International Civil Aviation Organization

MIDANPIRG/22 & RASG-MID/12 Meetings

(Doha, Qatar, 4 – 8 May 2025)

Agenda Item 5: 5.3 ANS (AIM, PBN, AGA-AOP, ATM-SAR, CNS and MET)

REDUCING THE RISK OF TCAS OCCURRENCES IN THE MIDDLE EAST REGION: STRATEGIC APPROACHES TO ENHANCING COLLISION AVOIDANCE AND AIRSPACE SAFETY

(Presented by the Islamic Republic of Iran)

SUMMARY

The Traffic Collision Avoidance System (TCAS) is an essential onboard safety mechanism designed to prevent mid-air collisions by providing pilots with real-time advisories. Despite its effectiveness, the Middle East (MID) region has experienced a number of TCAS Resolution Advisories (RAs), attributed to factors such as high traffic density, procedural non-compliance, and complex airspace structures. This working paper analyzes these underlying causes and proposes scientifically grounded mitigation strategies to enhance aviation safety in the MID region. Key recommendations include enhancing Air Traffic Control (ATC) procedures and training, improving pilot training and awareness, optimizing airspace structures, and fostering coordination among states and organizations. The establishment of a dedicated TCAS Risk Reduction Task Force under the Middle East Air Navigation Planning and Implementation Regional Group (MIDANPIRG) is proposed to implement these measures effectively.

Action by the meeting is at paragraph 3.

REFERENCE

- ICAO ANNEX 10 - AERONAUTICAL TELECOMMUNICATIONS - VOLUME IV- SURVEILLANCE RADAR AND COLLISION AVOIDANCE SYSTEMS
- ICAO DOC 4444 - PROCEDURES FOR AIR NAVIGATION SERVICES
- ICAO DOC 8168 – PROCEDURES FOR AIR NAVIGATION SERVICES:
- ICAO DOC 9871 – TECHNICAL PROVISIONS FOR MODE S SERVICES AND EXTENDED SQUITTER

1. INTRODUCTION

1.1 The Traffic Collision Avoidance System (TCAS) is an onboard safety mechanism designed to prevent mid-air collisions by providing pilots with real-time advisories to maintain safe separation between aircraft. Despite its effectiveness, the Middle East (MID) region has experienced a notable number of TCAS Resolution Advisories (RAs), often triggered by factors such as high traffic density, procedural non-compliance, and complex airspace structures.

1.2 This working paper aims to identify the underlying causes of these occurrences and propose scientifically grounded mitigation strategies to enhance aviation safety in the MID region.

2. DISCUSSION

BACKGROUND

2.1 The MID region encompasses some of the world's busiest air traffic corridors, characterized by rapid growth in air travel and significant En-route and terminal area congestion. Several following factors contribute to the prevalence of TCAS events in this region:

- *High Traffic Density*: The exponential growth in air traffic leads to increased encounters between aircraft, elevating the likelihood of TCAS advisories.

- *Airspace Structural Challenges*: The presence of limited segregated routes and reliance on conventional navigation procedures can result in conflicts and reduced separation margins.

- *Variability in Pilot and Air Traffic Control (ATC) Responses*: Differences in training, experience, and adherence to standard operating procedures (SOPs) can impact the effective resolution of TCAS events.

- *Incorrect Responses to TCAS RAs*: Instances where pilots do not follow RAs correctly or ATC provides conflicting instructions can exacerbate safety risks.

ANALYSIS OF TCAS INCIDENTS IN THE MID REGION

2.2 A comprehensive analysis of TCAS RA data from recent years reveals the following trends:

- *Altitude-Related Incidents*: A majority of RAs occur at high altitudes (Flight Levels 290-410), particularly in congested airways, indicating challenges in maintaining vertical separation.

- *Proximity during Departures and Arrivals*: Close-proximity operations at major airports contribute significantly to TCAS alerts, often due to non-standard climb and descent profiles.

- *Procedural Non-Compliance:* Deviations from established procedures, such as incorrect altitude assignments or unauthorized maneuvers, frequently lead to TCAS events.

