INTERNATIONAL AVIATION AND ENVIRONMENT SEMINAR

Nairobi, Kenya 16 to 17 June 2014

Operational improvements and Environment Performance Based Navigation (PBN) Air Traffic Management (ATM)

Seboseso M Machobane
RO ATM/SAR ESAF

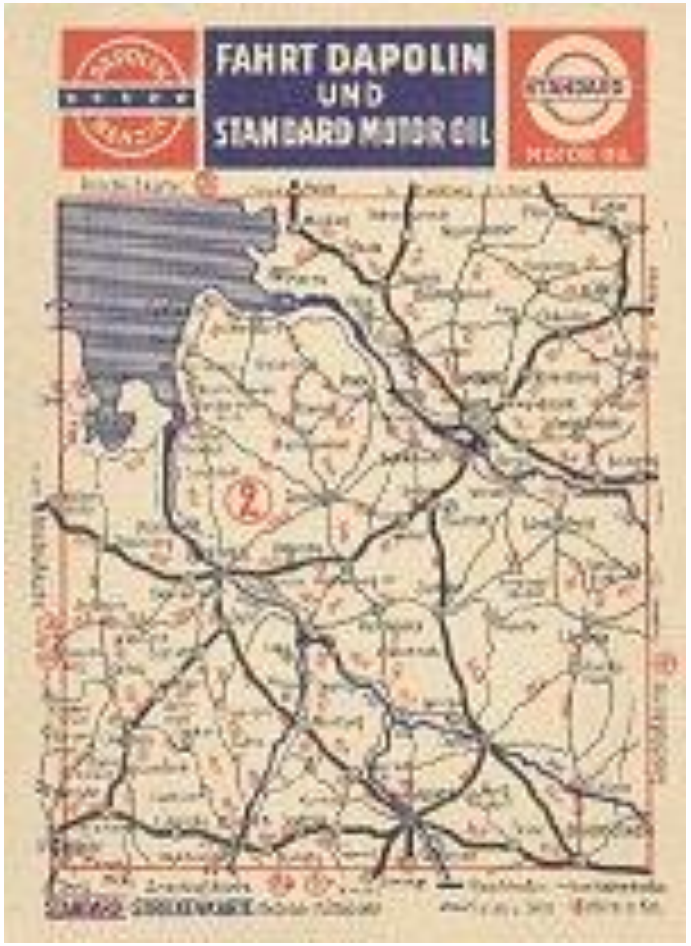
Discussion topics

- Evolution of air navigation
- Global ATM vision
- Performance based navigation (PBN)
- Operational improvements
  - PBN routes
  - Continuous Climb and Descent Operations
  - Airspace Concepts

Evolution of air navigation

IN THE BEGINNING

- And Rivers
- And Railroads
- And Buildings
- And Telephone Lines
- And Whatever Else I Can See



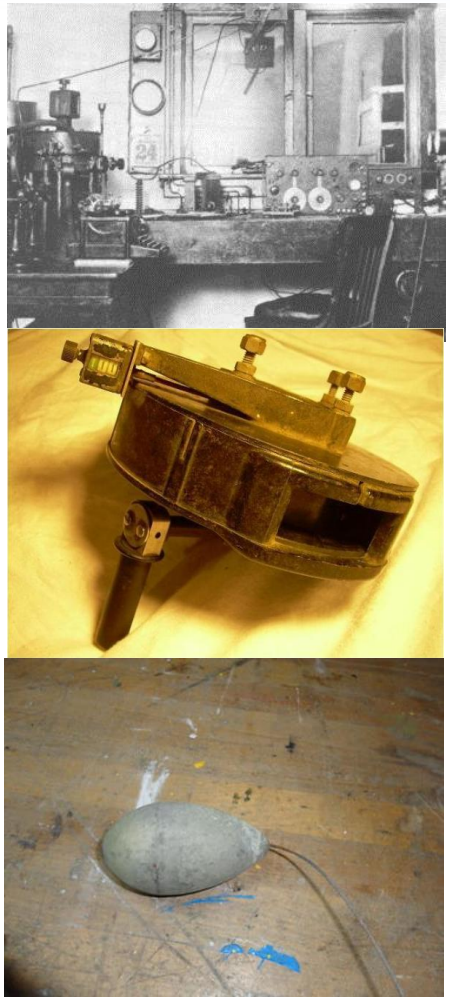
Evolution of air navigation (Cont.)

- 1910s
  - ✈ First Bonfires and Beacons
- Early 1920s
  - ✈ Lighted airport boundaries
  - ✈ Spot-lit windsocks
  - ✈ Rotating lighted beacons on towers
  - ✈ Lighted Airways

Introduction to PBN (Cont.)

RADIO

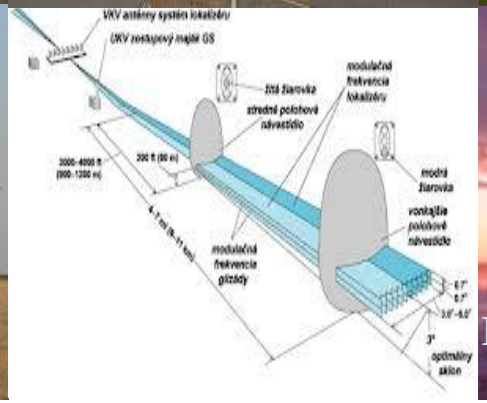
- Radio for Two-Way Communications
  - Weather Updates
  - Request Help With Navigation
- Radio for Navigation
  - Radio Marker Beacons
  - 4-Course Radio Range System
- Pilots Listen for Navigation Signals



