# Regulations Supporting FRA Initiatives and Case Study on FRA


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# Outlines

01 Definition of FRA

02 Understanding FRA Operation and Infrastructures

03 Comparing relevant concepts

04 Case Study on FRA Introduction in the Americas

05 Summary and Takeaways

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# Definition of FRA

# Where is the FRA originated from?

## FRA in ICAO Documents

- The ICAO Global Air Navigation Plan (GANP) identifies "Enable airspace users to fly their preferred trajectories" as **a Global Plan Initiative**. (Para 5.2.14)
- It will be provided by that "PIRGs identify dynamic/flexible planning elements for modernizing the regional air navigation systems, following a performance-based approach", aimed at accommodating preferred flight trajectories. (Para 2.2.4.4)

# Where is the FRA originated from?

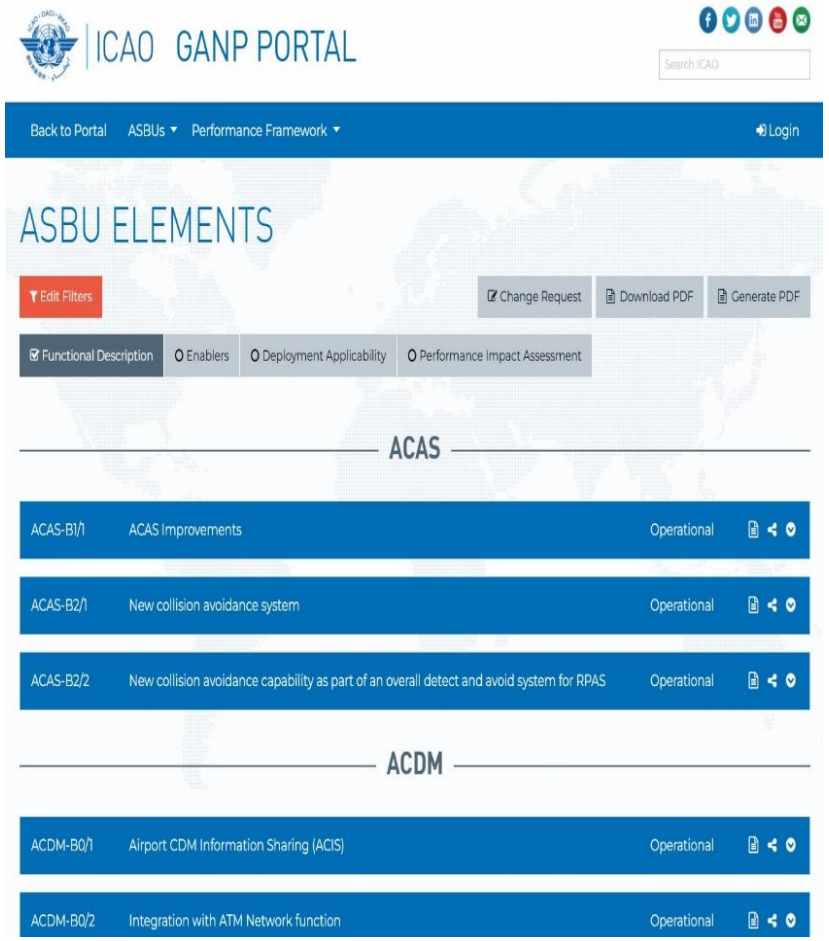
## FRA in ICAO Documents

- Enabling airspace users to fly their preferred trajectories
  - ➢ It's often referred to as Free Route Airspace (FRA) in the aviation industry.

- Enhancing Direct Routings with FRA
  - ➢ The term FRA is used to describe the many variations of dynamic and flexible ATS route systems that have been implemented in different locations throughout the world.