PROPOSED MITIGATION MEASURES

2.3 To address these challenges, the following scientifically grounded mitigation measures are proposed (Key Activities of the Proposed Task Force):

a) Enhancing ATC Procedures and Training

- *Standardization of Level-Off Procedures*: Implementing standardized altitude capture techniques can reduce TCAS triggers during cruise levels. Training programs should emphasize adherence to these procedures.
- *TCAS RA Awareness for ATCOs*: Providing specialized training for Air Traffic Control Officers (ATCOs) on the nature of TCAS RAs and appropriate responses can prevent conflicting instructions during RA events.
- *Advanced Conflict Detection Tools*: Deploying automation tools capable of predicting and preventing potential conflicts before RAs are triggered can enhance safety margins.

b) Pilot Training and Awareness

- *Mandatory TCAS Recurrent Training*: Incorporating regular simulator training sessions focused on correct TCAS RA responses ensures that pilots are well-prepared to handle such events.
- *Alignment of Standard Operating Procedures (SOPs)*: Harmonizing TCAS response procedures across airlines operating in the MID region can reduce variability in pilot actions during RA events.
- *Promotion of Post-RA Reporting and Analysis*: Encouraging a culture of reporting and analyzing TCAS events facilitates continuous improvement and knowledge sharing among stakeholders.

c) Airspace Optimization

- *Review and Modification of En-Route Structures*: Assessing and restructuring airways to minimize crossing conflicts and enhance traffic flow can reduce the likelihood of TCAS events.
- *Implementation of Performance-Based Navigation (PBN)*: Adopting PBN procedures decreases reliance on conventional navigation, allowing for more precise aircraft separation.
- *Strategic Deconfliction Measures*: Introducing altitude segregation strategies in congested Flight Information Regions (FIRs) can effectively manage traffic density and reduce conflict points.

d) Coordination Among States and Organizations

- *Establishment of a Regional TCAS Task Force*: Forming a dedicated task force under the Middle East Air Navigation Planning and Implementation Regional Group (MIDANPIRG) to analyze trends and propose region-wide solutions.
- *Data Sharing and Incident Analysis*: Promoting collaborative safety programs among MID states enables a proactive approach to TCAS risk reduction through shared data and best practices.
- *Harmonization of Procedures*: Standardizing TCAS-related operational procedures across regional airlines and Air Navigation Service Providers (ANSPs) ensures consistency in responses to TCAS events.

CONCLUSION

2.4 The Traffic Collision Avoidance System (TCAS) has been instrumental in enhancing aviation safety by reducing mid-air collision risks. However, the Middle East (MID) region continues to experience a number of TCAS Resolution Advisories (RAs), attributed to factors such as high traffic density, procedural non-compliance, and complex airspace structures.

2.5 To address these challenges, a comprehensive approach is essential. Enhancing Air Traffic Control (ATC) procedures and training is crucial; implementing standardized altitude capture techniques and providing specialized training for Air Traffic Control Officers (ATCOs) on the nature of TCAS RAs can prevent conflicting instructions during RA events.

2.6 Improving pilot training and awareness is equally important. Regular simulator training sessions focused on correct TCAS RA responses ensure that pilots are well-prepared to handle such events. Aligning Standard Operating Procedures (SOPs) across airlines operating in the MID region can reduce variability in pilot actions during RA events.

2.7 Optimizing airspace structures is another vital measure. Assessing and restructuring airways to minimize crossing conflicts and enhance traffic flow can reduce the likelihood of TCAS events. Implementing Performance-Based Navigation (PBN) procedures decreases reliance on conventional navigation, allowing for more precise aircraft separation.

2.8 Fostering coordination among states and organizations is essential for a unified approach to safety. Establishing a dedicated task force under the Middle East Air Navigation Planning and Implementation Regional Group (MIDANPIRG) to analyze trends and propose region-wide solutions is recommended. Promoting collaborative safety programs among MID states enables a proactive approach to TCAS risk reduction through shared data and best practices.

2.9 By adopting these scientifically supported strategies, the MID region can significantly enhance its aviation safety standards, ensuring safer skies for all stakeholders. The Civil Aviation Authority of Iran advocates for collective action through MIDANPIRG and the Regional Aviation Safety Group-Middle East (RASG-MID) to implement these measures effectively.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) establish a TCAS Risk Reduction Task Force: Form a dedicated task force under MIDANPIRG to analyze TCAS incident data, identify risk factors, and develop targeted mitigation strategies;

b) enhance ATC and Pilot Training Programs: Encourage states and ANSPs to implement comprehensive TCAS-related training initiatives for both controllers and pilots, emphasizing correct RA responses and procedural compliance;

c) review and Optimize Airspace Structures: Conduct a thorough assessment of current airspace configurations to identify and implement modifications that reduce conflict points and enhance traffic flow efficiency; and

d) promote Cross-Border Cooperation: Foster collaboration among MID states to facilitate data sharing, joint training exercises, and the harmonization of operational procedures related to TCAS events.

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