

# SHORTCUTS TO EFFICIENCY

*to fix your  
ATM challenges*

# COMMITTED TO BREAKTHROUGH INNOVATIONS

” Hungary, although a small country with respect to its population, is, however, a major one with respect to the recognition it has earned in the scientific community and the performance of its scientists; over the course of the 20th century no less than twelve Nobel Laureates (Albert von Szent-Györgyi in medicine, Dennis Gabor aka Gábor Dénes in physics and George A. Olah in chemistry, for example) trace their roots back to Hungary.

(Source: Fact Sheets on Hungary No. 5/2000, by the Ministry of Foreign Affairs)







## Most prominent results of HungaroControl 2013-2016

Continuous innovation activities have positioned HungaroControl at the forefront of European initiatives to improve flight safety, increase capacity, reduce airline costs, and enhance environmental protection. To this end, the Hungarian ANSP focuses primarily on developments that improve the efficiency of air traffic management, as well as the introduction of up-to-date technologies, both in partnership with other ANSPs, universities and technology providers (including its participation in the SESAR research and development programme) as well as on its own.

- ▶ Innauguration of HungaroControl's **state-of-the-art air navigation centre** in February 2013.
- ▶ **Re-opening of the upper airspace over Kosovo (KFOR sector) in April 2014.** The project demonstrates HungaroControl's capability of multiple cross-border operations.
- ▶ Introduction of **Hungarian Free Route Airspace (HUFRA)** In February 2015.
- ▶ Introduction of CPDLC (**Controller-Pilot Data-Link Communication**) in November 2015, 3 years ahead of the EU deadline.
- ▶ Participation in the industrial research, validation and demonstration activities of SESAR 2020, as a member of the **Frequentis SESAR partners consortium** (consisting of Atos, HungaroControl and Frequentis) since **July 2016**.
- ▶ **Live trial** of HungaroControl's **unique Remote Tower** concept at Budapest airport **without any restrictions** in **November 2016**. This was the first Remote Tower of its size and complexity, managing close to 600 movements.

THESE INNOVATIONS AND  
**CAPABILITIES** ARE DESCRIBED IN  
DETAIL ON THE FOLLOWING PAGES.



# FREE ROUTE AIRSPACE: SEAMLESS OPERATIONS

to maximise benefits for airspace users

In February 2015, HungaroControl became the **first in Europe to abolish the entire fixed flight route network** in its airspace, enabling aircraft to route freely through the airspace, without any restrictions.

The significance of this new traffic management concept is that aircraft can opt for the shortest possible flight path between the entry and exit points in Hungary's airspace. It is estimated that the Hungarian Free Route Airspace (HUFRA) solution could **generate annual savings of 1.5 million kilometres** in the distance flown by aircraft over Hungary. As a result, airlines are expected to **save nearly \$3 million worth of fuel** per year, which in turn could **cut CO<sub>2</sub> emissions by more than 16 million kilogrammes**.

Since HUFRA's introduction, HungaroControl's **safety performance has been maintained despite a 13 per cent traffic growth** in 2015. In addition, many airlines that previously circumnavigated Hungarian airspace due to the lack of appropriate routes are now routing over Hungary to take advantage of the benefits of HUFRA.

” cut CO<sub>2</sub> emissions by more than 16 million kilogrammes



# COMMITTED TO EXPAND FURTHER FREE ROUTE AIRSPACE IN EUROPE

In order to maximise benefits for airspace users, HungaroControl is continuing to work with other ANSPs and Functional Airspace Blocks (FABs) in a bid to remove restrictions to free airspace use even before the EU deadline of January 2022

Examples of these efforts include

- ▶ the **Night Free Route Airspace Budapest/Bucharest (N-FRAB)** between Hungary and Romania, introduced in August 2015;
- ▶ the introduction of **47 plannable direct routes on the northwest-southeast axis between the United Kingdom and Hungary** as of December 2015;
- ▶ and **technological preparations to create Free Route Airspace between the Black Forest and the Black Sea** (i.e. Germany and Romania), to be completed in 2017.

**Building on its own experience, HungaroControl is ready to co-operate with other ANSPs in order to help them meet the challenges posed by growing air traffic in Europe, with the goals of the Single European Sky in mind.**

**TAILORED TO YOUR NEEDS**

Thanks to its simulation and training facilities as well as its **ATS operations planning experts and ATM system designers**, HungaroControl's Knowledge Centre can offer **customised solutions to your ATM challenges**.

**To ensure safe and successful implementation** of seamless operation concepts, **preliminary validation is crucial**. The thorough validation process starts with defining the problem to which the best answer can be found **exploiting the advantages of fast-time and real-time simulations** displayed on **HMIs that are identical to the client's ATM system**.

