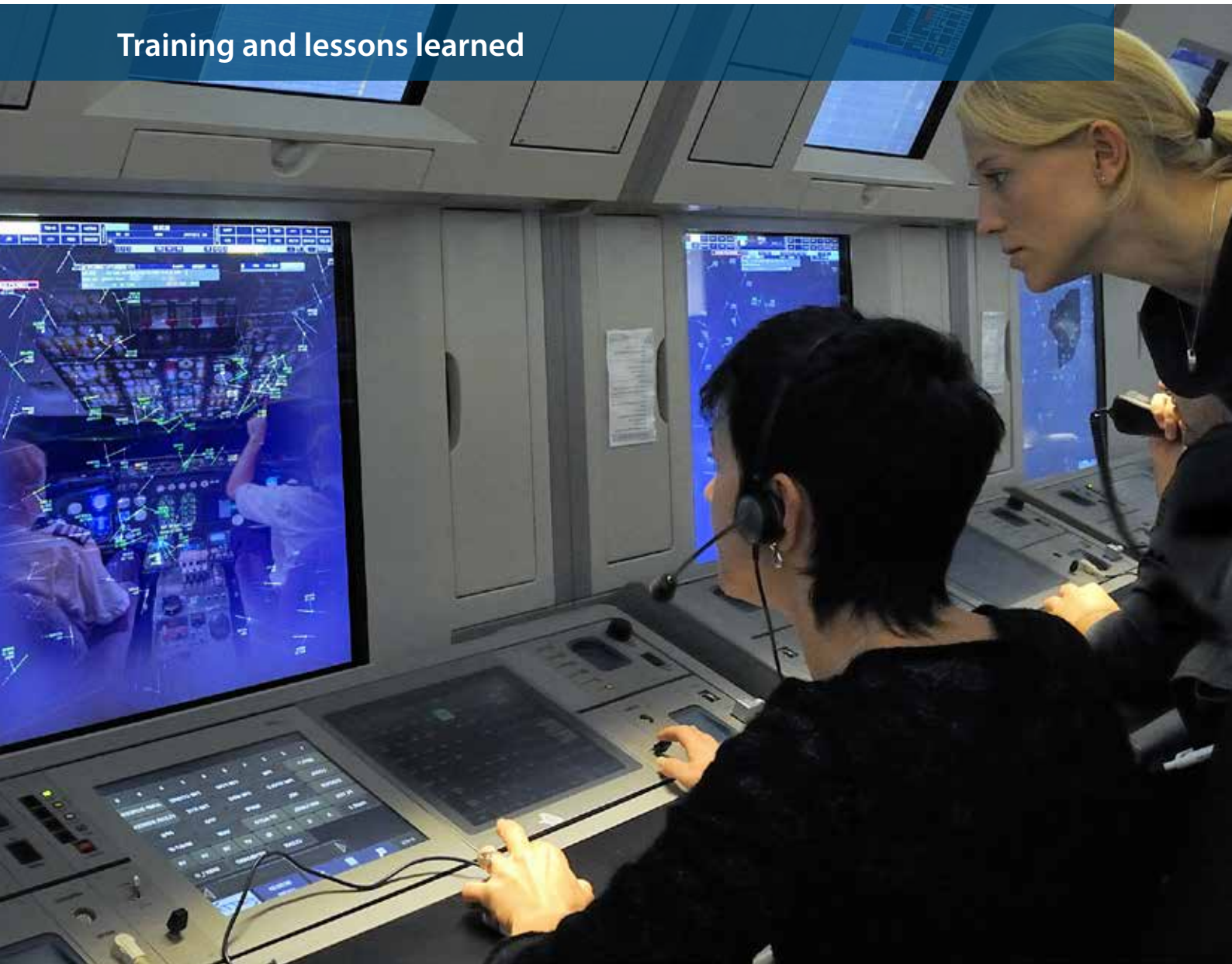
Network Manager
nominated by
the European Commission

EUROCONTROL

EVAIR Safety Bulletin No 13
2008-2013

Training and lessons learned



CONTENTS

EVAIR FUNCTION MANAGER'S PERSPECTIVE

The EVAIR team is pleased to present EVAIR Safety Bulletin No 13 covering the period 2008-2013. As in previous Bulletins, this one is also based on the reports coming from the airlines and ANSPs. Aircraft operators provide us with their ATM related safety reports for the European airspace on a daily basis whereas the main contribution from ANSPs is the feedback they provide on the airlines' reports and the regular provision of the 'Call Sign Similarity', 'ACAS RAs', 'Laser' reports etc.

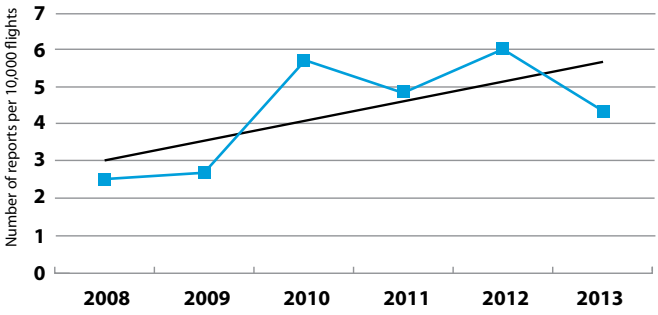


Figure 1: Incident data collection for 2008 - 2013

Data collection

For the period 2008 – 2013, EVAIR received more than 11,000 reports from different airlines. After an increase in the number of the reports recorded in 2012, we received 27% fewer reports in 2013 (Figure 1). Continuous monitoring will show us if the 2013 decrease will be continued in 2014. Irrespective of this, our data shows us that on a daily basis, within the busiest days and with the current reporting level, there were approximately 4.37 reports per 10,000 flights equating to roughly 12-15 occurrences per day across Europe.

In 2013 we received reports from more than 160 different airlines, including business aviation and private jets. This figure is within the average yearly number of airline data providers.

European ANSPs (and some from outside Europe) contribute massively to the EVAIR work; we are very grateful to the ANSPs who support our work by providing feedback on the ATM occurrences sent to EVAIR and also by supporting the monitoring of the Call Sign Similarity/Confusion project. Without their support it would be impossible to sustain a credible monitoring regime. Twelve (12) ANSPs who support this call sign similarity/confusion monitoring provided ATS service to almost 28 million flights during the period and provided about 3300 call sign similarity/confusion reports. In addition, ANSPs send us ACAS reports from the Mode S radar stations, laser reports, procedure violations, separation minima infringements etc.

Verification of EVAIR data with IATA STEADES

The good cooperation between EVAIR and IATA, and in that regard use of the IATA STEADES[1] statistics, has been very well received by our stakeholders and we expect that this cooperation will continue in the future. Besides the IATA contributions to the EVAIR Safety Bulletin, IATA works together with EUROCONTROL and specific ANSPs promoting and implementing ATM regional safety improvements.

Feedback – Reporting motivator and support to quick fixes

Good levels of reporting depend a lot on the feedback provided on the filed reports. Within EVAIR this is one of the major motivating factors for pilots to report. The best illustration for that is the rise of feedback provided on the total number of reports received from 1.3% in 2008 to 21% in 2013. We must say here that we are not always asked to get the feedback for airlines or ANSPs. A lot of occurrences are self-explanatory and neither airlines nor ANSPs ask for (or require) any feedback. This is the main reason that the percentage of the EVAIR reports covered by the feedback is not higher. We want to highlight that the trust built between the main stakeholders is also one of the main drivers for improving the feedback rate and in solving identified problems in an efficient way.

The form of the feedback information provided ranges from a few sentences to a few pages accompanied by the voice and radar records providing explanations of the root of the problem. The time frame for the feedback provision varies from a few days to a few months. It largely depends on the type, scale and scope of the problem raised and on the efficiency of the aircraft operators' and ANSPs' Safety Management Systems.

[1] *STEADES – Safety Trend Evaluation and Data Exchange System*

Main trends

Events

In 2013, all monitored areas within EVAIR: 'Level Busts', 'Runway incursions', 'Missed Approach/Go around', 'ACAS RAs' and 'Call Sign confusion', recorded a decrease in the number of events compared to 2012. Even more interesting is that in 2012 all of them, except 'Call Sign Confusion', recorded an increase versus 2011. The biggest decrease (in 2013) occurred within 'Level Bust' which saw a drop of 46% compared with the previous year.

Contributors to incidents

– Within the top seven contributors only two of them recorded a decrease, i.e. 'Mistakes' and 'Air-Ground Communication' which in general have the highest number of reports. The other five contributors recorded an increase. It is interesting to see that some of them such as 'Lapses', 'Traffic Information', and 'ATC Clearance/Instructions' have seen a constant rise for the last three years. In 2013, among the top seven contributors, the highest increase, 82%, was recorded within 'Coordination issues'.

ACAS RA data collection

We want to emphasise that ACAS statistics from manual reporting rely a lot on pilots' and air traffic controllers' perceptions and memories of the events rather than on measured or calculated values. However, a large number of reports have been based on the ANSPs' operational investigation which includes radar and voice records. After an increase in 2012, ACAS RAs collected manually decreased by 31% in 2013. On a daily basis we came from approximately 2 to 3 occurrences in 2012 to 1or 2 occurrences in 2013 for the whole European airspace. In terms of the daily number of TCAS RAs collected automatically by the Automated Safety Monitoring Tool (ASMT), in 2013 we had slightly higher number than in 2012 but still within the same range of 2 to 3 TCAS RAs. The data for these events comes from 13 Mode S radar stations operated by two ANSPs. Comparing these figures with the manual/pilot reporting, it shows that we are still not capturing a large number of TCAS RAs. Consequently, a more widespread introduction of automatic monitoring and data collection processes could help us identify and provide us with a much better picture of the operational and technical problems associated with TCAS.

Laser Interference

After two years of decrease, in 2013 we recorded a slight increase in the number of laser attacks. The data show that, on average in 2013, there were approximately 2 laser interferences per day across Europe. In addition to green laser interferences in 2013, we received three reports involving the newer blue laser. These devices are even more powerful and dangerous than the green ones and can cause permanent eye damage if targeted directly to the eyes. It is encouraging to see, though, that in the laser reports pilots and controllers are following the recommendations to report the attacks immediately: pilots to air traffic controllers and controllers to the police. However, continued use of green laser and appearance of the blue lasers requires more involvement of national/local aviation security and law enforcement units.

Remotely Piloted Aircraft Systems (RPAS) - An Emerging Threat?

In the same way that the threat of laser attacks emerged a few years ago, 2013 saw the first report to EVAIR concerning the uncoordinated operation of RPAS (Remotely Piloted Aircraft Systems) or 'drones' in the vicinity of aerodromes/inside controlled airspace. The growing trend of aerial photography has seen a significant rise in the popularity of devices such as 'quad copters' which are readily available on the open market. Commercial operators generally follow any local rules and regulations that are in place but many untrained and unlicensed 'enthusiasts' are not aware of the rules and the potential flight safety and security dangers. Like the laser problem, tackling the threat posed by uncoordinated operation of RPAS/drones will take the combined efforts of national/European authorities and stakeholder groups. EVAIR will monitor the situation and would welcome reports involving close encounters with these devices in the vicinity of airports/inside controlled airspace.

Call Sign Confusion

For the last three years EVAIR has recorded a steady decrease in the number of 'Call Sign Confusions' within pilots' reporting. Within ANSPs' reporting, after three years of decreasing numbers in 2013 we saw an increase in the number of the 'Call Sign Confusion' (CSC) events. This is due, in part, to an increase in the number of ANSPs reporting. EVAIR will continue to monitor the situation.

By the end of 2013, 25 airlines were using the EUROCONTROL Call Sign Similarity Tool (CSST) to partially or wholly de-conflict their flight schedules. Since then, more airlines have signed up to use the CSST and this should hopefully help to reduce the number of incidents induced by the similar call signs.

In 2013, ANSPs identified 194 different airlines having problems with similar call signs, the majority of which were recorded within the same airline. Normally, call sign events involve only 2 call signs but we did see one multi aircraft operator event in 2013 involving up to 6 similar call signs!

Stakeholders' Corner

IATA

The IATA analysis for EVAIR Safety Bulletin No 13 was conducted on Air Safety Reports (ASRs) held in IATA's Safety Trend, Analysis, Evaluation and Data Exchange System (STEADES) database. The STEADES database is comprised of de-identified safety incident reports from over 175 participating airlines throughout the world, with an annual reporting rate exceeding 190,000 reports per year. For the period 2008 – 2013 a total of 653,529 all type of airlines' reports were submitted and collated into STEADES. The airlines participating and submitting data to STEADES represent a total of 43,634,240 flights from 2008 to 2013. The nature of data collection within STEADES only allows for rates normalized by sectors flown to be calculated by region of operator (not region of event occurrence), as determined by the Air Operator Certificate state of the airlines that submit data. The ASRs analyzed for this report were extracted from the STEADES database

The reader should also bear in mind that the data and rates presented are based on events reported by flight and cabin crew and therefore influenced by airline reporting cultures and not covering only ATM field. The topics of 'Altitude deviation reports', 'Go-around reports', Aircraft / Traffic Collision Avoidance System reports, 'Call Sign Confusion' reports, Loss of communications' reports and 'Wake turbulence' reports are categorized in the STEADES database according to descriptors assigned at source by the STEADES participating airlines. Considering the five year period, all categories showed various increasing trends for the rates from 2009 to 2013. These increases may be due to a number of factors including improved reporting cultures and new airlines joining STEADES. Of concern are 'Altitude Deviation' reports, which increased year over year since 2009. The rate for 'Altitude Deviation' reports is approximately 12 times higher in 2013 compared to the rate in 2008. It is interesting to note that all five of these categories may be related to traffic density, meaning that occurrences are likely to increase as traffic (and pilot/controller workload) increases.

Security and Confidentiality

In collecting and processing data, EVAIR follows strict security and confidentiality arrangements. Safety data provided are properly safeguarded and de-identified and the information is only used for the promotion and enhancement of aviation safety.

EVAIR Suggestions/Improvements

EVAIR is constantly looking at ways to improve its services and products. Suggestions and proposals are more than welcome. Please forward any thoughts, ideas and comments to Ms Dragica Stankovic EVAIR Function Manager:
dragica.stankovic@eurocontrol.int

ATM EVENTS AND SUPPORT TO EUROPEAN SAFETY ACTION PLANS

Selected types of European ATM events are presented in this EVAIR Safety Bulletin No 13. The data provides an opportunity to check the status of the trends, especially those related to the European Action plans, studies or projects which are in EVAIR's sphere of interest. As additional added value, the data enables us to compare European and the Global trends thanks to the availability of IATA STEADES data.

Our aim is to provide to operational ATM safety experts another perspective of ATM safety as seen through the data provided voluntarily by the airlines and ANSPs. Indeed, reader reaction and feedback tells us that the view brought by EVAIR gives them the opportunity to adjust their safety picture and pay attention to areas where they had no previous safety information or, if they did, where it was very obscure.

Traditionally, we look at the five event types (Figure 2 & 3):

- Level Busts
- Runway incursions
- Missed Approach/Go around
- ACAS RAs
- Callsign confusion

These events were selected because EUROCONTROL (in conjunction with other stakeholders) developed action plans for them or produced other types of studies.

It is interesting to note that in 2013 within EVAIR all the monitored areas recorded a decrease in the number of events compared with 2012. Even more interesting is that all of them, except 'Call Sign Confusion', recorded an increase versus 2012.

