SUPPORTING EUROPEAN AVIATION

Free Route Airspace (FRA)

“Giving users the freedom to plan a route in specified airspace”

Part 1 - FRA in Europe

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17 - 18 NOV 2026

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NETWORK MANAGER

Presentation Purpose

Implementation of FRA in Europe

- FRA in ICAO.
- European FRA general and ATC system requirements (2014 - 2025).
- FRA in Europe - Concept, Implementation, Lessons Learnt, Design, Visualisation, Flight Efficiency.

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FRA in ICAO

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Global Air Navigation Plan - ASBU

Improved operations through enhanced en-route trajectories

Aviation System Block Upgrade (ASBU) Operational Threads:

- FRTO (Free-route operations):

  2019+

  - FRTO-B1/1 - **Free Route Airspace (FRA)**.
  - FRTO-B1/2 - Required Navigation Performance (RNP) routes.
  - FRTO-B1/3 - Advanced Flexible Use of Airspace (FUA) and management of real time airspace data.
  - FRTO-B1/4 - Dynamic sectorization.

  2025+

  - FRTO-B2/1 - Local components of integrated ATFM and ATC Planning function (INAP).
  - FRTO-B2/2 - Local components of Dynamic Airspace Configurations (DAC).
  - FRTO-B2/3 - Large Scale Cross-Border Free Route Airspace (FRA).

- TBO (Trajectory-based operations):

  2031 onward

  - TBO-B3/1 Network based on-demand synchronization of **trajectory-based operations**.



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ICAO 14th Air Navigation Conference (26 AUG - 6 SEP 2024)

Report on the Committee on Agenda Item 3

Air navigation system performance improvement

Recommendation 3.1/4 - Free route airspace

That **States**:

a) **actively collaborate** with neighbouring States to implement free route airspace;

that **ICAO**:

b) **develop provisions** and **guidance material** to support harmonised implementation of free route airspace, including implementation across airspace boundaries and regions.

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European FRA Requirements

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2014 - 2021

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Free Route
Deployment

- Free Route may be deployed both through the use of Direct Routing Airspace and through FRA.

- Direct Routing Airspace is the airspace defined laterally and vertically with a set of entry/exit conditions where published direct routings are available. Within this airspace, flights remain subject to air traffic control.

- Initial implementation of Free Route may be done on a structurally limited basis, for example by restricting the available entry/exit points for certain traffic flows, through the publication of DCTs, which will allow airspace users to flight plan on the basis of those published DCTs. DCT availability may be subject to traffic demand and/or time constraints. The implementation of FRA based on DCTs may allow the removal of the ATS route network. Procedures for transitioning between free route and fixed route operations shall be set. To facilitate early implementation before the target deployment date, free route could be implemented in a limited way during defined periods.

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Free Route
System Functionality

- ATC systems shall implement the following:
  - Flight data processing system, including HMI, to manage trajectory/flight planning without reference to the fixed ATS network.
  - Flight planning systems to support FRA and cross-border operations.
  - ASM/ATFCM to manage FRA.
  - For FRA, Medium Term Conflict Detection (MTCD) including Conflict Detection Tools (CDT), Conflict Resolution Assistant (CORA), Conformance Monitoring, and APW for dynamic airspace volumes/sectors; Trajectory prediction and de-confliction shall support an automated MTCD tool adapted to operate in FRA airspace and, when required, on DCT.
- ATC systems may receive and utilise updated flight data coming from an aircraft (ADS-C EPP) where data link functionality is available.
- Airspace users' systems shall implement flight planning systems to manage dynamic sector configuration and FRA.
- Flight Data Processing System (FDPS) shall support FRA, DCT and A-FUA.
- The controller working position shall support the operating environments, as appropriate.

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Free Route
Geographical Scope

- Free Route shall be provided and operated in the airspace for which the EU Member States are responsible at and above flight level 310 in the ICAO EUR region.

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Free Route
Deployment Targets

- **DCT** as from 1 January 2018.
- **FRA** as from 1 January 2022.

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2022 - 2025

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Free Route Airspace
Deployment

- To facilitate implementation before its target date, initial FRA may be implemented in a limited way during defined periods or on a structurally limited basis. Initial FRA implementation in portions of airspace reduced vertically or laterally, or both, is considered only as an intermediate step to achieve the full and consistent implementation of FRA.

- FRA connectivity with TMAs must be ensured by one of the following options:
  - Lowering FRA vertical limit to the TMAs upper vertical boundaries.
  - Linking appropriate arrival/departures points.
  - Defining FRA connecting routes.
  - Extending the existing standard arrival and departure routes.
  - Connecting with the underlying fixed ATS routes via set of waypoints reflecting the typical climbing/descending profiles.

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Free Route Airspace
System Functionality

- ATC systems must support FRA, ASM and A-FUA implementations. The concerned operational stakeholders must choose the appropriate tool/function to achieve this objective based on their operational environment.
- Supporting functions/tools may include any of the following:
  - Support to the operating environments to manage and display trajectories in FRA environment on the controller working position and the human-machine interface (HMI);
  - Flight data processing system (FDPS) supporting national, cross-border FRA operations and FRA connectivity with TMAs;
  - ATC/ASM/ATFCM interoperability;
  - Dynamic change of a volume of airspace from a fixed route network to FRA;
  - Conflict alert, detection and resolution tools, such as conflict detection tools (CDT) including medium-term conflict detection (MTCD) and/or tactical controller tool (TCT), conformance monitoring (MONA), and area proximity warning (APW) for dynamic airspace volumes/sectors;
  - Trajectory prediction supported by an automated conflict detection tool adapted to operate in FRA;
  - For cross-border FRA, the ATC systems supporting the exchange of flight intent data, such as through OLDI message.
- Airspace users' systems must support flight planning to ensure the safe and efficient utilisation of ASM, A-FUA and FRA including the partial implementation and intermediate steps deployed before the target date.
- Data exchange between stakeholders mandated to deploy the flexible airspace management and FRA must be implemented using available SWIM services. The concerned systems must be able to provide or use SWIM services. Existing data exchange technology may be used until SWIM is available.

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Free Route Airspace

Geographical Scope

- The final objective is the deployment of final FRA in the entire airspace under the responsibility of the EU Member States involved at least above FL305, with no time limit and no reduction on capacity and cross-border FRA between neighboring states, irrespective of national/FIR boundaries.

Free Route Airspace
Deployment Targets

- FRA implementation is carried out in two phases as follows:
  - **Initial FRA**: with time and structure constraints - target date 31 December 2022.
  - **Final FRA**: constant free route implementation with cross-border dimension and connectivity to TMAs - target date 31 December 2025.

