MINISTRY OF
TECHNOLOGY AND INDUSTRY

TRANSPORTATION SAFETY BUREAU

FINAL REPORT

AirSerbia, Airbus A319, YU-API, ASL73E

Travel Service, Boeing 737-800, N917XA, TVS5WZ

SunExpress, Boeing 737-800, TC-SEZ, SXS1R

Érsekvadkert area, 28 September 2018

Serious Incident

2018-0732-4

The sole objective of a safety investigation is to find the causes and circumstances of aviation accidents or incidents and to initiate the necessary safety measures; furthermore, to make recommendations in order to prevent similar cases in the future. It is not the objective of an investigation to apportion blame or liability.

Introduction

Synopsis

Class of the occurrence		serious incident
Aircraft 1 (hereinafter: AC1)	manufacturer	Boeing Co.
	model	B737-800
	registration	TC-SEZ / SXS1R (SunExpress 1R)
	operator	SunExpress
Aircraft 2 (hereinafter: AC2)	manufacturer	Airbus S.A.S.
	model	A319-100
	registration	YU-API / ASL73E (AirSerbia 73E)
	operator	Air Serbia
Aircraft 3 (hereinafter: AC3)	manufacturer	Boeing Co.
	model	B737-800
	registration	N917XA / TVS5WZ (Skytravel 5WZ)
	operator	Smartwings (Travel Service)
Occurrence	Date and time	28 September 2108, 17:04 UTC
	Location	Érsekvadkert area
Fatalities / severe injuries		0 / 0
Damage to aircraft		Undamaged

At about 17 o'clock on 28 September 2018 in the area of Érsekvadkert, a separation minima infringement occurred in the controlled airspace of Hungary, which involved three aircraft (AC1: SXS1R, AC2: ASL73E, AC3: TVS5WZ) crossing one another's routes. The air traffic controller of the sector who managed these aircraft received AC3 (entering the country from the north) at FL360 from the previous sector, and authorised it to climb to FL390.

Forty seconds later, when the air traffic controller realised that a relevant traffic (AC1) was coming at FL380 from the opposite direction, he ordered the flight crew of AC3 to stop climbing at FL370, and turn 10 degrees to the left because of AC2 which was also flying at FL370. The AC3 crew correctly read the FL370 altitude back, and requested confirmation for the 10-degree right turn instead of the previously received left turn order. The air traffic controller erroneously confirmed the command. In order to maintain separation, he then ordered AC2 turn left to 320 degrees and informed them on the relevant traffic.

Owing to the correctly issued turn orders, the mandatory radar separation minima would probably not have been infringed but, due to AC3's erroneous turn (left instead of right,) AC2 and AC3 were on a converging track at the same height.

After the air traffic controller realised that AC3 had turned erroneously right, he gave them a corrective command to assume a heading of 160 degrees, which the flight crew read back and informed the air traffic controller that they were reacting to the TCAS RA, during which they had performed a climb command. A few seconds later, AC1, which was flying above AC3, reported TCAS RA due to the decreasing vertical separation between them, and it also began to climb.

As a result of the erroneous turn, the shortest distance between AC2 and AC3 decreased to 2.9 NM horizontally and 500 ft. vertically. The mandatory radar separation minima are 5 NM and 1000 ft.

Subsequent to the TCAS ordered evasive manoeuvres, the aircraft returned to their authorised flight levels and continued their flights to their respective destinations according to plan. No one was injured in the occurrence, and the aircraft involved were not damaged.

During the investigation, the IC came to the conclusion that the root cause of the occurrence was the communication error between the EC of the sector involved and AC3. In addition, the IC identified the contributing factors listed in *Chapter 3.2 Causes*.

In the course of the safety investigation, the air traffic management service involved took measures relating to the occurrence within its organisation, in order to prevent similar cases.

With regard to the measures taken by HungaroControl in the course of the safety investigation, the IC of the TSB found no grounds to issue a safety recommendation.

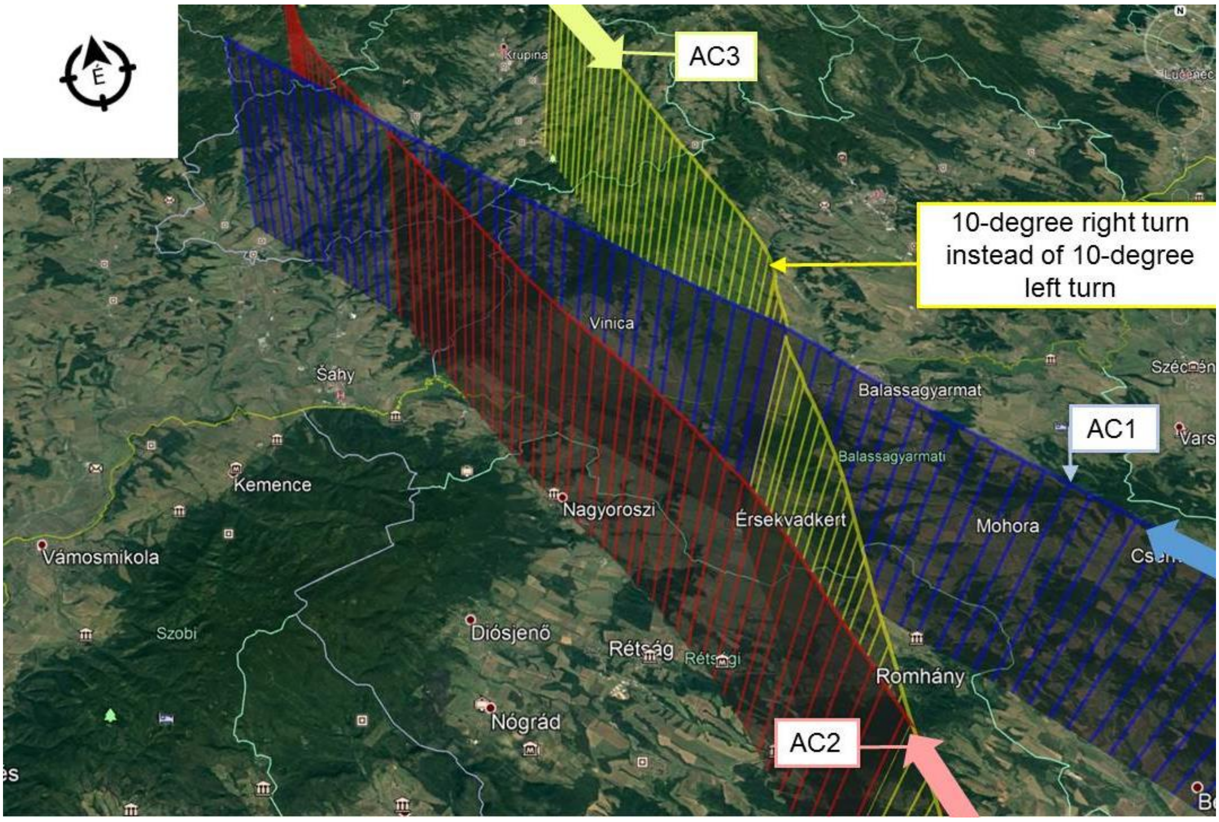

Figure 1: Flight paths of the aircraft involved in the occurrence

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Definitions and abbreviations

ACAS	*Airborne Collision Avoidance System*
ACC	*Area Control Center*
ACS	*Area Control Surveillance (area control with an airspace surveillance system)*
Aerodrome	*A defined area (including any buildings, installations and equipment) on land or water or on a fixed offshore or floating structure intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft*
AGL	*Above Ground Level*
ARP	*Airport Reference Point*
ATS	*Air Traffic Service*
Budapest CTA	*Budapest Control Area*
CARD window	*Conflict And Risk Display*
CFL	*Cleared Flight Level*
coupling	*Frequency coupling between the channels of the air traffic control system*
EASA	*European Union Aviation Safety Agency*
EC	*Executive Controller*
EH	*East High sector – at the time of the occurrence: FL365 - FL660*
EL	*East Low sector – at the time of the occurrence: 9500 ft. - FL365*
FIC	*Flight Information Center*
FL	*Flight level, expressed in 1000 feet*
Flight plan	*Specified information provided to air traffic service units, relative to an intended flight or portion of flight of an aircraft*
GND	*Ground*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
IFR	*Instrument Flight Rules*
ITM	*Ministry for Innovation and Technology*

Kbvt.	*Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents and other transportation occurrences*
LHCC - Budapest FIR	*Hungarian Flight Information Region (The area bounded by the state border of Hungary, where air traffic management service is provided up to the STD altitude of 14000 m.)*
LHENHT	*The merged sectors of the East area control (EN) of Hungary (LH): High (H), Top (T),*
LHENLMU	*The merged sectors of the East-North area control (EN) of Hungary (LH): Lower (L), Middle (M), Upper (U)*
LT	*Local Time*
MATIAS	*Magyar Automated and Integrated Air Traffic Control System (developed for HungaroControl by a company called THALES)*
MIT	*Ministry of Technology and Industry*
MTOM	*Maximum Take-Off Mass*
NFM	*Ministry for National Development (Legal Predecessor of ITM)*
NKH LH	*National Transport Authority, Office of Air Transport (Nemzeti Közlekedési Hatóság Légügyi Hivatal - until 31 Dec 2016)*
NM	*Nautical Mile*
PC	*Planning Controller*
RVSM	*Reduced Vertical Separation Minima*
STCA	*Short Term Conflict Alert*
STD	*Standard atmospheric pressure (1013.25 hPa)*
TCAS	*Traffic alert and collision avoidance system*
TCAS RA	*Traffic alert and collision avoidance system Resolution Advisory*
TCAS TA	*Traffic alert and collision avoidance system Traffic Alert*
TSB	*Transportation Safety Bureau, Hungary*
UTC	*Coordinated Universal Time*
VFR	*Visual Flight Rules*

General information

All times indicated in this report are in Coordinated Universal Time (UTC). At the time of the occurrence, summer time was in use in Hungary and therefore local time was UTC + 2 hours.

