The Free Route Airspace Implementation Workshop / 2

Bangkok, Thailand

13th Nov 2024

This event is jointly organised with

EU - Asia Aviation Partnership Projects (APP)

FRA - Bringing the World Together

FREE ROUTE OPERATION (FRTO) TRAINING FOR ATC

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FREE ROUTE OPERATION ≠ FREE FLIGHT

Technically all flights continue under controlled by ATC

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FREE ROUTE OPERATION

IMPACT ON ATC

- AIRSPACE ORGANISATION
- CONFLICT MANAGEMENT
- ATC PROCEDURES
- COORDINATION PROCEDURES
- WORKING METHOD

TRAINING NEEDS

- FRTO CONCEPT
- AIRSPACE MANAGEMENT IN FRTO
- PBN FOR ATC
- ATC PROCEDURES
- FLIGHT PLANNING

- COORDINATION PROCEDURES
- ATMAS – HUMAN MACHINE INTERFACE
- CONFLICT DETECTION TOOLS
- AIR SITUATION DISPLAY
- TOWARDS TRAJECTORY BASED OPERATION

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ATC PROCEDUREs

- Separation Minima
- Phraseology
- Contingency procedures
- Human Machine Interface (HMI)
- FPL

Implementation of FRTO **DOES NOT CHANGE** CURRENT APPLICABLE ATC procedures!

ATCO need to familiar with the COMPLEXITIES of FRTO CONCEPT, increase SITUATIONAL AWARENESS, and optimizing ATM Automation System (ATMAS) tools & features
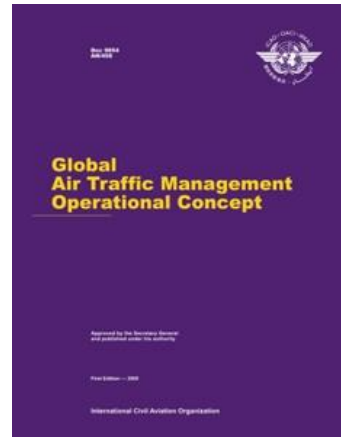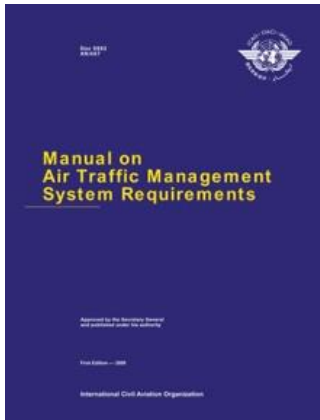
FRTO CONCEPT

REFRESH TRAINING

SIMULATION

FRTO CONCEPT

DEFINITION: FRA, FRTO, UPR

| FRA	FRTO	UPR
A specific airspace within which airspace users may freely PLAN a route between a defined entry point and a defined exit point with the possibility to route via intermediate way points without referring to the ATS route network.	An airspace design concept where aircraft can plan their routes freely within a specified airspace, without being constrained by fixed airways	A flight path chosen by an aircraft operator based on operational preferences, typically for efficiency, time savings, or fuel optimization, while still adhering to airspace constraints and ATC requirements.

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TYPES OF FRTO

DIRECT ROUTE OPERATION (DRO)
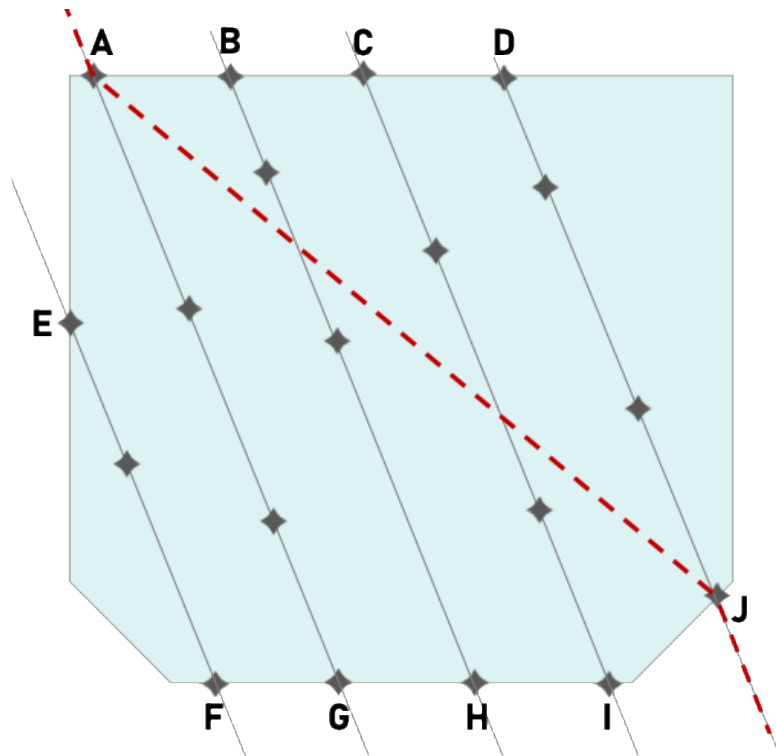
Direct ENTRY to EXIT
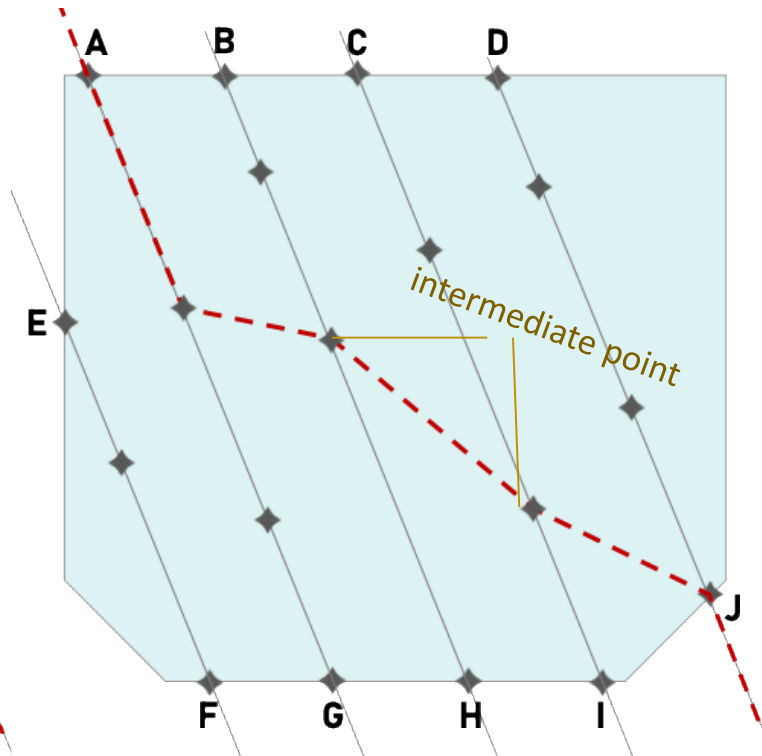
Direct via Intermediate Point

