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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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Trajectory Based Operations (TBO)

Flight and Flow Information for a Collaborative Environment (FF-ICE)

FF-ICE Operational Requirements
(OR) Small Working Group (SWG)

Topics

- 01 Background
- 02 Introduction to TBO and FF-ICE
- 03 Phased Approach to Implementation Strategy
- 04 Sharing on Implementation Strategy / Plans

Decision ATM/SG/10-3: Establish FF-ICE Operational Requirements Small Working Group

What:

That, ATM/SG establishes the FF-ICE Operational Requirements Small Working Group, that will:

- a) study ICAO global TBO and FF-ICE provisions and the outcomes of relevant ICAO technical panels and regional technical groups;
- b) to prepare a set of draft harmonised regional operational requirements of FF-ICE/R1, and related operational processes and procedures;
- c) present related information to the FF-ICE seminar to be organised by ATMAS TF in 2023;
- d) recommend an appropriate approach to devise a FF-ICE implementation strategy for the APAC region; and
- e) recommend priority ASBU elements and develop draft regional performance objectives for consideration for inclusion in the Asia/Pacific Seamless ANS Plan version 4.0.

Who are here?



Engineers



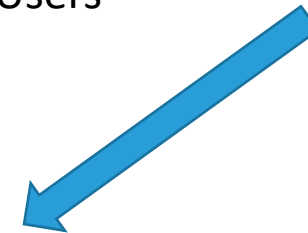
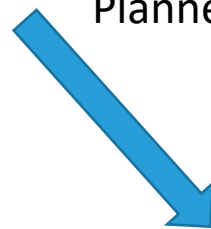
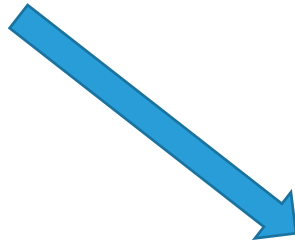
Planners



Airspace Users
/ Airlines



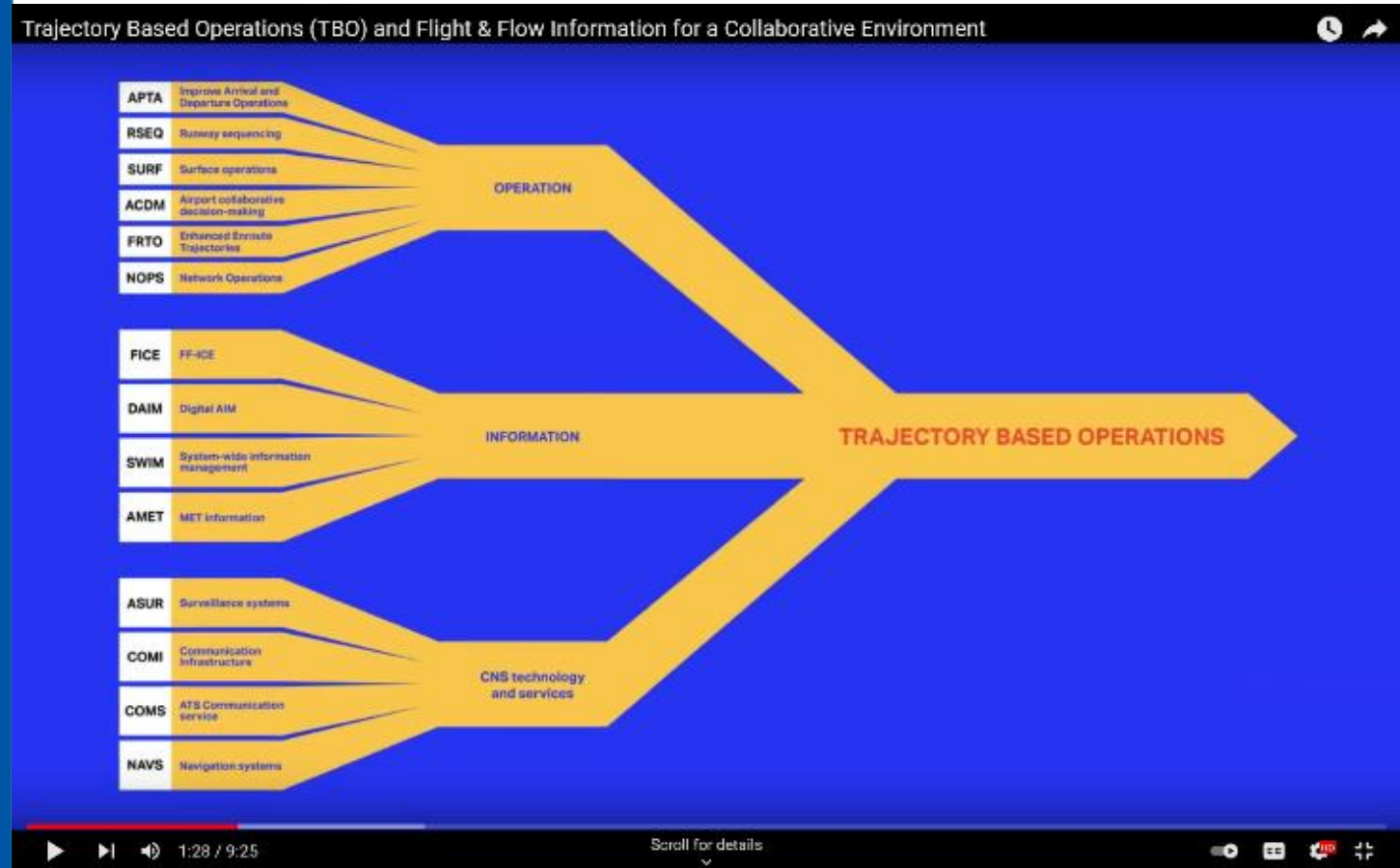
Air Traffic
Controllers



Trajectory Based Operations

02 Introduction to TBO

Video by IATA
(available on
youtube)



<https://www.yout-ube.com/watch?v=A0rGw2Ebojw>

Basics of TBO

TBO is about predicting **where** a flight will be and **at what time**

- This forms the basis for a 'strategic plan'

A trajectory is used as a **reference** for the flight and shared between systems and stakeholders

A trajectory is defined in four dimensions

- Latitude, Longitude, Altitude, and **Time**

The trajectory is **updated** as operations evolve over time and new information becomes available

