NET*ALERT* NEWSLETTER

It's time for action

ENSURING THE EFFECTIVENESS OF SAFETY NETS

Understanding
RA Integrity

Displaying ACAS Resolution Advisory (RA) information at the controller working position has the potential operational benefits of improved situational awareness and reduced possibility of contradictory clearances being issued to an aircraft involved in an RA encounter. The utility of RA downlink will depend on, amongst other factors, the frequency of RA events. For that reason one of the objectives of the monitoring part of the PASS[1] study was to quantify the frequency and type of RA occurrences. That part of the study is now complete, and has concluded that RA encounters are rare and can be monitored reliably by Mode S radars - with some caveats …. read on!

RA encounter

RA issued in cockpit

TCAS surveillance and coordination messages

Threat aircraft

RA downlink messages during and some time after an RA encounter

RA downlink messages from threat aircraft if RA issued in cockpit
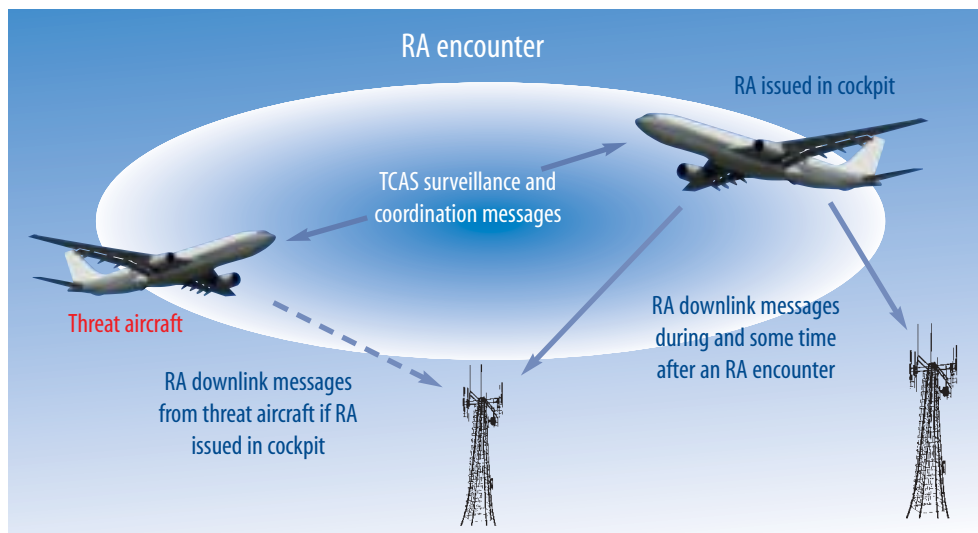
Distinction between RA message and RA encounter

WELCOME

This 5th issue of NET*ALERT* focuses on the findings of research that has been ongoing into RA Downlink to analyse the quantity and reliability of messages and gather an operational view of ACAS performance. We report on two separate studies whose results will help inform **if** and **how** RAs could be displayed to the controller.

The Safety Nets team has also continued to lend support to service providers and on the back page you will find news of a visit the team made to Georgian ANSP SAKAERONAVIGATSIA.

This Safety Nets newsletter is written for people working in airlines, air traffic control centres, and the organisations that support them. We are always happy to send additional copies to interested organisations. Please contact us if you need extra copies or if you have comments related to the articles in this issue. Our details are on the back page.

Analysis of RA encounters

RA downlink data was collected from six DSNA Mode S radars, covering most of the European core area, over a period of 7 months. The collected data comprised over 1,300,000 flight hours and more than 350,000 RA downlink messages. A single encounter will lead to several downlink messages, the number depending on the duration of the RA, the amount of overlapping radar coverage, and the radar refresh rate.

The analysis revealed that only 12,476 (3.6%) of the recorded messages corresponded to RAs triggered on-board 1029 aircraft involved in 880 RA encounters. The remaining 96.4% of messages were "empty". That was not unexpected as this

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problem had already been indentified in previous Mode-S radar monitoring studies.