intermediate point

FREE ROUTE OPERATION (FRTO)
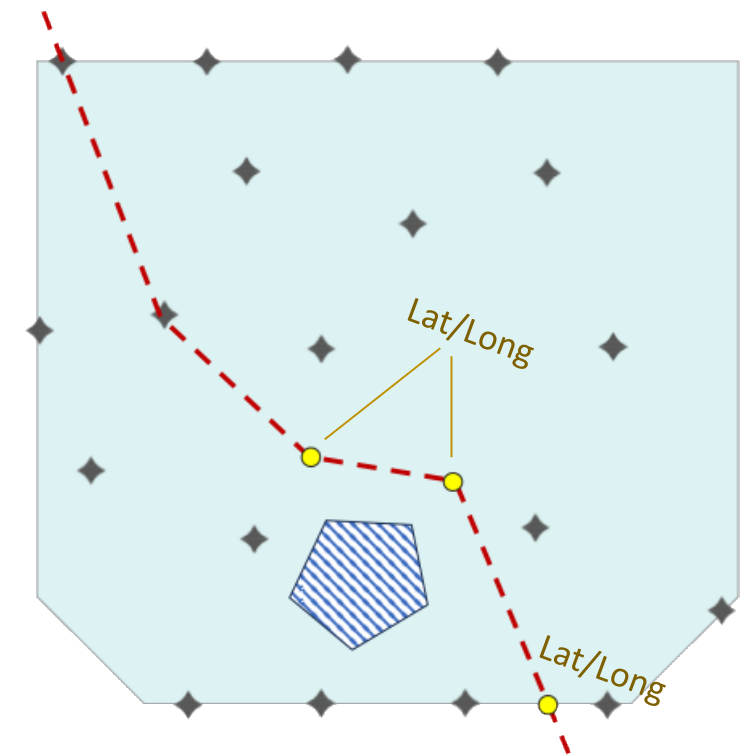
Free Route using LAT/LONG

Lat/Long

Lat/Long

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UNDERSTANDING FRTO RULES

AIRSPACE MANAGEMENT	TRAJECTORY CONSTRUCTION RULES	TYPE OF FLIGHT	FUA
Vertical Limit	FRTO types	Domestic	Avoid PRD
Horizontal Limit	Duration without point	International	Conditional routes
Near boundary ops	Lat/long at boundary	Overflying	
Cross border	Lat/long at designated		
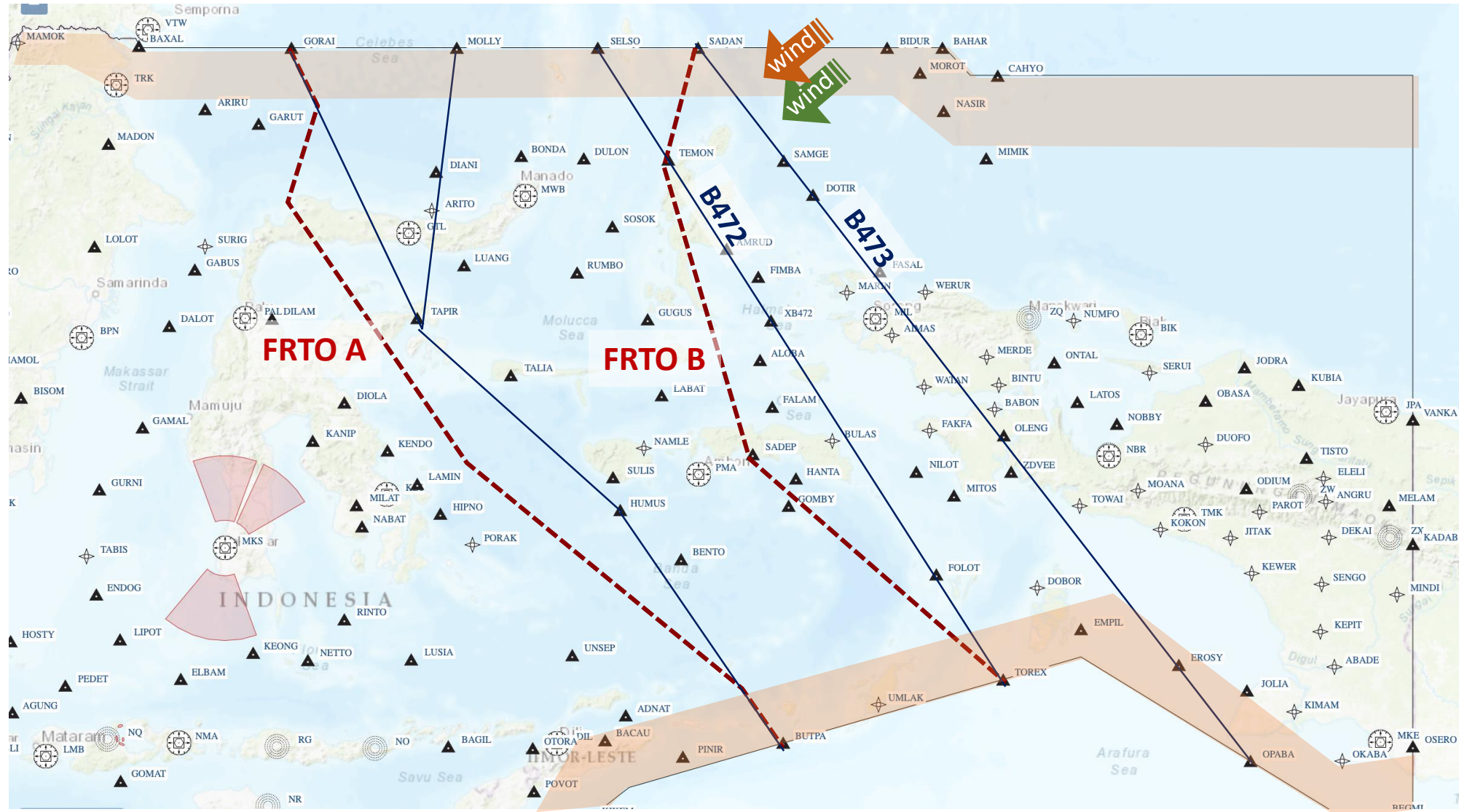
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CONFLICT MANAGEMENT