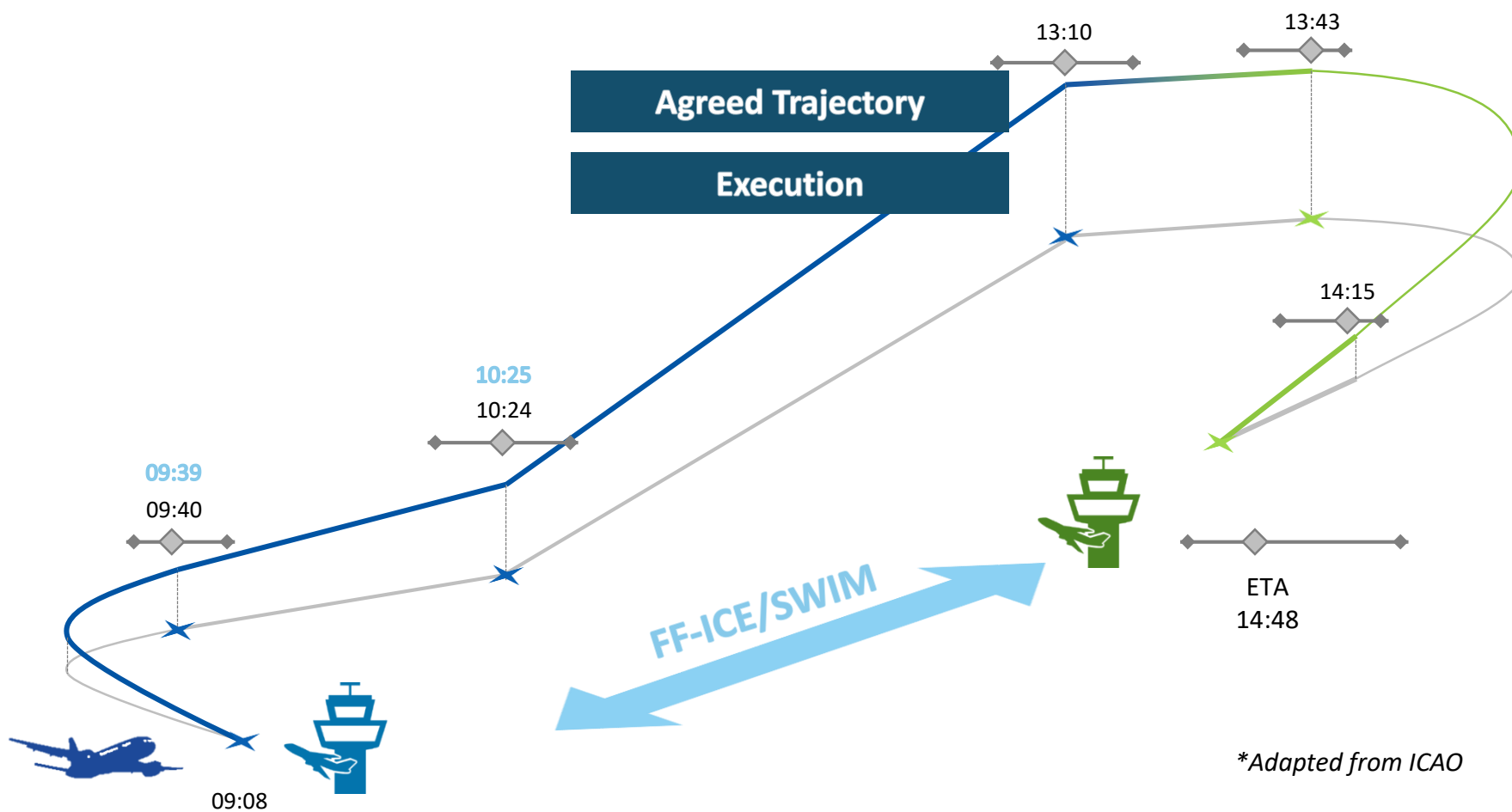
TBO is a NOT an **individual** system

TBO is a **collection** of systems, capabilities, processes, and people working together to achieve operational objectives

Although COTS solution exists to implement elements of TBO, there are currently **no COTS solutions** to implement TBO as a whole

