Overview

• KPA
• ASSEMBLY RESOLUTIONS
• OPERATIONAL IMPROVEMENTS
• IFSET
• FRAMEWORK
The air navigation system should contribute to the protection of the environment by considering **noise** and **emissions** in the implementation and operation of the global air navigation system.
In October 2010, the 37th Session of the ICAO Assembly adopted Resolution A37-19. The provisions of this Resolution build on ICAO’s past achievements and add new measures relating to international aviation including:

- The outcome of the 37th Assembly represents a key milestone in the continuing efforts of ICAO to address GHG emissions from international aviation
- The global annual average fuel efficiency improvement metric of 2 per cent until 2020 and the aspirational goal of 2 per cent annual fuel efficiency improvement from 2021 to 2050
- The medium-term global aspirational goal of carbon neutral growth from international aviation at 2020 levels
- The requests to ICAO to develop the necessary tools in order to assess the benefits associated with ATM improvements
In October 2013, the 38th Session of the ICAO Assembly adopted 2 more Resolution A38-17 on the ICAO policies and practices related to environmental protection (general provisions, noise and local air quality) and A38-18 (Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change)

The provisions of these Resolutions address in the introduction ...

*Whereas* many of the adverse environmental effects of civil aviation activity can be reduced by the application of comprehensive measures embracing **technological improvements, more efficient air traffic management** and **operational procedures** and the **appropriate use of airport planning, land-use planning and management** and **market-based measures**

*Declares* that ICAO, as the lead United Nations (UN) Agency in matters involving international civil aviation, is conscious of and will continue to address the adverse environmental impacts that may be related to civil aviation activity and acknowledges its responsibility and that of its Member States to achieve maximum compatibility between the **safe and orderly development of civil aviation** and the **quality of the environment**
The provisions of these Resolutions emphasize also on ...

Recognizing that air traffic management (ATM) measures under the ICAO’s Global Air Navigation Plan contribute to enhanced operational efficiency and the reduction of aircraft CO2 emissions

Resolves that States and relevant organizations will work through ICAO to achieve a global annual average fuel efficiency improvement of 2 per cent until 2020 and an aspirational global fuel efficiency improvement rate of 2 per cent per annum from 2021 to 2050, calculated on the basis of volume of fuel used per RTK performed

Requests States to:

... e) accelerate the development and implementation of fuel efficient routings and procedures to reduce aviation emissions

f) accelerate efforts to achieve environmental benefits through the application of technologies that improve the efficiency of air navigation and work with ICAO to bring these benefits to all Regions and States, taking into account the Aviation System Block Upgrades (ASBUs) strategy
Operational ATM improvements

- Performance Based Navigation - PBN
- Continuous Climb Operations - CCO
  Continuous Descend Operations - CDO
- Air Traffic Flow Management (ATFM)
- Flexible Use of Airspace - FUA
- EUROCONTROL Flight Efficiency Initiative (FEI)
- ....
ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET)

- Simple to use and scientific defendable
- States are asked to report on fuel savings from operational improvements in 2012
- Not all States have the ability to quantify these savings
- Environmental benefit reports be of interest for various user groups
What does IFSET

• Allows those States without modelling and/or measurement capabilities to estimate fuel savings from operational improvements
• Consistent with CAEP-approved GHG models
• Consistent with Global Air Navigation Plan
• Easy-to-use / minimal data requirements
• The tool can estimate:
  – Effects of shortening / eliminating level segments on departure and arrival
  – Effects of shorter routes (either in time or distance)
  – Effects of cruising at different altitudes
  – Effects of reduced taxi times
What IFSET does not do

The tool does not replace detailed modelling or measurement of fuel consumption already available in a State or from an international organisation (e.g. AEM - EUROCONTROL)
How does IFSET work

- **Pre-computed aircraft performance**
  - Level, climb and descent fuel consumption
  - By group of aircraft type
  - In 1000 foot intervals

- **Detailed scenario input**
  - Fleet mix defined for baseline and post-implementation scenario (Aircraft type [generic or specific [under discussion]])
  - “Remaining flight distance” (as a surrogate for weight)
  - User selects “elements” to define the baseline and “new” procedure

- **Evaluation by comparing scenarios**
  - Tool estimates the change in total fuel consumption between the 2 scenarios
IFSET (ICAO Fuel Savings Estimation Tool) should be used to determine actual savings in fuel and resultant reduction in GHG emissions. IFSET should be made available to States for the purposes of estimating changes in fuel consumption from the implementation of operational measures and obtaining State feedback.