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FRA in Europe

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Free Route Airspace

"A specified airspace within which users may freely plan a route between a defined entry point and a defined exit point, with the possibility to route via intermediate (published or unpublished) significant points, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control."

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Free Route Airspace: The Concept

Since June 2012

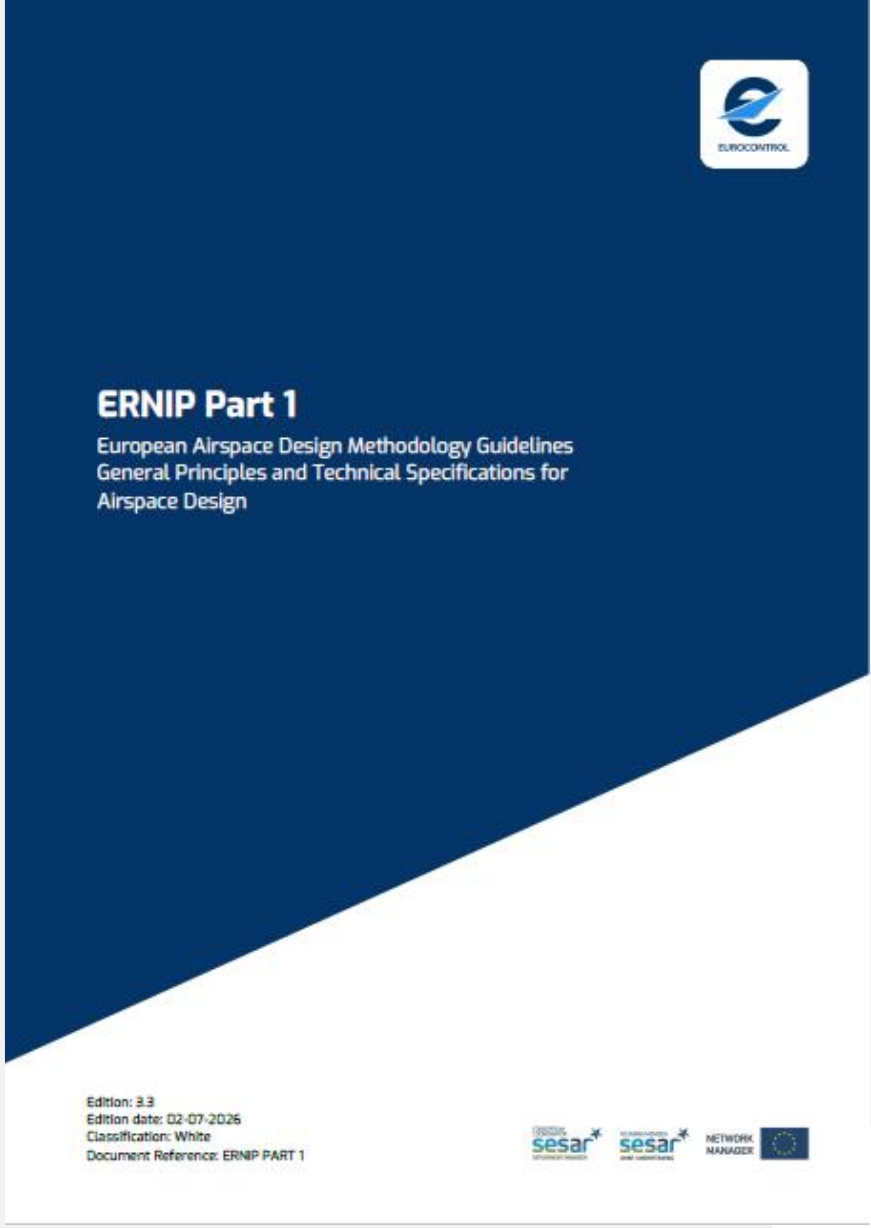
European Route Network Improvement Plan - Part 1

Chapter 10 FREE ROUTE AIRSPACE

Section 1 - FRA Concept
Section 2 - FRA Design
Section 3 - FRA Implementation
Section 4 - FRA in Aeronautical Information Products

Note: FRA AIP publication requirements are included in ERNIP Part 1, Chapter 9.

https://www.eurocontrol.int/publication/european-route-network-improvement-plan-ernip-part-1



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Free Route Airspace: The Concept

Main Principles



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Free Route Airspace: Implementation
Summary

- FRA implementation started on **07th May 2009** by Portugal within the airspace of Lisboa ACC AoR.
- FRA is currently implemented within the airspaces of almost **40 States** in Europe either only inside the State or as cross-border between States.
- Large cross-border FRA areas are also implemented.

https://www.eurocontrol.int/concept/free-route-airspace

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Free Route Airspace: Implementation

The Schedule

- The checklist of implementation actions is established in Europe and applies to the NEW FRA projects, regardless being inside a State or cross-border between States.

- FRA Project - START:
  T0 - (24 - 30) months BEFORE implementation, depending on the expected impact.

  Local FRA CONOPS discussed to ensure harmonised network FRA implementation.

- FRA Project - END (possible):
  T0 + (1 - 6) AIRAC cycles

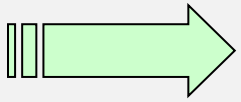
  Post implementation analyses and fine-tuning of implementation.

- Coordination includes - State(s) [ANSP(s)/CAA(s)/NSA(s)/Military], AOs, ICAO.

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Free Route Airspace: Implementation

Ways - Laterally



- Flights allowed to flight plan within “specified airspace” between officially published **E**ntry/e**X**it points or via **I**ntermediate points.

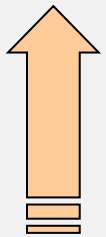
- “Specified airspace” (controlled airspace) usually represents:
  - CTA;
  - Part of CTA - particular CTA Sector; or
  - Area of responsibility for relevant air traffic control (ATC) unit (ACC AoR).

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Free Route Airspace: Implementation

Ways - Vertically

- Above:
  - FL305
  - FL285
  - FL245
  - FL195
  - FL175
  - FL095
  - 9500 FT
  - LAL (Lower Available Level)



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Free Route Airspace: Implementation

Ways - Timely

- Core Night (e.g. 23:00 - 05:00 (22:00 - 04:00)).
- Extended Night (e.g. 20:00 - 07:00 (19:00 - 06:00)).
- Weekend (e.g. SAT - SUN).
- Extended Weekend (e.g. FRI 13:00 (12:00) - MON 07:00 (06:00)).
- Seasonal (e.g. Winter period - H24, Summer period - Night).
- H24.



