PBN Procedure Design Course 2026

ICAO APAC FPP

Beijing,China

(7-25/Sep/2026)

CONTINUOUS DESCENT OPERATIONS (CDO)

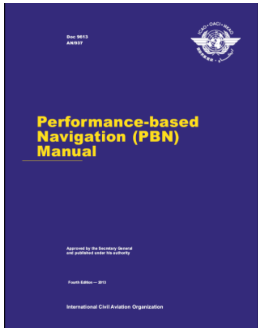
CONTENTS

- General Overview
- Optimum Vertical Path
- Facilitating CDO
- Benefits of CDO
- CDO Design
- CDO Design Methods
- CDO Implementation

1.GENERAL OVERVIEW

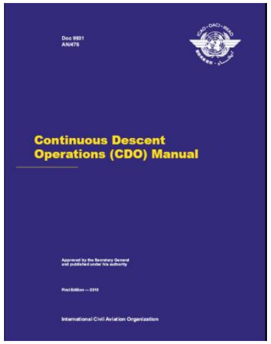
❖CDO, CCO, and Airspace

ICAO Doc 9613
PBN Manual

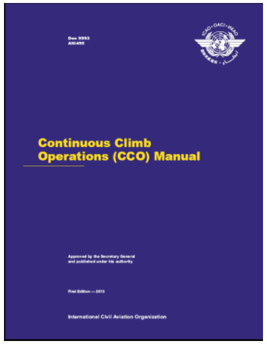


ICAO Doc 9992
PBN Airspace Design

ICAO Doc 9931
CDO



ICAO Doc 9993
CCO



CDO IMPLEMENTATION

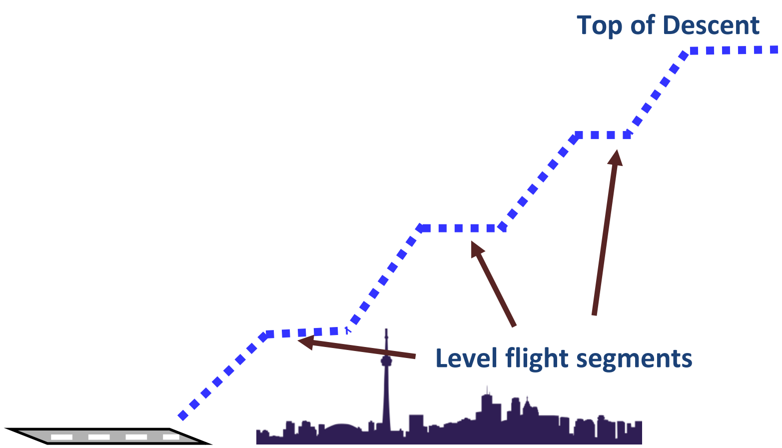
CCO IMPLEMENTATION

GENERAL OVERVIEW

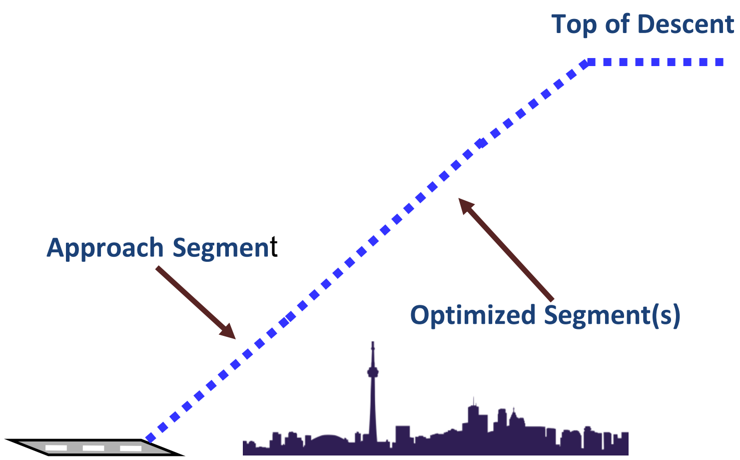
- CDO is an aircraft operating technique
  - Aided by appropriate airspace design, procedure design, and appropriate ATC clearance
  - Enabling the execution of a flight profile optimized to the operating capability of the aircraft
  - With low engine trust setting and a low drag configuration
  - Thereby reducing fuel burn and emissions during descent
- CDO should always be considered by
  - airspace designers and procedure designers
  - especially when implementing new Arrivals (STAR) and Approaches
- Usable by 85% of the aircraft, 85% of the time

GENERAL OVERVIEW

Conventional Step-down



Continuous Descent Operations

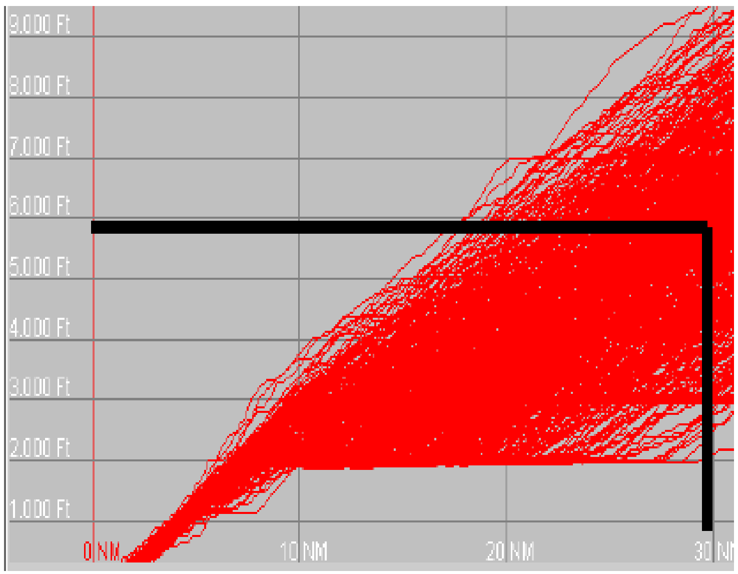


➡ **But in reality long and high-beginning CDOs are VERY DIFFICULT to achieve**

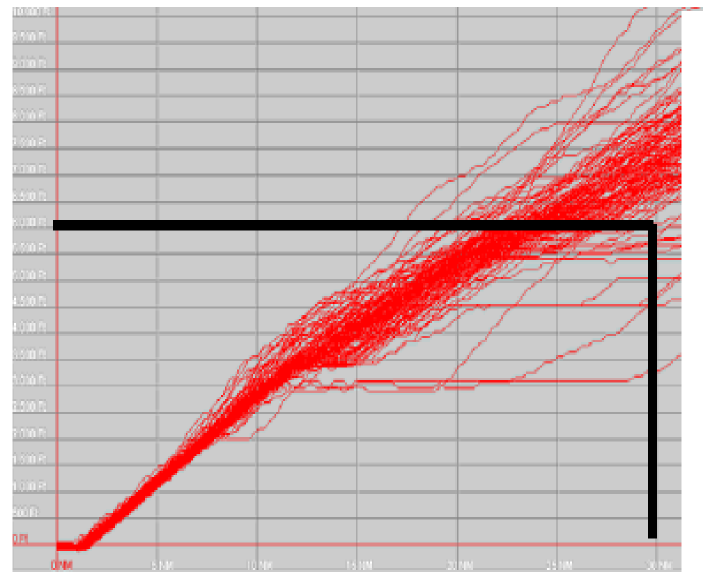
2.OPTIMUM VERTICAL PATH

- The optimum vertical path angle will vary depending on:
  - Type of aircraft and its actual weight
  - Weather (wind, temperature, atmospheric pressure, icing conditions)
  - Other dynamic considerations
- The maximum benefit is achieved by keeping the aircraft as high as possible until it reaches the optimum descent point.

OPTIMUM VERTICAL PATH



Flight tracks before CDO



Flight tracks after CDO

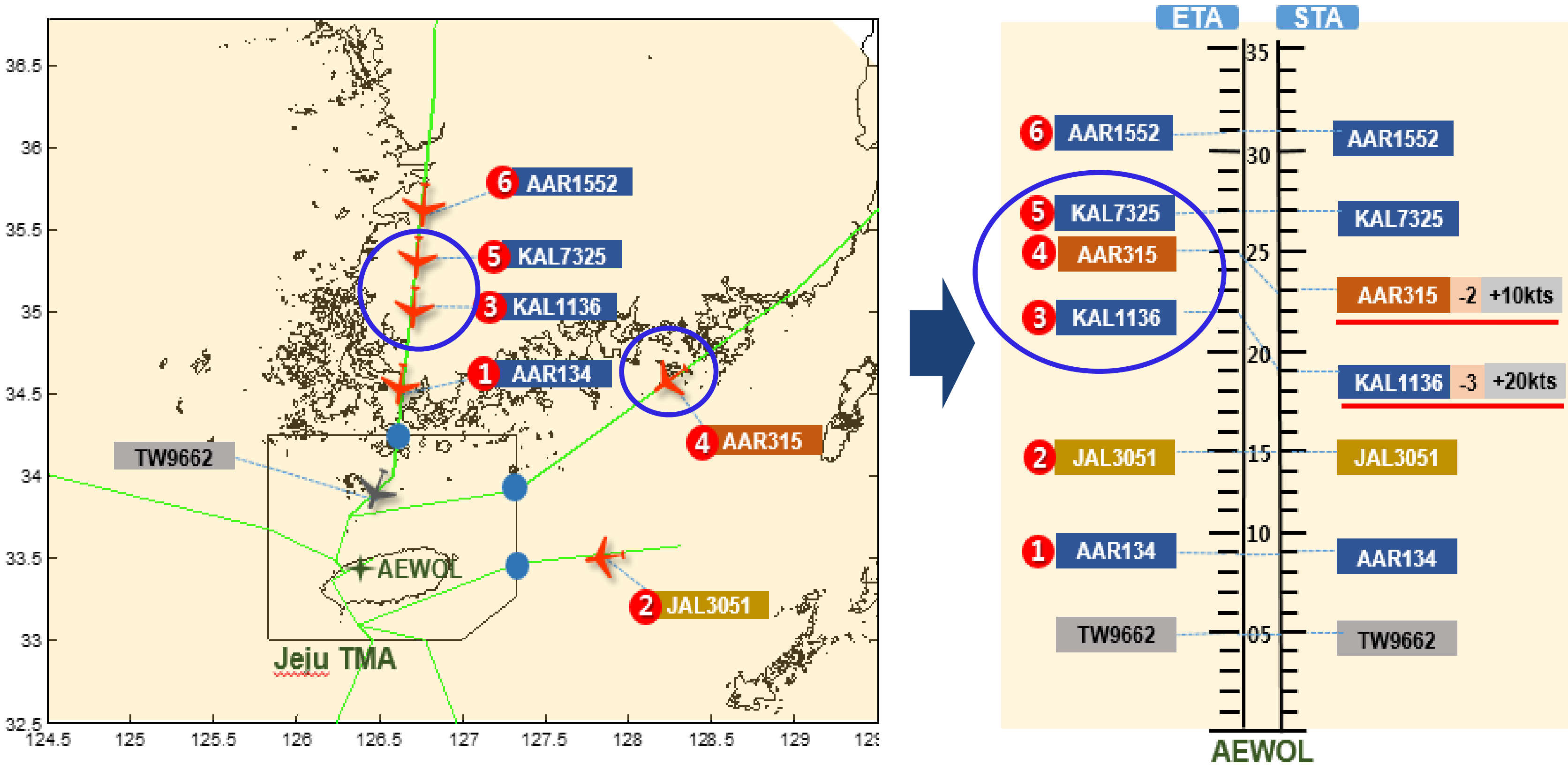
3.FACILITATING CDO

- Should start from the TOD to FAF/FAP, but …
- Sequencing could be achieved during cruise or early phase of descent.
- Must consider aircraft performance limits and known wind data, when assigning altitude and speed restrictions.
- Distance to go (DTG) should be provided while being radar vectored.
- Supporting tools (e.g. AMAN) may increase airspace capacity.

