ICAO

SAFETY

NORTH ATLANTIC SYSTEMS PLANNING GROUP (NAT SPG)

2020 Annual Safety Report

2021 Edition

International Civil Aviation Organization (ICAO) North Atlantic Region

2020 Annual Safety Report

Safety Policy

Safety is the NAT SPG's core business function. The NAT SPG is committed to developing, implementing, maintaining and constantly improving strategies and processes to ensure that all our aviation activities take place under a balanced allocation of organizational resources. The NAT SPG will aim to achieve the highest level of safety performance and meet regional safety objectives in line with national and international standards, the Global Aviation Safety Plan (GASP), and the Global Air Navigation Plan (GANP).

Objective

The objective of the NAT SPG member States is to maintain and, where possible, improve the agreed safety standards in all activities supporting the provision of air navigation services in the NAT Region:

- All involved States are accountable for the delivery of the agreed level of safety performance in the provision of air navigation services in the North Atlantic Region.
- All involved States are accountable for the delivery of the agreed level of safety performance in aircraft operations in the North Atlantic Region.
- Safety in the NAT Region is managed through the organization and activities of the relevant implementation and oversight groups established by the NAT SPG, in coordination with the non-member States and observers, to achieve its Safety Objective.

Guiding Principles

The NAT SPG will act to:

- **Clearly** define all accountabilities and responsibilities for the delivery of safety performance with respect to the provision of air navigation services and participation in the NAT SPG and its contributory bodies;
- **Support** the safety management activities that will result in an organizational culture that fosters safe practices, encourages effective safety reporting and communication, and actively manages safety within the NAT Region;
- **Share** safety related data, knowledge and expertise with concerned stakeholders;
- **Disseminate** safety information and NAT operating requirements to stakeholders;
- **Establish and implement** hazard identification and risk management processes in order to eliminate or mitigate the safety risks associated with air navigation services supporting aircraft operations in the North Atlantic Region;
- **Establish and measure** NAT Region safety performance against agreed safety standards; and
- **Continually improve** our safety performance through safety management processes.

All of the NAT member States contribute experts to the NAT SPG, or one or more of its various subgroups, and so support the overall management of safety in the Region. The NAT safety policy is enhanced by the agreement of member States to use the information shared at NAT SOG meetings for the purposes of education and for making safety improvements within the Region. This has paved the way for members to discuss and share information and act upon it within the framework of the NAT SPG.

Executive Summary

The North Atlantic Region's eighth Annual Safety Report (ASR) is issued by ICAO's North Atlantic (NAT) Systems Planning Group (SPG) and presented in the following pages. This report covers calendar year 2020 which, as a result of the global health crisis, has posed our industry with an unprecedented challenge. In 2020 and into 2021 the traditional methods for data analysis and validation have not been available. The data has been cross-checked to ensure the highest possible level of fidelity, but the data presented may require verification when the crisis allows and those reading this report should consider the results presented in that context.

The NAT SPG structure is established to study, monitor and evaluate the air navigation system in the NAT region taking into account changes to technology, changing traffic characteristics and traffic forecasts. The number of flight hours in the NAT HLA in 2020 was 892,137 a significant reduction on that reported in 2019. Until the onset of COVID-19, traffic had predicted to grow at a rate of 2.4% annually between 2020 and 2024. Despite some positive medical developments, it is unlikely that a return to pre-COVID19 levels will be seen for several years.

Safety Performance in the NAT HLA continues to be monitored by the measures and targets associated with a set of 12 Safety Key Performance Indicators (SKPIs) with targets based on three years of rolling data. Eight (8) of the SKPIs have met their target in 2020 (six (6) were achieved in 2019). Improvements were seen in the following SKPIs:

- Steady improvements in the number of Large Height Deviations (LHDs) where datalink was not in use.
- A reduction in the number of minutes that aircraft with datalink spent at the wrong flight level, and
- A reduction in the number of GNE events involving operations with datalink

A significant reduction was also witnessed in the rates of losses of separation in the vertical and lateral dimension, but these measures are more sensitive to traffic density than other measures might be. Performance levels in some SKPIs appears degraded where datalink is not in use, specifically in the rate of minutes spent at the wrong flight level or the rate of GNEs. These are attributable to a number of long duration non-datalink flights that occurred during the temporary relaxation of the datalink mandate (DLM).