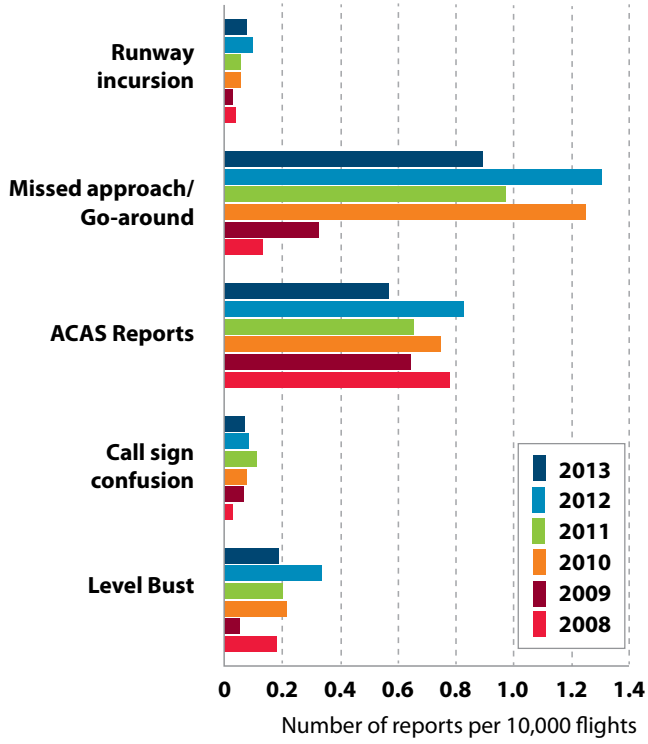


Figure 2: European ATM Events 2008 – 2013

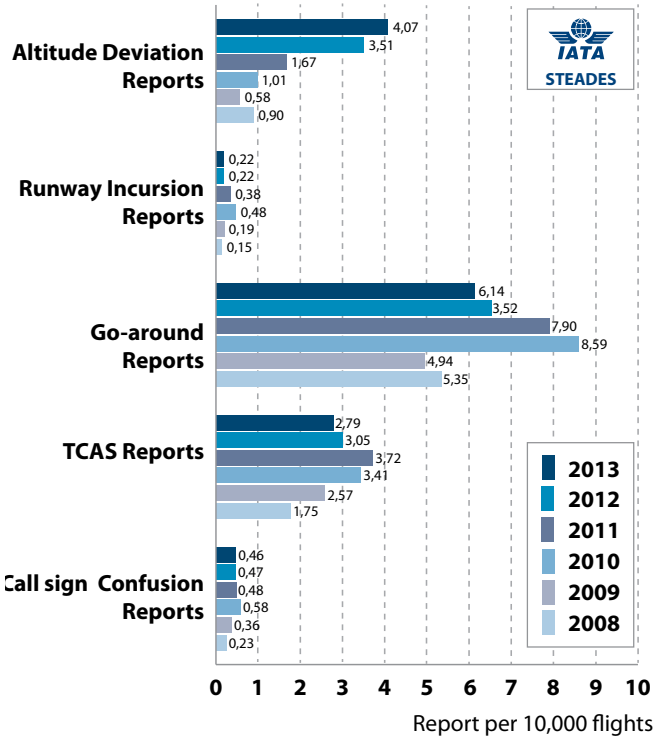


Figure 3: ATM events 2008 – 2013

Rates within STEADES regarding the 5 selected event types are generally similar. The only difference is that within STEADES 'Altitude Deviation' ('Level Bust') recorded an increase versus 2012.

More detailed statistical information for each of the five types of event is presented later in this Bulletin. You can also find out more about each of the event types on SKYbrary:

http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Level_Bust;

http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Incursions;

http://www.skybrary.aero/index.php/European_Action_Plan_for_the_Prevention_of_Runway_Excursions_(EAPPRE)

To learn more about STEADES: www.iata.org/steades

CONTRIBUTORS TO ATM OCCURRENCES

The intention of having this chapter in the EVAIR Safety Bulletin is to show that there are contributors which are common to different event types. This means that by mitigating their impact, or even better eliminating them, will have a beneficial effect not only on the five areas presented in the Figure 2 but also on others which have not been presented in this Bulletin.

Figure 4 presents the top seven high-level contributors common to the majority or almost all the different types of events presented in the EVAIR Safety Bulletins and especially to those presented in the figure 2. The contributor 'Air-Ground communication' is examined further in the chapter Air-Ground Communication on page 21.

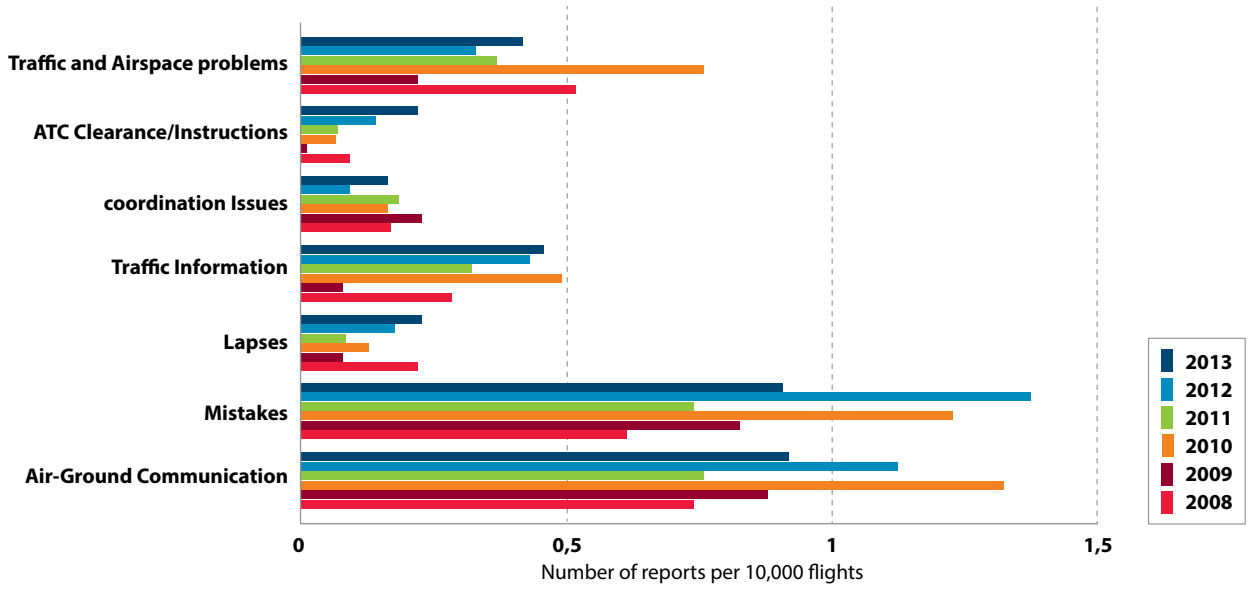


Figure 4: Contributors to ATM incidents – all phases of flight 2008 – 2013

It is interesting to note that within the top seven contributors, only two of them recorded a decrease 'Mistakes' and 'Air-Ground Communication' which in general have the highest levels. The other five recorded an increase. Some of them like 'Lapses', 'Traffic Information' and 'ATC Clearance/Instructions' have seen a constant rise for the last three years. The data, including feedbacks from the ANSPs or AOs provides us with an indication that we perhaps need to pay more attention on these areas either through activities such as refresher training courses or by raising the awareness through the different local or pan-European tools.

'Traffic and Airspace problems' and 'Coordination issues' recorded an increase in 2013 after having decreased in 2012. Among the top seven contributors 'Coordination issues' recorded an increase of 82% in 2013.

GO-AROUND

The answer to the question, "why do we monitor 'Go-around?', is that although it is a normal phase of flight it does not mean that there are no safety issues associated with it. Our monitoring and high level statistics together with the provided feedbacks support this. Therefore EVAIR and IATA STEADES will continue to monitor 'Go-around' in order to identify safety issues and broken barriers associated with the manoeuvre. This monitoring has been in place for a number of years: EVAIR at the pan-European level and IATA STEADES at the global level. The aim of the monitoring, besides the identification of safety concerns, is to support and provide assistance to different activities and stakeholders enabling them to mitigate and whenever possible fix the problems that precipitate 'Go-arounds'. Having in mind that the 'Go-around is closely linked with flight efficiency, fuel saving and airspace capacity, mitigation or elimination of the main causes and broken barriers makes a positive contribution to overall ATM system performance. Common EUROCONTROL-IATA visits to the different ANSPs together with invited airlines show that 'Go-around' is not an isolated 'local' problem but has a pan-European dimension.

During the period 2008 – 2013, both the EVAIR and IATA repositories show an increasing trend per 10,000 operations; although both datasets show a downward movement in 2013. The 2013 'Go-around' Safety Forum identified numerous issues related to 'Go-arounds' and provided a set of conclusions for consideration by the different stakeholder groups.

http://www.skybrary.aero/index.php/Portal:Go-Around_Safety_Forum_Presentations

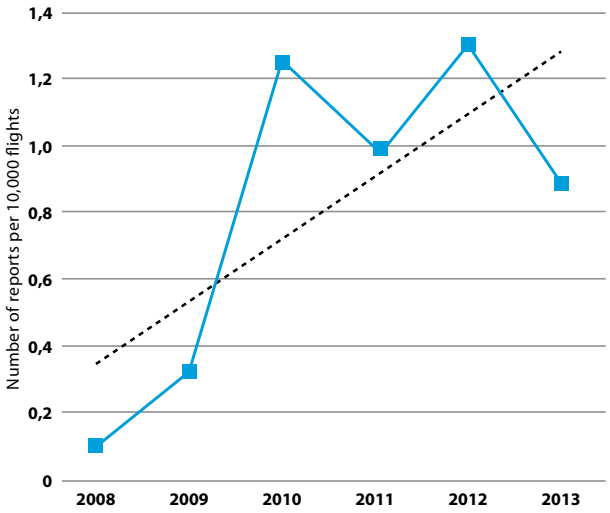


Figure 5: Missed approach-Go-around 2008-2013

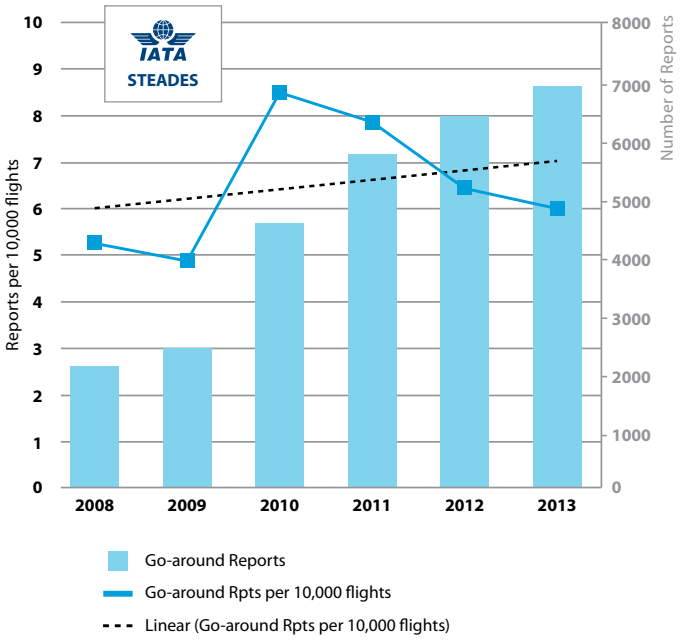


Figure 6: Go-around reports 2008-2013

In-depth analysis of the 'Go-around' in Figure 7 shows a number of contributors. A quick comparison of the 2008 – 2012 period with 2008 – 2013 shows that a 5% increase was recorded within the area of 'Separation Minima Infringement' while 'Landing without clearance' increased marginally. The following areas recorded slight reductions of the number of events: 'Runway occupied', 'Weather', 'Wake turbulence' and 'Birds'.

The increase of the 'Separation Minima Infringement' is an indication of controllers' and pilots' performance especially during the approach phase. It is closely linked with speed limit issues, either related to the controllers' incorrect instruction or pilots' lack of the respect of the controllers' instruction. The speed problem is also linked to the impact of the wind which may not always be properly taken into consideration. It is also necessary to say that 'Separation Minima Infringement' is closely linked also with controllers' lack of knowledge concerning aircraft categorisation and performance. Improvements in controller training provide an efficient and cost-beneficial way to mitigate the identified risk factors.

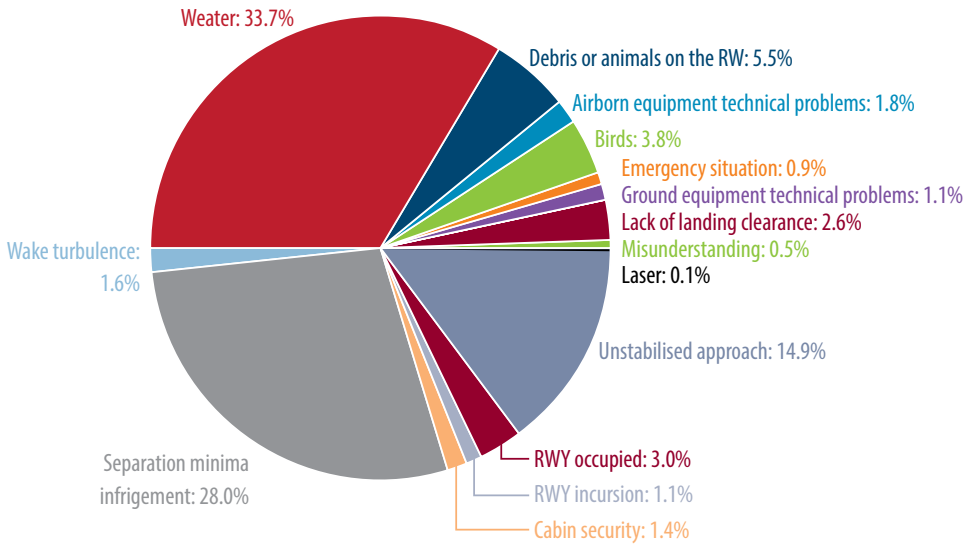


Figure 7: Go-Around contributors 2008-2013

RUNWAY INCURSIONS

The trend lines for the complete period 2008 - 2013 within both EVAIR and IATA STEADES repositories show an increasing trend (Figures 8 & 9) in the number of reported Runway Incursions. However, it is interesting to see that relative figures at pan-European and Global level recorded a reduction in the number of 'Runway Incursions' in 2013. Further monitoring will show if this trend will continue in both repositories. Within IATA STEADES, we already see this trend for the last few years.

For the period 2008 – 2013 within EVAIR data, 'Runway Incursion' occurred at more than 60 different locations across Europe involving 35 different Air Operators. However, in 2013 EVAIR recorded 'Runway Incursions' at 31 different locations involving 23 Air Operators and 14 ANSPs.