➡ These methods should be selected and designed with the goal of allowing the highest percentage of use during the broadest period of air traffic operations

4. BENEFITS OF CDO

❖ AMAN Concept

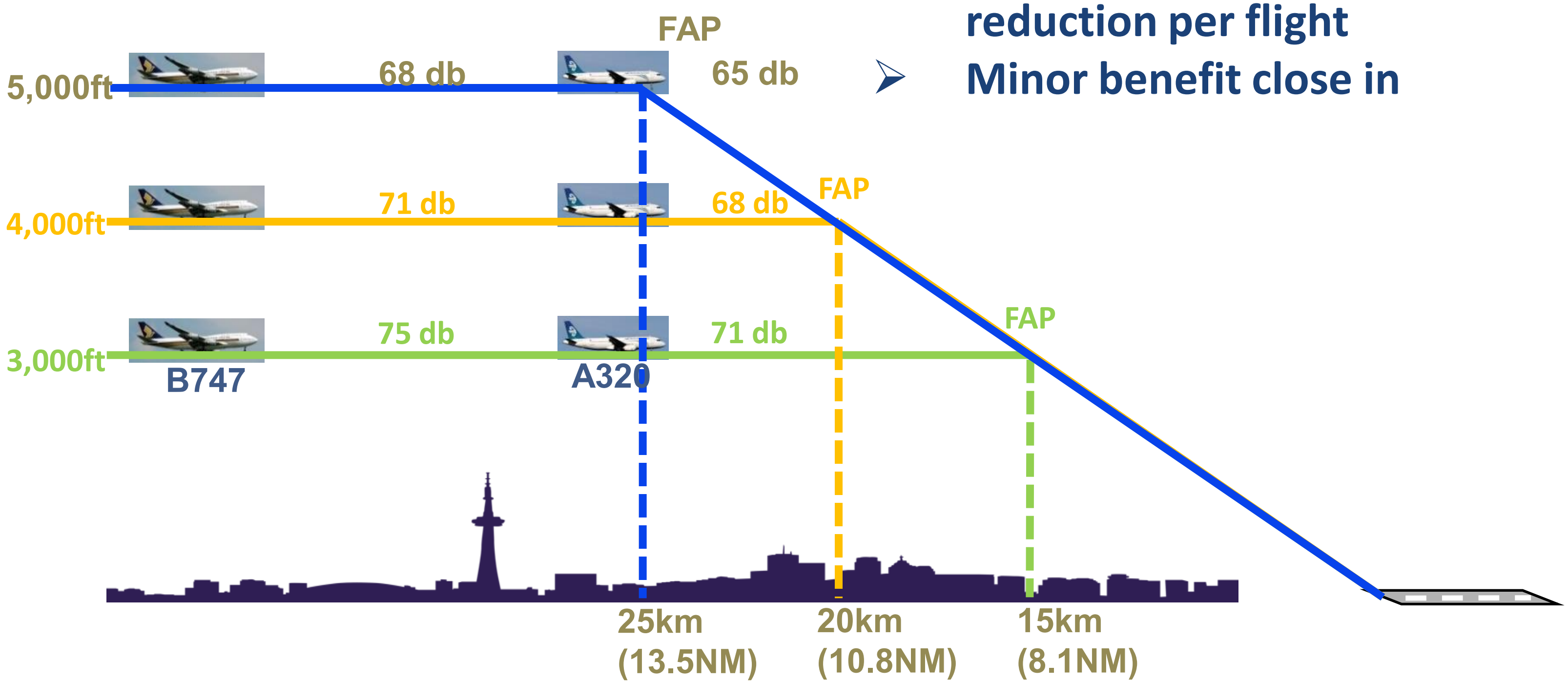


BENEFITS OF CDO

- **CDO increases**
  - **Flight predictability (predefined routes)**
  - **Airspace efficiency & Capacity (segregated Dep. & Arr. routes)**
  - **Safety (consistent and stabilized flight path, CFIT)**
- **CDO reduces**
  - **Fuel burn (cost savings)**
  - **Emissions and noise level (environmental benefits)**
  - **Pilot & controller workload**
  - **Radio transmission**
  - **CFIT**
- **However, if either CDO is not properly designed or ATC lose the flexibility, there could be a risk of reduced capacity and efficiency.**

BENEFITS OF CDO

❖ Noise and flight level

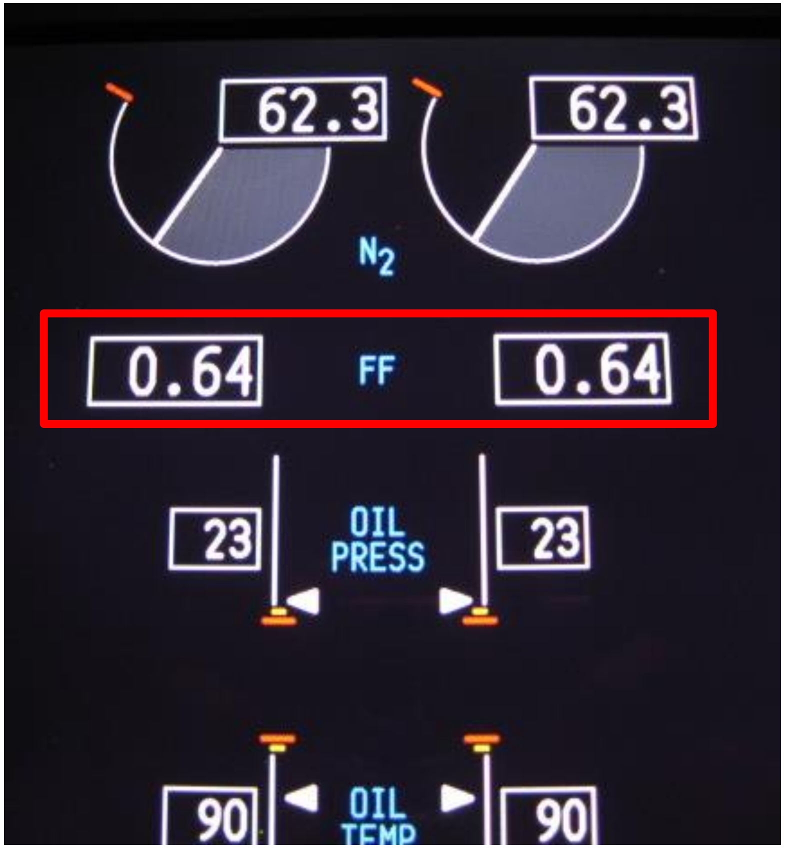


- 15-25km from touchdown, 1-7db noise reduction per flight
- Minor benefit close in

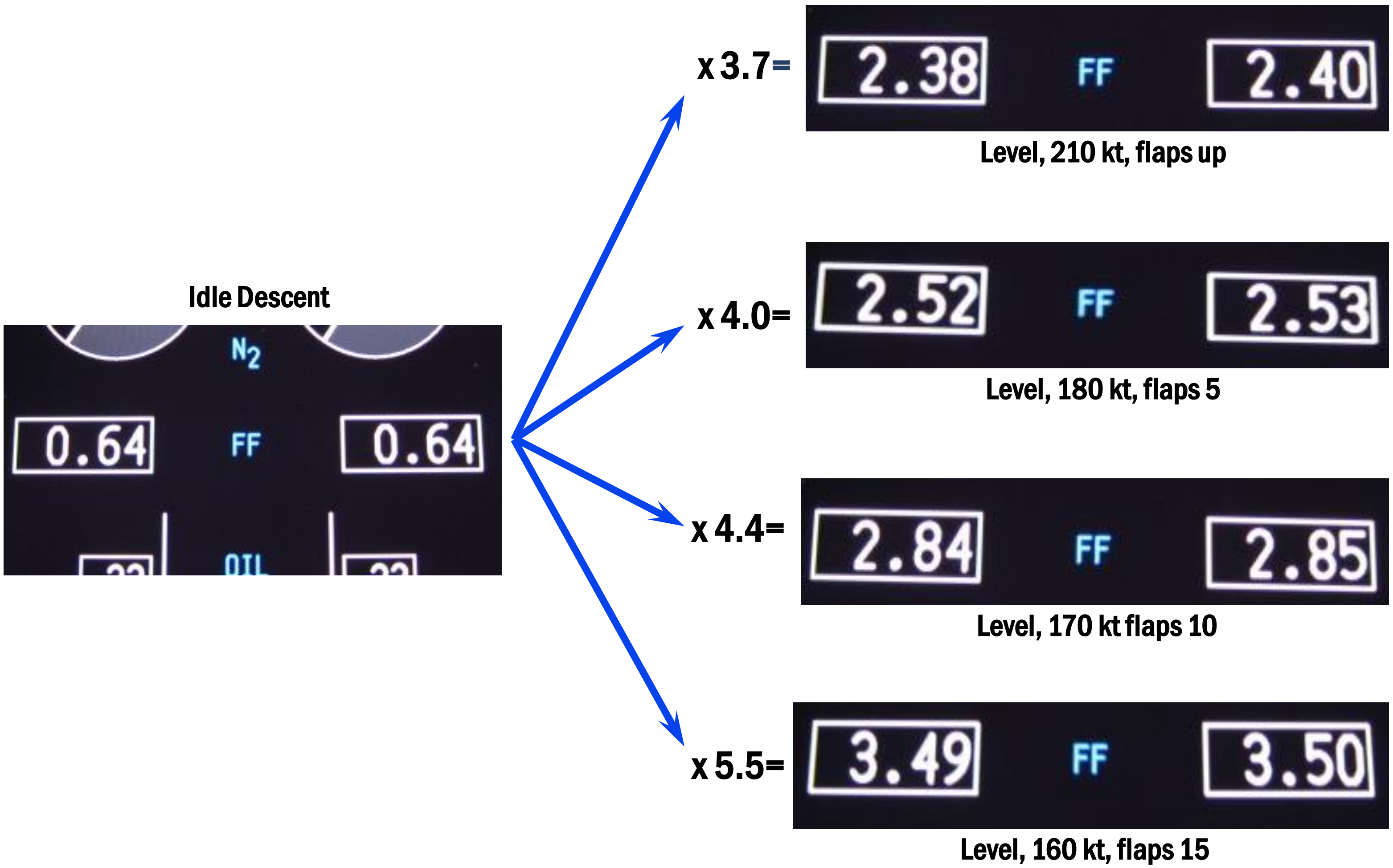
BENEFITS OF CDO

❖ **Importance of an Idle Descent**

- Idle Descent
- 640 lbs/hr/engine
- 1280 lbs/hr
- 3.2 gal/min



BENEFITS OF CDO



5.CDO DESIGN

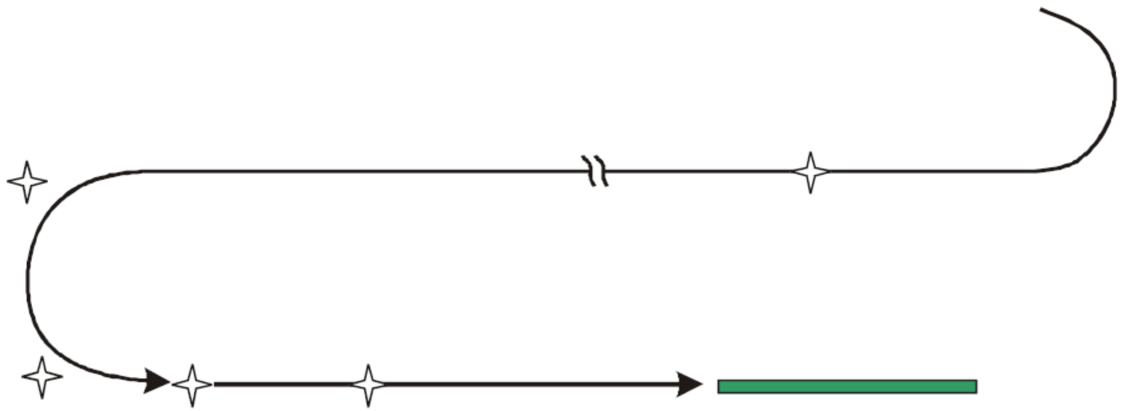
- A CDO design
  - is integrated with the airspace concept
  - must balance the needs of departing aircraft with the CDO arrival aircraft.
  - needs to consider populated areas, adherence to noise abatement routes, any dedicated take-off techniques, implementation time, etc.
- Fully optimized CDO may not always be possible
- Laterally and/or vertically fixed CDO routes could be applied to dense traffic environment.
- Vector based CDO could offer worthwhile efficiency and capacity improvements