HOT SPOTs CHANGES

Routine hot spots   **Dynamic hot spot**

- FRTO implementation ~~may~~ result in more complicated traffic conflict management

- As aircraft trajectory no longer fixed (ATS route), ATC cannot rely on routine hot spot locations

- Dynamic hot spots easily multiply for one or more FRTO

- ATC need to utilize more ATMAS tools, especially prediction & conflict detection feature, as developed.

- Simulator exercise must cover as many conflict scenario as it can

SEPARATION APPLICATION

SURVEILLANCE ENVIRONMENT

- Apply standard surveillance separation minima: 5NM or 10NM or as applicable
- Control technique: Vectoring
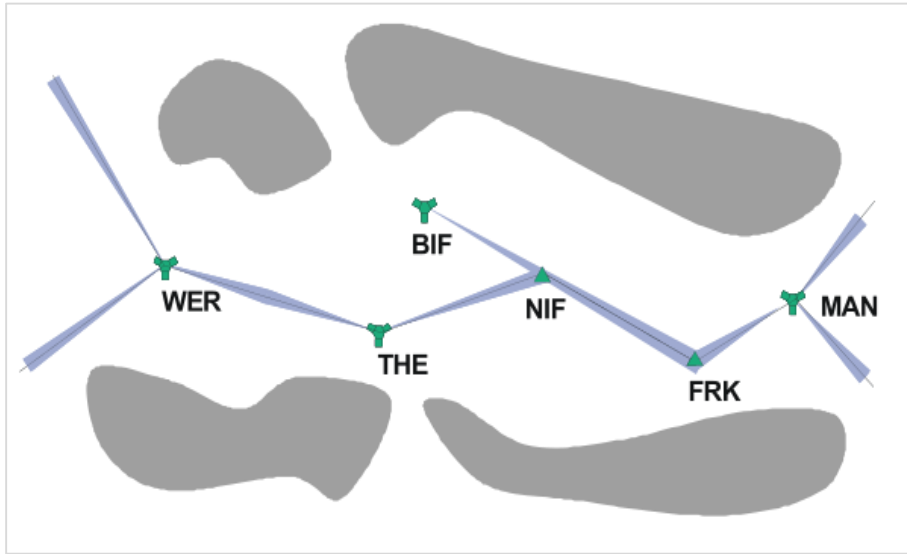
PROCEDURAL ENVIRONMENT

- ❑ Apply procedural and PBN (+ PBCS) separation
  - ❑ Lateral separation
  - ❑ Longitudinal
- ❑ Control technique
  - ❑ Time restriction
  - ❑ Distance reporting

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PBN FOR ATC

PBN AS FRTO ENABLER

Performance Based Navigation (PBN) is an area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Area navigation principles permit aircraft operation on any desired flight path within the coverage of ground or space based navigation aids or within the limits of the avionics onboard the aircraft, or a combination of these

