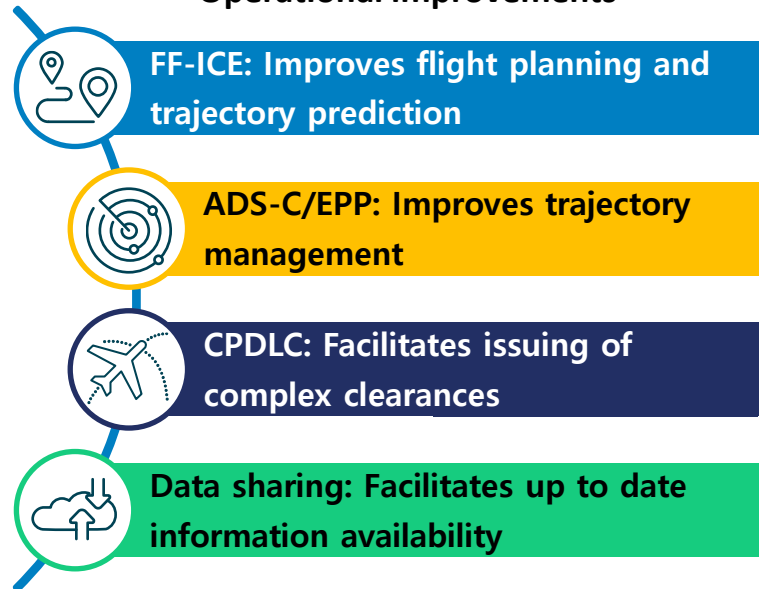# TBO is a triple win: Win for users, passengers, and for the environment

What is TBO?

1 **TBO** is a system of systems, integrating **multiple components** to enhance ATM

2 **TBO** is not just an ATM initiative; it is a framework to be used by all connected actors: **AU, A/C manufacturers, ANSPs** and **Computer flight planning service providers**

3 TBO is all about facilitating flights as close as close as possible to the **optimal trajectory**

4 TBO is a **long-term concept**, however, capabilities under validation (**FF-ICE, ADS-C EPP** or **CPDLC**) can be used to build TBO apps

Operational improvements

FF-ICE: Improves flight planning and trajectory prediction

ADS-C/EPP: Improves trajectory management

CPDLC: Facilitates issuing of complex clearances

Data sharing: Facilitates up to date information availability

These advancements will lead to a lighter workload for ATCOs, enhanced airspace capacity, and valuable environmental benefits

In Europe, the TBO vision and roadmap are embedded within the European ATM Master Plan

- Focus on **efficiency** and **environment**

- Agreed on the **TBO roadmap** prepared in consultation with all European stakeholders

- **Content:** Vision, roll-out, deployment priorities, development priorities, benefits and investment needs

- Adopted in **December 2024**

- **TBO Roadmap time** horizons:

  - **2030** – Significant progress on research & innovation

  - **2035** – Implementation of 10 strategic deployment objectives

  - **2045** – Full implementation

https://www.sesarju.eu/MasterPlan2025

sesar
JOINT UNDERTAKING

European ATM
Master Plan

Making Europe the most
efficient and environmentally
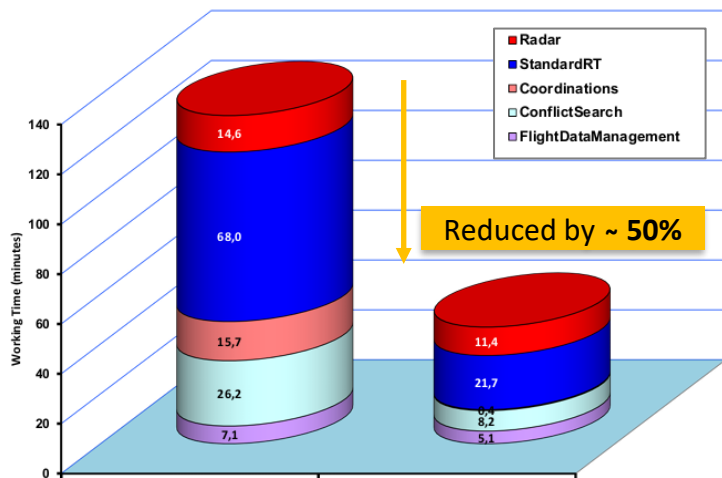friendly sky to fly in the world

2025 EDITION

The implementation of TBO in Europe has been validated to bring significant benefits across multiple dimensions

#1. Network Manager (NM)

#1. Average Working Time to process 100 Flights Current vs. 2040 (NM)

Legend:
- Radar
- StandardRT
- Coordinations
- ConflictSearch
- FlightDataManagement

Working Time (minutes)