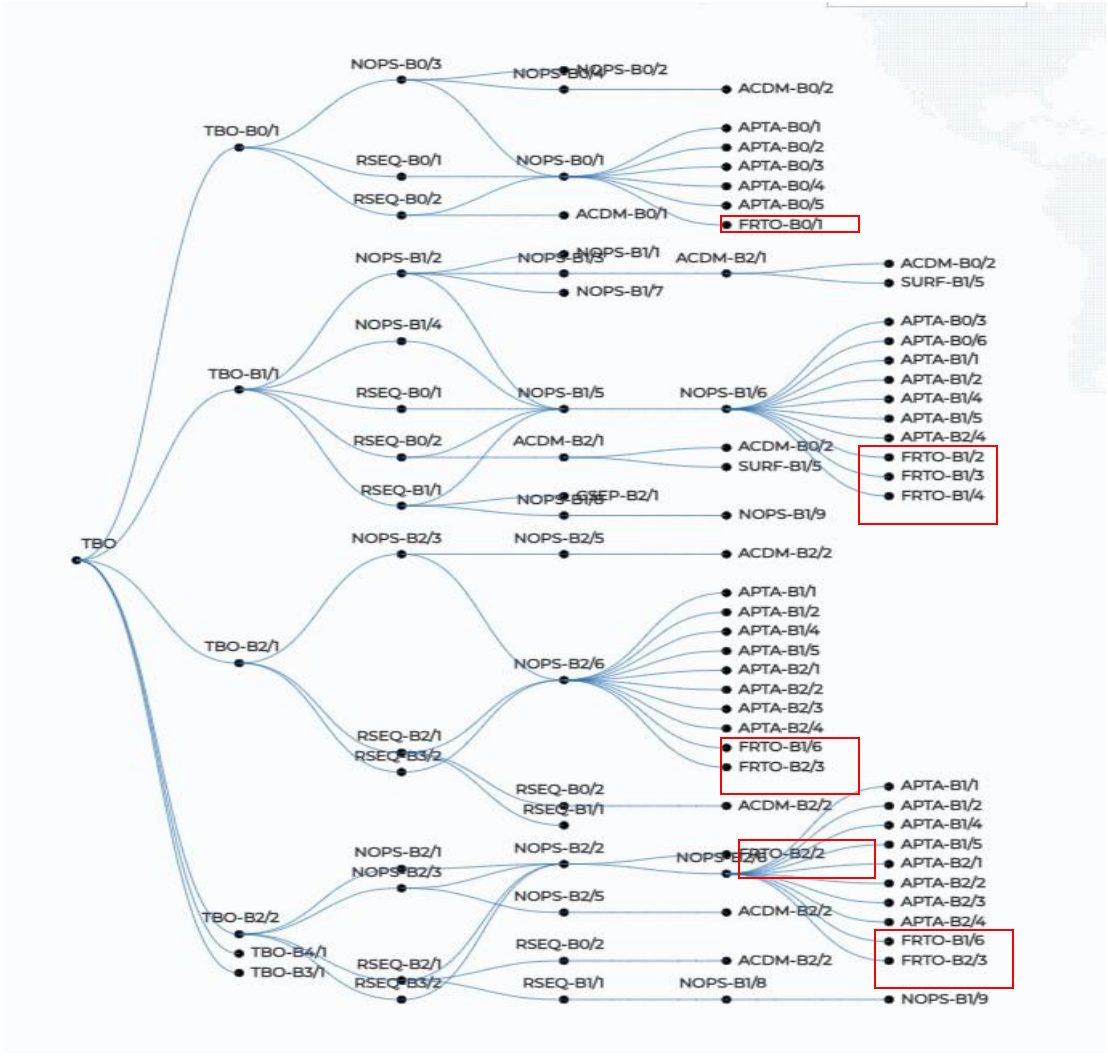
# How and where does the FRA define?

- The ASBU is a methodology developed by the ICAO to enhance global air navigation.
- Key Components of ASBU
  - ASBU Blocks, Modules, Threads
- How does it implement?
  - The ASBU framework is designed to be implemented in phases.



# Where is the FRA in place of aviation?

- This is the **TBO tree** in operational thread of ASBU.



# What is the definition of FRA?

## In ASBU an **enabler as Block 1-1 in FRTO**

| FRTO-B1/1 | Free Route Airspace (FRA) | Operational |
|---|---|---|

☐ Sixth edition of the GANP

**Main Purpose**

The Free Route Airspace (FRA) concept brings significant flight efficiency benefits and a choice of user preferred routes to airspace users.

As a step to full trajectory-based operations, the FRA concept brings increased flight predictability, reduced uncertainty for the ATM network function, which in turn can lead to potential capacity increases for ATM, which will also benefit the user.

**New Capabilities**

FRA is a specified volume of 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) waypoints, without reference to the ATS route network, subject to airspace availability. Within this airspace, flights remain subject to air traffic control.

FRA enables airspace users to fly as close as possible to what they consider the optimal trajectory without the constraints of a fixed route network structure.

# What is the Free Route Airspace (FRA)?

- Free Route Airspace is for "Giving airspace users the freedom to plan a route within specified airspace."