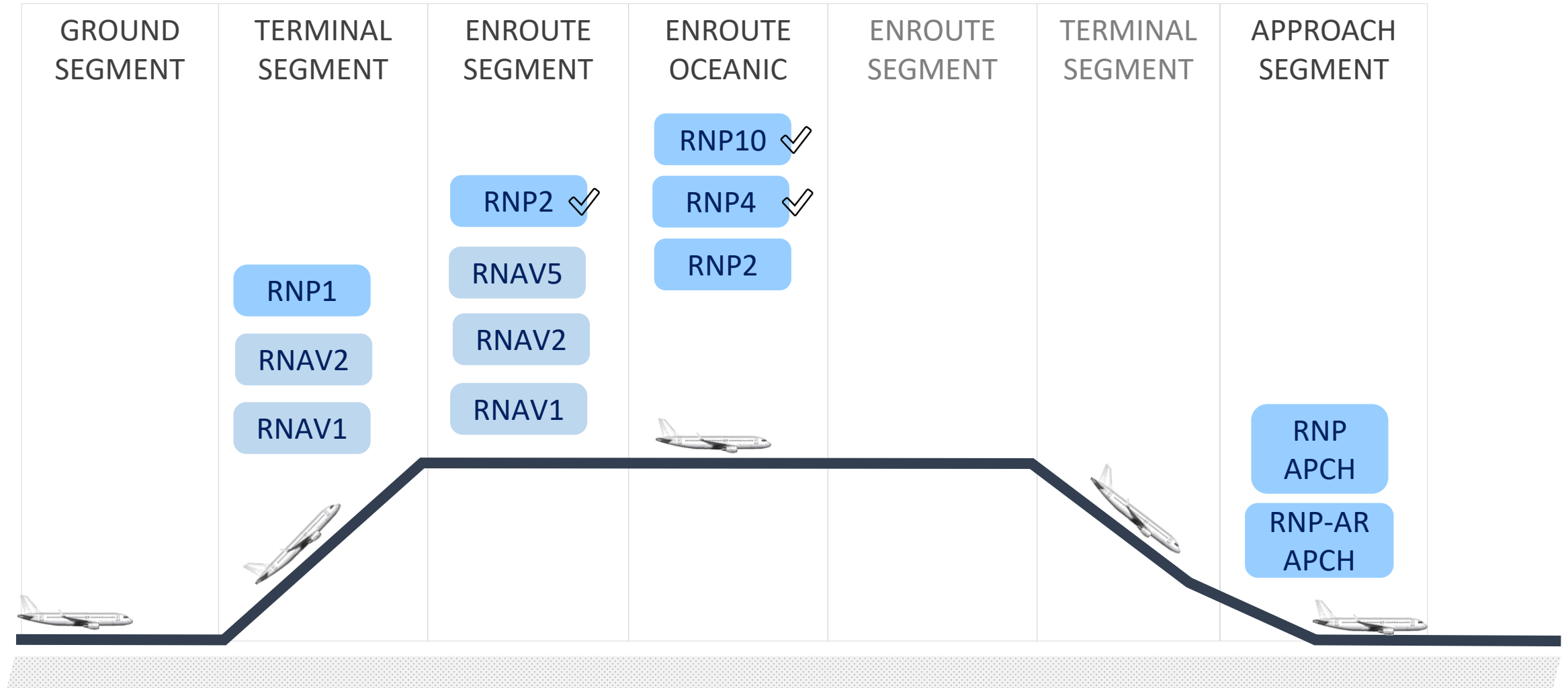**FRA -** **Bringing the World Together**
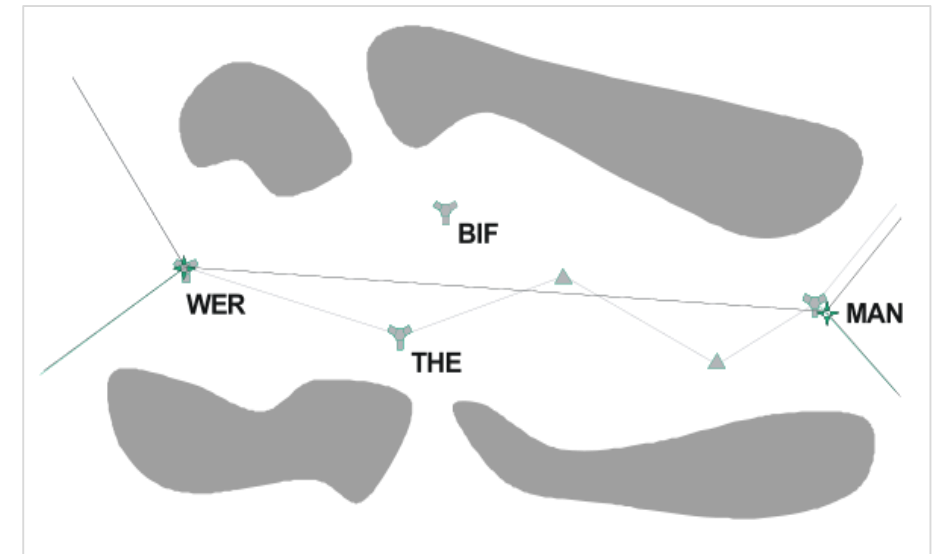
PBN FOR ATC TRAINING
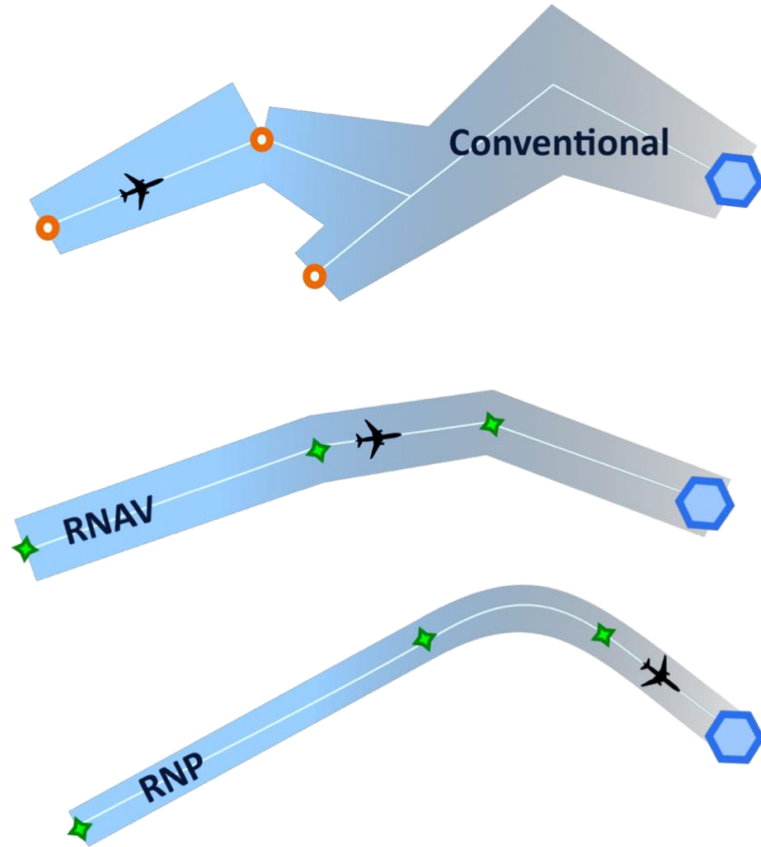
- Based on ICAO PBN Document 9613 Volume II Part B and Part C section x.2.6, PBN training for ATC consist of:
  - Core Training
  - Navigation Specification training

CORE TRAINING	NAVSPEC TRAINING

1. How area navigation system works in this area
2. Flight plan requirements
3. ATC procedures
   a. ATC Contingency procedures
   b. Separation minima
   c. Mixed equipped environment
   d. Transition between different operating environment
   e. Phraseology
	[depends on the PBN navigation specification implemented in your airspace]

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NAVIGATION SPECIFICATION APPLICATION

GROUND SEGMENT	TERMINAL SEGMENT	ENROUTE SEGMENT	ENROUTE OCEANIC	ENROUTE SEGMENT	TERMINAL SEGMENT	APPROACH SEGMENT
	RNP1	RNP2 ✓	RNP10 ✓			RNP APCH
	RNAV2	RNAV5	RNP4 ✓			RNP-AR APCH
	RNAV1	RNAV2	RNP2			
		RNAV1				

