

FINAL REPORT

2012-159-4P SERIOUS INCIDENT

Budapest FIR – Bugac area 11 June 2012

Bombardier CRJ900 / Airbus A320 D-ACKC / OE-LEU

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents, incidents or irregularities and to initiate the necessary technical measures and make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to investigate or apportion blame or liability.

INTRODUCTION

The present investigation was carried out by the Transportation Safety Bureau of Hungary 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 of the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- MET Decree 123/2005 (XII. 29.) on the regulations of the technical investigation of aviation accidents, incidents and irregularities;
- In absence of other related regulation of the Kbvt., in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service

The Kbvt. and the MET Decree 123/2005 (XII. 29.) jointly serve the compliance with Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree 278/2006 (XII. 23.).

Under the aforementioned regulations

- The Transportation Safety Bureau of Hungary shall investigate the aviation accidents and the serious aviation incidents.
- The Transportation Safety Bureau of Hungary may investigate aviation incidents and irregularities which in its judgement would have resulted in accidents under other circumstances.
- The technical investigation is independent of any administrative, infringement or criminal procedures initiated in connection with the transport accident or incident.
- In addition to the aforementioned laws, throughout the technical investigation ICAO Doc 9756 and Doc 6920 Manual of Aircraft Accident Investigation is applicable.
- The present final report shall not be binding, nor shall an appeal be lodged against it.

No conflict of interest has arisen in connection with any member of the investigating committee. Persons participating in the technical investigation shall not act as experts in other procedures concerning the same case.

The IC shall safe keep the data having come to their knowledge in the course of the technical investigation. Furthermore the IC shall not be obliged to make the data – regarding which its owner could have refused the disclosure of the data pursuant to the relevant act – available to other authorities.

DEFINITIONS AND ABBREVIATIONS

ACC SV	Area Control Centre Supervisor		
ACS-RAD	Approach Control Surveillance – Aerodrome Radar Control		
ATC	Air Traffic Control		
ATPL	Airline Transport Pilot License		
ATS	Air Traffic Services		
CAT	Instrumental Landing System Category		
СВ	Cumulonimbus clouds		
CLAM	Cleared Level Adherence Monitoring		
СО	Co-pilot (First Officer)		
CPT	Captain		
CVR	Cockpit Voice Recorder		
E+yy sec	A time after FL crossing		
E-0	The moment of flight level crossing (13:56:00)		
EL	East Low ATC Sector		
E-xx sec	A time prior to the FL crossing		
FDR	Flight Data Recorder		
FIR	Flight Information Region		
FL	Flight Level		
GAT	General Air Traffic		
GmbH	Gesellschaft mit beschränkter Haftung		
IC	Investigating Committee		
ICAO	International Civil Aviation Organization		
IFR	Instrumental Flight Rules		
IIC	Investigator-In-Charge		
IR	Instrumental Rating		
Kbvt.	Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents		

LHCC MET	Budapest FIR Ministry of Economy and Transport
NTA DAT	National Transport Authority, Directorate for Air Transport
PF	Pilot Flying
PIC	Pilot in Command
PNF	Pilot Not Flying
QDM	Quick Distance Measure
RVSM	Reduced Vertical Separation Minima
STCA	Short Term Conflict Alert
SV	Supervisor
TCAS	Traffic Alert and Collision Avoidance System
TCAS RA	TCAS Resolution Advisory
TCAS TA	TCAS Traffic Advisory
TSB	Transportation Safety Bureau
UTC	Coordinated Universal Time
VMC	Visual Meteorological Conditions
VOR	VHF (Very High Frequency) Omni directional radio Range
WL	West Low ATC Sector
WT	West Top ATC Sector
WU	West Upper ATC Sector

SUMMARY OF THE OCCURRENCE

Occurrence category Serious		Serious incident	
	Class	Fixed wing aircraft	
	Manufacturer	Bombardier	
Aircraft Nº 1	Туре	CRJ900 (CL600-2D24)	
	Registration	D-ACKC	
	Operator	Lufthansa Cityline GmbH	
Aircraft № 2	Class	Fixed wing aircraft	
	Manufacturer	Airbus	
	Туре	A320	
	Registration	OE-LEU	
	Operator	Niki Luftfahrt GmbH	
Occurrence	Date and time (LT)	11 June 2012, 15:57	
	Location	Budapest FIR – BUG area	

Reports and notifications

The occurrence was reported to the dispatcher of TSB at 16:20 on 11 June 2012 by the HungaroControl ATS Centre supervisor.

TSB dispatcher

- informed the duty personnel of NTA DAT at 16:37 on 11 June 2012,
- notified the accident investigating organization of the State of Operator at 15:52 on 12 June 2012,
- notified the accident investigating organizations of other concerned States at 15:54 on 12 June 2012.