CDO DESIGN

- Accurate planning for an optimum descent path is
  - facilitated by the pilot and/or the FMS
  - knowing the flight distance to the runway, and the level above the runway from which the CDO is to be initiated
- Wind and weather information helps to improve the accuracy of the flight descent path.
- However, exact distance or flying time may not always be precisely known.
- Thus planning and communication between the pilot and the ATC are required for a CDO.

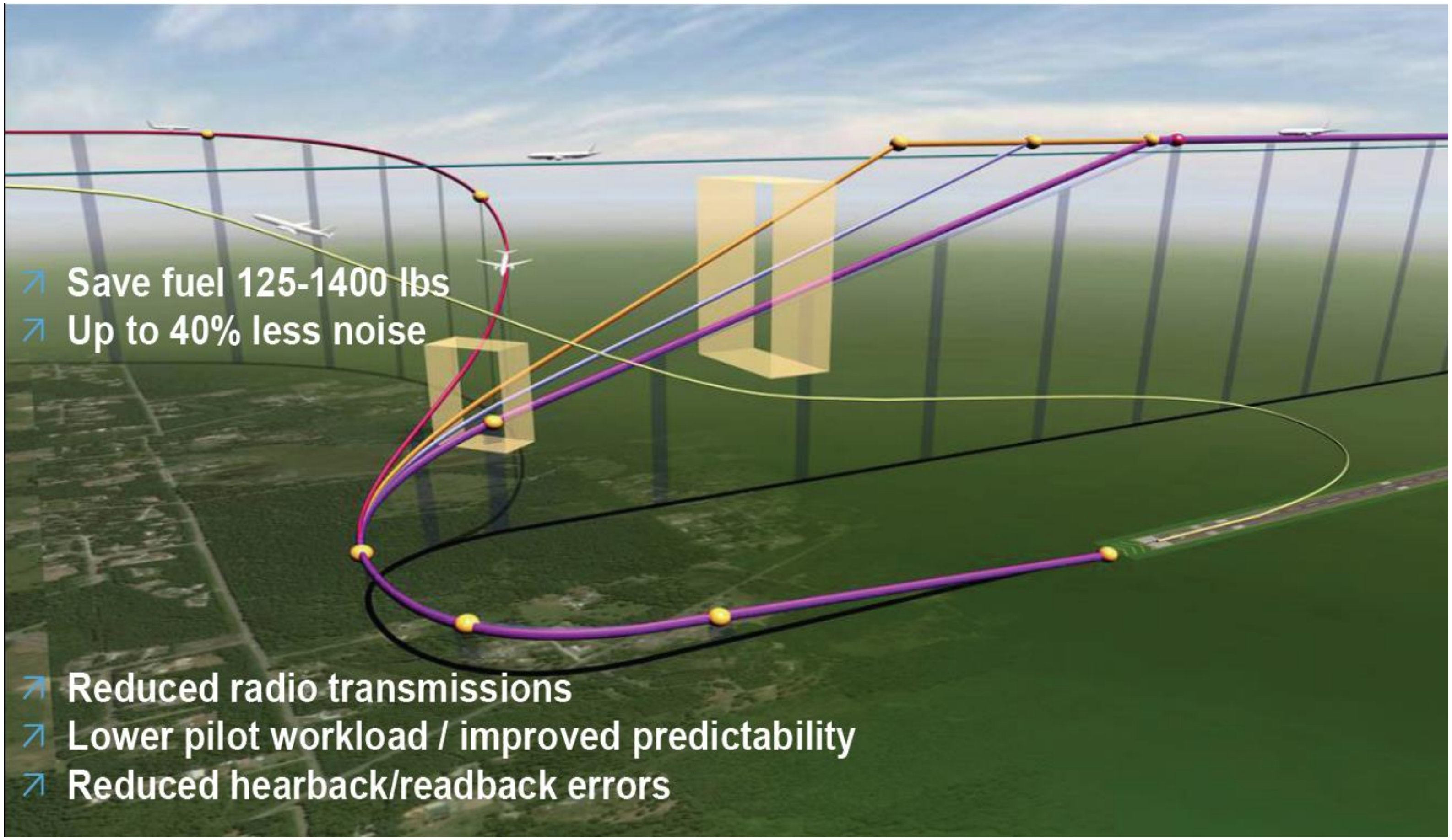
CDO DESIGN

- Two methods of CDO design : “closed path” and “open path”
- Closed path design
  - Lateral flight track is predefined up to/including FAF/FAP, e.g. STAR.
  - Exact distance to runway is precisely known.
  - FMS can accurately implement automated optimized descents.
  - The procedure may be published with crossing levels, level windows and speed constraints.



CDO DESIGN

❖ Closed path design



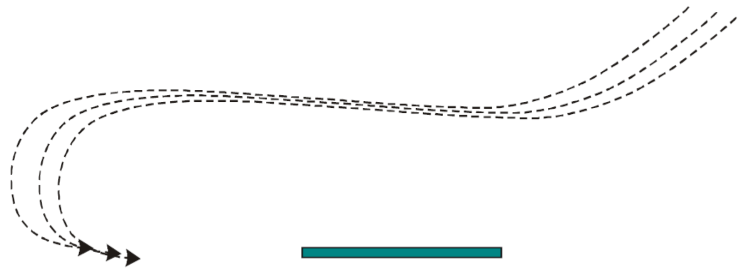
CDO DESIGN

- **Closed path design example (HNL KANEA, KLANI, REEEF CDO)**

CDO DESIGN

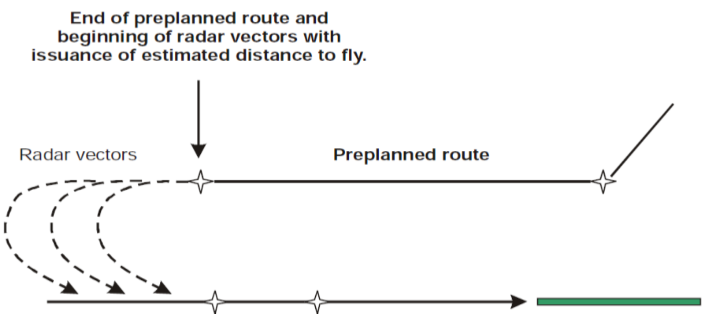
1) Vectored CDO

- ATC gives "Distance-To-GO" estimate
- Descent is at the pilot discretion.



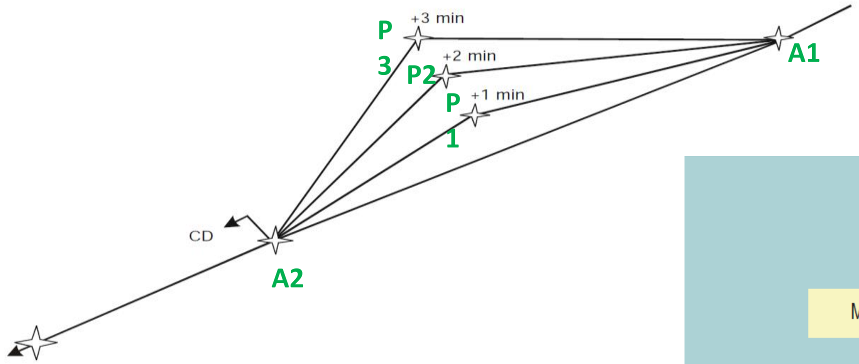
2) Open CDO to downwind

- Ends in a downwind leg leaving the controller to clear the aircraft to final
- ATC gives "Distance-To-GO" estimate
- Combination of a fixed route and radar vector to FAF/FAP

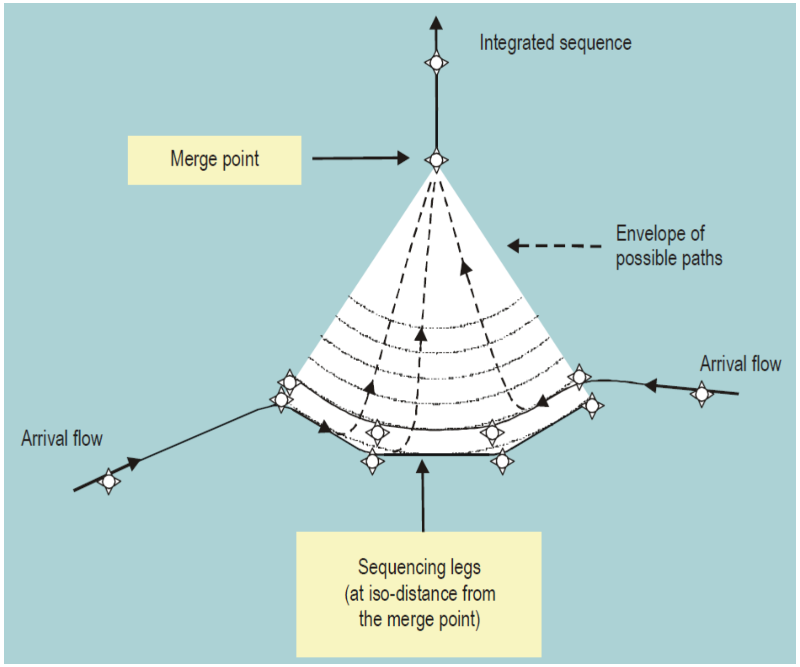


CDO DESIGN

3) Path stretching method



4) Point Merge method



6.CDO DESIGN METHODS

- **CDO design procedures**
  - Choose the minimum lateral path
  - Optimize the lateral path considering
    - Airspace (restrictions, noise abatement, etc.)
    - Departing aircraft of the destination airport
    - Other traffic toward/out of adjacent airports
    - Aircraft navigation capability
    - Airport agreements, traffic flow rates, airport sectorization
    - Terrain, etc.
  - Apply required speeds and/or altitude profiles
    - But limit speed/altitude restrictions to the minimum necessary
    - Altitude restrictions may “at”, “at or above/below”, or a window
    - Speed restrictions should not be less than 280kts above 10,000ft
  - Review and modify as necessary

