

FINAL INVESTIGATION REPORT



SERIOUS INCIDENT TCAS-RA

**SERENE AIR FLIGHT SEP540 BOEING B737-800
AIRCRAFT REG. NO. AP-BNA (OPQT TO OPIS) AND
MILITARY AIRCRAFT ON 12-11-2024**

SCOPE

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ABBREVIATIONS

ACAS	Airborne Collision Avoidance System ACAS
ATS	Air Traffic Services
BASIP	Bureau of Aircraft Safety Investigation Pakistan
CPA	Closest Point of Approach
FL	Flight Level
ft	Feet
h	Hours
hPa	Hectopascals
ICAO	International Civil Aviation Organization
IOU	Incident Occurrence and Unserviceability Report
kts	Knots
m	Meters
NM	Nautical Mile
NTSB	National Transportation Safety Board
OPIS	Islamabad International Airport
OPQT	Quetta International Airport
PAA	Pakistan Airports Authority
PASI	Pakistan Air Safety Investigation Act
RA	Resolution Advisory
ROC	Rate of Climb
RWY	Runway
s	Seconds
SL	Sensitivity Level
STAR	Standard Arrival Chart Instrument
TA	Traffic Advisory
TCAS-RA	Traffic alert and Collision Avoidance System – Resolution Advisory
USA	United States of America
UTC	Universal Time Coordinated

INTRODUCTION

The serious incident was reported to BASIP by Pakistan Airports Authority (PAA) vide Incident Occurrence and Unserviceability Report (IOU)¹. This serious incident was notified² to International Civil Aviation Organization (ICAO) and National Transportation Safety Board (NTSB), United States of America (USA) in line with Annex-13. The investigation has been conducted by BASIP. All corresponding timings are mentioned in Universal Time Coordinated (UTC).

¹ PCAA IOU Report dated 12 November, 2024

² ICAO Initial Notification dated 24 February, 2025

SYNOPSIS

On 12 November 2024, Serene Air flight SEP540, Boeing 737-800, Registration no. AP-BNA operating from Quetta International Airport (OPQT), Quetta, Pakistan to Islamabad International Airport (OPIS), Islamabad, Pakistan experienced a serious incident involving TCAS-RA (Traffic alert and Collision Avoidance System – Resolution Advisory) with military aircraft, under Cherat Approach (South) control and while descending to FL150 near TOMON.

Despite prior coordination to restrict the military aircraft to FL120, one of the military aircraft commenced an unanticipated rapid climb beyond the assigned level, reducing vertical separation. SEP540 received TCAS-RA and promptly stopped its descent at FL156. The minimum separation between the aircraft reduced to approximately 1.3 Nautical Mile (NM) laterally but remained more than 1,000 ft vertically.

Following resolution of the conflict, SEP540 continued its descent without further incident and landed safely at Islamabad. The occurrence highlighted shortcomings in inter-unit military coordination and the challenges of managing mixed traffic in adjacent sectors.

SECTION 1 - FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. On 12 November, 2024, Serene Air flight SEP-540, Boeing 737-800 aircraft, Reg. No. AP-BNA, operated from OPQT, Quetta, Pakistan to OPIS, Islamabad, Pakistan on Air Traffic Services (ATS) route MOMKA – J134 - ZB – J139 – KALMI – OPIS (Figure 1) as a scheduled passenger flight.

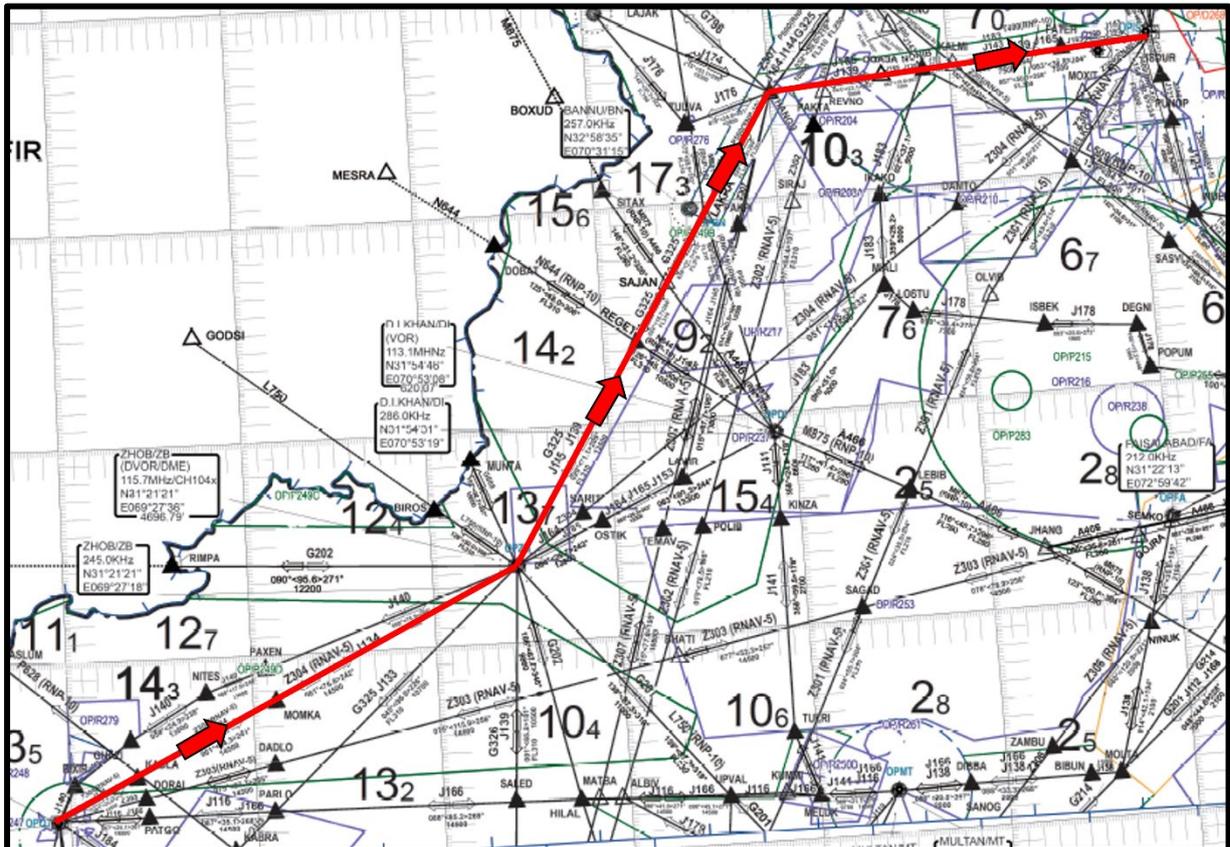


Figure 1 Route Map SEP-540

1.1.2. Cherat Approach South lies within the Cherat Control Zone. Aircraft approaching or departing from Islamabad (OPIS) may be directed to or from Cherat Approach for air traffic control services provided by military controllers.