The Vertical collision risk estimate (CRE) for 2020 was calculated to be 19.7×10^{-9} fapfh (52.6×10^{-9} in 2019) which reduces by 72% to 5.5×10^{-9} fapfh with Strategic Lateral Offset Procedure (SLOP). This represents the lowest level since 2000 and the second lowest level since the widespread introduction of Reduced vertical Separation Minima (RVSM) in the NAT in 1997. The Lateral Collision Risk for the year 2020 is estimated to be 3.6×10^{-9} fapfh, which represents a decrease of 74% compared to 2019.

The Scrutiny Group were presented with half of the number of events to scrutinize in 2020 as they were for 2019 (133 vs 266). The top 10 contributing factors in 2020 based on LHD or Lateral event data largely remained the same as 2019 with some minor differences. "ATC coordination" errors have risen to the top (11% of all scrutinized events in 2019 vs 18% in 2020), "messages not actioned by ATC" and "equipment" have dropped from the list to be replaced by "crew other" (8% of all scrutinized events) and "incorrect application of contingency (other than weather)" (6% % of all scrutinized events).

The North Atlantic Scenario

The airspace of the North Atlantic, which links Europe and North America, is the busiest oceanic airspace in the world. The NAT Region is a pioneer in the implementation of advanced procedures and technology supporting the progress of the global air navigation and aviation safety plans.

Traffic mainly flows in a broadly East-West orientation in a twice daily pattern where a daily organized track system takes account of airspace users' needs and weather patterns. NAT core traffic flow is almost exclusively jet transport aircraft that operate in the upper airspace in the en-route phase of flight.

Since March 2019, approximately 70% of the core NAT traffic has been able to make use of the surveillance capability offered by space based Automatic Dependent Surveillance-Broadcast (ADS-B) augmenting an increasing use of Automatic Dependent Surveillance-Contract (ADS-C). The number of flights eligible for the separation standards enabled by ADS-B has increased steadily since the capability was introduced.

Communication is, to a large extent, based on satellite-based data link, also referred to as Controller-Pilot Data Link Communications (CPDLC) with High Frequency radio being utilized less often. This leads to air traffic management and operation that is fundamentally different in concept to typical domestic operations, with a greater focus on strategic rather than tactical techniques although, as the NAT embraces new technologies this balance has begun to change.

The number of flight hours in the NAT HLA in 2020 was 892,137, which is a significant decrease from the 2,063,908 flight hours in 2019. This was expected due to the COVID-19 pandemic and the associated reduction in air travel during 2020. The NAT Economic, Financial and Forecast Group (NAT EFFG) estimates that in 2020, during the peak week of July 15 to July 21, approximately 5,621 flights crossed the North Atlantic. This figure was 13,733 for that same week in 2019.

Safety Performance Monitoring and Measurement

Note 1: In 2020 and 2021, the organization and conduct of all meetings of NAT SPG and its contributing bodies were heavily impacted by the consequences of the COVID-19 pandemic. Because of this, the events that occurred in the NAT HLA between January and December 2020, even though scrutinized in 2020 and 2021 by a small group of experts, could not be reviewed by the usual full NAT Scrutiny Group (NAT SG) membership during a face-to-face meeting. The values for safety performance presented in this report for 2019 and 2020 could therefore be revisited when full face-to-face NAT SG meetings can be reconvened, and are subject to change.