✓ **Implemented = specific training needs**

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SPECIFIC NAVIGATION SPECIFICATION TRAINING

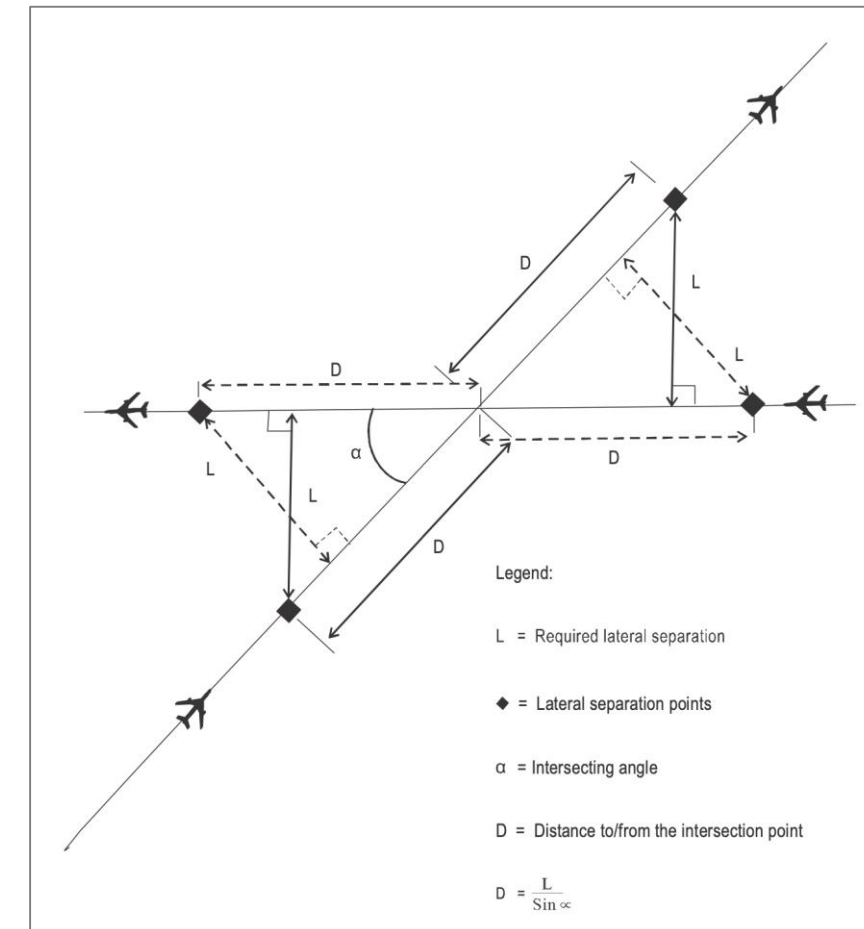| RNP/RNAV 10	RNAV2 (ENROUTE)	RNP4

1. Functional capabilities and limitation of RNP/RNAV 10
2. Accuracy, integrity, availability & continuity
3. GPS receiver, RAIM, fault detection and exclusion (FDE) and integrity alerts
4. Reporting of gross navigation error
	1. Functional capabilities and limitation of RNAV 2
	2. Accuracy, integrity, availability & continuity
	3. GPS receiver, RAIM, FDE and integrity alerts
	4. Waypoint fly-by versus fly-over concept (and differences in turn performance)
		1. Functional capabilities & limitation of RNP 4
		2. Accuracy, integrity, availability and continuity including on-board performance monitoring and alerting
		3. GPS receiver, RAIM, FDE and integrity alerts
		4. Waypoint fly-by versus fly-over
		5. For application 30/30 separation minima
		   a. CPDLC communication
		   b. ADS-C system and simulation training
		   c. Effect of periodic reporting delay/failure on longitudinal separation.

PBN SEPARATION

ICAO Doc 4444 PANS-ATM 16th Edition, Chapter V (separation) ICAO introduce application of **PBN separation minima** which are not sensor based (like VOR, VOR/DME) but **performance requirement based** (RNP, RCP, RSP).

- Lateral separation between aircraft operating on intersecting tracks or ATS routes shall be established in accordance with the following.

  - an aircraft converging with the track of another aircraft is laterally separated until it reaches a lateral separation point that is located a specified distance measured perpendicularly from the track of the other aircraft; and

  - an aircraft diverging from the track of another aircraft is laterally separated after passing a lateral separation point that is located a specified distance measured perpendicularly from the track of the other aircraft.

Navigation	Separation
RNAV 10 (RNP 10)	93 km (50 NM)
RNP 4	42.6 km (23 NM)
RNP 2	27.8 km (15 NM)

Legend:

L = Required lateral separation

◆ = Lateral separation points

α = Intersecting angle

D = Distance to/from the intersection point

$$D = \frac{L}{\sin \alpha}$$
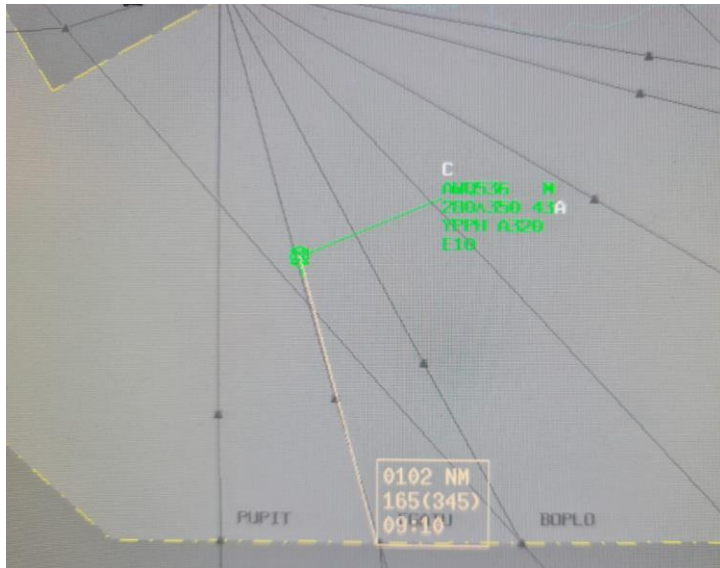
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ATMAS FEATURE

BRL & FPCP

BEARING AND RANGE LINE (BRL)

It provides a means of measuring the bearing (direction) and distance between map locations and aircraft. It also provides a time estimate for an aircraft at a point.