In the end, conclusions in the final report are drawn from analysed data to support implementation. Moreover, the simulation environment can be utilised later on for ATCO trainings or fine-tuning the solution based on to real-life experience.

# REMOTE TOWER: A NEW APPROACH FOR MID-SIZE AIRPORTS

building future ATM infrastructure

TAILOR-MADE  
AUGMENTED  
REALITY

HungaroControl is making intensive efforts towards implementing remote control for airports with medium traffic.

By 2018, HungaroControl aims to operate a **full-time remote tower in Budapest**. Although Budapest Airport will not be the world's first remotely controlled airport, it will be the **first of its size and complexity**, with nearly 100,000 movements per year.

The rTWR concept at Budapest airport is built on **the bidirectional integration of the existing ground surveillance system and an appropriately positioned camera network**, aiming to enhance air traffic controllers' situational awareness and flight safety. The main contributors of the BUD rTWR project are **INDRA NAVIA** and **SeaRidge Technologies**.

The **sophisticated ground surveillance system** called **A-SMGCS** (Advanced Surface Movement Guidance and Control System) makes Budapest TWR capable to handle aircraft up to 70% of the maximum capacity without any visual references (typically during bad weather conditions).

**Distributed fixed cameras and pan-tilt-zoom (PTZ) cameras deployed around the manoeuvring area** are equipped with thermo sensors, can be controlled independently and will cover the whole manoeuvring area so the supervisor can easily adjust the visual by presets for various traffic situations and weather conditions.

The captured video stream is placed on a large video wall providing **common and role-specific visual information** for ATCOs. **The live picture can be labelled with graphical symbols and flight data for additional information** to help manage situations such as runway occupation, flight direction, etc. Furthermore, ATCOs can adjust the picture according to their preferences by using filters like geographical borders, saturation or contrast.

A-SMGCS can assign video images to any of the tracks as a video thumbnail. ATCOs can click on this thumbnail and the integrated **system moves the assigned camera to this track quickly and display the live capture**. Thus, ATCOs can determine what the object really is: an aircraft, an animal, a truck or a human, etc.



# SUCCESSFUL DEMONSTRATION

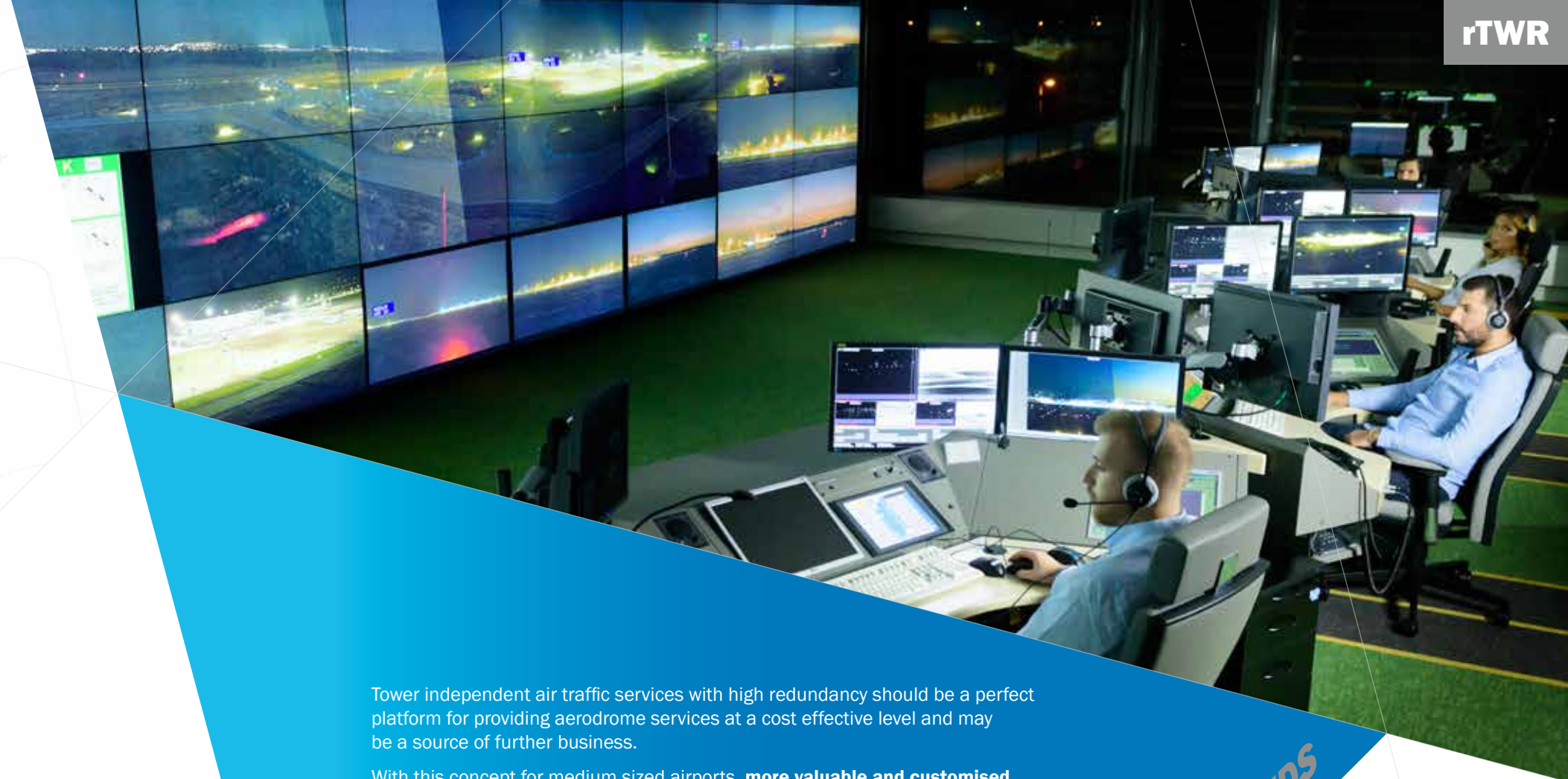
At the end of 2016 HungaroControl successfully **completed live trials** of its integrated Remote Tower at Budapest Airport, managing close to **600 movements without any limitation** or constraints. All responsibilities were delegated to a fully seated shift including 4 ATCOs and a supervisor (total of 13 ATCOs).