We take this opportunity to draw the attention of our readers and experts - especially those from the airports' runway safety teams to make the best use of the European Action Plans for the prevention of the Runway Incursions (and Excursions) in mitigating or solving identified problems.

http://www.skybrary.aero/bookshelf/books/151.pdf

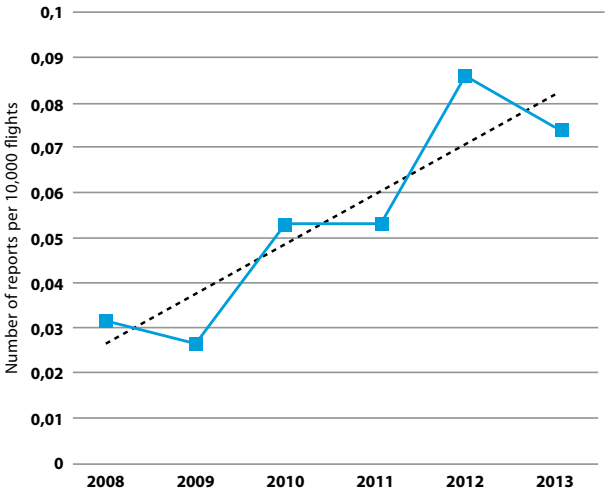


Figure 8: Runway Incursion 2008-2013

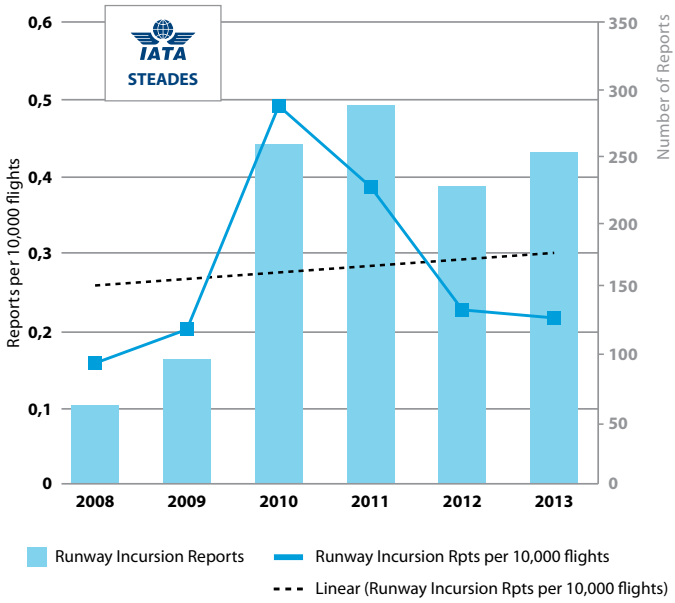


Figure 9: Runway Incursion 2008-2013

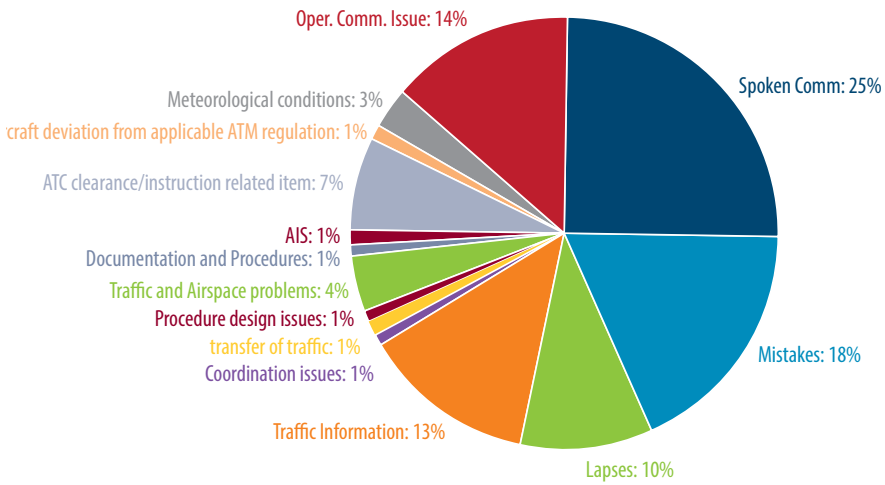


Figure 10: Runway Incursions in-depth analysis cumulated figures 2008 – 2012

In this Safety Bulletin (Figure 10) we show a more detailed picture related to 'Runway Incursions' contributors.

The EVAIR repository shows a number of these contributors. 'Spoken communication', 'Mistakes' and 'Operational communication' account for almost half of the problems. Among them, 'Hear-back omitted', 'Misunderstanding' and 'Planning' feature in the greatest number of reports. It is important to note that 17% of the 'Runway Incursions' events also involved an aircraft executing a 'Go-around'. The most frequent problem was other traffic on the runway or runway not vacated. 'Traffic information' with 10% is also an area of concern which deserves more attention; usually it is related to 'late' or 'incorrect' traffic information.

LEVEL BUST

For the period 2008 – 2013 'Level Bust' occurrences account for 4.8% of the overall EVAIR reports. The largest number of Level Bust events, as reported by the AOs, occurred within the En-route phase, i.e. 62% which is slightly higher than for the previous period. TCAS, as the last airborne safety net, acted in 9% of the 'Level Busts', which is 2% less than for the previous period.
For the period 2008 – 2013, 'Level Bust' events occurred at more than 128 different locations across Europe; in 2013 it occurred at 31 locations. For the complete monitored period, more than 50 commercial AOs were involved in 'Level Bust' scenarios; in some areas it was a repeat problem.

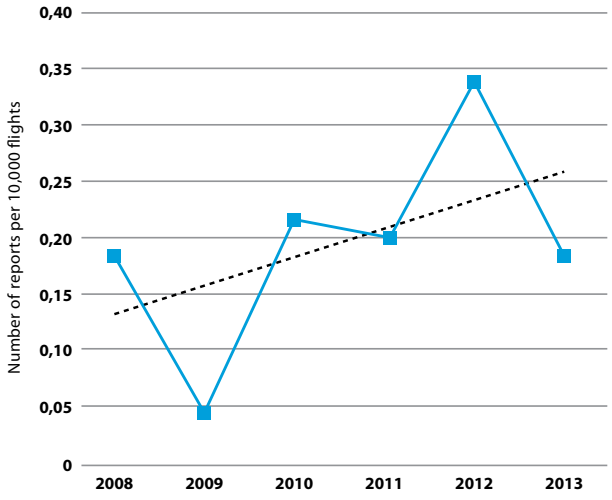


Figure 11: Level bust 2008-2013

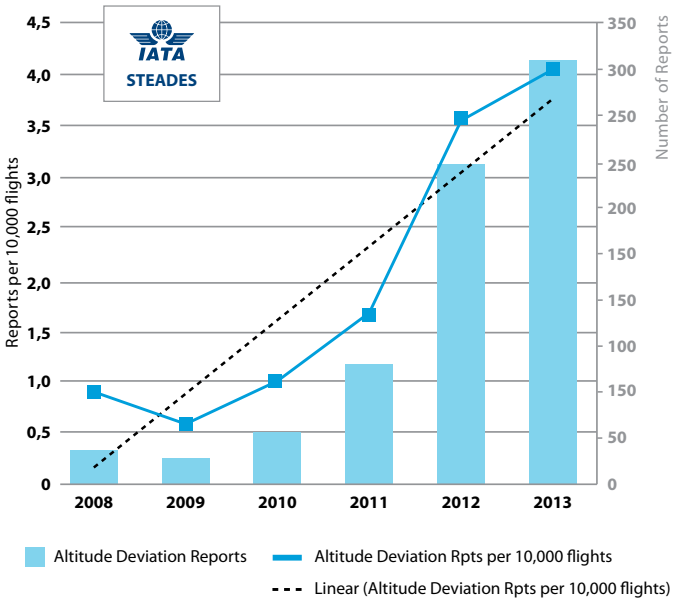


Figure 12: Altitude Deviation 2008-2013

The trend lines in both the EVAIR and IATA STEADES repositories show an upward profile (Figures 11 & 12). After a high increase in 2012, EVAIR recorded a decrease in 2013 achieving a level below year 2011. On the other side, IATA STEADES data shows a continuous increase in the number of 'Level Busts' since 2008. One of the reasons for the reduction of the number of 'Level Busts' (according to EVAIR data) within the European region could be the impact of the (Call Sign Similarity project and use of the EUROCONTROL) Call Sign Similarity de-confliction tool. This tool reduces the number of call sign similarities which are one of the main contributors to Level Bust events.

Within the EVAIR repository we identified more than 40 different 'Level Bust' contributors. In 31% of them ATM had direct involvement and in 17% indirect; the remaining 52% are assigned to the airborne element. Figure 13 shows the majority of those 40 different contributors. It is interesting that 'Planning', 'Misunderstanding/misinterpretation', 'Hear-back omitted', 'Call Sign Similarity' and 'Pilot problems' - usually linked to the familiarity with the airspace, full understanding and situational awareness – account for more than 50% of the 'Level Bust' issues. This clearly indicates where to look in order to improve the situation.

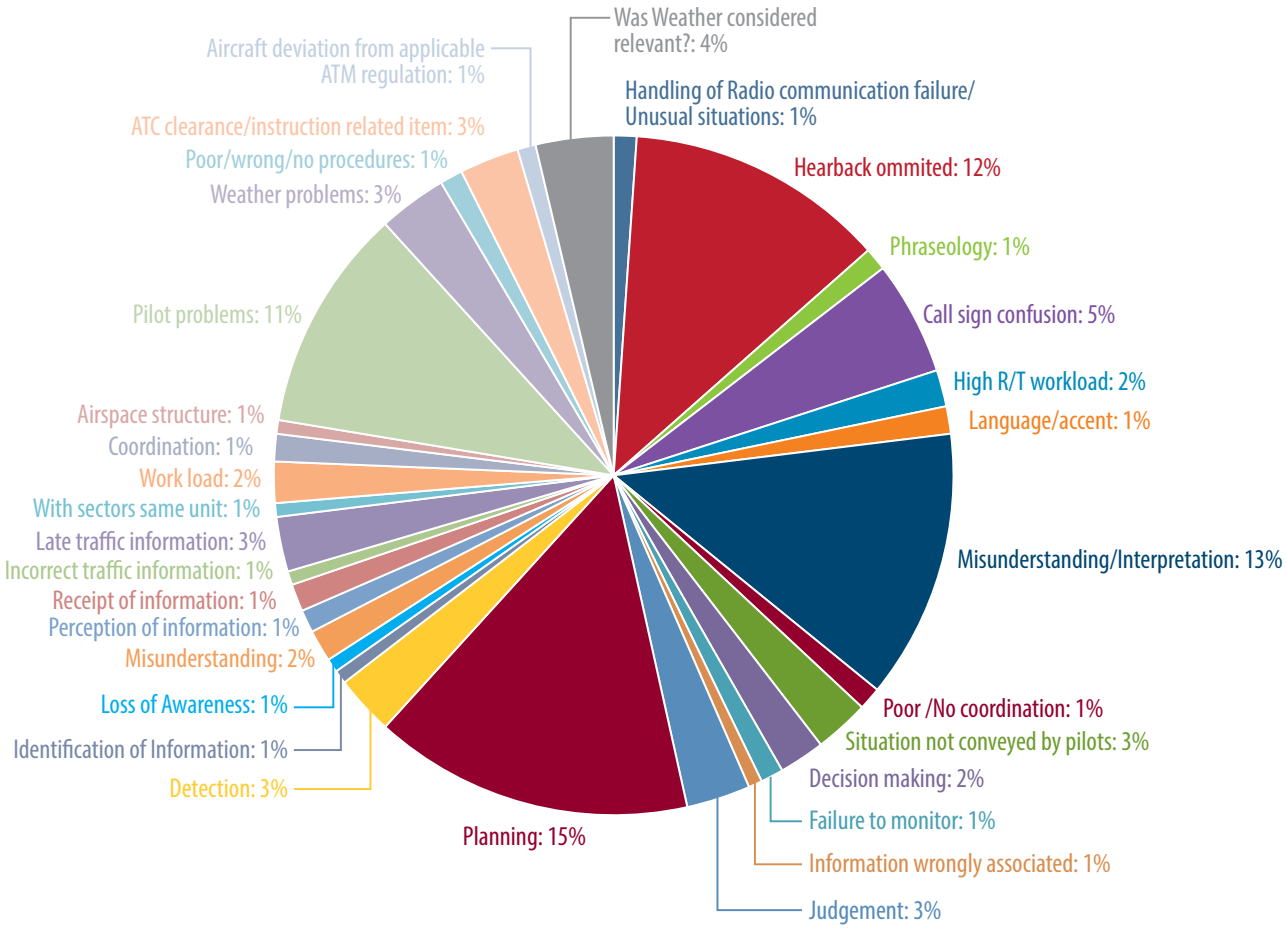


Figure 13: Level Bust contributors cumulative figures 2008 - 2013

EVAIR SUPPORT TO CALL SIGN SIMILARITY IMPLEMENTATION PROJECT

EVAIR continues to monitor the use and effectiveness of the EUROCONTROL (Call Sign Similarity) de-confliction Tool (CSST) and the associated CSS Service Level 1, namely, the detection and de-confliction of similar call signs in a single Aircraft Operator's schedule. Since the EVAIR monitoring results will be used among other facts for the CSST safety assessment and as a decision making element to go on with the Level 2, we provide more details than for the other monitoring areas.

CSST Operations Update

Further refinements continue to be made to the Tool and these came into effect with the NM 18.0 and 18.5 software release in March and October 2014 respectively. Further changes are in the pipeline for NM 19.0 Release in March 2015. These refinements are in response to user feedback and are all intended to make the CSST more user-friendly and/or to improve its detection and de-confliction capabilities.

Those Aircraft Operators (AOs) who have not yet started using the CSST are invited to join the growing number (now 40) who already use the CSST to partially or fully de-conflict their flight schedules. Our data shows us that the average de-confliction rate for AOs using the Tool is just over 90%. This is in line with previous seasonal figures and is well above expectations. The really good news is that this success rate is also reflected in 'live' operations. As will be shown in the later graphs in this section, the absolute number and rate of CSS/C events for CSST Users is very small in particular when compared with non-CSST Users. So at this stage of the CSS Project we can say that the Tool is working as envisaged – the number of similarities and confusions (at least for Tool Users, is down) which is **good news for safety**. Simultaneously, there have been efficiencies in the de-confliction process.

It is also pleasing to report that through the CSST performance monitoring regime – supported by EVAIR – we also continue to contact many AOs who, whilst not actually using the Tool, are willing to make ad hoc mid-seasonal changes to known (reported) conflicts. This is also a major success for the Project; of course we would like more CSST Users (see below) but this random cooperation is better than doing nothing, as was often the case in the past.

However and notwithstanding these successes, we cannot rest on our laurels. There is still a large number of AOs who we would like to see make the transition from interest in the CSST to actually using it. Furthermore, there are many more airlines that have not shown any interest in CSST and it's our job to reach out and encourage them to join us. Globally there is a lot of interest in what we are doing and we continue to receive enquiries from the Middle and Far East as well as North America and Africa. So, if you are reading this and you're not sure if your airline is using CSST then please go and ask; likewise, if you're a controller and not sure if your ANSP is sending call sign similarity/confusion data to EVAIR then please ask the appropriate person. The data we receive helps us understand how effective the CSST is in 'live' operations and, as explained many times before, EVAIR is happy to facilitate contact and feedback between AOs and between AOs and ANSPs to resolve call sign similarities/confusions and other operational issues.

CSS Feedback – Questionnaires and User Group

As part of a continuous customer feedback process, 2 short questionnaire surveys were launched during October and November 2013. The first was targeted mainly at AOs to gain their opinions about the utility and effectiveness of the CSST. The second was aimed more at the ANSPs with the intention of finding out more about the CSS 'local' rules that may apply in certain states and/or are applied by the ANSPs. The analysis of the responses will be used to inform future development of the CSST and associated services and will be discussed during the **CSS User Group meeting which was held in EUROCONTROL HQ Brussels on Tuesday 27 January 2015.**

It's also not too late to complete one or both of the questionnaires. These may be accessed via the following web links:

CSST:
https://adobeformscentral
com/?f=VgTusJwNbpoe4F0%2AhOImdA

ANSP Local Rules:
https://adobeformscentral.com/?f=llge5hHpwuJiQfJgra-jWg

Call Sign Management Cell (CSMC) Support

The CSMC (nm.csmc@eurocontrol.int) is also on hand to help the AOs to pass through the application process. The CSMC prepares the CSST for the forthcoming season and is available to discuss AOs' training requirements. Familiarization sessions can be provided in Brussels or, if requested and subject to CSMC staff availability, may be provided on-site at the AOs' premises.