Only 17% of all encounters resulted in a co-ordinated RA (i.e. in 83% of the encounters, an RA was generated on-board of only one of the aircraft involved). Reasons for this include the geometry of the conflict being such that the RA was not generated on the TCAS-equipped threat aircraft, the threat ☞
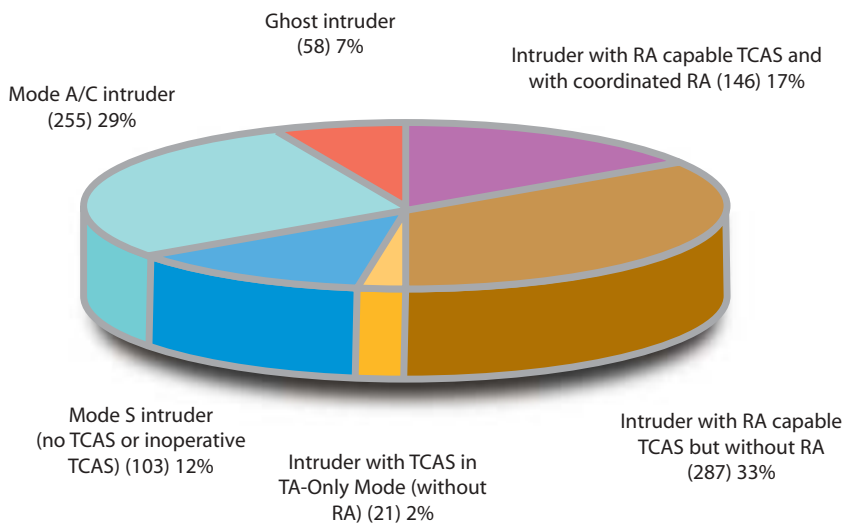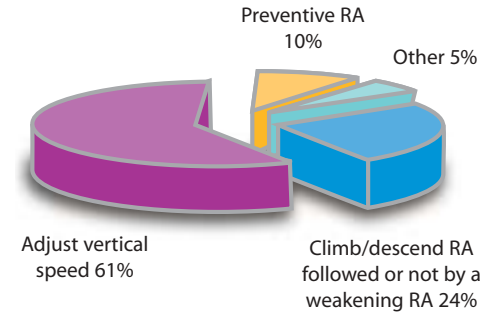
1 Performance and safety Aspects of STCA, full Study

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RA Integrity
continued

aircraft not being TCAS equipped or the threat aircraft TCAS being in Traffic Advisory (TA) only mode. The first case occurs when one aircraft is climbing or descending while the other is in level flight (on the latter aircraft, narrower parameters for RA generation apply).

Types of RA

Some of the 880 RAs were classified as "intentional" – i.e. they were generated during flight testing or military operations. Among the remaining "unintentional" encounters, the majority (61%) of RAs were solely "adjust vertical speed" RAs. In 24% of cases, the RA was a "climb" or "descend" RA, usually followed by a weakening RA to "adjust vertical speed". About 10% were preventive RAs, occurring mainly between IFR and VFR flights.

Preventive RA 10%
Other 5%
Adjust vertical speed 61%
Climb/descend RA followed or not by a weakening RA 24%

Ghost intruder (58) 7%
Intruder with RA capable TCAS and with coordinated RA (146) 17%
Mode A/C intruder (255) 29%
Mode S intruder (no TCAS or inoperative TCAS) (103) 12%
Intruder with TCAS in TA-Only Mode (without RA) (21) 2%
Intruder with RA capable TCAS but without RA (287) 33%

Distribution of RA encounters as a function of threat aircraft equipage

Messages that corresponded to RAs triggered on-board aircraft were also checked for errors and inconsistencies in the information that was downlinked. It was found that in 33% of the cases where the threat aircraft is not Mode S equipped, aircraft report incorrect relative bearing or altitude of the threat. Whether these errors would have any impact on the display of RAs to controllers needs to be determined.

Only 12,476 (3.6%) of the recorded messages were valid.

Conclusions so far

This study has provided an insight into the frequency of occurrence of RA encounters and their distribution over a number of factors, including threat aircraft equipage, flight levels and type of RA. The main finding was that there is a relatively low occurrence of RAs. The work enhanced understanding of the issues which exist with down-linked messages, which are currently being addressed. It also confirmed that RA encounters could be reliably monitored via Mode S.

The findings of the study will now be discussed in the SPIN Sub-Group to form recommendations for the future of RA downlink.

