Presented by

Eric FORTUNATO
Head of ETOPS/LROPS Programs
Product Integrity – Engineering Directorate
Airbus

Overview of new ETOPS / LROPS / EDTO rules

Impact on Aircraft Certification and Approval of Operators

Presentation prepared for:

ICAO Fourth Meeting of the Regional Aviation Safety Group – Pan America (RASG-PA)

Miami, 19-21 October 2011

AIRBUS

Overview of New EDTO rules

- **Introduction**
  - Foreword / Airbus experience
  - Applicability / Acronyms
  - Evolution of the rules – major milestones
  - Recall: intent & content of initial ETOPS regulations

- **New ETOPS / LROPS / EDTO Regulations**
  - Why new rules?
  - New rules (ICAO, EASA and FAA): overview of main changes
  - Focus on EDTO proposed amendment (State Letter of June 2011)
  - Recap: impact of the new rules on existing and future long range operations

- **Conclusions**

- *Appendix*
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Foreword

- This presentation has been prepared for the ICAO Fourth Meeting of the Regional Aviation Safety Group – Pan America (RASG-PA), held in Miami (October 19th – 21st 2011) .

- The elements presented herein reflect the current status and knowledge of existing and up-coming rules related to EDTO/ETOPS/LROPS.
  - *New FAA ETOPS Rule (published and implemented in 2007) and final AC 120-42B*
  - *New EASA ETOPS Rule, published and implemented in 2010*
  - *New ICAO EDTO provisions of State Letter SP 59/4.1-11/8 of June 2011*

- The information contained in this presentation may therefore require to be updated as final rules and interpretative material are published.

Foreword: Airbus ETOPS experience

Foreword: Airbus ETOPS experience

Airbus has over 3 decades of ETOPS experience:

- First 90 min (ICAO rule) operations with A300B2/B4 in **1976**
- First Airbus aircraft (A310 & A300-600) certified for ETOPS in **1986**
- A320 is the first Fly-By-Wire aircraft to be approved for ETOPS in **1991**
- First early ETOPS approval program: A330 in **1994**
- First ETOPS>180 min certification: A330 (pax version) in **2009**
  - Certified Max DT capability corresponds to ~240 min (ISA, still air)

- As of today, Airbus ETOPS twins have accumulated over 11 million ETOPS FH
  - ~90% of A330 operators are ETOPS