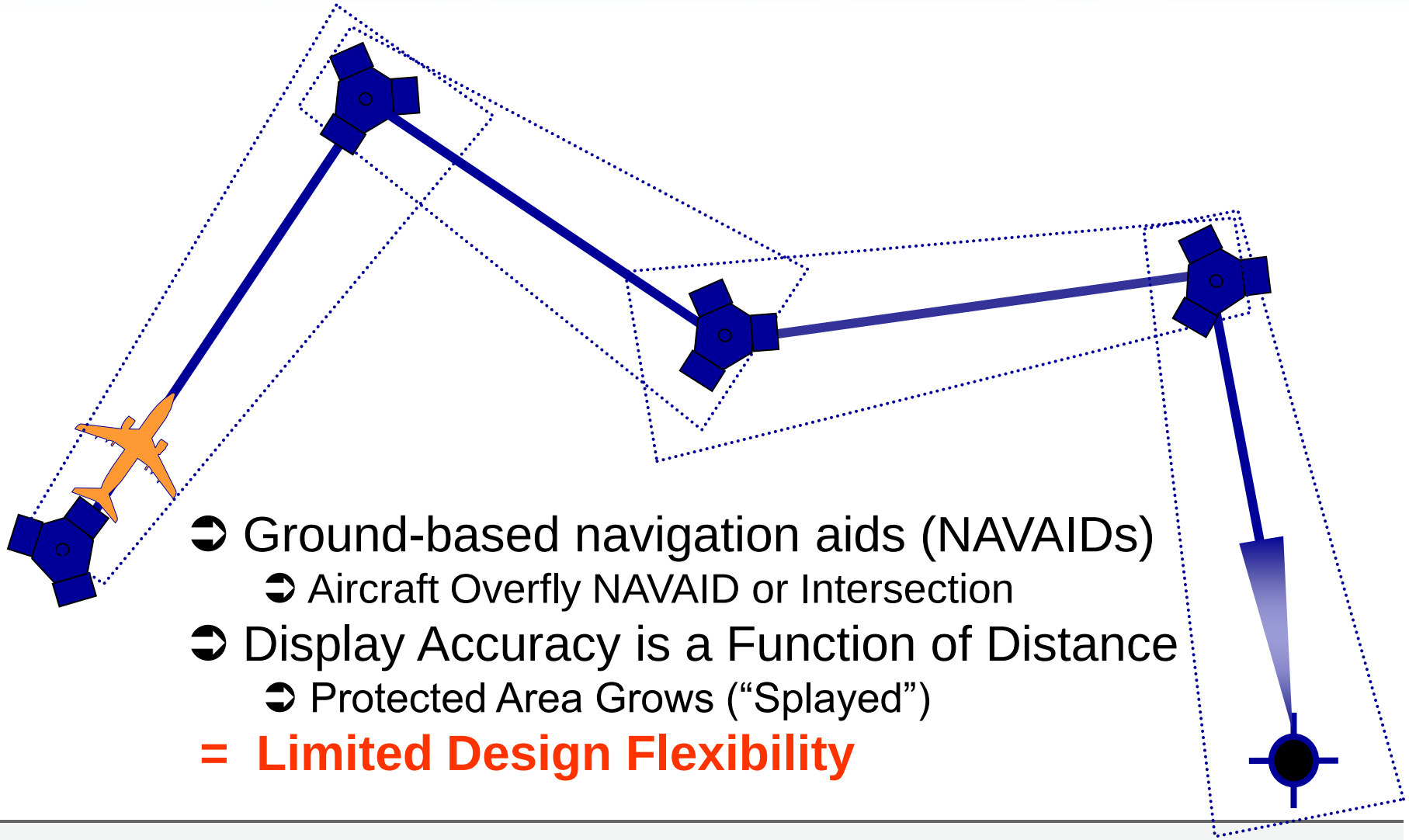
Evolution of air navigation

Navigation aids

NDB VOR ILS DME



Evolution of air navigation



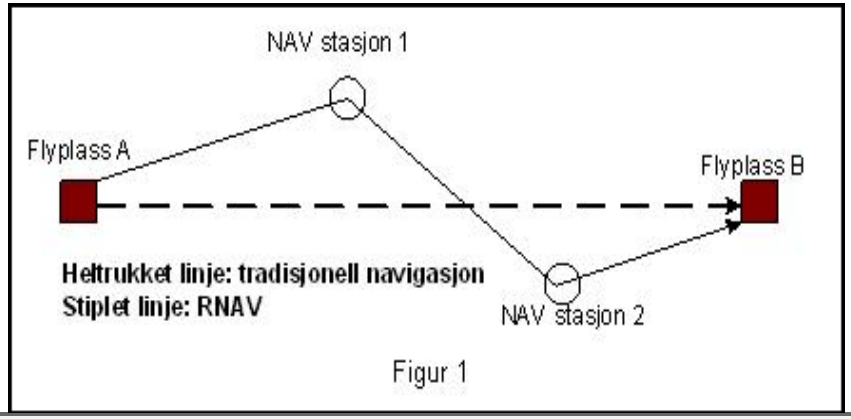
- Ground-based navigation aids (NAVAIDs)
  - Aircraft Overfly NAVAID or Intersection
- Display Accuracy is a Function of Distance
  - Protected Area Grows (“Splayed”)

= Limited Design Flexibility

Evolution of air navigation

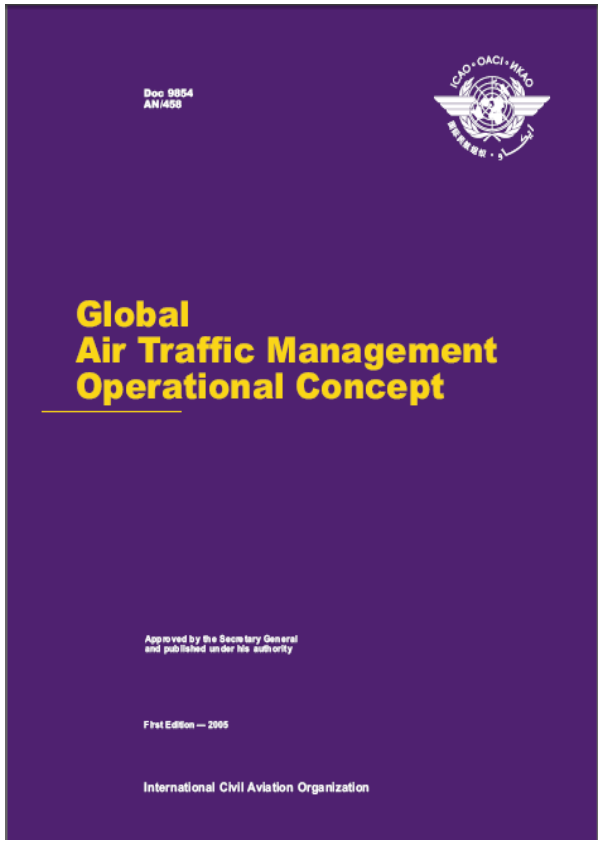
Area Navigation (RNAV)

- RNAV is a method of navigation enabling aircraft to fly on any desired flight path:
  - within the coverage of referenced NAVAIDS, or
  - within the limits of the capability of self-contained systems
- Developed in the 1960s
  - First routes published in the 1970s in the US
  - Uses VOR, DME (and later GPS) signals to generate trajectories which are not “VOR to VOR”
- RNP
- Developed in the 1990s
  - First RNP approach 1996



Figur 1

The ATM Operational Concept - Global ATM vision



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**
- meets national security requirements.

Global ATM vision (Cont.)