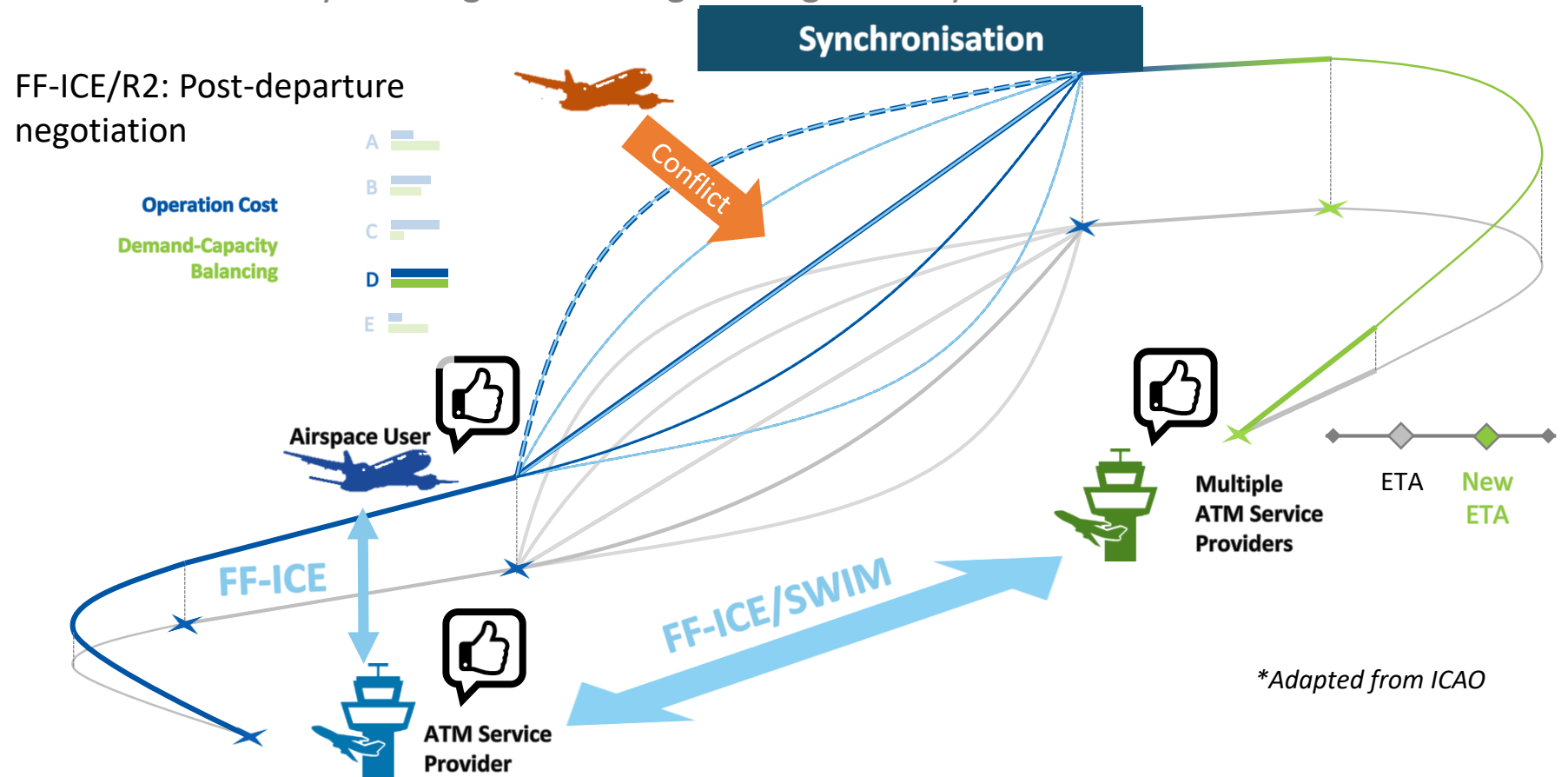
Agreed Trajectory

The Agreed Trajectory is shared, maintained and used by all stakeholders

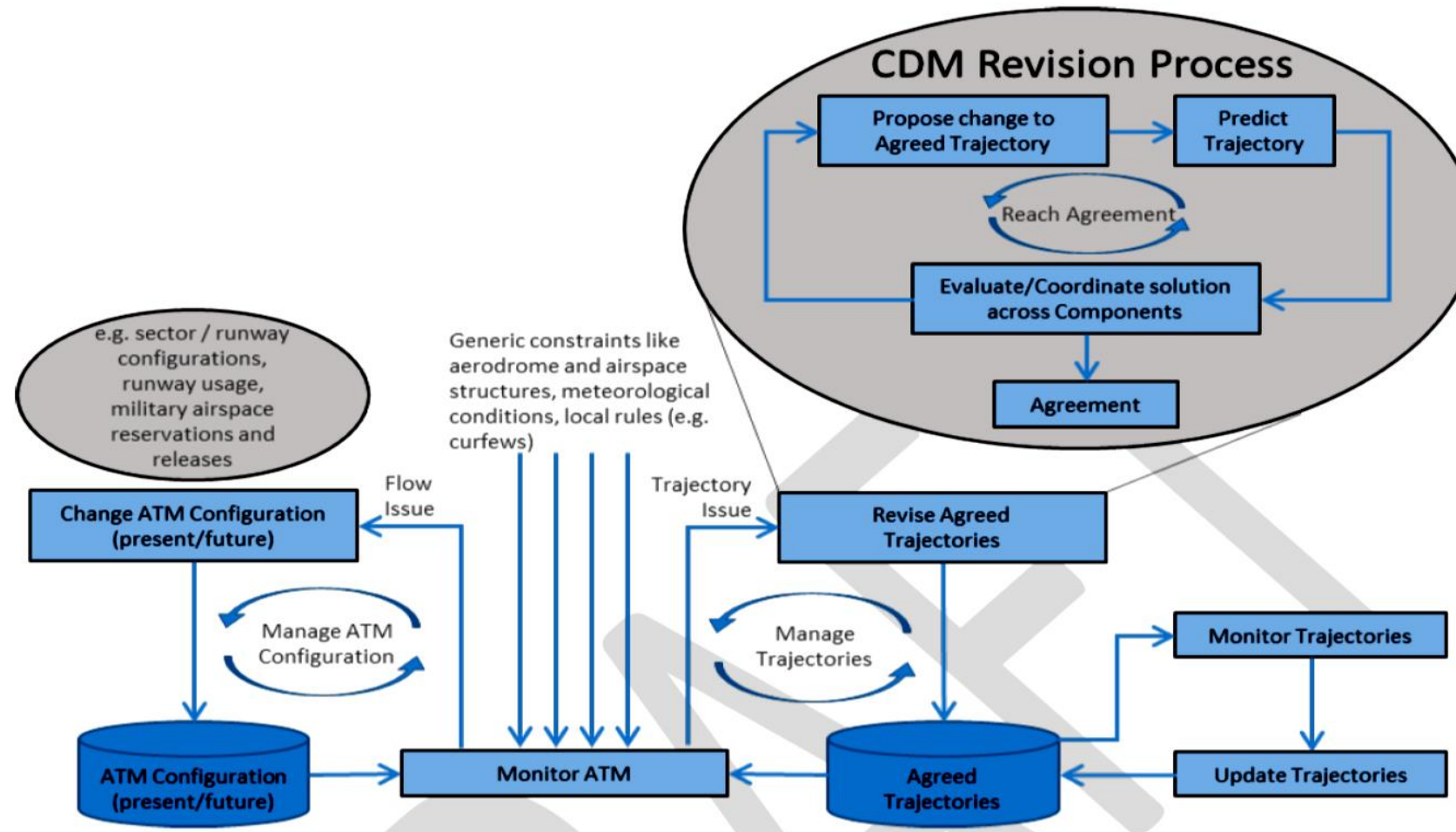


Agreed Trajectory

- On departure and remaining portion of flight, negotiations are carried out using FF-ICE/R2 mechanisms and changes to Agreed Trajectory can be made.
- Changes will be shared timely via air-ground and ground-ground systems