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Free Route Airspace: Implementation

Ways - Flights

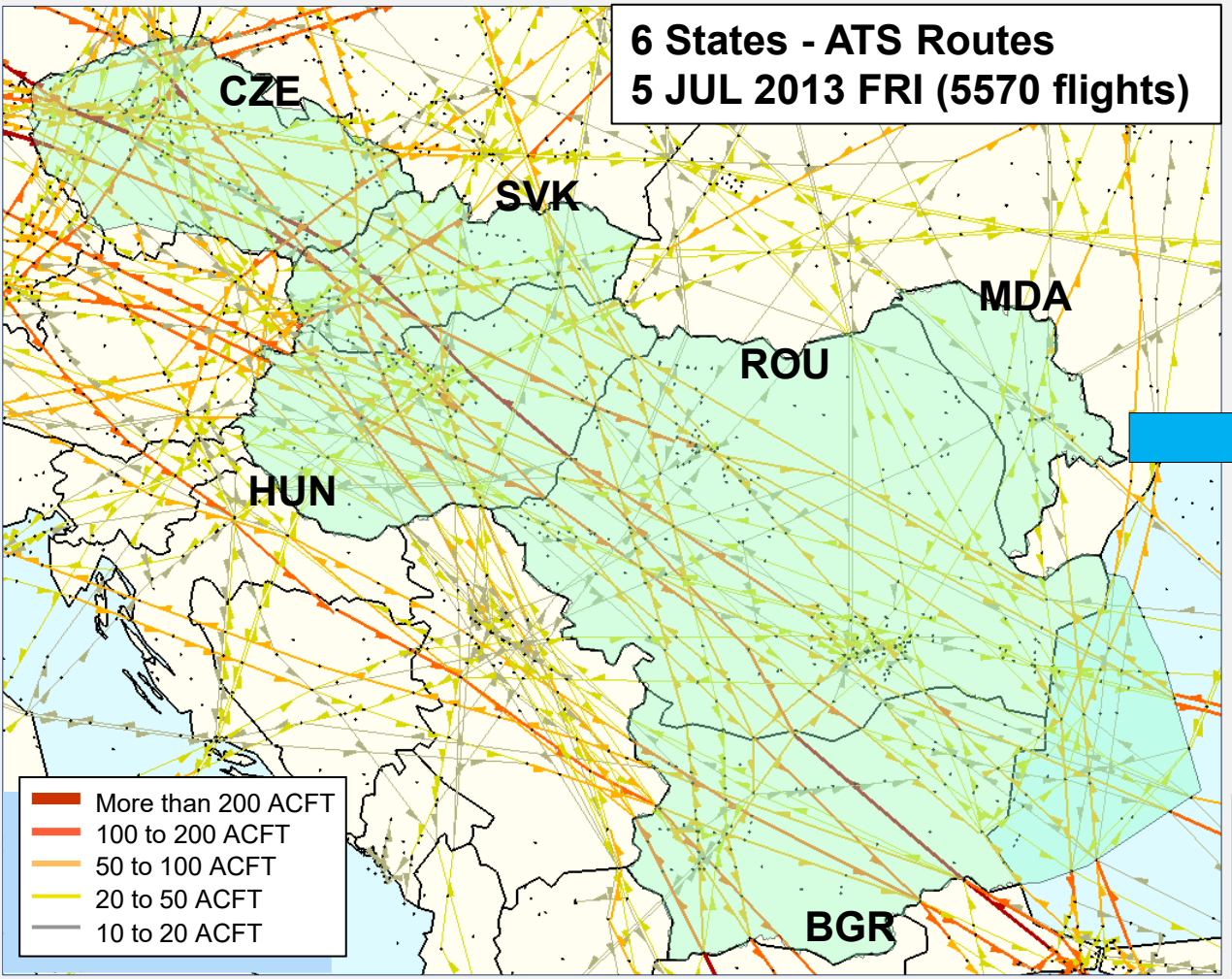
- Overflights only (e.g. arrivals to and departures from State aerodromes via ATS routes).
- Overflights and only arrivals to and departures from major State aerodromes.
- Overflights and arrivals to and departures from all State aerodromes.

