

Safety net nuisance alerts – more than just a numbers game



By Rod Howell

The aim of ground based Safety Nets, such as Short Term Conflict (STCA), Minimum Safe Altitude Warning (MSAW), Area Proximity Warning (APW) and Approach Path Monitor (APM), is to enhance the safe control of aircraft by providing a timely alert to the controller whenever a flight comes into a state of higher risk – potential mid-air collision, collision with terrain, infringement of protected airspace or deviation from the expected approach path.

In the last three decades, Safety Nets have progressed from a novel concept to become more-or-less de facto standard components of the ATM system. Yet, despite these decades of operational use, certain aspects of safety nets operation still remain a concern – not least of which is the frequency of nuisance alerts.

The EUROCONTROL specifications for each of the safety nets define a nuisance alert as: an alert which is correctly generated according to the rule set but is considered operationally inappropriate.

GROUND BASED SAFETY NETS

Short Term Conflict Alert – Intended to assist the controller in preventing a collision between aircraft by generating, in a timely manner, an alert of any potential or actual infringement of prescribed separation minima.

Minimum Safe Altitude Warning – Intended to warn the controller of an increased risk of controlled flight into terrain by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

Area Proximity Warning – Intended to warn the controller of unauthorised penetration of an airspace volume by generating, in a timely manner, an alert of a potential or actual infringement of the required spacing to that airspace volume.

Approach Path Monitor – Intended to warn the controller of an increased risk of controlled flight into terrain by generating, in a timely manner, an alert of aircraft deviation from the expected final approach path.



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Whilst a modest number of nuisance alerts can often be tolerated by controllers, too many nuisance alerts can have deep and far reaching consequences. It has been known for too many annoying alerts to cause controllers to turn down the volume of speakers, and tape up flashing lights! In the more extreme cases, the safety nets are intentionally partially disabled (e.g. in the TMA or below a particular flight level) or switched off completely.

Controllers and pilots need time to respond to and resolve a safety nets alert and therefore very short duration (i.e. just a few seconds) alerts are generally considered a nuisance. However, because there are such a wide variety of mid-air situations and operational environments a simple mathematical formula can't truly be applied to determine whether or not a particular alert was a 'nuisance'.

A number of common types of nuisance alert are easily identified:

- Obnoxious Alerts – those that are louder, brighter, and / or longer than necessary
- Alerts which are not related to a real situation (e.g. due to surveillance errors)
- Alerts which only involve flights that are not of concern to ATC (e.g. military exercises, formation flights, mid-air refuelling)
- Alerts due to unknown RVSM status to which STCA applies an inappropriate vertical separation threshold
- Alerts which may appear on the display too late to be useful or annunciate intermittently due to poor set-up/tuning
- Alerts caused by aircraft converging rapidly (though still safely cleared)