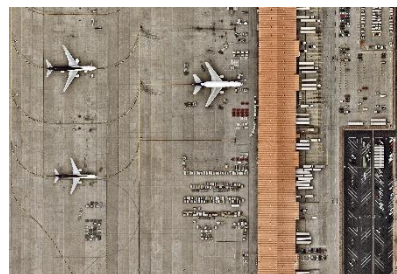
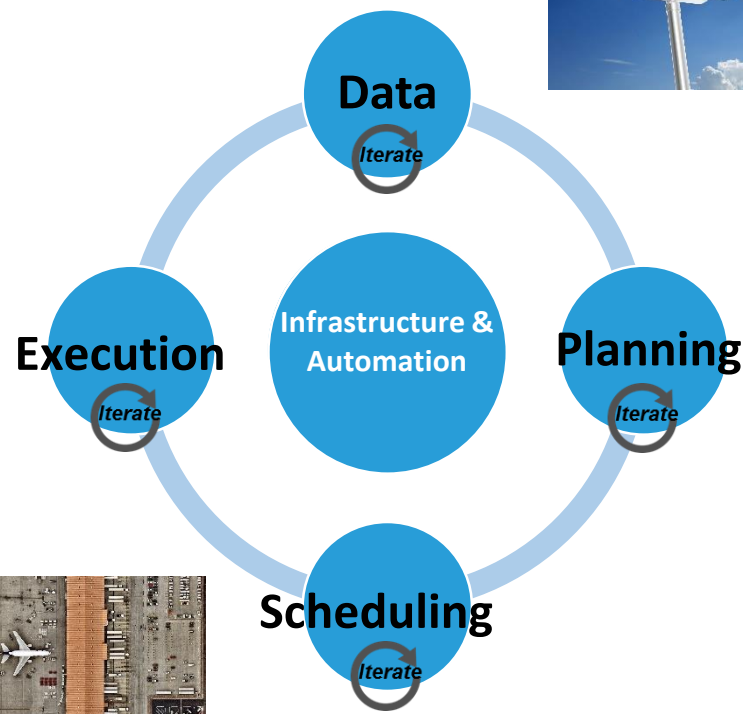


Management of ATM Ops in a TBO environment



Getting to TBO

Requires Partnership Among ANSPs and Operators



Key TBO Building Blocks

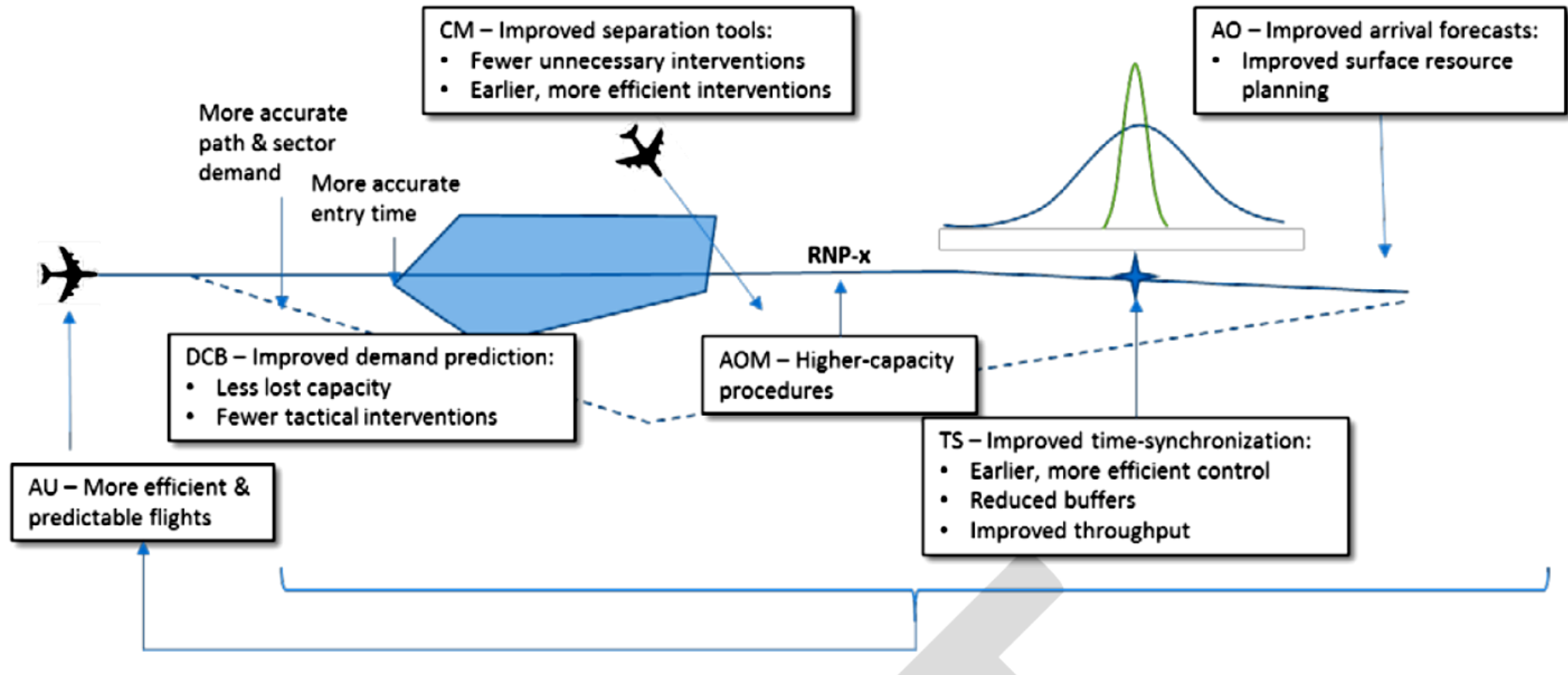
Based on ASBU Threads

Technology (ASUR and COMS)	Operations (NOPS)	Information (FICE and SWIM)
<p>ADS-B Monitoring via aircraft state</p> <p>ADS-C Aircraft-derived trajectory downlink for synchronisation</p> <p>CPDLC Delivery of closed, end-to-end clearance</p> <p>PBC, PBS, PBN Provide assurance on CNS performance characteristics</p>	<p>ATFM Improved trajectory forecast and enhanced DCB</p>	<p>FF-ICE Information environment supporting standards-based coordination, and trajectory planning & negotiation</p> <p>SWIM Technical infrastructure for collaborative environment</p>