Current bar:
- 14,6
- 68,0
- 15,7
- 26,2
- 7,1

2040 bar:
- 11,4
- 21,7
- 6,4
- 8,2
- 5,1

Reduced by ~ **50%**

- **Sector capacity increase by ~ 100%**
  (from 45 flights/h to 97 flights/h)

#2. Airspace Users (AUs) – Early adoption of technologies

- Use of ATS B2 (ADS-C + CPDLC v2)
- Use cases at Maastricht Upper Area Control (MUAC)

Later start of descent

Desc. Window EPP supported

EPP ToD

Controller Experience without EPP

14 kg CO_2

Earlier direct routing

ToC

Climbing to FL370

On Radar heading for separation

Earlier direct with EPP Information

Conflicting traffic in FL360

4 kg CO_2

Better en-route delay absorption

LONDON TMA

XMAN/ AMAN

4 kg CO_2

Benefits with Maastricht until 2027

Benefits with EU ANSPs for all Airlines from 2028 (Mandate)

relations estimate

65 A320neo/A321neo aircraft newly delivered from 2024 onwards will be equipped with ADS-C EPP

65

Years: 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032

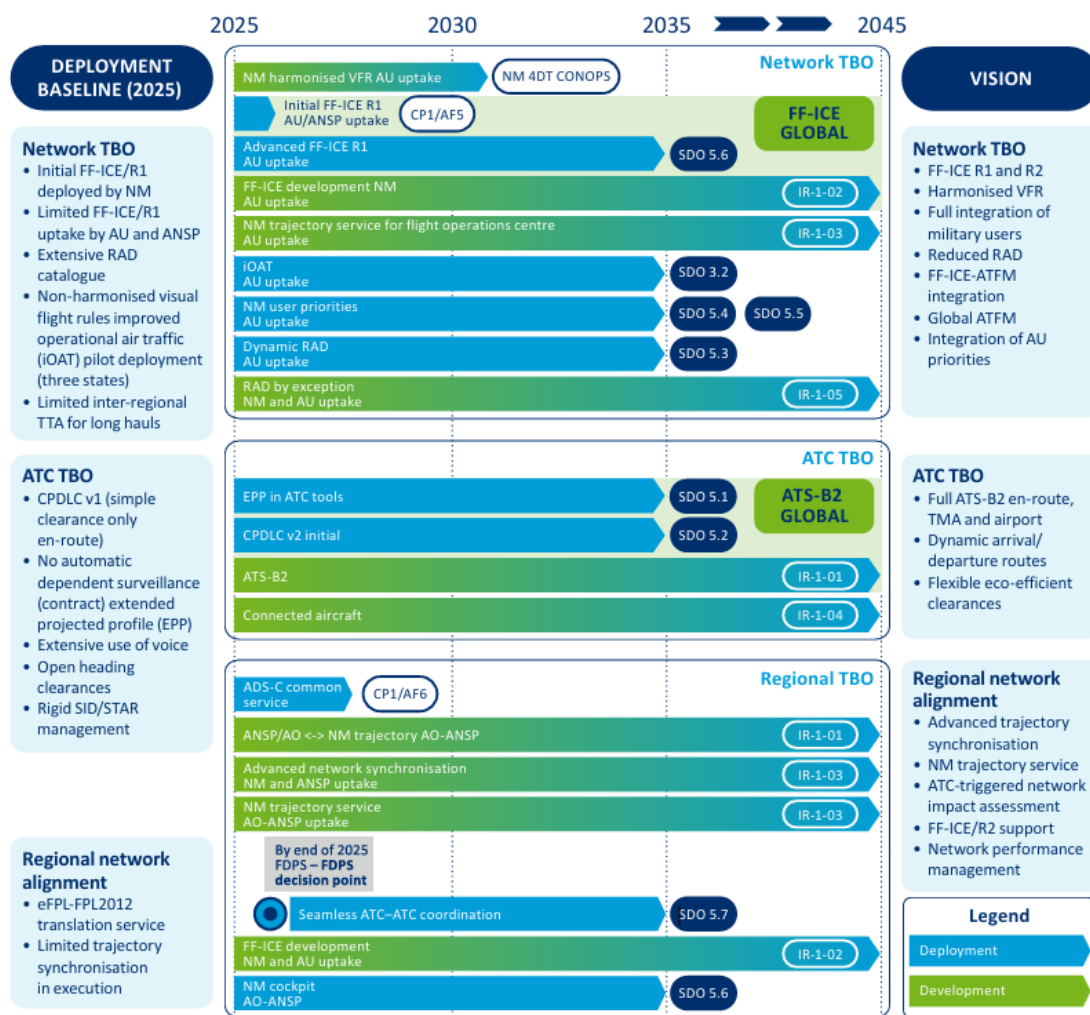**Mandate is in effect**

- Scenario 1: accumulated Savings
- Scenario 2: accumulated Savings

EASA

European TBO Roadmap
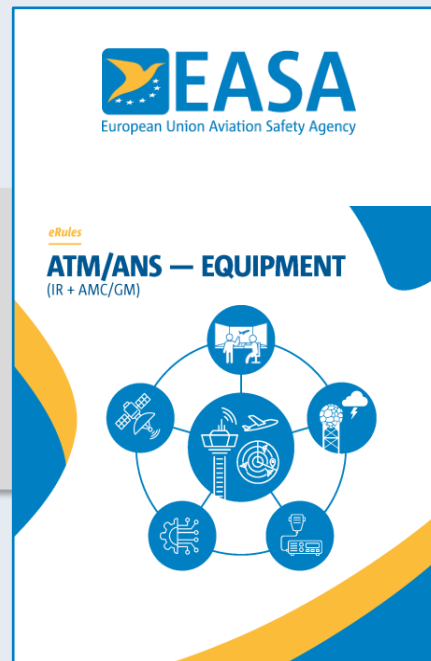
Trajectory Management grouping:

- **Network TBO:** Network Manager – Flight Operations Centers during pre & post-departure

- **ATC TBO:** Flight decks and ATC units during post-departure

- **Regional TBO:** Intra-European coordination between the NM, ANSPs, and airports

Phase 1 (by 2030): Common Project 1 (CP1) regulation with **first FF-ICE/R1** filing services by **2026**

SESAR Joint Undertaking | MP A.1. TBO roadmap

EASA

2025   2030   2035   2045

DEPLOYMENT BASELINE (2025)

VISION

Network TBO

- NM harmonised VFR AU uptake — NM 4DT CONOPS
- Initial FF-ICE R1 AU/ANSP uptake — CP1/AF5
- Advanced FF-ICE R1 AU uptake — SDO 5.6 — FF-ICE GLOBAL
- FF-ICE development NM AU uptake — IR-1-02
- NM trajectory service for flight operations centre AU uptake — IR-1-03
- iOAT AU uptake — SDO 3.2
- NM user priorities AU uptake — SDO 5.4 SDO 5.5
- Dynamic RAD AU uptake — SDO 5.3
- RAD by exception NM and AU uptake — IR-1-05

Network TBO
- Initial FF-ICE/R1 deployed by NM
- Limited FF-ICE/R1 uptake by AU and ANSP
- Extensive RAD catalogue