On average, RAs encounters occurred every 960 flight hours on board TCAS equipped aircraft. The average duration of all RAs was 33 seconds, with 85% of RAs lasting between 5 and 45 seconds.

The distribution of encounters across flight levels was also analysed. A noticeable peak occurred below FL 40, corresponding to encounters between IFR flights and VFR flights. Outside this, most encounters occurred between FL 90 and FL 140 and between FL 210 and FL 360 because level-off geometries most frequently happen in these altitude bands.

Just 37 aircraft with faulty transponders continuously transmitting RA messages accounted for the majority of empty messages.

Analysis of RA messages

Returning to the 96.4% of RA downlink messages that are "empty" (i.e. do not correspond to RAs triggered on-board aircraft). Most of the empty messages are sent, continuously by a small number of aircraft throughout their flights – just 37 aircraft with faulty transponders continuously transmitting RA messages accounted for the majority of these. These messages are a nuisance, but can be easily detected by an RA monitoring system.

On average, RAs encounters occurred every 960 flight hours on board of TCAS equipped aircraft. The average duration of all RAs was 33 seconds, with 85% of RAs lasting between 5 and 45 seconds.

The full report can be downloaded from this web page:
http://www.eurocontrol.int/safety-nets/public/standard_page/PASS.html

RA Downlink
Monitoring from Langen

DFS has an ACAS monitor installed in the Langen ACC. We asked Steffen Marquard of DFS to explain how the system works and how the findings are being used.

"The Langen ACAS monitor detects and records all Resolution Advisory (RA) events in the airspace around Frankfurt. Recorded information can then be combined with radar data to show vertical and horizontal separations for an RA. This information can be used in activities such as statistics monitoring, supporting ACAS equipment specifications, planning of airspace structures and ATC procedures, and as necessary to support incident investigations (see text box for more information)."

"The ACAS monitor has shown that there are about 1.5 to 3 RAs per day in the Frankfurt area. Over a period of 221 consecutive days, 302 valid RAs were recorded by the system. The geographical pattern of the alerts indicates that there are no significant 'hotspots' of RA activity."

Future work
"The experience gained at Langen is being taken a stage further by DFS through a new ACAS monitoring project. Further monitoring stations will be installed to provide complete coverage of German airspace, allowing DFS to build up an overview of the system as a whole, in addition to investigating specific events."

"Another major task is to investigate the technical feasibility of downlinking and displaying RAs on the controller working position. The work will recommend if and how RAs could be displayed to the controller taking into account factors such as data quality and the time delay between the occurrence of the RA and it being displayed on the controller work position. Such recommendations will then need to be considered in the light of other factors outside of the scope of the project such as legal, procedural and HMI issues".

How the ACAS monitor works
In addition to the RA co-ordination messages broadcast between aircraft, ACAS transmits an RA broadcast message to the ground (on a frequency of 1090 MHz) and also stores the RA information in the aircraft transponder which can be extracted via Mode S radar (on a frequency of 1030 MHz).