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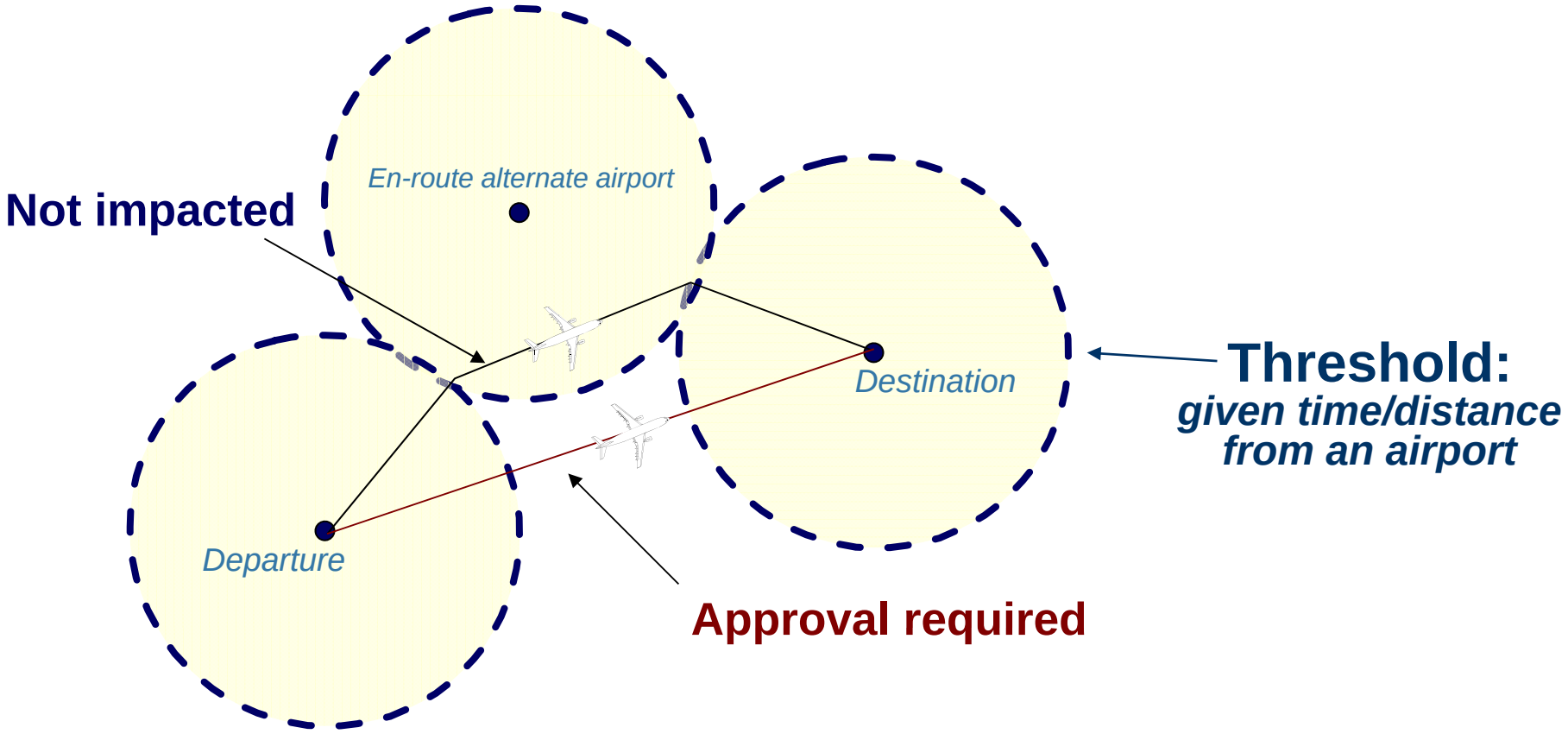
Applicability: concept of threshold