CDO DESIGN METHODS

- **Closed path CDO design**
  - **Altitude restrictions of STAR should allow most aircraft to descent unimpeded.**
  - **An upper limit is set for**
    - **Separation from other air traffic flows, or**
    - **ATC coordination purposes**
  - **The lower limit is set for**
    - **Terrain clearance**
    - **Airport arrangements**
    - **Separation from other air traffic flows, and**
    - **ATC coordination purposes.**

CDO DESIGN METHODS

- **Closed path CDO design - calculations**
  - Upper level limit is defined as “at or below” restrictions
  - Calculated as
    - (Distance from FAF/FAP X 350ft/nm) + FAF/FAP altitude)
  - Lower level limit is defined as “at or above” restrictions
  - Calculated as
    - When starting at or below 10,000ft

      (FAF deceleration distance X 160 ft/nm)

      + ((distance from FAF – FAF deceleration distance) X 220 ft/nm)

      + FAF/FAP altitude
    - When starting above 10,000ft

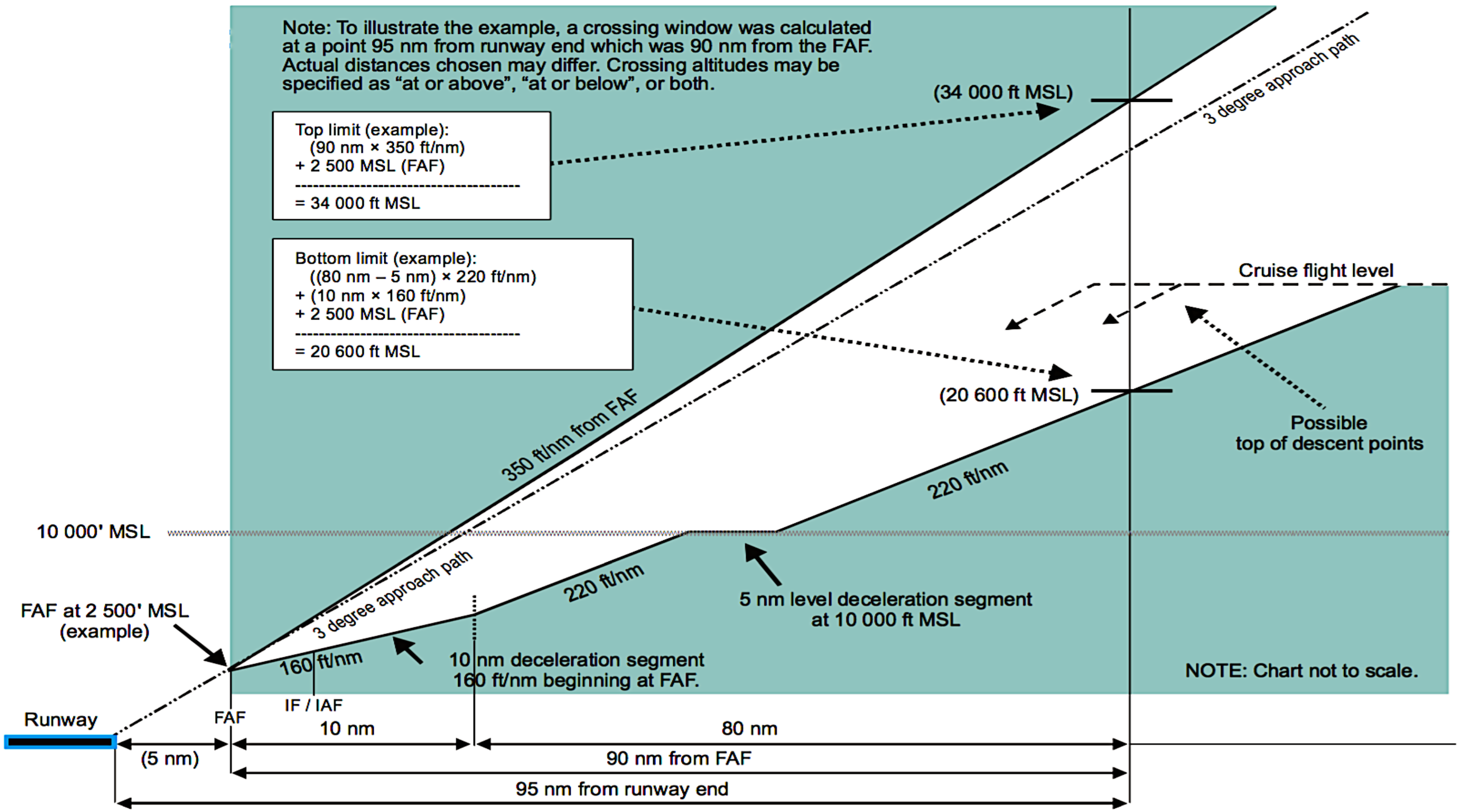
      (FAF deceleration distance X 160 ft/nm)

      + ((distance from FAF – FAF deceleration distance – 5nm)

