protect against the more serious predicted level-busts (where horizontal separation is predicted to be significantly eroded).

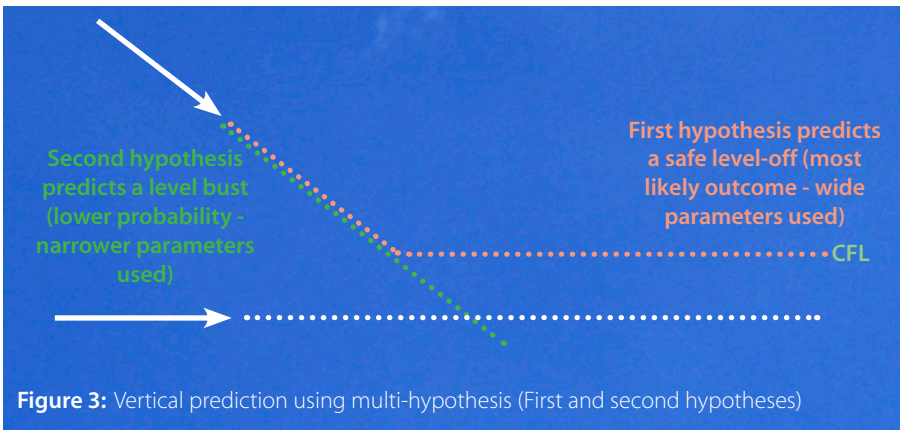


Figure 3: Vertical prediction using multi-hypothesis (First and second hypotheses)

How easy is it to implement multi-hypothesis?

Depending on how your STCA system currently works, multi-hypothesis in the vertical dimension might in fact be quite easy to implement.

If the STCA system has the option to use (or not to use) the CFL by a parameter switch, then implementing multi-hypothesis should be reasonably straight forward. With this option all 'predicting' filters need to have two instances. The first instance of each filter will always use the CFL, the second instance will never use the CFL. Key parameters for each filter have to be independent. So if, for example, there is one parameter called 'Linear PredictionLateralSeparation', then there must be another parameter defined for the second instance of the filter 'Linear Prediction LateralSeparation2ndHypothesis'. The second hypothesis filter parameters must be set to smaller/narrow values than the first hypothesis in order to make the multi-hypothesis technique worthwhile.

Similarly, true multi-hypothesis in the horizontal plane should also use two sets of parameters.

Safety nets at the 12th ICAO
Air Navigation Conference (AN-Conf/12)

In just a few weeks AN-Conf/12 will consider the SPIN-originated European action paper on compatibility of safety nets. The paper outlines the opportunities for reducing incompatibilities, which fits with the aim of the conference to achieve consensus and commitment for a harmonised global air navigation system.

The paper invites the conference to:

■ Request ICAO to develop an ICAO Manual for Ground-based Safety Nets; this could be based on the specifications and guidance material already developed in Europe. Publication of such material in an ICAO Manual would give further impetus to the harmonisation process, both in Europe and the rest of the world. Harmonisation of STCA helps to make the overall system-of-systems behaviour more predictable.

■ Request ICAO to review the provisions related to ground-based and airborne safety nets in PANS-ATM (Doc 4444). For example, the responsibilities in case of no pilot report and non-compliance with the RA are unclear. Equally, no clear criteria exist to determine if and when other aircraft are affected. A review should remove ambiguity and take into account that ACAS RAs could be displayed to controllers.

■ Request ICAO to adopt a more holistic and coordinated approach towards developing Standards And Recommended Practices (SARPs) for future ground-based and airborne safety nets. The aim is to provide synergies and avoid duplication of effort in the quest for safety nets that are fit for purpose in the future environment of operations.

SESAR update

Our regular review of SESAR safety nets related projects follows…

Evolution of Ground-Based Safety Nets (P 4.8.1)

The preliminary evaluation of enhanced ground-based safety nets using existing down-link aircraft parameters (DAPs) in TMA and en-route environments is nearing completion. A mature safety assessment will be completed to support the safety assurance. This will then be consolidated into Safety and Performance Requirements (SPR) which are due to be completed by the end of 2012. Validation of an industrial STCA prototype using DAPs is on the agenda for 2013 and will be led by ENAV.