Investigating committee

On 12 June 2012 the Director-General of the TSB assigned the following Investigating Committee (hereinafter referred to as IC) for the investigation of the occurrence:

IIC:	László GRÉZ	investigator
IC member:	György HÁY	investigator
IC member:	László PÁL	investigator

Representatives of the operators:	László Szalai, HungaroControl Zrt. Manfred Fratzl, Niki Luftfhart GmbH
Representatives of States of Operators:	Peter Rogl, Austria George Blau, Germany Christian Blanke, Germany

Overview of the investigation procedure

The IC examined the relevant recordings of radar screens, radio and telephone calls, filed flight plans as well as the technical documentation of aircraft and personal information on flight crews and ATC operators. The IC also reviewed the Captain's Reports, the CVR, FDR and TCAS data and working time/resting time logs. The IC also conducted interviews with the ATC operators.

Short summary of the occurrence

Flight DLH9949 (D-ACKC, CRJ900) took off from Timisoara to Munich for a technical transfer flight with an inoperative TCAS system. The aircraft requested clearance for climbing from FL320 to FL330 while flying near BUG VOR. The ATC repeated the clearance to the pilots at the time of transferring their aircraft to the ATC of the next sector and also told them the new frequency. The pilots, however, misunderstood the ATC and started climbing to FL360.

As a consequence, the separation between DLH9949 and another aircraft (NLY2803, OE-LEU, A320) flying at FL340. At the moment of breach of vertical separation minimum the horizontal separation was 2.6 NM. When the two aircraft was situated at the same altitude the hotizontal separation got reduced to 1.9 NM. When the required vertical separation was reached again, the horizontal separation was 0.7 NM.

There was no reported damage or injury related to this serious incident.

The IC believes that the flight crew of DLH9949 oveshoot the altitude without clearance and this mistake led to the serious incident.

The IC proposed a number of safety recommendations in order to prevent similar occurrences.

1. FACTUAL INFORMATION

1.1 History of flight

Flight DLH9949 entered the Hungarian Airspace at 13:47:03 UTC near MOPUG at FL248 (in climb to FL300) and was heading to ARSIN.

- Registration D-ACKC
- Flight: IFR, technical transfer without passengers
- Flight number: DLH9949
- Type of operation: GAT
- Departure: Timisoara (LRTR)
- Time of departure: 13:30 UTC (16:30 LT)
- Planned/actual destination: Munich (EDDM)
- Time of arrival: 14:39 UTC (16:39 LT)



D-ACKC



Bombardier CRJ 900 cockpit (illustration)

Flight NLY2803 was a scheduled passenger flight that entered the Hungarian airspace at 13:50:37 UTC near PARAK and headed towards TORNO at FL340.

- Registration: OE-LEU
- Flight: IFR, scheduled passenger flight
- Flight number: NLY 2803
- Type of operation: GAT
- Departure: Santorini (LGSR)
- Time of departure: 12:18 UTC (15:18 LT)
- Planned/actual destination: Vienna (LOWW)
- Time of arrival: 14:36 UTC (16:36 LT)





Airbus 320 cockpit (illustration)

Location and time of the serious incident: Budapest FIR - BUG VOR (Bugac), FL 340, 11 June 2012, 15:57 LT (13:57 UTC), daylight, VMC - among high CB clouds.



Planned route of NLY2803 (PARAK-TORNO, red) and DLH9949 (MOPUG-ARSIN, yellow)

The previous day the aircraft D-ACKC encountered a lightning strike during landing at Timisoara therefore a technical inspection was necessary. The TCAS system was found faulty (there was a "TCAS DISPLAY FAIL" error message).

No other fault or malfunction was found.

The crew spent the night in a Timisoara hotel where they arrived around 11:30 UTC. The pilots received a phone call with instructions concerning the following day's transfer flight details around 22:00. Otherwise the resting was undisturbed and was longer than 24 hours. The crew left the hotel around 12:10 UTC.

The aircraft took off from Timisoara for a transfer flight to Munich, with no passengers on board (call sign DLH9949).

The aircraft contacted the controller of East Low sector (EL) of Budapest ATS centre at 13:47:03 UTC while near MOPUG crossing FL248, ascending.

The EL sector was active on the Eastern part of Budapest FIR zone situated east of the Danube River, between FL100 and FL355. The sector was serviced by two controllers: a radar controller (EL EC) and a planner-controller (EL PC); the team was handling 10 aircraft in the subject period. The maximum capacity of the sector is 18 aircraft within 20 minutes, or 40 aircraft within 60 minutes. The actual workload was within the limits as follows:

12:00-13:00 – 7,

13:00-14:00 - 14,

14:00-15:00 - 13,

15:00-16:00 - 8 aircraft.