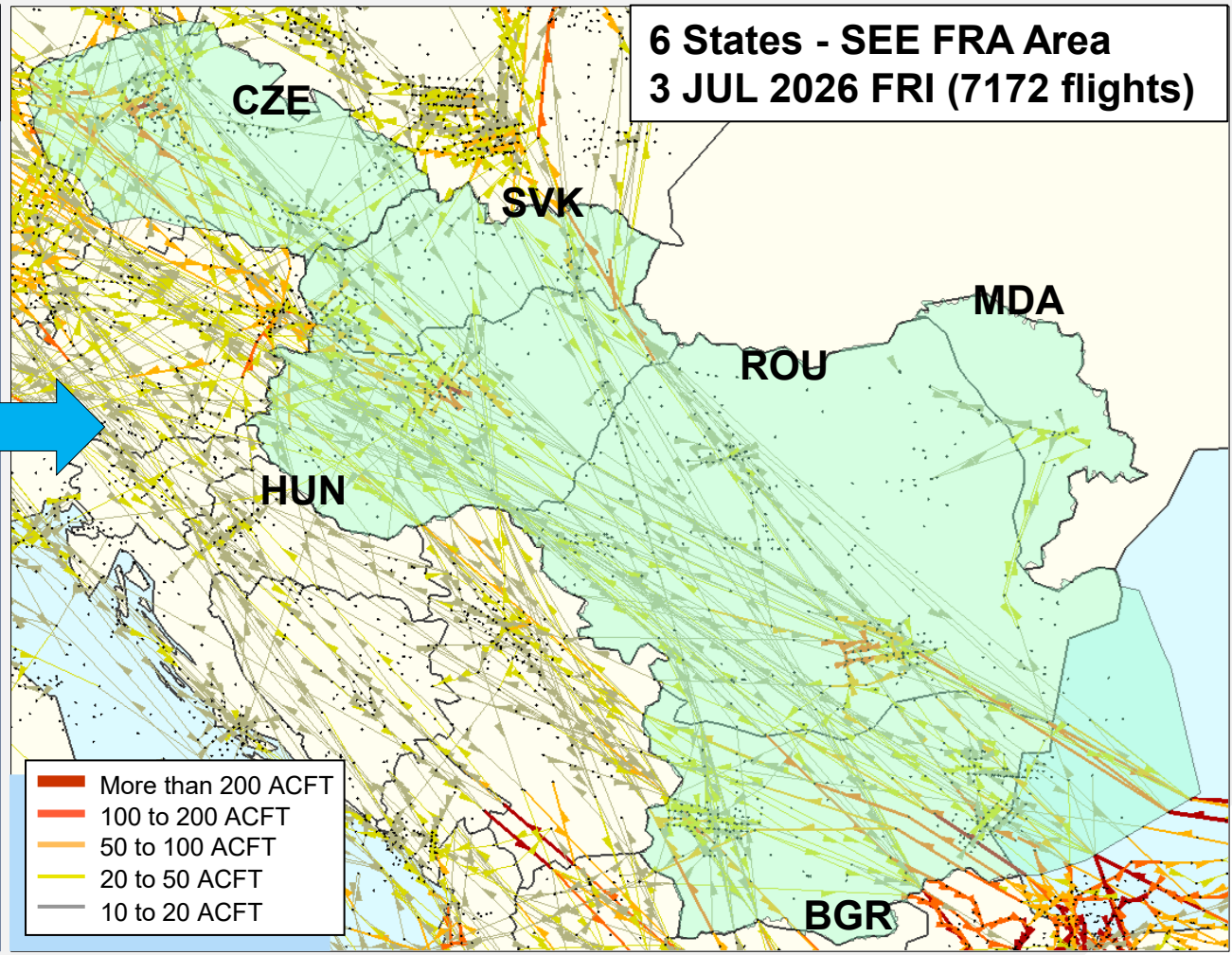


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Free Route Airspace: Implementation

Cross-border Visualisation - South East Europe FRA area





- **Bulgaria (BGR), Czech Republic (CZE), Hungary (HUN), Moldova (MDA), Romania (ROU), Slovakia (SVK)**

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Free Route Airspace: Implementation

SEE FRA Area Evolution - DCTs

Date	State	Laterally	Vertically	Timely
02 MAY 2013	CZE	ACC AoR	FL165/FL245 - FL660	23:00 - 05:00 (22:00 - 04:00)
02 MAY 2013				Weekend
05 FEB 2015				H24 specific DCTs
28 APR 2016	SVK	ACC AoR	FL245 - FL660	H24

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Free Route Airspace: Implementation

SEE FRA Area Evolution - Free Route Operations

Date	State	Laterally	Vertically	Timely
14 NOV 2013	BGR	CTA	FL245 - FL660	23:00 - 05:00 (22:00 - 04:00)
	ROU	CTA	FL105 - FL660	23:00 - 04:00 (22:00 - 03:00)
01 MAY 2014	MDA	CTA	FL095 - FL660	23:00 - 05:00 (22:00 - 04:00)
11 DEC 2014	ROU	CTA	FL105 - FL660	23:00 - 05:00 (22:00 - 04:00)
05 FEB 2015	HUN	ACC AoR	9500 FT - FL660	H24
30 APR 2015	MDA	CTA	FL095 - FL660	20:00 - 05:00
20 AUG 2015	HUN/ROU	ACCs AoR	9500 FT/FL105 - FL660	23:00 - 05:00 (22:00 - 04:00)
30 MAR 2017	HUN/ROU/BGR	ACCs AoR	9500 FT/FL105/FL175 - FL660	23:00 - 05:00 (22:00 - 04:00)
09 NOV 2017	MDA	CTA	FL095 - FL660	H24
01 FEB 2018	BGR	ACC AoR	FL175 - FL660	H24: 01 FEB 2018 - 23 MAY 2018
11 OCT 2018	BGR	ACC AoR	FL175 - FL660	H24: 11 OCT 2018 - 22 MAY 2019
06 DEC 2018	HUN/ROU/BGR/SVK	ACCs AoR	9500 FT/FL105/FL175/FL245 - FL660	23:00 - 05:00 (22:00 - 04:00)
28 MAR 2019	BGR	ACC AoR	FL175 - FL660	H24
	SVK	ACC AoR	FL245 - FL660	H24
07 NOV 2019	HUN/ROU/BGR	ACC AoR	9500 FT/FL105/FL175 - FL660	H24
27 FEB 2020	BGR/ROU/HUN/SVK	ACCs AoR	9500 FT/FL105/FL175/FL245 - FL660	H24 / 20:00 - 06:00 (19:00 - 05:00)
28 JAN 2021	BGR/ROU/HUN/SVK	ACCs AoR	9500 FT/FL105/FL175/FL245 - FL660	H24
25 FEB 2021	CZE	ACCs AoR	FL095 - FL660	H24
24 FEB 2022	BGR/ROU/HUN/SVK/MDA	ACCs AoR	9500FT/FL095/FL105/FL175/FL245 - FL660	H24
23 FEB 2023	BGR/ROU/HUN/SVK/MDA/CZE	ACCs AoR	9500FT/FL095/FL105/FL175/FL245 - FL660	H24

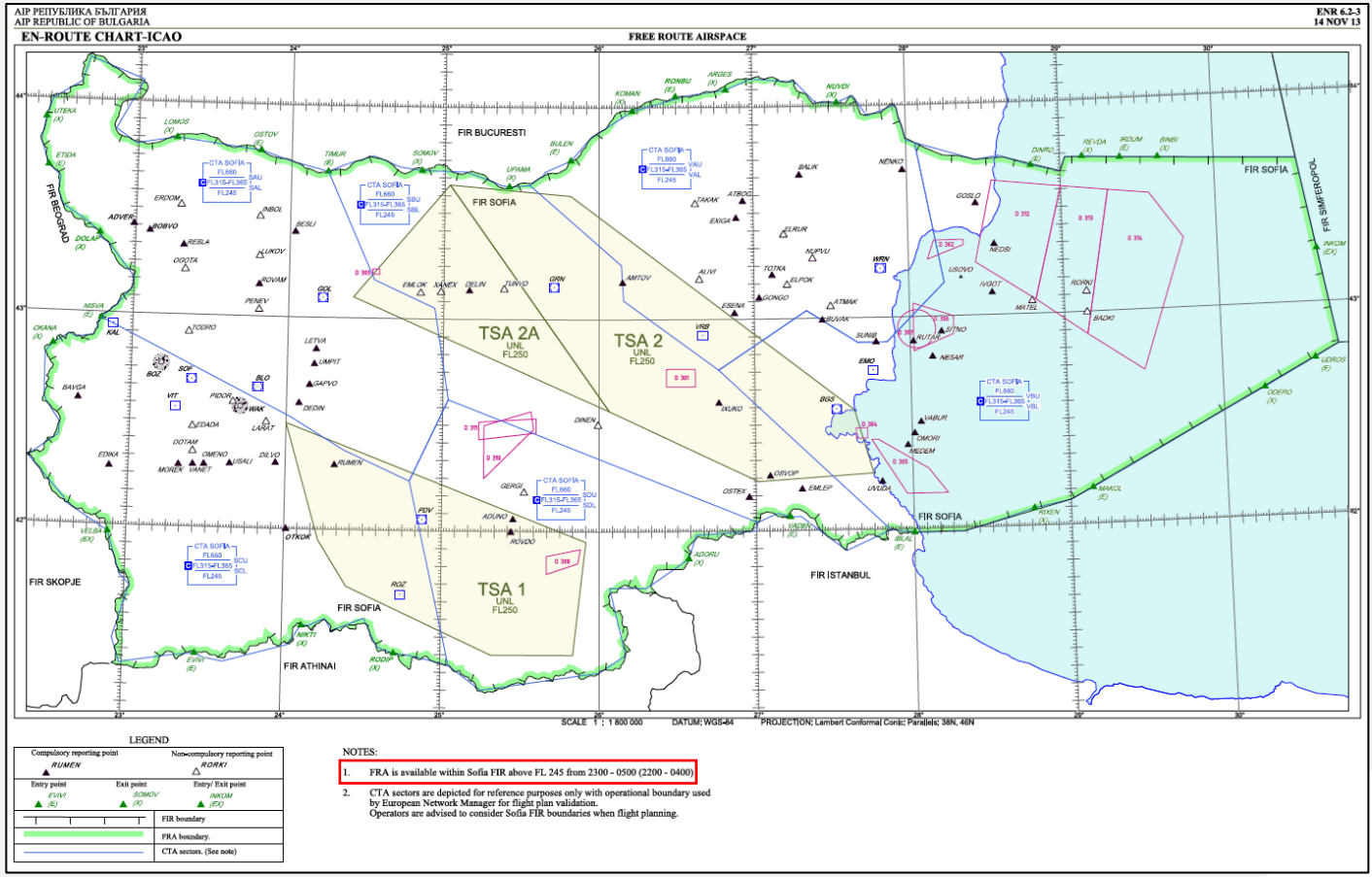
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Free Route Airspace: Implementation

