



NETALERT - the Safety Nets newsletter February 2017 | N°22

WELCOME

Innovative concepts of operations such as Free Route Airspace and the exponential growth of Remotely Piloted Aircraft Systems pose new challenges for safety nets. The good news is that ANSPs don't need to wait for major changes to improve their effectiveness, nor to incur great expense.

In our first article we talk to Peter Kearney from the Irish Aviation Authority who explains how new audio alerts can bring significant benefits without having to break the bank. Would they work in your operations?

More often than not, the lessons gleaned by one ANSP can benefit others. Many are provided in EUROCONTROL's 'Level 3' safety net technical guidance material, which was published in January. Our second article explores what's changed since 'Level 2' was published nearly 10 years ago.

We close the newsletter with a brief overview of the last Safety Forum conference. All the proceedings from the event are on SKYbrary – definitely worth checking out!

And finally, we must share some sad news about the passing of a dear colleague from the world of Safety Nets, Vera Oleinikova. See 'In Memoriam' on page 6.

“Conflict-conflict” – the IAA adds meaning to safety nets alerts



At the 2016 Safety Forum held in June last year, the Irish Aviation Authority's (IAA) Director of ATM Operations and Strategy, Peter Kearney, presented the latest work on safety nets from the IAA and Cranfield University. In this article, Peter tells us all we need to know about these exciting new developments.

What is the work the IAA has undertaken on safety nets alerts?

The IAA is currently developing and testing new semantic audio alerts for our safety nets as alternatives to the existing audio alerts used in our ATM system - Short-term Conflict Alert (STCA), Minimum Safe Altitude Warning (MSAW) and Area Proximity Warning (APW). Semantic alerts replace the standard 'beep, beep, beep' alerts with a voice indicating which safety net is alerting.

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Why the interest in moving away from the audio alerts?

Despite traditional audio alerts being the norm amongst most ATM systems, increasing evidence from different industries suggests that semantic audio alerts are more

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“Conflict-conflict” – the IAA adds meaning to safety nets alerts

continued

effective. We therefore wanted to investigate if our system could warn controllers in a less obstructive way whilst giving them information on the nature of the conflict.

At present, our controllers rely on traditional acoustic audio alerts for safety nets. Each has an identical audio alert (BEEP BEEP BEEP). This means they are not easily distinguishable from one another and do not provide controllers with any information about which safety net is alerting. Consequently, controllers have to identify the cause of the critical situation before applying a resolution strategy. In addition to the time taken to identify the reason for the alert and suppress the alarm, there is also a risk of an incorrect judgement being made about which safety net is alerting. This can lead to the application of an inappropriate resolution strategy - particularly if two or more alerts take place simultaneously.

Finally, we realised that the way traditional alarms are presented could potentially startle controllers. By the time they recover full awareness, a few vital seconds might have elapsed.

What exactly is different for controllers with these new audio alerts?

The semantic audio alerts trigger in two stages. First, when a conflict is detected, a beeping alarm immediately rings to catch the controllers' attention. Then, approximately a second later, this is followed by a voice informing them about which safety net is alerting. For example, if an STCA alert goes off, controllers will hear a voice saying 'CONFLICT CONFLICT'.

How did you develop and test these new alerts?

We used a free online software (AT&T Natural Voices) to produce alert recordings from a piece of text. We then tested the alarms by doing a study involving 38 of our controllers using the current acoustic system and 39 using the new semantic audio alerts.

Screenshots of representative unsafe events taken from the IAA's simulation rig were presented to the two groups. From time to time, one of the alarms would go off, and the controllers would identify the relevant conflict on the screenshot. On each occasion the time between the alarm being triggered and when the controller identified the correct conflict was recorded. To quantify the improvements for the three safety nets, we then calculated the mean time difference between the controllers presented with traditional audio alarms and those given the new semantic ones.

And what were the results?

On average we observed a 20% reduction in mean response time across the three safety nets. Interestingly, this is irrespective of the controller's age and experience. By presenting the alert in a more controlled manner and informing controllers of the nature of the event being signalled, we enabled them to resolve the situation faster and more accurately. This means, when implemented, controllers can return to routine operations in the sector faster, reducing the overall impact of a critical event to other traffic within the sector.