**The demonstration** of Budapest 2.0. SESAR LSD project **proved that this kind of technology is suitable for both contingency purposes and live traffic control**, and supports the finalization of implementation of remote tower for Budapest.

## BEYOND THE BORDERS

This concept has made inroads into the international market: **the emergency control centre at Dubai International Airport (DXB) could be implemented according to the suggestion of a consortium of five companies, including HungaroControl.** The main goal of the project is to provide a sustainable and safe contingency tower solution at 100% capacity level for Dubai Air Navigation Services (DANS) at Dubai International by relocating their aerodrome services to a remote location when needed.

”HungaroControl is currently implementing its remote tower technology at Budapest International Airport



Tower independent air traffic services with high redundancy should be a perfect platform for providing aerodrome services at a cost effective level and may be a source of further business.

With this concept for medium sized airports, **more valuable and customised visual information can be gained** from available data to enhance ATCOs' situational awareness and the level of safety.

Remote tower technology is a **cost effective business development platform for regional and seasonal airports as well.** HungaroControl is now active in demonstrating the capabilities of such systems for the entire European ATM community, under the umbrella of a SESAR LSD project called Budapest 2.0.

**TAILORED TO YOUR NEEDS**



# CONTROLLER-PILOT DATA-LINK COMMUNICATION

meet the increasing demands  
on ATCO-pilot communication

In many ATC sectors in Europe the congestion on voice communication channels has become a bit of a bottleneck, limiting available airspace capacity. As traffic forecasts indicate further significant increase, ANSPs have to prepare for using an alternative independent communication channel which is able to relieve the overloaded radio frequencies.

HungaroControl has always been committed to technological innovations, doing its best to provide efficient tools to its air traffic controllers or its clients as fast as possible, regardless of any deadlines for their introduction. As one of its major technology development projects, the company **introduced CPDLC in November 2015, three years ahead of the EU deadline.**

AT THE FOREFRONT  
OF ATM DEVELOPMENT





# CRYSTAL CLEAR MESSAGING

- ▶ The new feature provides an additional communication channel between pilots and controllers to send non-time critical short text messages. As these messages are in written form, the number of misunderstandings can be reduced, further improving flight safety. CPDLC instructions are accessible directly from the track labels. Misunderstandings due to radio interference and fatigue-related mistakes can be ruled out.
- ▶ ATCOs and pilots are free to decide to use it.
- ▶ Routine tasks are accelerated.
- ▶ Radio frequencies are available for more important messages.

The new software was jointly developed by THALES and HungaroControl as an integral part of the company's cutting edge air traffic control system (MATIAS).

According to HungaroControl's experience, some airlines are reluctant to use CPDLC, but there are positive feedbacks from the pilots of Turkish Airlines, Emirates and Qatar Airways.