SEE FRA Area Evolution - Initial State Developments

BGR Phase 1

- Laterally: CTA=ACC AoR.
- Vertically: FL245 - FL660
- Timely: 23:00 - 05:00 (22:00 - 04:00)
- Flights: Only overflights, ARR/DEP via ATS routes
- Reasons for scenario chosen:
  - FRA inside CTA (no ATS delegation).
  - Connectivity to the major TMA, which upper limit is FL245.
  - Less operational CTA Sectors (2 or 3) with less coordination.
  - No requirement for CTA Sectors changes or adaptations.
  - Low traffic demand with less unexpected flows and crossings.
  - No military activity and additional coordination.



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Free Route Airspace: Lessons Learnt

Airspace Design

- Proper definition of FRA significant points (E, X, I, A, D, e.g.) to provide efficiency in flight planning.
- Consider efficient design of FRA significant points to avoid special areas, especially those for military use when active.
- Provision of airport connectivity via FRA connecting routes, when required, for proper channelling of arrival and departure traffic to/from major airports.
- Adjustment of control sectors to FRA, when necessary, avoiding short sector entries and border clips.
- Application of non-standard planning zones, if necessary to protect unexpected trajectories.

Free Route Airspace: Lessons Learnt

Procedural

- Consider all civil-military coordination requirements.
- Validation and ATCO training requirements (theoretical briefings or simulations), if needed.
- AOs involvement in flight plan checking, if such option exists.
- Preliminary ATC system feasibility assessment in the FRA planning phase. Provide OPS requirements for system developments, if any.
- Preferably avoid mixed FRA operation in terms of:
  - Night and day (not ideal solution).
  - FRA and ATS route network (AOs will rather use ATS route network).
  - Preferable avoid unpublished point (unpublished point, defined by geographical coordinates or by bearing and distance), not easy to manage it without proper system support and relevant ATC procedures (e.g. CPDLC).
- Consider specificities in Flight Level Orientation Scheme (FLOS), if any, especially in cross-border FRA.
- Consider establishment of proper Area of Common Interest (ACI), if necessary, in cross-border FRA.
- Post implementation activities, traffic monitoring and coordination with AOs to facilitate flight planning efficiency.
- Share lessons learned with others.

Free Route Airspace: Lessons Learnt

ATC System

- FRA significant points:
  - Limitations in data storage or undesired increase in data storage in large cross-border FRA areas. (Example of commonly agreed solution - Filing of one FRA point per FIR).
  - Requirements for one point after exiting FRA for FPL termination purposes, especially when adjacent is a large cross-border FRA area.
  - Flight plan processing issues due to duplicated NAVAID IDs.
- FRA re-entry:
  - Depending on FRA area shape, the flight path might re-enter the same ACC AoR twice.
- FRA direct flight planning options (DCT):
  - Limitations in cross-border DCT length.
  - Pre-FRA implementation limitations (ICAO requirement - 200NM) not allowing processing of longer DCT.
- FRA data transfer:
  - Difficulties in data transfer outside of published significant points (5LNCs or NAVAIDs).
- FRA versus ATS routes
  - Flight plan processing issues due to breaks of ATS route designators (Some States changed completely the designation of their remaining ATS routes).

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Free Route Airspace: Lessons Learnt
ATC Service

- Operating a FRA environment offers improved traffic predictability due to more stable trajectories. At the same time, it enhances the use of conflict detection tools. The FRA concept leads to a better spread of conflicts compared with the concentration of conflicts generated by the former fixed ATS route network.

- FRA shows a slight decrease in ATCOs workload because of FRA implementation, mainly coming from a decrease in radio transmissions, monitoring and coordination tasks.

- ATCOs working with FRA environment are adamant that they do not want to go back to a fixed ATS route network. Before FRA, aircraft received tactical directs from ATCOs to shorten their route, but there was no logical correlation between the fixed ATS route network and how the aircraft actually flew. FRA offers airspace users the ability to fly directly according to their filed flight plan route while ensuring efficiencies in fuel planning, consumption and costs.