Collision Risk Estimates

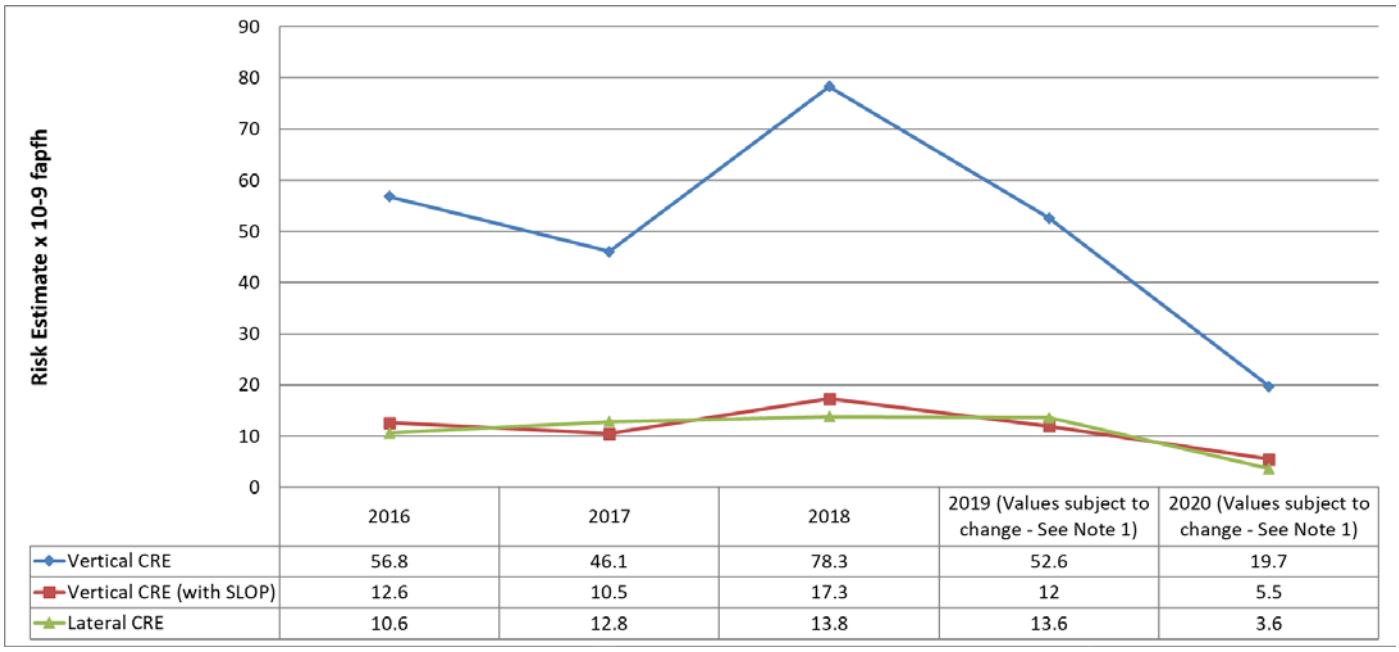
The estimated risk of a mid-air collision, referred to as Collision Risk Estimate (CRE), is reported in terms of fatal accidents per flight-hour (fapfh) and is calculated in the lateral and vertical planes. The model used for computation essentially assumes each aircraft is a box having a fixed x, y, and z orientation and approximates the risk of collision by integrating the crossing rate over the period when two boxes are close to each other in each dimension.

Estimates of Vertical and Lateral Collision Risk for 2020 in the NAT HLA are based on risk bearing events reported to the NAT Central Monitoring Agency (CMA) for the period January to December 2020. Flight activity data from five NAT Oceanic Control Areas (OCAs) was used in deriving an estimate of Vertical and Lateral Collision Risk. The risk estimates were calculated for the Middle zone (Gander and Shanwick OCAs), the North zone (the Reykjavik OCA), and the South zone (the New York East and Santa Maria OCAs) and then combined to derive a risk estimate for NAT HLA.

The Vertical Collision Risk Estimate for 2020 was estimated to be 19.7 x 10^{-9} fapfh for all NAT HLA. Figure 1 shows that this reduces by 72% to 5.5 x 10^{-9} fapfh with SLOP. The Vertical Collision Risk Estimates in 2020 both with the SLOP effect incorporated and without SLOP are lower in comparison to 2019 estimates.

Figure 1 also presents the Lateral Collision Risk for the year 2020, estimated to be 3.6 x 10^{-9} fapfh, which represents a decrease of 74% compared to 2019. This result is a significant decrease in the lateral collision risk estimate compared to 2019.

The reduction in air travel caused by the COVID-19 pandemic is considered the reason for the significant decrease in estimated collision risks.