Flight Deck Capabilities / Connected Aircraft

- FMS
 - Clearance execution (closed, end-to-end, RNP)
 - Aircraft-derived trajectory
- EFB / Mobile Device
 - Enables further air-ground connectivity
 - Provides applications for analysis & display

Benefits of Improved Trajectory Prediction Accuracy



02 Introduction to FF-ICE

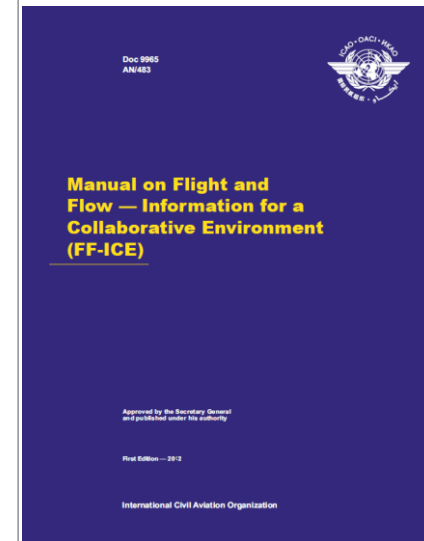
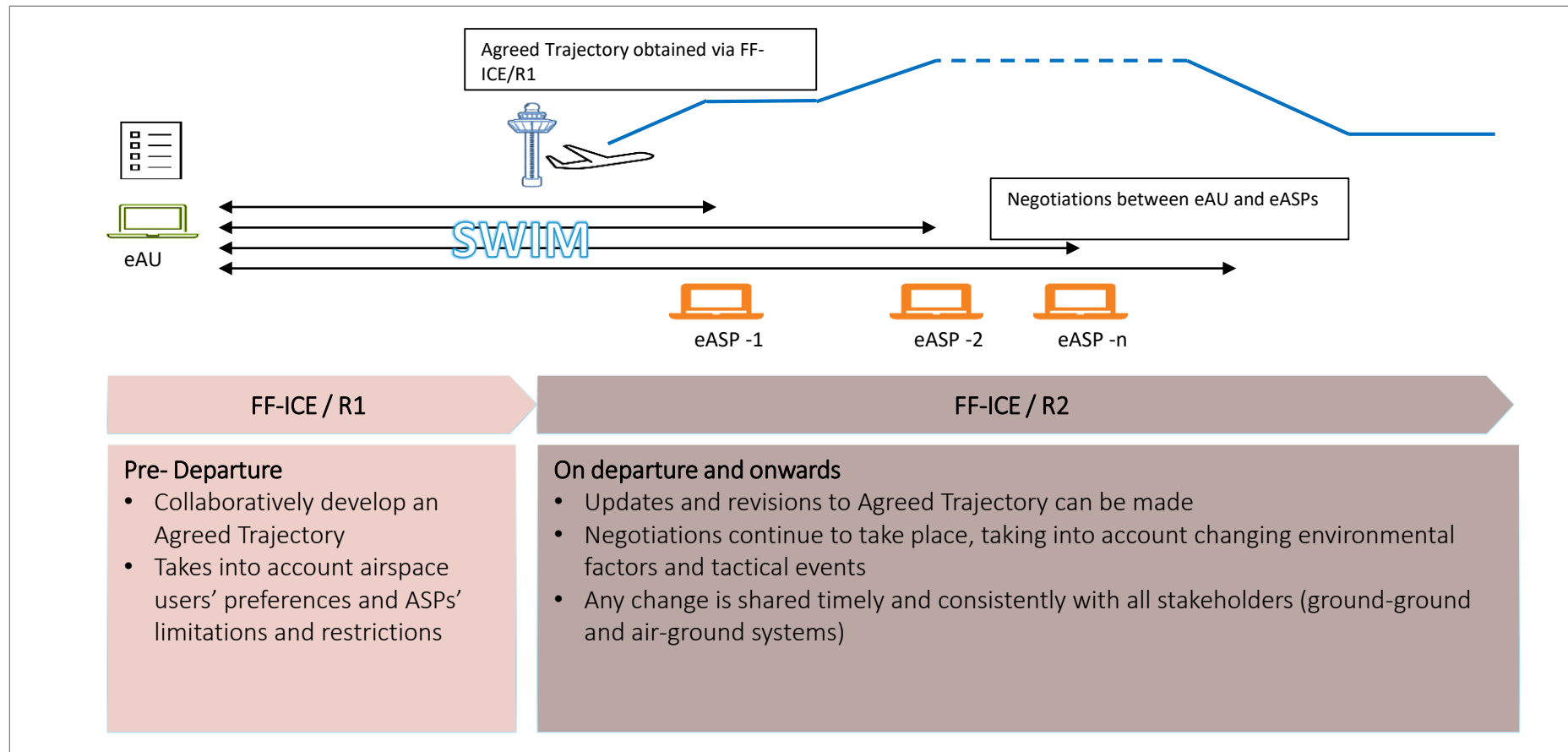
What is FF-ICE?

- Flight and Flow Information for a Collaborative Environment (FF-ICE) facilitates **sharing of 4D flight trajectory information among all stakeholders** to collaboratively establish a preferred flight trajectory between all parties
- FF-ICE will modernise the present day ICAO flight plan (FPL 2012) and flight planning process to enable the realisation of the ICAO Global ATM Operational Concept (GATMOC) vision and an essential enabler to support Trajectory Based Operations (TBO)

Vision Statement




To achieve an interoperable global air traffic management system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements

FF-ICE to support TBO



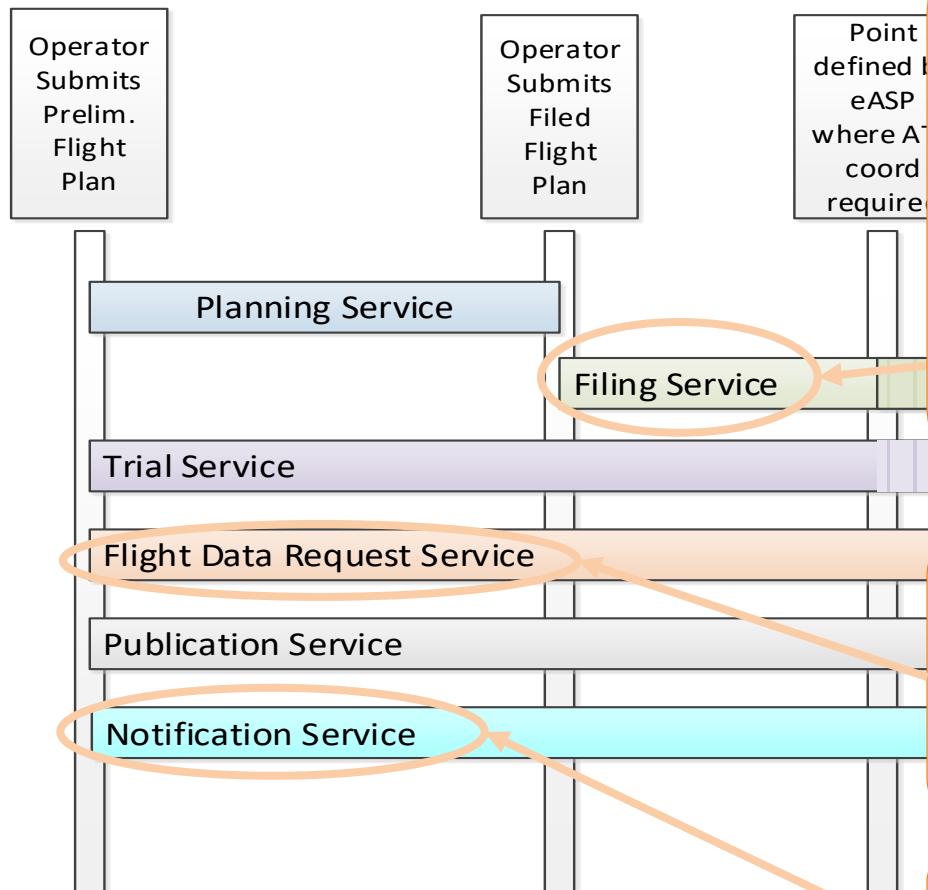
eFPL: FF-ICE flightplan
 eASP: FF-ICE capable ATM Service Provider
 aASP: non-FF-ICE capable ATM Service Provider
 eAU: FF-ICE capable Airspace User
 aAU: non-FF-ICE capable Airspace User

Difference Between FPL 2012 and FF-ICE

	FPL 2012	FF-ICE Flight Plan	Near Term Benefits
 <div style="border: 2px solid #00AEEF; border-radius: 15px; padding: 5px; display: inline-block;">Data Fields</div>	<ul style="list-style-type: none"> Limited data fields Fixed flight plan form 	<ul style="list-style-type: none"> Expansion of data fields providing more details possible XML schema 	<ul style="list-style-type: none"> Changes made with lower cost as FF-ICE flight plans are scalable
 <div style="border: 2px solid #00AEEF; border-radius: 15px; padding: 5px; display: inline-block;">Collaboration</div>	<ul style="list-style-type: none"> No acknowledgement upon receipt of flight plans aAUs unable to trial alternative routings aAUs unable to negotiate on trajectories 	<ul style="list-style-type: none"> Status feedback from eASPs for all submissions from eAUs eAUs allowed to trial alternative routings eAUs allowed to negotiate on preferred trajectories 	<ul style="list-style-type: none"> Higher predictability on routes and flight trajectory that will be given to flight eAUs can plan ahead and optimise flight trajectories ANSPs have more accurate demand information for planning of airspace utilisation/other resources. Filed flight plans are also more likely to be unaltered significantly
 <div style="border: 2px solid #00AEEF; border-radius: 15px; padding: 5px; display: inline-block;">Automation</div>	<ul style="list-style-type: none"> Manual processing and corrections required Lacks linkage to database of restrictions 	<ul style="list-style-type: none"> Extensive use of automation to conduct checks and compliances to restrictions Automated responses to eAUs SWIM enables subscription of required data from other systems 	<ul style="list-style-type: none"> Alleviates workload of human operator and minimise human error for both eAU and ANSPs
<div style="border: 2px solid #00AEEF; border-radius: 15px; padding: 5px; display: inline-block;">Main Usage</div>	<div style="border: 2px solid #00AEEF; background-color: #ADD8E6; padding: 10px;"> <p>Inform aASPs of flight intent; Individual aASP uses limited and static flight plan information for their own planning</p> </div>	<div style="border: 2px solid #00AEEF; background-color: #ADD8E6; padding: 10px;"> <p>A live flight plan with detailed trajectory, that is constantly updated as plans change, and consistently shared and used by all stakeholders</p> </div>	

eFPL: FF-ICE flightplan
 eASP: FF-ICE capable ATM Service Provider
 aASP: non-FF-ICE capable ATM Service Provider
 eAU: FF-ICE capable Airspace User
 aAU: non-FF-ICE capable Airspace User

Intro to 6 FF-ICE Services



Serves existing functions

- File flight plan (FPL)
- Update FPL

Improved features

- eASP to provide digital filing status to all FPLs (states whether flight plan is accepted)
 - Digital exchange of constraints information
 - Operator and eASP able to collaboratively reach an agreed trajectory
- Re-evaluation service – eASP updates filing status if there are new constraints