  - It's the concept of corridor airspace as specified operating time and predefined vertical, horizontal boundaries to use it.

# FRA in Asia Pacific

## In Seamless ANS Plan for APAC region

7.32 Within Category R airspace, ADS-C surveillance and CPDLC should be enabled to support PBN-based separations, as well as UPR and DARP, consistent with **COMS-B0/1** and **B0/2, FRTO-B0/1** to **B0/4** and **FRTO-B1/1** to **B1/7**.

7.34 ATS surveillance systems should enable basic conflict detection and conformance monitoring STCA, MTCD, APW, APM and MSAW consistent with **FRTO-B0/4** and **SNET-B0/1** to **B0/4** (Priority 1). Route Adherence Monitoring (RAM) should be utilised when monitoring PBN route separations. Cleared Level Adherence Monitoring (CLAM) should be utilised to monitor RVSM airspace.

7.54 ACCs should enable, where practicable, Free Route Airspace, RNP routes, Advanced FUA and Airspace Management (ASM), Dynamic Sectorisation, Enhanced Conflict Detection Tools and Conformance Monitoring and Multi-Sector Planner Function consistent with **FRTO-B1/1** to **B1/7**.

*Note: CPAR is a key enabler for 'free route airspace' and enroute UPR and DARP operations.*

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# Understanding FRA Operation and Infrastructures

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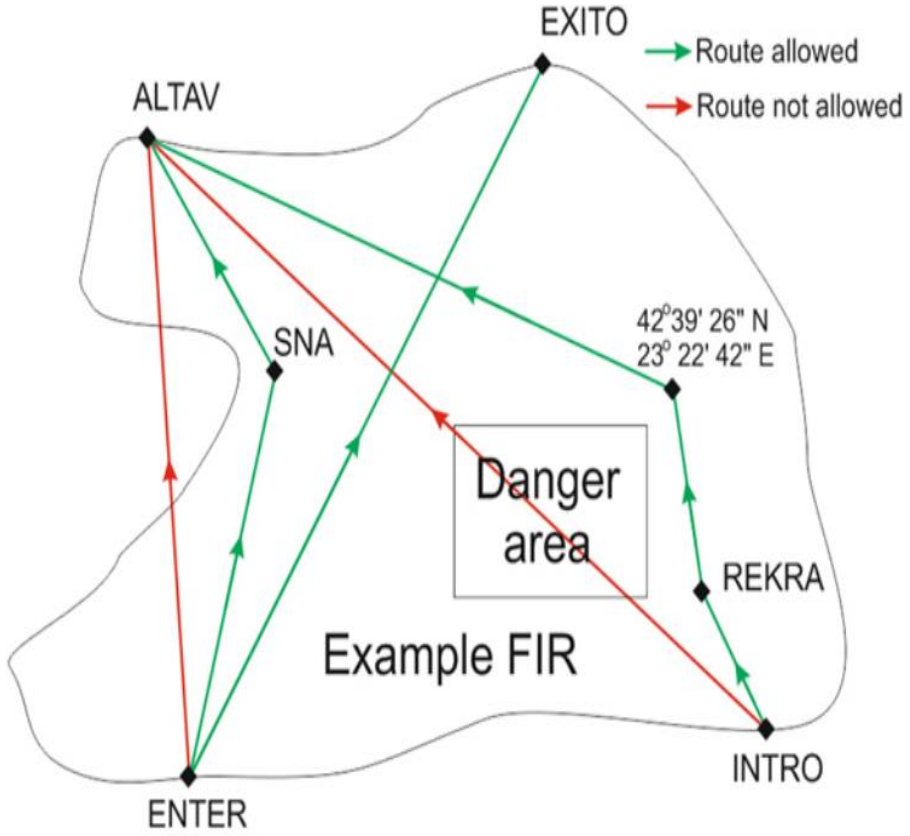
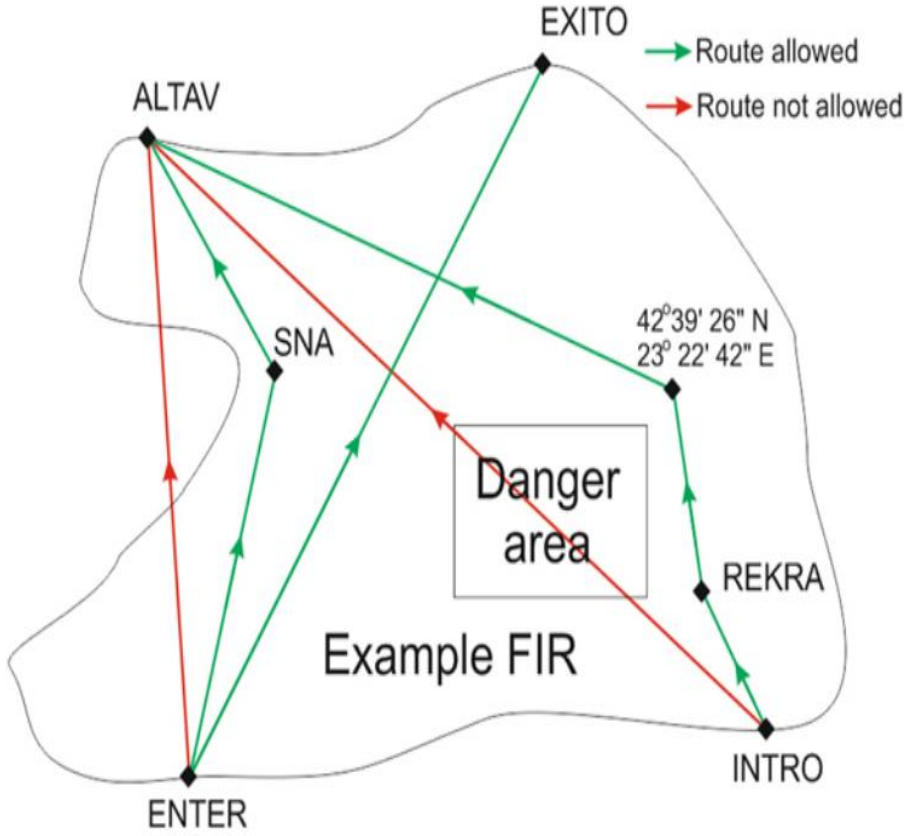
# Understanding FRA operation-1