FLIGHT PLAN CONFLICT PROBE (FPCP)

It provides data for a display to air traffic controllers whenever any two aircraft are predicted to approach each other within certain separation criteria in the horizontal and vertical dimensions
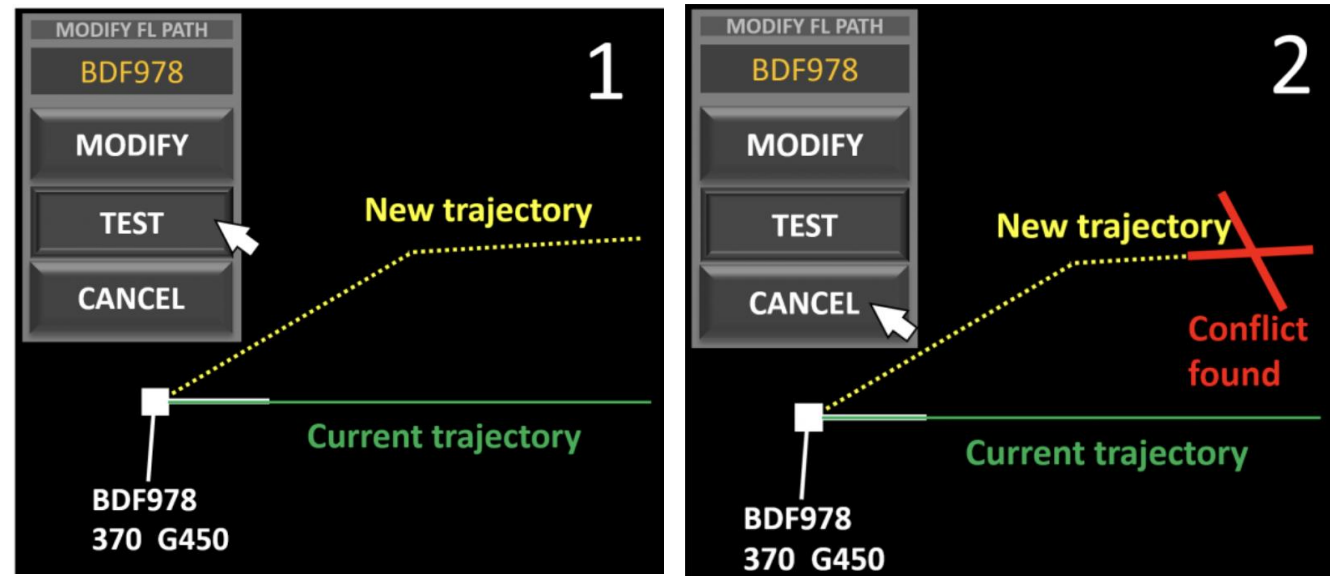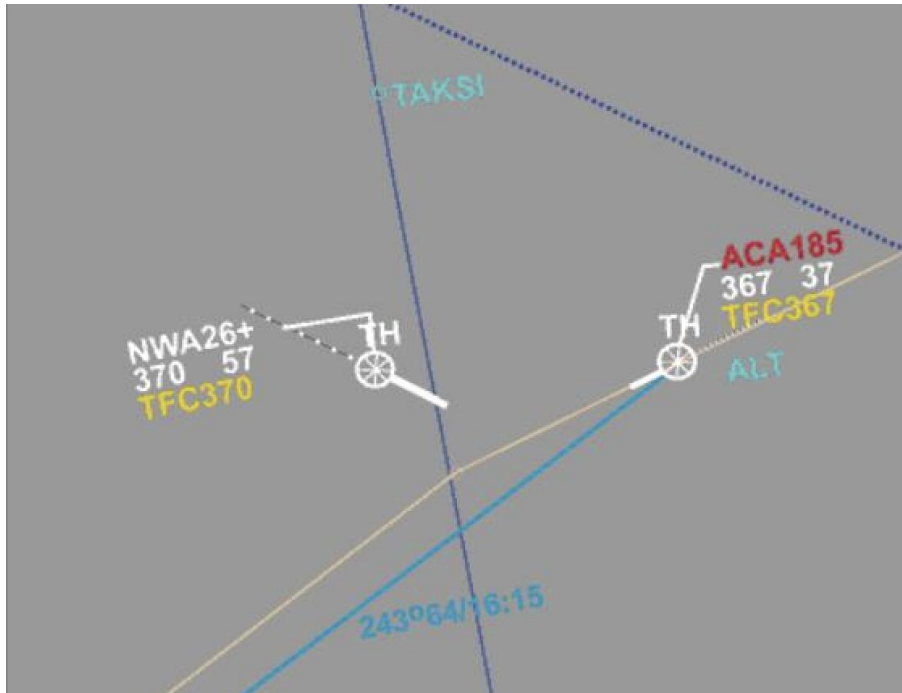
MTCD & TCT

MEDIUM TERM CONFLICT DETECTION (MTCD)

MTCD is a flight data processing system added functionality designed to warn the controller of potential conflict between flights in his area of responsibility in a time horizon extending up to 20 minutes ahead.