Name Lateral limits Vertical limits Class of airspace	Unit providing service	Callsign/ Language Area and conditions of use Hours of service	Frequency/ purpose	Remarks
1	2	3	4	5
<p>CHERAT NORTH APPROACH</p> <p><i>Area bounded by lines joining points 334300N/0710259E then along the clockwise arc of a circle of 59.99NM radius centred on 335300N/0721358E to 340259N/0732506E; 340303N/0731013E; 335816N/0725200E; 334500N/0725100E; 334500N/0723609E; 334017N/0723613E; 333858N/0722459E; 333752N/0720130E; 333427N/0705640E to point of origin.</i></p> <p><u>UNL</u> <u>GND</u></p> <p>Class of Airspace:C Except on ATS Routes</p>	Cherat North Approach	Cherat North (English) H24	121.2 MHZ Secondary FREQ. 125.6 MHZ Primary FREQ.	
<p>CHERAT SOUTH APPROACH</p> <p><i>Area bounded by lines joining points 333427N/0705640E; 325800N/0702959E; 325300N/0703959E; 333000N/0710659E then along the counter clockwise arc of a circle of 60.21NM radius centred on 335300N/0721358E to 325741N/0714555E; 323814N/0714513E; 323731N/0722314E; 325328N/0722350E; 325529N/0723447E; 325510N/0725151E; 324259N/0731101E; 330416N/0730026E; 330840N/0725044E; 330842N/0724743E; 331816N/0724727E; 332030N/0723756E; 332049N/0722459E; 333858N/0722459E; 333752N/0720130E to point of origin.</i></p> <p><u>UNL</u> <u>GND</u></p> <p>Class of Airspace:C Except on ATS Routes</p>	Cherat South Approach	Cherat South (English) H24	126.25 MHZ Secondary FREQ. 127.35 MHZ Primary FREQ	Excluding Islamabad TMA West.
<p>ISLAMABAD TMA South</p> <p><i>Area bounded by lines joining points 331034N/0725040E; 330840N/0725044E; 330416N/0730026E; 324259N/0731101E; 324642N/0732151E; 331143N/0731742E to point of origin.</i></p> <p><u>FL205</u> 6500FT AMSL</p> <p>Class A above FL 150 Class C at or below FL 150</p>	Islamabad APP	Islamabad APP (English) H24	121.5 MHZ Emergency FREQ 121.65 MHZ Primary FREQ 124.65 MHZ Secondary FREQ.	
<p>ISLAMABAD TMA West</p> <p><i>Area bounded by lines joining points 333556N/0720130E; 332120N/0720128E; 332049N/0722459E; 333858N/0722459E to point of origin.</i></p> <p><u>FL175</u> 9500FT AMSL</p> <p>Class A at or above FL 150 Class C at or below FL 150</p>	Islamabad APP	Islamabad APP (English) H24	121.5 MHZ Emergency FREQ 121.65 MHZ Primary FREQ 124.65 MHZ Secondary FREQ.	

Table 1 Cherat Approach (North / South) Airspace

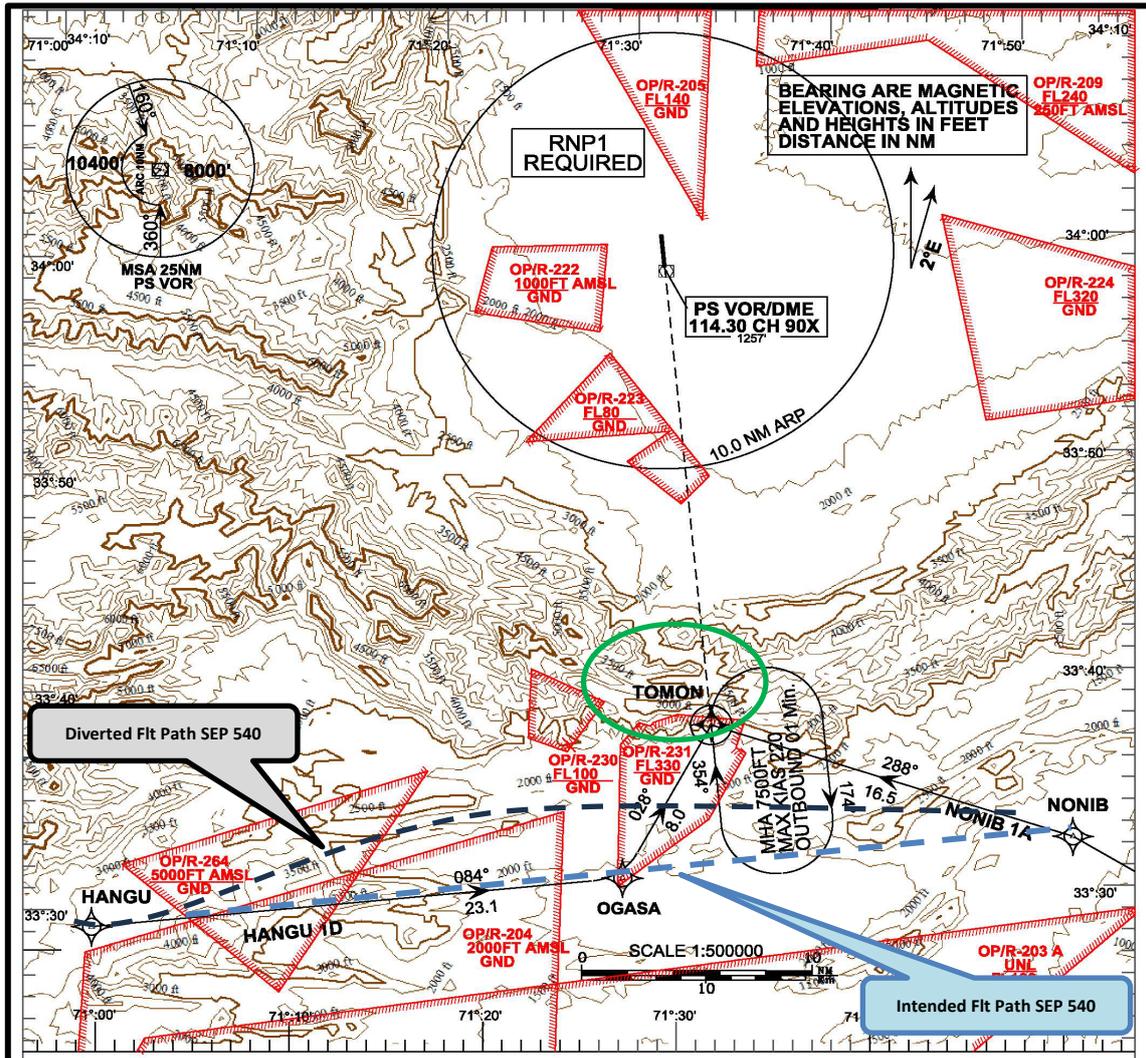


Figure 3 Position TOMON (South of PS)