• Aircraft engine emissions are directly related to fuel burn. Each kilogram of fuel saved reduces carbon dioxide (CO2) emissions by 3.16 kg

• Quantitative benefits examples per flight (estimates only - using rule of thumb)
  – Shorter routes: flight time saved 4 min, fuel 200 kg, 600 kg of CO2
  – Improved flight profiles: time saved 0 min but higher/better altitude, fuel 20 kg, 60 kg of CO2
  – Better approach procedures: time saved 3 min, fuel 150 kg, 450 kg of CO2
  – Improved aerodrome operations: time saved while taxiing 2 min, fuel 30 kg, 100 kg of CO2
• States are requested to insert at least the indication of the route length difference of the new proposals when compared to the initial route length into the State reports, so that the savings in terms of mileage, flight time, fuel and CO2 emissions could be further analysed by using IFSET.

• RDGE confirmed again the importance of such information on the savings which would reflect the efforts made by the whole aviation industry in reducing fuel consumption, flight time, mileage and its impact on the environment (CO2 emissions) and States agreed to submit the information about the implemented ATS Routes to the RDGE meetings.
The availability of the fuel savings and related CO2 reductions could be an additional benefit in the procedure design process when comparing various design options.

The IFSET information could also serve as an extra argumentation element in the actual implementation campaign indicating to all stakeholders the economic and emissions benefits of the new procedures.

After actual implementation the data can also be used to raise the awareness and familiarisation aspects of the new procedures to pilots and controllers.
IFSET and CDOs

- Continuous Descend Approaches (CDA) in Munich, Germany

Daily business

The controllers give in about 90% of the time the same clearance!!!

STAR und then Transition

from DFS CDA EDDM presentation at EUROCONTROL
CDO – „keep it simple“

- To enable a high amount of CDOs with a fuel-efficient descend out of FL 270 down to FL 090 without reducing the overall capacity
- Basically independent from aircraft type (no Props)
- Runway dependent, only inbounds with a „long downwind“
- Optimized for the overall system – not optimized for every flight
- Avoidance of longer level flights in lower levels
- Benefit: small for each flight, big for the overall system
- Flight level constraints on the STAR:
  - Predictable for the ATC und Cockpit-Crew
  - Flexibility for different aircraft and different weights through „level windows“
  - Directs are always possible, the CDO will be continued at the next waypoint with constraint
  - Usable during „low and medium traffic load“ even during the rush hour
- Automating common procedures

Simple structure

- CDO starting points
  - between FL 230 und 270, free speed
- before TMA below FL 190, max. speed 280 KIAS
- Turning to downwind
  - between FL 170 und FL 110
  - Speed 230 KIAS
- Short before abeam EDDM (DM456)
  - at or above FL 110, Speed 230 KIAS
- Short after abeam EDDM (DM454)
  - at FL 90, Speed 220 KIAS (no more vertical guidance)
- Continue to the last waypoint on the transition (DM450)
IFSET and CDOs

Result after 9 months of north CDOs

More than 7000 CDOs (> 53% of possible traffic)

about 280 tons of fuel savings
• Full airspace re-design and implementation of new RNAV SIDs & STARs (as CCOs and CDOs) resulted not only in an increase of safety (less conflicts) but also in fuel savings and related CO2 reductions

• The IFSET simulations included the ATS route length reduction, the possibility to fly on appropriate FLs/Altitudes and the use of optimized flight profiles (more efficient APP/DEP procedures)

• After the actual implementation in Baku FIR in March 2014 the theoretical benefits were compared to the actual operational benefits from the aircraft operators flying in/out of Baku and the initial trends were confirmed after 6 months
• Example of a CDO

from AZANS presentation at ATMGE19 in 2014
IFSET and Airspace Design

• Example of a CCO

**ADEKI DEPARTURE RW 16/18**

**SCENARIO 1**

A/C NUMBER 383  
(GYD-SAGIL- ADEKI)

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<td>Wastage</td>
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<td>Saving 38200 KG (16,3 %)</td>
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From AZANS presentation at ATMGE19 in 2014.
## Departures

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<tr>
<th>Scenario</th>
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<th>New Fuel Consumption in Kg</th>
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Savings calculated from AZANS presentation at ATMGE19 in 2014.
IFSET and Airspace Design

• Arrivals

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Total savings: -190200

From ATAN presentation at ATMGE19 in 2014
### IFSET and Airspace Design

From AZANS presentation at ATMGE19 in 2014

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<td><strong>Final</strong></td>
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<td><strong>Departure</strong></td>
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<td><strong>Arrival</strong></td>
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<td><strong>Total</strong></td>
<td>700800 kg</td>
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IFSET and ATM Performance