All geographical locations throughout this document are provided in WGS-84 standard.

The content of this report is in accordance with the requirements set out in ICAO Appendix 13, Chapter 6 and ICAO Doc 9756, Chapter IV.

Reports and Notifications

The occurrence was reported to TSB's call center at 17:55 on 28 September 2022, by the on-call officer of HungaroControl.

Investigation Committee

The Head of TSB appointed the following persons in the investigating committee (hereinafter: IC).

Investigator-in-Charge	Nacsa JD, Zsuzsanna	investigator
Member	Erdősi, Gábor	investigator
Member	Joó, Klementina	investigator

Overview of the Investigation Process

Subsequent to the notification, the on-call manager of the TSB decided that an investigation is required and will be launched.

Pursuant to Article 5 of REGULATION (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/ECA the TSB is required to initiate an investigation in the following circumstances.

1. *"Every accident or serious incident involving aircraft other than specified in Annex II to Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (6) shall be the subject of a safety investigation in the Member State in the territory of which the accident or serious incident occurred."*

This investigation was started pursuant to Article 5 (1) of Regulation (EU) No 996/2010 of the European Parliament and of the Council.

In the course of the investigation the IC has taken the following steps:

- obtained the following from the Hungarian air traffic management service:
    - LAN radar data
    - the display and audio recordings of the MATIAS system, relating to EH EC and PC positions
    - audio recordings of radio frequencies
    - audio recordings of the telephone coordination between the sectors
- interviewed the EH EC and the EH PC
- reviewed the legislation relating to TCAS systems
- analysed the recorded radar, audio and visual materials.

Principles of the investigation

This investigation is being carried out by Transportation Safety Bureau on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes to the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents (referred to as Kbvt. throughout the document),
- NFM (Ministry for National Development) Regulation 70/2015 (XII.1) on safety investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- In matters not covered by Kbvt., Act CL of 2016 on General Public Administration Procedures.

The competence of the Transportation Safety Bureau of Hungary is based on Government Regulation № 230/2016. (VII.29.) on the assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau with legal succession.

Pursuant to the aforesaid legislation,

- Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious incidents.
- Transportation Safety Bureau of Hungary may investigate aviation and incidents which – in its judgement – could have led to accidents of more severe consequences in different circumstances.
- Transportation Safety Bureau of Hungary is independent of any person or entity that may have interests in conflict with the objectives of the investigating body.
- In addition to the aforementioned legislation, TSB of Hungary shall conduct safety investigations in line with ICAO Docs 9756 and 6920 Manual of Aircraft Accident Investigation.
- This Report shall not be binding, nor shall an appeal be lodged against it.
- The original of this report was written in Hungarian.

No conflict of interest has been found between safety investigators of the IC. No investigator assigned to a safety investigation has been involved as an expert in any other procedure pertaining to the same case and shall not do so in the future.

The IC shall retain all data and information having come to their knowledge in the course of the safety investigation. Furthermore, the IC shall not be obliged to make such data and information available to other authorities, whose disclosure could have been legally refused by their original owner.

This Final Report is based on the Draft Report prepared by the IC and shall be sent to all involved parties for comments, as set forth by the relevant regulations.

No comments on the Draft Report were received from the interested parties within the legal deadline.

Copyright

Translation

This document has been translated from Hungarian. Although efforts have been made to provide a translation as accurate as possible, discrepancies between the versions might occur. In such eventuality, the Hungarian version shall prevail.

Factual information

1.1 Flight History

The occurrence took place at about 17 o'clock on 28 September 2018 in the controlled airspace in the area of Érsekvadkert, Hungary. The occurrence involved three aircraft flying according to IFR and the air traffic controllers of the East High (EH) sector of HungaroControl controlling them at the time of the occurrence.

AC1 took off from Antalya International Airport (LTAI) with a delay of 75 minutes, and its destination was Berlin-Tegel Airport (EDDT). It contacted the EH sector of the Hungarian air traffic control, south of BUDOP (Hungarian-Romanian border) at FL380, at 16:47. After identification, it was directed to LALES (Czech Republic-Slovakian border) directly, with maintaining level. *(Flight path of AC1: blue lines in Figure 1.)*

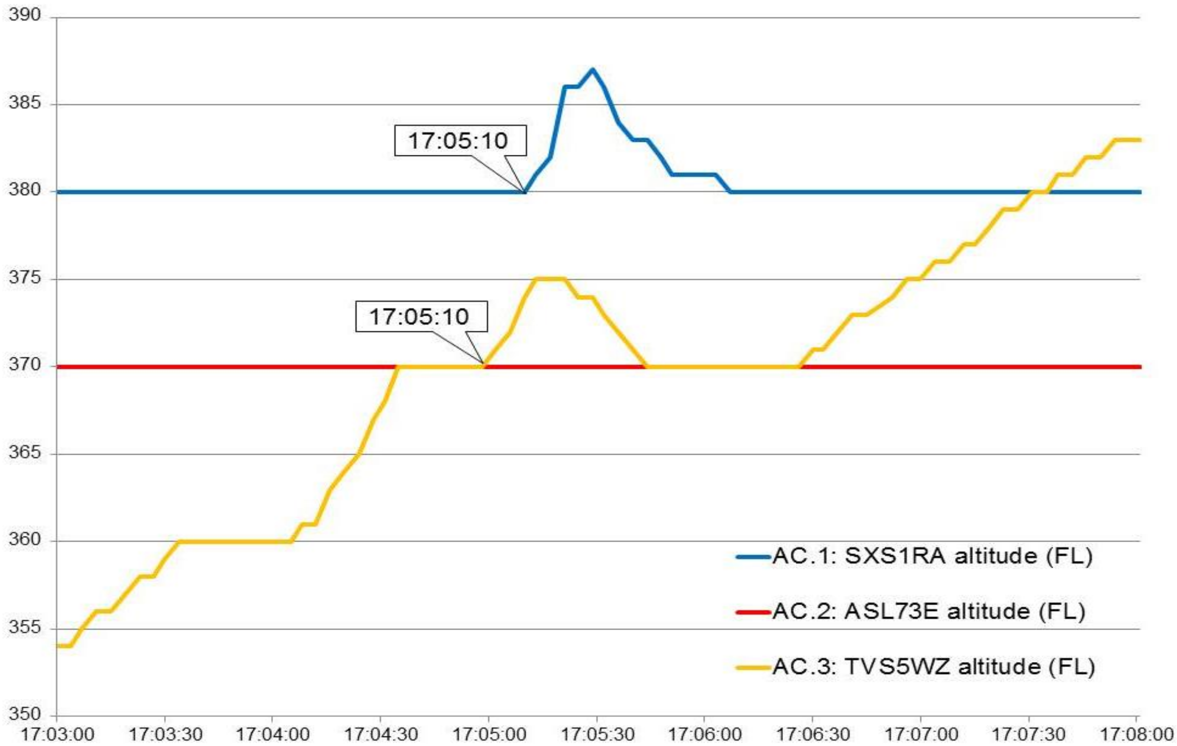

Figure 2: Flight altitudes of the aircraft involved in the occurrence

AC2 took off from Nikola Tesla Airport, Beograd (LYBE) with a delay of 25 minutes, and its destination was Kastrup Airport, Copenhagen (EKCH). It contacted the EL sector of the Hungarian air traffic control, while in climb to FL320, before PARAK (Serbian-Hungarian border,) at 16:48. After identification, it was authorised to climb to FL340, which it started, adding that they would like to climb to FL380. Then it was authorised to climb up to the top of the sector boundary (FL360) and was directed to the REGLI (Czech Republic-Poland) directly. When it reached the sector boundary, the EL sector sent it over to the EH sector for further climb where it initially was authorised to climb to FL370, due to crossing traffic (AC1). *(Flight path of AC2: red lines in Figure 1.)*