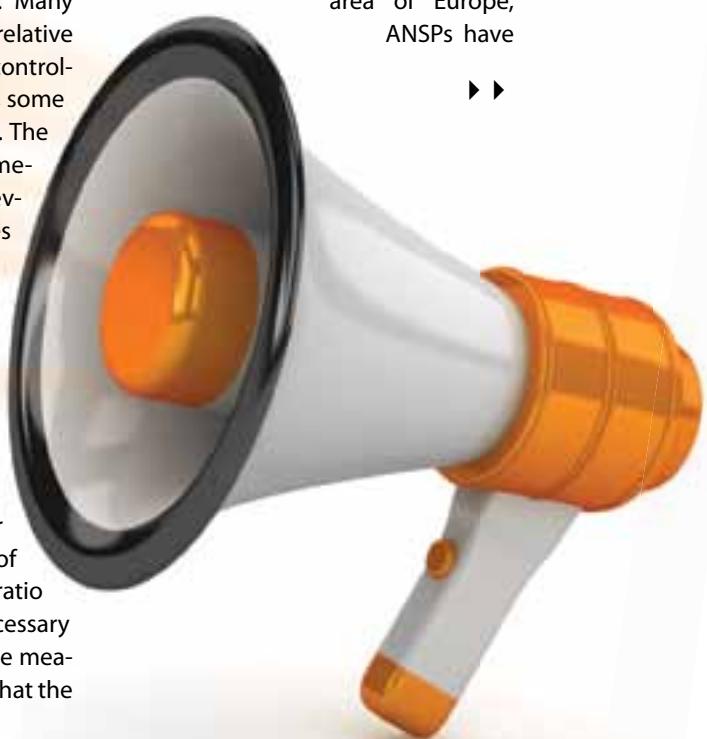
The "annoyance factor" aside, it seems that a clear argument can be made that too many nuisance alerts can erode controllers' trust in a Safety Net and therefore lead to a late or absent controller response when a genuine risk arises. Anyone who doubts the well-known "cry wolf" effect should note how many people look out of the office window the next time a car alarm sounds in a car park. The analogy isn't perfect, because getting up to look out of the window requires a little more effort than looking at the traffic display, but it can still be concluded that if the nuisance alert rate is sufficiently high, the "cry wolf" effect will be there.

In addition to the potential erosion of trust, a high level of unnecessary Safety Net alerts will contribute to the risk that the controller may choose to complete a current or ongoing task before giving attention to the alert or may be distracted from a more important task or conflict situation. Many Safety Nets do not convey the relative urgency of the situation to the controller (and amongst those that do, some do it much better than others). The point is that an inability to immediately recognise which of several alerts is more pressing does have a safety implication.

Performance measurement

There are a number of measurements that could be made to quantify how well a Safety Net is performing - the number of alerts per day, the number of alerts per sector per day, the ratio of Nuisance (unwanted) to Necessary (wanted) alerts, etc. Whilst these measures might be useful to check that the

performance of a Safety Net has been maintained over a long time period (months or years), they will not help to resolve any underlying issues with a Safety Net. Furthermore, none of these measures on their own can be used as a basis for Safety Net performance targets that can be applied across all types of airspace. Whilst in the core area of Europe, ANSPs have



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worked hard to decrease the unwanted / wanted alert ratio, the absolute number of alerts per day is still relatively high. On the other hand, in the least busy airspace, a Safety Net might generate a low number of alerts per day, but a large proportion of these may be unwanted or nuisance alerts.

Far more important than the bare statistics is to analyse and understand what types of alerts are occurring; only with this knowledge can effective action be taken to reduce the number of nuisance alerts to a level that is acceptable.

A multi-disciplinary safety nets team within the ANSP organisation (or within each major control centre)

must be charged with tuning and maintaining the Safety Nets. This team should comprise an experienced engineer, en route and TMA controllers and safety staff. Communication is paramount – it is of fundamental importance that controllers and engineers share an understanding of the safety nets technical limitations and operational issues.

In addition, many ATM systems automatically record safety nets log files. The safety nets team therefore has access to the information regarding the numbers of alerts, and with a little analysis can reveal (to some extent) what types of nuisance alerts are occurring. These log files should be used to inform the engineer where and in what circumstances the Safety Nets problems occur so that they can be resolved.

Potential engineering solutions

Experience built up over many years of examining Safety Nets performance in various States has shown that many of the problems with them tend to fall into one of three categories:

1. Problems that require a change or improvement to the software
2. Problems that require a change to basic Safety Nets parameters
3. Problems that require a careful tuning of the alerting thresholds

The nuisance alerts that lead us to the first path include the obnoxious alerts mentioned previously (too loud, too bright, too long), those due to split tracks (surveillance errors) (see figure 1), and those caused by STCA applying an inappropriate vertical separation threshold when no RVSM status information is available for a specific flight. All these will normally require a fix from the system supplier.