Learn More About Call Sign Similarity

If you are interested in learning more about the CSS Project then please contact the CSS Project Manager and co-chair of the CSS User Group, Mr Richard Lawrence, at:
richard.lawrence@eurocontrol.int or via
callsign.similarity@eurocontrol.int

You can also contact the Call Sign Management Cell (CSMC) at nm.csmc@eurocontrol.int

And find more information on the Call Sign Similarity Project please at: http://www.eurocontrol.int/services/call-sign-similarity

The latest Call Sign Similarity/Confusion data reported to EVAIR and the comparison with IATA STEADES data is shown below.

CALL SIGN SIMILARITIES AND CONFUSIONS 2008 – 2013 TRENDS

EVAIR uses two tracks to monitor Call Sign Similarities and Confusions: One from the airlines and the other from ANSPs. Reports coming from pilots are mainly related to the confusions, while those coming from ANSPs are similarities and confusions.

pilots' reports - Callsign confusion

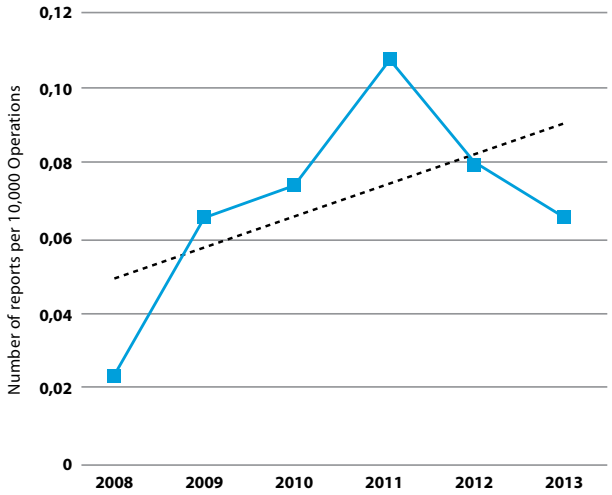


Figure 14: Callsign Confusion 2008-2013

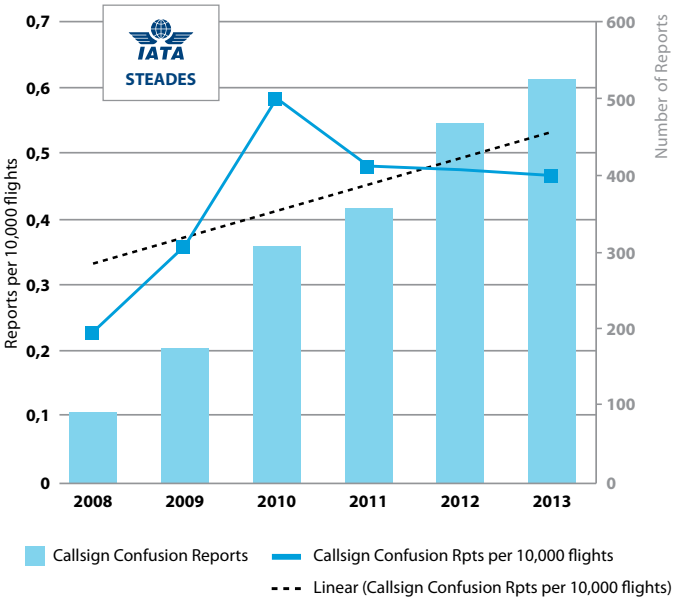


Figure 15: Callsign Confusion 2008-2013

In 2012 and 2013, both EVAIR and IATA STEADES repositories, recorded a reduction (in absolute figures) in the number of pilots' reports related to the 'Call Sign Similarities/Confusions'. However the trend lines within both repositories still show an increasing trend. If the data would be looked only for the last four years then the trend line would show a gradual decline. We will continue to monitor to see what the results will be, especially having in mind that the number of AOs using the EUROCONTROL Call Sign Similarity de-confliction tool increases from day to day. Currently (November 2014) about 40 airlines are using the CSST to partially or wholly de-conflict their flight schedules. This compares with 18 CSST users at the end of 2012 and 25 at the end of 2013. It's possible that the continued decrease in 'Call Sign Confusions' in 2013 as reported by pilots may be linked with the increased number of the airlines using the de-confliction tool. Other factors which could also account for the drop in numbers are the airlines willingness to make mid-season, ad hoc changes to call signs following intervention by EVAIR and/or the EUROCONTROL Call Sign Management Cell following submission of CSS/C reports, or the continued increase of the application of the alphanumeric logic for creating call signs. EVAIR will continue to monitor the data and play its part in facilitating mutual cooperation and support between the airline and ANSP communities.

During 2008 – 2013, 'Call Sign Confusion' as reported by pilots, occurred at more than 60 different locations across Europe. It is interesting to note that in 2012 and 2013 we had the conflict of the similar call signs for the same number of locations but not always at the same locations. For the period 2008 – 2013, we recorded 10% fewer 'Call Sign Similarities' within the en-route phase which comparing with the other phases of flight still has the largest number of reports (57%). According to the airlines' reports, 71% of the 'Call Sign Confusions' occurred between two or more aircraft from the same airline. However, during 2013, this percentage is lower and 66% of the similarities were classified as 'Single AO' events. Again, it could be another indicator of the positive effect of the use of the Call Sign Similarity de-confliction tool.

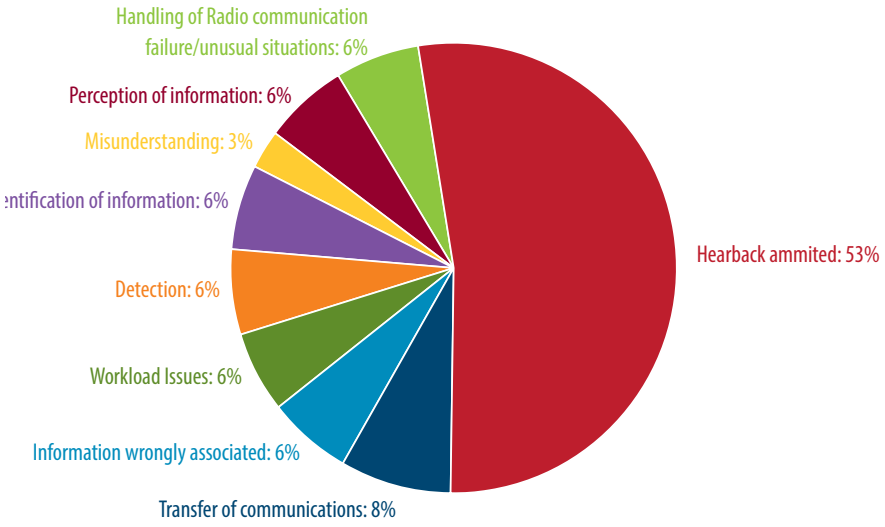


Figure 16: Call Sign ATM contributors 2008 – 2013

AIR NAVIGATION SERVICE PROVIDERS' CALL SIGN SIMILARITIES AND CONFUSIONS

For this Safety Bulletin about 3300 CSS/C voluntary reports have been provided from 12 ANSPs who, for the monitored period, provided ANS to almost 28 million flights. The majority of the ANSPs report monthly but some of them report daily. EVAIR as well as CSMC are flexible in this regard and we deal with these reports whenever they are provided. Daily reporting enables the CSMC to make an earlier approach to AOs to request a change of call sign(s) in response to reported CSS/C events. Pleasingly, so far all AOs have shown a willingness and readiness to change an affected call sign(s) even during the current scheduled season whenever it was possible.

The data set provided by the ANSPs is bigger than the one provided by the AOs and gives a wider view in some areas and possibilities for more statistical analysis. This is very important because EVAIR has been tasked to monitor the 'Call Sign Similarity/Confusion' project in terms of the efficiency of the CSS de-confliction algorithm and the tool. The graph at figure 17 shows that in 2013 194 AOs were identified as having problems associated with 'Call Sign Similarity/Confusion'. The improving level of ANSP reporting provides the opportunity for either the CSMC and/or EVAIR to address these AOs and ask for a change of Call Signs identified as similar.

Figure 18 shows the total number of the CSS and CSC reports irrespective of the use of the 'Call Sign Similarity' de-confliction tool or not. The graph shows an increase in the number of CSS and CSC events in 2013. It is suspected that the main reason behind these figures is the growth in ANSP reporting – 13 ANSPs at the end of 2013 compared with 9 at the end of 2012. There is also heightened awareness about the importance of the good reporting for the identification of similarities and confusions and the possibilities to make mid-season changes to similar Call Signs. In recent months a further 3 ANSPs have joined the EVAIR CSS/C reporting regime and it's hoped that more will follow.

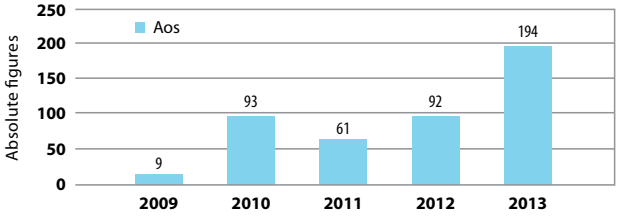


Figure 17: Number of AOs with the CSS/C as identified by ANSP 2009 - 2013

Figure 19 compares the situation concerning CSS and CSC events between CSST users and non-users per 10, 000 flights. Data for 2013 shows an increase in both types of events for tool users and non-users. Again, increased reporting may account for some of this growth. However, it is important to note that the trends for CSS/CSC events within the CSST users cohort of AOs is much lower than for their non-CSST user counterparts. EVAIR will continue to monitor the situation closely to see how these trends develop in the future.

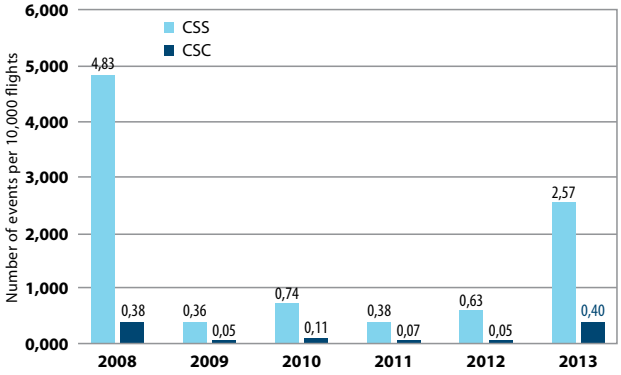


Figure 18: Call Sign Similarities/Confusions by ANSPs 2009 – 2013

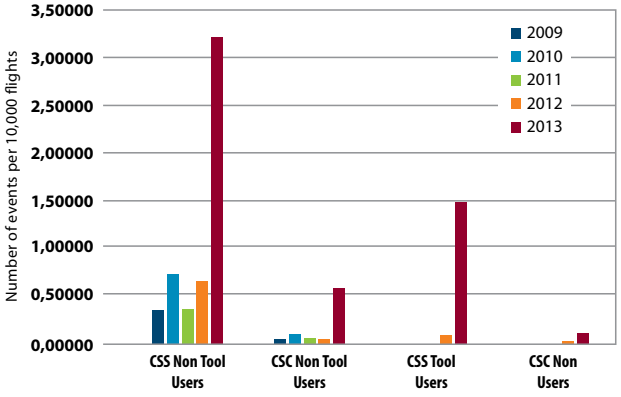


Figure 19: Call Sign Similarities/Confusions – De-confliction tool users and non-users 2009 - 2013

AIR-GROUND COMMUNICATION

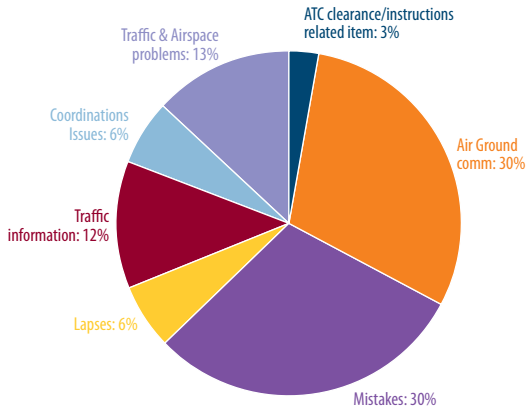


Figure 20: Contributors to ATM Incidents cumulative figures 2006 - 2013

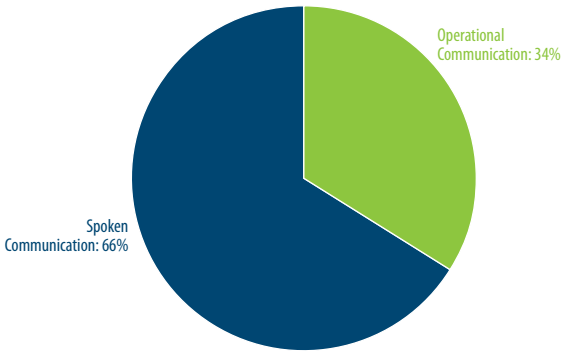


Figure 21: Air-Ground communication cumulative figures 2006 - 2013

'Air–ground communication' according to the EUROCONTROL HEIDI taxonomy covers two main areas: 'Spoken' and 'Operational' communication (see definitions on the page 45).

'Air-Ground communication' as presented on the Figure 20, is one of the contributors with the highest contributions to the top seven contributors common to all events monitored by EVAIR. As such, 'Air-ground communication' contributes e.g. to the 'Runway Incursions', 'Level Busts', 'ACAS RAs', 'Call sign Similarities/ confusions' and 'Go-around' etc.

A drill down through the data base shows that within 'Air-ground communication', 'Spoken' communication is a factor in two thirds (66%) of cases whilst 'Operational' communication accounts for the remainder (Figure 21).

A further drill down through the 'Spoken' communication area (Figure 22) shows that the areas with the largest number of reports were 'Situation not conveyed by pilots' and 'Misunderstanding/ Interpretation'. It is encouraging to see that these areas show a steady decline in the number of reports from 2010 to 2013. The same applies to 'Call Sign confusion'. The area which shows a steady increase is 'Other pilots" problems.

This area encompasses a number of issues such as pilots forgetting to turn on the loudspeakers after taking off a headset; wrong displayed frequency; problems to communicate with the ground ATC; blocked frequency by other aircraft; frequency range of the ground stations and lack of readability; and use of the 2nd transmitter and forgetting to change it back to the working frequency.

Within 'Operational Communication' (Figure 23) among the five different contributors 'Hear back omitted' and 'Handling of radio communication failure/unusual situations', recorded more reports than the others. It is important to note that although 'Phraseology' featured in fewer cases than 'Hear back omitted' and 'Handling of radio communication failure/unusual situations', during the last two years it recorded an increase. We will continue to monitor these contributors to watch the future trend developments.