Expectations of the ATM Community

- Access and Equity
- Capacity
- Cost-effectiveness
- Efficiency
- **Environment**
- Flexibility
- Global interoperability
- Participation by the ATM community
- Predictability
- Safety
- Security

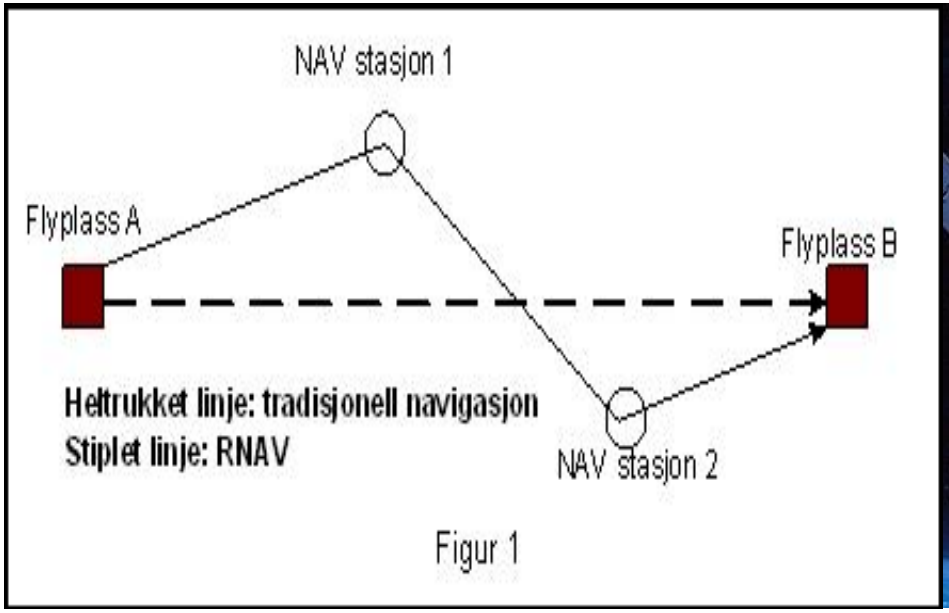
Performance based navigation (PBN)
Enabler of the Vision & operational Improvements

Assembly Resolutions - A36-23; A37-11

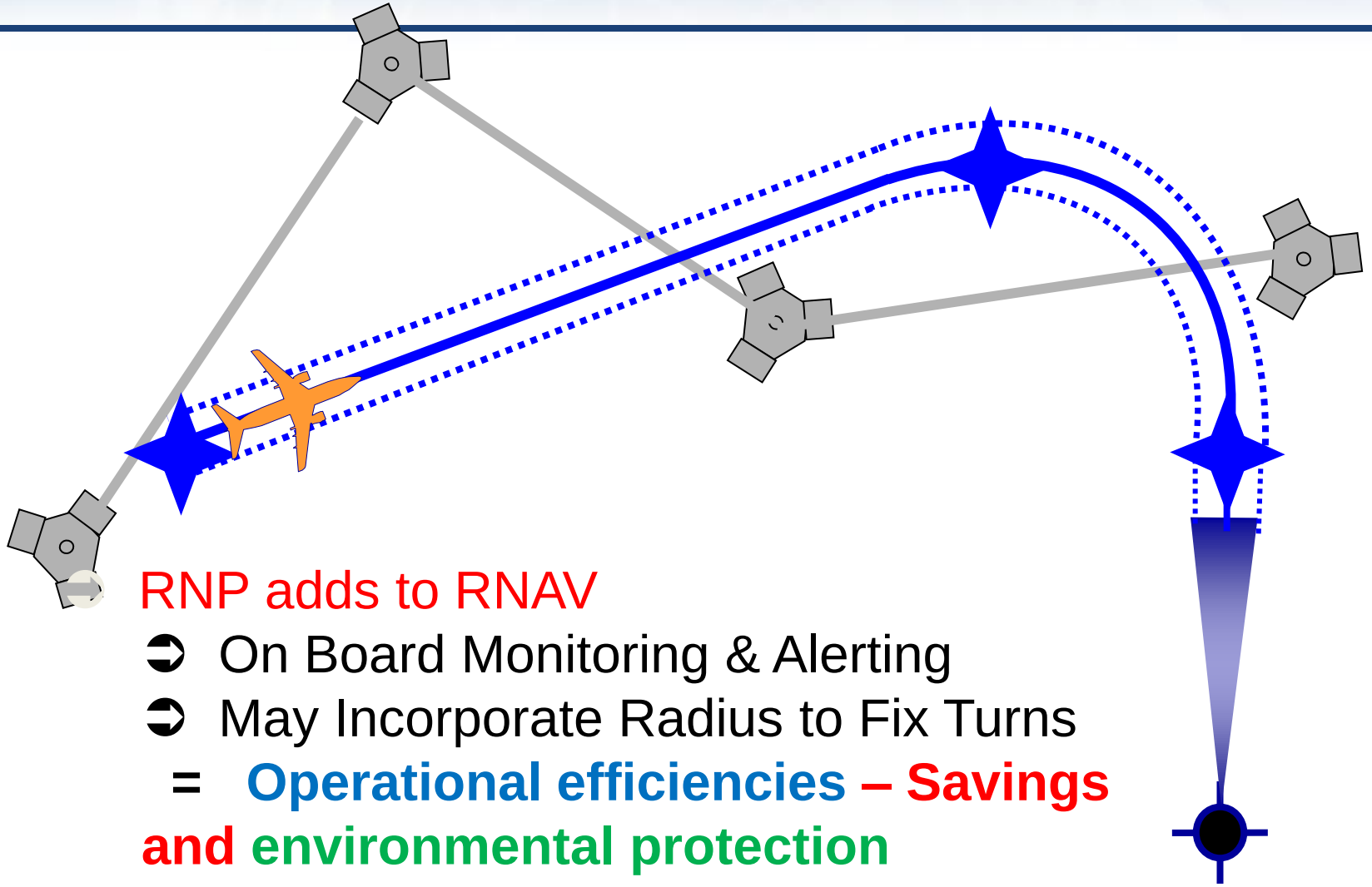
- Navigation based on specified system performance requirements for aircraft operating on a air traffic route, instrument approach procedure, or in a designated airspace
  - Potential for aircraft to demonstrate requirements compliance through a mix of capabilities, rather than only specific equipment
  - Regulators will not always need to write new compliance documents for new capabilities

PBN (Cont.)

- The technology supporting RNAV (the stem of PBN) has advanced from terrestrial to space-based, providing significant flexibilities
- GNSS (GPS, GLONASS, etc.; augmentations)



PBN (Cont.)