Free Route Airspace: Design
Possible ATC Limitations

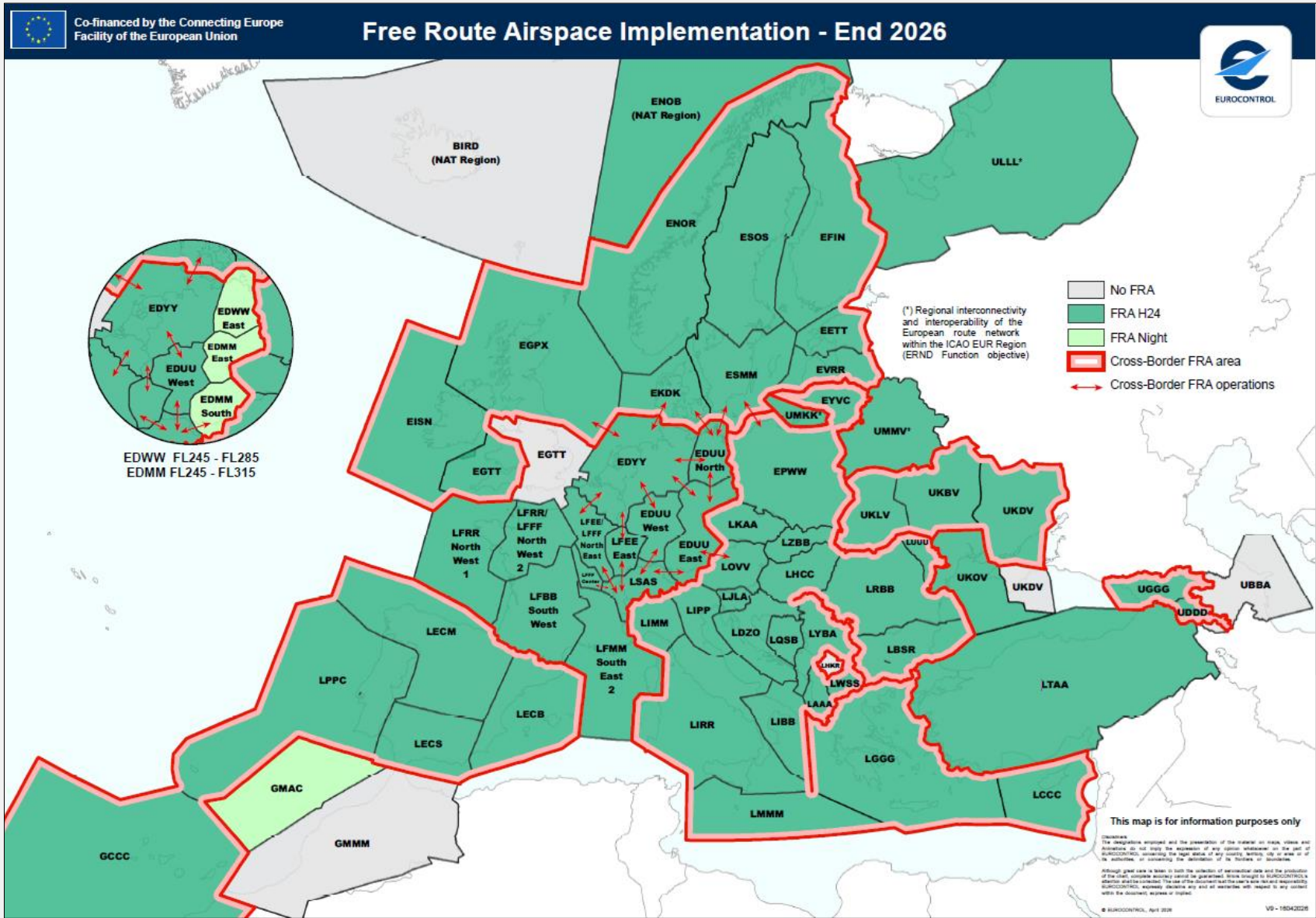
- FRA en-route DCT Limitation:
  - Do not allow FRA DCT above certain length.
  - Reference ICAO Doc 4444 PANS-ATM, Appendix 2, ITEM 15, (c) - points normally not more than … 370 km (200 NM) apart.
- FRA area boundary - close proximity DCT protection:
  - Do not allow FRA flight planning close, by certain distance, to the FRA area boundary.
  - Reference ICAO Doc 4444 PANS-ATM, 8.6.5.1 c) - flights shall not be closer than … 4.6 km (2.5 NM) or a distance equivalent to one-half of the prescribed separation minimum or …
- FRA area boundary - close proximity or clipping DCT allowance:
  - Allow FRA flight planning close, by certain distance, to the FRA area boundary or to clip that FRA area boundary.
- FRA flows crossing prevention:
  - Do not allow flight paths crossing immediately after entering FRA area (pair of two entry point).
- Mandatory FRA Intermediate point:
  - Allow FRA flight planning only via defined FRA (I) points for ATC purposes (channelling of traffic, prevention ATC sector clipping, etc.).
- Avoidance of special areas:
  - Description how to flight plan in FRA across the active Special Areas.
- FRA significant point per airspace volume:
  - Flight planning requirement for mandatory inclusion of one FRA significant point per airspace volume (FIR, UIR, CTA, AoR or FRA Cell) in flight plan ITEM 15.

Free Route Airspace: Visualisation Status

EUROCONTROL Network Manager AoR*

* This visualisation also includes the FRA implementations in Belarus and the Russian Federation (Kaliningrad FIR, Saint-Petersburg FIR).