      X 220 ft/nm) + FAF/FAP altitude

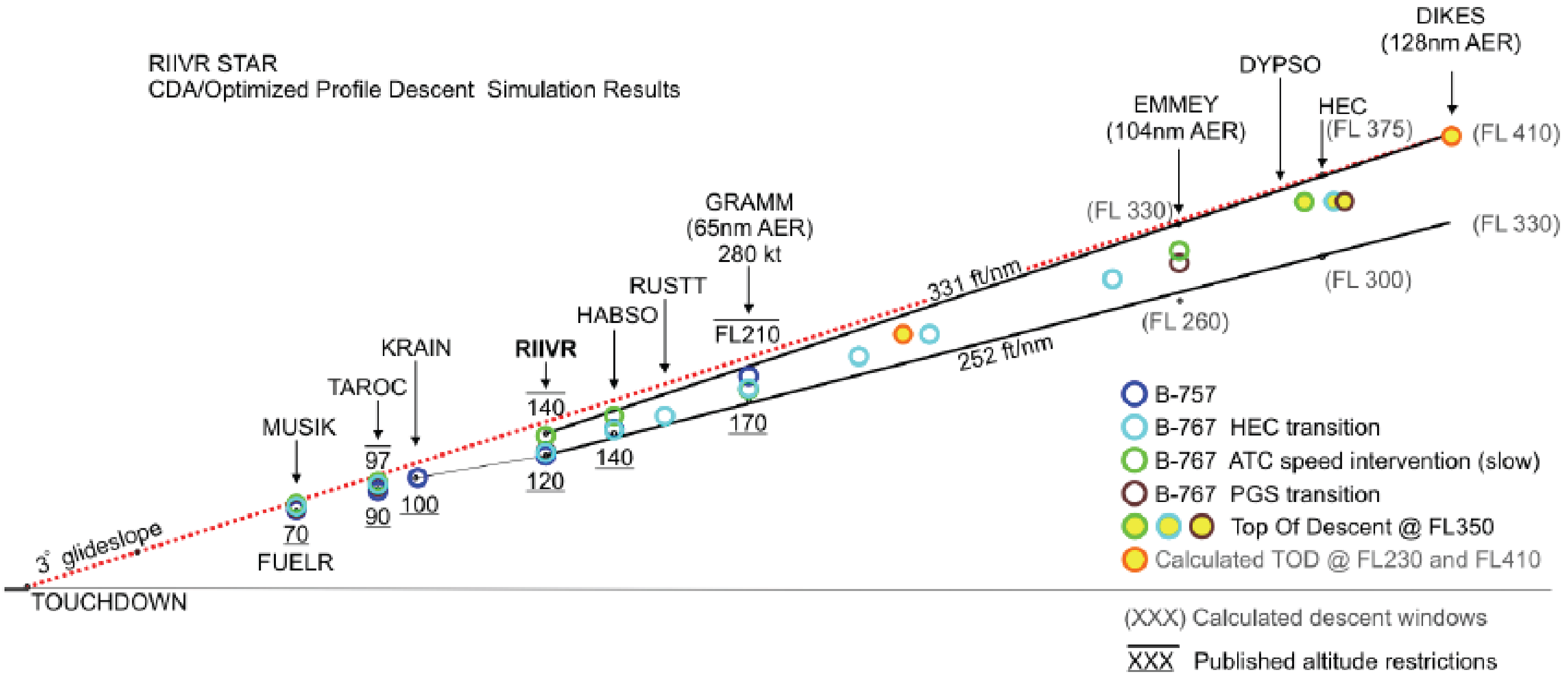
CDO DESIGN METHODS

❖ Closed path CDO design



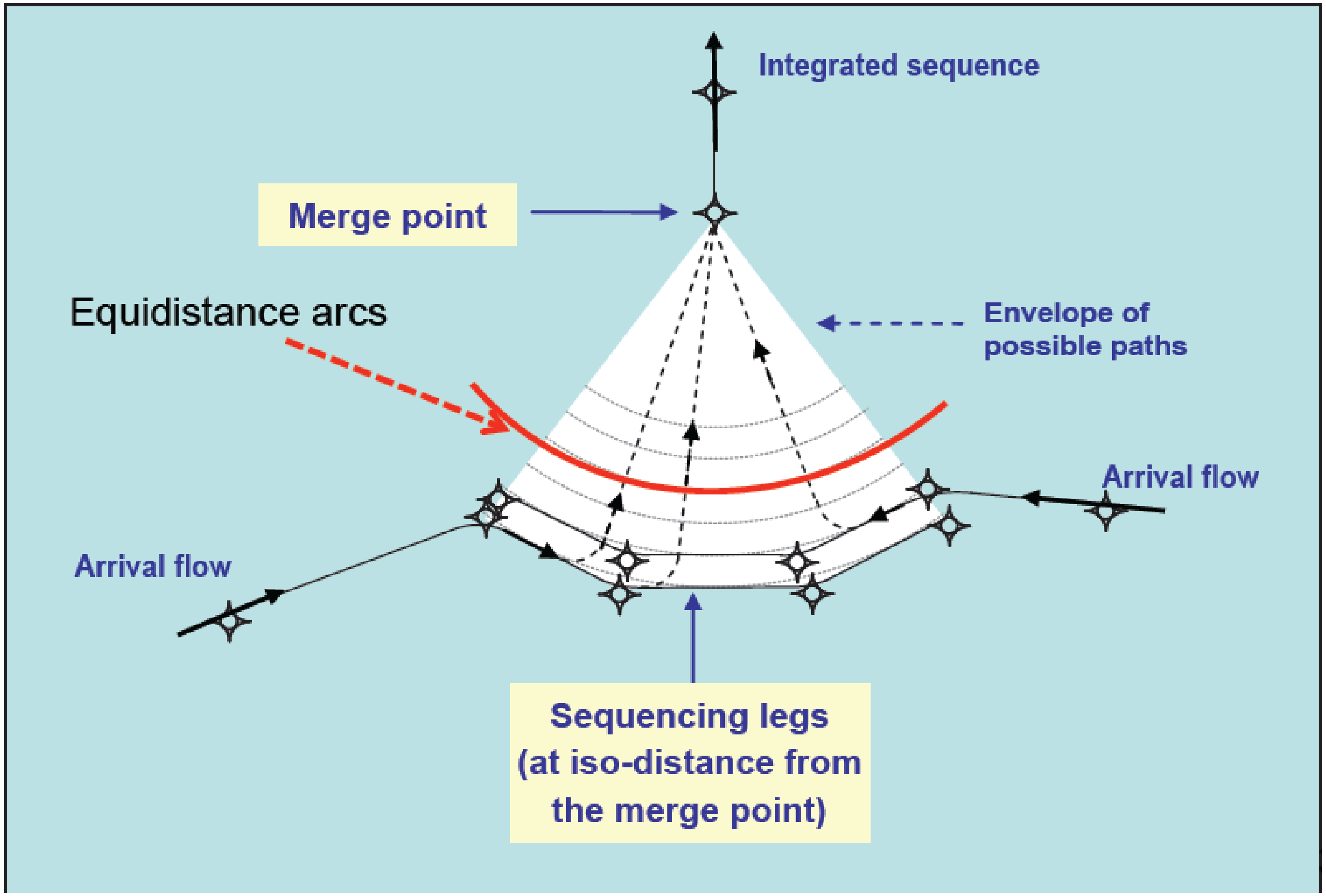
CDO DESIGN METHODS

- **Closed path CDO design**
  - **Simulation results (RIIVR STAR, KLAX)**

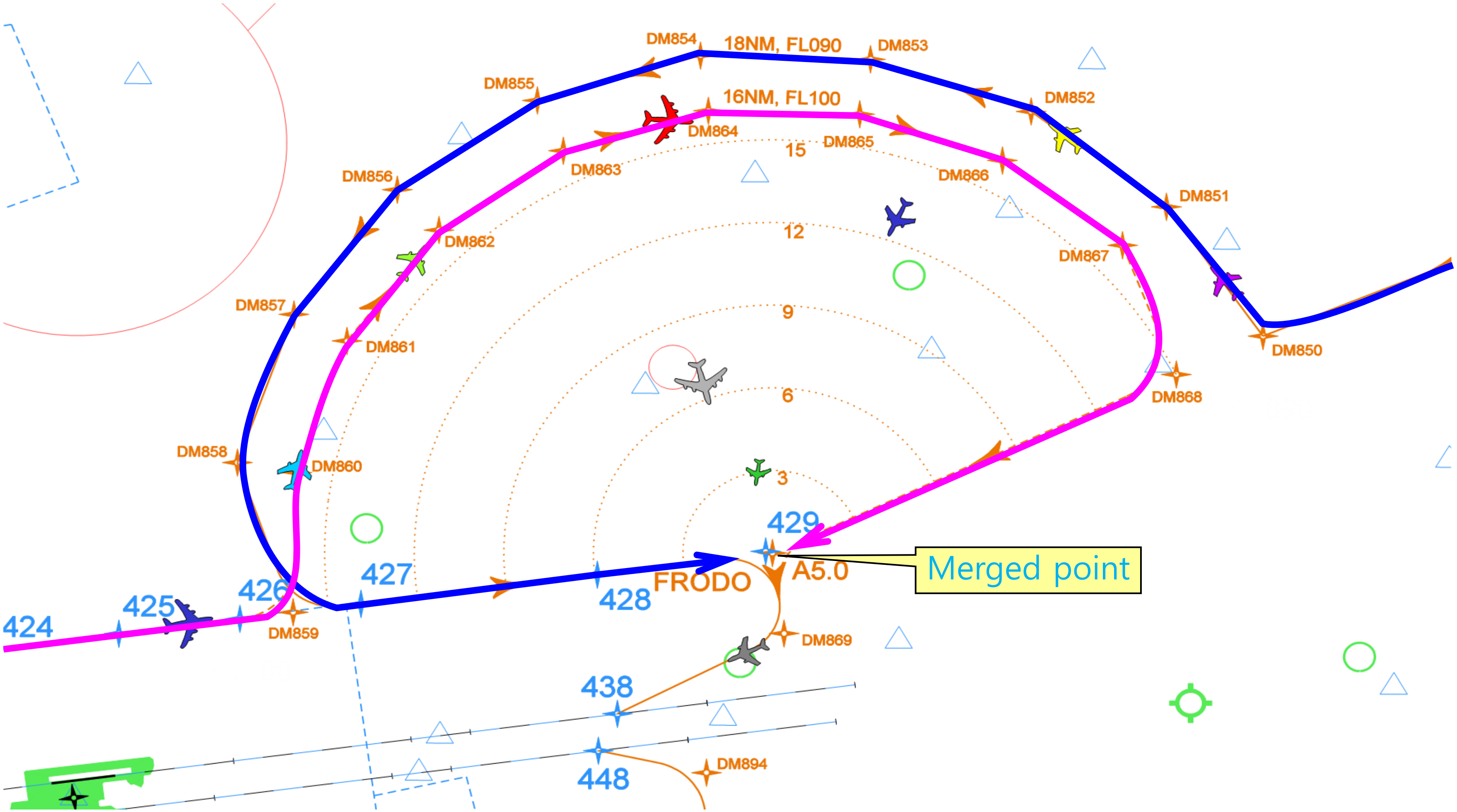


CDO DESIGN METHODS (open path)

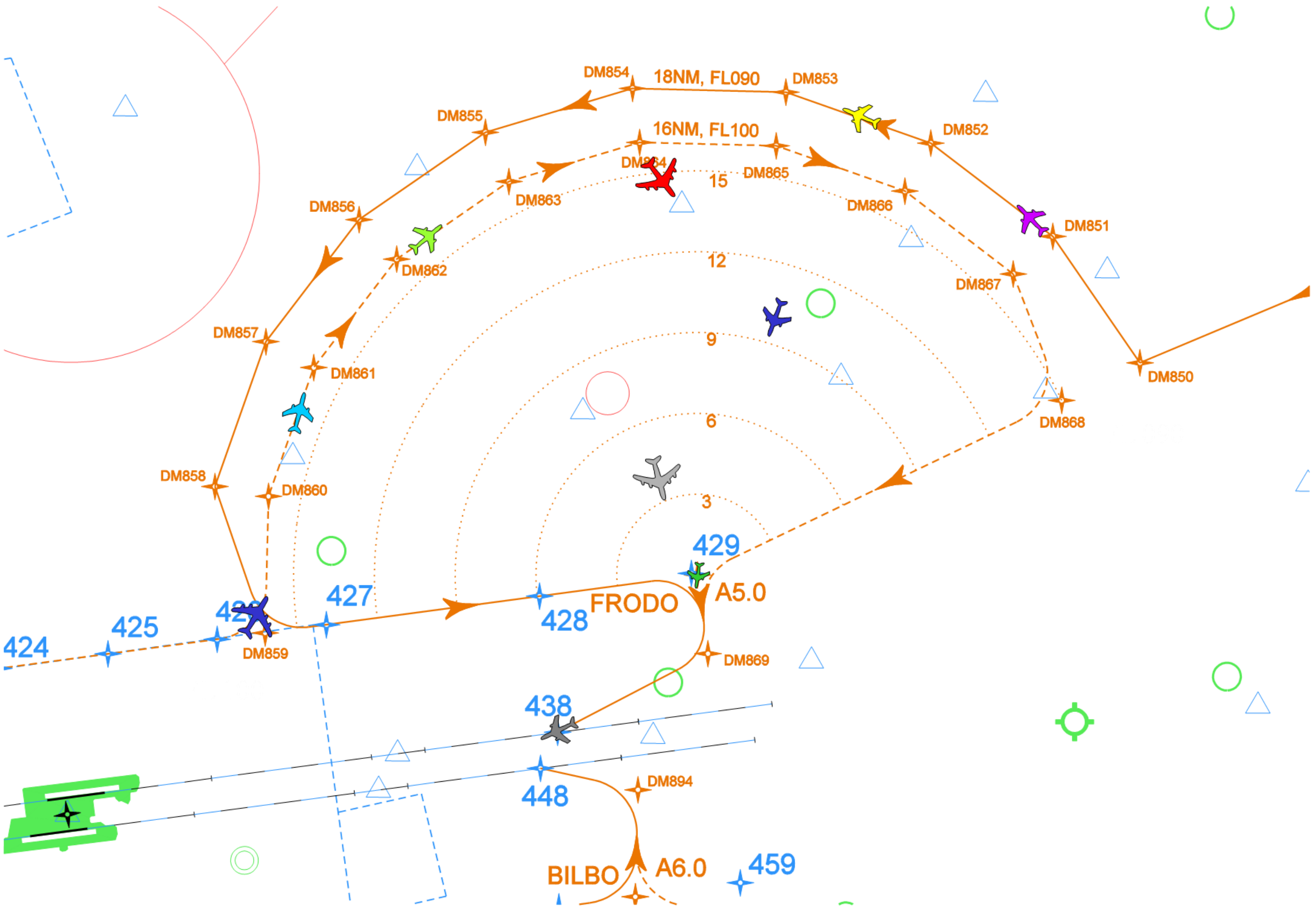
- Open path CDO design – Point Merge



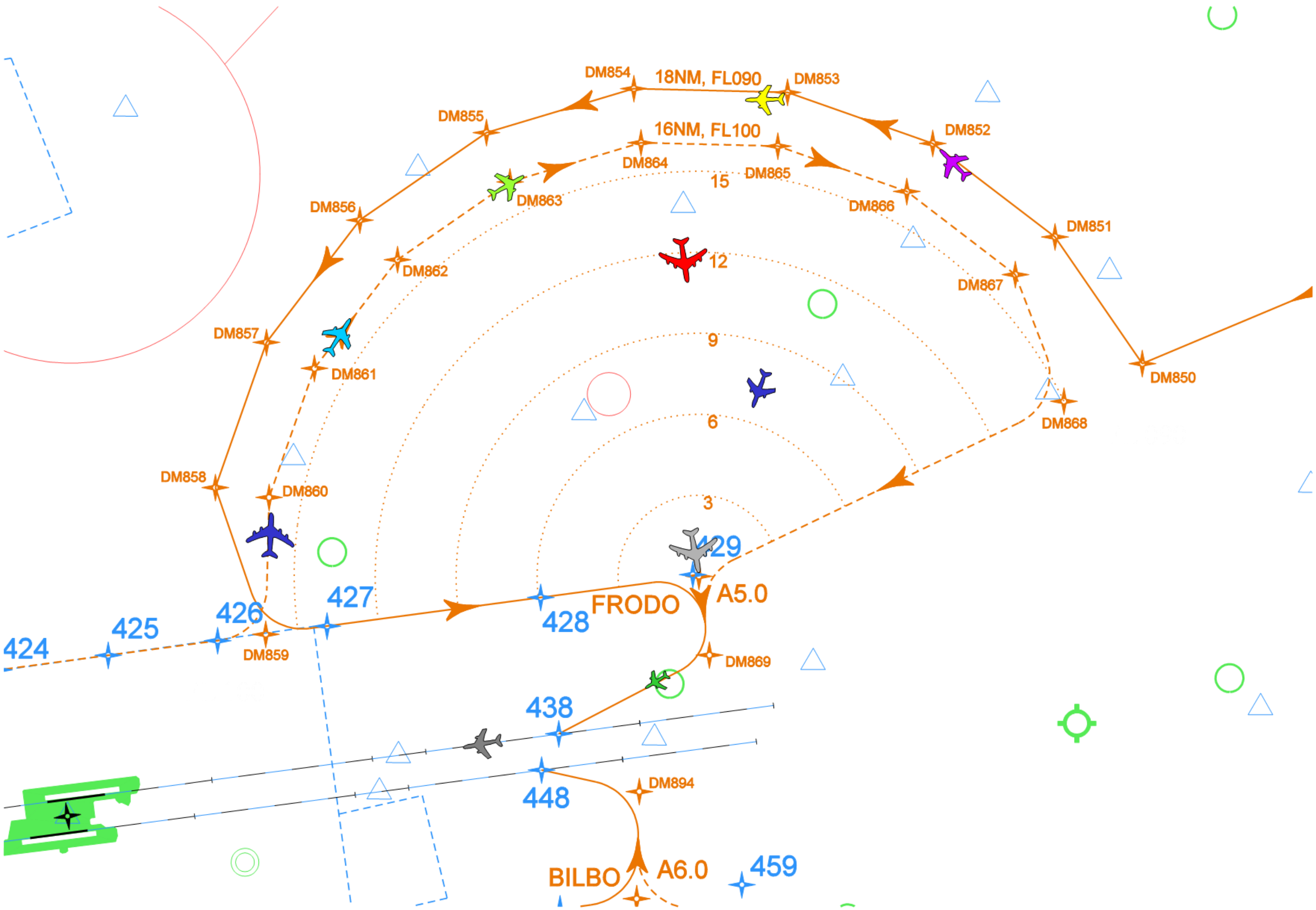
CDO DESIGN METHODS (open path)