There are sets of

Certification & Operational requirements

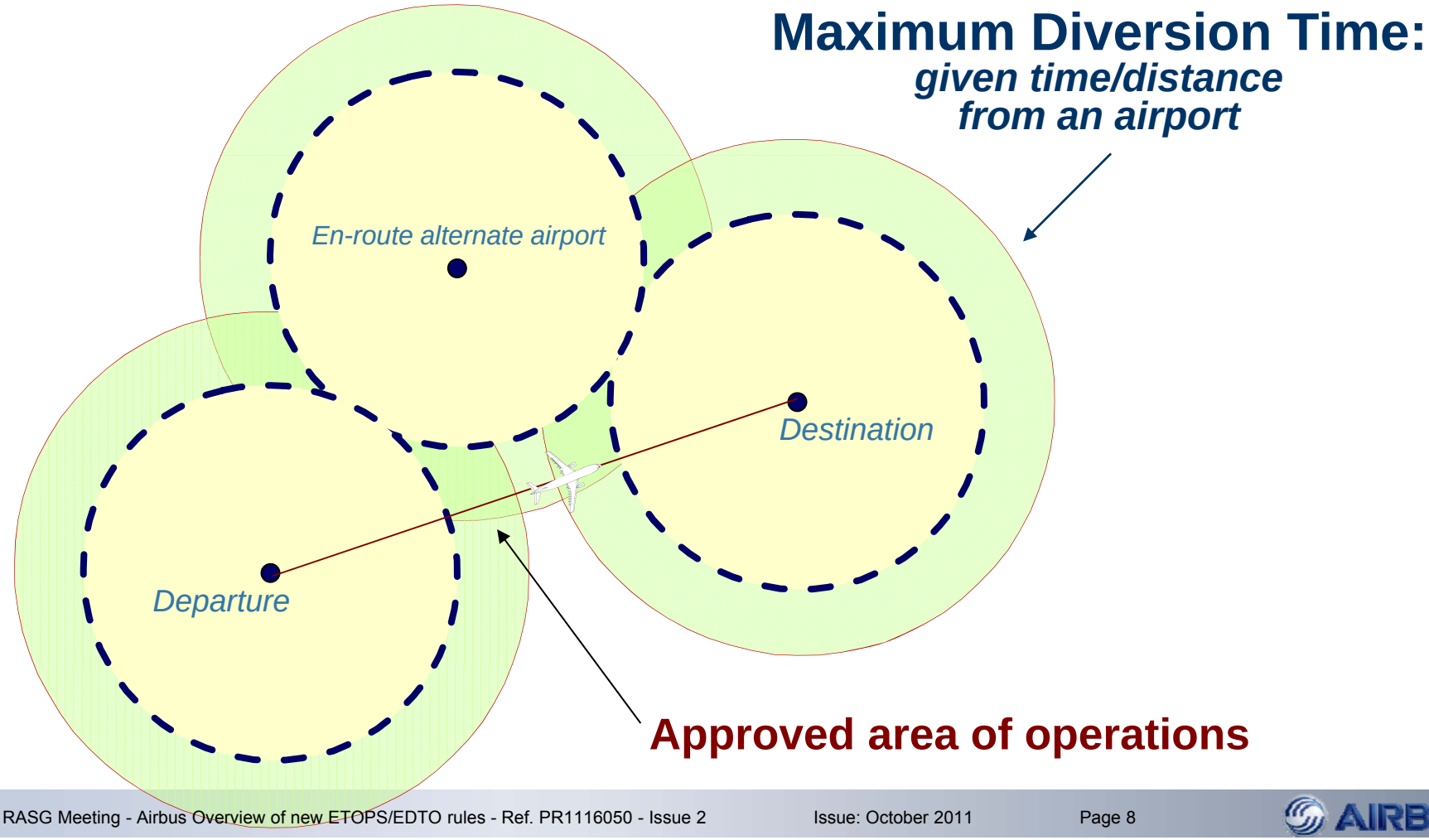
which applies when

an aircraft is operated beyond applicable threshold



Concept of Maximum Diversion Time

These Certification & Operational requirements also introduce the concept of **Maximum Diversion Time**, thus defining an approved/authorized area of operations



