



WORKING PAPER

FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

- Agenda Item 2: Timely and safe use of new technologies**
2.3: 2026-2028 Edition of the Global Aviation Safety Plan (GASP)

MOVING BEYOND COMPLIANCE MEASUREMENT

(Presented by Civil Air Navigation Services Organisation (CANSO) and
International Federation of Air Traffic Controllers' Associations (IFATCA))

EXECUTIVE SUMMARY

There is a need to evolve safety performance measurement towards the proactive management of risks, beyond only measuring compliance against ICAO Standards (i.e., separation standards).

Air navigation services providers (ANSPs) have typically managed risks by measuring deviations against the Standards. Ever-improving safety levels, and the scarcity of serious safety events has limited our retrospective learning.

This paper proposes complementing current compliance-based metrics, with a new methodology that continuously evaluates the dynamic interactions between aircraft pairs and closer approximate vulnerabilities in the system, with regards to the potential exposure to a mid-air collision.

Action: The Conference is invited to agree to Recommendation 2.3/x – Moving beyond compliance measurement.

1. INTRODUCTION

1.1 Air navigation services providers (ANSPs) carry the responsibility to provide for the safe separation of aircraft within a defined airspace, and the need to continually understand and reduce the risks of an aircraft accident. In the context of mid-air collision risk, Standards have long been established. The Standards are for the separation of aircraft, such as but not limited to, the distance between aircraft flying under instrument flight rules (IFR). A loss of separation event has traditionally been used as a proxy to measure the ANSP's exposure to this accident risk. These events are either manually reported and/or automatically detected by the processing of surveillance data. Each loss of separation event is then scored as to its "severity" class, based on the minimum horizontal/vertical separation and assessment of the potential risk for a collision.

¹ Arabic, Chinese, English, French, Russian and Spanish versions provided by CANSO.

1.2 Measuring the severity of a loss of separation is a key metric for all ANSPs. However, it is not the only metric that can provide insight into the true exposure to mid-air collision risk.

1.3 The current methods of safety performance measurement also fail to identify all other instances where the geometry and the predicted dynamic interaction between two aircraft may carry a significant risk of collision, even if the operation is considered compliant within operational separation Standards.

1.4 Due to the implementation of many safety improvements, the number of actual losses of separation have reached very low levels. Analysis of instrument flight rules (IFR)-IFR losses of separation with air traffic management (ATM) contribution undertaken by CANSO, show that on average across 31 ANSPs, 0.007% (or 7×10^{-5}) of IFR flights experienced a loss of separation in 2022, with historical values showing very similar figures. Aggregately, these 31 ANSPs managed 24.4 million IFR flights, with 966 IFR-IFR losses of separation in 2022. This low number of events can also give a false impression of the system's true resilience and the extent to which risk exposure remains. In some way, it falls short of ICAO Annex 19 – *Safety Management's* definition of safety: *“the state in which risks associated with aviation activities, related to, or in direct support of the operation of the aircraft, are reduced and controlled to an acceptable level”*.

1.5 Subsequently, the measurement of IFR-IFR losses of separation will not provide a complete understanding of safety risks in a system, despite the high compliance to airborne separation standards. The term ‘controlled’ in Annex 19’s definition of safety has less to do with measuring outcomes (i.e., “lagging indicators”), but more to do with so called “leading indicators” that describe how well the airspace is managed, regardless of the number of occurrences. As such, there is a benefit to complementing current compliance-based metrics with a methodology that will continuously evaluate the dynamic interactions between aircraft pairs in closer approximate vulnerabilities, against the potential exposure to a mid-air collision.

2. DISCUSSION

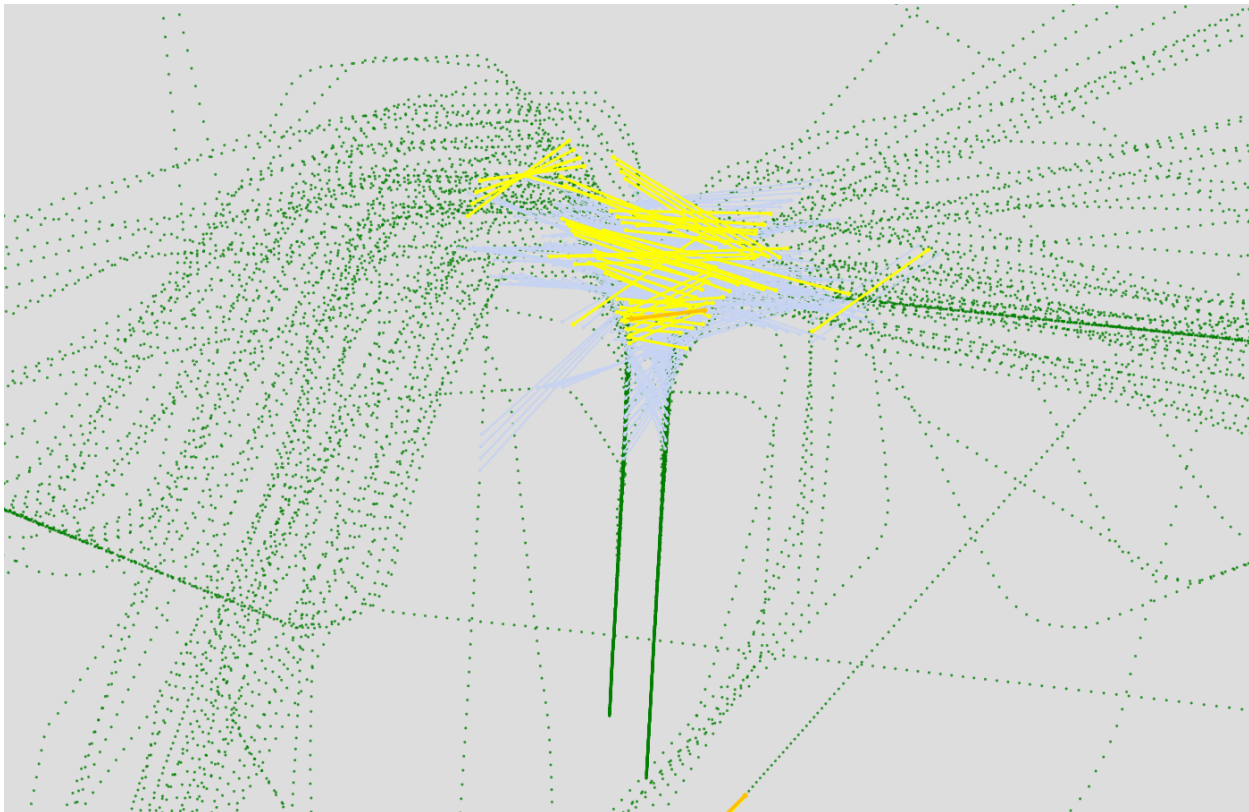
2.1 Supplementing the measurement of losses of separation (compliance-based) with a measurement that better expresses the potential risk of collision that ANSPs are actively managing (risk-based) can be done by processing surveillance data in a manner that will detect how often aircraft have converging trajectories in a defined area of airspace. The data could indicate whether a pair of aircraft with only a short period of time, would be predicted to either collide or come into very close proximity to one another without a subsequent change of trajectories.