AC3 was flying from Ostrava Leos Janacek Airport (LKMT) to Rhodos Diagoras International Airport (LGRP). It contacted the EL sector of the Hungarian air traffic control, flying at FL350, at 17:01. Upon contact, it requested authorisation to climb to FL390, which it was granted up to FL360, due to the sector boundary, and it was redirected to the EH sector for further climb. *(Flight path of AC3: yellow lines in Figure 1.)*

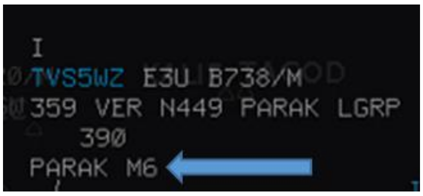

Figure 3: 'M6' entry in the OP-TEXT field

EL EC indicated by the entry 'M6' (abbreviation for the Hungarian word maradhat – indicating it can remain at their sector) in the OP-TEXT field of the system *(Figure 3)* that, despite redirection, the aircraft is allowed to stay at FL360, but EH EC (Executive Controller of the East High sector) authorised a climb to FL390-ig, and subsequently realised the conflict with AC1 first and then with AC2 as well. At 17:04:20, EH EC stopped AC3's climb at FL370 and ordered it to turn 10 degrees to the left, and diverted AC2 by ordering a turn to 320 degrees to the left, and informed its crew on the relevant traffic, in order to keep the 5 NM radar separation between AC2 and AC3 at the FL370 (however, in the meantime STCA had already given an alert *(Figure 11)* relating to each aircraft *(Appendix 1)*).

Thecrew of AC3 correctly read FL370 back, and requested confirmation for the 10-degree right turn instead of the previously received left turn order. The air traffic controller erroneously confirmed the order. Due to the right turn, AC3 turned in the direction of AC2 at the same altitude and, at 6.2 NM distance – at 17:04:58, i.e. short after starting the turn – AC3's TCAS gave the crew a climb command *(Figure 2)*. While the TCAS' evasive manoeuvre command was issued and performed, the shortest distance between AC2 and AC3 decreased to 2.9 NM horizontally and 500 ft. vertically.

When, at 17:05:10, AC3 exceeded FL373 during its climb due to the TCAS RA, then AC1, flying above AC3, was also given a TCAS RA climb command due to the threatening aircraft coming from beneath *(Figure 2).* The horizontal and vertical distances between AC1 and AC3 decreased to 2.3 NM and 600 ft..

After their evasive manoeuvres, both aircraft returned to their cleared flight levels and continued their flights according to plan.

Figure 4: The separation minima infringement displayed in the MATIAS screen

1.2 Injury to Persons

	Crew		Passengers	On the Aircraft	Others
	Flight Crew	Cabin Crew			
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	0	0	0	0
Not injured	No data	No data	No data	No data	
Summary	No data	No data	No data	No data	

1.3 Aircraft Damage

The aircraft was not damaged related to the occurrence.

1.4 Other Damage

The IC had got no information on other damage by the completion of the investigation.

1.5 Personnel Information

In the case of radar control, each sector is managed by 2 air traffic controllers. The shift change took place at 16:40; both of the air traffic controllers involved in the occurrence started their second consecutive night shift. The occurrence took place at 17:04, i.e. 24 minutes after the shift change.

1.5.1 Air Traffic Controller's data (EC)

Age, nationality, gender		30 years old, Hungarian, male
Licence data	type	Air Traffic Controller
	professional valid until	23/11/2018
	ratings	LHCC ACS
Certificates		Air Traffic Controller
Medical class and valid until		Class 3, 08/06/2020
Service time	in the preceding 24 hours	5 hours 15 minutes
	in the preceding 30 days	46 hours 55 minutes
	in the preceding 180 days	379 hours

1.5.2 Air Traffic Controller's data (PC)

Age, nationality, gender		37 years old, Hungarian, male
Licence data	type	Air Traffic Controller
	professional valid until	23/02/2019
	ratings	LHCC ACS
Certificates		Air Traffic Controller

Medical class and valid until		Class 3, 16/05/2019
Service time	in the preceding 24 hours	6 hours
	in the preceding 30 days	46 hours 15 minutes
	in the preceding 180 days	304 hours

1.6 Aircraft Information

No general airworthiness, engine and loading data of the three aircraft involved – other than that given below – had any effect on the course of events and therefore no further details are necessary.

1.6.1 AC1 data

Class	Fixed wing aircraft (MTOM > 5700kg)
Manufacturer	Boeing
Model	B737-800
Turbulence category	M
Nationality and registration marks	TC-SEZ
Airline	SunExpress
Call sign at the flight concerned	SXS1R

Figure 5: The aircraft with call sign SXS1R involved in the occurrence (AC1) (Source: www.jetphotos.com)

1.6.2 AC2 data

Class	Fixed wing aircraft (MTOM > 5700kg)
Manufacturer	Airbus
Model	A319
Turbulence category	M
Nationality and registration marks	YU-API
Airline	AirSERBIA
Call sign at the flight concerned	ASL73E

Figure 6: The aircraft with call sign ASL73E involved in the occurrence (AC2) (Lj.2) (Source: https://www.jetphotos.com)

1.6.3 AC3 data

Class	Fixed wing aircraft (MTOM > 5700kg)
Manufacturer	Boeing
Model	B737-800
Turbulence category	M
Nationality and registration marks	N917XA
Airline	SmartWings
Call sign at the flight concerned	TVS5WZ

Figure 7: The aircraft with call sign TVS5WZ involved in the occurrence (AC3) (Source: https://www.jetphotos.com)

1.6.4 On-board warning systems

All of the three aircraft involved were equipped with a transponder and TCAS. No evidence or factual information relating to improper functioning of the system was revealed in the course of the investigation.

The ICAO ACAS standard means an on-board system designed to prevent airborne collisions which is based on secondary surveillance radar (SSR) transponder signals, which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders. ACAS II is the improved version of that standard, which also gives a vertical avoidance command in case of danger, in addition to traffic information.

It should be noted that ACAS parameters are chosen to be as compatible as possible with separation minima standards, however, ACAS does not give warnings on loosing of separation minima. Pursuant to Annex to Commission Regulation (EU) No 1332/2011 of 16 December 2011 laying down common airspace usage requirements and operating procedures for airborne collision avoidance:

“AUR.ACAS.1005 Performance requirement

1. *The following turbine-powered aeroplanes shall be equipped with collision avoidance logic version 7.1 of ACAS II:*
    a) *aeroplanes with a maximum certificated take-off mass exceeding 5,700 kg;*
    b) *aeroplanes authorised to carry more than 19 passengers.*
2. *Aircraft not referred to in point 1 which are equipped on a voluntary basis with ACAS II shall have collision avoidance logic version 7.1.”*

…

“AUR.ACAS.1010 ACAS II Training

Operators shall establish ACAS II operational procedures and training programmes so that the flight crew is appropriately trained in the avoidance of collisions and becomes competent in the use of ACASII equipment.”

TCAS is an aircraft-based system that is the only commercially available system (equipment) in the ICAO ACAS II standard.

The purpose of the system is to detect nearby aircraft in flight and reduce the risk of collisions by providing information and instructions to pilots in an emergency.

On aircraft on which TCAS is installed, the system continuously monitors the airspace surrounding the aircraft *(Figure 8)* and displays the position of other aircraft with an appropriate active transponder on the pilot’s instrument panel. It warns pilots of the presence of other aircraft equipped with a transponder which are potentially dangerous, and provides them with Traffic Alert (TA) and Resolution Advisory (RA) by visual displays of such alerts, as well as by voice commands. This system is completely independent of air traffic control.

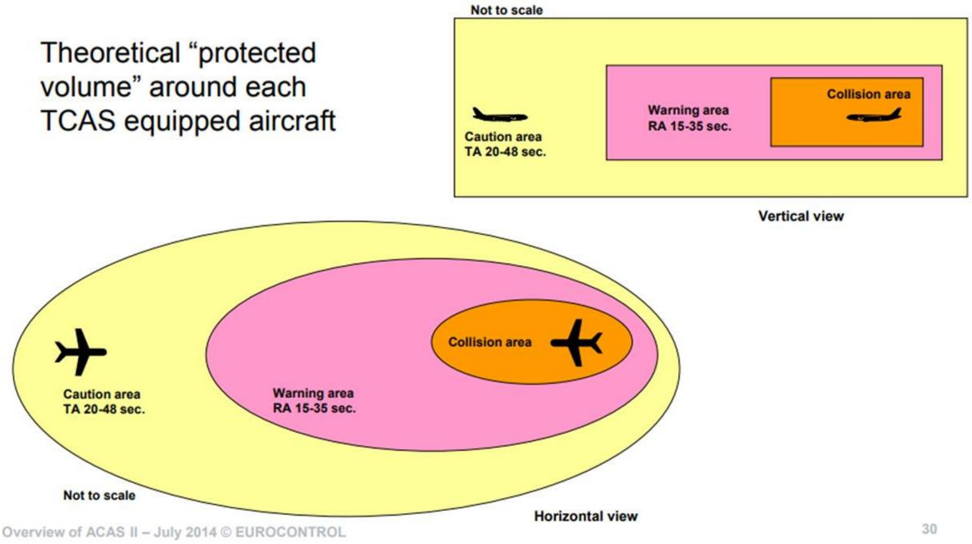

Figure 8: TCAS “protection areas”
(Source: EUROCONTROL PASS project – https://www.skybrary.aero/bookshelf/books/1445.pdf)