TACTICAL CONTROLLER TOOL (TCT)

TCT warns the executive (tactical) controller of potential conflicts within the sector. To do this it usually combines current aircraft tracks with an accurate tactical trajectory that reflects the aircraft's current behaviour.
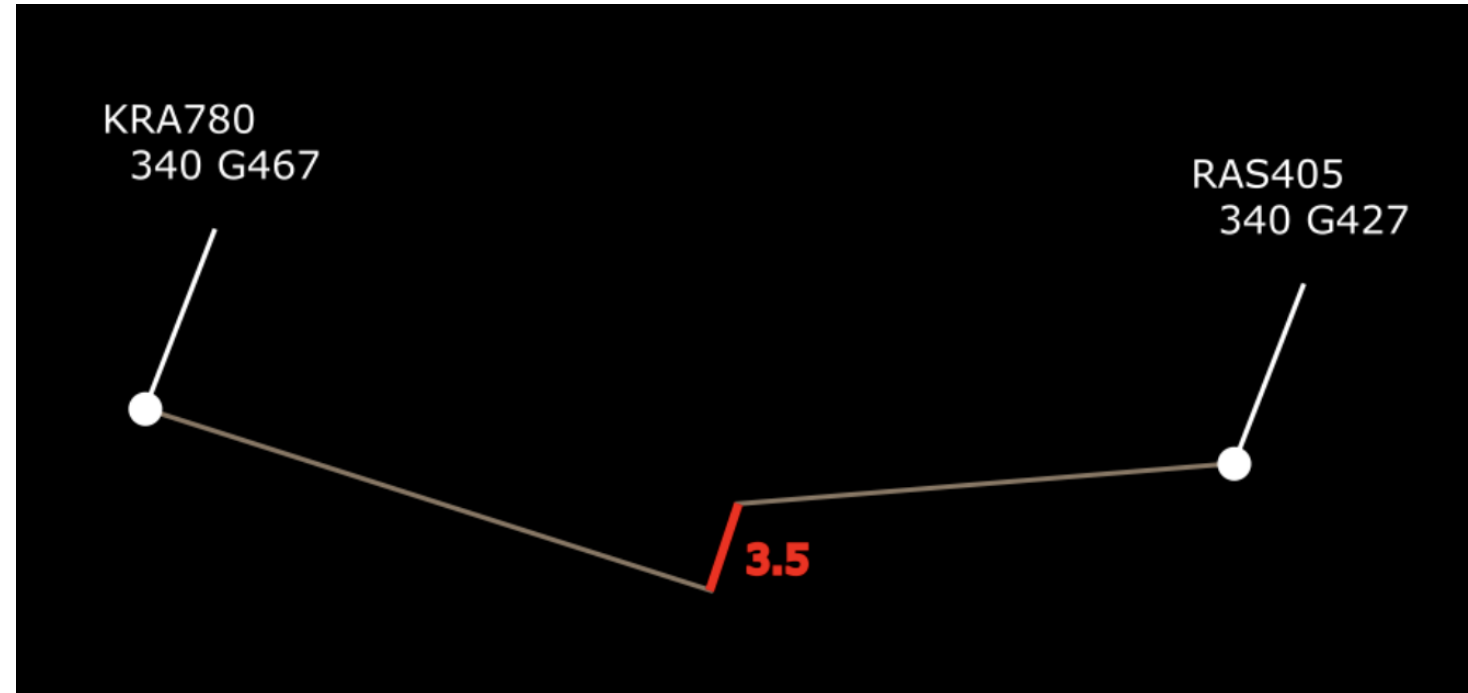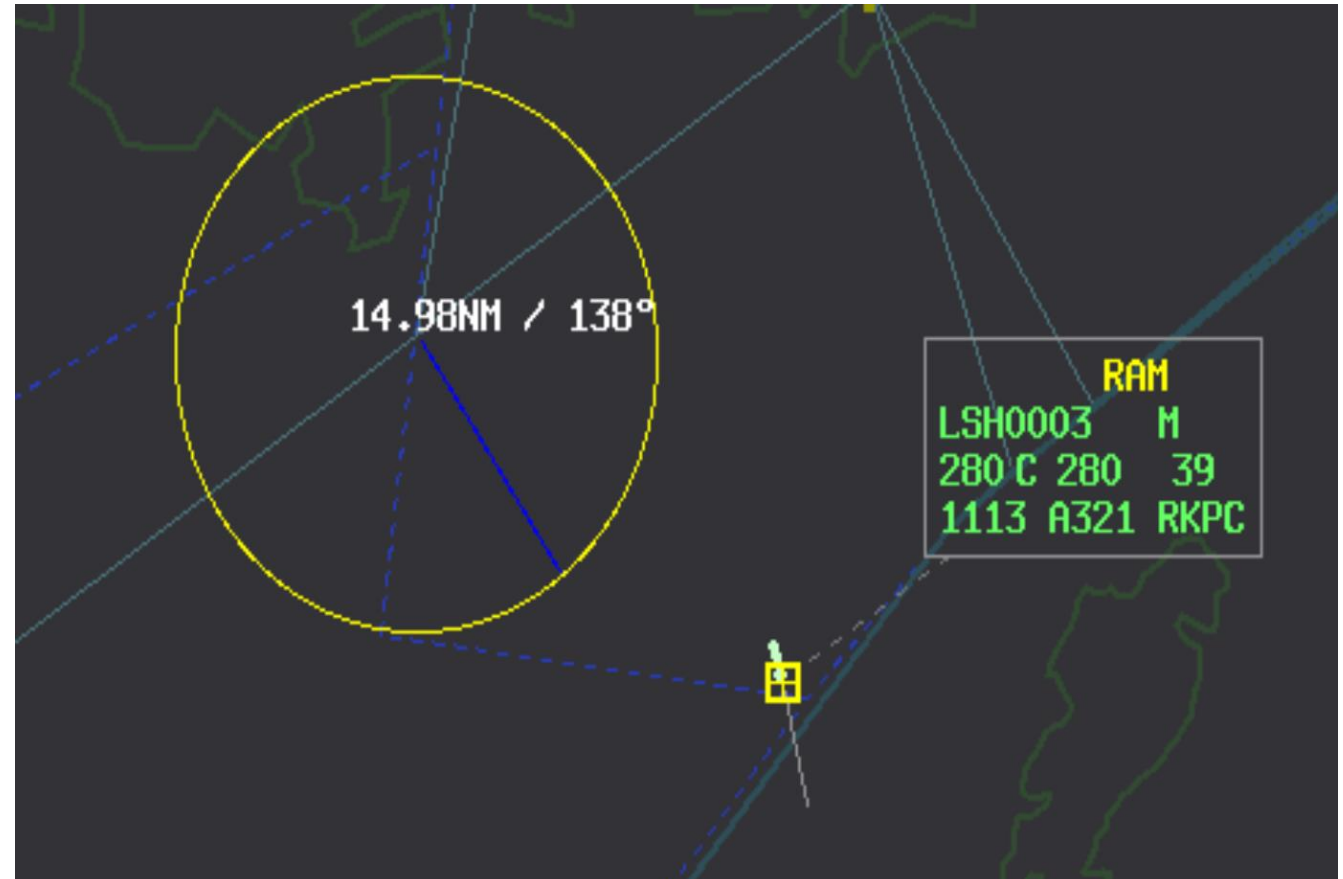
Route Adherence Monitoring (RAM) is a controller advisory tool designed to assist in the early identification of a variation between the actual and the expected trajectory.).