https://www.eurocontrol.int/concept/free-route-airspace

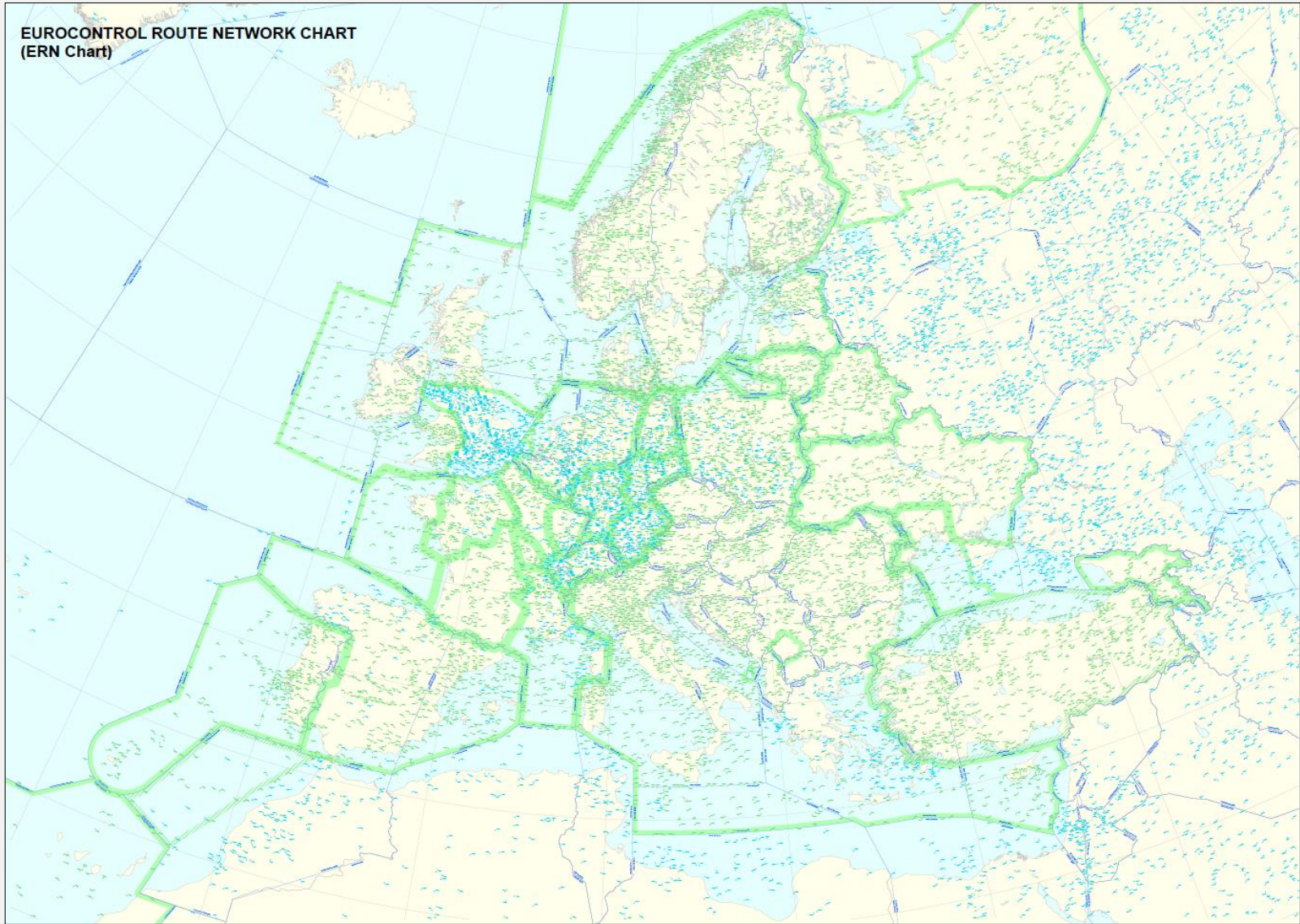


Free Route Airspace: Visualisation Chart

EUROCONTROL Network Manager AoR*

* The snapshot from the EUROCONTROL produced route network chart (ERN) also includes the FRA implementations in Belarus and the Russian Federation (Kaliningrad FIR and Saint-Petersburg FIR).