Due to the weather (thunderstorms) the above number of aircraft, however, were trying to avoid the storms therefore the actual workload was equivalent to a moderate/heavy. The occurrence took place just before the end of shift.

The EL EC radar scale was set to 110 NM.



Budapest ACC EL sector, PC/EC workstations

DLH9949 was heading to ARSIN and she was higher than usual at the sector border. At 13:49:22 she was nearing FL300 and requested further ascend to FL380. The controlled granted climb to FL320.

NLY2803 contacted EL at 13:50:37 while near PARAK at FL340. She was instructed towards BALUX but the pilots did not accept it because of the weather therefore she continued towards TORNO.

Both aircraft neared the EL sector border (the Danube River).

There were 3 active sectors in the Western part of Budapest FIR, as follows:

- West/Lower (WL) FL100–FL330,
- West/Upper (WU) FL340-FL350,
- West/Top (WT) FL360-FL660.

WL initiated an electronic coordination with EL at 13:54:50 regarding handover of DLH9949 at FL330 and NLY2803 at FL340.



EL EC screen: Electronic coordination initiated by WL EC on DLH9949/FL330



EL EC screen: Electronic coordination initiated by WL EC on NLY2803/FL340

EL EC replied with electronic approval and at 13:54:51 approved DLH9949 for FL330. The pilots acknowledged the clearance and started the climb.

EL EC advised NLY2803 at 13:55:12 (E-48 sec) via radio to switch to WL at 133.200 MHz. At the same time EL EC initiated the handover of the aircraft to WL with the TRANSFER function.



EL EC screen: EL EC initiates handover of NLY2803 to WL with TRANSFER

EL EC also advised DLH9949 at 13:55:21 (E-39 sec) via radio switch to WL at 133.200 MHz. The controller confirmed the approved altitude. ("DLH 9949, climb to FL330 and contact also 133 point 2. Tschüss!").

At the same time EL EC initiated the handover of the aircraft to WL with the TRANSFER function. $\pmb{\vee}$



EL EC screen: EL EC initiates handover of DLH9949 to WL with TRANSFER

DLH9949 asked for confirmation of the new frequency but she did not acknowledged the new approved altitude. At this point the aircraft was in climb, and her altitude of FL324 corresponded with her creared altitude.

At the time of the frequency switch (E-39 sec) the Pilot Flying of DLH9949 set FL360 on the Autopilot Control Panel. \checkmark



DLH9949 FDR data: Setting FL360 on Autopilot Control Panel

Legend: Blue continuous- Altitude (feet), Orange dotted- Set altitude (feet), Orange continuous- Vertical speed (feet per minute)

At 13:55:38 (E-22 sec) a warning appeared on the EL EC radar screen indicating that the pilot set an altitude (FL360) different from the altitude approved by ground control (FL330). \checkmark



EL EC screen: S mode set altitude difference warning

STCA and CLAM alerts appeared on EL EC and WL EC radar screens at 13:55:48 (E-12 sec) when DLH9949 overshoot her approved altitude. The computer-calculated separation between DLH9949 and NLY2803 was less than 1 NM. \checkmark



EL EC screen: STCA and CLAM alert related to relative position of DLH9949 and NLY2803



WL EC screen: STCA and CLAM alert related to relative position of DLH9949 and NLY2803

At this moment DLH9949 contacted WL EC at 13:55:48-kor (E-12 sec) and reported crossing FL355 towards FL360. The controller was occupied with the radar screen information and another radio call therefore he did not understand the call and did not respond.

The set altitude difference warning (triggered by the DLH9949 radar working in S mode) appeared on the WL EC radar screen only after the STCA alert, at 13:55:51 and just for a short time. It reappeared later at 13:56:40.

The vertical speed of DLH9949 at the moment of same flight level crossing was +3.800 feet/min.



WL EC screen: S mode set altitude difference warning for DLH9949/FL360. Vertical speed of +3.800 feet/min is also indicated

NLY2803 contacted WL at 13:55:58 (E-2 sec) At the same time the Pilot Not Flying noticed the nearby upcoming traffic on their TCAS screen.

DLH9949 crossed the altitude (FL340) of NLY2803 at 13:56:00 (E-0). ↓



WL EC screen: DLH9949 crosses altitude of NLY2803. At the time of the snapshot DLH9949's altitude was already FL342, horizontal separation 1.8-1.9 NM, decreasing

WL EC identified NLY2803 at 13:56:04 (E+4 sec).

NLY2803 asked WL EC at 13:56:10 (E+10 sec) if he knew about another traffic at 1 o' clock from her. The controller replied that he just noticed it. He also measured the distance between the two aircraft on the radar screen using the QDM function.