Serves existing function

- Replace current request for FPL

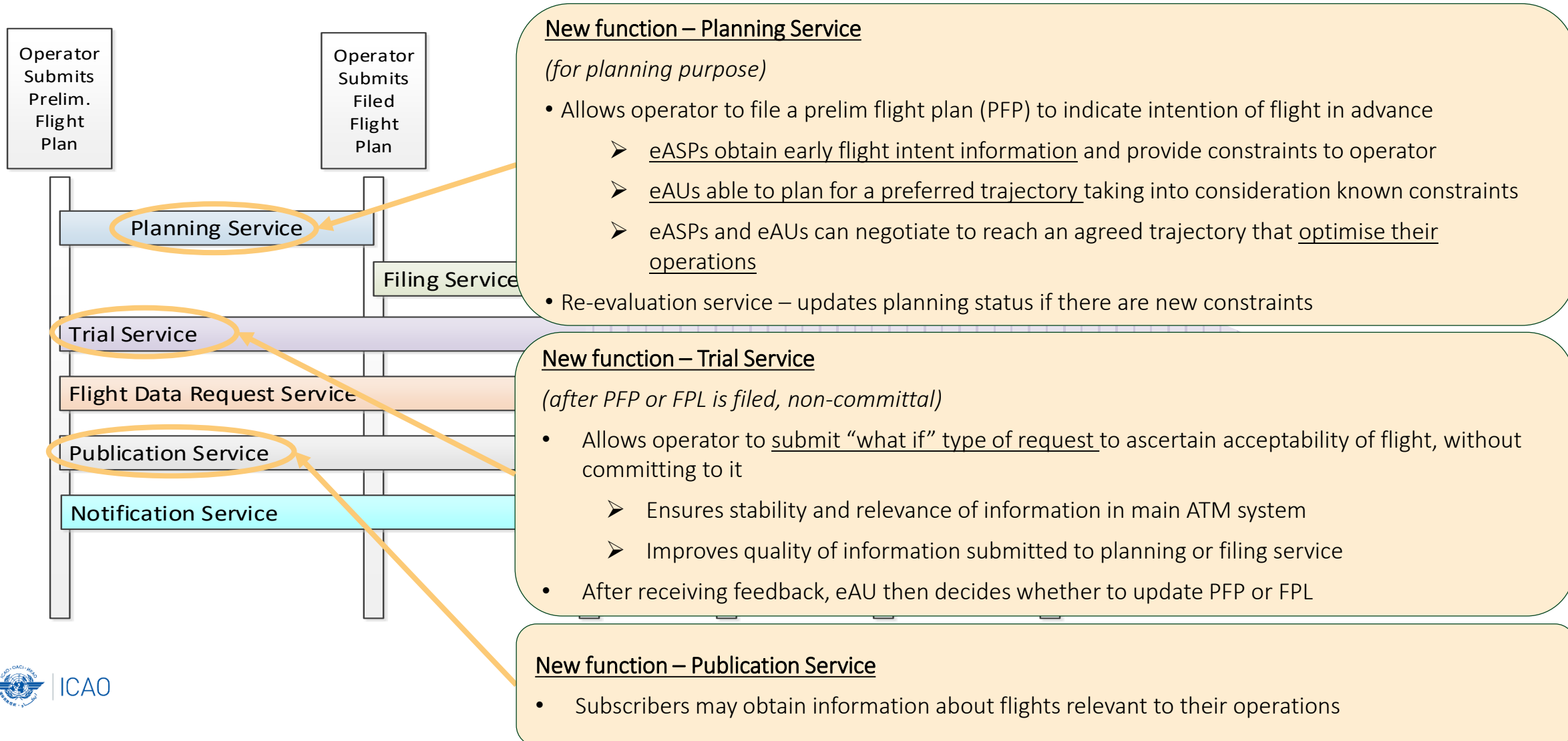
Improved features

- Request for status of the flight (**whether flight plan is accepted**)

Serves existing function

- Replace current Arrival and Departure notification thru' AFTN

Intro to 6 FF-ICE Services



Long Term Benefits FF-ICE?

Enhanced flight planning and ATM with FF-ICE

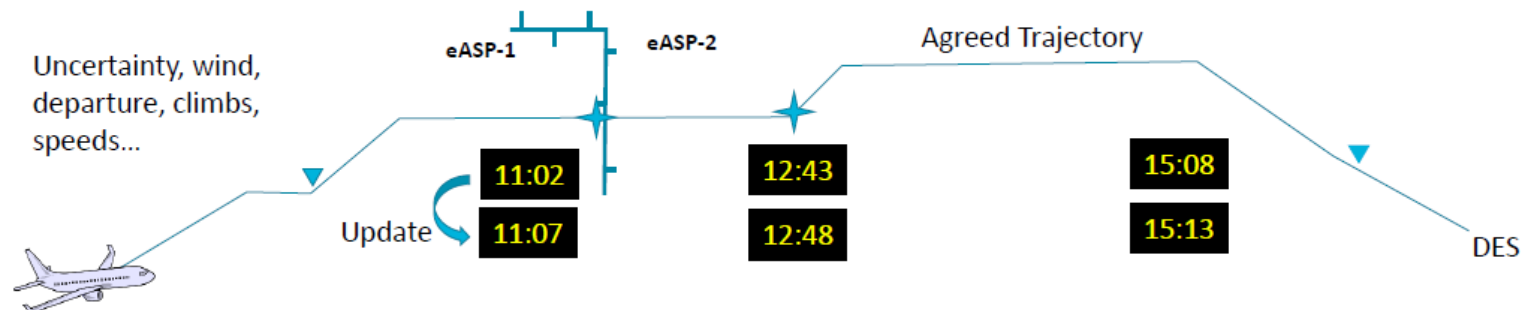
Increased predictability and accuracy of flight trajectories and pilot's intent. This will allow ATC to manage flights in advance to better utilise airspace and airport resources

Enables collaboration between ATM service providers and airspace users (through negotiations) to adjust and agree on final flight trajectory throughout entire phase of flight to better cater to ATM needs and user's preference. Harmonised way of issuance of time and/or altitude crossing restrictions to standardise air traffic flow management measures (demand/capacity balancing function)

Fundamental building block for future ATM

Future releases of FF-ICE will enable trajectory negotiation between ground and air nodes (while in flight) for more refined ATM – beyond DCB, FF-ICE can support even conflict management (CM) and traffic synchronisation (TS) to enhance safety and optimise airspace and airport capacity