	2016	2017	2018	2019 (Values subject to change - See Note 1)	2020 (Values subject to change - See Note 1)
Vertical CRE	56.8	46.1	78.3	52.6	19.7
Vertical CRE (with SLOP)	12.6	10.5	17.3	12	5.5
Lateral CRE	10.6	12.8	13.8	13.6	3.6

Figure 1 - Collision Risk Estimates in the NAT HLA (2016-2020)

Safety Key Performance Indicators (KPIs)

The NAT SPG has established Safety KPIs and associated targets for the NAT HLA. The NAT HLA performance in 2020 is shown the table below[1]. The 2020 figures are shown in green where the performance meets the targets and red otherwise.

Safety KPI		Target		2017 Performance	2018 Performance	2019 Performance	2020 Performance
i	Number of accidents	0		0	0	0	0
ii	Number of fatal accidents	0		0	0	0	0
iii	Number of fatalities related to aviation fatal accidents	0		0	0	0	0

[1] The flight hours flown value calculations use the actual flight hours since 2018, whereas, for the previous years, the figures were calculated using the estimated flight hours of 3.25 hours per aircraft

Safety KPI		Target	Previous rolling three-year period of performance (2017-2018-2019)	2017 Performance	2018 Performance	2019 Performance (Values subject to change – See Note 1)	2020 Performance (Values subject to change – See Note 1
iv	Rate of LHD events (No of LHD events divided by No of flight hours flown in the NAT region), involving operations with Data Link in use	Reduction over previous rolling three-year period of performance	3.04×10^{-5}	2.67×10^{-5}	2.87×10^{-5}	3.59×10^{-5}	**4.71×10^{-5}**
v	Rate of LHD events (No of LHD events divided by No of flight hours flown in the NAT region), involving operations with Data Link not in use	Reduction over previous rolling three-year period of performance	7.52×10^{-6}	1.20×10^{-5}	7.18×10^{-6}	3.39×10^{-6}	**5.60×10^{-6}**
vi	Percent of Long Duration[2] LHD events	Reduction over previous rolling three-year period of performance	1.71%	0.00%	2.67%	2.47%	**4.26%**
vii	Rate of minutes that aircraft, with Data Link in use, spent at the wrong flight level (Amount of minutes spent at the wrong flight level divided by total duration of flights in minutes)	Reduction over previous rolling three-year period of performance	8.34×10^{-7}	8.63×10^{-7}	6.95×10^{-7}	9.45×10^{-7}	**5.23×10^{-7}**
viii	Rate of minutes that aircraft, with Data Link not in use, spent at the wrong flight level (Amount of minutes spent at the wrong flight level divided by total duration of flights in minutes)	Reduction over previous rolling three-year period of performance	5.90×10^{-7}	4.91×10^{-7}	1.05×10^{-6}	2.34×10^{-7}	**8.21×10^{-7}**
ix	Rate of GNE events (No of GNE events divided by No of flight hours flown in the NAT region) , involving operations with Data Link in use	Reduction over previous rolling three-year period of performance	1.16×10^{-5}	6.54×10^{-6}	1.72×10^{-5}	1.11×10^{-5}	**8.97×10^{-6}**
x	Rate of GNE events (No of GNE events divided by No of flight hours flown in the NAT region), involving operations with Data Link not in use	Reduction over previous rolling three-year period of performance	5.67×10^{-6}	5.45×10^{-6}	4.79×10^{-6}	6.78×10^{-6}	**7.85×10^{-6}**
xi	Rate of losses of separation (vertical) (No of losses of separation events divided by No of flight hours flown in the NAT region)	Reduction over previous rolling three-year period of performance	1.04×10^{-5}	1.14×10^{-5}	9.58×10^{-6}	1.02×10^{-5}	**4.48×10^{-6}**
xii	Rates of losses of separation (lateral) (No of losses of separation events divided by No of flight hours flown in the NAT region)	Reduction over previous rolling three-year period of performance	5.82×10^{-6}	4.91×10^{-6}	3.83×10^{-6}	8.72×10^{-6}	**0**

Table 1 – Safety Key Performance Indicators (SKPIs) and associated targets (2017-2020)