- Non-harmonised visual flight rules improved operational air traffic (iOAT) pilot deployment (three states)
- Limited inter-regional TTA for long hauls

Network TBO
- FF-ICE R1 and R2
- Harmonised VFR
- Full integration of military users
- Reduced RAD
- FF-ICE-ATFM integration
- Global ATFM
- Integration of AU priorities

ATC TBO

- EPP in ATC tools — SDO 5.1 — ATS-B2 GLOBAL
- CPDLC v2 initial — SDO 5.2
- ATS-B2 — IR-1-01
- Connected aircraft — IR-1-04

ATC TBO
- CPDLC v1 (simple clearance only en-route)
- No automatic dependent surveillance (contract) extended projected profile (EPP)
- Extensive use of voice
- Open heading clearances
- Rigid SID/STAR management

ATC TBO
- Full ATS-B2 en-route, TMA and airport
- Dynamic arrival/departure routes
- Flexible eco-efficient clearances

Regional TBO

- ADS-C common service — CP1/AF6
- ANSP/AO <-> NM trajectory AO-ANSP — IR-1-01
- Advanced network synchronisation NM and ANSP uptake — IR-1-03
- NM trajectory service AO-ANSP uptake — IR-1-03
- By end of 2025 FDPS – FDPS decision point
- Seamless ATC–ATC coordination — SDO 5.7
- FF-ICE development NM and AU uptake — IR-1-02
- NM cockpit AO-ANSP — SDO 5.6

Regional network alignment
- eFPL-FPL2012 translation service
- Limited trajectory synchronisation in execution

Regional network alignment
- Advanced trajectory synchronisation
- NM trajectory service
- ATC-triggered network impact assessment
- FF-ICE/R2 support
- Network performance management

Legend
Deployment
Development

EUROPEAN INITIATIVES TOWARDS TBO

Europe is making significant strides in **Trajectory-Based Operations (TBO)** through key initiatives led by **SESAR JU**, **EUROCONTROL**, and **EASA**

COLLABORATION BETWEEN APAC AND EUROPE ON TBO

APAC

1 **Technical** and **regulatory knowledge sharing**

2 Framework for **collaboration Europe-APAC**

Regulatory experience

Unified Concept

Knowledge sharing

Global Interoperability

Thank you for your attention!

To continue the conversation, please contact:

Daniel Cruz

Bangkok Project Office Manager | ATM/ANS & Safety Intelligence Expert, EASA – SCOPE APP Project

daniel.cruz.ext@easa.europa.eu

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