How are these new audio alerts going to be implemented?

The next step is to integrate the semantic alerts

into our operational ATM system. In parallel, we will train our controllers using a harmonised syllabus to ensure they are familiar with them. Once that is done, the traditional audio alerts will be phased out.

What are your recommendations and lessons learnt for other interested ANSPs or manufacturers?

Both the literature on the subject and our experience show that audio alerts should be designed to incorporate a number of features. They need to be distinguishable from other alarms, provide knowledge about the situation and minimise the risk of startled response by the controller.

In addition, this initiative demonstrates that safety net improvements can be cost-effective. Firstly, we designed, developed and implemented our solution quickly using free software. Secondly, being able to train controllers using a common syllabus is also a big advantage in terms of costs. Our work also highlights that, by being creative, even relatively simple and easily implementable solutions can have a significant impact on the safety of operations.

What are your next steps?

Our aim is to further improve these audio alerts. We are considering using an eye tracker to study where controllers are looking when alarms are triggered. In particular, we hope to measure their pupil dilation, giving us a sense of the stress levels they are exposed to in such circumstances. Ultimately, we hope this will further improve safety for crew and passengers flying through our airspace.

Peter Kearney

Peter has been working with the Irish Aviation Authority for over 17 years, starting as an air traffic controller. He is the IAA's Director of Operations and Strategy since 2012 and regularly represents the IAA at international fora including ICAO, CANSO, and EUROCONTROL. He holds a Master's degree in Human Factors and Safety in Aeronautics from Cranfield University.



Further information

You can watch Peter Kearney's speech to Safety Forum at http://www.skybrary.aero/index.php/Portal:Safety_Nets_Forum_Videos

More information on 'The impact of alerting design on air traffic controllers' response to conflict detection and resolution' can be found in Volume 56 of the International Journal of Industrial Ergonomics: <http://www.sciencedirect.com/science/article/pii/S0169814116301159>

'Level 3' documentation – still ensuring the effectiveness of safety nets

EUROCONTROL has been producing technical guidance material on ground-based safety nets for the best part of two decades. A new set of 'Level 3' documentation was released on 18th January 2017. In this article, we explain the reasons for producing the new material, explore the contents, and look at how Air Navigation Service Providers and the wider industry could use this material to improve their safety nets.

'Level 3' documentation – learning from working with ANSPs

Working in close collaboration with several Air Navigation Service Providers (ANSPs) has enabled the Safety Nets community to accumulate a significant amount of practical experience since the 'Level 2' documentation was released in 2007/8. The new documentation captures various lessons learnt and recommendations on implementing

safety nets observed over the years.

Updating the guidance material also became necessary to ensure it remained up-to-date with the latest and future advances in Air Traffic Management. In particular, the incorporation of Area Proximity Warning into the Free Route Airspace (FRA) concept was a particular catalyst for the new documentation. The 'Level 3' material incorporates new operational and technological developments as well as the results of SESAR I.

What is 'Level 3' documentation?

The 'Level 3' material is a series of documents specifying the minimum requirements and providing guidance for the definition, implementation, optimisation and operation of safety nets. It covers the four traditional

ground safety nets: Short Term Conflict Alert (STCA), Minimum Safe Altitude Warning (MSAW), Approach Path Monitor (APM) and Area Proximity Warning (APW). These guidelines, building on the legacy of the previous two editions, are intended to facilitate the harmonisation of safety nets by providing recommendations and implementation examples.

All four sets of 'Level 3' documentation adopt a common, harmonised structure:

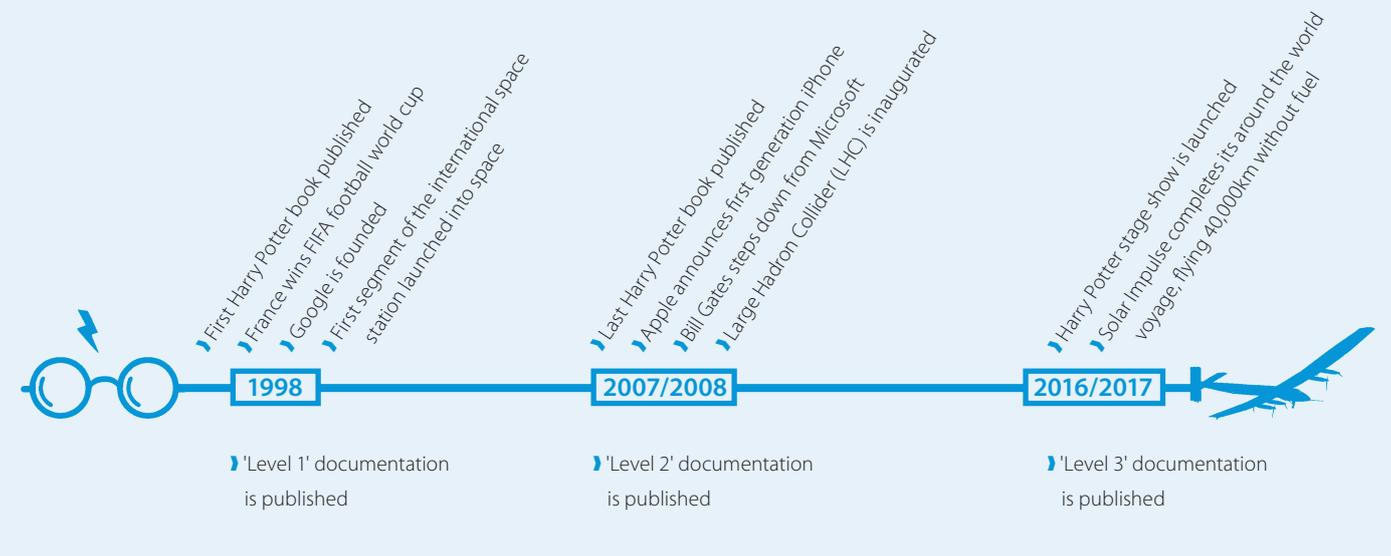
- Part I describes the safety net concept of operations and requirements;
- Part II contains overall guidance for the various stages of the safety nets lifecycle;
- Part III provides a generic implementation example and detailed guidance for optimisation and testing of that safety net.

Harry Potter and the Ground-Based Safety Nets

It's 1998 and whilst JK Rowling is publishing the first Harry Potter book, EUROCONTROL releases the Operational Requirement Document for European ATC Harmonisation And Implementation Programme (EATCHIP) Phase III ATM Added Functions. This document, also referred to as 'Level 1', discusses ground-based safety nets automation to support the detection and resolution of potential problems within a certain prediction horizon.

Roughly 10 years later, JK Rowling is publishing the last Harry Potter book - and EUROCONTROL the 'Level 2' documentation. Released between 2007 and 2008, the Specifications and Guidance Material for STCA, MSAW, APM and APW provide a broader context than automation alone, addressing other aspects such as policy, organisational clarity and training.

Last year in 2016, JK Rowling launched 'Harry Potter and the Cursed Child' stage show and now EUROCONTROL has released the 'Level 3' documentation. Despite some spooky parallels with Harry Potter, ground-based safety nets are reassuringly 'real world' and developing alongside other ATM innovations.



'Level 3' documentation - still ensuring the effectiveness of safety nets continued

A practical example - Using Cleared Flight Level (CFL) and/or Selected Flight Level (SFL)

'Level 3' documentation provides recommendations on the best way forward when considering using the CFL and/or SFL.



'Level 3' documentation – ANSPs pick what works for them

The new guidance was developed by safety nets experts from across Europe, coordinated via the SPIN sub-group.

One difference from the previous edition of the documentation is that whilst 'Level 2' were 'Specifications' and therefore mandatory, 'Level 3' are 'Guidelines' and therefore at the discretion of each Member State. This supports a more flexible approach to implementing safety nets as each ANSP can refer to the 'Level 3' documentation without the need to formally comply with its requirements. The Guidelines can also be used to complement other recognised documentation such as EUROCONTROL Rules and Specifications or ICAO Recommended Practices and Procedures.

EUROCONTROL Safety Nets expert Stan Drozdowski explains: "Over nearly a decade

we've worked with a range of ANSPs on safety nets, each of which has had its own unique requirements. Therefore, the new material is about providing a portfolio of guidance and best practices from which ANSPs can pick and choose what's applicable to them". A practical example of such guidance is provided in the textbox above.