** From Eurocontrol Portal website*

- Definition and Concept of FRA
  - ➢ Flexibility vs. Standard Airway Usage
  - ➢ Route Determination in FRA boundaries
- Choosing Routes within FRA Boundaries
  - ➢ Limitations: Entry/Exit Points and Avoiding Restrictions
  - ➢ Using Navigational Aids and Turning Points
- Turning Points and Their Role
  - ➢ Navigational Aids, Published Points, and Coordinates
  - ➢ Visualizing FRA Rules

# Understanding FRA operation-2




** From Eurocontrol Portal website*

- Diagram: Allowed and Not Allowed FRA Routes
  - ➢ Reasons for Route Rejection
  - ➢ Scope of FRA Implementation
- FRA within Sectors and FIRs
  - ➢ Extending FRA Across Multiple FIRs
  - ➢ Tactical Direct Routing and Its Limitations
- Tactical Direct Routing and Fuel Efficiency
  - ➢ Shortcomings: Adjustments and Fuel Costs
  - ➢ Customized Fuel-Efficient Routes in FRA
- Planning in Free Route Airspace
  - ➢ Benefits of Custom Route Planning

# Infrastructure for FRA implementation-1

- To apply and operate FRA, states need to have the necessary infrastructure.
  - Advanced ATM systems
  - Establish procedures for the coordination and communication
- More detail requirements
  - Safety Management
  - **Advanced CNS Technologies**
  - **Airspace Design and Configuration**
  - **Air Traffic Control Procedures**

# Infrastructure for FRA implementation-2

- More detail requirements
  - **Trajectory prediction and conflict detection tools**
  - **AIS publications to provide clear procedures**
  - Training and Education
  - **Air Traffic Flow Management** (ATFM)
  - Regulation and Standards
  - Performance Monitoring and Evaluation

03

# Comparing Relevant Concepts

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# Comparing Relevant Concepts - 1

- **Trajectory-Based Operations (TBO)**
  - ➢ The collaborative management concept of aircraft trajectories from departure to arrival
    - ✓ To enhance **predictability**
    - ✓ By collaborative decision making (**CDM**)
    - ✓ For optimizing aircraft **trajectories for fuel efficiency**
    - ✓ With **advanced automation** systems

# Comparing Relevant Concepts - 1

## TBO vs FRA

| | TBO | FRA |
|---|---|---|
| **Scope** | Focuses on the **collaborative management** of aircraft trajectories | Focuses on **providing aircraft with the freedom to plan** and fly their own routes |
| **Planning Horizon** | Involves **long-term strategic planning** of aircraft trajectories | Focuses on the **flexibility of route selection** during flight within a predefined airspace |
| **Collaboration** | Typically involves **multiple stakeholders** | Coordination between **airspace users and ATM Service Providers** |

# Comparing Relevant Concepts – 2

- **User Preferred Routes (UPR) vs FRA**
  - Airspace users could file UPRs that are accepted on a tactical basis.
  - It allows pilots to select a preferred route from a set of predefined routes.
  - FRA is an airspace operating concept that allows for more direct routing.