**The total budget of the large-scale implementation project was EUR 6.8 million of which 20% was co-financed by the European Union through the Trans-European Transport Network (TEN-T).**



Co-financed by the European Union  
Trans-European Transport Network (TEN-T)

**To ensure the safe and successful implementation of a new technology in ATC, preliminary validation is crucial.** The whole CPDLC implementation process in Hungary was supported by HungaroControl's R&D and Simulation Centre (CRDS) concerning HMI design, validation concept and execution as well as the subsequent training of controllers. **Give your controllers sufficient time to hone their CPDLC skills before using it in real-life situations.**

The thorough validation process starts with defining the problem to which the best answer can be found **exploiting the advantages of fast-time, then real-time simulations using HMIs that are identical to the client's ATM system.**

In the end, the conclusions in the final report are drawn from analysed data in order to support implementation. Moreover, the simulation environment can be utilised later on for ATCO trainings or fine-tuning the solution based on real-life experience.

Continue reading for more information on HungaroControl's validation based solutions...

## TAILORED TO YOUR NEEDS

# MERGESTRIP: SIMPLE, YET INGENIOUS MERGING

A unique ATM tool  
to enable CDO

In order to facilitate continuous descent approaches, to enhance TMA efficiency and to protect the environment, HungaroControl developed MergeStrip, an ATM tool building on EUROCONTROL's Point Merge system.

**MergeStrip stands for both HungaroControl's new traffic planning concept and the support tool as well.** As a unique CDO enabling tool it **allocates approaching aircraft to a "strip"** by considering their actual position and speed. Based upon the calculations performed by the program, **controllers can easily** and quickly **identify the preliminary interventions required** to carry out sequencing continuously and in the right schedule.

**MergeStrip brings a brand new way of representation of the current traffic situation, both horizontally and vertically with the only requirement of 3 waypoints in the TMA.**



As it is difficult to judge for both pilots and ATCOs whether an aircraft is on the right glide path, the last phase of the sequencing can easily result in **unpredictable and expensive level flight in low altitudes**.

In order to improve ATM performance and to lessen negative side effects:

MergeStrip supports **pilots**

- to **plan freely** their arrival routes from a long distance i.e. **from the edge of TMA radar coverage**
- to **conduct continuous descent** approaches ideally **from the top** of descent

MergeStrip assists **controllers**

- to **plan easily** with the shortest possible route, and issue **shortcuts as soon as possible**
- to abandon special arrival procedures

MergeStrip benefits **both the aviation industry and society**

- making aviation more efficient
- reducing fuel burn and CO<sub>2</sub> emissions
- mitigating noise load on the population near airports

WIN-WIN STRATEGY



# PROVEN BENEFITS

Since its introduction, MergeStrip has earned credit from airlines and significant interest from other ANSPs in and outside Europe.

”

Reduced fuel consumption is noticeable since April this year. Congratulations! Thank you.

Robert Sklorz, Captain and Fuel Efficiency Project Manager, Wizz Air, November 2013

# TAILORED TO YOUR NEEDS

Thanks to its simulation and training facilities as well as its ATS operations planning experts and ATM system designers, HungaroControl's Knowledge Centre can offer customised solutions to your ATM challenges.

To ensure safe and successful implementation of seamless operation concepts, **preliminary validation is crucial**. The thorough validation process starts with defining the problem to which the best answer can be found **exploiting the advantages of fast-time and real-time simulations** displayed on **HMIs that are identical to the client's ATM system**.

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# KEEPING CHANGES UNDER CONTROL

Centre of Research, Development and Simulation



## Safety & Validation

The aviation industry is facing the inevitable requirements to reduce fuel consumption, emissions and noise load while enhancing performance. In order to improve operational and cost efficiency while keeping up with the continuous growth in air traffic, air navigation service providers (ANSPs) often need to apply modified or completely new procedures in their operations. After all, **changes of any kind are likely to involve risks, while safety must remain the No. 1 priority** for all service providers.

To resolve these seemingly conflicting objectives and not to lose sight of unintended consequences, **CRDS** (Centre of Research, Development and Simulation) **supports ATM changes by optimising decision making** for ANSPs and civil aviation authorities (CAAs) with the help of preliminary modelling.

**Fast-Time and Real-Time Simulations are available** to validate procedure designs and ATM system changes prior to their implementation.



CRDS operates Central Europe's largest ATC simulator facility based on the ESCAPE platform developed by EUROCONTROL. Thanks to the capacity upgrade in February 2016, the centre is capable to conduct large-scale simulations up to **34 controller** working positions and **26 pilot** working positions. The place where the comfort of 90% human-machine interface (HMI) similarity makes air traffic control officers' work easier and more pleasant.