The size of the “protected area” continuously monitored by the equipment depends on the flight altitude of the given (own) aircraft; these dimensions are given in the table below *(Figure 9).*

Own Altitude (feet) (Az adott, „saját” légijármű repülési magasság)	SL	Tau (Seconds)		DMOD (nmi)		ZTHR (feet) Altitude Threshold		ALIM (feet)
		TA	RA	TA	RA	TA	RA	RA
< 1000 (AGL)	2	20	N/A	0.30	N/A	850	N/A	N/A
1000 - 2350 (AGL)	3	25	15	0.33	0.20	850	600	300
2350 – 5000	4	30	20	0.48	0.35	850	600	300
5000 – 10000	5	40	25	0.75	0.55	850	600	350
10000 – 20000	6	45	30	1.00	0.80	850	600	400
20000 – 42000	7	48	35	1.30	1.10	850	700	600
> 42000	7	48	35	1.30	1.10	1200	800	700

Figure 9: Determination of the sensitivity levels of the TCAS equipment and the alert thresholds (the values for the aircraft concerned are highlighted in yellow in the table)
(Source: FAA – Introduction to TCAS II Version 7.1)

ACAS standard / TCAS system

- In the event of a TA (Traffic Alert) signal, the pilot does not have to/should not react, but only observe the behaviour/movement of the relevant traffic (ICAO Doc 8168);
- In the event of an RA (Resolution Advisory) signal, the pilot must react, pursuant to point 11014, Implementing Regulation (EU) No 923/2012 (hereinafter: SERA) (*Appendix 2*).

In addition to the pilots concerned, the above mentioned part of the SERA also contains mandatory procedures for the air traffic controllers concerned.

According to related research performed earlier (2014) by EUROCONTROL:

“According to monitoring in the central European airspace, around 80% of the RAs experienced involved only a single aircraft. The explanation is as follows:

- *either the intruding/threatening aircraft was not equipped with TCAS,*
- *or the geometry of the conflict was such that the RA was not generated on the threat aircraft equipped with TCAS,*
- *or the TCAS of the threat aircraft was in TA only mode.”*

(Source: EUROCONTROL PASS project – https://www.skybrary.aero/bookshelf/books/1445.pdf)

1.7 Meteorological information

Neither the weather nor visibility had any influence on the course of events and therefore need not be discussed in detail.

1.8 Aids to Navigation

The navigation equipment had no influence on the course of events and therefore not needed to be discussed in detail.

1.9 Communication

At the time of the occurrence, AC1 established and maintained continuous two-way radio communication on the 136.800 MHz frequency of Budapest ACC EH sector, while AC2 and AC3 on the 132.790 MHZ frequency of Budapest ACC EH sector. Both of the above mentioned frequencies in the EH sector were operating in ‘coupling’ mode.

According to data provided, the EH EC frequency occupancy was approximately continuous during the occurrence, with a continuous high frequency load between 16:55 and 17:15.

Confirming the EC's and the PC's testimony, it was audible during the audio replay how the sector was saturating and the radio traffic was getting denser, and how verbal ideas to resolve the situation were coming from the controlroom during the incident, which created noise.

Communication tasks are divided between air traffic controllers as follows:

- the EC communicates by radio with the crew of the aircraft being managed in their sector,
- the PC coordinates electronically or orally with neighbouring ATS sectors (neighbouring ATS sectors within the country and neighbouring foreign ATS units).

Due to his own tasks (conflict research, continuous coordination with neighbouring sectors,) the PC working in the complex and busy EH sector was less able to assist and support the work of the EC working in the sector.

The communication equipment had no influence on the course of events and therefore not needed to be discussed in detail.

1.10 Aerodrome Information

The parameters of the airport did not affect the accident, further details are not required.

1.11 Data recorders

The IC did not obtain the flight data recorders of the aircraft involved, neither the data recorded by them.

The data recording systems required for the air traffic service provider were operating and the data recorded by them was evaluable.

HungaroControl uses several different systems to provide air traffic services, including air traffic control. Data generated (and mandatorily recordable) in the course of providing these services are recorded in different ways:

- MATIAS system: video record of the EC’s and PC’s work desk display and audio materials, for reconstruction of the air traffic controllers’ activity and the sequence of events.
- LAN radar recording: based on data recorded by the radar, software can replay air traffic with aircraft call sign, altitude, turbulence category and speed. The software allows distance measurements and aircraft position analysis.
- Ground-based voice recorders: The air traffic control frequencies and telephone lines are recorded, which, together with the replay of the co-ordinations and frequency communications, help one understand the process of aircraft moving into a given position.

1.12 Wreckage and Impact Information

There was no wreckage in connection with the occurrence.

1.13 Medical Information

There was no forensic medical examination.

1.14 Fire

There was no fire.

1.15 Survival Aspects

No one was injured.

1.16 Tests and Research

The IC did not perform or order any special tests or examinations.

1.17 Organizational and Management information

Controlled airspaces are divided into sectors. The flow management unit at HungaroControl is responsible for facilitating overload-free operation of the ATC units. In preparing a sectorisation plan, the primary focus should be on monitoring the expected workload on the sectors and aiming for an expected workload on the operating sectors of around 70-80% of the ideal, taking into account the constant variation in the forecast.

The capacity values issued for the sectors are indicated in Chapter 3 of ATS Work Technology.

At the time of the occurrence, horizontal sectorisation was in effect as follows: EASTNORTH (EN, eastern Hungary) and WEST (W, western Hungary) sectorisation. At the time of the occurrence, vertical sectorisation in EASTNORTH part of the country was in effect as follows: Lower+Middle+Upper: between 9500 ft. and FL365, and High+Top: between FL365 and FL660.

<table>
<tr><th>Sector</th><th>Lower limit</th><th>Upper limit</th><th>Sectors involved</th><th>Lower limit</th><th>Upper limit</th></tr>
<tr><td>Top (ET)</td><td>FL385</td><td>FL660</td><td rowspan="2">High (EH)</td><td rowspan="2">FL365</td><td rowspan="2">FL660</td></tr>
<tr><td>High (EH)</td><td>FL365</td><td>FL385</td></tr>
<tr><td>Upper (EU)</td><td>FL345</td><td>FL365</td><td rowspan="3">Lower (EL)</td><td rowspan="3">9500 ft.</td><td rowspan="3">FL365</td></tr>
<tr><td>Middle (EM)</td><td>FL305</td><td>FL345</td></tr>
<tr><td>Lower (EL)</td><td>9500 ft.</td><td>FL305</td></tr>
</table>

The capacity values issued for the sectorisation in force at the time of the occurrence were as follows:

LHCC EASTNORTH merged sectors

Airspace block	**Sector occupancy** (number of aircraft expected on the frequency at a time)	**Sector capacity** (Aircraft/60 min)
LHENLMU	16	44
LHENHT	18	53

After the occurrence, the sector capacity value changed on 23/05/2019 as follows:

LHCC EASTNORTH merged sectors

Airspace block	**Sector occupancy** (number of aircraft expected on the frequency at a time)	**Sector capacity** (Aircraft/60 min)
LHENLMU	16	40
LHENHT	18	50

The work of the ATS units of HungaroControl is basically determined, in addition to legislation, by the currently effective ATS Manual (work technology); the relevant parts of the ATS manual effective at the time of the event are listed in Appendix 1.

1.18 Additional Information

1.18.1 Other relevant data relating to the air traffic situation preceding the occurrence

A replay of the screen recordings of the MATIAS system showed that the EH EC's radar scale was set to 170 NM at the time of the occurrence.