Different acronyms for the same subject

1985 - 2006

ICAO

EASA

FAA

ETOPS

Extended **T**win **OP**eration**S**

Applicable to Twins only

Different acronyms for the same subject

2007 - 2010

ICAO

EASA

FAA

ETOPS

Extended **T**win **OP**eration**S**

Applicable to Twins only

ETOPS

Ex**T**ended **OP**eration**S**

Applicable to Twins, Tris and Quads

Different acronyms for the same subject

2011

ICAO

EASA

FAA

EDTO

Extended **D**iversion **T**ime **O**perations

Applicable to Twins, Tris and Quads

ETOPS

Extended **T**win **OP**eration**S**

Applicable to Twins only

ETOPS

Ex**T**ended **OP**eration**S**

Applicable to Twins, Tris and Quads

LROPS

Long **R**ange **OP**eration**S**

Applicable to Tris & Quads only

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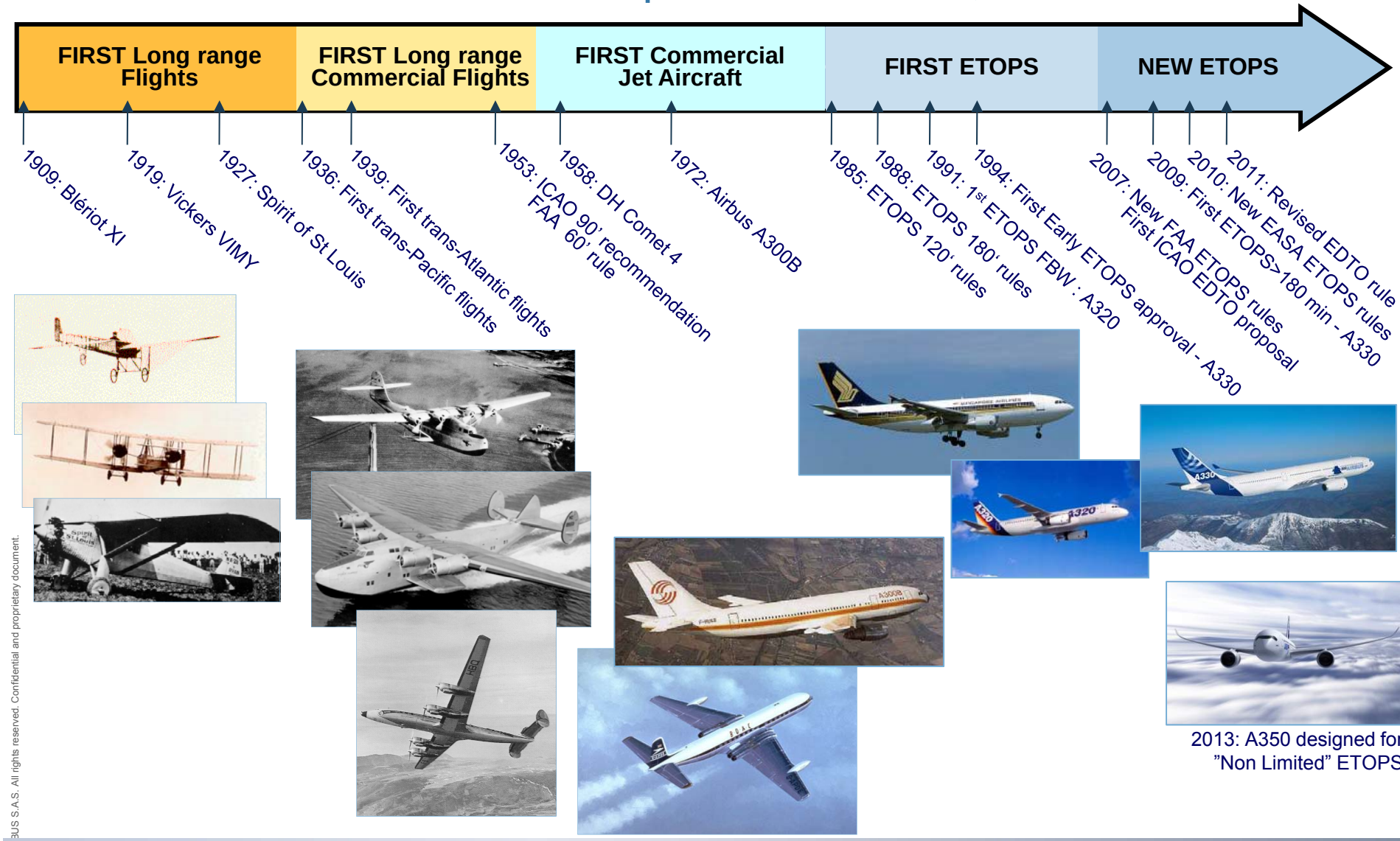
Extended Diversion Time Operations Milestones

Extended Diversion Time Operations : Past, Present & Future



2013: A350 designed for "Non Limited" ETOPS

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The logic of ETOPS

The objective of initial ETOPS rules (1985):

"Overall level of operational safety consistent with that of **modern 3 and 4 engine aircraft"**