*Feels like home*

*Human-in-the-loop*

However, not being content merely with providing an environment both for machine-made and human-in-the-loop simulations, HungaroControl has decided to add European Operational Concept Validation Methodology (E-OCVM) based Human Factor analysis expertise. On the one hand, **the source of scientific analysis is the large quantity of objective data extracted from the system during the simulation.**

On the other hand, collecting subjective feedback through generic and simulation-specific questionnaires also plays a key role. This way, ATM experts and decision makers will be able to foresee potential changes in human performance and **to prevent safety issues related to workload and situational awareness.**

related –  
but not limited to –  
the followings:

#### 1 PROTOTYPING AND DEVELOPMENT ACTIVITIES

- ▶ ATM system development
- ▶ ATM functions prototyping
- ▶ Human-Machine Interface prototyping
- ▶ CPDLC prototyping (e.g. track symbol, label content, working methods, etc.)

#### 2 VALIDATION OF NEW AND INNOVATIVE TECHNOLOGIES AND TECHNOLOGICAL SOLUTIONS

- ▶ CPDLC validation
- ▶ ATM system validation

#### 3 VALIDATION OF NEW OPERATIONAL CONCEPTS

- ▶ New airspace validation
  - Reopening a closed airspace (e.g. Kosovo Upper Airspace)

#### ▶ Airspace and sector development

- Free Route Airspace validation
- Route network development
- New Sectorization
- New Division Level
- New Constraints / XFLs
- New FLAS (Flight Level Allocation Scheme)

#### ▶ Validation of PBN (Performance-Based Navigation)

- CCO & CDO (continuous climb & descent operations)
- New Standard Instrument Departure Route validation
- Arrival transition validation from Standard Arrival Routes;
- Validation of PBN designed holding areas and associated missed approaches

## KEY CRDS CAPABILITIES

#### 4 VALIDATION OF NEW SUPPORTING TOOLS AND DEVICES

- ▶ MergeStrip validation (HungaroControl's Arrival Manager Tool)
- ▶ Validation of Arrival and Departure Management Systems (AMAN / DMAN)
- ▶ Motion controlled ATCO workstation

#### 5 HUMAN FACTORS ASSESSMENT CAPABILITIES

- ▶ ATCO workload measurement
  - Objective measurements (e.g. MEMS, eye-tracking & motion sensor devices)
  - Subjective measurements (ISA-Instantaneous self-assessment; Bedford Workload Scale; NASA-TLX; Simulation Specific Questionnaire)
- ▶ ATCO situational awareness measurement
  - Objective measurement (Eye-tracking device)
  - Subjective measurement (SASHA-Q; Simulation Specific Questionnaire)

#### 6 MODELLING, SIMULATING AND ANALYSING UNUSUAL, EMERGENCY AND EXTREME SITUATIONS

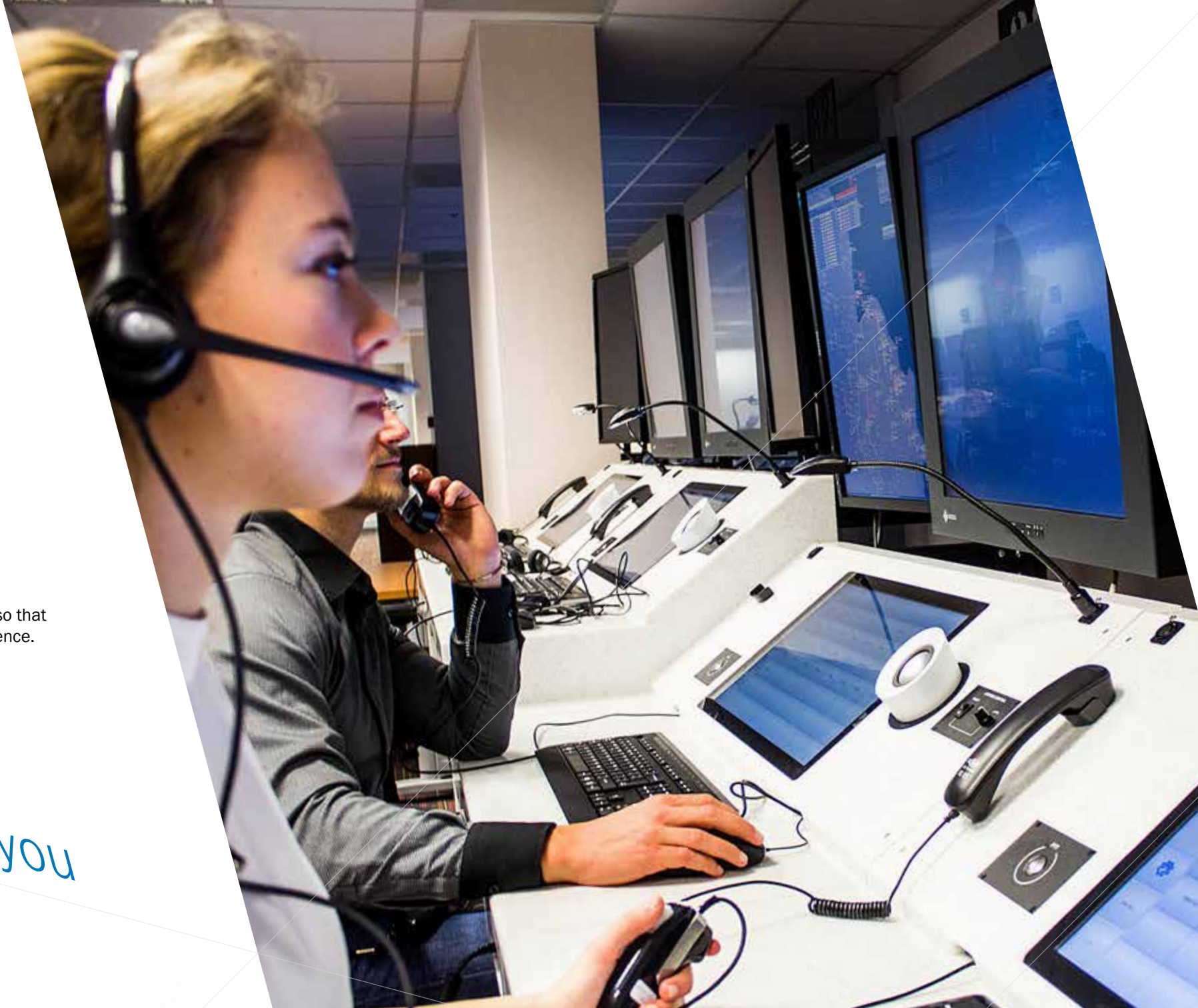
- ▶ Emergency simulations
  - Radio failure
  - Fire in the cockpit
  - Bomb on board
  - Hijack, etc.
- ▶ Extreme situations
  - Volcanic ash
  - Airspace closure