WL EC screen: WL EC measures the actual and calculated distance between DLH9949 and NLY2803 using QDM function

At 13:56:15 (E+15 sec) the TCAS on board of NLY2803 issued a TA advisory. The Pilot Flying disengaged the autopilot while the PNF switched the TCAS screen scale to 10 NM and accidentally saw the other aircraft, ascending, to their right.

WL EC electronically took over NLY2803 at 13:56:18 (E+18 sec).



WL EC screen: WL EC takes over the controlling of NLY2803

DLH9949 contacted WL EC at 13:56:21 (E+21 sec) reporting FL346 towards FL360. The controller identified the flight at 13:56:26 (E+26 sec) and the pilots requested further climbing.

At the same time the captain of DLH9949 járat saw another aircraft (most possibly NLY2803) approximately 600-700 feet below, on a crossing route.



WL EC screen: Position of DLH9949 and NLY2803 at the moment DLH9949 could be raised on radio again

At 13:56:27 (E+27 sec) the TCAS of NLY2803 issued an RA warning. NLY2803 continued the level flight, in accordance with the TCAS advisory. The captain was not able to report the warning to the controller because the frequency was occupied by DLH9949. The TCAS RA warning, however, appeared on the WL EC radar screen, thanks to the S mode operation. \checkmark



WL EC screen: S mode TCAS RA warning related to NLY2803

DLH9949 was already above NLY2803 and communicated on WL frequency while flying in WU-controlled airspace. Here she got into conflict with two other aircraft, one of them is DLH630 at FL350, under WU control, and the other one is TVL2230 at FL370, under WT control, both heading towards DLH9949. The latter conflict was generated due to the fact that the computer was unable to estimate the target altitude of DLH9949. The MATIAS system generated STCA alerts.



WL EC screen: STCA warning related to DLH9949, DLH630 and TVL2230

WL EC measured the expected distance between DLH630 and DLH9949 at 13:56:30 (E+30 sec) with QDM function, and at 13:56:33-kor (E+33 sec) instructed DLH9949 to level off at FL350.

WL EC electronically took over DLH9949 at 13:56:40 (E+52 sec). At this moment DLH9949 was in climb, at FL349.



WL EC screen: WL EC takes over DLH9949

At the same time (E+40 sec) the NLY2803-related STCA and CLAM alerts ceased on EL EC radar screen.

The S-mode set altitude difference warning for DLH9949 reappeared on WL EC radar screen at 13:56:43 (E+55 sec) then it disappeared after 2-3 sec.



WL EC screen: DLH9949 S mode set altitude difference warning



LH9949 set FL350 at 13:56:45 on the autopilot (when reaching this altitude) and the aircraft leveled off.

DLH9949 FDR data: Setting FL350

Legend: Blue continuous- Altitude (feet), Orange dotted- Set altitude (feet), Orange continuous- Vertical speed (feet per minute)

WU sector (above EL sector), however, notified WL EC that FL350 issued for DLH9949 would not be satisfactory because DLH630 could get close to DLH9949 while avoiding the storms. The controller asked DLH9949 at 13:57:58 about the possibility of a left turn, and later, at 13:58:07 directed her to make a left turn and a heading of 260. Meanwhile DLH9949 again requested a higher altitude and reported traffic at 1 o' clock. WL EC approved FL360 and transferred her to the top level sector control.

The S mode TCAS RA warning disappeared from the WL EC radar screen at 13:57:18.

The STCA alert for DLH9949 and DLH 630 ceased at 13:57:48.

The two aircraft involved in the serious incident - DLH9949 and NLY2803 - were flying on convergent courses and their relative distances were as follows:

Horizontal separation at the time DLH 9949 crossed the approved FL330: 2.6 NM.

horizontal separation, NM	vertical separation (DLH9949), feet
2.4	-500
2.1	-100

Horizontal separation at the time DLH 9949 crossed FL340: 1.9 NM.

horizontal separation, NM	vertical separation (DLH9949), feet
1.7	+400
1.5	+500
1.1	+600
0.9	+700
0.8	+800
0.7	+1000



The course of events (13:54:45 - 13:57:30 magnified)

1.2 Injuries to persons

None.

1.3 Damage to aircraft

None.

1.4 Other damage

None.