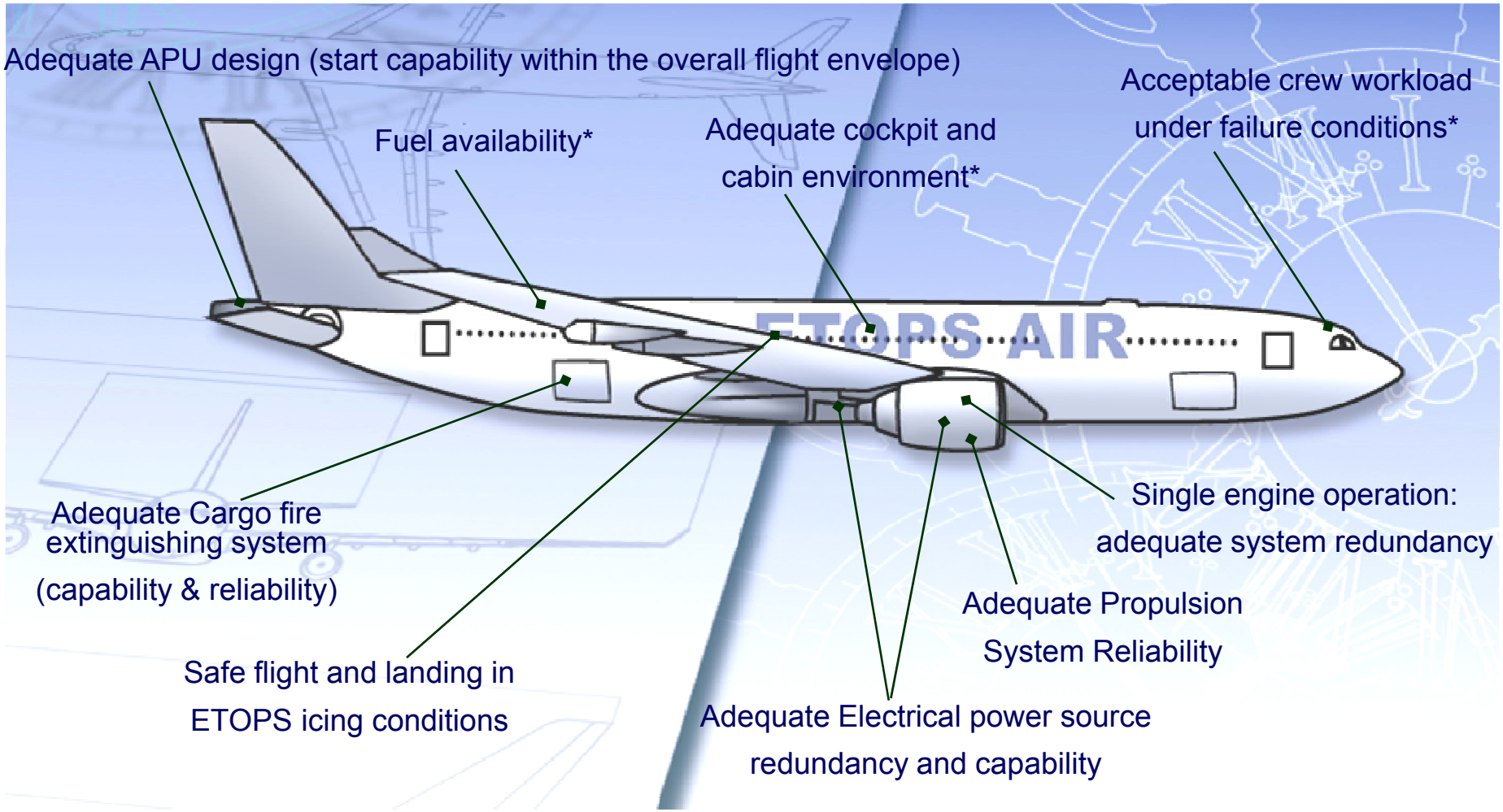
Intent of the new ETOPS regulations

Basically, the ETOPS concept implemented 25 years ago is not changed:

PRECLUDE a diversion by	PROTECT the diversion by
designing reliable airplane, engines and systems	implementing systems/functions required for safe ETOPS diversion & landing
ETOPS Type Design & Reliability approval (Certification) of the Aircraft	
implementing specific maintenance precautions	having operational plans in place for the protection of passengers and crew
ETOPS Operational Approval of the Airline	

ETOPS approval of the Aircraft *(ETOPS Certification)*

To obtain an ETOPS approval of an aircraft, the Manufacturer must show :



* = Analysis considers failure conditions for the maximum diversion time/distance

Relevant system safety assessments must take into account the maximum diversion time/distance

ETOPS approval of the Airline *(ETOPS operational approval)*

To obtain an ETOPS operational approval, the Airline must ensure that the required process elements are implemented:

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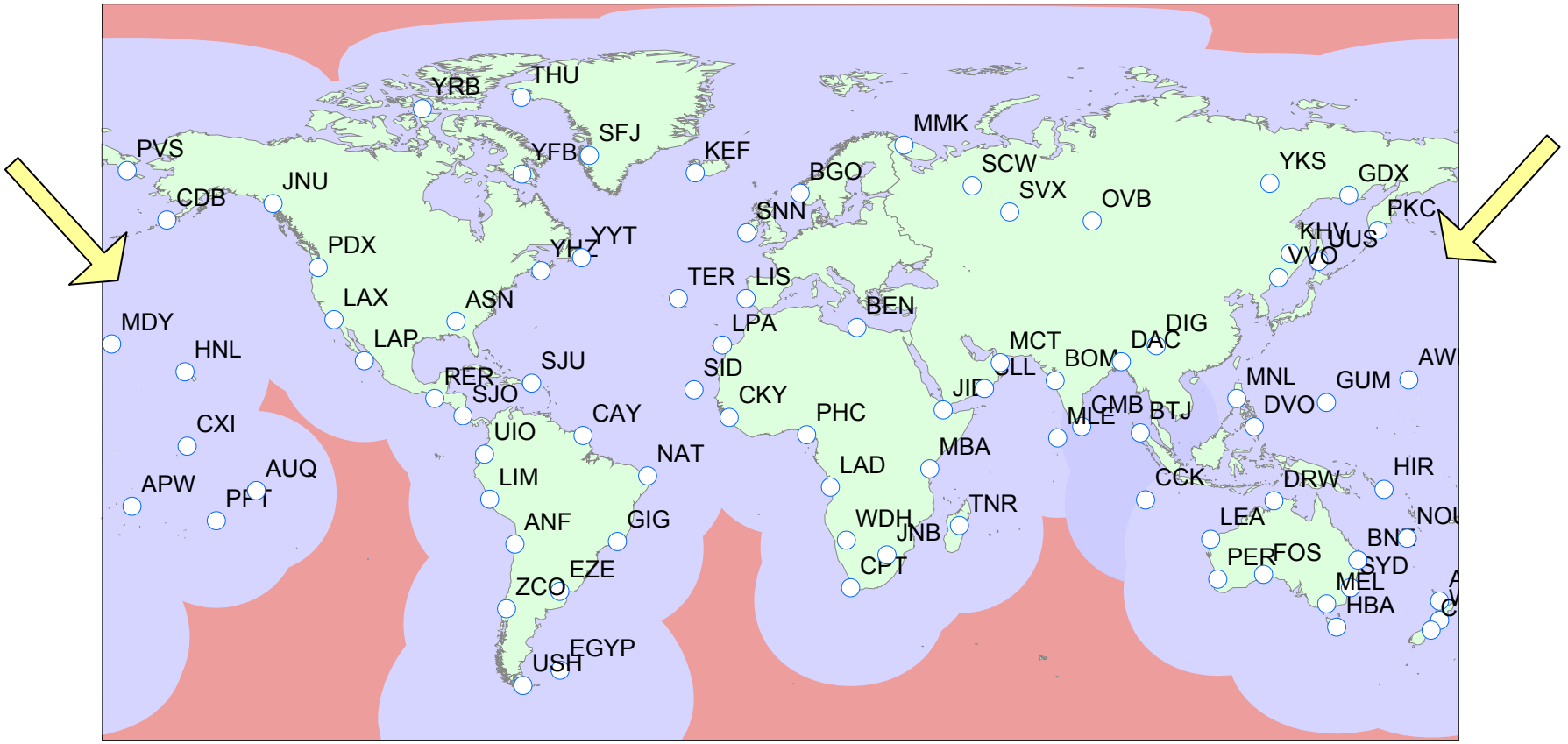
ETOPS areas (twin engine aircraft)