The second category of nuisance alerts is caused when the basic eligibility and inhibition parameters have not been set up for the specific operational environment. No two operational environments are the same, so these parameters must be set by either the system supplier or the ANSP (preferably both, working together) – this should ideally be done during Site Acceptance Testing of the ATM system, and certainly before it goes into operational service.

Typical symptoms of inappropriate basic parameter settings are STCA alerts for pairs of military aircraft undergoing exercises, and MSAW alerts for military or VFR flights.



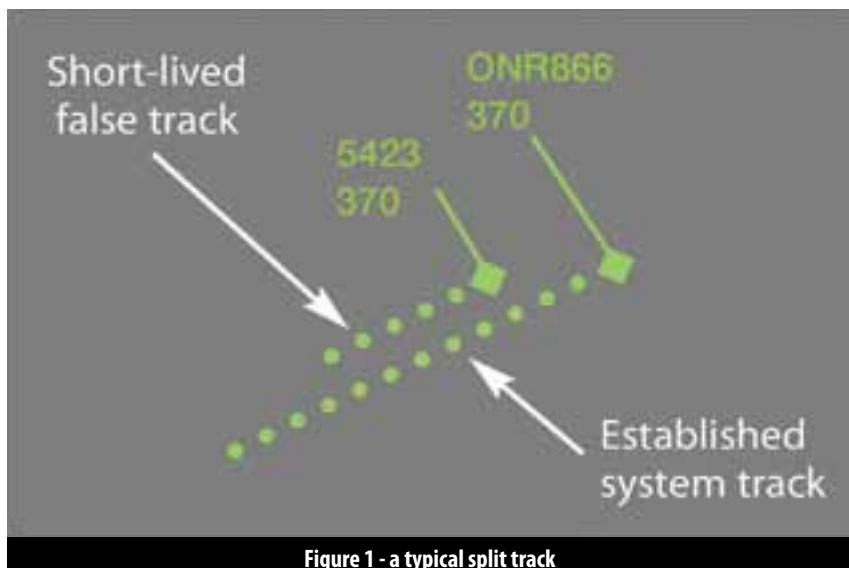


Figure 1 - a typical split track

The final category of nuisance alerts normally requires a deeper analysis of the precise circumstances that are causing them, followed by careful optimisation of the alert thresholds for all Safety Nets as well as the specific cases of the MSAW alerting surface, APW volumes and the APM approach definitions. Detailed parameter optimisation is most worthwhile when other causes of nuisance alerts have already been resolved. Alert log files and traffic recordings are invaluable at this stage.

If they are available, then specific safety nets optimisation tools can be used as a means of fine tuning.

Importantly, the tuning of the parameters should not be left to engineers alone. Controllers should be widely consulted on any borderline wanted/unwanted conflict situations and the consensus view of the appropriate balance between alert rate and warning time should, where possible, be taken into account.

Does training play a role in the battle against nuisance alerts?

The EUROCONTROL Specifications for the various ground-based safety nets have a specific requirement on controller training (see the box below). It is important that controllers know how the safety nets should behave and equally essential that they report when a safety net is not behaving as expected or as necessary for safe air traffic control.

Training of engineers can also play a crucial role. Engineers involved in system testing or system specification need to have a very firm grasp of what will be acceptable in terms of the safety nets system capacities, capabilities and performance. Furthermore, it is essential that system suppliers offer training and support to enable ANSPs to set up and optimise the safety nets before operational use, and to perform ongoing optimisation during the product lifetime. 

REQUIREMENTS ON TRAINING AND COMPETENCE

In regard to requirements on training and competence, the EUROCONTROL Specification for STCA states:

The ANSP **shall** ensure that all controllers concerned are given specific STCA training and are assessed as competent for the use of the relevant STCA system.

Note: The primary goal of the training is to develop and maintain an appropriate level of trust in STCA, i.e. to make controllers aware of the likely situations where STCA will be effective and, more importantly, situations in which STCA will not be so effective (e.g. sudden, unexpected manoeuvres).

Comparable training requirements apply to **all** the ground based safety nets.