[2] Long Duration LHD event means an event unprotected by ATC for 20 minutes or more, based on a threshold established after review of historical data reported to the NAT CMA

Scrutiny of events

A small team made up of the NAT SG Rapporteur, NAT CMA and NAT MWG members carried out a provisional scrutiny of 133 events which were reported to the NAT CMA as occurring in the NAT High Level Airspace (HLA) of the Oceanic Control Area (OCA) of Shanwick, Santa Maria, Reykjavik, New York East, Gander and Bodo during the year 2020. These events were categorized as follows:

- 47 Large Height Deviations (LHDs)
- 57 actual lateral deviations, including:
    - 15 GNEs and
    - 13 ATC Interventions where when the Air Traffic Controller (ATCO) caught and corrected a lateral deviation before it developed into a GNE
- 26 coordination events, where coordination between two Units has not been correctly carried out, leading to a vertical, lateral or time event.
- One (1) longitudinal loss of separation event
- 30 prevented events where the ATCO prevented a deviation or an uncoordinated flight profile entering the airspace of another ANSP.

Note 2: It is important to note that the sum of the values will not equal to the number of events as one event can be counted in one or more dimensions.

It is worth noting that ATC interventions and preventions are positive indicators that the ATC system has recognized an error, often through data link equipage capabilities, warning the controllers in sufficient time to take pre-emptive action. Underlying causes of all lateral deviations (incipient or actual) are often identical – the magnitude depends upon the timeliness of identification and corrective action.

The review of these 133 events of 2020 showed that the top 10 contributing issues allocated to LHD and lateral events were:

1. *ATC coordination* where an error occurring during the coordination between two ATC sectors or ANSPs contributed in 24 (18%) of the events of 2020.
2. *Flight Plan vs. Clearance* where flying, or intending to fly the planned route instead of the cleared route contributed in 24 (18%) of the events of 2020. In most cases (19 out of the 24), deviations did not actually occur as they were prevented by an ATCO.
3. *Did not adhere to ATC clearances* in either the vertical or the lateral dimension where a crew, for no identifiable reason, operated a flight profile different to the ATC clearance (e.g. changed vertical profile or routed to a different waypoint which was not contained in the clearance or the filed flight plan or due to contingency) contributed to 22 (17%) of the 2020 events.
4. *Weather* where weather conditions experienced during the flight contributed in 15 (11%) of the events of 2020.
5. *Dispatch*, where a flight plan issue contributed in 11 (8%) of the 2020 events. This can for example be an arrival route into an FIR or airport not filed as per the national AIP of flight plans filed incorrectly, causing the existence of multiple flight plans with different routes for one flight.

6. *Crew-Other*, where a crew action contributed to 10 (8%) of the 2020 events but there is insufficient information or evidence to allocate any of the currently scrutinized causal factors.

7. *Waypoint updating* involving waypoint entry or deletion errors by flight crews contributed to 9 (7%) of the events of 2020.

8. *Incorrect Application of Contingency Other than for Weather,* where crew deviated from their assigned clearance due to an emergency situation but did not follow the correct procedure for in-flight contingencies in Oceanic Airspace, contributed to 8 (6%) of the events in 2020. This can for example correspond to crew changing altitude due to a reduction in aircraft performance caused by severe turbulence but without starting to turn to offset laterally.

9. *Readback/Hearback,* where incorrect read back or hear back of a clearance contributed in 7 (5%) of the 2020 events. This can for example be when crew readback an incorrect clearance which was not picked up by the receiving ATC Unit.

10. *CPDLC Uplink messages*, where crew misunderstood or misread a CPDLC uplink message, or indicated an issue with their CPDLC contributed in 7 (5%) of the 2020 events.