- IFSET could also be used to address the deviation from the most efficient flight path (in this example based on the route length for the flight from EDDM to LTAI in the green line).
- The inefficiency of the ATM system operations (actual route lengths for the same city pairs in the red line) could be measured in terms of additional fuel burn and extra CO2 emissions.
- Small improvements in the flight efficiency of ATM system operations (various route proposals for the same city pairs in the blue lines) could also be accompanied with estimates in fuel consumption reduction and their related environmental (CO2 emissions) benefits.

From EUROCONTROL’s 50 MPCPE evaluation, as presented in RNDSG/74.
KPA

ASSEMBLY RESOLUTIONS

IFSET (State Letter, AN 13/61-12/4)

It is critical that a harmonized implementation of a fuel saving estimation process is used to support a coordinated global effort towards reduction of the aviation impact on climate change; therefore ICAO has developed the ICAO Fuel Savings Estimation Tool (IFSET)

Regional Performance Framework

ENV working papers with conclusions endorsed at PIRG level (EANPG, NATSPG, etc.)
• Fleet Mix
  - Single aisle
  - Twin aisle
  - Commuter

• Procedure mix “distance remaining”
IFSET example

- Fleet mix
  - 100 large single aisle jets
  - 70 single aisle jets
  - 20 turboprop
  - 10 large business jets
- Aircraft mix “distance remaining” between 740 and 2120 NM
- Procedure mix with CDO starting 30 NM later

Estimated Fuel Savings Report
- Old fuel consumption 87400 kg
- New fuel consumption 61200 kg
- Savings 26200 kg fuel and 82792 kg CO2 emissions
<table>
<thead>
<tr>
<th>KPA</th>
<th>OBJECTIVES</th>
<th>FOCUS AREAS</th>
<th>INDICATORS</th>
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<tr>
<td>SAFETY</td>
<td>Ensure safety continuous improvement through reduction of ATM related safety occurrences and implementation of uniform safety standards</td>
<td>En-route ATFM Delay</td>
<td>Effectiveness of Safety Management (Safety Maturity Survey)</td>
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<td>Airport ATFM Delay</td>
<td>Level of State Safety/Just culture (Safety Culture Survey)</td>
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<td>Adoption of an harmonized occurrences severity classification system (methodology)</td>
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<td>CAPACITY</td>
<td>Capacity meets demand</td>
<td>Flight Efficiency</td>
<td>Average horizontal en route flight efficiency (length of the en route part of the actual trajectory/last flight planned route vs great circle)</td>
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<td>EFFICIENCY</td>
<td>Ensure users may use most efficient routes</td>
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<td>Average en-route ATFM delay generated by airspace volume</td>
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<td>Average ATFM delay per flight in the main airports</td>
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<td>ENVIRONMENT</td>
<td>Contribute to the protection of environment (fuel/CO2 emissions reduction)</td>
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<td>CO2 emissions related to inefficiencies in route extension</td>
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<tr>
<td>COST EFFECTIVENESS</td>
<td>Contribute to optimization of costs for ANS</td>
<td>ATCO Productivity</td>
<td>IFR Flights and flight hours per ATCO hour on duty</td>
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<tr>
<td>PARTICIPATION BY ATM COMMUNITY</td>
<td>Ensure States' participation to Regional planning activities</td>
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<td>Level of participation of States to Regional planning activities</td>
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</table>
• EANPG/53 Conclusion 34

– Measuring and reporting of environmental benefits from operational improvements

That ICAO Regional Director, Europe and North Atlantic, invite:

• States to consider that all plans to implement operational improvements to be encompassed by an environment benefits analysis;

• States to use IFSET or a more advanced model/measurement capability available to estimate environment benefits accrued from operational improvements; and

• The COG Performance Task Force to investigate on how the IFSET or a more advanced model/measurement capability available be better used so as to meet the ICAO global reporting requirements on the environmental benefits from operational improvements.
THANK YOU

North American Central American and Caribbean (NACC) Office
Mexico City

South American (SAM) Office
Lima

ICAO Headquarters
Montreal

Western and Central African (WACAF) Office
Dakar

European and North Atlantic (EUR/NAT) Office
Paris

Middle East (MID) Office
Cairo

Eastern and Southern African (ESAFA) Office
Nairobi

Asia and Pacific (APAC) Office
Bangkok