separated by a horizontal distance of 0.78NM). Non-identical addresses are assumed to be 'false' RAs, for example with unknown or invalid content or active RAs without an intruder, and not recorded.
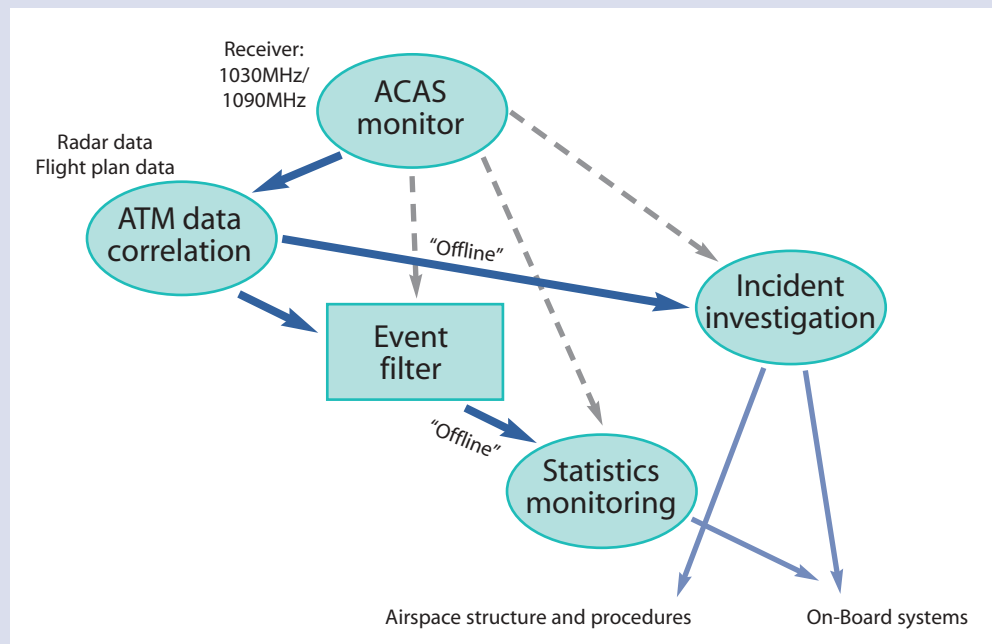
The ACAS monitor at Langen receives all RAs and combines and filters data from both the 1090 MHz and 1030 MHz channels. An event filter compares the unique ICAO 24-bit addresses of the RA broadcast message and the RA information extracted via Mode S. Where two identical addresses are correlated, the RA is assumed to be valid and the event recorded. These are then combined with radar and flight plan data to allow aircraft tracks and the event geometry during the RA to be displayed graphically and analysed (see example on the right for an RA where the aircraft are
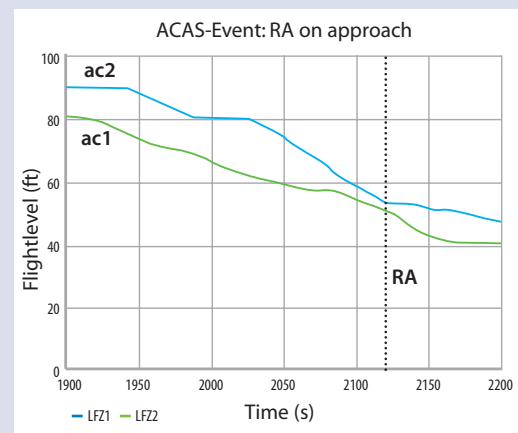
Further information on the DFS ACAS monitor project may be found at:
http://www.eurocontrol.int/safety-nets/public/news/080527_safety_nets_workshop_2.html

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Systems Upgrade
and Safety Focus

Pictured above, a selection of attendees at a seminar held in Georgia 14-15 January 2009. Martin Griffin, Eurocontrol Head of ATS (third from left) and Stanislaw Drozdowski (far left) from the Safety Nets team joined 30 safety managers, operational, technical and legal staff from the Georgian ANSP **(SAKAERONAVIGATSIA Ltd)** to discuss their systems upgrade and use of STCA and MSAW.

A key part of the seminar was a briefing on the Safety Nets standardisation materials and support available. The participation of Boško Rafailović (Serbia & Montenegro Air Traffic Services Agency Ltd.) highlighted the willingness within the ATM community to share experience in the field of Safety Nets.

The initiative was well-received, even attracting national television coverage in Georgia! EUROCONTROL has since been invited to assist with tuning Safety Net parameters. This support is also available to others – please contact us.

Participants at the seminar in Georgia

Spreading the message

On the theme of the use of downlinked aircraft parameters, 150 civil and military operational, technical, regulatory and safety experts from across Europe, attended an information day on 17th December, focusing on the safety and efficiency benefits gained from the deployment of Secondary Surveillance Radar (SSR) Mode S Enhanced Surveillance (EHS).

This development enables controllers to know the airspeed, heading, vertical rate and the selected altitude, without having to ask the pilot. Early experience confirms that it not only saves time and effort in the form of reduced radio telecommunication between pilots and controllers, it also has significant safety benefits, including reducing the number of level busts and improving situational awareness. Presentations also dealt with how EHS can be used in surveillance and Safety Nets processing. The benefit of using selected flight level in STCA was highlighted.

More details can be found at:
http://www.eurocontrol.int/corporate/public/event/081217_modes_infoday.html

Contact us by phone:
Ben Bakker (+32 2 729 3146),
Stan Drozdowski (+32 2 729 3760) or
Hans Wagemans (+32 2 729 3334); or by
email: safety-nets@eurocontrol.int