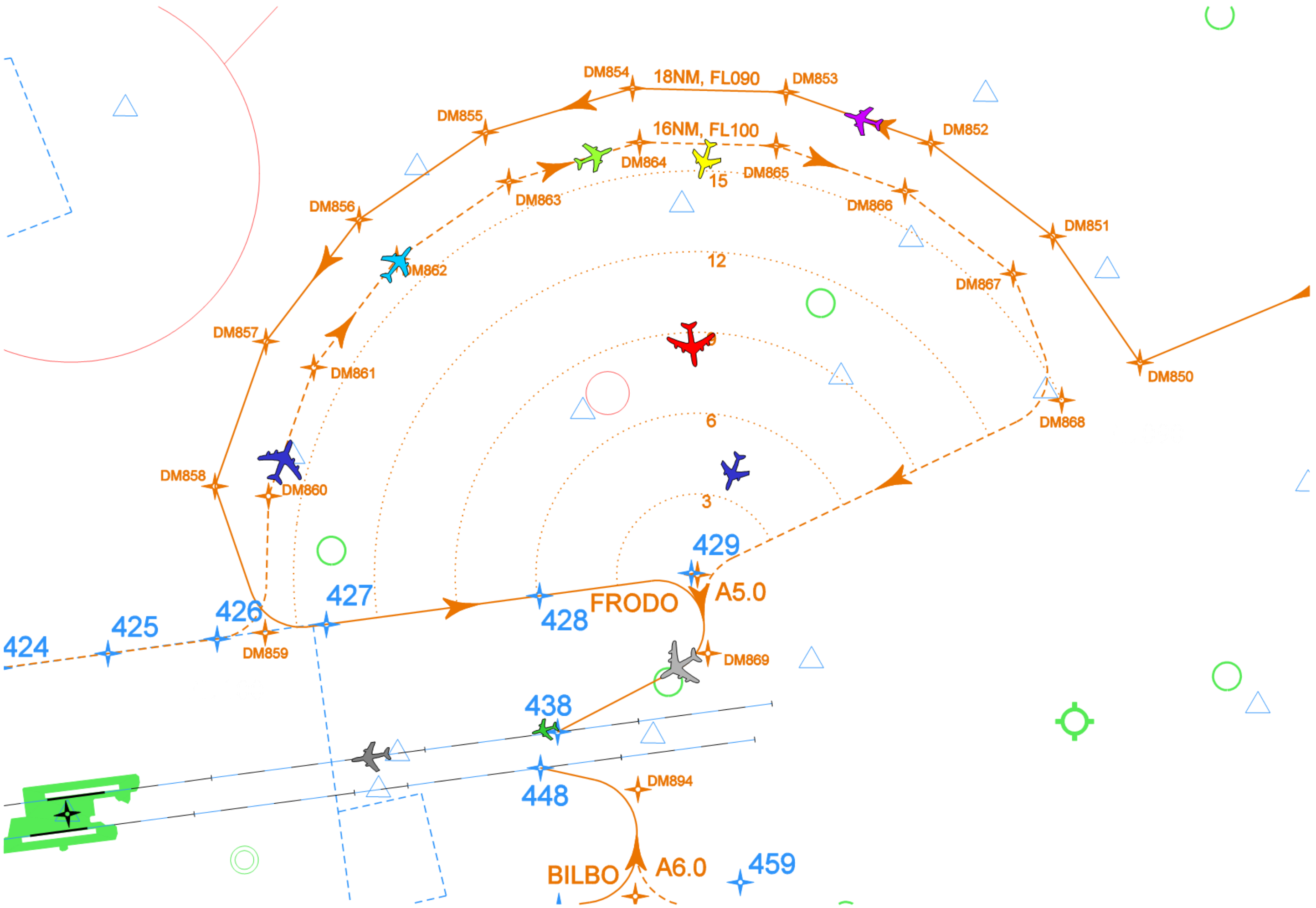
CDO DESIGN METHODS (open path)



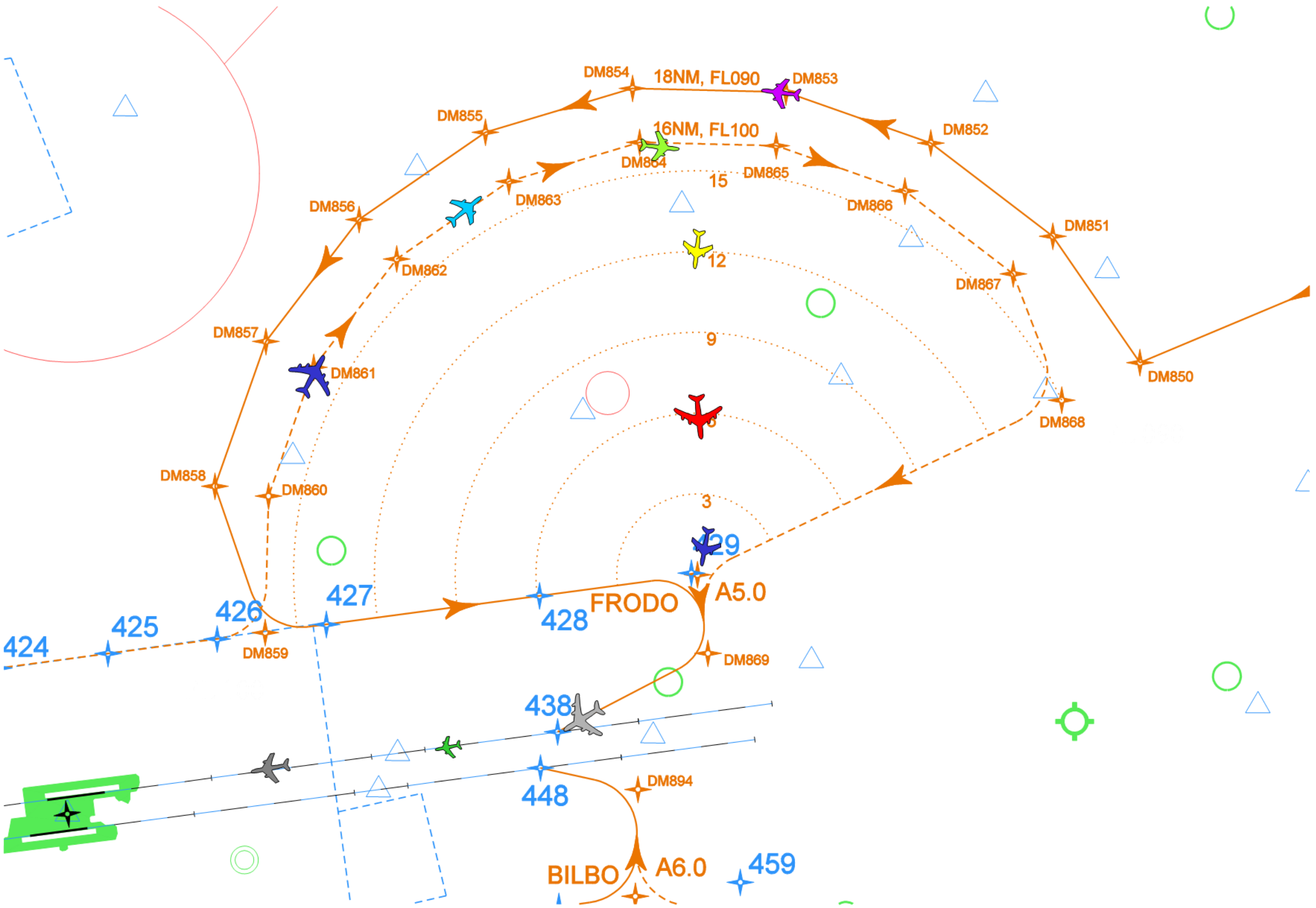
CDO DESIGN METHODS (open path)



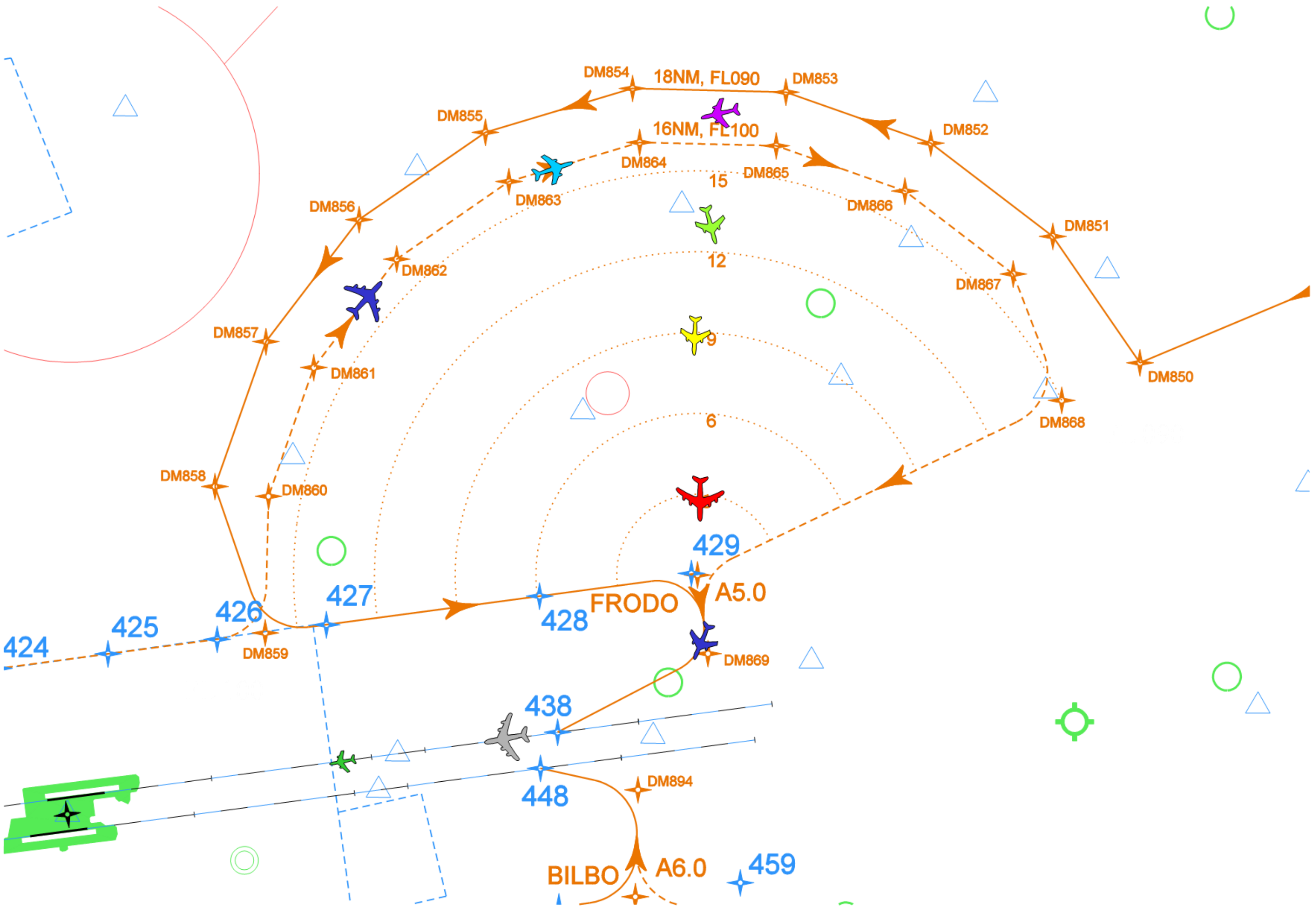
CDO DESIGN METHODS (open path)