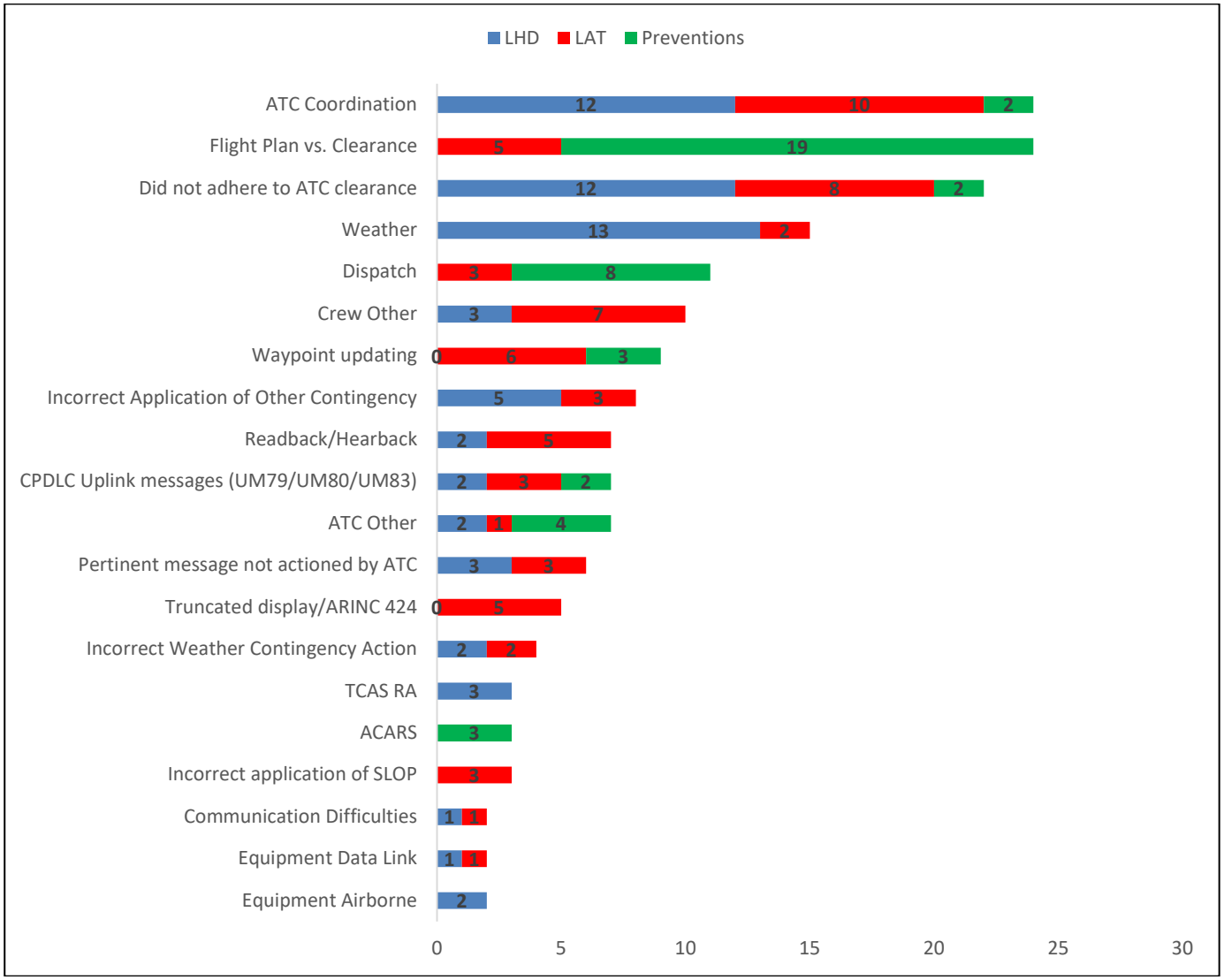


Figure 2: Contributing issues to events in the NAT HLA in 2020 (subject to change – see Note 1)

Prevented deviations for all event types were classified according to the implemented mitigations used to avert a deviation. The results of this classification are presented in Figure 4, demonstrating that the practice of requiring position reporting of "NEXT and NEXT +1" and the "CONFIRM ASSIGNED ROUTE" CPDLC message sets (UM137/DM40) are proving to be of benefit.