1.1.4. 070912. SEP540 contacted Cherat Approach South at position LAKRA maintaining FL330. The aircraft was identified on radar and initially given descend to FL290.

1.1.5. 071002. SEP540 was given descend to FL150, with the instructions to expedite passing FL260 due to reciprocal departing traffic from Islamabad.

1.1.6. 071200. 02 military aircraft (Squawk Code: 4305) requested recovery from military area on UHF frequency from Cherat Approach South. They were initially cleared to 10,000 ft and then re-cleared to FL120, on pilot request and were handed over to Peshawar ATC, short of TOMON.

1.1.7. 071405. SEP540 was instructed to turn left heading 050 degrees and thereafter to proceed direct to position KALMI (making the aircraft drift almost 5 NM to the left of its intended route).

1.1.8. 071557. Upon pilot request, SEP540 was given further descend to FL110. Meanwhile, PS ATC informed that military aircraft will be holding over TOMON. At this time the military aircraft were North of TOMON on Southerly heading. PS ATC was advised by Cherat Controller to restrict climb of military aircraft above FL120, due traffic en-route.

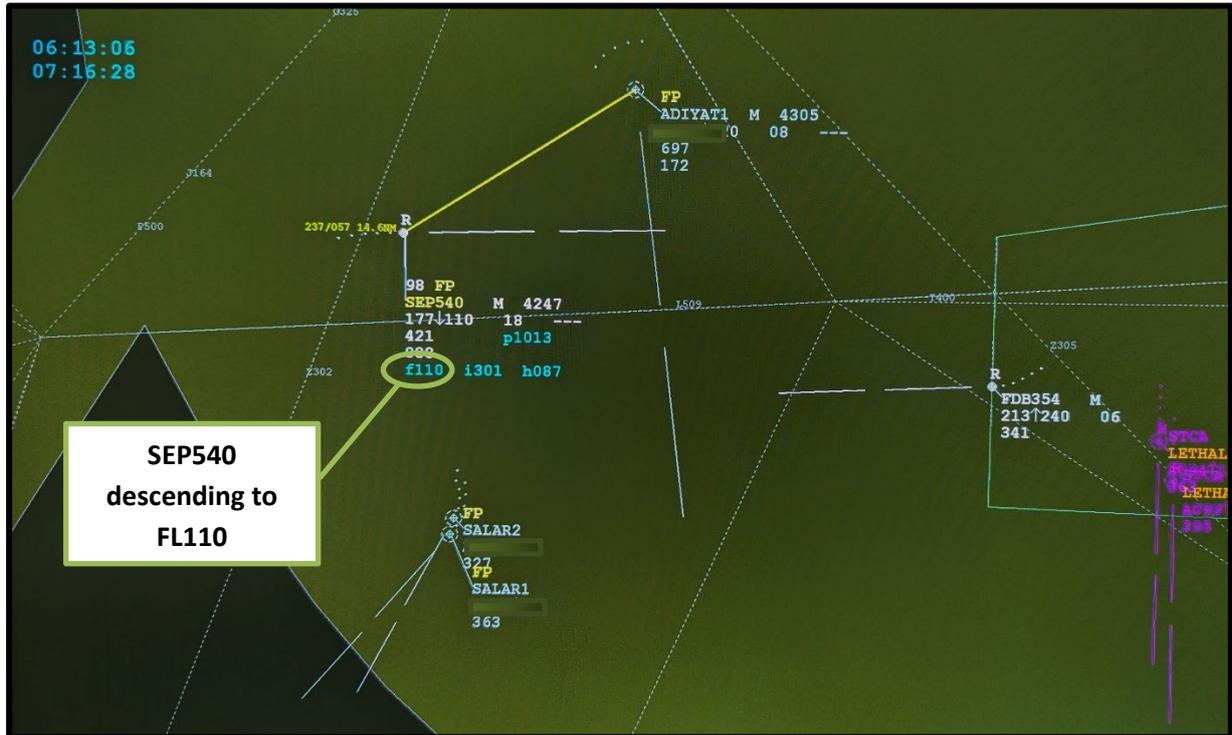


Figure 4 SEP540 descending to 11000ft

1.1.9. 071648. While passing FL173, SEP540 was instructed to stop descend at FL150 due 02 military aircraft holding over TOMON at FL120. (Figure 5)