1.5 Information on the personnel

1.5.1 Captain of D-ACKC

Age, citizenship, gender		57, German male
	Туре	ATPL (A)
	Professional valid until	22 Aug 2012
Licence data	Medical valid until	27 Sep 2012
	Certificates	CPT CLRJ100
	Ratings	PIC, IR, CAT III
Hours flown / Number of take-offs	Total	11 268 hrs
	In the previous 30 days	93 hrs
	In the previous 14 days	20 hrs
	In the previous 24 hours	10 hrs
	On the given type in total	9 139 hrs
Role at the time of the occurrence		PNF
Resting time in the last 48 hrs prior to the occurrence		more than 24 hrs

1.5.2 First Officer of D-ACKC

Age, citizenship, gender		28, German male
Licence data	Туре	CPL (A)
	Professional valid until	26 Aug 2014
	Medical valid until	6 Dec 2012
	Certificates	CLRJ100 CO
	Ratings	-
Hours flown / Number of take-offs	Total	1.111:15 hrs
	In the previous 30 days	114:02 hrs
	In the previous 14 days	61:22 hrs
	In the previous 24 hours	10:02 hrs
	On the given type in total	1.111:15 hrs
Role at the time of the occurrence		PF
Resting time in the last 48 hrs prior to the occurrence		more than 24 hrs

1.5.3 ELEC air traffic controller

Age, citizenship, gender		55, Hungarian male
	Professional valid until	19 May 2013
Licence	Medical valid until	24 Mar 2013
	Certificates	air traffic controller
	Ratings	ACS-RAD LHCC
Workload in the	e previous week:	5 June, 10:30 - 14:00 8 June, 09:30 - 13:00
Shifts on the day of the occurrence (UTC):		11:00 -12:30 WL EC 12:30 -14:00 EL EC
Experience in the given position:		31 yrs

1.5.4 WLEC air traffic controller

Age, citizenship, gender		34, Hungarian male
Licence	Professional valid until	13 May 2013
	Medical valid until	12 Nov 2012
	Certificates	air traffic controller
	Ratings	ACS-RAD LHCC
Workload in the previous week:		6 June, daytime 7 June, nighttime
Shifts on the day of the occurrence (UTC):		06:58 - 07:37; 08:45 - 10:15; 12:30 - 14:00; 14:55 - 16:15
Experience in the given position:		9 yrs

1.6 Aircraft data

1.6.1 General

Irrelevant.

1.6.2 Airworthiness data

1.6.2.1 D-ACKC

Certificate	Number	15078
	Date of issue	9 Feb 2010
	Valid until	25 Feb 2012
	Last review date	10 Feb 2012
	Limitations	-

1.6.2.2 OE-LEU

Certificate	Number	3992
	Date of issue	14 Jan 2009
	Valid until	10 Feb 2012
	Last review date	25 Oct 2011
	Limitations	-

1.6.3 Engine data

Irrelevant.

1.6.4 Load and balance data

Irrelevant.

1.6.5 Description of the failed equipment

The TCAS system onboard D-ACKC was inoperative with "TCAS DISPLAY FAIL" warning message and the flight crew was aware of this information. (ATC, however, did not have any information on the TCAS status.)

TCAS data from the OE-LAU aircraft could not be downloaded due to memory error.

1.6.6 Onboard warning systems

Both aircraft were equipped with an S mode secondary transponder and a TCAS system. The TCAS of D-ACKC (flight DLH9949) was inoperative on the day of the occurrence.

1.7 Meteorological information

Daylight VMC, high CB clouds (extending up to FL370).

There was a jetstream in the area and to the South, between FL330-FL340, with a Western-Eastern direction, with core wind speeds reaching 110 knots.





1.8 Aids to navigation

Irrelevant.

1.9 Communication

The occurrence happened close to a sector border at the time of the frequency change. Both flights changed from 130.575 MHz (Budapest ATS Centre EL sector) to 133.200 MHz (WL sector).

The first call of DLH9949 on 133.200 MHz to WL EC was jammed by another call on 121.500 MHz.

1.10 Data on aerodrome

Irrelevant.

1.11 Data recorders



DLH9949 FDR data and transcript of radio traffic Legend: Blue continuous- Altitude (feet), Orange dotted- Set altitude (feet), Orange continuous-Vertical speed (feet per minute)

The ATC system data recorders were operating normally therefore the IC was able to use recorded data.

The CVR data downloaded from D-ACKC were irrelevant to the occurrence. The FDR data proved to be useful. TCAS data were not available.

The IC did not request data download from OE-LAU.

1.12 Wreckage and impact information

There was no wreckage.

1.13 Medical examination

There was nothing indicating that physiological factors or other factors affected the flight crew.

Medical forensics examination

There was no medical forensics examination.

1.14 Fire

There was no fire.

1.15 Survival aspects

There was no injury. Rescue was not necessary.

1.16 Test and research

Tests and researches were not initiated by the IC. The IC examined the ground-based data recording equipment. The IC requested a data download and evaluation from the CVR, FDR and TCAS systems of aircraft D-ACKC. The FDR data download was successful, and the IC evaluated the recordings.

1.17 Organisational and management information

The characteristics of the organizations concerned did not contribute to the occurrence therefore their analysis was not required.

1.18 Additional information

The IC was not informed about any relevant additional information.

1.19 Useful or effective investigation techniques

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

2. ANALYSIS

Based on available information, the crew of DLH9949 was well-rested when they started the flight.