CDO DESIGN METHODS (open path)

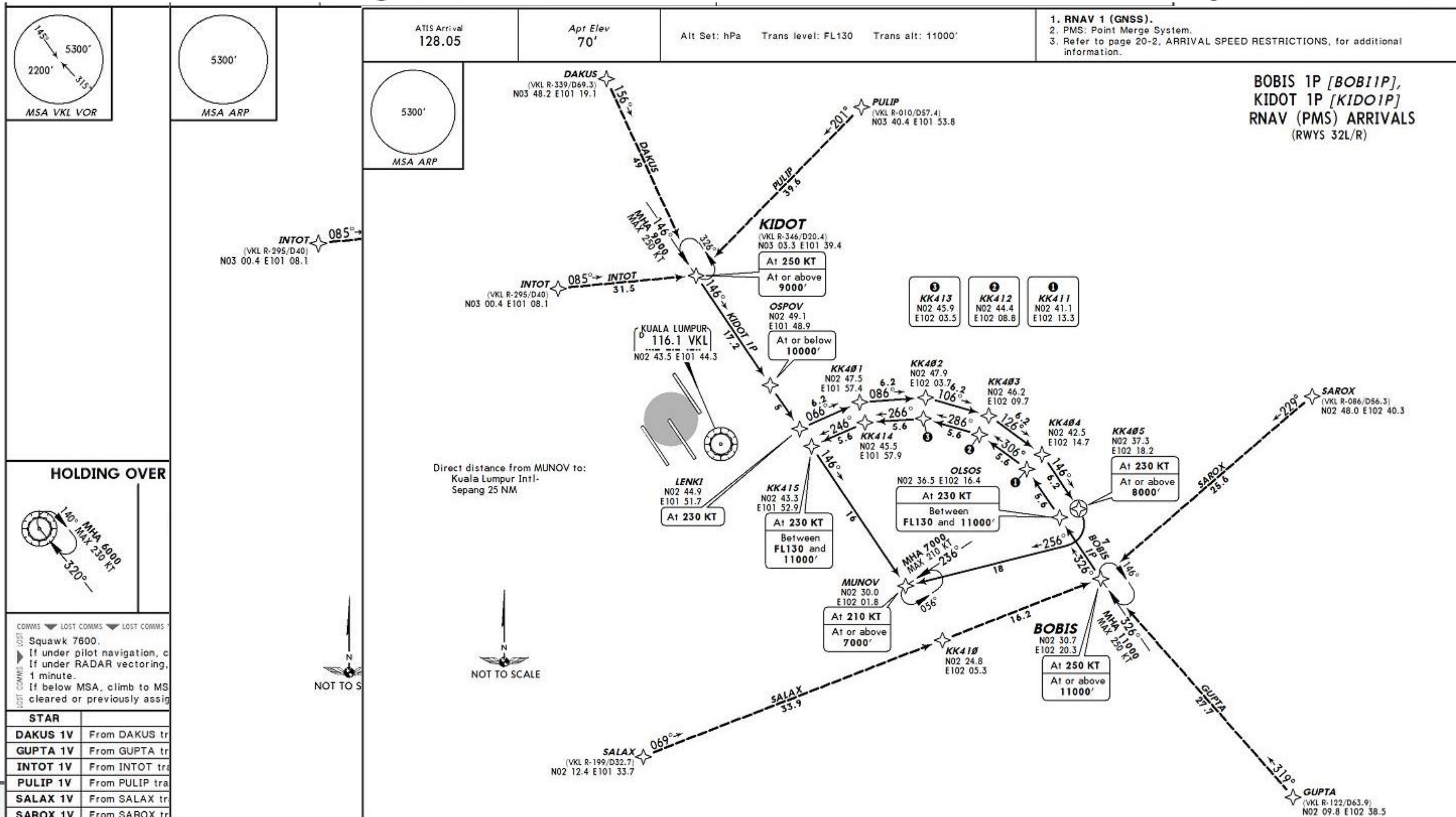


CDO DESIGN METHODS (open path)



CDO DESIGN METHODS (open path)

❖ Point Merge Procedures – Kuala Lumpur, Malaysia

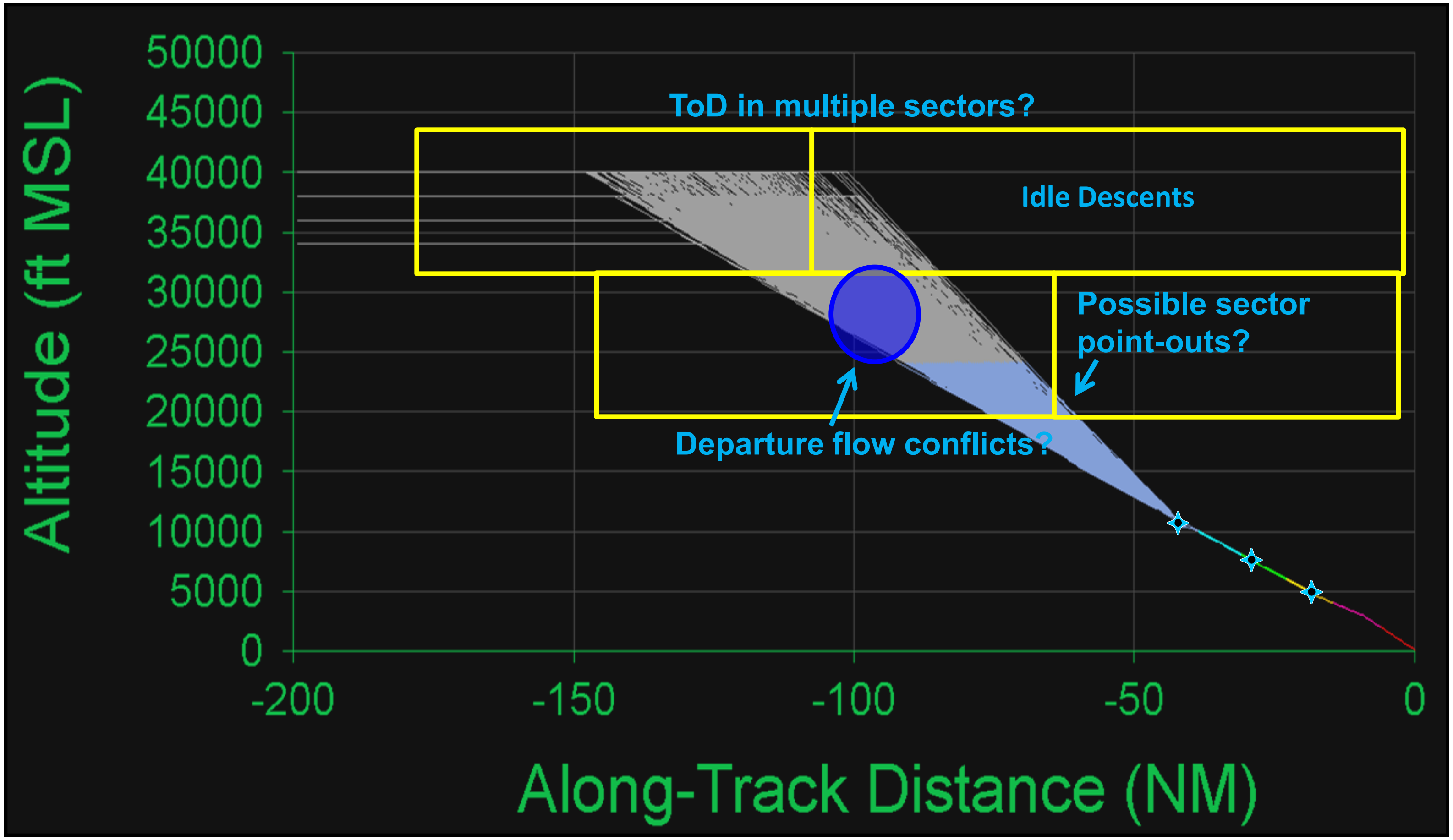


CDO DESIGN METHODS

- De-confliction of airspace
  - Build routes vertically separated
  - Build routes laterally separated

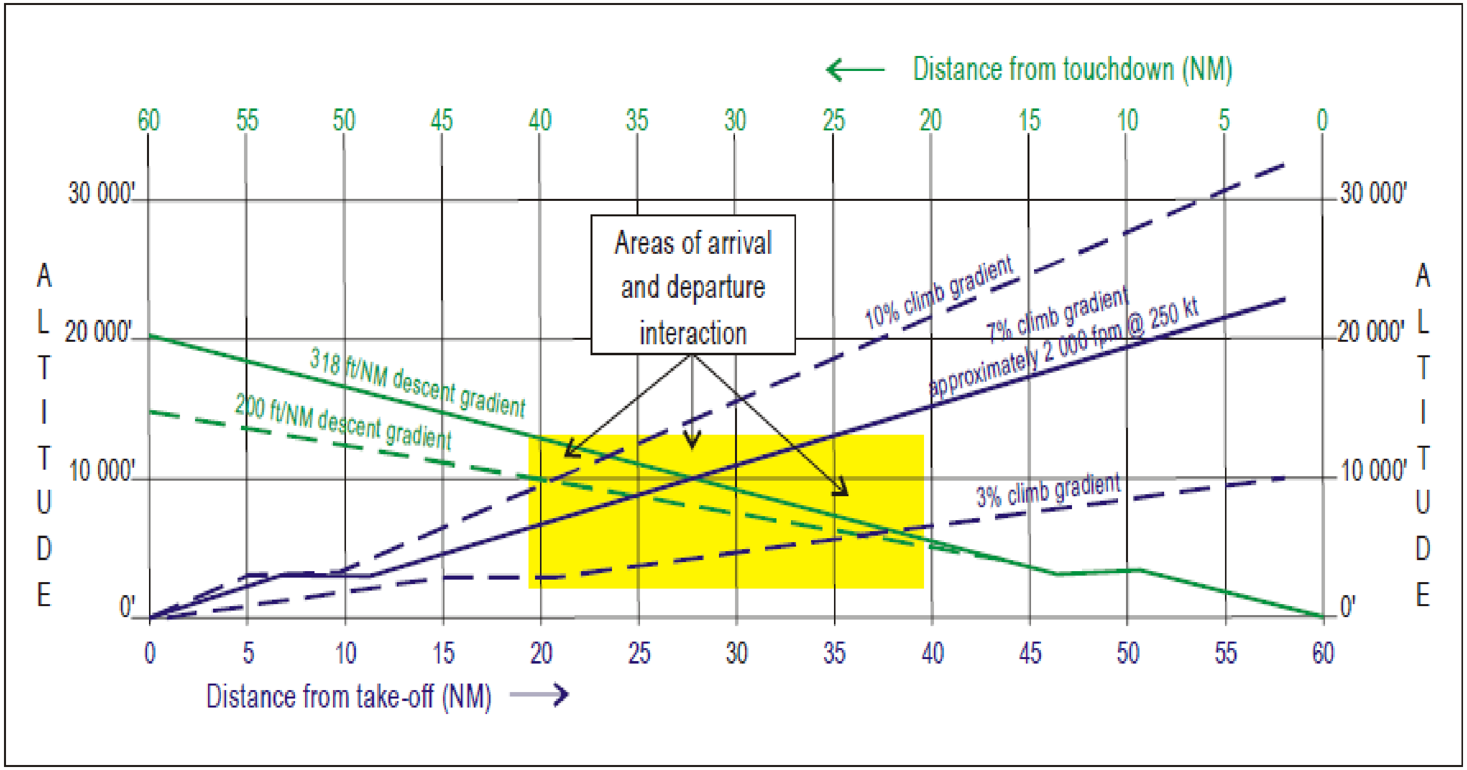
- Procedure design needs to balance
  - Aircraft need for altitude range to adjust trajectory
  - Controller need to limit altitude range to make room for other aircraft
  - Daily traffic cycle, seasonal changes and varying trends over time
  - Competition between routes for larger vertical envelopes