2.2 For each detected interaction, such a time to conflict methodology, calculates a score that represents the significance of the interaction based on the aircraft geometries and additional adaptable parameters (e.g., altitude, time until closest point of approach, civil-military mixed interaction, etc.). This provides a more accurate view of the latent exposure to the risk, regardless of operational procedures, airspace classification, rules of the air, the aircraft planned path and, especially, whether the operation was compliant to separation standards.

2.3 By evaluating these interactions, an area of airspace may be identified as a hotspot experiencing repeated risk events. This does not mean that it is inherently unsafe, but rather that it is inherently vulnerable. At a minimum, this methodology empowers the organization to objectively identify areas of potential vulnerability in the airspace and assess whether sufficient risk mitigation barriers are in place and able to effectively manage the risk.

2.4 Key to the application of this methodology is the idea that a compliant operation (i.e., when there is no loss of separation) may still contain intrinsic vulnerabilities that may go unseen or undetected because of the low frequency of non-compliant operations.

2.4.1 The picture below shows one day of flights for approaches on two parallel runways, which are just at the bottom of the image. Lines are drawn between aircraft pairs that have a potential future collision risk. The line colours (light blue, yellow, orange, or red) respectively represent the significance of the interaction. This is demonstrating the inherent risk that is present in the airspace, even though the operation is considered compliant (there were no losses of separation). The model does not evaluate what is *planned* to occur, but rather the immediate risk that exists at each surveillance data point. This parallel approach scenario exemplifies the methodology quite well. In this example aircraft from both the west and east are planned to turn south to intercept the final approach of one of the two runways.



2.4.2 It is obvious that parallel approach operations require a robust set of situational awareness and alerting systems, procedures, and skill levels from both the ANSP and aircraft operators in order for the risk of a collision to be controlled. The use of risk exposure metrics to depict the significance of the interactions in the absence of any non-compliance event provides a more complete understanding. Such insight can cause the organization to ask questions regarding risk controls, potential unbalanced reliance on pilots complying to instructions in a situation where a collision scenario can quickly evolve should they not comply, or whether situational awareness and alerting systems and the design of procedures are effectively aiding controllers.

3. CONCLUSION

3.1 While compliance-based metrics (e.g., IFR-IFR losses of separation) are always going to be a necessary and useful part of an ANSP's *compliance* picture, they are insufficient on their own to provide a complete picture of the organization's risk exposure and vulnerabilities with regards to a mid-air collision.

3.2 The suggested methodology would bridge this gap by supporting the move towards risk-based management, regardless of airspace separation requirements, the rules of the air being applied, the type and wake turbulence category of involved aircraft and whether the operation is compliant and yet carrying risk.

3.3 The suggested methodology also helps organizations understand what is traditionally considered normal, failure-free operations, answering positive questions such as "what has helped us keep an operational scenario safe despite the inherent risk present in the system?" This methodology also facilitates the progression from a failure-based safety-I perspective towards more of a success-based safety-II perspective.

3.4 Considering the above, the Conference is invited to support the following recommendation:

Recommendation 2.3/x – Moving beyond compliance measurement

That States:

- a) and air navigation services providers (ANSPs) consider developing methodologies and safety performance indicators to assess and monitor risk beyond existing or conventional compliance measures;
- b) and ANSPs share safety performance indicators identified for ANSP safety performance measurement and safety risk monitoring by submitting a change request, following the maintenance process, to the Global Air Navigation Plan (GANP, Doc 9750) performance framework; and

that ICAO:

- c) consider the addition of new safety performance indicators for ANSP safety performance measurement and safety risk monitoring identified by States and service providers in the next edition of the *Global Aviation Safety Plan* (GASP, Doc 10004).

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