The aircraft arrived to Hungarian airspace at a much higher altitude than usual for flights originating from Timisoara and was in dynamic climbing. A strong headwind could contribute to the intensive climb, and the pilots - having no passengers on board - probably wanted to get above the CB clouds as soon as possible.

The pilots of DLH9949 requested higher and higher altitude at each time the contacted ATC, including occasions after the time of the occurrence. The IC's attempts to reveal the reason behind the crew's drive for high altitude were unsuccessful.

DLH9949 flew with an inoperative TCAS system. It was not against the rules but the missing information otherwise available when the TCAS works could have greatly reduced the situation awareness of the pilots. Since the TCAS was 'silent' the pilots coud assume that no one was near them and everything was all right with regard to nearby traffic, while in reality they were in trouble.

It is not required to inform the ATC on an inoperative TCAS, therefore it was not mentioned either in the radio chat or on the flight plan. It should be noted that the status of TCAS system does not make any difference with regard to how ATC handles aircraft.

The workload of EL sector was moderate by the number of handled aircraft but moderate/heavy by the weather conditions (the aircraft were constantly manoeuvring around thunderclouds).

Following a coordination initiated by WL EC, EL EC granted FL330 for DLH9949, then transferred the flight to the Western sector.

Altitude FL340, however, belonged to WU above WL. The MATIAS computer system still transferred DLH9949 to the WL sector, the reason of which remained unknown to the investigators. Because WU sector was opened just prior to the occurrence, it is possible that the computer system did not have enough time to refresh the data, while the WL EC worked with the data displayed on his radar screen.

This random operation of the system later proved to be beneficial because the two conflicting aircraft belonged to the same ATC operator but in general such a system logic could be a source of misunderstanding.

EL EC understood from the radio chat that DLH9949 was motivated for further climbing therefore he repeated the approved altitude when directing the pilots to switch frequency. This altitude - FL330 - was lower that DLH9949 requested but granting a higher altitude was not possible due to nearby traffic.

The captain of DLH9949 was PNF while the First Officer flew the aircraft (PF).

DLH9949 acknowledged FL330 from FL320 and immediately started climbing.

The captain did not understand the first transmission regarding the new frequency and asked for it again. He did understand the second message from ATC but he did not repeat the new appproved altitude.

At the same time the PF set FL360 (from FL 330) on the autopilot control panel.

The IC believes that both pilots were expecting approval for the desired FL360 and when the ATC told them the new altitude, they heard what they wanted to hear instead of the real information. The situation was made even more difficult by the

stormy weather, the PF could not focus on the captain's discussion with the ATC. The captain, on the other hand, did not understand the first message regarding the frequency change, and when he received itt he second time, the ATC repeated an altitude clearance already issued, which was unusual.

The IC examined two possible scenarios on why the flight overshot the approved altitude.

In the first scenario the pilots were not sure they had the clearance for FL360 but they continued the climb nevertheless. The IC believes that this scenario is highly improbable, given the fact that the pilots were professionals. Should they have been unsure, they would probably contact the ATC and ask for clarification. The opinion of the IC is reinforced by the radio chat that does not contain any reference or hint that the pilots were not 100% sure they had the clearance for FL360.

A second scenario makes much more sense to the IC. According to this scenario, the captain was busy with setting the new radio frequency while the First Officer set the new altitude; and his action went unnoticed by the captain. When DLH9949 contacted WL the first time, the captain reported their altitude which was a reading of the autopilot altitude rather than the previously approved altitude.

Since they had no TCAS, the pilots of DLH9949 did not have information on the nearby traffic. In fact, they had NLY2803 in the immediate vicinity, and their desired altitude brought them in conflict with two more aircraft (see below). Eventually the separation minima concerning these two aircraft were not breached thanks to the actions of the ATC personnel.



The occurrence and the conflicts generated in the affected airspaces

DLH9949 crossed the altitude of NLY2803 with a high, +3.800 feet/min vertical speed that they gradually decrease as they were getting closer to the desired FL360. The vertical speed just below FL350 was around +1.000 feet/min so when the WL EC directed them to stop the climb, the aircraft was able to level off at that altitude.

The attempt to read the TCAS data of NLY2803 was unsuccessful due to a memory error, but the data sent to ground via S mode showed that the system was functioning normally. Prior to DHL9949's crossing of their altitude, NLY2803's TCAS gave a TCAS TA advisory, giving the pilots a warning on nearby traffic. The TCAS RA warning ("Monitor Vertical Speed") came when DLH9949 was already

higher than the other aircraft. The warning was triggered by the decreasing horizontal separation.

Since the TCAS is an anti-collision system and not for maintaining separation, it did not give TCAS RA earlier because the collision-related separation minima were breached at a later phase.