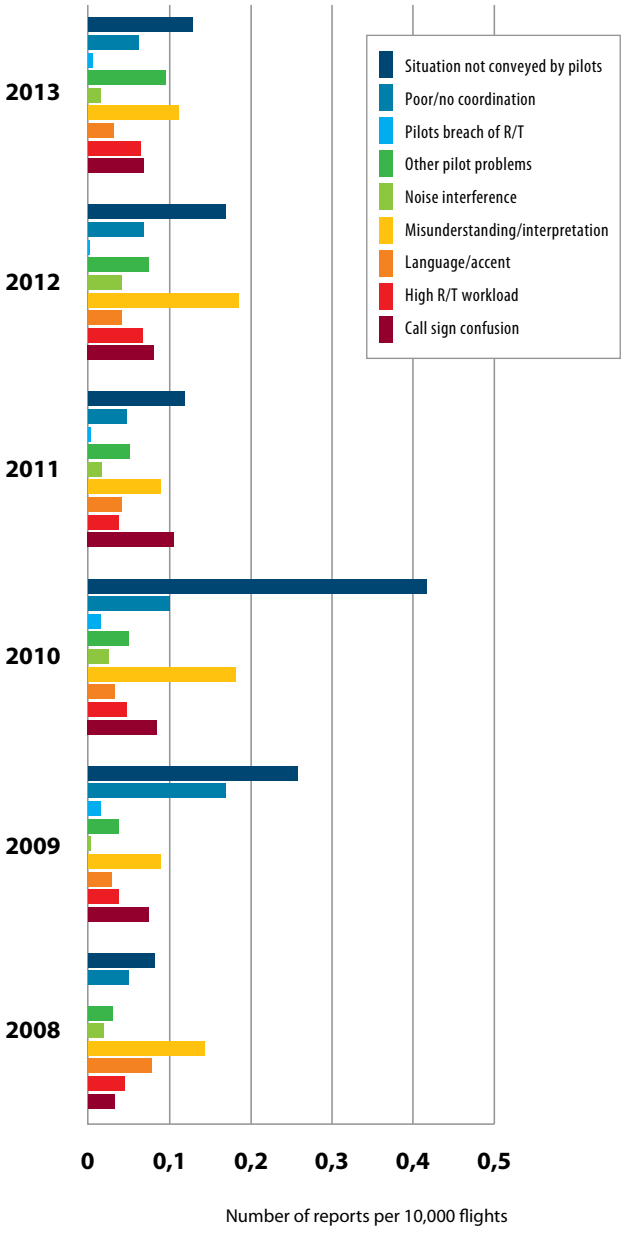


Figure 22: Spoken communication 2008-2013

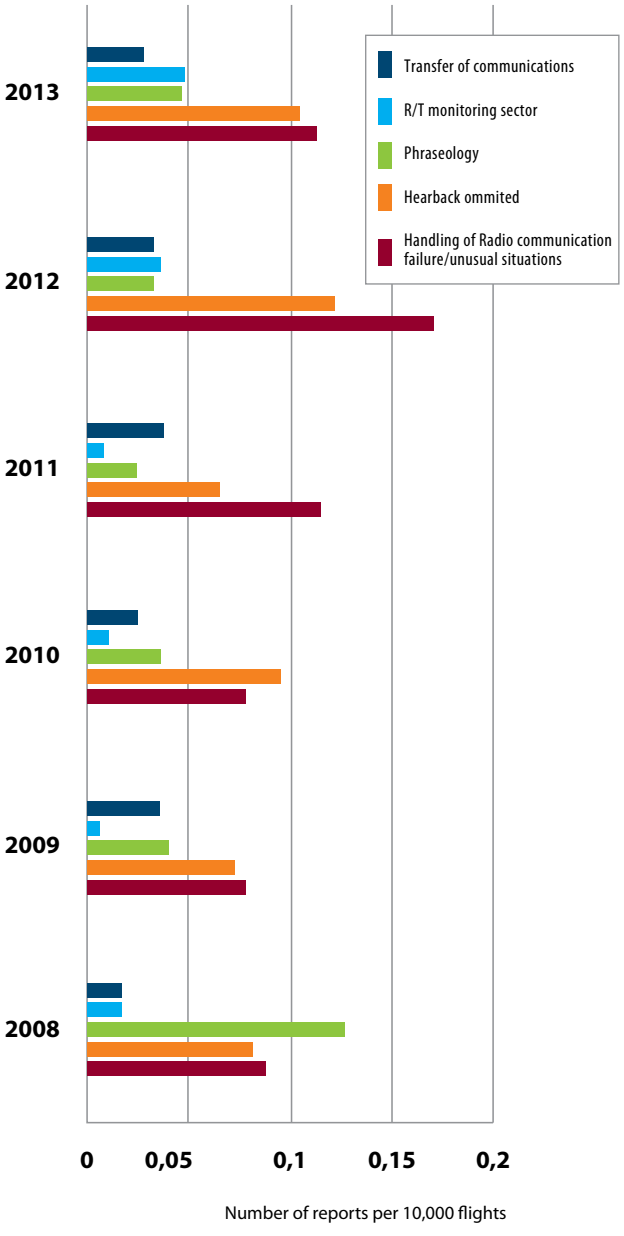


Figure 23: Operational communication 2008-2013

LOSS OF COMMUNICATION 2008 - 2013

Following requests from our stakeholders, EVAIR also produces high-level analysis related to the temporary 'Loss of communication'. For the period 2008 – 2013, EVAIR identified 308 losses of communication.

For the period 2011-2013, 'Loss of communication' was recorded at 36 locations within 16 states. In 2013, the same phenomenon was recorded at 21 locations within 12 different states. Some of the locations/FIRs had repeated 'Loss of communication' problems. In 2013, EVAIR recorded also one 'En-route' 'Loss of Communication' event which resulted in an actual military interception.

A comparison between EVAIR and IATA data shows different trends. EVAIR data indicates an upward trend whereas IATA data shows a downward movement per 10,000 flights. Further monitoring will demonstrate if this trend difference will continue.

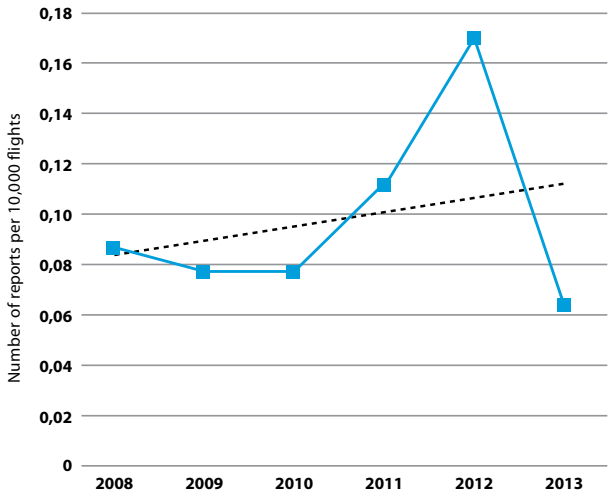


Figure 24: Loss of communication 2008 - 2013

Figure 24 shows the yearly trend from 2008 to 2013. After two years of increases (2010-2012), EVAIR recorded a reduction of the 'Loss of communication' reports in 2013. Again, further monitoring will show if this trend is set to continue.

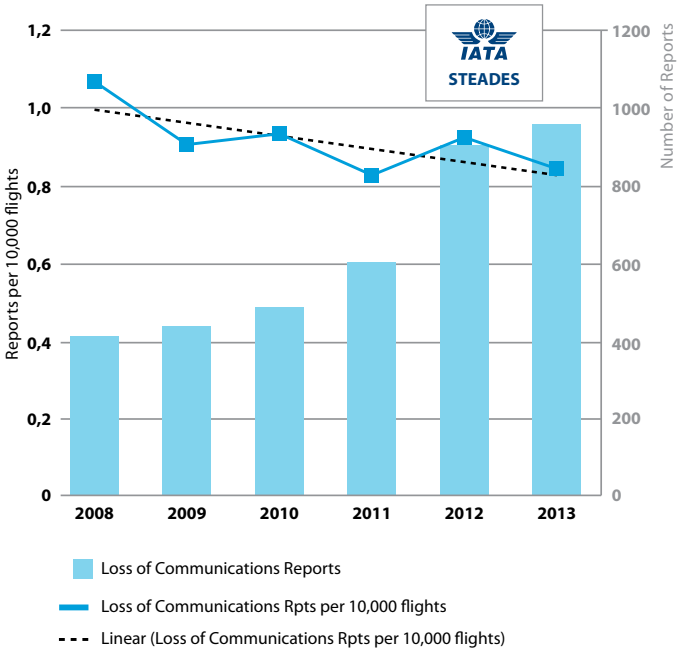


Figure 25: Loss of communication 2008 - 2013

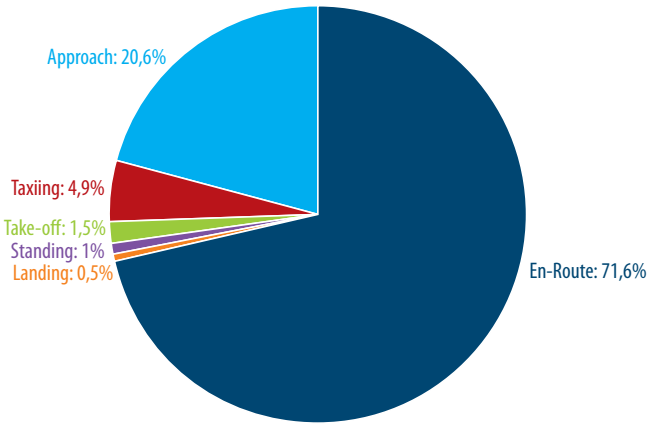


Figure 26: Loss of communication – Phases of flight 2008 - 2013

The largest number of 'Loss of communication' reports occurred during the en-route phase; contributions came from both the airborne and ATM (ground) side.

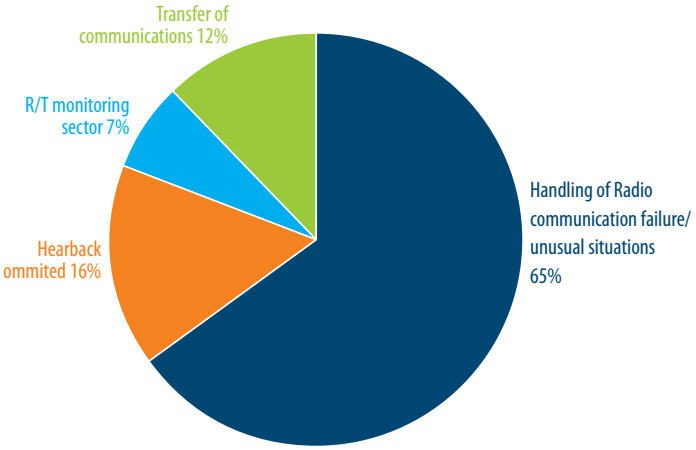


Figure 27: Loss of communication – Operational communication 2013

'Operational' communication in 2013 gives the best picture about the main root causes of 'Loss of communication' events. As Figure 27 shows, the main contributor is 'Handling of radio communication' which, among others, includes 'Wrong frequency selection' by pilots or 'Wrong frequency instructions' provided by air traffic controllers. The other contributors with higher contributions are 'Hear-back omitted' with 16% and 'Transfer of communication' with 12%.

ATM contributed directly to 'Loss of communication' in 24% of cases. The most frequent ATM contributory factors were: 'Lack of internal coordination'; 'Hand over of the traffic to the neighbouring sectors'; 'Operational' and 'Spoken Communication'; 'R/T Interferences'; 'High R/T Workload'; and 'Wrong frequency provided to the pilot'.

Figure 28 shows that in 46% of events there was no ATM involvement. In these situations the contributions came from the air or from the ground commercial radio stations interfering with the operational frequency. The most frequent pilots' contributions are related to 'Wrong frequency selection' and 'Read-back'; missing the check of 'Compulsory points' where they have to change frequency also features.

Often 'Loss of communication' events were associated with the other types of ATM events such as: 'Call sign Confusion', 'Level Bust', 'Runway incursions' and 'Un-authorized penetration of airspace'.

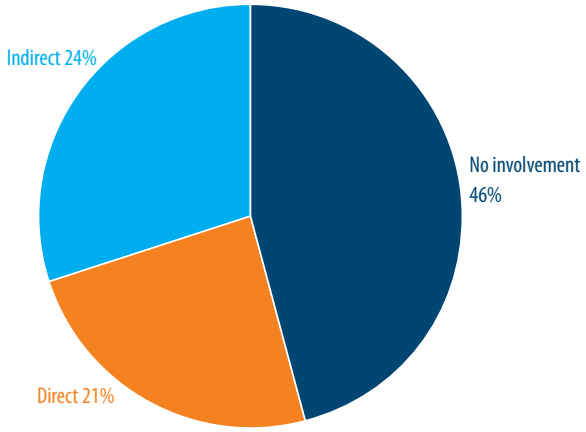


Figure 28: Loss of Communication – ATM system contribution 2008 - 2013

SPECIFIC EVENTS
LASER THREATS ACROSS EUROPE

The measured period for laser interference events and threats is 5 years. Laser interference reports now account for 14% of the overall reports in the EVAIR data repository. There was a significant increase in the number of laser interference reports in 2010. This jump followed a period of heightened awareness about the threat and pushed the trend line upwards where it remains but at a less dramatic rate of climb. If 2010 is taken out of the equation, then the trend for the last 4 years shows a downward trajectory. In all our statistics the most affected phase of the flight is, unsurprisingly, 'Approach'.

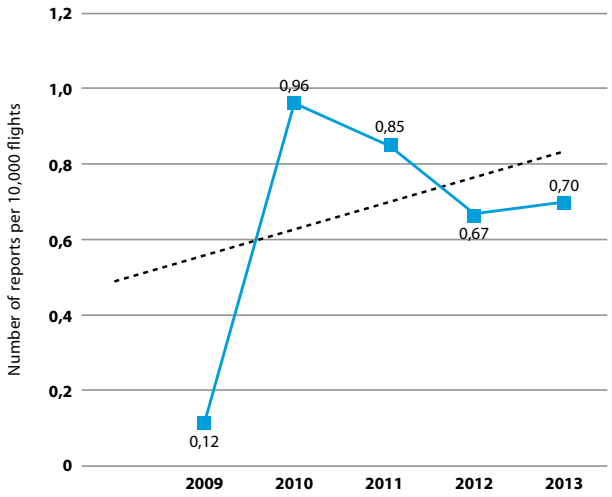


Figure 29: Laser 2008-2013

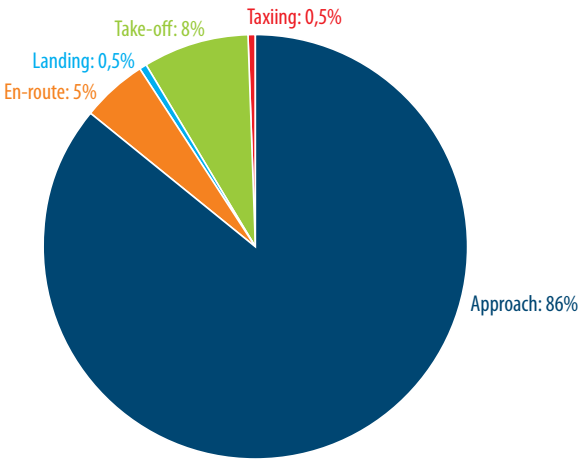


Figure 30: Laser 2008-2013

It is encouraging to see in the laser reports that pilots and controllers follow the recommendations to report laser interferences immediately: pilots to air traffic controllers and controllers to the police. We hope that pilots and controllers will continue reporting these events, since without reporting it will be difficult to fight this problem. However, reporting without full involvement of other national and European judicial, legal and aviation regulatory stakeholders will not solve the issue. Concerted action is required, including the involvement of EASA, to take fresh steps to tackle the threat of laser interference in aviation (and other transport fields) and to continue the fight against the perpetrators of these illegal activities.

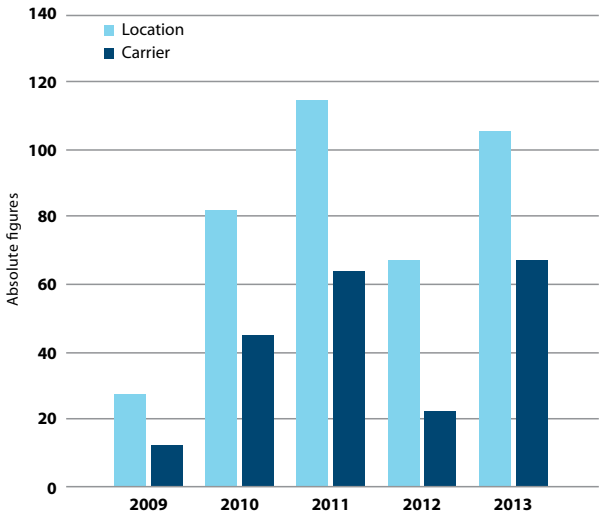


Figure 31: Laser interferences No of locations and No of affected carriers 2008-2013

The number of air carriers affected by laser interference in 2013 was much higher than in 2012. sixty seven (67) different carriers were affected in 2013 versus 22 in 2012. This is a significant increase, although looking at the number of locations we had a slight decrease in 2013 when we recorded 105 versus 115 in 2012. This tells us that we had an increased number of laser interferences at the same locations, which confirms the need for the involvement of all stakeholders to unite in the fight against the perpetrators. In 2013, we received 3 reports concerning the use of the new 'blue' lasers which are much more powerful and dangerous than the

'green' ones. Indeed, 'blue' laser devices can cause permanent eye damage and it is worth re-iterating the previous advice to pilots and controllers not to look directly at the source of the light. The availability of 'blue' lasers on the open market should also provide additional impetus for national/European authorities to address the threat of laser interference in aviation.