Time	Event	Number of aircraft in the EH Sector
16:47:30	AC1 enters the EH sector at FL380, in the south-east, at the Romanian-Hungarian border.	8
16:48:00	AC2 enters the EL sector at FL 320, in the south, at the Serbian-Hungarian border, and then, while climbing, it is redirected to the EH sector.	8
16:53:30	AC2 is authorised up to FL370 due to AC1; there were 11 aircraft in the sector at that time, and 12 aircraft were approaching the sector.	11 approaching: 12
16:55:34	The PC of the Slovakian air traffic control coordinates AC3 to FL390, and EL PC coordinates a height of FL350 with his Slovakian colleague.	13
16:57	The STCA indication of the MATIAS system lights up in the south of the EH sector. The 2 aircraft which have activated it pass each other with a separation of 5.5 NM, in a fully regulated and controlled way, but the system highlights them, because the value is close to the separation minima.	18
17:01	AC3 enters the EL sector at FL350. AC3 requests authorisation to climb to FL390, which the EL EC acknowledges and requests patience.	20
17:02	EL EC authorises climb up to FL360.	19
17:03	EL EC transfers AC3 to the EH sector for more climb, and types in the OP-TEXT field that AC3 may remain at FL360.	17
17:04:08	AC3 requests and receives authorisation from EH to FL390, i.e. the FL above AC1. Now, the distance between AC1 and AC3 is 15.9 NM, on a converging course. According to the report of the EC and PC, neither of them realised the relevant traffic.	18

Both EC and PC stated that the traffic had been busy, but, according to EC, still manageable. PC stated that, due to the amount of coordination tasks, he thought had not been able to assist EC sufficiently with the conflict search. Due to the complexity of the sector, the CARD window assisting conflict research showed a fairly large number of expected conflicting or non-conflicting pairs of aircraft. According to their accounts, both air traffic controllers in the sector skipped checking of the CARD window *(Appendix 1)*, due to the traffic load and the high number of the conflicts indicated.

1.18.2 Separation minima

The separation minima which apply to the occurrence are specified in the following sections of Decree 57/2016. (XII. 22.) of the Ministry of National Development on the rules and procedures of the Air Traffic Control Services:

- Point 139 Section 3 (1):

"139. Radar separation: separation used when the position of aircraft is determined by radar;"

- Section 130 (1) of the Decree:
  "Vertical separation minima:
  a) Nominal 1000 ft. (300 m):
  aa) below FL290 (8850 m STD) and
  ab) between RVSM cleared aircraft in the EUR RVSM airspace,"

- Section 258 (1) of the Decree:
  "The horizontal separation minima based on radar or MLAT shall not be less than 5 NM (9.3 km), except as otherwise provided in Subsections (2) to (4) or in Chapter XI for independent or interdependent parallel approaches."

- Point 2.2.1 of Annex 18 to the Decree:
  "The radar separation minima in the Budapest CTA is 5 NM."

On the basis of the flight plans received for the aircraft concerned, the IC found that all three aircraft had been capable of RVSM.

1.18.3 Flight altitudes

According to the table in Appendix 3 of SERA, the prescribed altitudes are "odd" (…FL350, FL370, FL390…) from 000 degrees to 179 degrees, while "even" (…FL360, FL380, FL400…) from 180 degrees to 359. Any deviation from this pattern is subject to authorisation from the air traffic controller pursuant to Section 131 (8) of Decree 57/2016. (XII. 22.) of the Ministry of National Development and to section SERA.5020 (b), or possible in the cases listed in the AIP. The prescribed altitudes also greatly assist traffic controllers' work as well as that of the flow management and airspace management department.

1.19 Useful or Effective Investigation Techniques

The investigation did not require techniques differing from the conventional approach.

2. Analysis

According to the respective flight plans of the aircraft concerned, each of them had a transponder, and were equipped with TCAS *(1.6.4)*, and were capable of RVSM *(1.18.2).* Due to their RVSM capability, the mandatory horizontal separation minima to be provided between them was 5 NM and the vertical separation minima was 1000 ft. (300 m) in the given airspace at the time of the occurrence *(1.18.2)*.

Based on the report of HungaroControl related to the occurrence, it may be stated in general that substantial increase in the number of low cost flights in the period preceding the occurrence brought significant increase in traffic in the LHCC - Budapest FIR sectors. Part of these flights departed from airports located in nearby FIRs (the increase was observed from the N, E and S directions) and therefore LHCC - Budapest FIR sectors were largely involved in the managing of their climbs and descents. This fundamentally determined and significantly increased the complexity and workload of sectors, including the sector concerned, during the period under involved in this occurrence.

Various tools are available to air traffic services to distribute or reduce the load. One of these basic tools is flow planning (flow planning – Appendix 1). However, despite all efforts, traffic jams keep occurring, for example due to flight delays. Some of these aircraft (including AC1 and AC2) increased the number of aircraft managed at the same time and thus the complexity of the sector during the period of the occurrence in the sector affected. It should be noted that if the increase in traffic is expected to be small and last a short period of time, then the SV, in consultation with air traffic controllers and flow managers, may decide not to open a new sector for this short period of time, as that would result in a greater extra workload than managing the increased traffic.

The IC has examined the ATS Manual (work technology) in force at the time of the incident at the air traffic service organisation concerned, including its provisions on sector occupancy values. At the time of the occurrence, the Manual set a limit of 18 aircraft for the merged sector concerned *(1.18.1)*. According to the data recorded, the number of aircraft actually managed simultaneously before the occurrence had increased significantly within a short period of time (from 8 to 20) and was still 20 at the time of the occurrence *(1.18.1).* Comparing the actual values with the Manual's provisions clearly shows that the occupancy of the affected sector (EH) was at the limit of the sector's load limit before the event and significantly exceeded it at the time of the event.

The IC regards this circumstance as a significant stress factor contributing to the occurrence of the incident, because, in its view, it represented a significant workload for the controllers involved, regardless of the complexity of the traffic “overflow”.

The IC also regarded it as a further factor increasing the workload that the radar range of the EC concerned was set to 170 NM at the time of the occurrence (way beyond the EC's area of responsibility), the label content display contained several elements in addition to the mandatory label fields, which resulted in several overlapping labels that the EC had to keep rotating apart *(1.18.1).*

The controller of the adjacent low sector presumably wanted to fulfil the climb request of the aircraft concerned (AC3), so, despite the low occupancy of his sector, the controller of the adjacent low sector initiated and coordinated a sector change (climb to FL390) for AC3 (Appendix 1) to the already overloaded sector concerned. Since this circumstance further increased the load on the already highly loaded sector, and because keeping AC3 in the low sector (even for a few minutes longer) could have broken the chain of events leading to the later conflict, this factor was regarded by the IC as an additional contributing factor to the occurrence.

After a frequency change, the receiving sector shall, if possible, ensure entry (authorising climb/descent) of the aircraft to his sector at the first communication exchange. If that is not possible, he/she should immediately initiate coordination with the transferring sector. As the controller of the lower (EL) sector saw that the climb of AC3 was unlikely to be resolved at the first exchange of messages, he indicated by the code 'M6' entered in the OP-TEXT field of the system for electronic communication *(Figure 3*: 'M6' entry in the OP-TEXT *)* that AC3 could remain at FL360 after the transfer, but did not verbally coordinate this, as this is the controller's practice of reducing coordination, which is not included in the Work technology.