On the EL EC radar screen the S mode set altitude difference warning, and the subsequent STCA and CLAM alerts appeared only when the operator advised the flights on radio to contact the WL sector and at the same time initiated an electronic transfer operation. It means that at the moment of initiation the flights were still at their approved course and altitude. (The transfer process is in accordance with the approved job protocols.)

The EL EC did not notice the S mode set altitude difference warning on his screen because he considered the flight transferred and because he was busy with another traffic situation. Moreover, such short warnings are rather common in the daily routine and the operators do not pay much attention to them.

If the operator is expecting and looking for such a warning, it can be easily spotted, but since it is not an alert, it does not necessarily attract attention.

When the STCA and CLAM alerts appeared, they too went unnoticed by the operator for reasons mentioned above.



Fields of sight according to FAA Human Factors Design Guide. HungaroControl uses this guide as main reference

The IC examined how the visible alerts could go unnoticed. After transferring DLH9949 and NLY2803 to another sector, the EL EC was working with traffic on the upper third as well as on upper right quadrant of his screen. The STCA alert appeared in the lower left quadrant, approximately 20-25 degrees below his normal plane of sight.

In case the operator does move his head, the alert falls outside his normal field of sight. The IC believes that if the operator focused on the above mentioned traffic on his screen then the conflicting aircraft in the lower left corner were not visible for him.

The occurrence took place close to the end of the 3-hour normal shift. The operator worked half shift as WL EC and another half shift as EL EC, without rest. HungaroControl procedures allow a maximum of 90 minutes of work in front of a screen, and at least a 15-minute rest shall follow. The IC did not receive an explanation of the 3-hour shift without rest. (It was found that this was not the first time for the person in question that he worked a full shift with no rest.)

The IC believes that the operator who works in a management function most of the time decided not to take a break because his schedule was tight. He worked as an ATC because he needed a minimum time to keep his ATC licence. As a result, tiredness and fatigue at the end of the shift could have their effect on the operator's reflexes, data processing and decision-making abilities and speed.

Due to the above factors the EL EC operator did not notice the STCA and CLAM alerts therefore did not respond accordingly. It should be noted that by this time he could not have done much, given the short time available and the aircraft listening to another frequency.

The EL EC radar screen scale was set to 110 NM. It was in accordance with the 90-120 NM suggested by the job protocol. The actual scale should be set to provide necessary visibility of neighbouring sectors.

The IC could not determine the exact time when the EL EC noticed the conflict and the generated alerts. One possible moment could be 13:56:30 (E+42 sec) when EL EC moved the label of DLH9949 on the screen. WL EC had already taken over NLY2803 and was directing DLH9949 via radio.

When the STCA and CLAM alerts came in, the WL sector had not accepted the flights yet, either electronically or on radio. WL EC did see the conflict but assumed that it was not (yet) his responsibility and did not know that the aircraft were already on his frequency.

The STCA and CLAM alerts came in on WL EC screen when DLH9949 tried to contact him, unsuccessfully. Another aircraft called the operator at the same moment, using emergency frequency (121.5 MHz) that made the call of DLH9949 a gibberish. Due to this communication trouble and the serious conflict situation on the screen the operator did not respond to DLH9949 and contacted only NLY2803 who was the next caller.

WL EC did not suggest an avoidance manoeuvre because the events were happening too fast. When he managed to contact NLY2803 the flight level crossing had already been completed and there was no immediate danger of collision.

WL EC started to clarify the situation at 13:56:10 (E+10 sec), took over NLY2803 and measured the actual and expected distance from DLH9949.

Then DLH9949 called again and reported climb to FL360. The operator did not know about this clearance so he checked if such an altitude was possible.

In fact, DLH9949 was already in a higher sector and FL360 belonged to a third sector. Another flight, DLH630 at FL350 was approaching but he calculated that a temporary FL350 approval was possible for DLH9949.

DLH630, however, had to avoid a thunderstorm and the WU sector controlling the flight warned WL EC that FL350 for DLH9949 would result in a conflict.

Therefore WL EC directed DLH9949 to a left turn, 260 degree heading, then approved FL360.

WL EC screen indicated the S mode set altitude difference warning for DLH9949 for a short time, then disappeared. The reason was that the flight was not yet under his control therefore the 5th line of the label (containing S mode data) was visible only upon mouseover (yellow "360'). The STCA/CLAM alerts, however, drew away the operator's attention therefore he did not notice the warning.

S mode set altitude difference warning for DLH9949 came in again on WL EC screen when he took over the flight electronically. This time the 5th line of the laben did contain the S mode data. Yet the indication disappeared again because WL EC entered the FL360 requested by DLH9949 into the MATIAS system thus the approved altitude corresponded with the altitude set on the autopilot control panel of the aircraft. At this time the computer cancelled the STCA alert regarding DLH9949 and TVL2230 as well as the CLAM alert for because the parametres of actual and calculated track matched.