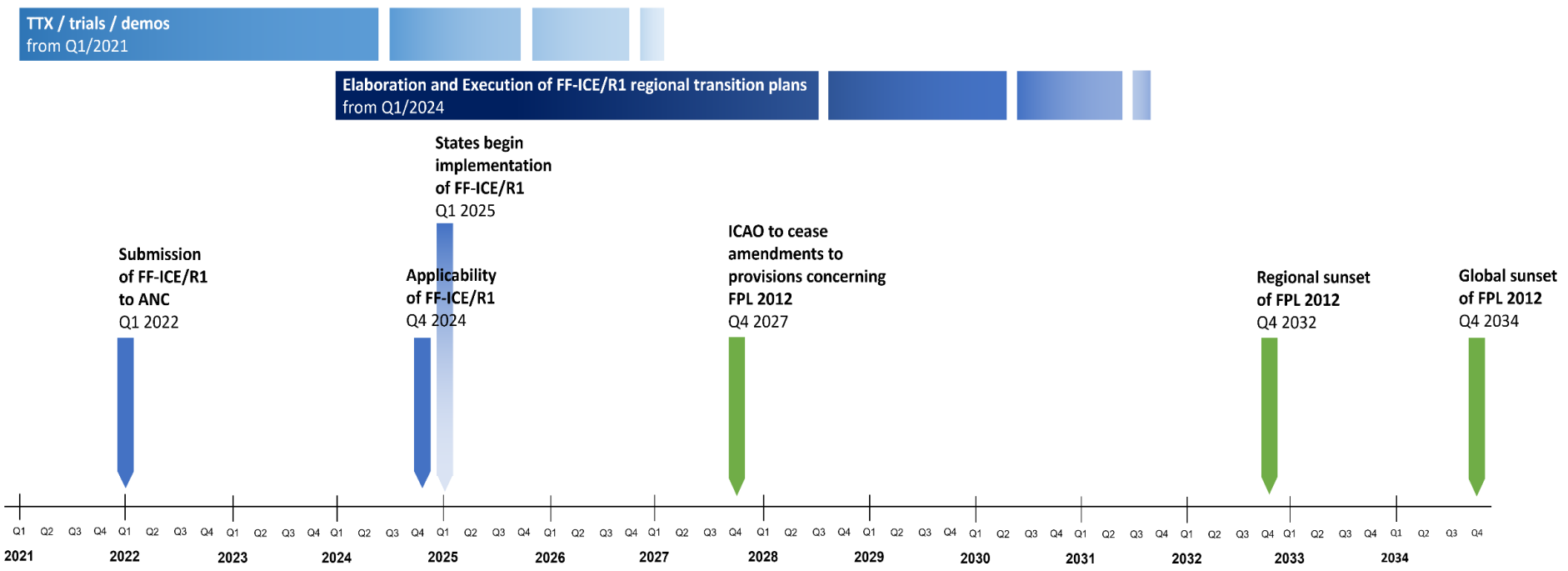
Implementing FF-ICE/R1 is first step to developing enhanced flight planning processes focused on pre-flight phase. It is also a fundamental building block for longer term vision of TBO. These are not solely FF-ICE benefits but could also be shared benefits of the other TBO building blocks.



Global Timeline

Overview of Implementation Strategy of FF-ICE

(Extract from ICAO Doc 9965 – Manual on FF-ICE (Draft of 2nd Edition))

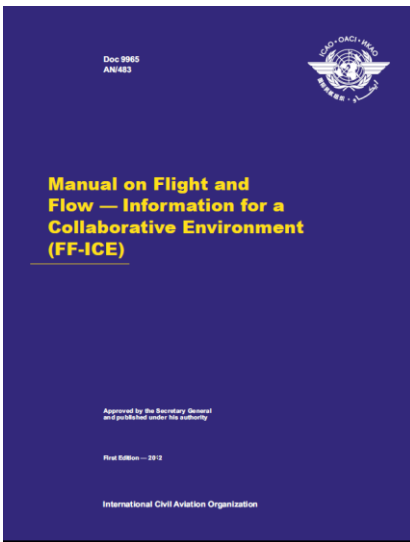


End 2024: FF-ICE/R1 provisions, concept documents and implementation guidance finalised and made applicable

2025 onwards: States begin implementation of FF-ICE/R1 including workshops, table-top exercises, demos and/or trials

End 2032: Regional sunset of FPL 2012

2034: Global sunset of FPL 2012



03

Phased Approach to Implementation Strategy

- Learning from FPL 2012 implementation, transition to FF-ICE flight plan will be a phased approach
- Provisions for FF-ICE/R1 is expected to be made applicable by 2024
- Mixed mode operations will likely be prolonged till sunseting of FPL2012 in year 2032-34
- ASP or AU may use **translators** to implement FF-ICE/R1 however full benefit may not be realised
- Incremental implementation of translators and/or **Minimum FF-ICE/R1**

Phased-Approach to FF-ICE(R1) Implementation

Non FF-ICE Capable	Use of Translators	Min FF-ICE/R1 Svc	Varying lvs of FF-ICE Implementation	Full FF-ICE/R1 Service
FPL2012 <ul style="list-style-type: none"> • Accepted 	FPL2012 <ul style="list-style-type: none"> • Accepted 	FPL2012 <ul style="list-style-type: none"> • Accepted 	FPL2012 <ul style="list-style-type: none"> • Accepted 	FPL2012 <ul style="list-style-type: none"> • Accepted
FF-ICE Flight Plan <ul style="list-style-type: none"> • Not Accepted 	FF-ICE Flight Plan <ul style="list-style-type: none"> • Accepted but limited utility 	FF-ICE Flight Plan <ul style="list-style-type: none"> • Accepted 	FF-ICE Flight Plan <ul style="list-style-type: none"> • Accepted 	FF-ICE Flight Plan <ul style="list-style-type: none"> • Accepted
FF-ICE/R1 Svc Provided <ul style="list-style-type: none"> • None 	FF-ICE/R1 Svc Provided <ul style="list-style-type: none"> • Filing Svc • Flt Data Req Svc 	FF-ICE/R1 Svc Provided <ul style="list-style-type: none"> • Filing Svc • Flt Data Req Svc 	FF-ICE/R1 Svc Provided <ul style="list-style-type: none"> • Filing Svc • Flt Data Req Svc • 1 or more other FF-ICE/R1 Svc 	FF-ICE/R1 Svc Provided <ul style="list-style-type: none"> • All 6 FF-ICE/R1 Svc

Implementing filing service & flight data request service would allow global sunset of FPL2012

Strategy to FF-ICE Phased Implementation

Global Strategy

- ICAO to spearhead with workshops, briefings and technical symposiums
- No more amendments to ICAO FPL 2012 unless due to aviation safety
- Promote minimal FF-ICE/R1 capability by system design

Regional Strategy

- Regional harmonised implementation approach to maximise benefits
- Establishing incremental steps for States' planned transition to FF-ICE/R1.
- Set transition dates for the regional

Pioneer Group (Proposed)

- Proposed formation of pioneer group for Asia/Pacific region as early implementors of minimum FF-ICE/R1 system capability



From Doc 9965 Vol II (draft)

Sharing by ATMB, Airways NZ, AEROTHAI, FAA and CAAS



Thank You!