RNP adds to RNAV

- On Board Monitoring & Alerting
- May Incorporate Radius to Fix Turns

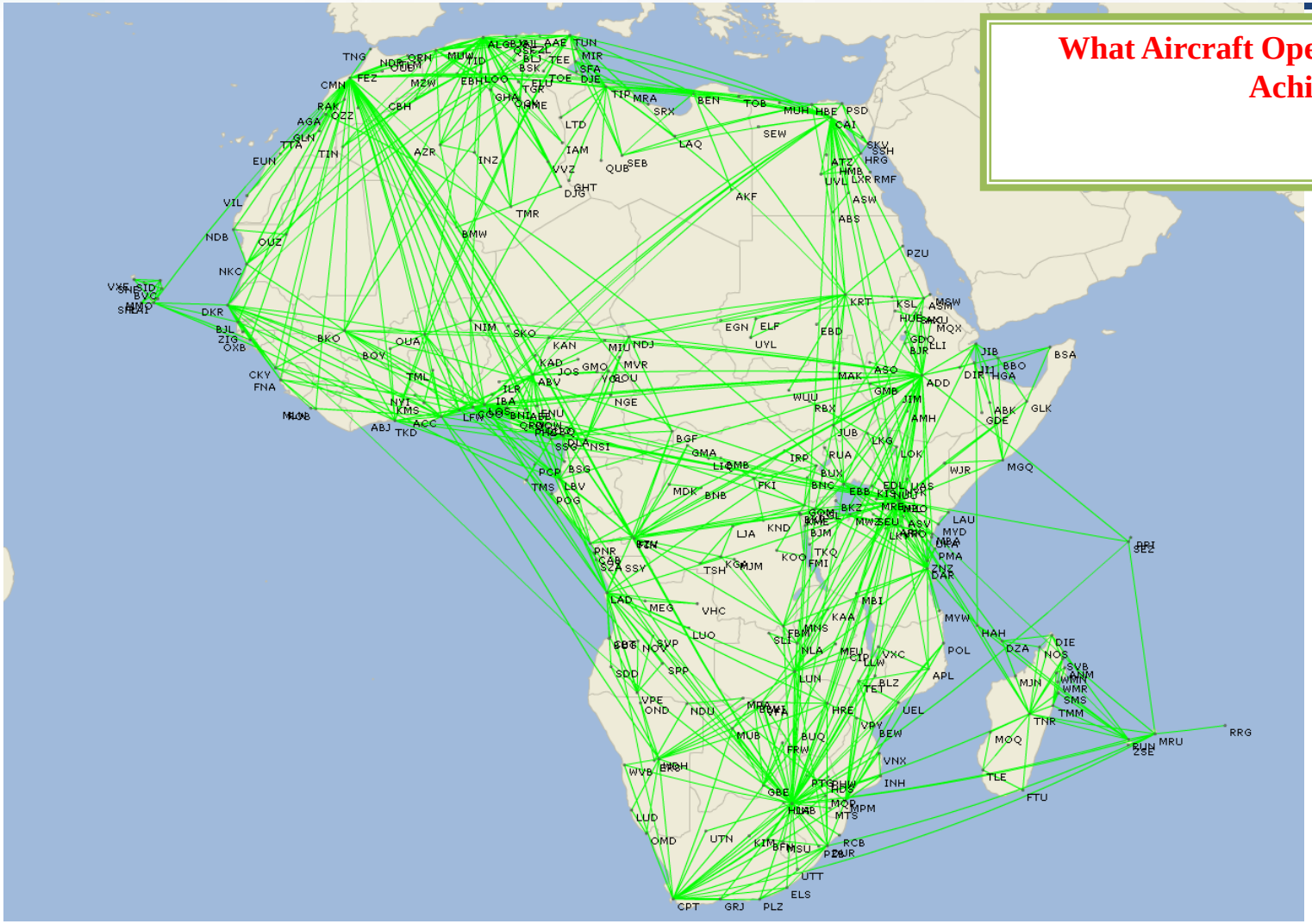
= **Operational efficiencies – Savings and environmental protection**

Operational improvements

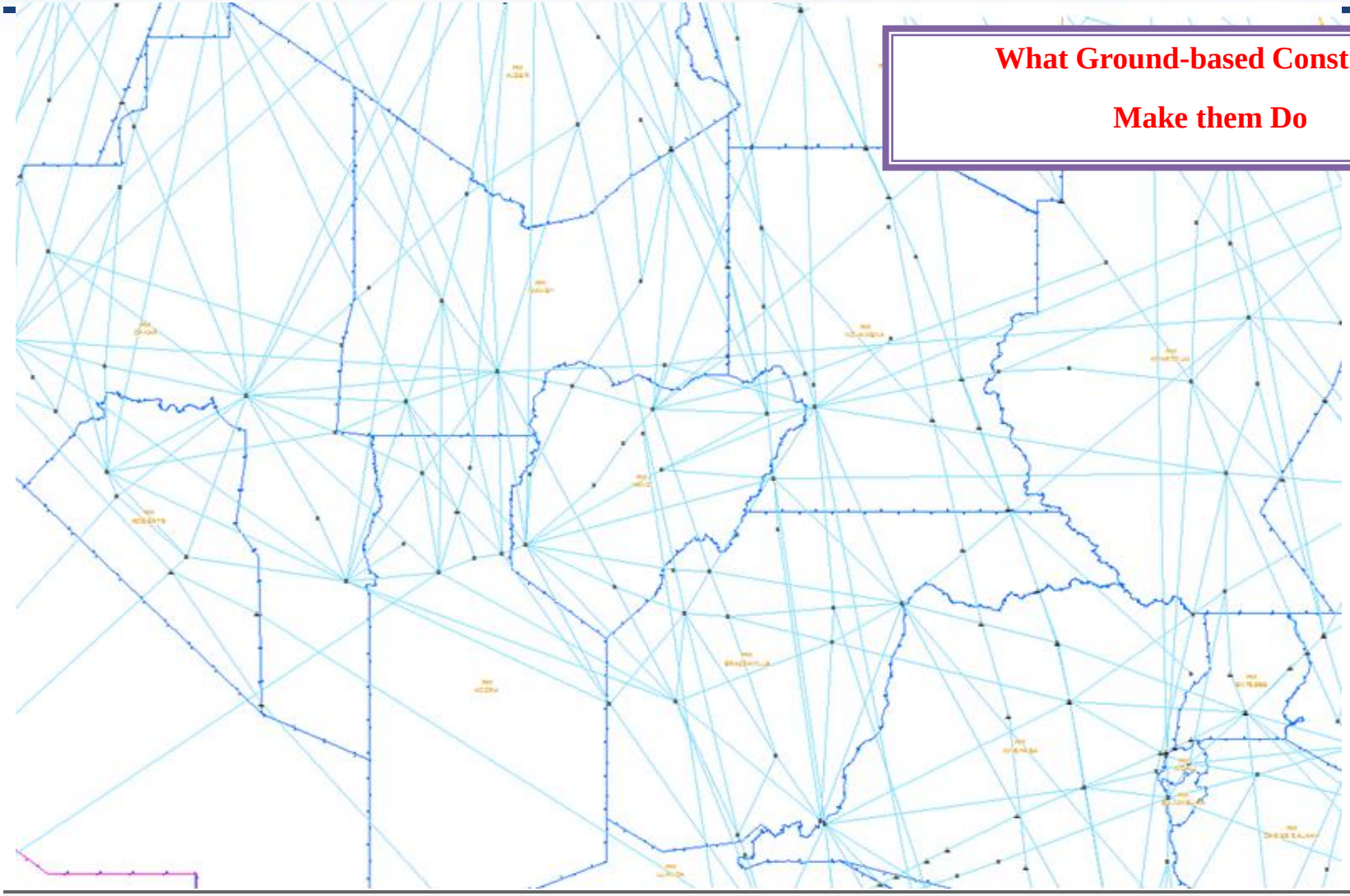
Environmental protection related operational improvements

- Direct routing particularly for short segments
- Multiple routes to provide flexibility – long sectors
- Predictable availability of optimum flight levels
- Cruise climb in certain airspaces
- Navigation through/by special use airspace
- Flexible Use of Airspace (FUA)
- Avoidance of noise sensitive areas
- Terminal area precision: capacity, flexibility
- Enabling Continuous Climb Operations (B0-CCO)
- Enabling Continuous Descent Operations (B0-CDO)
- etc.