https://www.eurocontrol.int/service/cartography



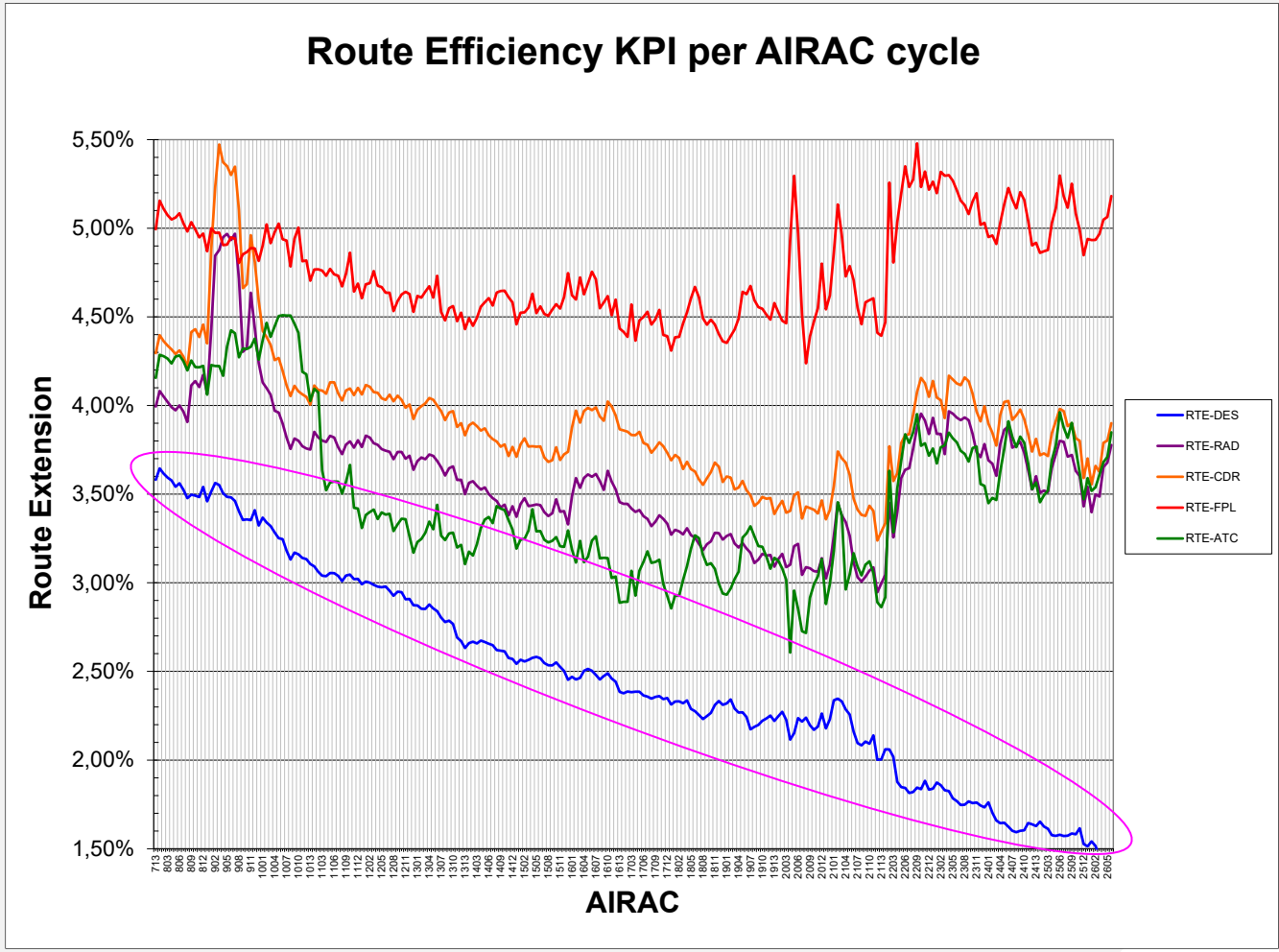
Free Route Airspace: Flight Efficiency

Benefits - Route Performance Indicator

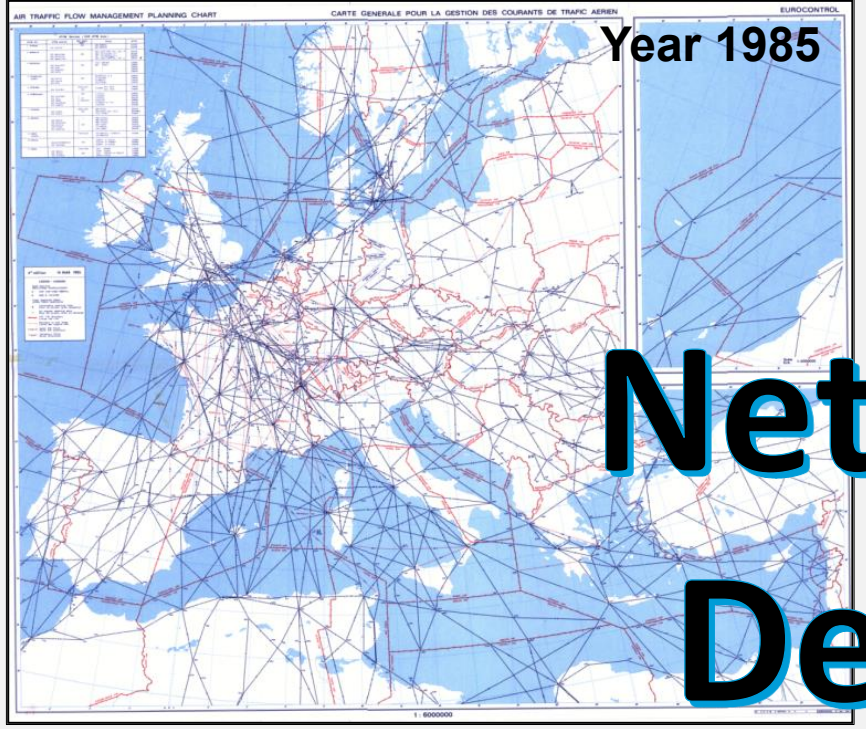
- Flight extension due to route network design (**RTE-DES**): The difference between the shortest plannable route length (from TMA exit and entry points) and the great circle distance.

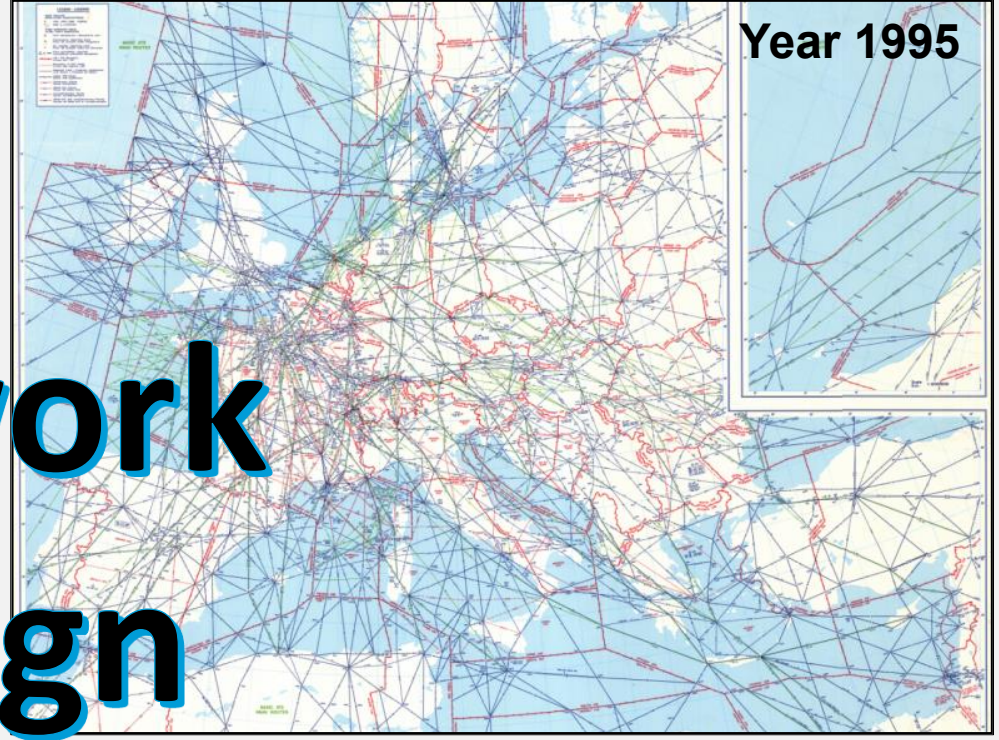
- AIRAC 0713 - AIRAC 0905 - AIRAC 2609:
  - **3.58%** - **3.48%** - **1.43%**

- Major FRA implementations impacting flight efficiency:
  - First FRA implementation - MAY 2009
  - MAY 2010
  - JUN/NOV 2011
  - DEC 2012
  - MAY/NOV 2013
  - FEB/APR/NOV 2015
  - JUN/DEC 2016
  - MAR/MAY/OCT 2017
  - …
  - Next FRA implementation - 26 NOV 2026

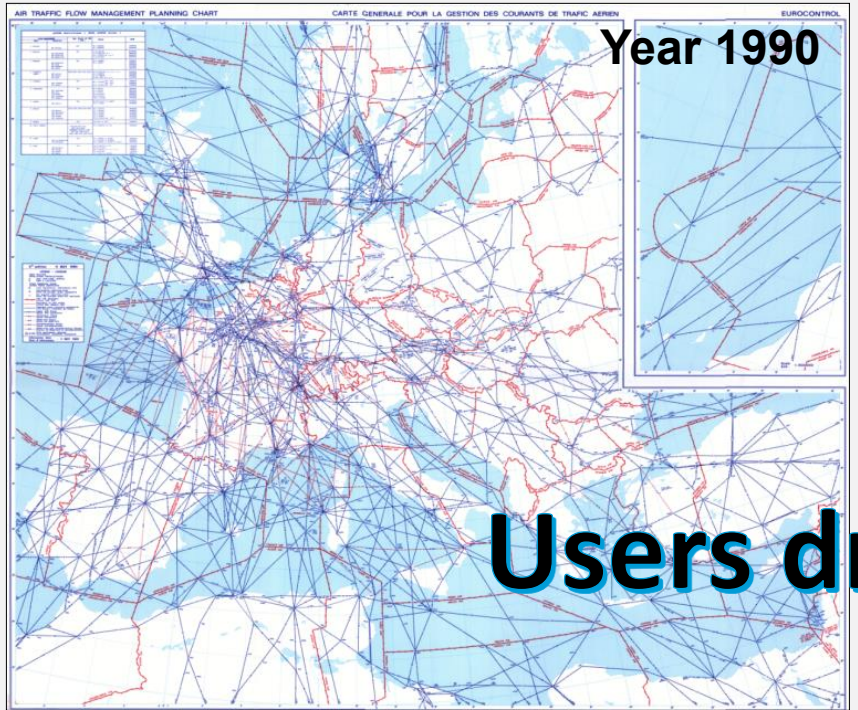


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Network Design





Users drive Design

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SUPPORTING
EUROPEAN
AVIATION

Thank you!

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