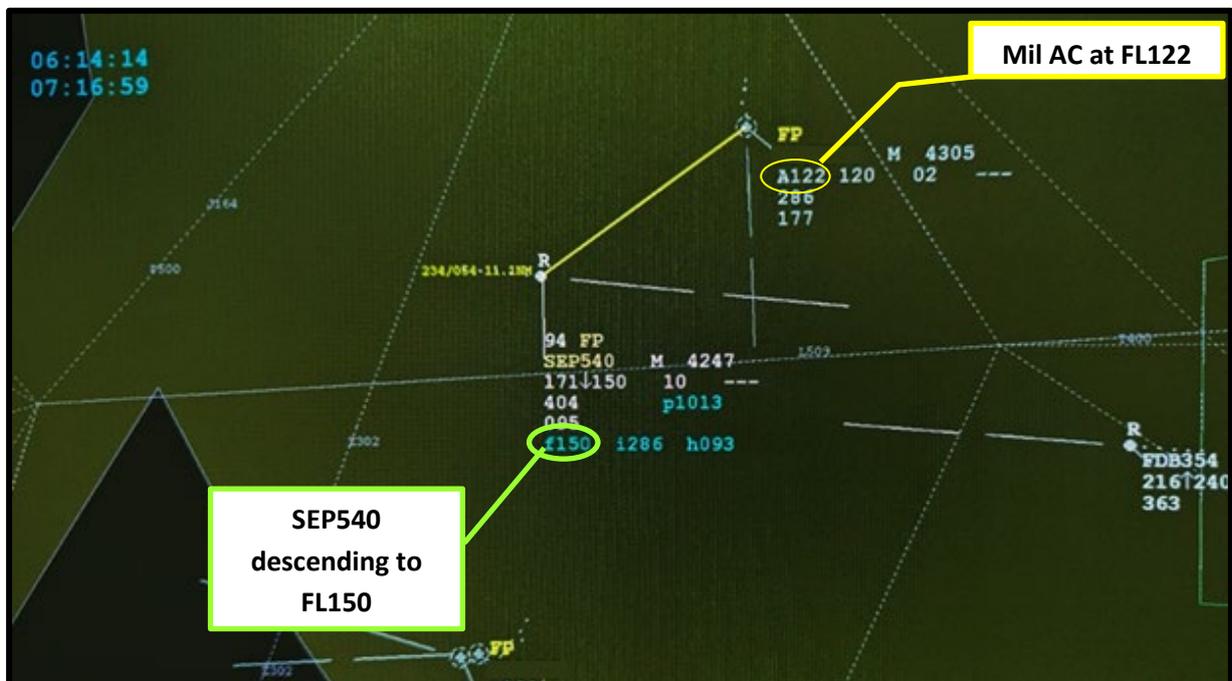


Figure 5 SEP540 re-cleared descend to FL150

1.1.10. 071756. SEP540 reported TCAS-RA approximately 4 NM South-East of TOMON and stopped descent at FL156. At that time, the military aircraft were observed getting closer to SEP540, one of the military aircraft climbing out of FL138, with the rate of climb 4,400 ft/min. The distance between the two aircraft at that time was 2.2 NM. (Figure 6)

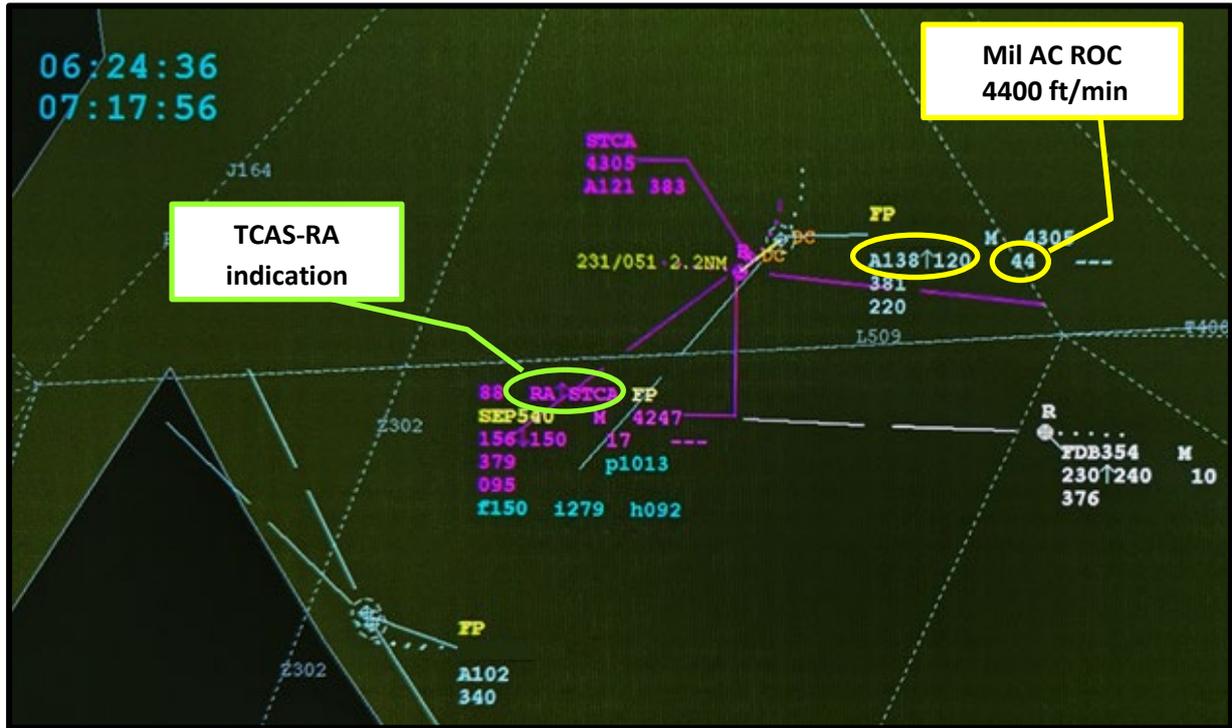


Figure 6 SEP540 reported TCAS-RA

1.1.11. 071806. While crossing, the conflicting aircraft were 1.3 NM apart, and the military aircraft was passing of FL140 for higher. Thereafter, the military aircraft changed their trajectory and headed towards North. (Figure 7)