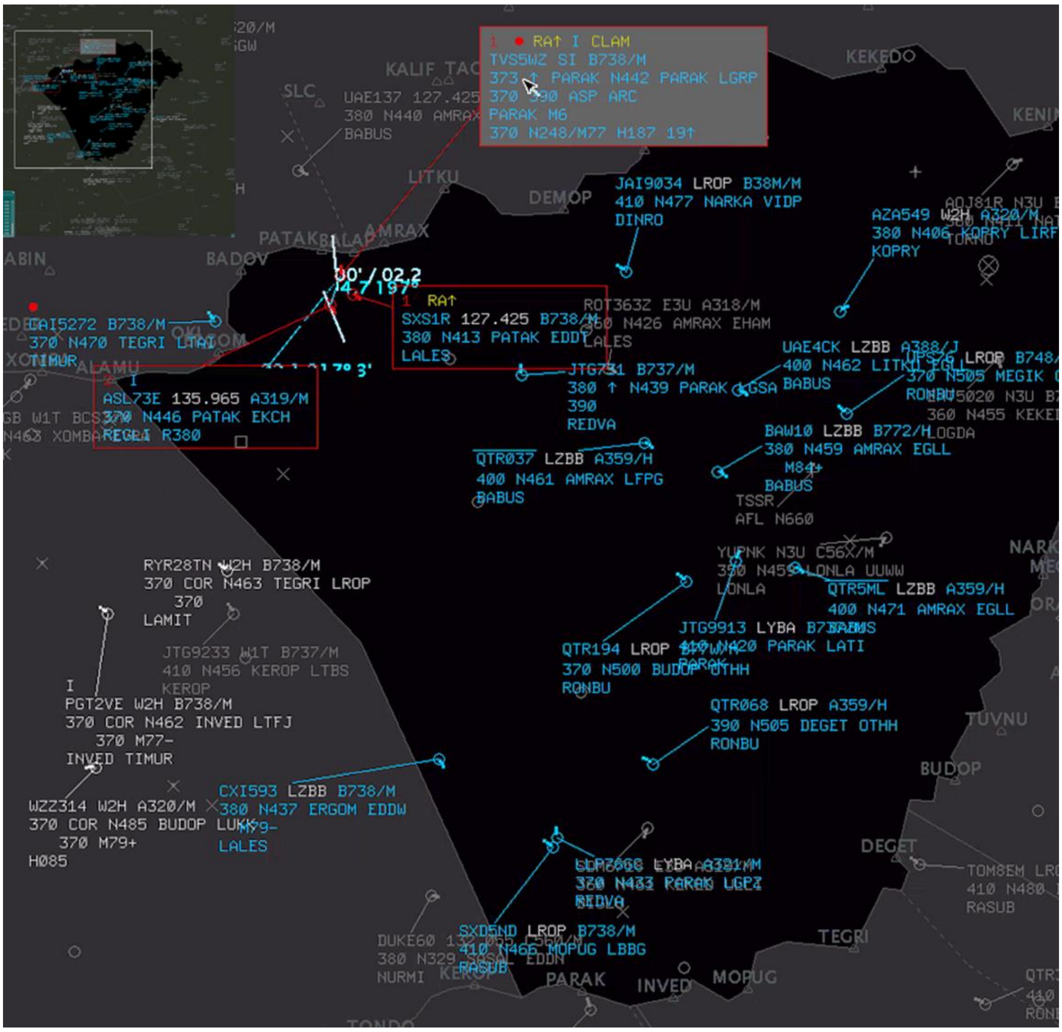

Figure 10: EH EC's MATIAS screen at the time of the occurrence

It is conceivable that this procedure could be a useful part of the work technology in certain circumstances, once it has been integrated into the system after a preliminary analysis. However, in the point of view of the IC, this circumstance contributed more to the loss of information during the course of events and thus to the occurrence. This is confirmed by the fact that the controller of the receiving sector concerned did not notice it and did not even attempt to keep AC3 at FL360.

Based on an assessment of the data recorded, the IC concludes that in the period prior to the incident, the controller of the sector concerned was concentrating on the significant number of aircraft coming predominantly from the south and on resolving conflicts in the southern part of the sector. Among the aircraft flying from south to north was AC1 (later involved in the incident), maintaining FL380, and AC2, which could only be allowed to climb to FL370 by the air traffic controller instead of the requested FL380 because of AC1. The fact that the air traffic controller allowed a height for the traffic on the 331-degree heading which was a dedicated height for opposing traffic *(1.18.3)* – which, according to the IC, was already the result of a planning resulting from the high traffic load – contributed to the occurrence to some extent later on.

The PC working in the sector concerned – due to his own tasks (*1.19 and 1.18.1)* resulting from the complex and dense traffic he was responsible for – could not sufficiently assist and support the work of the EC working in the sector, and therefore the cooperation between the two of them was reduced. In the IC's point of view, that workload level also contributed to the decision of the EC concerned to accept the low sector altitude request for AC3 coming from the North and to take it over, despite the load of its own sector, thus further increasing the number of the aircraft managed by him and the load of his sector.

The result of all that was that the EC concerned, fulfilling AC3's request (despite the fact that it could have stayed at FL360), cleared the requested climb from FL360 to FL390 without noticing its expected conflict with AC1. However, due to the allowed climb, AC3 came into conflict with AC1 arriving opposite on FL380. In the IC's view, these factors that led to the conflict situation (taking over AC3 and allowing it to climb to FL390) contributed to the subsequent occurrence, because the resolution of the conflict situation they created forced the EC concerned to give instructions to AC3 subsequently. Furthermore, when examining the conflict research of the EC concerned prior to the clearance of the climb of AC3, the IC found that the measurement of the distance for checking the distance of significant number of relevant traffic, the conflicts between AC1 and AC2; and AC1 to AC3 had been omitted. In the view of the EC, this fact also confirms that the high traffic load contributed significantly to the occurrence.

In this situation, the EC concerned instructed AC3 to stop climb at FL370 and turn left 10 degrees, and AC2, coming opposite at the same altitude (FL370), was instructed to turn left to the 320-degree direction (while STCA had already given alert to all three aircraft *(Figure 11)(Appendix 1)*.

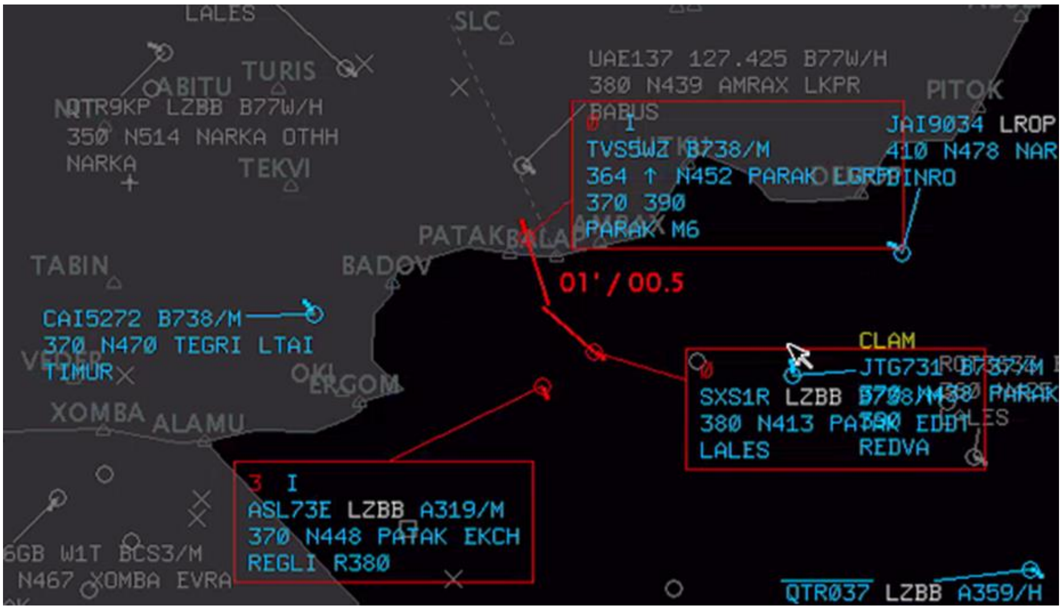

Figure 11: Appearance of the STCA alert when AC3 climbed from FL360.

The quick, sudden change to the earlier instruction may have caught AC3 by surprise. Reacting to this – executing an "abrupt" stop of the climb – certainly implied an increase in workload for the pilots. According to the IC, this factor may have contributed to the AC3's pilot's reading back an incorrect turn direction. His uncertainty is illustrated by the fact that he specifically asked for confirmation of the instruction for the turn he had been reading back. However, the EC concerned – presumably due to the stress of the heavy workload and the urgency to resolve the conflict situation as soon as possible – did not detect and confirmed (as detailed in 1.1) the mistaken turning direction (right instead of left) for AC3. The IC assumes that this miscommunication could possibly had been prevented if AC3 had been instructed by the controller to turn to a specific heading (e.g. to 155 degrees) instead of a relative heading (by 10 degrees). The fact that – due to the noise from the workroom (interspersed with advice), the ever-increasing workload and the time pressure – the EC concerned possibly “heard back what he wanted to hear” may have contributed to the confirmation of the wrong turn. (It should be noted that, for the same reasons, presumably the PC concerned did not detect the mistake either.) The IC considers these activities of the controllers concerned as traffic-following behaviour instead of planned traffic control.

However, as a result of the confirmed wrong turn, AC3 turned towards AC2 which was at the same altitude as AC3, and the distance between them started to decrease. (The shortest horizontal distance between AC2 and AC3 was 2.9 NM and the minimum vertical distance was 500 ft.).

Although the resulting occurrence (separation minima infringement) was detected by the EC concerned, but the instruction to AC3 to turn left to 160 degrees to establish the required separation could only be read back by AC3, because the TCAS had instructed AC3 to climb due to the proximity of AC2 *(Figure 2)*. However, when AC3 crossed the FL373 height while climbing due to the TCAS RA, and was approaching AC1 flying above it, AC1 also received a TCAS RA climb command due to the threatening aircraft coming from below *(Figure 2)*. This reduced the horizontal distance between AC1 and AC3 to 2.3 NM and the vertical distance to 600 feet. After examining the course of the incident, the IC is of the opinion that the TCAS system, which is designed to prevent collisions between aircraft, was activated during the process and that the instructions it gave effectively helped to normalise the situation.

Examining the causal chain of events described above, the IC has concluded that the direct cause of the event (separation minima infringement) and the subsequent chain of events was the confirmation of the wrong turn direction by the EC of the sector concerned, and the 10-degree right turn started by AC3. The IC regards this factor – Identified as the root cause of the incident – as miscommunication due to the increased workload.

In addition to those above, based on the examination of the circumstances of the incident and the air traffic controllers involved, the ATC is of the opinion that the excessive amount of information displayed in the so-called CARD window of the MATIAS system for air traffic controllers (Appendix 1) due to the high traffic volume rather than helped controllers to identify the actual conflicting aircraft pairs it made it more difficult. The fact that both managers in the sector neglected to address the CARD window due to the high number of reported conflicts and the high traffic load just added to that. In the view of the IC, setting the CARD window to potentially focus more on the aircraft in actual conflict, and thus make it more manageable, could have facilitated earlier recognition of the conflict in point by the air traffic controllers of the sector concerned. In view of this, the IC regarded it as a limitation in the configuration of the software and therefore as an ergonomic factor contributing to the incident, i.e. as a stress factor resulting from the workload of the controllers involved, which also contributed to the incident.