#### 7 INTEGRATING REMOTELY PILOTED AIR VEHICLES IN THE CIVIL AIRSPACE

- ▶ Analysis of UTM
- ▶ Area Proximity Warning Systems
- ▶ Penetration Proximity Warning







#### DEFINITION AND PREPARATION

The validation procedure starts with a thorough preparation phase by measuring the traffic demand and assessing the future plans. As a result, the designed scenarios can be as close to the theoretical optimum as possible.

#### EXECUTION

According to the result of the mapping phase, more proposals can be tested in minimum time frame and requirements with Fast-Time Simulation. Thus, only the most promising scenarios should be validated in a realistic environment with Real-Time Simulation. In order to create customised statistics to help find the best way of implementation, all relevant data are recorded during the simulations.

#### ANALYSIS AND REPORTING

Analysing all the recorded data (both objective and subjective), conclusions are drawn in the final report which results in a safe and smooth solution to the customer's ATM issue.

#### FUTURE OPPORTUNITIES

After the project is completed, CRDS keeps the airspace environment, data and custom HMIs, so that the simulation setting can be utilised later on to fine-tune the solution based on real-life experience.

*Thinking outside the box*

Validation is only one item in the CRDS toolbox that supports ATM development. Strengthening its R&D capabilities, the centre co-operates with both industrial and academic partners to develop **knowledge-based products and services in order to fix current ATM challenges** and to prepare for future ones.

For more information on CRDS's validation based solutions, visit [www.crds.hu](http://www.crds.hu)

How we work with you



# EPC: ENTRY POINT CENTRAL

## Scandinavian ATC training philosophy and methodology

EPC (Entry Point Central) is the joint, Budapest-based air traffic controller (ATCO) training academy of HungaroControl and Entry Point North (EPN), the world's leading ATCO training centre of the Swedish, Danish, Norwegian and Irish ANSPs, opened in 2011.

In EPC, well-prepared Hungarian instructors provide initial training of ATCOs using state-of-the-art Scandinavian training methodology – thus securing that the next generations of Hungarian ATCOs acquire competitive knowledge and an internationally prestigious qualification.





# SAFETY AND QUALITY

Entry Point North's premium training and services comply with the most stringent international requirements. At EPC, ab initio **students start practical training as early as during the fifth week of the course**, using EPC's simulator. They can also participate in familiarisation flights, where they can observe what is happening in the cockpit – thanks to Wizz Air. The training provided by EPC fully complies with the standards of EUROCONTROL, thus the academy is open to serving the ATCO training needs of other ANSPs as well.

## Tailor-made services to meet individual clients' needs

The Entry Point North Group provides competitive ATS training and services to meet customer needs in the global market. The air navigation academy of Budapest opened its gates to other countries in 2013. Besides basic ATCO training, EPC also provides development trainings such as **OJTI** (on the job instructor training), **OJTI refresher** (refreshing training for instructors) and the **Assessor training** (training for operational competency assessors).