Planning is underway to progress future work in 4.8.1. An operational concept and an initial feasibility assessment are due to be developed by autumn 2012 for the adaptation of ground-based safety nets to operate in a future 3/4D trajectory environment. Looking further ahead to 2013, preliminary validation activities on operational and safety benefits, safety assurance and costs estimates of ground-based safety nets adapted to trajectory-based operations are planned. The work will be conducted by NATS, DSNA and EUROCONTROL.
Partners: DSNA (leader), NATS, ENAV, SELEX, EUROCONTROL

Safety Nets Adaptation to New Modes of Operation (P 10.4.3)

The performance evaluation of STCA, being developed by THALES, is nearly complete. It will first be provided to SESAR partners and then delivered to the SJU by the end of September 2012. A presentation and demonstration is planned to take place at a future SPIN meeting. Similar to 4.8.1, planning is taking place for the next trial of the STCA industrial prototype in 2013. Phase 2 system specifications for STCA, APW, MSAW and APM will also be available by the end of September 2012. These will be used as inputs to the development of the prototype and verification plan.

A new prototype for processing RAs will be specified and developed in 2012-2013. This prototype will be provided to DFS as part of a validation exercise for the display and use of ACAS RA downlinks.
Partners: THALES (leader), DSNA, ENAV, EUROCONTROL, INDRA, SELEX

Evolution of Airborne Safety Nets (P 4.8.2)

In the work area identifying and evaluating possible future modifications to ACAS, an assessment of reduced TCAS thresholds in US airspace has taken place. The benefits were presented to both EUROCAE WG75 and RTCA SC147.

Work is also underway to evaluate the use of trajectory data by ACAS to enable better conflict prediction. The benefits of using ADS-B data in the ACAS horizontal miss distance filter will be assessed using over 100 RA encounters.

Finally a validation report on improvements in collision avoidance between ACAS and non-ACAS equipped aircraft (i.e. general aviation (GA) aircraft equipped with a system capable of passive co-ordination with current and future ACAS) has been delivered.
Partners: DSNA (leader), AIRBUS, NATS, EUROCONTROL

TCAS Evolution (P 9.47)

The overall aim of this project is to develop an industrial prototype to be validated by P 4.8.2. Work continues on both (i) the preliminary system impact assessment of the changes to TCAS proposed in 4.8.2 and (ii) the development of performance objectives and functional requirements for the use of improved hybrid surveillance in Europe. For the impact assessment, the focus will be on the use of ADS-B data by ACAS mentioned in 4.8.2 above.
Partners: Honeywell (leader), AIRBUS, DSNA, EUROCONTROL

Ground-Airborne Safety Net Compatibility (P 4.8.3)

DFS continues to analyse RA encounters collected from ACAS monitoring stations and Mode S radars to support analysis of the operational benefits of presenting TCAS RAs on the controller working position. Further investigations have been made of pilot compliance with RAs. During the coming months the collection of RAs from the 15.4.3 prototype will be completed and the findings used to help refine the preliminary RA downlink operational concept. A mock-up to prepare for a preliminary validation of the operational concept has been produced. Work is now underway to develop the scenarios to be used in the validation.

The work area examining the interaction between STCA and ACAS within the future ATM environment, as defined in SESAR Step 2, will start soon. It will take into account evolutions of STCA and ACAS developed in 4.8.1 and 4.8.2.
Partners: DSNA (leader), DFS, AENA, INDRA, AIRBUS, EUROCONTROL

ACAS Monitoring (P 15.4.3)

The prototype ACAS monitoring system is due to be handed over in the summer. This will allow the final RA downlink data collection and evaluation task to be started in 4.8.3.
Partners: THALES (leader), INDRA, EUROCONTROL, DFS

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