New rules were required first to address need for more than 180 min DT in some areas



180 Min Exclusion Zones

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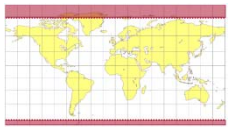
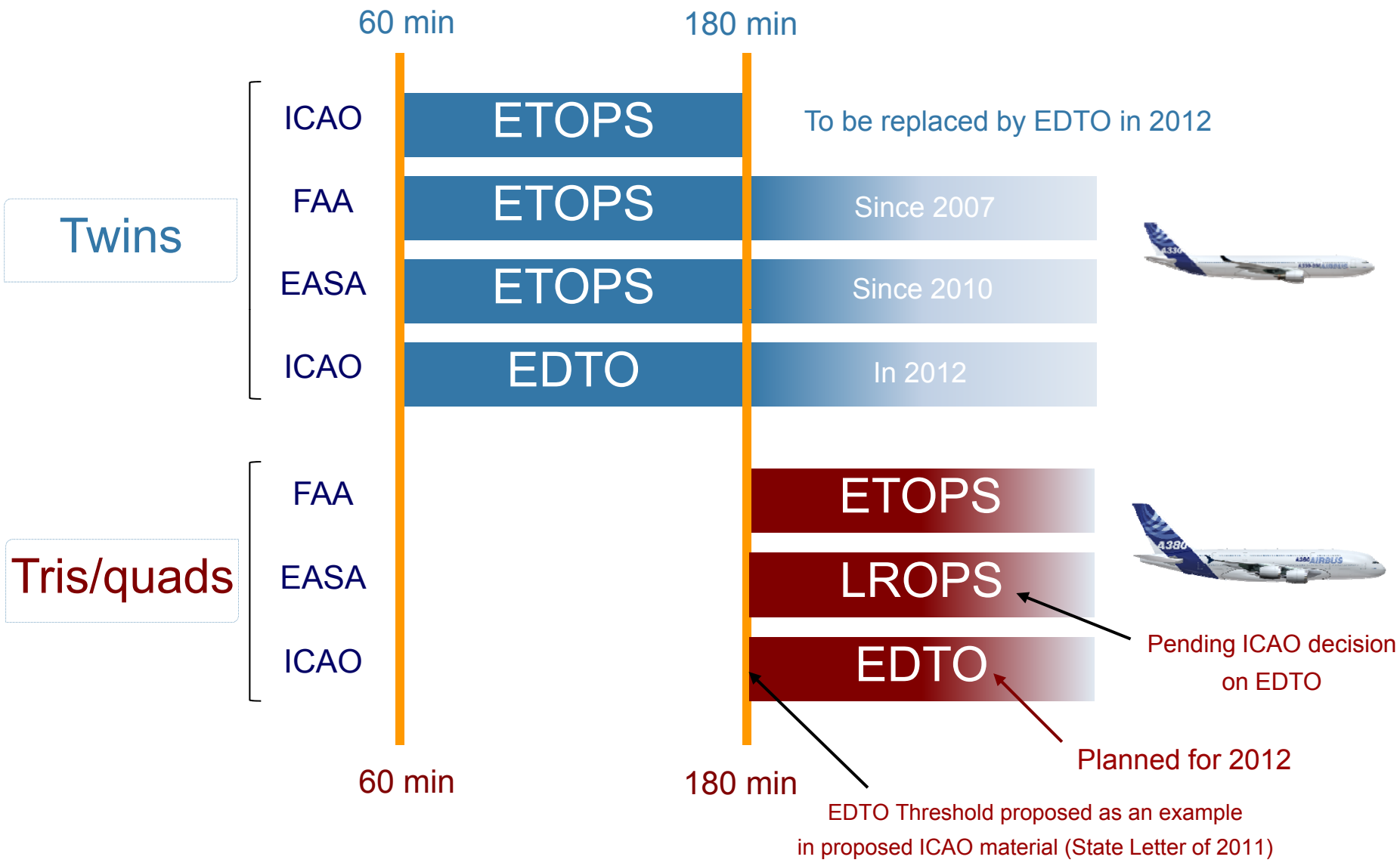
New ETOPS/LROPS/EDTO rules: main changes