Continuous improvement is still key

The 'Level 3' documentation is very much an update rather than a re-write. As Stan Drozdowski says: "The key messages from 2007/8 still remain valid today and we're definitely not advocating tearing up the rule book for the sake of it. Most importantly, safety nets need to be continuously improved, and the guidelines promote that message. The 'Level 3' documentation provides new material, mostly aimed at improving the implementation of safety nets. But the majority of the material developed over the years continues to be relevant in today's context. For this reason, the documentation

also re-emphasises the prerequisites needed to support safety nets."

The infographic on page 5 summarises some of the key elements found in the 'Level 3' documentation – new topics are in blue whilst material already covered in the previous documentation is in orange.

Next steps for ANSPs

The new guidance material provides real value by drawing on the experience acquired by a multitude of ANSPs across Europe. Sharing their lessons learnt and recommendations in implementing safety nets can benefit all stakeholders.

The 'Level 3' documentation also acts as a framework allowing ANSPs to set up efficient processes to continuously adapt and improve safety nets to better support controllers in our ever changing operational environments.

'Level 3' documentation - still ensuring the effectiveness of safety nets continued

Organisational aspects, as part of a mature Safety Management System (SMS), ensure safety nets improvements are adequately supported. This includes:

- **Management commitment** to promote a clear policy on the use of safety nets and provide sufficient resources;
 - **Team effort** from all stakeholders including operational, technical, safety experts as well as ATCOs, working together with Industry and Regulators;
 - Willingness to **optimise and improve** safety nets by exploiting new technological developments and adapting for an increasingly complex operational environment.
- See NETALERT 16 for more in this topic.

Recommendations on ATCO training, which should include:

- **A comprehensive training syllabus** covering, amongst others, the role played by safety nets and how to use them, how safety nets work, their performance and limitations and how to provide feedback on their operations;
- **Explanations on new functionalities and significant changes** made to safety nets since the last time the ATCO was trained;
- **Known unexpected behaviours** of safety nets.

Understanding the impact of the surveillance infrastructure on the performance of safety nets:

- While conventional Mode 3A/C SSR can support some safety net functionalities, **Mode S SSR is an essential enabler** for effective safety nets in complex operational environments;
- **More accurate altitude reporting** (in 25 ft rather than 100 ft increments) can reduce the time it takes to report a deviation;
- **Complementary Multi-lateration infrastructure** could be deployed to obtain effective safety net operations at lower altitudes, especially with demanding terrain. See NETALERT 21 for more on this topic.

Developing and employing new methods to undertake safety net optimisation, based on:

- Employing the most **adequate optimisation concept and procedure**;
- Recording the most relevant data to **monitor performance**;
- Testing safety nets by **implementing robust reference cases**

Adapting APW to support the Flexible Use of Airspace (FUA) concept by **interfacing the safety net with airspace booking tools** and getting real-time updates of which volumes are used and at what times they are booked.

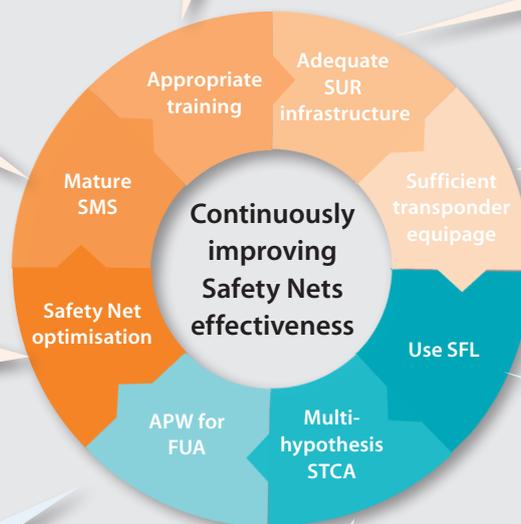
Deploying multi-hypotheses for STCA can significantly improve alerting performance:

- By allowing to **optimise warning time** based on the flight trajectory considered to be the most likely;
 - But noting that it requires twice the amount of optimization effort.
- See NETALERT 15 for more on this topic

Sufficient transponder equipage is required to ensure safety nets provide consistent protection as they can only generate alerts for aircraft that are equipped with pressure altitude-reporting transponders. See NETALERT 20 for more on this topic.