The monitoring of the laser interferences will continue and, as for the other types of the ATM occurrences, our data providers can send reports to: Dragica.stankovic@eurocontrol.int

More information about lasers is available on SKYbrary. (www.skybrary.aero).

Remotely Piloted Aircraft Systems (RPAS) An Emerging Threat?

In the same way that the threat of laser attacks emerged a few years ago, 2013 saw the first report to EVAIR concerning the uncoordinated operation of RPAS (Remotely Piloted Aircraft Systems) or 'drones' in the vicinity of aerodromes/inside controlled airspace. The growing trend of aerial photography has seen a significant rise in the popularity of devices such as 'quad copters' which are readily available on the open market. Commercial operators generally follow any local rules and regulations that are in place but many untrained and unlicensed 'enthusiasts' are not aware of the rules and the potential flight safety and security dangers. Like the laser problem, tackling the threat posed by uncoordinated operation of RPAS/drones will take the combined efforts of national/European authorities and stakeholder groups. EVAIR will monitor the situation and would welcome reports involving close encounters with these devices in the vicinity of airports/inside controlled airspace.

ACAS REPORTING

EVAIR has been engaged in monitoring the operational, procedural and technical elements of ACAS for a number of years. The aim of the monitoring is to support the continued safe and effective operation of ACAS by identifying and measuring trends and issues associated with Resolution Advisories (RAs).

ACAS is the generic term for Airborne Collision Avoidance Systems, of which TCAS II is the only implementation so far. ACAS is intended to improve air safety by acting as a 'last-resort' method of preventing mid-air collisions or near collisions between aircraft. Although ACAS II implementation was completed in 2005, ACAS monitoring continues to improve safety by identifying technical and procedural and operational deficiencies. In the coming years the monitoring will also focus on TCAS II version 7.1 equipages and performance which will be mandated in European Union airspace on all civil aircraft over 5700 kg MTOM or 19 passengers' seats as of December 2015.
http://www.eurocontrol.int/sites/default/files/publication/files/ACAS-Bulletin-17.pdf

ACAS data have been collected either automatically via the Automated Safety Monitoring Tool (ASMT) developed by EUROCONTROL, or manually thanks to airlines and Air Navigation Service Providers(ANSPs) reporting.

It should be noted that some number of ACAS/TCAS statistics from manual reporting rely on pilots' and air traffic controllers' perceptions and memories of the events rather than measured or calculated values. However, others are supported by ANSPs' feedback based on the operational investigation which includes radar and voice records. In any case, care is needed when comparing manually collected data and data that are captured automatically. Messages about typical performance should generally be taken from the automatic recording of events. Manual reporting tends to emphasise the more significant events and gives insights into perception of the ACAS II system.

MANUAL ACAS REPORTING

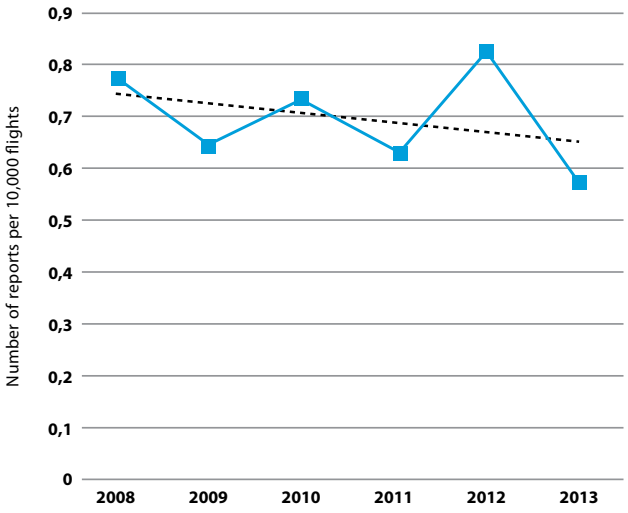


Figure 32: Manually reported ACAS incidents 2008 – 2013

The trend line shows a slight decrease through the whole monitored period. After an increase in 2012, we recorded a decrease of 32% in 2013. Translating this situation on a daily level, we came from 2.5 ACAS RAs daily in 2012 to 1.7 in 2013. Further monitoring will show if this trend will continue.

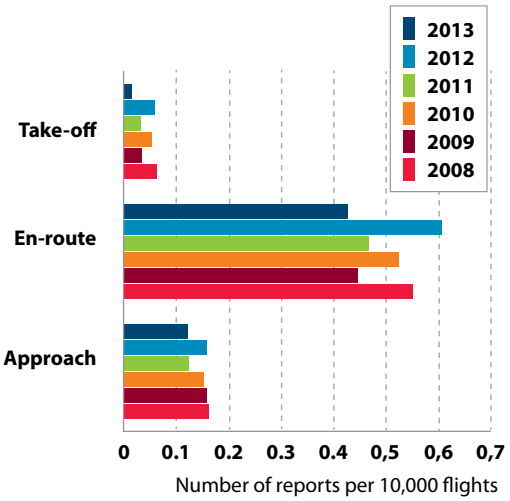


Figure 33: Manually reported ACAS incidents by phase of flights 2008 – 2013

Monitoring of the whole period shows that within the pilot reporting, the largest number of RAs occurs within the en-route phase. However, automated monitoring shows a slightly different picture in that the highest number of reports is within the TMAs, i.e. at lower altitudes. Through all monitored phases of flight we see a decrease in the number of TCAS RAs. In the previous EVAIR Safety Bulletin, we said that the increase in the number of TCAS RAs in 2012 could be linked to the start of the introduction of the TCAS 7.1 and lack of familiarity with this new version; maybe now we could say that after slow consolidation and familiarization of the air crews with the TCAS 7.1 and different EUROCONTROL awareness activities and the ACAS bulletin dedicated to the TCAS 7,1, we are seeing a reduction of TCAS RAs. In any case, further monitoring should give as clearer picture.

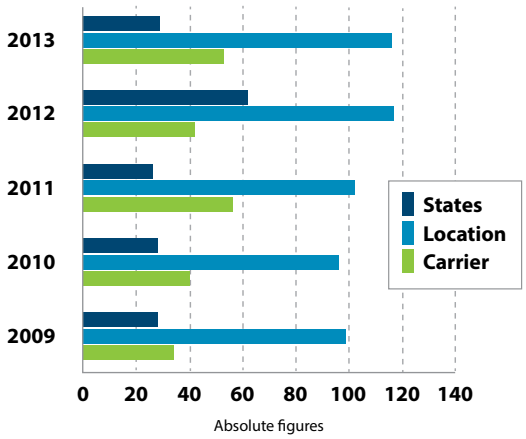


Figure 34: Manually reported ACAS incidents per states, locations & carriers 2008 – 2013

Figure 34 shows that the number of locations where TCAS RAs occurred is almost the same in 2013 as it was in 2012; however, the number of states where these incidents were recorded reduced from 62 to 32. When looking at the list of states - which due to confidentiality reasons is not presented here - we see that the absolute figures of the number of TCAS RAs, per specific state, increased more than 50%. This is an alarm message for these states to pay more attention to this issue and see which kind of measures is possible to be taken to mitigate the situation.

ICAO ADREP definitions of types of RAs are shown below.

- **Useful RA** - The ACAS II system generated an advisory in accordance with its technical specifications in a situation where there was or would have been a risk of collision between the aircraft.

- **Unnecessary (Nuisance) RA** - The ACAS II system generated an advisory in accordance with its technical specification in a situation where there was not, or would have not been, a risk of collision between the aircraft.

- **Unclassifiable RA** - The ACAS II system generated an advisory that cannot be classified because of insufficient data

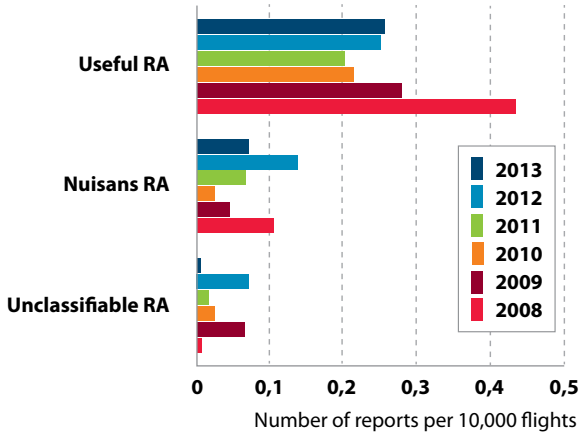


Figure 35: ACAS RA Classification 2008 - 2013

Pilots have confidence in TCAS as most ACAS RAs are classed as 'Useful RAs' and are followed in the vast majority of cases. It is interesting to see that the number of 'Nuisance TCAS RAs' decreased significantly in 2013 back to the level recorded in 2011, so the ratio 'Useful RAs' vs. 'Nuisance' and 'Unclassifiable RAs' has improved. The reduction may be connected with the wider introduction of the TCAS version 7.1; further monitoring should show whether this supposition is true or otherwise.

ACAS RA INSTRUCTIONS SUMMER 2008 -2013

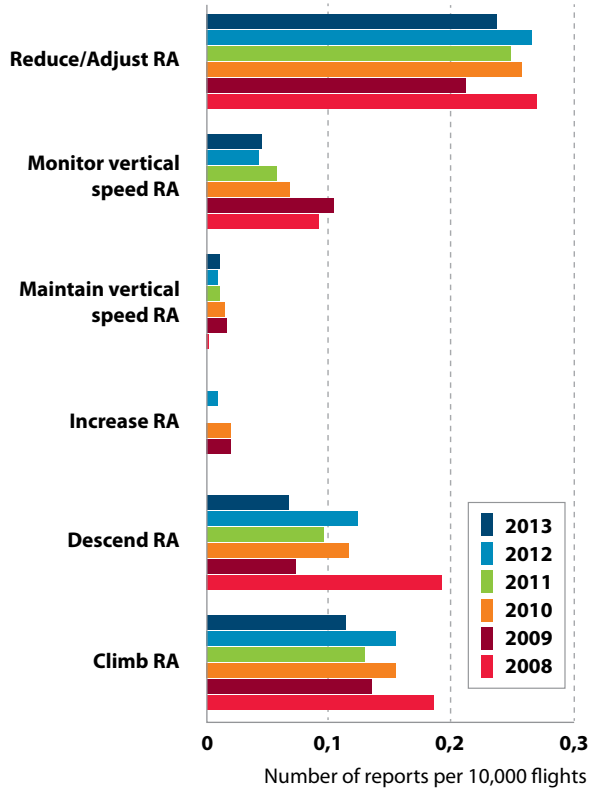


Figure 36: ACAS RA Instructions 2008-2013

The area with the largest ACAS RA reports is 'Reduce/Adjust RA', which with the new TCAS 7.1 version changes into 'Level off – Level off'. We see a decrease in this type of ACAS RA instruction in 2013. The areas of ACAS RA instructions with a slight increase of reports are 'Monitor and Maintain vertical speed RA'. We will see if, after December 2015 when TCAS 7.1 version will be mandatory, the situation will improve further.

ACAS FL DISTRIBUTION

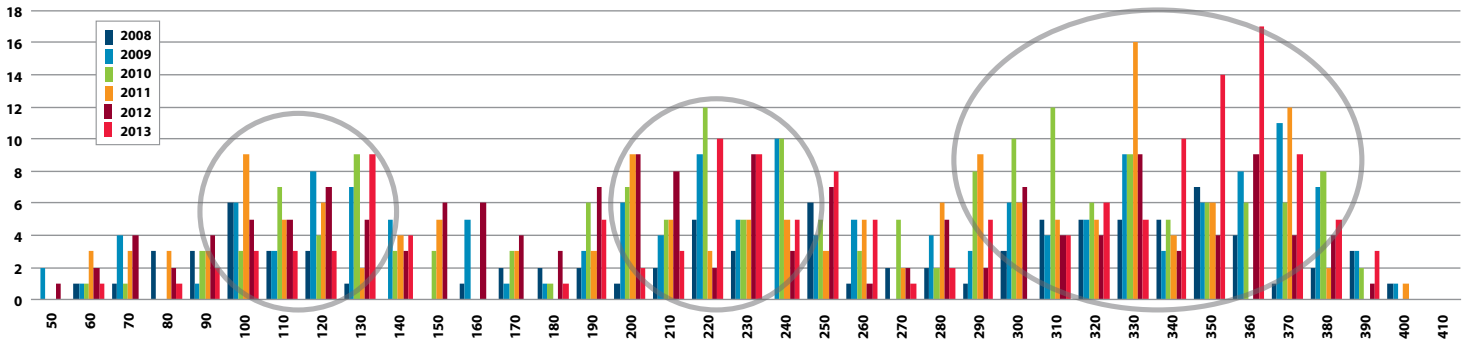


Figure 37: ACAS Flight Level Distribution 2008-2013 absolute figures

ACAS RAs FL distribution in absolute figures shows, as usual, three main clusters: i.e. between FLs 100 - 143; FLs 200 – 250; and FLs 290 - 380. This distribution is more or less characteristic for the whole monitored period.

TCAS RAs COLLECTED AUTOMATICALLY FROM MODE S RADARS

The Automated Safety Monitoring Tool (ASMT) is being used to record and analyse a set of TCAS RAs downlinked by a number of Mode S radars in Europe. The set of statistics presented in this document has been assembled from data collected during 2010-2013 all year periods.

Definitions

RA event	A sequence of RAs (i.e. the initial RA and secondary RAs if any) received from an aircraft
Initial RA	First RA of an RA event
Secondary RA	All other RA of an RA event (i.e. RA received after the initial RA)
Reversal RA	A resolution advisory that reverses the sense of the initial RA (e.g. a Climb RA after a preliminary Descend RA)
Strengthening RA	A subsequent RA that increases the intensity of the preceding RA (e.g. a Climb or Descend RA after a preliminary "Level-off, Level-off" (LOLO) or "Adjust Vertical Speed, Adjust" (AVSA) RA, or an Increase Climb or Descent RA after a preliminary Climb or Descend RA)
Weakening RA	A subsequent RA that requests pilots to level-off after the initial Climb or Descend RA once the risk of collision is resolved with the objective to limit the deviation caused by TCAS to ATC clearances
Intruder	A transponder-equipped aircraft within the surveillance range of TCAS for which TCAS has an established track (as defined within ICAO Annex 10). In the context of EVAIR, we only consider intruders against which RAs are triggered
1,000ft level-off encounter	Either an aircraft in vertical evolution levelling-off 1,000ft apart from a level aircraft or two aircraft in opposite vertical evolution both levelling-off 1,000ft apart from each other

Availability of data

Before 2009, EVAIR automatic monitoring analysis relied on Mode S radar data received from one radar (in busy airspace). In 2009, Mode S radar data from nine additional radars were used bringing the total to 10. Then, in 2010, two more radars were added and in 2011 data from another one became available. Consequently, EVAIR now monitors RA downlink data from thirteen radars supplied by two ANSPs.

Number of RA events recorded

The following table provides an average of daily and monthly rates for RA occurrences in each radar coverage region, for each year period since 2010.