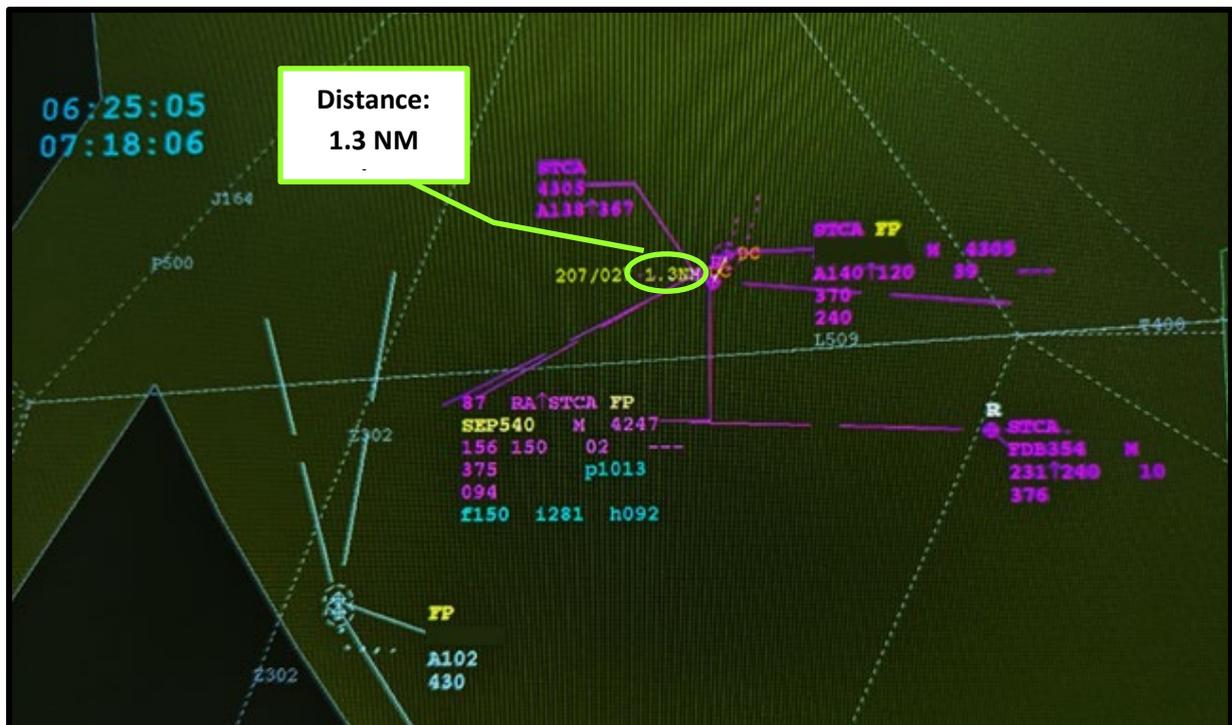


Figure 7 Conflicting aircraft 1.3 NM apart

1.1.12. 071824. SEP540 reported clear of the conflicting traffic and continued descend to FL150. The aircraft was re-cleared to descend 11,000 ft. (Figure 8)

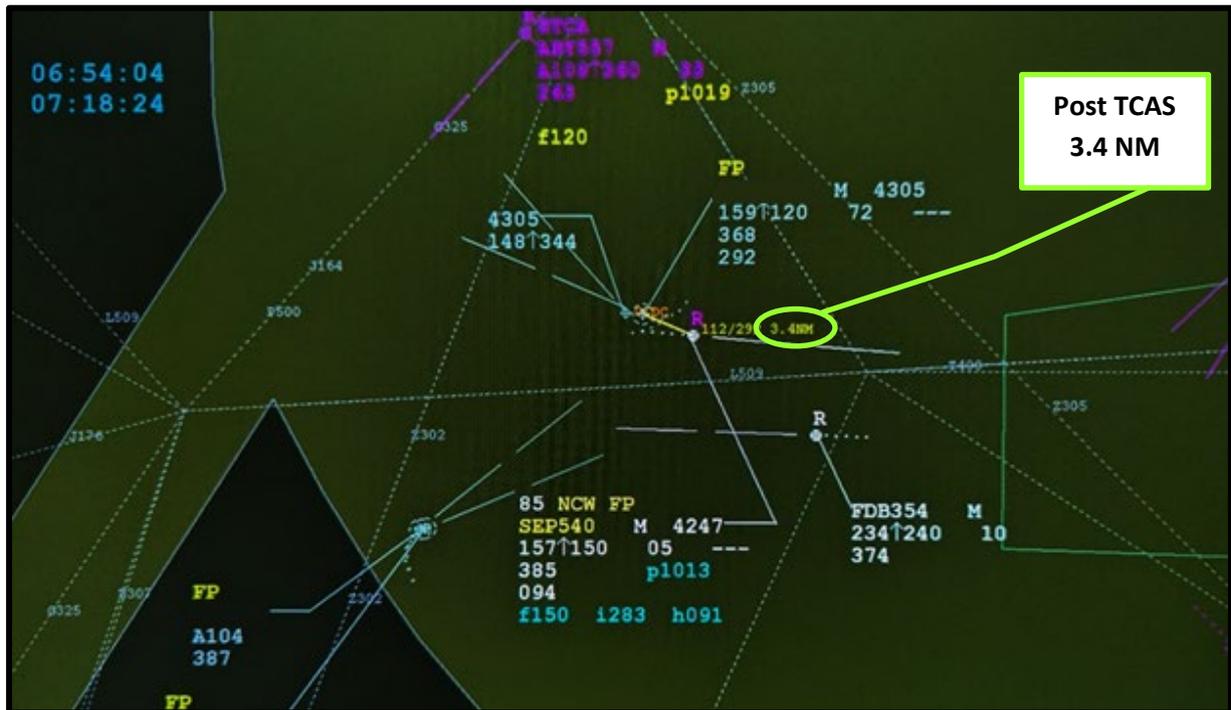


Figure 8 SEP540 clear of conflicting traffic

1.1.13. 072200. SEP540 was changed over to Islamabad Approach on frequency 121.650 MHz.

1.2. Injuries to Person(s)

1.2.1. No injury was reported to any person on board any of the aircraft.

1.3. Damage to Aircraft

1.3.1. No damage was reported due to this incident to any of the aircraft.

1.4. Other Damage

1.4.1. Not Applicable.

1.5. Personnel Information

1.5.1. Not Applicable.

1.6. Aircraft Information

SEP-540	
Aircraft Make & Model	Boeing 737-800
Registration Marking	AP-BNA
Manufacturer Serial No.	61352
Operator	Serene Air
Sector	OPQT – OPIS

Table 2 SEP-540 Aircraft details

1.7. Meteorological Information

1.7.1. No significant weather was reported by Meteorological Watch Office (MWO) at the time of the incident.

METAR
OPIS 27012KT 5000 FU SCT040 BKN100 21/12 Q1018 NOSIG R/H 55%=

Table 3 METAR details for OPIS

METAR DESCRIPTION	
OPIS	(Station ID) Islamabad
27012KT	Wind Direction & Speed- Wind Direction: 270°, Speed: 12 knots (kts)
5000	Visibility- 5,000 meters (m).
FU	Weather Smoke
SCT040	Cloud Scattered 4,000 ft above ground level
BKN100	Cloud cover Broken clouds base 10,000 ft
21/12	Temperature: 21°C, Dewpoint: 12°C
Q1018	Altimeter setting - QNH 1018 hPa (hectopascals)
NOSIG	No significant change is expected within the next 2 hours (h)
R/H 55%	Relative Humidity 55%

Table 4 METAR description

1.7.2. Wind coming from West at 12 knots. Visibility was 5 km with smoke present. Scattered clouds at 4,000 ft and broken clouds at 10,000 ft. The temperature was 21°C, dew point 12°C, relative humidity is 55%. The pressure was 1018 hPa, and no significant changes were expected.