PBN routes - Direct routes are preferred on short segments



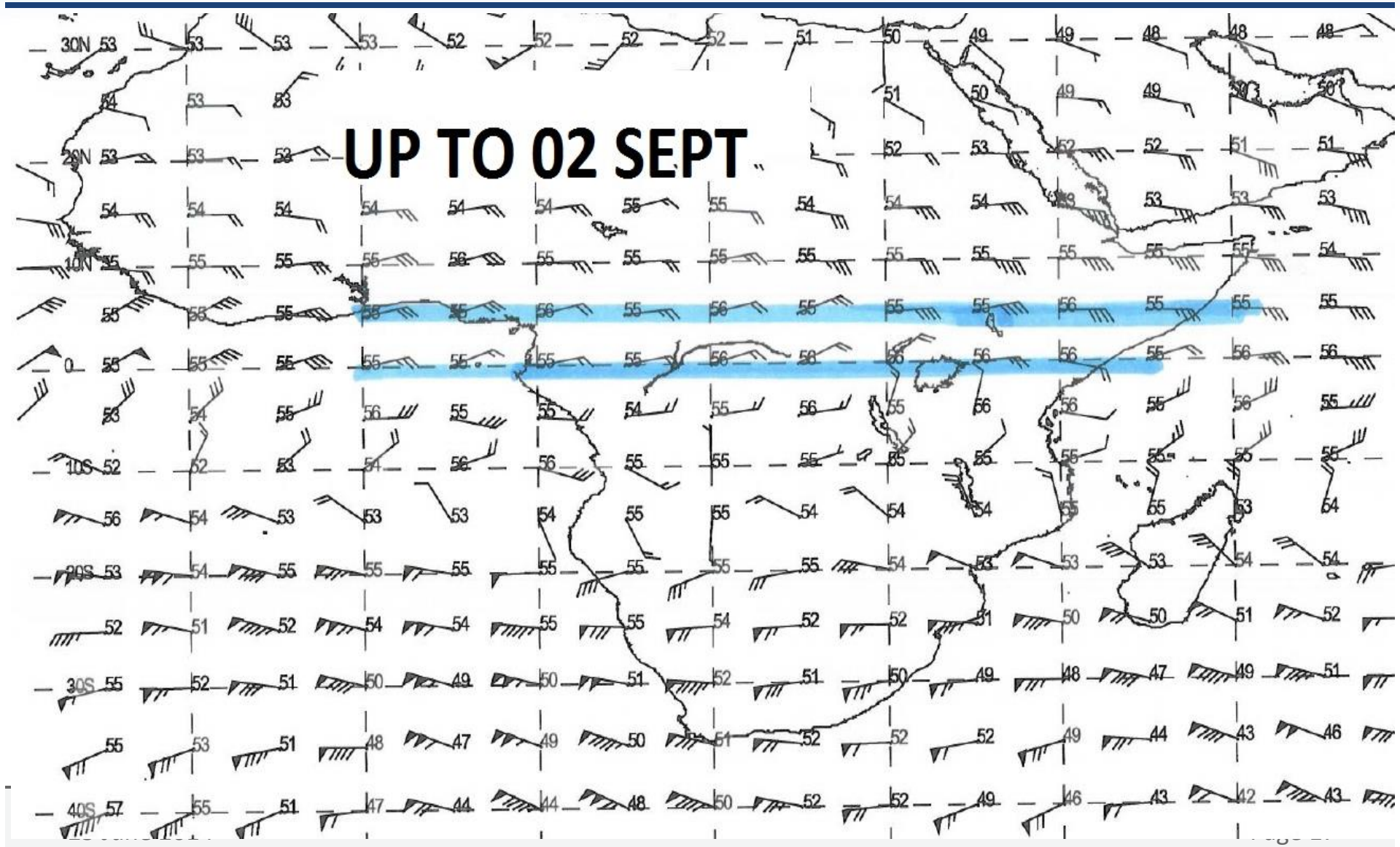
Dependence on age old airspace systems and operations