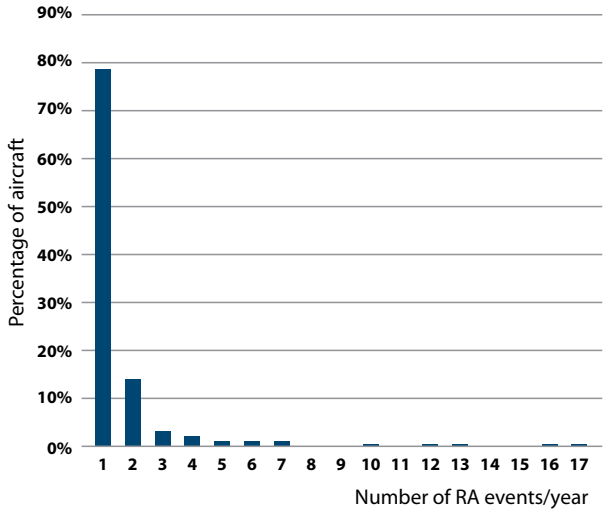
Year	Daily RA event rate (average)	Monthly RA event rate (average)	Radar coverage
2010	1-2	~ 50	10 radars supplied by two ANSPs
2011	~ 2	~ 60	12 radars supplied by two ANSPs
2012	2-3	~ 80	13 radars supplied by two ANSPs
2013	~ 3	~ 90	13 radars supplied by two ANSPs

Table 1: Averages of RA events recorded (2010-2013)

The figures presented in Table 1 show an increase in the number of RA events recorded by EVAIR due to, partly an increase in radar coverage and traffic since 2010, and also possibly to the improved quality of RA-downlink messages (e.g. less empty RA-downlink messages). Indeed, the detection and correction of RA downlink anomalies handled by the EUROCONTROL Mode S monitoring team might have contributed to this improvement.

On average, around three RA events have been recorded per day during the whole 2013 year period (compared to about four per day in the 2013 summer period) in the region covered by the thirteen radars available to EVAIR.

Since the absolute number of RA events has increased, only percentages will be provided to present an indication of TCAS performance over time in this document.



Aircraft reporting days

The following table provides the percentage of aircraft involved in one and more RA events per year.

Some aircraft were detected as reporting RAs on more than one occasion. The Mode S address was looked at for those reporting on several occasions and the data from 2013 shows that these are mainly military aircraft. Therefore, it is very unlikely commercial aircraft will have more than one RA event in a year.

Figure 38: ???

RA events by flight level bands and type of intruder equipage

The following figures provide the number of RA events recorded by flight level bands for 2013 with a split for the second figure between the cases where the intruder is Mode C (e.g. VFR or military traffic); Mode S (TCAS II equipped without any triggered RAs to a large extent but also Mode S transponder equipped without TCAS); or TCAS II equipped with a triggered RA.

At low levels, the majority of RAs are triggered against Mode C intruders, whereas at higher levels (i.e. above FL100), most RAs are triggered against Mode S intruders (i.e. TCAS equipped or not, and with or without RAs triggered on-board the intruder). Indeed, above FL100, most aircraft operate IFR. Those who are subject to ACAS mandate are required to be equipped with a Mode S transponder. For the other IFR aircraft, even if the European Commission Implementing Regulation number 1207/2011 only requires Mode S Elementary Surveillance for 2017, most of them are already compliant with it (and so these aircraft are already equipped with Mode S transponders).

In a large majority of events, only one aircraft out of the two receives an RA, even though both are TCAS equipped. Indeed, TCAS does not always symmetrically generate RAs (e.g. in 1,000ft level-off encounters).

The majority of RAs below 3,000ft are triggered against VFR traffic whereas above FL100 RAs are mostly triggered against IFR traffic (e.g. Mode S and TCAS equipped).

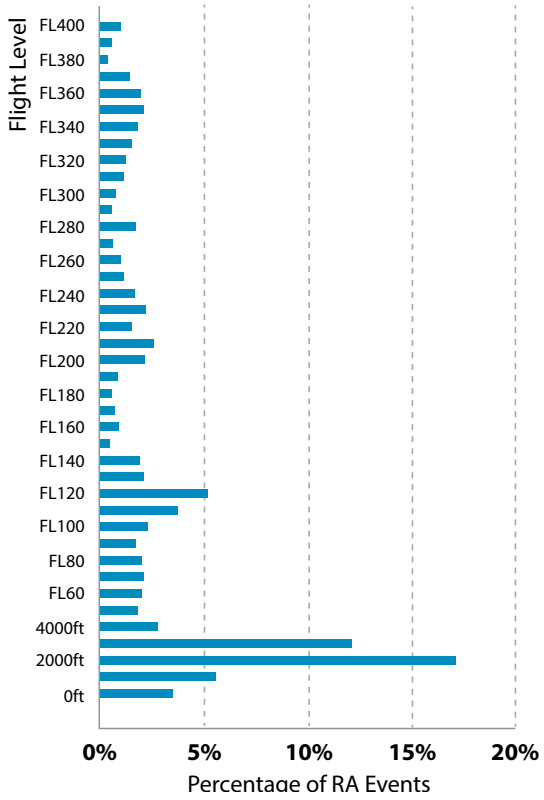


Figure 39: RA events by flight levels

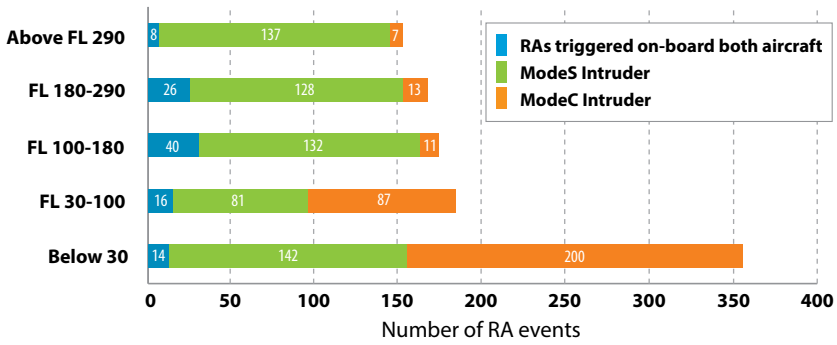


Figure 40: RA events by flight level bands and type of intruder equipage (2013)

Type of RAs

In December 2011, the European Commission published Implementing Rule 1332/2011 mandating the carriage of TCAS II version 7.1 within European Union airspace from 1st December 2015 by all aircraft currently equipped with version 7.0 and from March 2012 by all new aircraft[2]. One of the reasons for developing version 7.1 were cases found in recorded and reported events in which pilots unintentionally responded in the opposite direction to "Adjust Vertical Speed, Adjust" (AVSA) RAs (i.e. the vertical rate was increased instead of reduced). To prevent incorrect pilot responses, AVSA RAs have been replaced by "Level Off, Level Off" (LOLO) RA. Currently, and until 1st December 2015, both versions of TCAS II (i.e. v7.0 and v7.1) are in operation in European airspace[3].

The following table provides the type of all RAs recorded in 2010-2013 year periods.

Year	AVSA or LOLO	Monitor VS	CL or DES	Maintain VS	Increase CL or DES	Reverse CL or DES	Crossing CL or DES
2010	39%	23%	32%	2%	1%	1%	2%
2011	39%	17%	40%	1%	1%	0%	2%
2012	43%	21%	32%	1%	1%	0%	2%
2013	43%	25%	24%	3%	2%	1%	2%

Table 2: Type of RAs (2010-2013

AVSA - "Adjust Vertical Speed, Adjust" RAs (of TCAS II version 7.0)
CL - "Climb, Climb" RA
DES - "Descend, Descend" RA
LOLO - "Level-off, Level-off" RA introduced in TCAS II version 7.1 (replacing AVSA RAs)
Maintain VS - "Maintain Vertical Speed, Maintain" RAs

The results show that the types of RAs recorded in 2013 are in line with the ones from 2010 to 2012 year periods.

[2] *Above 5,700 kg maximum take-off mass or a maximum passenger seating capacity of more than 19*
[3] *EU 1332/2011 does not apply to State aircraft. Those can be equipped with TCAS I, TCAS II version 6.04a, 7.0 or 7.1, unless they operate in German airspace where ACAS II (i.e. TCAS II version 7.0 or 7.1 is required).*

The following sub-sections separate the results by Initial versus Secondary RAs.

Type of Initial RAs

The following figure provides the type of Initial RAs recorded in 2013 year period

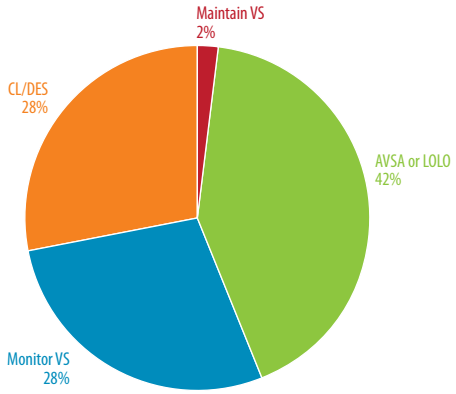


Figure 41: Type of Initial RAs (2013)

In 2013, about 70% of recorded RAs did not require a deviation from ATC clearance (i.e. AVSA for version 7.0, LOLO for version 7.1 and, Monitor and Maintain Vertical Speed RAs). Typically, in these cases, TCAS RAs have been compatible with ATC clearances and aircraft operations.

Type of Secondary RAs

The following figure provides the type of Secondary RAs recorded in 2013. For information, only about 20% of RA events include secondary RAs.

Secondary RAs may be split into two different categories:

- **Weakening RAs** (i.e. AVSA for version 7.0 and LOLO for version 7.1), requesting pilot to level-off after the initial Climb or Descend RA once the risk of collision is resolved with the objective to limit the deviation caused by TCAS to ATC clearances,

- **Strengthening RAs** (e.g. Climb or Descend RA after an initial AVSA or LOLO, or an Increase Climb (resp. Descent) RA after an initial Climb (resp. Descent) RA) requesting to increase the vertical rate requested by the initial RA; and

- **Reversal RAs** (e.g. Climb RA after a Descend RA) requesting to manoeuvre in the opposite direction to the initial RA.

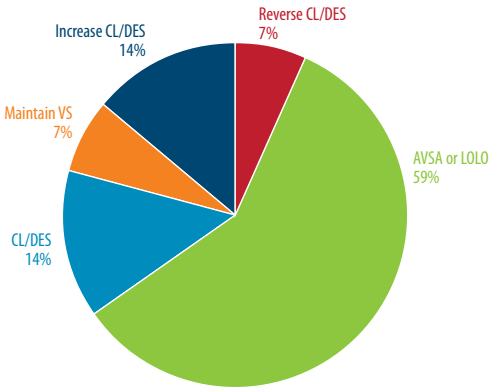


Figure 42: Type of Initial RAs (2013)

In EVAIR recorded data for 2013 about 60% of secondary RAs were weakening RAs. In this set of data, Reverse and Increase RAs mainly concerned military aircraft that did not follow their initial RA.

Pilot response to RAs

For the purpose of the study, pilot responses to RAs have been split into different categories:

- **"Followed"**: The pilot responded to the RA as intended by TCAS,
- **"Excessive"**: The pilot responded to the RA but by unnecessarily exceeding the vertical rate requested by TCAS,
- **"Below required"**: The pilot either correctly responded to the RA but too slowly or failed to achieve the vertical rate requested by TCAS,
- **"Opposite"**: The pilot went in the opposite direction to the TCAS RA.

The first sub-section provides information concerning pilot response to initial RAs as opposed to the second sub-section which focuses on secondary RAs. Indeed, since secondary RAs are very rare and stressful for pilots (except for weakening RAs) it is preferable to separate the two sets of statistics for comprehension purposes.

Pilot response to Initial RAs

The safety benefits provided by TCAS highly depend on pilots' responses to RAs. The following table and figure provide information concerning pilots' responses to initial RAs on respectively 2010-2013 year periods and 2013 year period only.

Year	Followed	Excessive	Below required	Opposite
2010	73%	8%	12%	7%
2011	76%	8%	10%	7%
2012	77%	5%	11%	7%
2013	72%	7%	15%	6%

Table 3: Pilot response to Initial RAs (2010-2013)

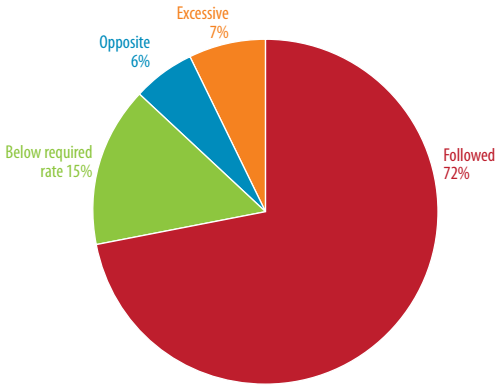


Figure 43: Pilot response to Initial RAs (2013)

The results obtained for 2013 are in line with the ones from 2010 to 2013 with about 70% of the pilots achieving the requested vertical rate, 7% exceeding it, 15% either achieving it but too slowly or failing to achieve it and 6% reacting in the opposite direction. For information, most of the incidents involving opposite responses concerned military aircraft. Generally, initial RAs are satisfactorily followed by pilots.

To further enhance pilot compliance to RAs and thus safety, Airbus has developed, certified and implemented a solution that couples TCAS II to the Auto Pilot for an automatic response to RAs (i.e. AP/FD TCAS RA mode). EUROCAE WG-75 has developed Minimum Aviation System Performance Specification (MASPS) for Flight Guidance System (FGS) coupled to TCAS (ED-224). These standards specify system characteristics that provide guidance to designers, manufacturers, installers and users of the system and equipment.

Pilot response to Secondary RAs

The following table and figure provide information on pilot response to secondary RAs for respectively the period between 2010-2013 and for 2013 only.

Year	Followed	Excessive	Below required	Opposite
2010	27%	10%	25%	38%
2011	31%	7%	37%	25%
2012	33%	8%	36%	23%
2013	48%	8%	31%	13%

Table 4: Pilot response to Secondary RAs (2010-2013)

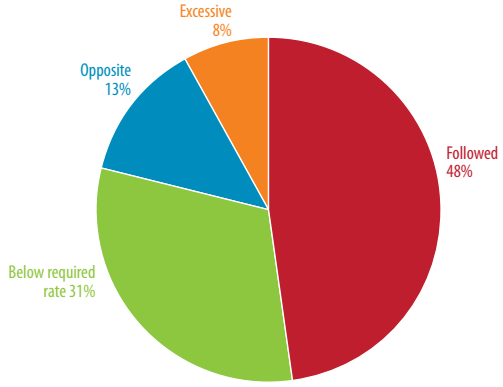


Figure 44: Pilot response to Secondary RAs (2013)

The results obtained for 2013 show an improvement in pilots' responses to secondary RAs since 2010. However, compliance with secondary RAs is still not as good as for initial RAs even though these figures should be mitigated as part of these secondary RAs concern military aircraft.

These figures should serve to emphasize the need for pilots to be trained to follow the full sequence of RAs that they receive. A wider implementation of the AP/FD TCAS RA mode would also contribute to improve the compliance with secondary RAs.

'Ownship' vertical rate at the time of Initial RA

The following table provides information concerning the vertical rate of 'ownship' at the time of the triggering of the initial RA (between 2010-2013).

Vertical rates are split into three categories: "High" vertical rates (i.e. above 1,500 fpm), "Normal" vertical rates (i.e. below 1,500 fpm) and "Level".

Year	High	Normal	Level
2010	27%	62%	11%
2011	26%	59%	15%
2012	25%	56%	19%
2013	35%	53%	12%

Table 5: Ownship vertical rate at the time of Initial RA (2010-2013)

'Ownship' vertical rate at the time of Initial RA

The following table provides information concerning the vertical rate of 'ownship' at the time of the triggering of the initial RA (between 2010-2013).