1.8. Aids to Navigation

1.8.1. Navigational Aids for OPIS, Islamabad are provided below: -

OPIS AD 2.19 RADIO NAVIGATION AND LANDING AIDS

TYPE OF AID	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
ILS/LOC CAT I 28R	IBIP	110.7 MHz	H24	333312.69N 0724812.32E	530.96 M	Nil
ILS/LOC CAT III 28L	IBBA	108.100 MHz	H24	333306.01N 0724810.82E	535.39 M	-
ILS/LOC CAT I 10R	IBAP	111.300 MHz	H24	333240.69N 0725052.37E	535.92 M	-
DVOR/DME (3°E/2017)	BTR	114.600 MHz CH93X	H24	333239.54N 0725121.84E	535.11M	Coverage 200 NM
GP/TDME 10R	IBAP	332.300 MHz CH50X	H24	333306.34N 0724834.23E	545.95M	3° RDH/TCH 50 FT
GP/TDME 28R	IBIP	330.200 MHz CH44X	H24	333254.84N 0725031.54E	549.50M	3° RDH/TCH 50 FT
GP/TDME 28L	IBBA	334.700 MHz CH18X	H24	333240.29N 0725029.68E	546.89M	3° RDH/TCH 50 FT

Table 5 Navigational Aids for OPIS

1.9. Communications

1.9.1. Communications facilities for Cherat Control are provided below: -

Service designation	Call sign	Frequency	Hours of operation	Remarks
1	2	3	4	5
APP	Cherat APP	121.200 MHZ	H24	Cherat Approach Frequency
APP	Cherat APP	125.600 MHZ	H24	PAF. Primary Frequency.
APP	Cherat North	121.200 MHZ	H24	Secondary Frequency
APP	Cherat North	125.600 MHZ	H24	Primary Frequency
APP	Cherat South	126.250 MHZ	H24	Secondary Frequency
APP	Cherat South	127.350 MHZ	H24	Primary Frequency
ATIS	D-ATIS	126.700 MHZ	H24	For broadcasting of terminal information
G/A/G	Radio	2923.000 KHZ	H24	HF Secondary Frequency
G/A/G	Radio	5601.000 KHZ	H24	HF Primary Frequency
TWR	Peshawar Tower	121.500 MHZ	H24	VHF Emergency Frequency
TWR	Peshawar Tower	121.800 MHZ	H24	Ground Frequency
TWR	Peshawar Tower	122.900 MHZ	H24	Primary Frequency.
TWR	Peshawar Tower	243.000 MHZ	H24	UHF Emergency Frequency
TWR	Peshawar TWR	118.400 MHZ	H24	Stand by Frequency
Apron	Peshawar TWR	118.300 MHZ	H24	Stand by Frequency

Table 6 Communication Facilities Cherat Control

1.10. Aerodrome Information

1.10.1. Not Applicable.

1.11. Flight Recorders

1.11.1. Not Applicable.

1.12. Wreckage and Impact Information

1.12.1. Not Applicable.

1.13. Medical and Pathological Information

1.13.1. Not Applicable.

1.14. Fire

1.14.1. Not Applicable.

1.15. Survival Aspects

1.15.1. Not Applicable.

1.16. Test and Research

1.16.1. Not Applicable.

1.17. Organizational and Management Information

1.17.1. The TOMON holding point lies within the airspace under the jurisdiction of Cherat North. Management of air traffic in this sector involves coordination between Cherat North, Cherat South, and Peshawar ATC units due to overlapping civil and military operations. This dual management structure, combined with the proximity to route J-139 and continuous military activity, creates a high-density operational environment requiring strict inter-unit coordination between the ATC units to ensure separation and minimize conflict risk.

1.18. Additional Information

1.18.1. **TCAS Working Principle** – TCAS stands for Traffic alert and Collision Avoidance System, and its purpose is to minimize the risk of mid-air collisions between aircraft. Working independently from Air Traffic Control, TCAS uses nearby aircraft's transponder signals to alert pilots to the danger of mid-air collisions. It does so by constructing a three-dimensional map of airspace through which the aircraft is travelling. In detecting the other aircraft's transponder signals, it can foresee the potential collisions based on speeds and altitude of planes passing through the airspace in question. If TCAS detects a potential collision, it will automatically notify each of the affected aircraft. In this instance, it will automatically initiate a mutual avoidance manoeuvre. This involves the system informing the crews of the aircraft in question both audibly and visibly to either climb or descend in a manner that ensures that, when their paths cross, they do not meet.