What Ground-based Constraints

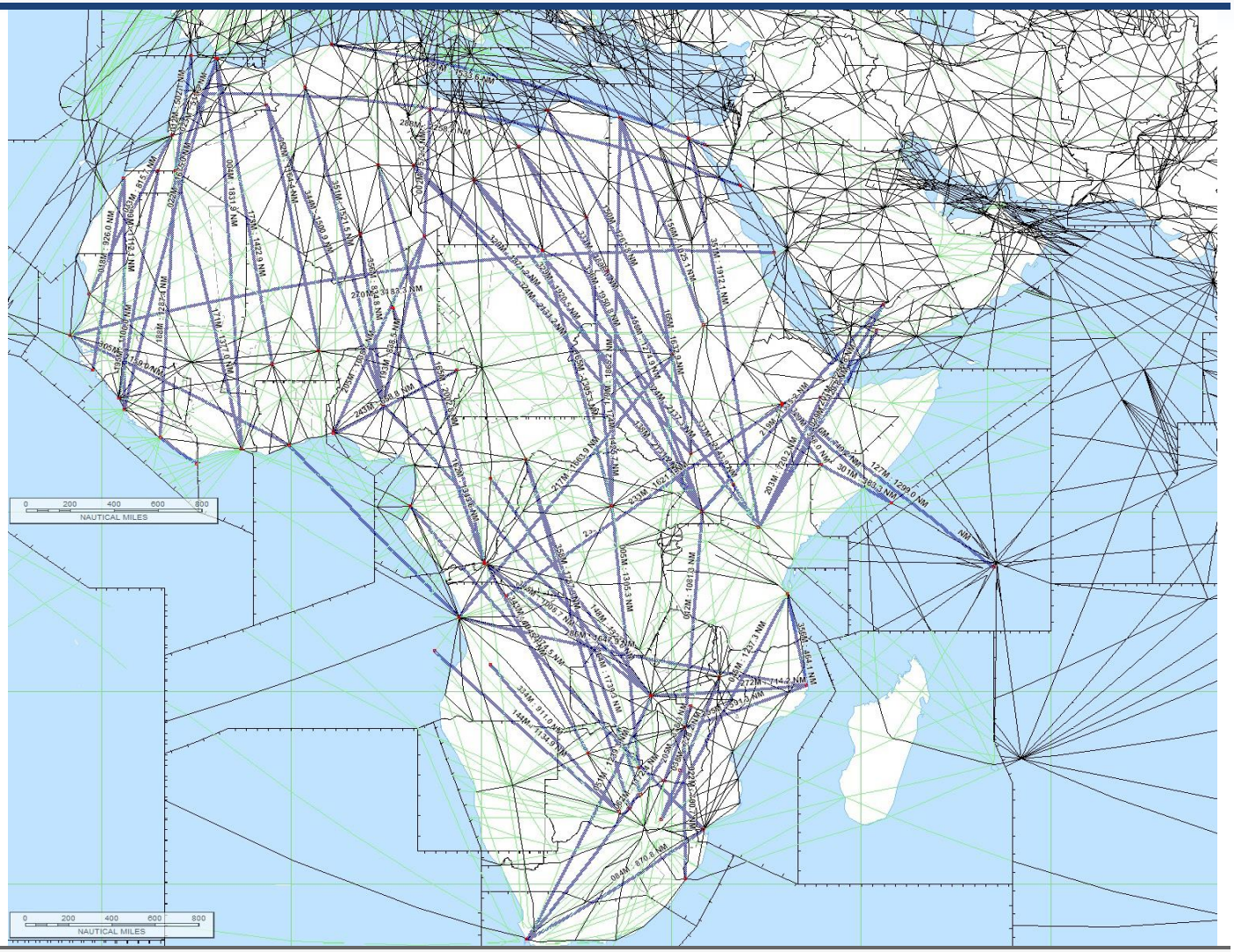
Make them Do

Operational improvements
Flexibility for long distance flights



Operational improvements
Flexibility for long distance flights

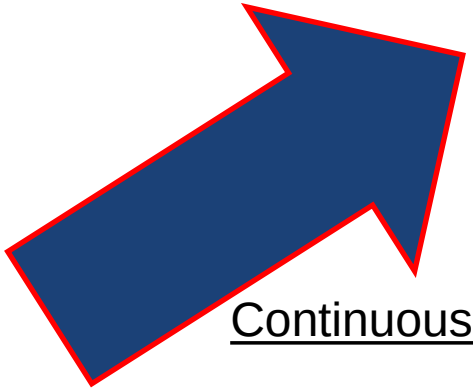
Depending on winds and other weather conditions, a flight operation can select route trajectories with most advantage



Operational improvements
Flexibility for long distance flights

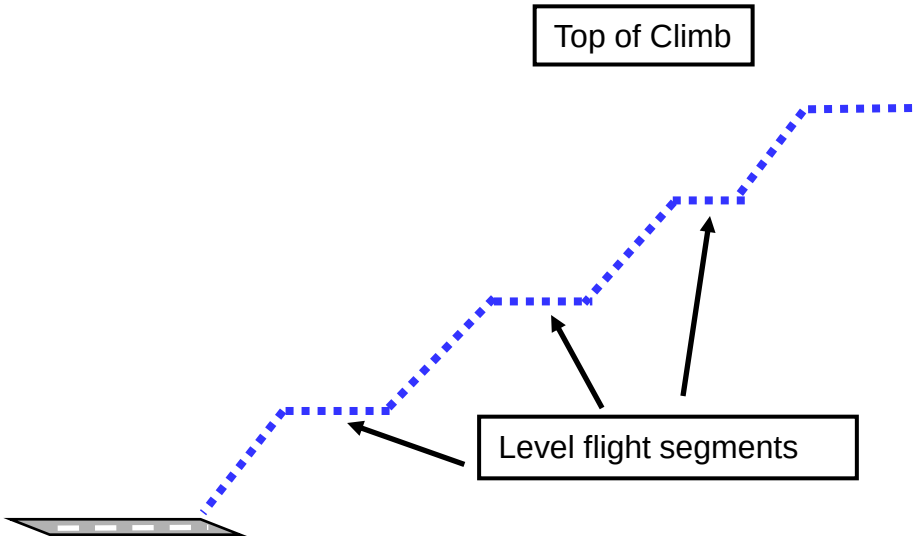
- Recently (April 2014) agreed on over 150 ATS route trajectories
- Prioritized based on benefits and implementation feasibility:
  - High benefits and Ease of implementation
  - High benefits and Lack of ease of implementation
  - Low benefits Ease of implementation
  - Low benefits and Lack of ease of implementation
- Accurate benefits under calculation

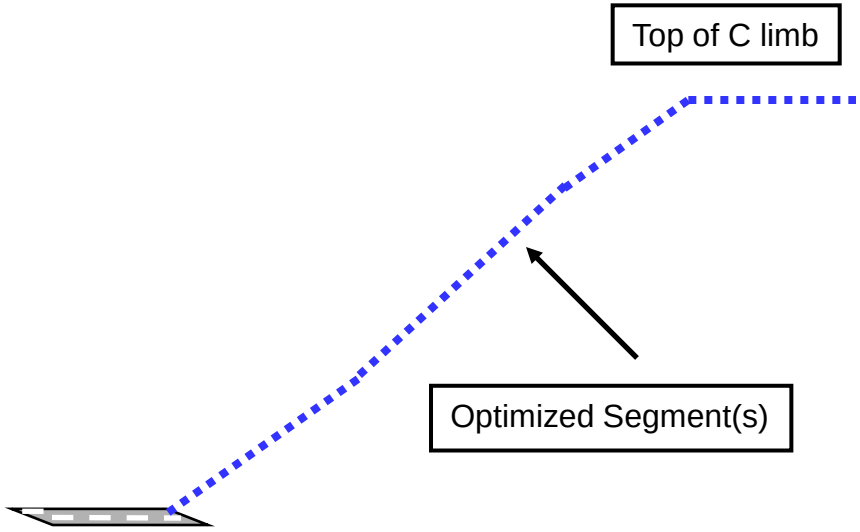
Operational improvements
Conventional vs. CCO