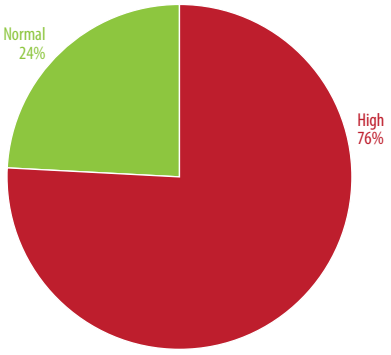


Figure 45: 'Ownship' vertical rate at the time of Initial AVSA or LOLO RA (2013)

About 75% of 2013 recorded AVSA and LOLO RAs were triggered on-board aircraft with vertical rates above 1,500 fpm. AVSA and LOLO RAs are the great majority of RAs triggered during 1,000ft level-off encounters.

A majority of these RAs are perceived as operationally undesired by air traffic controllers and flight crews and could be avoided by complying with the following ICAO Annex 6 recommendation being in force since 2011:

- **"Recommendation"** - Unless otherwise specified in an air traffic control instruction, to avoid unnecessary airborne collision avoidance system (ACAS II) resolution advisories in aircraft at or approaching adjacent altitudes or flight levels, operators should specify procedures by which an aeroplane climbing or descending to an assigned altitude or flight level, especially with an autopilot engaged, may do so at a rate less than 8 m/sec or 1 500 ft/min (depending on the instrumentation available) throughout the last 300 m (1 000 ft) of climb or descent to the assigned level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level.

However, this recommendation is not always applied. It can only be applied when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level. Furthermore, some pilots have reported not being comfortable in modifying autopilot setting when approaching the selected altitude because an erroneous action may lead to an altitude bust while there is another aircraft at or approaching an adjacent altitude.

For information, to prevent the triggering of RAs in 1,000ft level-off encounters, Airbus has developed, certified and implemented a solution called TCAP (TCAS Alert Prevention) that relies on new altitude capture laws taking into account TCAS II TA thresholds. These new altitude capture laws consist in reducing the own vertical speed automatically at the approach of the selected altitude upon various conditions. This solution has been proven to be very efficient and to enable to safely remove more than 90% of the RAs in 1,000ft level-off encounters. EUROCAE ED-224 document also addresses this function in addition to the AP/FD TCAS RA mode.

RA events by Horizontal Geometry

The following figure provides the horizontal geometry (cf. definition of terms in Annex 2) involved in 2010-2013 year periods recorded RA events.

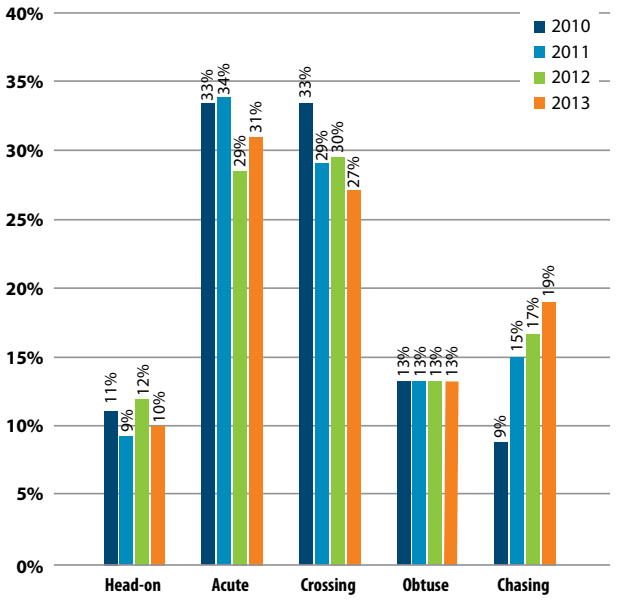


Figure 46: Horizontal Geometry of RA events (2013)

In 2013 (as for 2010-2012 year periods), a great majority of EVAIR recorded RA events were triggered while aircraft were in 'acute' or 'crossing' trajectories.

ANNEX 1 – EUROPEAN ACTION PLANS

European action plan for Air-Ground communications safety

The Air-Ground Communication (AGC) Safety Improvement Initiative was launched by the EUROCONTROL Safety Team in 2004, and is addressing communications issues identified in the Runway Incursion and Level Bust Safety Improvement Initiatives as well as other issues of the concern such as call sign confusion, undetected simultaneous transmissions, radio interference, use of standard phraseology, and prolonged loss of communication. Communication between air traffic controllers and pilots remains a vital part of air traffic control operations, and communication problems can result in hazardous situations. A first step towards reducing the incidence of communication problems is to understand why and how they happen. The Action Plan is available on the ALLCLEAR Communication Toolkit
http://skybrary.aero/index.php/Solutions:ALLCLEAR

The European action plan for the prevention of Level Bust

Reducing Level Busts is one of EUROCONTROL's highest priorities. EUROCONTROL began raising awareness of the Level Bust issue in 2001, organised series of workshops, and established a Level Bust Task Force to define the recommendations and to formulate an action plan to reduce Level Busts.

The Level Bust action plan is the product of work carried out by EUROCONTROL's cross-industry Level Bust Task Force, which was set up in 2003. The Task Force reviewed the evidence available, identified the principal causal factors, and listened to the Air Navigation Service Providers and aircraft operators with experience in reducing Level Busts.

The Action Plan contains recommendations for Air Traffic Management, Air Traffic Controllers, and Aircraft Operators. It designed to reduce the frequency of Level Busts and reduce the risks associated with Level Busts. Implementation of the Action Plan will be monitored by the Task Force monitoring group reporting to the EUROCONTROL Safety Improvement Sub Group (SISG).
http://www.eurocontrol.int/safety/public/standard_page/Level_bust.html

The European action plan for the prevention of Runway Incurions (EAPRI)

The numbers of runway incursion reports are rising. Accidents continue to take place on runways. Findings from those incident and accident reports have been used to determine the new recommendations contained in the updated European Action Plan for the Prevention of Runway Incursions.
The increasing availability of runway incursion incident reports is a positive indication of the commitment of organisations and operational staff to prevent runway incursions and runway accidents by learning from the past accidents and incidents and sharing this information across Europe.

The new recommendations contained in the Action Plan are the result of the combined and sustained efforts of organisations representing all areas of aerodrome operations.
The organisations that contributed to this action plan are totally committed to enhancing the safety of runway operations by advocating the implementation of the recommendations that it contains. These organisations include, but are not limited to, Aerodrome Operators, Air Navigation Service Providers, Aircraft Operators, and Regulators.
http://www.eurocontrol.int/documents/european-action-plan-prevention-runway-incursions

Call Sign Similarity (CSS)

The European Action Plan for Air Ground Communication Safety (conceived inter alia by EUROCONTROL, aircraft operators (AOs) and the Flight Safety Foundation) identified call sign similarity (CSS) as a significant contributor to air-ground communication issues. Analysis of ATC reported events shows that 5% involve incidences where CSS is involved. Some aircraft operators are trying to find solutions; the only known ANSP actively operating a service to de-conflict call signs is France's DSNA.

Research and CBA studies show that the most cost efficient way of providing a long-lasting, Europe-wide solution is to create a central management service to de-conflict ATC call signs. This strategy provides economies of scale and rapid pay back of investment (3 years). More importantly, it is calculated that it will eliminate over 80% of the CSS incidences and thus improve safety.
http://www.eurocontrol.int/safety/public/standard_page/Callsign_Similarity_project.html

ANNEX 2 – DEFINITIONS

Following definitions are extracted from the HEIDI and/or HERA Taxonomies.

HEIDI

(Harmonisation of European Incident Definitions Initiative for ATM) intends to finalise a harmonised set of definitions (taxonomy) for ATM related occurrences.

HERA

(Human Error in European Air Traffic Management) develops a detailed methodology for analysing human errors in ATM, including all error forms and their causal, contributory and compounding factors.

More information can be found at:

HEIDI:
http://www.eurocontrol.int/src/public/standard_page/esarr2_heidi.html

HERA:
http://www.eurocontrol.int/humanfactors/public/sitepreferences/display_library_list_public.html#5

DEFINITIONS

ATC clearance/instruction (HEIDI): Related to incorrect or wrong aircraft action. Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit and deviations from the clearance which cause runway incursions, taxiway incursions, apron incursions, Level Bust, unauthorised penetration of airspace etc.

Coordination (HEIDI): internal coordination encompassing coordination with sectors within the same unit, and sectors within the ATC suite; external coordination, civil/civil and civil/military; and special coordination, covering expedite clearance, prior permission required, revision and other special coordination.

Contributory factors (HEIDI): A part of the chain of events or combination of events which has played a role in the occurrence (either by easing its emergence or by aggravating the consequences thereof) but for which it cannot be determined whether its non existence would have changed the course of events.

Decision-Making (HERA): cover incorrect, late or absence of decision.

Failure to Monitor (HERA): failure to monitor people, information or automation.

Judgement (HERA): mainly associated to separation

Lapses (HEIDI): psychological issues encompassing: Reception of information, Identification of information, Perception of information, Detection, Misunderstanding, Monitoring, Timing, Distraction, Forgetting and Loss of awareness.

Level Bust (HEIDI): Any unauthorised vertical deviation of more than 300 feet from an ATC flight clearance Departing from a previously maintained FL, overshooting, undershooting, levelling-off at a different level than cleared level.

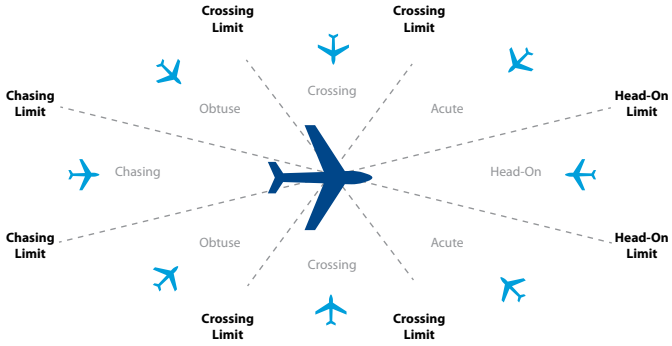
Mental/Emotional/Personality issues (HERA): include the following items

- Mental capacity: loss of picture or Safety Awareness
- Confidence in self, in others, in information, in equipment, in automation
- Complacency
- Motivation/Morale
- Attitudes to others
- Personality traits: aggressive, assertive, under-confident, risk taking
- Emotional status: stressed, post incident
- Miss-stored or insufficient learned information
- Planning: insufficient, incorrect or failed
- Recall of information: ailed, inaccurate, rare information, past information
- Violations: routine, exceptional

Mistakes (HEIDI): psychological issues encompassing: Information wrongly associated, Workload issues, Information not detected, Failure to monitor, Recall of information, Misunderstanding or insufficiently learned information, Judgement, Planning, Decision making, Assumptions and Mindset.

Operational communication (HEIDI): Air-Ground, Ground-Ground and Use of equipment verification testing. Air-Ground communication encompasses hear back omitted, pilots' read back, standard phraseology, message construction, R/T monitoring including sector frequency monitoring and emergency frequency monitoring, handling of radio communication failure, unlawful radio communications transmission. Ground-Ground communication refers to the standard phraseology, speech techniques, message construction, standard use of equipment like, radio frequency, telephones, intercoms etc.

RA geometry between two Aircraft (ASMT)



Runway Incursion (ICAO): Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Spoken communication (HEIDI): human/human communication encompassing air-ground and ground-ground communications but also call sign confusion, noise interference and other spoken information provided in plain language. Air-ground communication refers to language/accent, situation not conveyed by pilots, pilot's breach of radio telephony (R/T), workload, misunderstanding/misinterpretation, and other pilot problems. Ground-ground communication refers to misunderstanding/misinterpretation, poor/no coordination.

Taxiway Incursion (HEIDI): Any occurrence unauthorized presence on a taxiway of an aircraft, vehicle, person or object that creates a collision hazard or results in a potential loss of separation

Traffic & Airspace problems (HEIDI): there are four set of causal factors under this element

- **Traffic load & complexity**, encompassing excessive and fluctuating load, unexpected traffic demand, complex mix of traffic, unusual situations (emergency, high risk, other), Abnormal time pressure, under load and call signs confusion.
- **Airspace problems** composed of flights in non controlled and controlled air space, Airspace design characteristics(complexity, changes, other) and temporary sector activities(military, parachuting, volcanic activity, training)
- **Weather problems** such as poor or unpredictable(snow, slush, ice, fog, law cloud, thunderstorm, wind shear)
- **Pilot problems** concerning language, culture and experience aspects.

Traffic Information (HEIDI): essential and local traffic information provided by an air traffic controller to the pilot. Essential information is related to the provision of traffic information containing:

a) direction of flight of aircraft concerned;

b) type and wake turbulence category (if relevant) of aircraft concerned;

c) cruising level of aircraft concerned; and

d) estimated time over the reporting point nearest to where the level will be crossed; or

e) relative bearing of the aircraft concerned in terms of the 12-hour clock as well as distance from the conflicting traffic; or

f) actual or estimated position of the aircraft concerned. Local traffic in this context consists of any aircraft, vehicle or personnel on or near the runway to be used, or traffic in the take-off and climb-out area or the final approach area, which may constitute a collision hazard to the other aircraft and about which the information has to be provided.

Workload issues (HERA): concern both minimal and excessive workload

ANNEX 3 ACRONYMS

ACAS	Airborne Collision Avoidance System
ANSP	Air Navigation Services Provider
AO	Aircraft Operator
AP/FD TCAS	Automatic guidance (Autopilot - AP) and/or display cues to support pilot guidance (Flight Director - FD) upon Resolution Advisories – defined within ED-224 MASPS
ASMT	ATM Safety Monitoring Tool
ASR	Air Safety Report
ATC	Air Traffic Control
ATM/CNS	Air Traffic Management/Communication, Navigation, Surveillance
CSC	Call Sign Confusion
CSS	Call Sign Similarity
CSST	Call Sign Similarity Tool
ECAC	European Civil Aviation Conference
ELFAA	European Low Fare Airlines Association
ERAA	European Regional Airlines Association
EUROCAE	European Organisation for Civil Aviation Equipment, a non-profit organisation dedicated to aviation standardisation including MOPS for TCAS
EVAIR	EUROCONTROL Voluntary ATM Incidents Reporting
FL	Flight Level
GSIC	Global Safety Information Centre
HEIDI	Harmonisation of European Incident Definitions Initiative for ATM
HERA	Human Error in European Air Traffic Management
IACA	International Association of Charter Airlines
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
LAN	Local Area Network
MASPS[4]	Minimum Aviation System Performance Specification
Mode C	Altitude Reporting Mode of Secondary Radar (ICAO)
Mode S	Secondary Radar selective mode of interrogation
MOPS[3]	Minimum Operational Performance Standards
NM	Network Manager
OPS	Operations
PAN-OPS	Procedures for Air Navigation - Operations
RA	Resolution Advisory
RF	Radio Frequency
RTCA	A United States volunteer organization that generates minimum performance standards for CNS/ATM systems and equipment, including MOPS for TCAS
SARPS	Standard And Recommended Practices
RPAS	Remotely Piloted Airborne Systems
SISG	Safety Improvement Sub-Group
STEADES	Safety Trend Evaluation and Data Exchange System
TCAS	Traffic Collision Avoidance System
TA	Traffic Advisory
TCAP	"TCAS Alert Prevention". Altitude capture laws to prevent RAs during level-off encounters – defined within ED-224 MASPS
VFR	Visual Flight Rules
WT	Wake Turbulence

[4] *MASPS are focused on systems (which can be implemented by different equipment) while MOPS are focused on the equipment themselves*

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