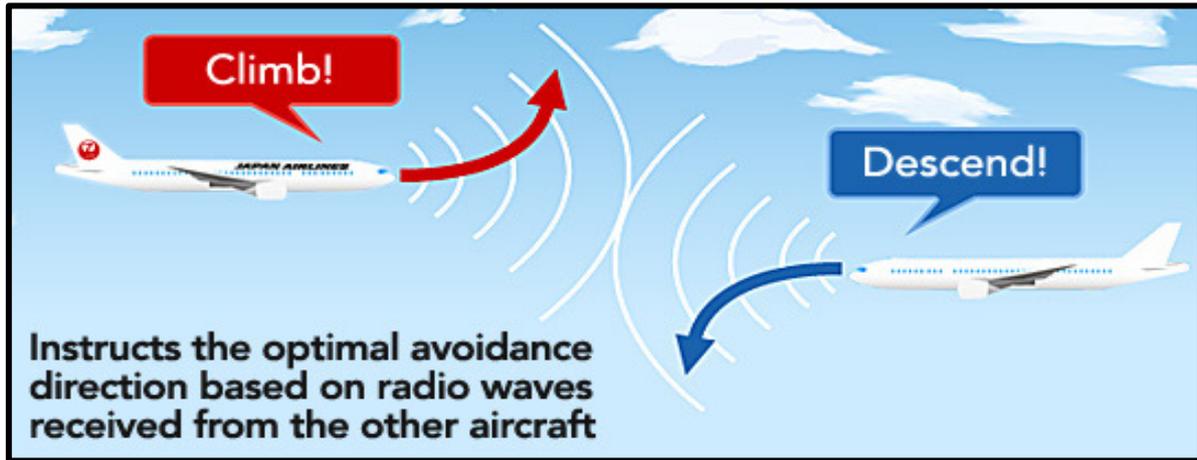


Figure 9 TCAS (TA) alert

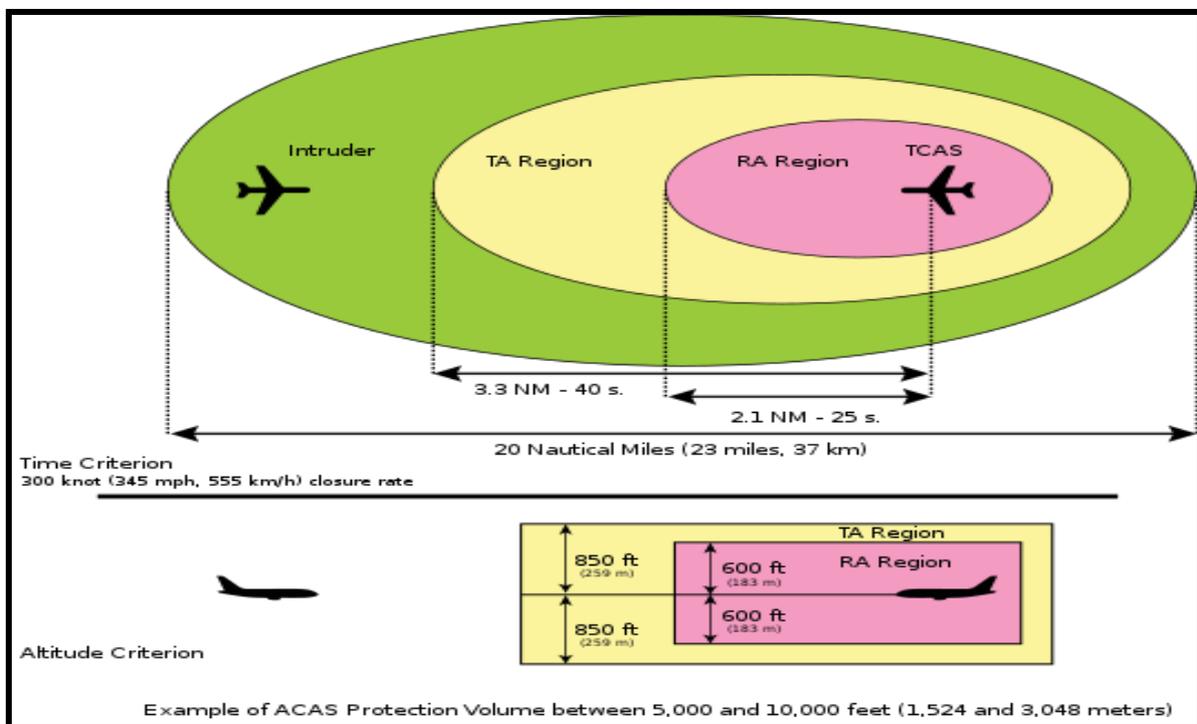


Figure 10 TCAS TA & RA ranges

1.18.2. Airborne Collision Avoidance System (ACAS)

1.18.2.1. The objective of ACAS is to provide advice to pilots for the purpose of avoiding potential collisions. This is achieved through Resolution Advisories (RAs), which recommend actions (including manoeuvres), and through Traffic Advisories (TAs), which are intended to prompt visual acquisition and to act as a precursor to RAs.

1.18.2.2. ACAS equipment in the aircraft interrogates Mode 'A' / 'C' and Mode 'S' transponders on aircraft in its vicinity and listens for their replies. By processing these replies, ACAS determines which aircraft represent potential collision threats and provides appropriate display indications (or advisories) to the flight crew to avoid collisions.

1.18.2.3. **Traffic Advisories (TAs)** – TAs alert the flight crew to potential RAs and may indicate the range, range rate, altitude, altitude rate and bearing of the intruding aircraft relative to own aircraft. TAs without altitude information may also be provided on Mode ‘C’ or Mode ‘S’ equipped aircraft that have temporarily lost their automatic altitude-reporting capability. The information conveyed in TAs is intended to assist the flight crew in sighting nearby traffic.

1.18.2.4. **Resolution Advisories (RAs)** – If the threat detection logic in the ACAS computer determines that an encounter with a nearby aircraft could soon lead to a near-collision or collision, the computer threat resolution logic determines an appropriate vertical manoeuvre that will ensure the safe vertical separation of the two aircraft. The selected manoeuvres ensure adequate vertical separation within constraints imposed by the climb rate capability and proximity to the ground of the two aircraft.

1.18.2.5. The RAs provided to pilot can be divided into two categories: corrective advisories, which instruct pilot to deviate from the current flight path (“CLIMB” when aircraft is in level flight); and preventive advisories, which advise the pilot to maintain or avoid certain vertical speeds (“DON’T CLIMB” when aircraft is in level flight).

1.18.2.6. **Warning Times** – In any potential collision, ACAS generates an RA nominally 15 to 35 seconds (s) before the Closest Point of Approach (CPA) of the aircraft. The ACAS equipment may generate a TA up to 20 s in advance of an RA. Warning times depend on Sensitivity Levels (SLs) of RAs.

1.18.3. **Traffic Display Symbology** – On the TCAS traffic display both colour and shape are used to assist the pilot in interpreting the displayed information.

1.18.3.1. Own-aircraft is depicted as a white or yellow aircraft-like symbol. Targets are displayed by different symbols, according to their threat status

1.18.3.2. Hollow white diamond – for other traffic. (No threat).

1.18.3.3. Solid white diamond – for proximate traffic.

1.18.3.4. Solid yellow or amber circle – for intruders (i.e. aircraft which trigger a TA).

1.18.3.5. Solid red square – for threats (i.e. aircraft which trigger an RA).

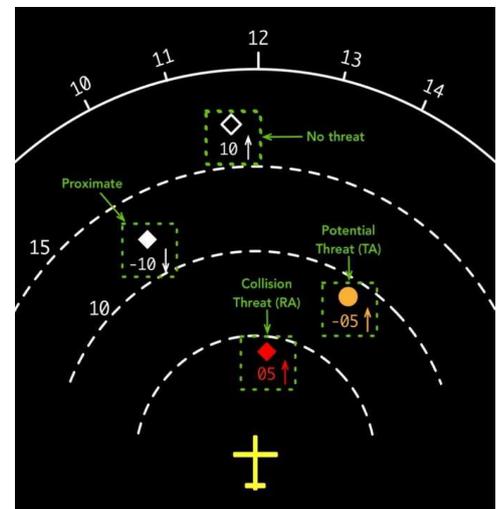


Figure 11 Traffic Display

1.19. Useful or Effective Investigation Techniques

1.19.1. Standard investigation procedures and techniques were used during the course of investigation.

SECTION 2 – ANALYSIS

2.1. General

2.1.1 On 12 November, 2024, Serene Air flight SEP540, B738 aircraft, Reg. No. AP-BNA operated from OPQT, Quetta, Pakistan to OPIS, Islamabad, Pakistan as a schedule passenger flight. The aircraft was in contact with Cherat Approach (South) when it reported TCAS-RA while descending to FL150, near TOMON, enroute to KALMI and stopped descend at FL156. Once clear of conflict, SEP540 continued descend to FL150. The aircraft was later re-cleared to descent 11,000 ft and was changed over to Islamabad Approach while approaching position KALMI. SEP540 landed safely at Islamabad.