Conventional Departure

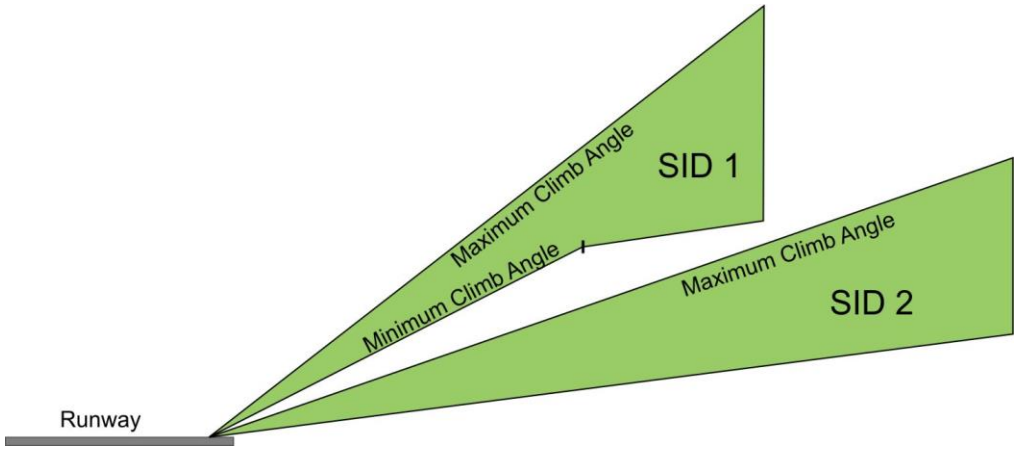
Continuous Climb Operations



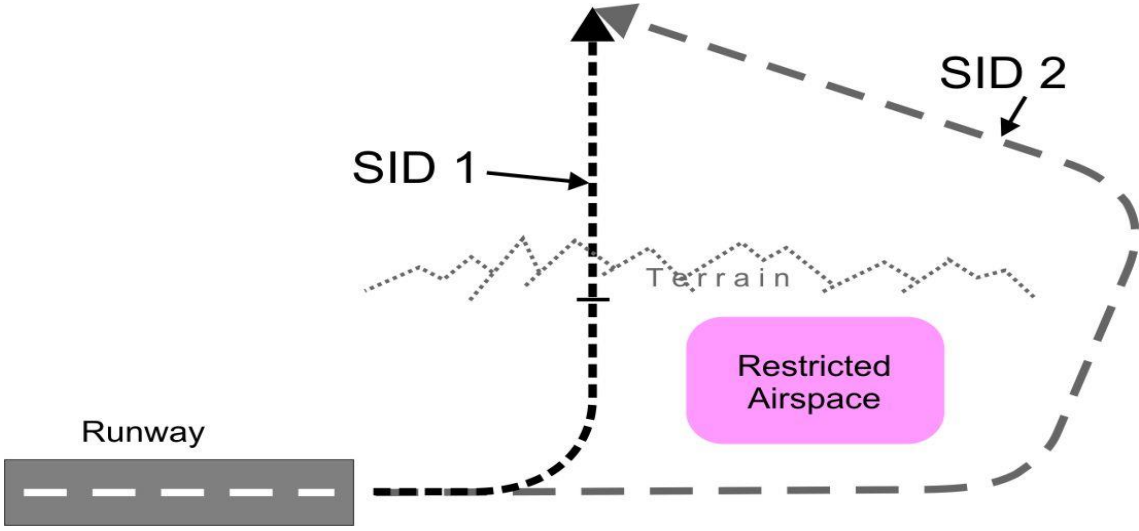


Operational improvements
Enhanced CCO

Design with multiple climb gradients

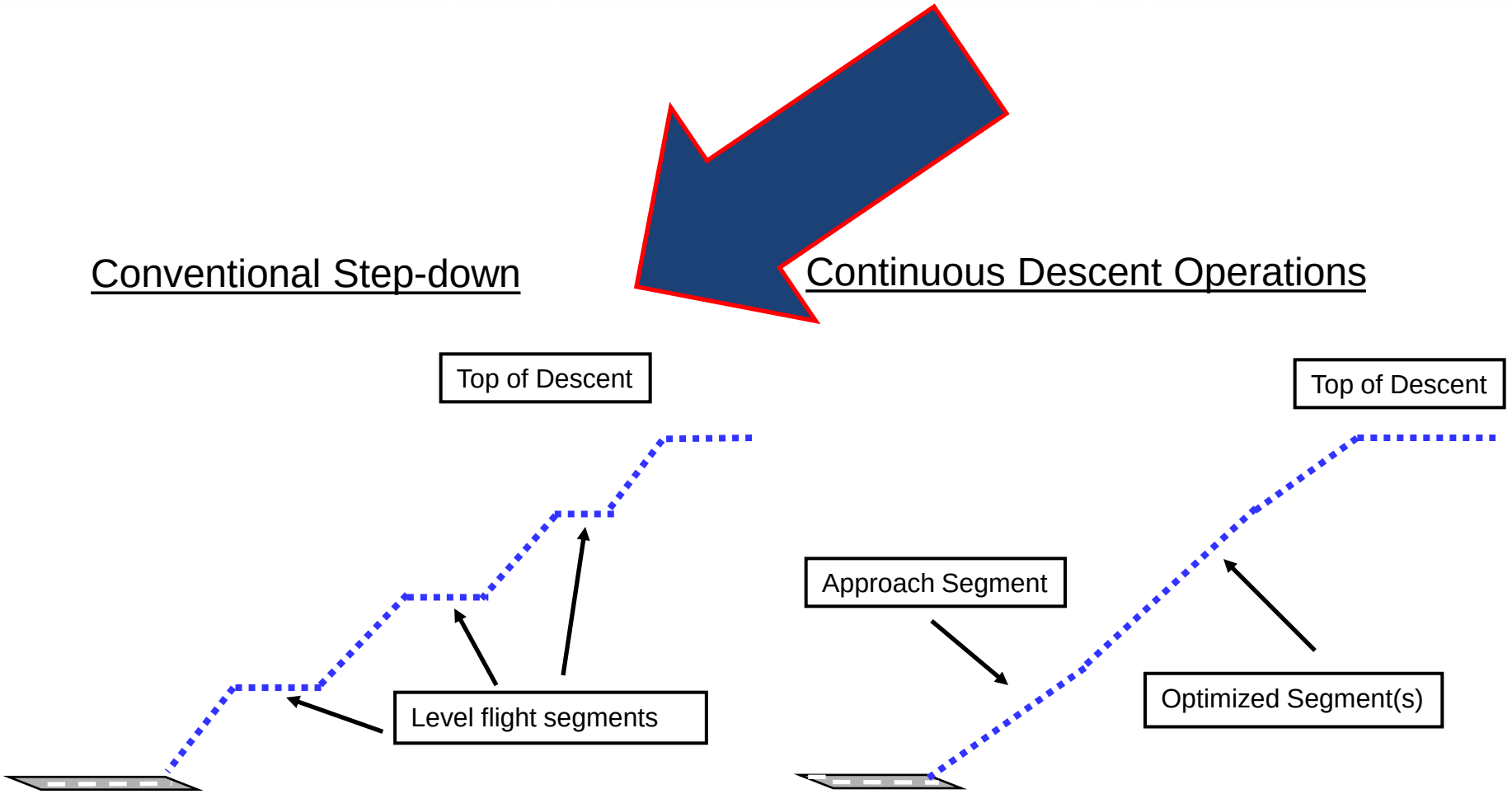


Profile view

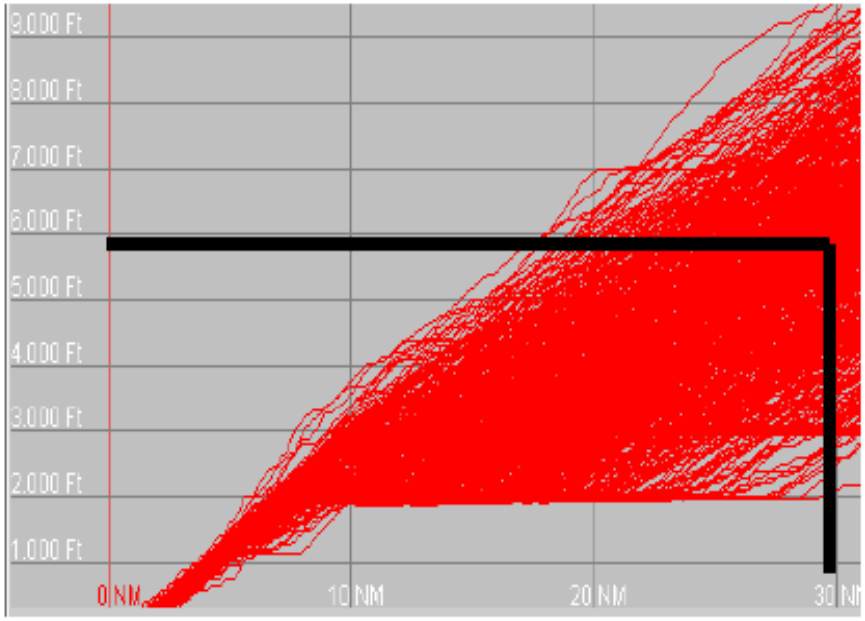


Top view

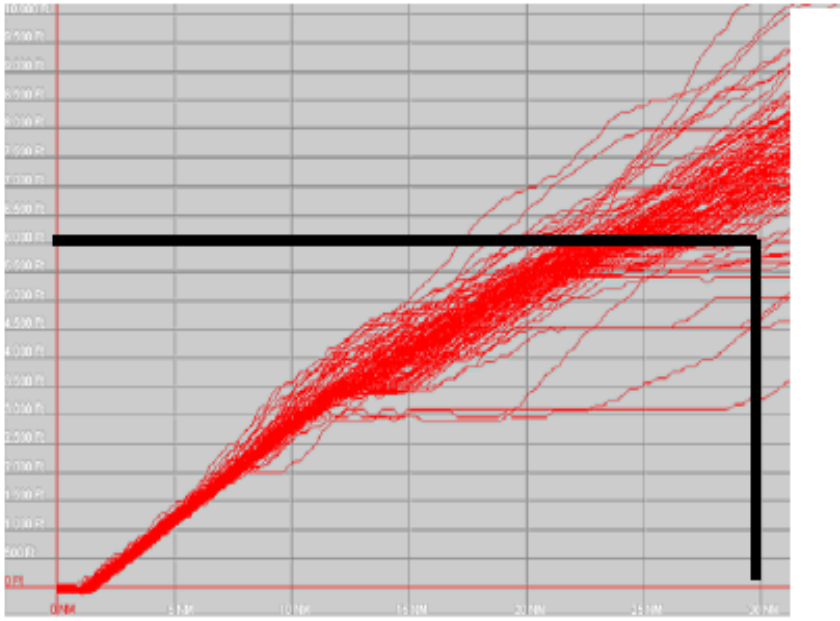
Operational improvements
Step-down (Dive and Drive) vs. CDO



Actual CDO Operation



Flight tracks before CDO

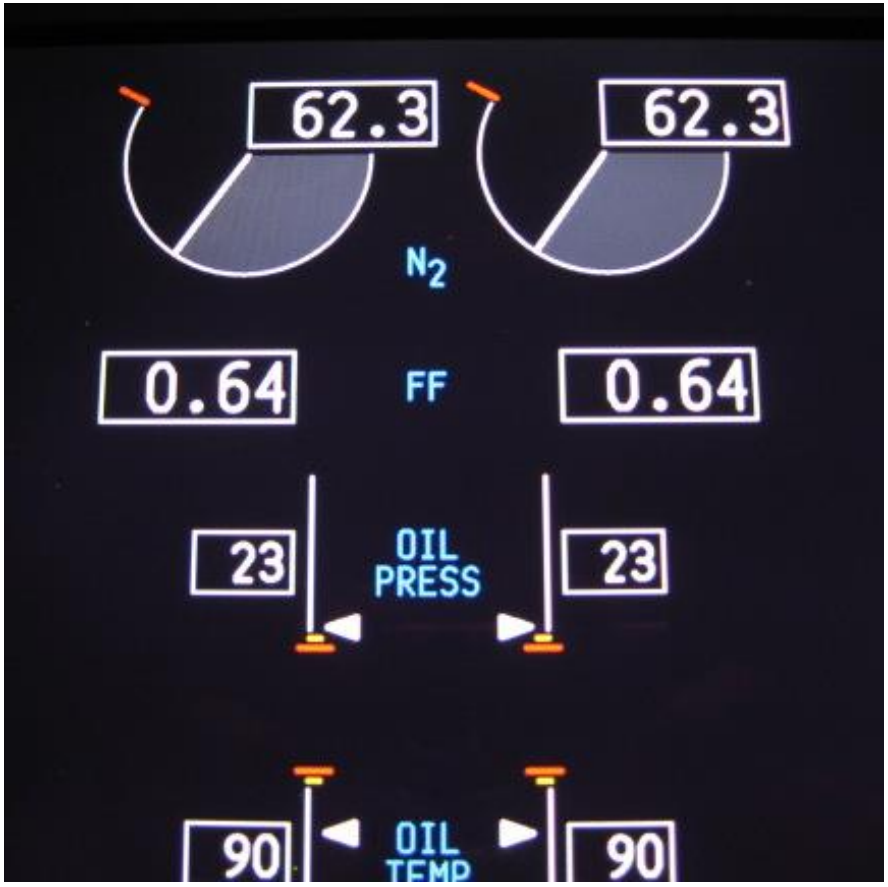


Flight tracks after CDO

Operational improvements

Importance of an Idle Descent