In FRTO where the trajectory of aircraft may not align with ATS route, RAM provides advance warning for controllers, in case of lateral deviation which COULD LEAD TO LOSS OF SEPARATION (the aircraft turns towards another one) or AIRSPACE INFRINGEMENT (the aircraft turns towards an area reservation or a volume of controlled airspace).

FLIGHT PLANNING

Flight planning check item depending on the FRTO Rules & Requirement:

- Equipment: item 10
  - PBN, ADS–C, CPDLC, etc.

- Trajectory rules: item 15
  - Entry/Exit point
  - Intermediate point
  - Designated point

- Identifying FRTO flights
  - Remark for flying FRTO (item 18), example: RMK/UPRINA

TOWARDS TRAJECTORY-BASED OPERATION

- FRTO directly supports Trajectory Based Operation (TBO) by giving aircraft more flexibility to plan their own optimal routes, which, in turn, supports collaborative trajectory negotiation.

- Trajectory Based Operation (TBO) represents a paradigm shift in air traffic management by focusing on the management of aircraft trajectories in four dimensions: latitude, longitude, altitude, and time.

- This is achieved through the use of advanced data exchange systems, predictive algorithms, and real-time communication between aircraft and ground systems
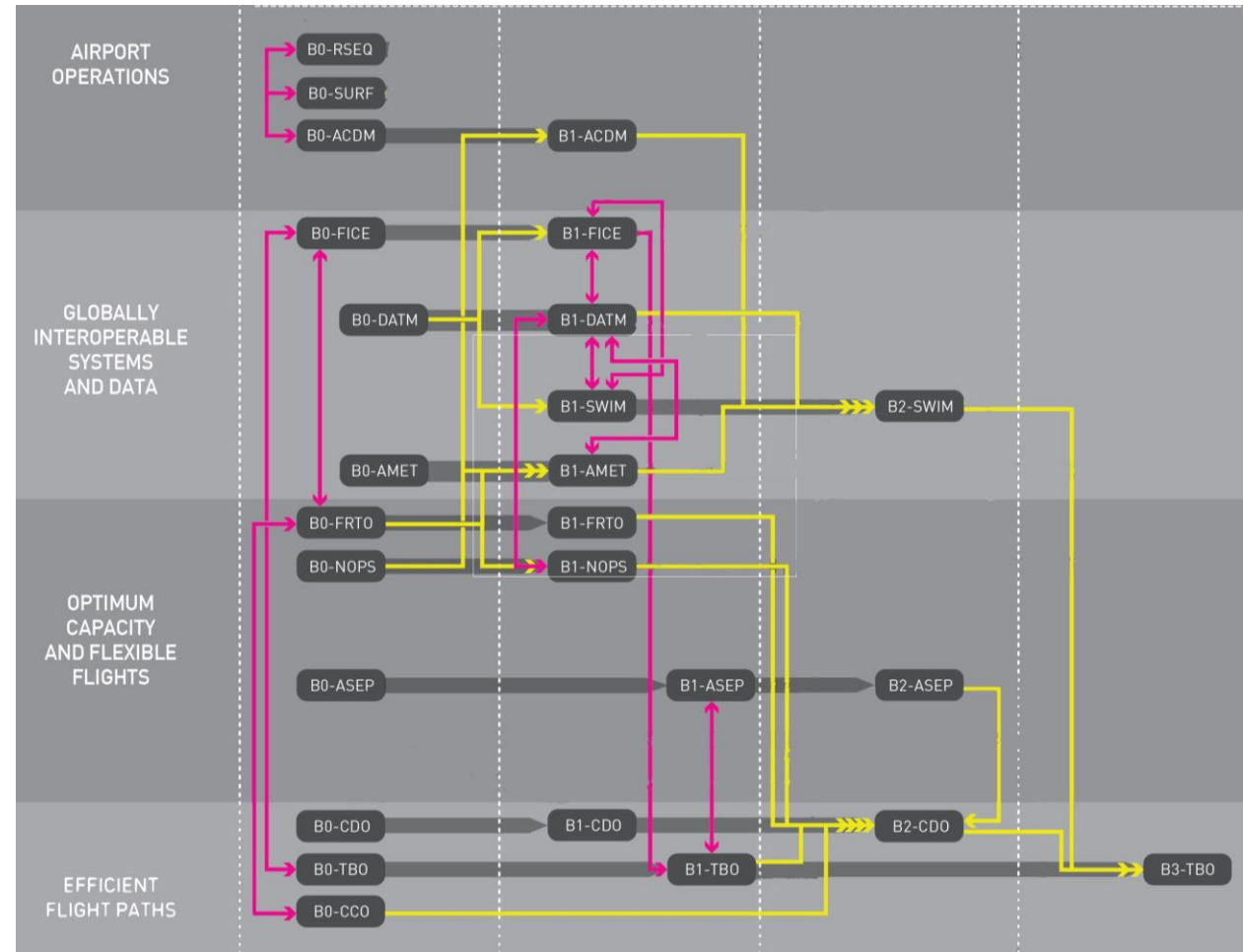
ASBU Dependencies (ICAO Doc. 9750 V.5 2016)

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KEY TAKEAWAYS

- Free Route is not a free flight. (Currently), aircraft flying FRTO is still controlled by ATC

- FRTO implementation does not change most ATC related procedure, however it needs to adapt to FRTO rules;

- Build training syllabus including simulator exercise that fit with FRTO rules which are implemented

- Optimize ATM automation system features to support ATC operation managing FRTO

- Introduce simple rules, gradually to more complex FRTO rules

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Thank You