3. CONCLUSIONS

3.1 Established facts

The flight crew of DLH9949 as well as EL EC and WL EC air traffic controllers possessed the necessary licences, ratings, qualifications, and experience to perform the given tasks.

The aircraft D-ACKC had a valid certificate of airworthiness and was technically fit for the flight. There is no evidence that any onboard system - except the TCAS - suffered damage as a result of the lightning strike prior to the occurrence.

The flight was performed according to the filed flight plan, at daylight, in good weather and visibility conditions.

DLH9949 overshot the approved FL330 and stopped the climb only at FL350 on ATC command.

As a result, several conflicts materialized between DLH9949 and other aircraft in the vicinity. Most importantly, the flight crossed the altitude of NLY2803 flying at FL340 within less than 2 NM.

The TCAS system of NLY2803 worked normally and the pilots followed the TCAS instructions.

EL EC did not react to warnings and alerts.

WL EC did not react to the S mode set altitude difference warning.

3.2 Causes

Direct cause

The IC established that the pilots of DLH9949 did not follow the ATC instructions and overshot the approved altitude. The PNF misunderstood the clearance for FL330, and there was no proper cross-check between the pilots.

Indirect causes

- The pilots of DLH9949 were driven for a very dynamic climb and they were able to perform it because there were no passengers on board.
- The disabled TCAS and the missing TCAS information generated a false sense of security for the pilots and greatly reduced their situation awareness.
- The captain of DLH9949 (PNF) did not notice that his First Officer (PF) set an altitude on the autopilot not corresponding with the ATC's verbal clearance.
- The stormy weather made the work of pilots and the ATC personnel more difficult and partially drew away their attention.
- EL EC did not notice the warnings and alerts on the screen. It should be noted that the events happened with aircraft flying near sector borders and changing frequencies.
- The work shift of EL EC was 3 hour long with moderate/heavy workload and no resting time therefore he must have been tired by the end of shift.
- EL EC did not follow the flight until the neighbouring sector took them over.
- The labels of conflicting traffic were displayed near or beyond the edge of the operator's field of vision therefore the operator noticed the warnings and alerts with a long delay.
- The S mode set altitude difference warning was visible on the WL EC screen for a very short time only therefore the operator was not able to timely and properly react to the warning.

4. SAFETY RECOMMENDATIONS

4.1 Safety recommendations proposed in the course of the investigation

None.

4.2 Safety recommendations proposed after finishing the investigation

The IC did not reveal problems or conditions concerning the the crew or the operators of the aircraft involved that would call for a safety recommendation because similar occurrences can be prevented if the relevant rules and regulations are observed.

Upon finishing the investigation the IC proposes to issue the following safety recommendations:

BA2012-159-4P-1: It was found that the STCA alert was displayed near or beyond the edge of the EL EC operator's field of vision resulting in a long reaction time.

Transportation Safety Bureau proposes HungaroControl to make use of another supplemental indication in addition to STCA alert that immediately draws the attention of the operator regardless of what part of the screen the operator is focusing on.

The approval and implementation of the recommendation would ensure that the ATC operators get timely notification on STCA warnings and alerts displayed on their screen outside their field of vision.

BA2012-159-4P-2: It was found that the S mode set altitude difference warning was not clearly noticeable for the operator resulting in a long reaction time.

Transportation Safety Bureau proposes HungaroControl to introduce a change in the displaying mode of S mode set altitude difference warning. In the proposed mode the named warning would switch to a higher level of alert if the altitude difference stays active for at least two consecutive signal refresh period.

The approval and implementation of the recommendation would ensure that ATC operators are notified faster and with higher reliability on the fact that a flight crew set an altitude different from the value cleared by ATC.

BA2012-159-4P-3: It was found that the serious incident happened near the end of 3-hour shift of EL EC. The long shift without break and the resulting tiredness of the operator could contribute to the occurrence, in fact, the operator did not notice the STCA alert.

Transportation Safety Bureau proposes HungaroControl to make it obligatory to its operators to have at least 15 minutes of rest after a 90-minute work in front of the screen.

The approval and implementation of the recommendation would reduce the possibility of work quality degradation due to fatigue and tiredness.

Budapest, 8 April 2013.

	László GRÉZ	
György HÁY IC member	IIC	László PÁL IC member

Appendices

Appendix 1 - Airborne Collision Avoidance System II (ACAS II), short description - not translated, original omitted

Appendix 2 - Short Term Conflict Alert system, short description - not translated, original omitted

NOTE:

The present document is the translation of the Hungarian version of the Final Report.

Although efforts have been made to translate it as accurately as possible, discrepancies may occur.

In this case, the Hungarian is the authentic, official version.