3. Conclusions

3.1 Findings

The air traffic controllers concerned had appropriate licences and ratings to perform their duties and held valid medical certificates at the time of the occurrence. *(1.5)*

All three aircraft involved were equipped with transponders and TCAS. The investigation did not reveal any evidence or facts that the systems were not working as intended. *(1.6.4; 2)*

AC1 used the 136.800 MHz frequency of Budapest ACC EH Sector to establish and maintain a continuous two-way radio contact, while AC2 and AC3 used the 132.790 MHZ frequency of Budapest ACC EH Sector during the occurrence. The above two frequencies in the EH sector were operating in merged mode. *(1.9)*

According to the data provided to the IC, the EH EC's frequency occupancy was approximately continuous during the occurrence. The frequency load was continuously high between 16:55 and 17:15. *(1.9)*

The required data recording systems of the air traffic control equipment were operational and the data recorded by them were made available to the IC and proved to be evaluable. *(1.11)*

At the time of the occurrence, there was EASTNORTH and WEST horizontal sectorisation; the following vertical sectorisation was in place in the EASTHORTH region at the time of the occurrence: Lower+Middle+Upper: between 9500 ft. and FL365, and High+Top: between FL365 and FL660. *(1.17)*

The EH EC's radar range was set to 170 NM at the time of the occurrence, which is well beyond the EC's area of responsibility. *(1.18.1; 2)*

On the basis of the flight plans provided for the aircraft concerned, the IC found that all three aircraft were capable of RVSM. *(1.18.2; 2)*

Prior to the incident, the number of aircraft actually being managed at the same time had increased significantly within a short period of time (from 8 to 20), and was still 20 at the time of the occurrence which, regardless of complexity, represented a considerable workload for the controllers involved. *(1.18.1; 2)*

The occupancy of the sector affected by the event (EH) was at the near the load limit set for the sector before the occurrence and significantly exceeded it at the time of the occurrence. *(1.18.1; 2)*

The air traffic controller of the EL sector, where the load was lower, coordinated a sector switch to the sector with higher load. *(1.1; 2)*

The air traffic controller of the EL sector indicated to the sector concerned, in a customary manner (by means of a note 'M6' in the OP-TEXT field) other than the process specified in the work technology, that AC3 may stay at FL360 after the handover. *(1.1; 2)*

Despite the workload of his own sector, the air traffic controller (EC) of the sector concerned accepted the altitude request of the EL sector for AC3. *(1.1; 2)*

Before clearing AC3 to climb from FL360 to FL390, the air traffic controller (EH EC) did not detect the expected conflict of AC3 with AC1 and AC2. *(1.1; 2)*

The air traffic controller (EH EC) cleared AC3 to climb from FL360 to FL390 despite the fact that it could have stayed at FL360. *(2)*

The very large number of expected conflicting and non-conflicting aircraft pairs displayed in the CARD window did not help the identification of actually conflicting aircraft pairs. *(2)*

Neither air traffic controllers in the sector addressed the CARD window, due to the high traffic load and the high number of reported conflicts. *(2)*

3.2 Causes

As a result of the investigation the IC concluded that the root cause of the accident was

- miscommunication between the EC of the sector concerned and AC3.

In addition to the above, the IC identified the following indirect causes and contributing factors:

- the load of the affected sector (EH) was continuously (at the time of the event and for a longer period before it) at the limit of the load limit defined in the sector, or exceeded it,
- the air traffic controller of the EL sector with a smaller sector load coordinated a sector change to the affected sector with a large sector load,
- the air traffic controller of the EL sector indicated to the affected sector that AC3 could remain at FL360 after the handover, in a manner established on the basis of customary law (with the M6 note entered in the OP-TEXT field) different from the work technology
- the air traffic controller (EC) of the affected sector accepted the altitude request of the EL sector for Lj.3 despite the workload of his own sector,
- the air traffic controller (EH EC) did not detect AC3 expected conflict with AC1 and AC2 before issuing AC3 the climb from FL360 to FL390,
- the air traffic controller (EH EC) issued AC3 a climb from FL360 to FL390, even though it could have stayed at FL360,
- AC2 received and used a flight level assigned for the opposing traffic;
- the representation of the very large number of expected conflicting and non-conflicting pairs of aircraft appearing in the CARD window did not help to recognize pairs of aircraft that are actually in conflict with each other,
- handling of the CARD window was omitted by both controllers of the sector due to the traffic load and the high number of reported conflicts,
- the radar monitor settings did not help reduce the load on the EC,
- the EH PC could not help the work of the EC due to its own tasks.

4. Safety Recommendations

4.1 Actions Taken by the Air Traffic Service During the Investigation

The air traffic service provider issued the following safety recommendations, implemented the following measures and achieved the following results within its organisation as a result of its own internal technical investigation in relation to the occurrence:

Safety Recommendation: *HC-BA-2018/35*

It is recommended that the ATSF management present the incident to ACC air traffic controllers in order to provide objective information on the incident;

Action:

Once the final version of the summary report has been received by the ATS department, it will be made available to the professional staff involved in the incident within 30 days in order to provide objective information.

Result:

The Summary Report of the incident was published as an annex to the ATSF Circular № 23/2018 for the ACC staff concerned.

Safety Recommendation: HC-BA-2018/36

It is recommended that the KIRO management review the capacity and occupancy values of the sectors due to the changed traffic conditions;

Action:

Due to the significant increase in complexity in the traffic of EA Budapest ACC, the hourly capacity values for both the basic and the merged sectors will be reviewed by 31 March 2019 and reduced where necessary. In line with that, the so-called occupancy values will also be reviewed, taking into account the fact that we have very limited influence on their evolution.

Result:

At the KIRO DSV meeting held on 09.01.2019, modified hourly capacity values were determined for the ACC sectors. They will be applied from 28 March 2019.

Safety Recommendation: *HC-BA-2018/37*

It is recommended that the KIRO management remind ACC air traffic controllers to exercise increased caution when initiating and accepting electronic coordination for sector changes to adjacent sectors in the event of high sector demand;

Action:

By 31 March 2019, we will examine how to change the ACC work technology to avoid imposing additional burdens on already heavily burdened sectors by limiting the initiation of automatic electronic coordination.

Result:

No45/2018 – Any change to the initiation of automatic electronic coordination requires modification of the MATIAS system, and will be integrated with Build 12 in 2021.

Safety Recommendation: HC-BA-2018/38

It is recommended that the KIRO management explore, in a joint effort with the ATRO experts, the possibility of making the CARD window more usable by setting appropriate parameters.

Action:

We will initiate a discussion with ATRO staff by 31 December 2018 to explore what improvements can be expected to make the MTCD function more "usable", and whether there is already a possibility to modify the parameters of the function at database level.

Result:

On 15 November 2018, the ATSF manager consulted with an ATRO staff member about expected MTCD modifications in Build 11. The consultation revealed that, as a result of the modification, the MTCD window will display significantly fewer of those alerts that do not indicate potential conflicts. The change was achieved by modifying the MTCD calculation algorithm and not by parameter setting. The ACC was informed on the changes within the framework of Build 11 staff training.

4.2 Interim Safety Recommendation(s)

TSB issued no safety recommendation during the investigation.

4.3 Concluding Safety Recommendation

With regard to the actions taken by HungaroControl in the course of the investigation, the IC of the TSB found no grounds to issue a safety recommendation.

Budapest, 03 October, 2022

……………………………
Nacsa JD, Zsuzsanna
Investigator-in-Charge

……………………………
Erdősi, Gábor
IC Member

……………………………
Joó, Klementina
IC Member

APPENDICES

Appendix 1:

Work technology extended with the FMP KFOR sector

1. GENERAL

1.1. Air Traffic Flow Management Position

The air traffic flow and capacity management (hereinafter: ATFCM) tasks related to Budapest FIR and the airspace of the KFOR sector are performed fully (strategic, pre-tactical, tactical) by EUROCONTROL Network Management Operations Centre (hereinafter: NMOC), in cooperation with the Flow Management Position (hereinafter: FMP) of the Air Traffic Flow and Capacity Management Unit.

2.1.2. Procedures

The flow manager shall take independent action on ATFCM issues, in cooperation with the SVs of the relevant ATC units of HungaroControl. The flow manager shall determine, in coordination with the NMOC, on the basis of available archived data and traffic forecasts, when and where it is likely that tactical ATFCM measures will be required.

Tactical measures may also be applied or proposed by the NMOC autonomously if the traffic forecasted on the basis of available data in the Budapest FIR or in the airspace of the KFOR sector exceeds the defined capacity.

2.2.2.1. Preparing a tactical sectorisation plan

The flow manager prepares a sectorisation plan for the Budapest ACC and Budapest APP and the KFOR sector on the tactical day, in which the optimal configuration of the available sectors is to be determined.