2.2. Flight Operations

2.2.1 **Crew Response to TCAS-RA** – The prompt response of SEP540 flight-crew was critical in preventing further loss of separation. Upon receiving the TCAS Resolution Advisory, the pilot immediately stopped descent at FL156. This rapid compliance maintained vertical clearance despite reduced separation.

2.3. Weather

2.3.1 No significant weather was reported enroute J139 as well as surrounding areas at the time of the incident.

2.4. Air Traffic Control

2.4.1 **Un-necessary deviation from the flight plan route** – The instruction given to SEP540 to turn left heading 050 and then direct KALMI resulted in the aircraft drifting approximately 5 NM left of the intended route, placing it closer laterally to TOMON where military aircraft were operating. This trajectory change contributed to later convergence with military traffic.

2.4.2 **Inter-unit coordination** – Although Cherat South had advised Peshawar ATC to hold the military aircraft over TOMON, restricting their climb to FL120, this restriction was not effectively enforced. The radar evidence confirmed that the military aircraft continued climb beyond FL120, ultimately reaching FL160.

2.4.3 **Limited ATC reaction time** – The military aircraft commenced its climb at 071733 while established in the holding pattern and already converging laterally toward SEP540. This unexpected climb occurred only moments before the TCAS-RA activation, hence significantly limiting the time available for the Cherat South controller to react effectively, leading to a TCAS-RA despite the stop descent instruction being issued.

2.4.4 **Rapid Climb of Military aircraft** – The TCAS RA was activated when SEP540 was descending out of FL156 for FL150 and the military aircraft was climbing through FL138, due to the high climb rate (4400 ft/min) and reducing proximity (2.2 NM).

2.4.5 Airspace Design and Segmented Control Responsibilities – The TOMON holding point is located approximately 21 NM on a bearing of 170° from Peshawar Runway 35 and lies along the southern boundary of Cherat North’s airspace jurisdiction. Due to its proximity to route J-139, aircraft holding over TOMON frequently come into potential conflict with transiting traffic operating along this airway. Additionally, low-level VFR traffic from Peshawar towards south often transits through the TOMON area and is controlled by Cherat North, further increasing the airspace complexity. Moreover, 10 NM circle around OPSS possess potential conflict of traffic holding over TOMON, resulting in a potential risk of traffic conflicts as per TCAS resolution advisory (RA) criteria, particularly considering the differing speeds and manoeuvrability characteristics of civil and military aircraft. The area involves multiple controlling and coordinating agencies, necessitating a high degree of inter-unit coordination to ensure safe and efficient traffic management. Despite previous efforts to improve coordination, the presence of multiple stakeholders and procedural limitations continue to pose challenges. It was observed that gaps remain in the existing ATC procedures, particularly concerning the seamless transfer of control and coordination of traffic between the respective ATC units.

SECTION 3 – FINDINGS

3.1. Findings

- 3.1.1 SEP540 was a scheduled commercial passenger flight from OPQT, Quetta, Pakistan to OPIS, Islamabad, Pakistan.
- 3.1.2 There were no technical issues or abnormalities was observed on the aircraft.
- 3.1.3 No significant weather was reported on route J139, as well as surrounding areas at the time of the incident.
- 3.1.4 While under the control of Cherat Approach (South), SEP540 was instructed to deviate from its planned route to accommodate departing traffic from OPIS, resulting in the aircraft drifting approximately 5 NM left of track; closer to the TOMON holding area.
- 3.1.5 02 military aircraft were operating in the TOMON holding pattern under Peshawar ATC control.
- 3.1.6 Cherat South advised Peshawar ATC to restrict the climb of the military aircraft to FL120; however, this restriction was not effectively enforced, and the aircraft commenced an unanticipated climb beyond FL120.
- 3.1.7 The military aircraft initiated a rapid climb, with a vertical rate of approximately 4,400 ft per minute, significantly reducing separation with SEP540.
- 3.1.8 Divided control of aircraft by Cherat South and Peshawar ATC resulted in increased coordination requirements between units handling aircraft of differing speed and manoeuvrability, hence reducing overall situational awareness and constraining the ability of the Cherat South controller to issue timely conflict resolution instructions, thereby increasing the risk of coordination lapses during the critical period between the military aircraft's climb and the TCAS RA activation.
- 3.1.9 SEP540's flight crew responded promptly and correctly to the TCAS-RA by stopping descent at FL156, preventing further loss of separation.

3.2. Cause / Contributory Factors

3.2.1. Cause

3.2.1.1. The incident occurred due to a **loss of prescribed separation** between Serene Air flight SEP540 and military aircraft operating near TOMON, following the **climb of the military aircraft beyond the coordinated flight level (FL120)**, resulting in a **TCAS Resolution Advisory-RA (MAC – Mid Air Collision)** activation on SEP540 during descent.

3.2.2. Contributory Factors

3.2.2.1. The trajectory modification of SEP540 bringing it closer to the TOMON area.

3.2.2.2. Limited reaction time available to Cherat South controller due to differing speed and manoeuvrability between civil/ military traffic.

3.2.2.3. Segmented control of adjacent traffic flows by separate ATC units in same airspace.

Note: Aviation Occurrence Category (ADREP Taxonomy)
“**Mid-Air Collision (MAC)**: Separation-related occurrences caused by either air traffic control or cockpit crew

SECTION 4 – SAFETY RECOMMENDATIONS

4.1. Safety Recommendations

4.1.1 Pakistan Airports Authority (PAA), in coordination with Air Headquarters (AHQ), may review the existing airspace structure and control responsibilities in the TOMON area and along route J-139 to assess the feasibility of unified control or sector consolidation in regions of high traffic convergence and same may be **clearly in-cooperated** in Letter of Agreements between ATC units.