EPC's services include **aviation and general English language training** provided for HungaroControl as well as performing English language examinations for pilots and air traffic controllers.

# CAPACITY AND EQUIPMENT

350 m<sup>2</sup>

of training facilities:  
classrooms, simulator  
rooms and a conference  
room fitted with the latest  
AV equipment

34

simulator  
positions

2x180°  
TWR 3D

## References

# SUCCESS STORIES OF HUNGAROCONTROL'S R&D ACTIVITIES

- ▶ **“SOUTH-EAST AXIS FREE ROUTE AIRSPACE-SEAFRA**  
CRDS performed real-time simulation in March 2016 to support the improvement of implementation of the Cross-border FRA Concept in AoR Beograd ATCC, Zagreb ATCC and Sarajevo ACC and study its impact on airspace sector configuration and ATCO performance.

**14** measured sectors (SMATSA, CCL)  
**1** unmeasured sector (BHANSA)”

- ▶ **“VALIDATION OF CONOPS (CONCEPT OF OPERATIONS) WITHIN THE FAB CE P1 FRA STUDY PROJECT, FAB CE AVIATION SERVICES LIMITED**  
CRDS applied fast-time and real-time simulation to investigate the changes (new hotspots, re-

entry traffic) brought by the x-Border FAB CE FRA at the end of 2016. Moreover, through real-time simulation different procedures were tested for conflict resolution close to the FIR boundary. In addition, the potential impact of active TRAs/TSAs on ATCO's performance was also investigated.

**16** measured sectors (Austro Control, ANS CR, BHANSA, Croatia Control, HungaroControl, LPS SR, Slovenia Control)”

## ▶ CPDLC INTRODUCTION THREE YEARS AHEAD OF THE EU DEADLINE

HungaroControl introduced Controller Pilot Data Link Communication (CPDLC) in November 2015. CRDS was instrumental in the preparations prior to the introduction of CPDLC, including HMI design, concept validation and the subsequent training of controllers.

- ▶ **CONTINGENCY REMOTE TOWER, DUBAI – CONTRIBUTING TO THE CONCEPT OF OPERATIONS FOR DUBAI AIR NAVIGATION SERVICES (DANS)**

A sustainable and safe contingency tower solution at 100% capacity level at Dubai International Airport could be implemented according to the suggestions of a consortium of five companies, including HungaroControl.

- ▶ **HUNGARIAN FREE ROUTE AIRSPACE (HUFRA)**  
In February 2015 HungaroControl was the first in Europe to abolish the entire fixed flight route network, thus enabling airplanes to use the airspace freely, without any restrictions. Prior to the implementation, the concept was validated at CRDS.

- ▶ **RE-OPENING THE UPPER AIRSPACE OVER KOSOVO AFTER 15 YEARS IN 2014 (KFOR SECTOR) – CONTRIBUTING TO THE NORMALISATION OF AVIATION IN SOUTH-EAST EUROPE.**

Based on EUROCONTROL data, the re-opening enables shorter routes and consequently a reduction of ca. 24,000 tonnes in annual fuel consumption, saving airlines nearly 18 million euros per year. CRDS performed real-time simulation in

December 2013 to prepare for the temporary NATO assignment.

**11** measured sectors (SMATSA, M-NAV)

- ▶ **DANUBE FAB CPDLC – OPERATIONAL CONCEPT VALIDATION**  
CRDS ran a real-time simulation for BULATSA and ROMATSA in November 2014 to investigate how data-link functionality can be implemented into HMIs and to foresee how the additional tool will affect flight safety, sector capacity and ATCO performance.

**6** measured sectors with multiple HMIs in one exercise (2 Bulgarian, 4 Romanian)

- ▶ **RNP REVERSION PROCEDURES IN CASE OF LOSS OF GPS SIGNAL – PERFORMANCE BASED NAVIGATION WITH 2020+ ENVIRONMENT**  
CRDS performed a real-time simulation for EUROCONTROL in June 2014 to analyse the effects of a potential GPS signal loss and the impacts on ATCO workload.