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



Operational improvements

Level-offs use 4-5 times more fuel

Idle Descent

x 3.7=

Level, 210 kt, flaps up

x 4.0=

Level, 180 kt, flaps 5

x 4.4=

Level, 170 kt flaps 10

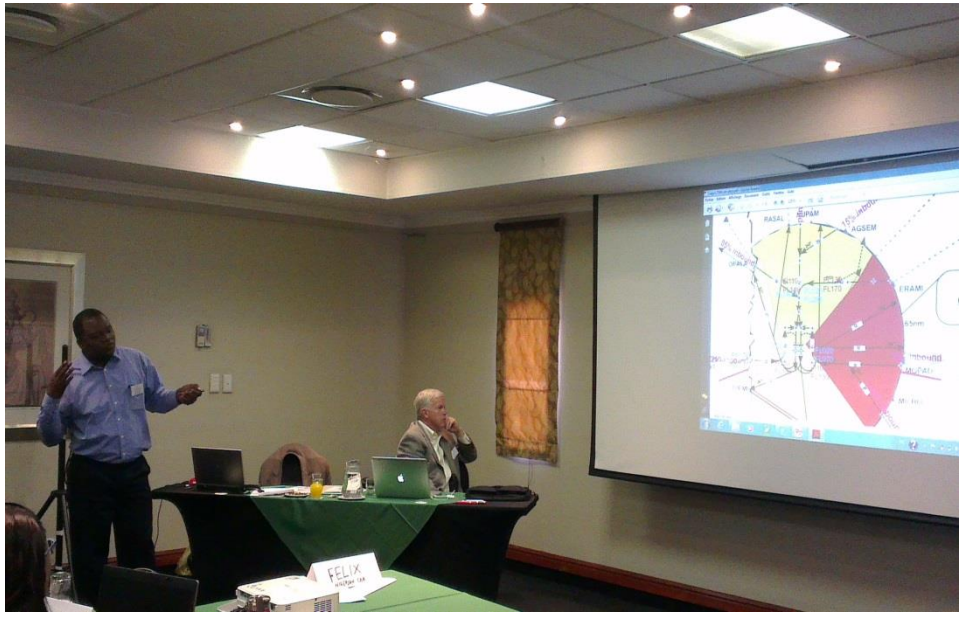
x 5.5=

Level, 160 kt, flaps 15

Operational Improvements

Airspace concepts – Comprehensive airspace reviews

- Airspace concept workshops and training undertaken in Johannesburg August 2013
- Safety
- Airspace efficiency
- ATS efficiency
- Environment
- Access
- Equity (GA, AT, etc.)

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Thank You