CDO DESIGN METHODS



CDO DESIGN METHODS

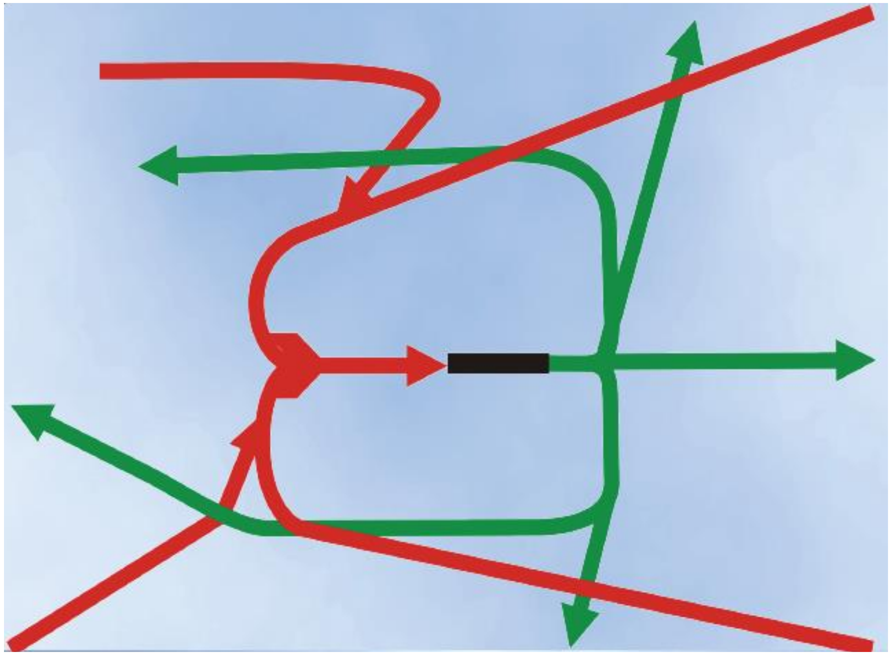
- **Conflict Zones**

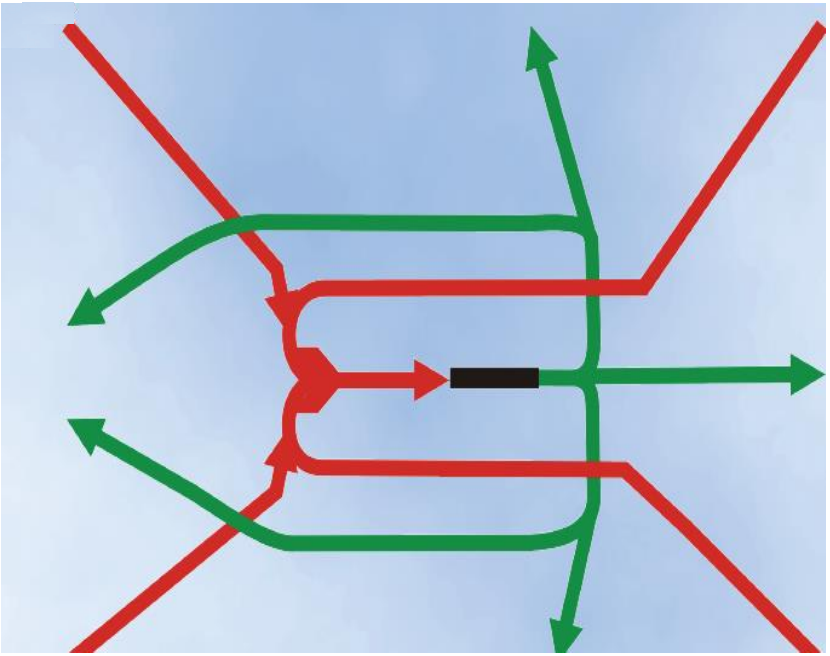


SAMPLE CHART ONLY: Similar graphs should be developed for each implementation depending on fleet

CDO DESIGN METHODS

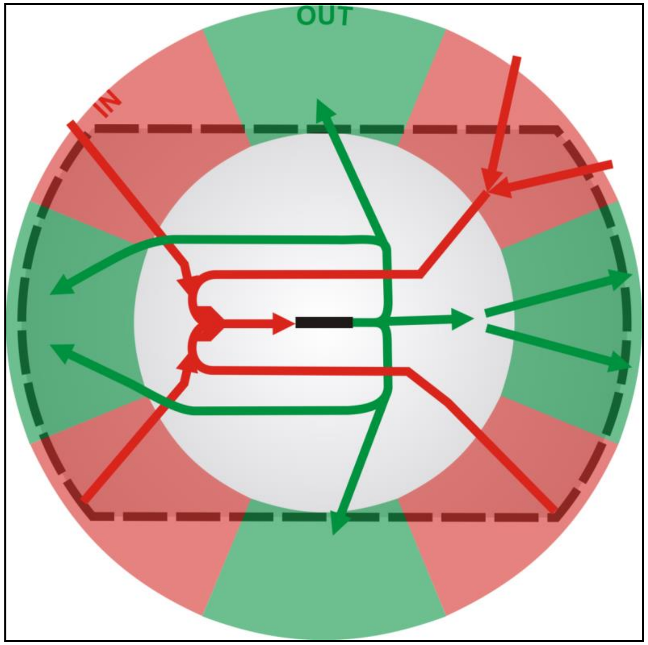
- **Profile interaction**





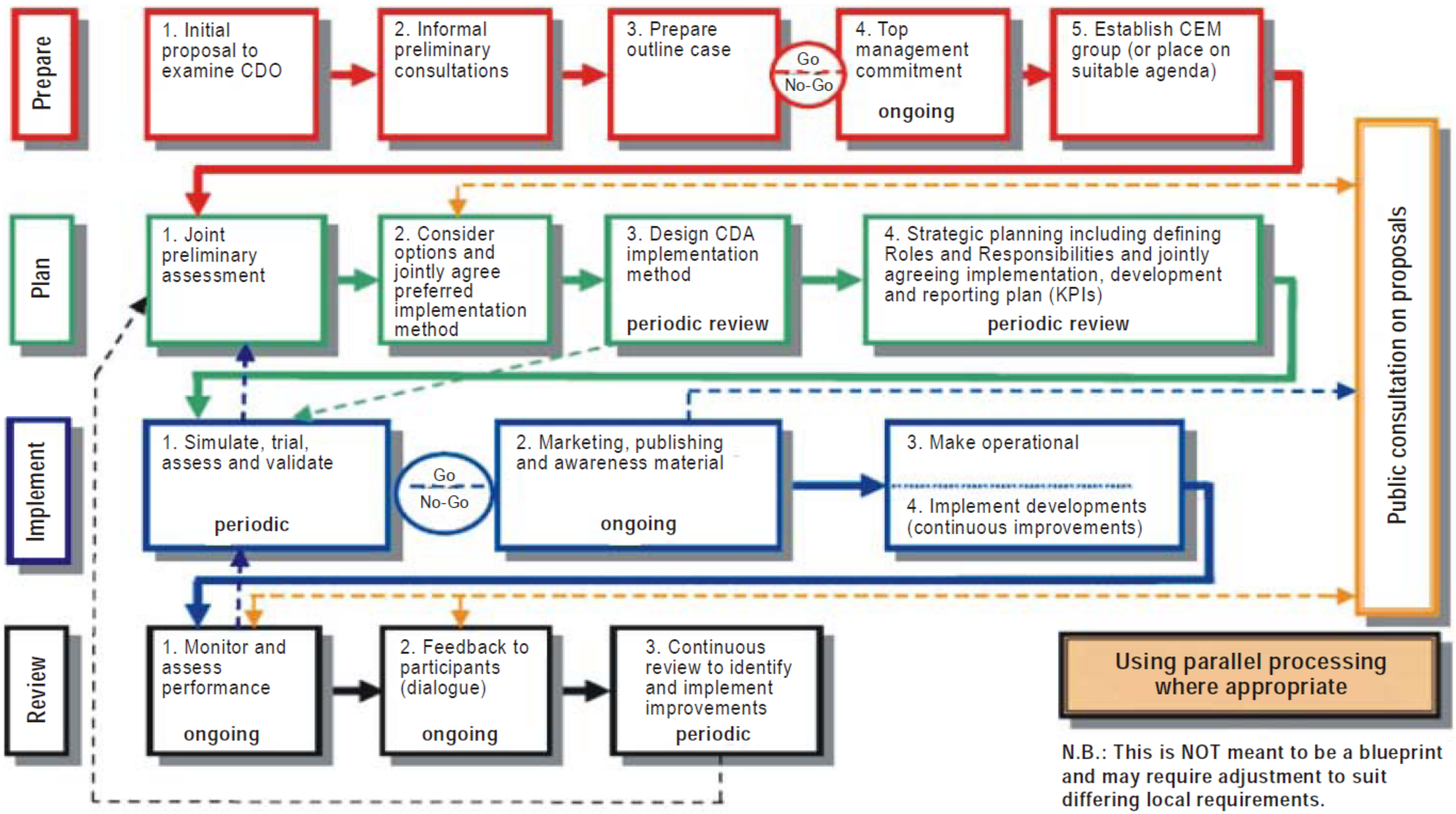
CDO DESIGN METHODS

- **Good Design Practice**
  - **Flows by quadrant (Corner Post), segregate Arrivals laterally and vertically from Departures**
- **Rules of Thumb**
  - **CDO descent rate**
    - **1000ft/3NM plus 10knots/1NM or**
    - **1000ft/4NM (4.1%)**
  - **Climb rate**
    - **Slow : 1000ft/5NM (3.3%)**
    - **Medium : 1000ft/3~4NM (4.1~5.5%)**
    - **Fast : 1000ft/2NM (8.2%)**



7.CDO IMPLEMENTATION

❖ CDO implementation process (refer to Doc 9931)



Questions?

Thank You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