Making best use of available surveillance data, especially the Selected Flight Level (SFL), helps to:

- **Pre-empt an aircraft levelling off at a certain level**, hence not conflicting with another aircraft, terrain or a restricted area;
 - **Reduce nuisance alerts**, particularly for level off situations;
 - **Provide extra warning time**, although it might reduce warning time in the event of an aircraft level bust;
- Note that the SFL is not used for APM. See NETALERT 21 for more on this topic.



RE-EMPHASISED in 'Level 3' documentation

NEW in 'Level 3' documentation

Further information

The Level 3 Guidelines can be found on the EUROCONTROL website.

STCA: <http://www.eurocontrol.int/articles/short-term-conflict-alert-stca-guidelines>

MSAW: <http://www.eurocontrol.int/articles/minimum-safe-altitude-warning-msaw-guidelines>

APW: <http://www.eurocontrol.int/articles/area-proximity-warning-apw-guidelines>

APM: <http://www.eurocontrol.int/articles/approach-path-monitor-apm-guidelines>

Safety Forum 2016 round up – focus on safety nets



The 4th instalment of the Safety Forum series took place at EUROCONTROL in Brussels on the 7th and 8th of June last year. This annual event, organised by the Flight Safety Foundation, the European Regions Airline Association and EUROCONTROL, is a key date in the calendar of any aviation safety expert. Here we take a look at the main topics discussed and highlight where to find further information.

Safety nets in a social-technical system

The Safety Forum 2016 aimed to explore airborne, ground-based, runway and airport surface safety nets to see how their collective effects can support global safety improvements. In that context, attendees discussed a wide range of topics such as new technological advances and implementations as well as the intended and unintended effects of safety nets. A topic which generated particular interest was how we can keep relying on safety nets without decreasing the skills of front-

line operators. A number of recurring themes emerged throughout the event:

- **Approach and Runway safety nets:** both areas have the potential to offer many opportunities for deploying safety nets and as such improve operational resilience, but these safety nets need to be intuitive to all users (ATCOs, pilots and drivers) to remain effective.
- **New safety nets for cockpit and vehicle applications:** moving towards innovative ways to improve situational awareness and decision making, especially since ground/cockpit cooperation and shared threat management is considered to be a major contributor to the improvement of any ATC system and its safety performance.
- **Safety nets reliance on accurate information:** maintaining relevant information (for example some runway

safety nets may use Aeronautical Information Publication (AIP) data) and adapting tuning according to the quality of the data is therefore essential.

- **Comprehensive training covering the technical, operational as well as human performance impact of safety nets:** due to their rare activation, safety net alerts can sometimes surprise and startle, which in turn may lead to overreaction or inappropriate response.
- **Monitoring safety nets performance effectively:** collecting data in a systematic and consistent way helps to accurately measure the level of protection offered by safety nets.

The event report describes a set of Action Opportunities directly applicable to Air Navigation Service Providers (as well as other aviation stakeholders). Indeed, a large number of topics addressed during the Safety Forum 2016 feature in the recommendations and lessons learnt from the 'Level 3' documentation.

See you this year!

This year's forum will take place on the 6th and 7th of June 2017 at EUROCONTROL in Brussels and will focus on 'Preventing Runway Collisions'.

Where to find more information?

All the outcomes of the Safety Forum 2016 are on SKYbrary, including the report, slide decks and video recordings of the presentations:
http://www.skybrary.aero/index.php/Portal:Safety_Nets

In addition to the event report, some stakeholders produced four posters to raise awareness of certain topics:

- Safety nets in real time simulations – EUROCONTROL
- Monitored approach – the SOP safety net – PicMA
- Safety nets efficiency – NATS
- Area Proximity Warning – DHMI



In Memoriam – Vera Oleinikova

A long standing representative to SPIN of the Lithuanian ANSP 'Oro navigacija', Vera Oleinikova, sadly passed away on 31st May 2016 after a short illness. Vera was full of energy and dedicated to her work. She participated in various national, regional and European projects. Always outspoken and witty, never shy to tackle controversial or difficult topics, she will be really missed.

The safety nets community has lost a valuable colleague. May she rest in peace.



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