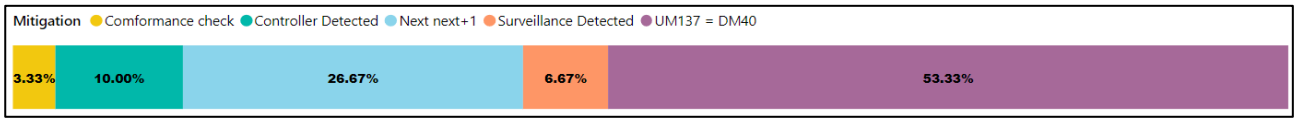


Figure 3: Mitigations used for prevented deviation events in 2020 (subject to change – see Note 1)

NAT regional priorities

Following the implementation of Space-Based Automatic Dependent Surveillance-Broadcast (SB ADS-B) in 2019, 2020 was a year to begin realising the real benefits of this implementation, even though the COVID-19 pandemic has, in some part, reduced the positive impact that the deployment could have realised. In accordance with NAT SPG conclusion 54/9, the trial of separations by SB ADS-B concluded in late 2020 enabled the provisions for the separation standard published in Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc4444).

In 2018, the NAT SOG was presented with information declaring the intent to deliver VHF communications in the Shanwick South East Corner and this change was successfully transitioned in January 2020. The changes were introduced in response to the datalink mandate (DLM) which had the potential to exclude many of the airframes operating in that area following the full implementation of the DLM. The separations (established in PANS ATM) are based on GNSS or RNP2 standards and enable a reduction in lateral and longitudinal separation standards.

As the COVID19 crisis deepened in the first half of 2020, an adhoc meeting of the NAT SPG agreed a temporary accommodation of non-datalink equipped aircraft within the NAT HLA to allow more flexibility for NAT airspace users. Initially the accommodation was planned for three months but quickly extended to six months before ultimately remaining in place until being withdrawn on the 23rd February 2021. The temporary accommodation was well managed within the reduced overall capacity of the ANSPs.

In late 2019, support had been gathered to improve coordination and establish possible means of collaboration with the Southern Atlantic (SAT) representatives. The remote nature of meetings held in 2020 gave rise to the opportunity for wider attendance at many of the NAT groups and some groups were attended by multiple SAT representatives as observers. It allowed the teams to look and think across regions and collaboration in this manner will be supported in coming years.

In 2019, the ASR included the NAT 2030 vision among its priorities and although it is appropriate to review and amend the plans that sit below that Vision in light of the events in 2020, it remains a relevant pathway to prioritize and deliver a proportionate series of improvements. The global and industry context and environment will drive the deliverables, but:

- It will seek to improve operational flexibility, by reducing the OTS footprint, discontinue the use of oceanic clearances and introduce procedures for the "dynamic airborne rerouting".

- It will strive to improve operational resilience through the development of its contingency procedures and improvements in communication performance all within the context of a developing cyber threat.
- It will embrace emerging technologies and techniques such as formation flights or self-separation and ready itself for new market entrants such as unmanned flight, supersonic or space flight and balloon operations.

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Appendix A

ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
ANS	Air Navigation Service
ATC	Air Traffic Control
ATS	Air Traffic Service
CPDLC	Controller-pilot data link communications (data link)
EFFG	Economic, Financial and Forecast Group
fapfh	Fatal Accidents per Flight Hour
GASP	Global Aviation Safety Plan
GNE	Gross Navigation Error
HLA	High Level Airspace
ICAO	International Civil Aviation Organization
KPI	Key Performance Indicator
LD LHD	Long Duration LHD
LHD	Large Height Deviation
NAT	North Atlantic
NAT CMA	North Atlantic Central Monitoring Agency
NAT EFFG	North Atlantic Economic, Financial and Forecast Group
NAT MWG	North Atlantic Mathematicians Working Group
NAT SG	North Atlantic Scrutiny Group
NAT SOG	North Atlantic Safety Oversight Group
NAT SPG	North Atlantic Systems Planning Group
OCA	Oceanic Control Area
OTS	Oceanic Track System
RVSM	Reduced Vertical Separation Minimum
SKPI	Safety Key Performance Indicator
SLOP	Strategic Lateral Offset Procedure

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International Civil Aviation Organization (ICAO)
European and North Atlantic (EUR/NAT) Office

3 bis villa Émile Bergerat
92522 Neuilly-sur-Seine Cedex, France
Tel.: +33 1 46 41 85 85
Fax: +33 1 46 41 85 00
E-mail: icaoeurnat@icao.int