**4** measured sectors / 2 en-route, 2 terminal



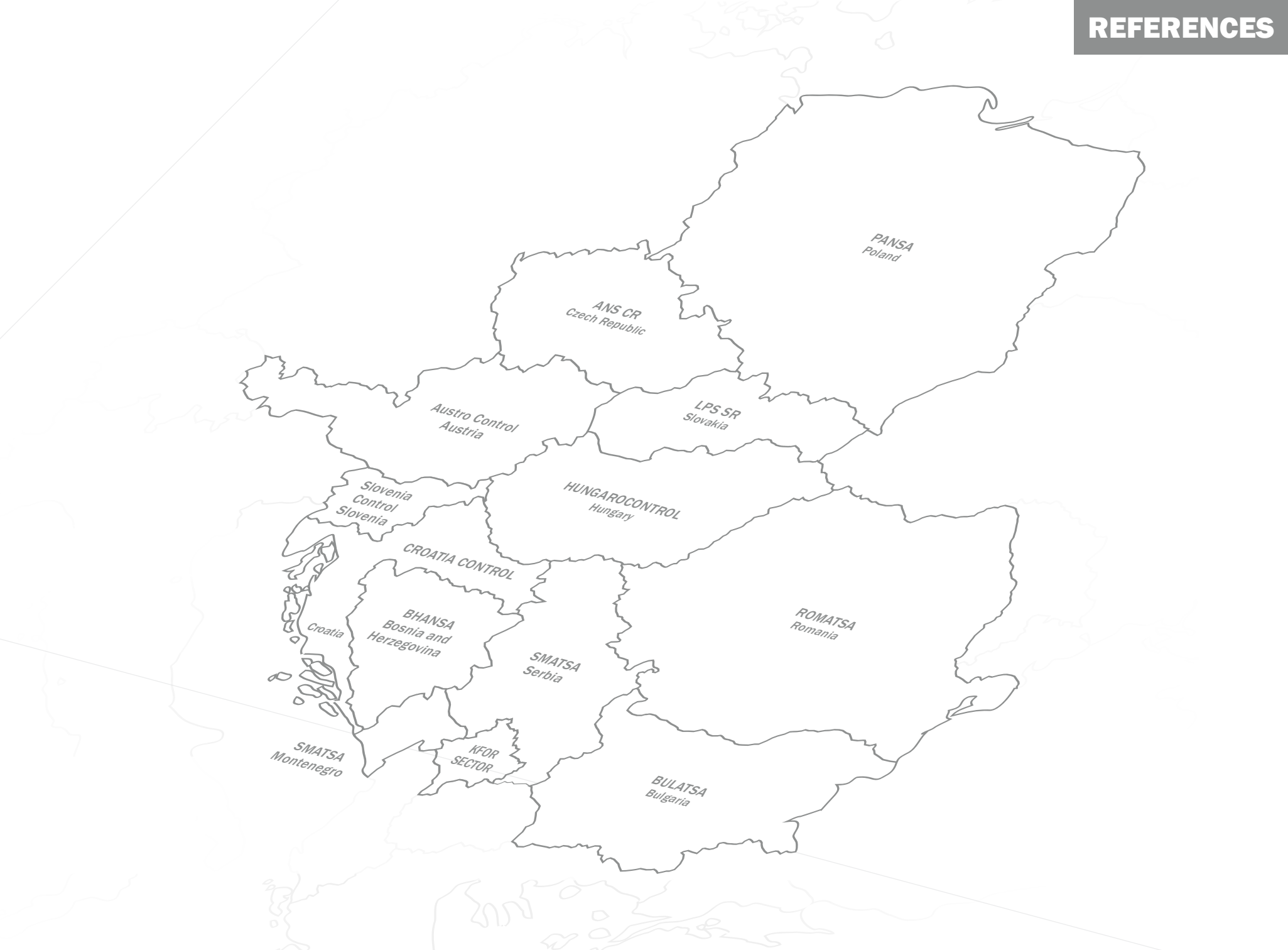


► **CROCONTROL GEO 4  
– AIRSPACE RESTRUCTURING**  
CRDS performed a real-time simulation for Croatia Control in March 2012 to validate new sector configuration.

**12** measured sectors  
/ 10 en-route, 2 terminal  
**7** feeder sectors

► **CEAP FRA – CENTRAL AND EASTERN EUROPEAN  
AIR NAVIGATION SERVICE PROVIDERS' PLATFORM  
FREE ROUTE SIMULATION**  
CRDS hosted a cross-border real-time simulation with PANSA, LPS SR and HungaroControl in May 2013 with multiple HMIs in one exercise to design, model and validate Polish, Slovakian and Hungarian airspace to be seamless.

**6** measured sectors



## CONTACT

Sales and Marketing Department  
HungaroControl Hungarian Air Navigation Services

Address: H-1185 Budapest, Igló utca 33-35.  
Postal address: H-1675 Budapest, PO Box 80

[en.hungarocontrol.hu](http://en.hungarocontrol.hu)

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**CPDLC**

**FREE ROUTE AIRSPACE**

**REMOTE TOWER**

**COMMITTED TO  
BREAKTHROUGH  
INNOVATIONS**

**KFOR SECTOR  
X BORDER REMOTE  
CONTROL**

**MERGE STRIP**