# Comparing Relevant Concepts - 3

- **Dynamic Airborne Reroute Procedure (DARP)**

  - A procedure that allows aircraft to change their flight plan while in flight.

    - ✓ For avoiding bad weather or taking advantage of favorable winds
    - ✓ More efficient flight paths, reduced fuel consumption and emissions

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# Case Study on FRA Introduction in the Americas

# Case Study on FRA Introduction in the America regions

- **The Three Steps to FRA**

✓ **Step 1 – SDR (Structured Direct Routing):**
Aircraft fly direct but controlled routes.

✓ **Step 2 – UPR (User Preferred Routes):**
Airlines suggest their best routes; approved by ATC.

✓ **Step 3 – FRA:**
Full freedom between entry/exit points in the airspace.

# Case Study on FRA Introduction in America regions

- **Strategic Direct Routing (SDR)**

  ✓ **SDR enables fixed direct route segments in upper airspace, designed for efficiency but not fully flexible like FRA.**

  ✓ **SDR includes:**

  – Defined entry/exit points from ATS routes.
  – Use of RNAV waypoints or navigation aids.
  – Suspension procedures for contingencies like radar failure or ATFM events.

# Case Study on FRA Introduction in America regions

- **User Preferred Routes (UPRs)**

  - ✓ UPRs are airline-proposed routes between two city pairs that optimize efficiency.
  - ✓ Require prior approval, coordination with ANSPs, and are usually tested through trial phases.
  - ✓ UPRs are officially published in AIP ENR 3.5 and/or on ICAO portals, and subject to airspace capacity and safety evaluations.
  - ✓ They represent an interim step to FRA by offering flexibility within controlled bounds.

# Case Study on FRA Introduction in America regions

- **Free Route Airspace (FRA)**

  ✓ **FRA allows aircraft to freely choose their trajectory between a defined entry and exit point without reference to published ATS routes.**

  ✓ **It builds upon lessons from SDR and UPR implementation, requiring:**

  – Seamless inter-FIR coordination.

  – ATC system upgrades for flight plan processing.

  – Cross-border agreement on points, procedures, and contingency plans.

  – Clear publication and data harmonization across FIRs

# Case Study on FRA Implementation in America regions

- **Technical and Procedural Elements for Consideration**
  - ✓ **Flight Plan Handling:**
    - Effective management of flexible routes requires robust systems for validating, processing, and monitoring user-preferred trajectories.
  - ✓ **Publication Standards:**
    - Consistent usage of AIP sections (e.g., ENR 2.6 for SDR, ENR 3.5 for UPRs) ensures clarity and harmonization.
  - ✓ **System Suspension Conditions:**
    - Clear criteria are outlined for when FRA, SDR, or UPR operations must revert to standard ATS routing.
  - ✓ **Performance Monitoring:**
    - KPIs are essential for evaluating time savings, fuel efficiency, and reduced emissions from optimized routes.

05

# Summary and Takeaways

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# Summary

- Trajectory Based Operation (TBO) is the broadest concept encompassing free flight.
  - Free Route Operation (FRTO) is a method within TBO that enables this.
  - FRTO includes Free Route Airspace (FRA).
  - And **FRA is preceded by** User Preferred Route (UPR), Direct Route (DRT), Flexible Use of Airspace (FUA), Dynamic Airborne Rerouting Procedure (DARP), etc.

# Summary

- **Build Step-by-Step**
  - Use SDR and UPR as preparatory stages before full FRA.
  - Trial phases help identify safety, system, and operational challenges.
- **Harmonize Across Borders**
  - Adopt standard publication and coordination practices.
  - Ensure consistency in implementation to enable seamless transitions between FIRs.
- **Enable With Technology**
  - Upgrade ATM systems for trajectory-based operations and flight plan management.
  - Integrate contingency and suspension procedures for resilience.
- **Evaluate Continuously**
  - Monitor airspace usage through data analysis and stakeholder feedback.
  - Refine operational models based on post-implementation reviews.

# Thank You


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