The sectorisation plan is drawn up on the basis of the allocated sector capacity values, the permitted sector occupancy values and the number of available controllers.

The tactical sectorisation plan is checked continuously, but at least every hour, according to the updated data, and adjusted as necessary. The sectorisation plan is continuously coordinated with the ATS SV.

The tactical sectorisation plan shall be prepared taking into account the following aspects:

a) *The priority task is to monitor the expected load of the sectors. Efforts should be made to keep the expected load of the operating sectors around the ideal 70% - 80%, taking into account the constant variation of the forecast.*
b) *Frequent configuration changes should be avoided, i.e. efforts should be made to ensure that the established configuration can be used over a longer period of time. However, this principle should in no case lead to the use of a configuration that leads to overloading any of the operating sectors.*
c) *The configuration to be used and the sector restrictions coordinated for that day should also be agreed.*

The actual sectorisation is kept in electronic form by the flow manager for statistical and pre-planning purposes.

2.3.2. Cooperation with the ATS SV

The flow manager performs the following tasks in cooperation with the ATS SV:

a) *Identify new sectorisation and job placements to meet expected traffic needs,* *b) Determine new capacity values in case of technical failure or adverse weather conditions,*

c) Reorganise traffic in the event of capacity reduction in adjacent FIRs; and

d) Other tasks related to flow management.

ACC Work technology

3. Control sectors and jobs

In order to reduce workloads, Budapest ACC can be divided into WESTSOUTH (WS), EASTNORTH (EN) and EAST (E) sector groups, and WEST (W), SOUTH (S) and NORTH (N) sectors.

ACC sectors have two controller positions: EC and PC.

The service is provided on a continuous basis, with the number of active sectors determined by the ATS SV depending on traffic.

5. Sectorisation

5.1. Opening and merger of sectors

At the request of the EC or the PC, the ATS SV may order the opening of a sector if traffic is below the specified sector capacity.

During the switchover, the sender and the receiver EC and PC agree current traffic. The PC consents to the new sectorisation to the ATS SV after coordination of the handover of traffic, if all relevant positions are ready.

A sector whose airspace is subject to an STCA alert can contribute to a new sectorisation only after the alert has been lifted.

7.2. The OP-TEXT field

Data entered in the OP-TEXT field have priority over data which appears in the related automated field.

Managing of the OP-TEXT field is subject to the following rules:

a) The instructions issued shall be entered by the controller issuing the instructions.

b) An entry related to an instruction issued may be rewritten only if an amending instruction is issued.

c) Any entry relating to instructions issued may be cancelled when the aircraft has passed the clearance limits both in time and space.

d) The conditions of the coordinated transfer shall be entered by the coordinating controller.

e) The entry relating to the conditions of the coordinated transfer may be deleted only by the receiving party.

f) Entering the transfer conditions is not a substitute for mandatory verbal coordination.

The information in the OP-TEXT field must be presented in a uniform format, as described in Annex 2 to this Manual. Entry into force: 2017. 01. 21.

8.4.3.2. Horizontal coordination

The rules for route modification are set out in section 8.8.2.

If there is a transfer of expected conflicting traffic (within 5 minutes of crossing the sector boundary) from the same sector, the transferring sector will verbally alert the accepting sector of the expected conflict.

8.4.3.3. Vertical coordination

Vertical movement is coordinated by rewriting the XFL/RFL value; from the MANCOORD window in the case of telephone coordination.

To change the XFL value, use the XFL/RFL menu. If the XFL/RFL value change results in a vertical sector change, the system will automatically start coordination.

The receiving sector may accept the value of the PEL offered or may offer a counter-proposal. The receiving sector may propose an FL value relating to itself only. If the receiving sector is unable to receive the aircraft involved in the coordination, the REJECT function shall be used and telephone coordination shall also be initiated.

Changes to the height values between adjacent sectors in the system database can be made by rewriting the XFL field with the consent of the receiving sector.

8.4.3.3.1. Aircraft changing sectors vertically

For aircraft changing sectors vertically, a change in the XFL/RFL or PEL is not considered a coordinated altitude. The acknowledgement of a PEL or XFL value is only the consent of the receiving party to the frequency change.

If the change of altitude also results in a change of sector, the transferring party may issue a change of altitude authorization for the last altitude of its own sector, or, in the case of a SKIP, that of the skipped sector. The aircraft may be transferred while climbing or descending to the approved altitude. The transferring party must ensure that there are no further conflicts in their own sector.

After a frequency change, the receiving sector shall, if possible, grant entry (climb/descent) of the aircraft to the receiving sector at the first change of message. If this is not possible, it shall immediately coordinate with the transferring sector.

8.10.1. CARD alert handling

The MATIAS system automatically performs a conflict analysis based on the FPLs and control data input received and processed. The conflict is displayed in the CARD window.

The conflicts displayed in the CARD window are checked by the EC or PC. If the conflict does not indicate an actual emergency or if it is within their own competence to take action to resolve the conflict, the alert may be acknowledged by both the EC and the PC.

It should be noted that if a distance value of less than 10 NM is acknowledged, the distance may be reduced below the separation minima without a new CARD Window alert.

<u>Short Term Conflict Alert (STCA)</u>

1. Operation

The radar data processing system of MATIAS continuously monitors the trajectories of the tracks and, if it considers that an aircraft is in danger of colliding with another aircraft within a certain time (hereinafter referred to as warning time), it gives an alert. If a conflict is detected which is expected to occur within a relatively short period of time, it will give an STCA alarm. The warning time is 60 seconds for TMA sectors, and 120 seconds for ACC sectors.

The STCA alert warns the controller before an infringement of the separation minima between aircraft (the values can be set at database system level; for ACC: 5.9NM, 800'; 1800' at non-RVSM; for APP: 3.5 NM, 800'). The system checks both the horizontal and altitude separation and alerts if both types of separation are likely to be damaged.

The system's database can be used to identify districts where STCAs operate or which can be exempted from STCA control. These are switched on and off by the ATS SV.

The STCA alert covers the tracks associated with the FPL (at least one of the aircraft involved in the conflict) and operating above the altitude defined in the database. In

Budapest FIR, STCA search is switched off at 2000 feet and below, and is not used in FIC positions.

STCA also takes RVSM airspaces into account.

The look-ahead time is 90 seconds in the TMA, and 180 seconds for ACC sectors.

The system can be set, per position, to give an STCA preliminary warning before the actual STCA alert (between the look-ahead time and the warning time). The preliminary warning function can be activated in the 'Settings Menu'.

2. Display

2.1 STCA preliminary warning

A red dot appears in the line '0' of the radar tag and remains there until the conflict is resolved or the case turns into an actual STCA alert.

2.2 Actual STCA alert

In the case of an STCA alert, the track position symbol, the linking lines and the history dots are red in colour. The radar tag gets a red frame.

Line '0' of the radar tag displays the separation minima calculated by the system (the shortest distance is displayed in the case of multiple STCA conflicts) in NM (rounded down).

In the traffic lists, the call sign field of the aircraft under STCA alert is indicated against a red background.

2.3 STCA SEP Tool Vector display

The operator can select the 'STCA SEP Tool Vector' function (available via the Track Control Window) to set automatic display of STCA Sep Tool vector lines in red for the tracks involved in a STCA conflict. The vectors show when and where the separation minima is going to occur and will remain visible until the conflict ceases to exist.

Appendix 2:

<u>Section 11014 of Implementing Regulation (EU) No 923/2012</u>

Section 11014 of Implementing Regulation (EU) No 923/2012/EU (hereinafter: SERA):

"b) In the event of an ACAS RA, pilots shall:

1. *respond immediately by following the RA, as indicated, unless doing so would jeopardise the safety of the aircraft;*
2. *follow the resolution advisory (RA) even if there is a conflict between the RA and an ATC instruction to manoeuvre;*
3. *not manoeuvre in the opposite sense to an RA;*
4. *as soon as possible, as permitted by flight crew workload, notify the appropriate ATC unit of any RA which requires a deviation from the current ATC instruction or clearance;*
5. *promptly comply with any modified RAs;*
6. *limit the alterations of the flight path to the minimum extent necessary to comply with the RAs;*
7. *promptly return to the terms of the ATC instruction or clearance when the conflict is resolved; and*
8. *notify ATC when returning to the current clearance.*

c) When a pilot reports an ACAS RA, the controller shall not attempt to modify the aircraft flight path until the pilot reports "CLEAR OF CONFLICT".

d) Once an aircraft departs from its ATC clearance or instruction in compliance with an RA, or a pilot reports an RA, the controller ceases to be responsible for providing separation between that aircraft and any other aircraft affected as a direct consequence of the manoeuvre induced by the RA. The controller shall resume responsibility for providing separation to all the affected aircraft when:

1. *the controller acknowledges a report from the flight crew that the aircraft has resumed the current clearance; or*
2. *the controller acknowledges a report from the flight crew that the aircraft is resuming the current clearance and issues an alternative clearance which is acknowledged by the flight crew."*