What is really new in the proposed/revised

EDTO/ETOPS/LROPS rules:

	ICAO	FAA	EASA
Provides requirements for “Unlimited ETOPS” (Twins) Reduced ETOPS fuel reserves 	✓	✓	✓
Introduces new requirements on Tris and Quads 	Threshold Established by State All ops (cargo & pax) No certif.	>180 min Cargo ops excluded Certif from 2015	?
Addresses Polar Operations 	Not addressed in EDTO elements of State Letter of 2011	✓	Addressed In Existing rules
Addresses Passenger Recovery Plan 	Not addressed in EDTO elements of State Letter of 2011	✓	Outside scope of EASA responsibilities

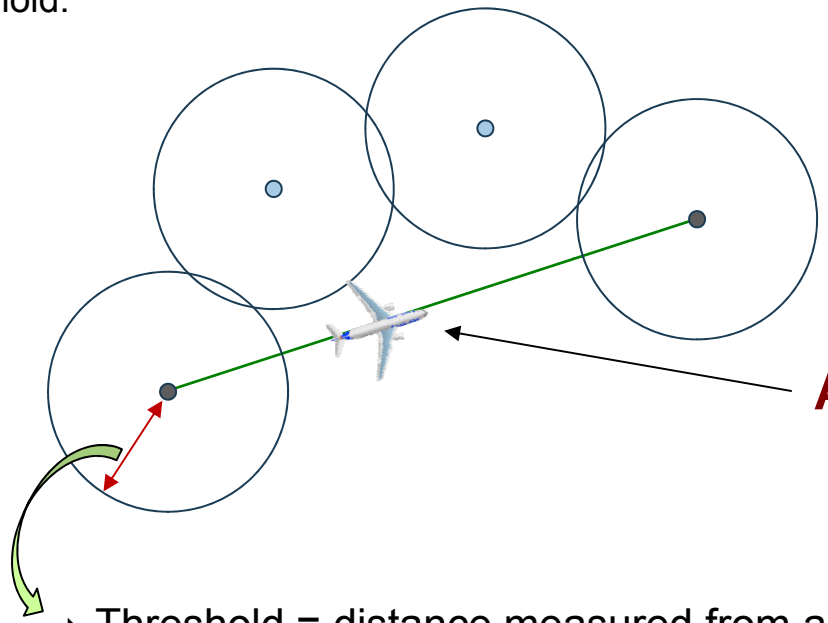
ETOPS/LROPS/EDTO Thresholds



New ETOPS/LROPS/EDTO rules: main changes

- Unless it has received an ETOPS/EDTO Operational Approval, an operator cannot operate an aircraft on a route that goes beyond applicable threshold.

Operational criteria main novelties



***OEI**: one-engine-inoperative*

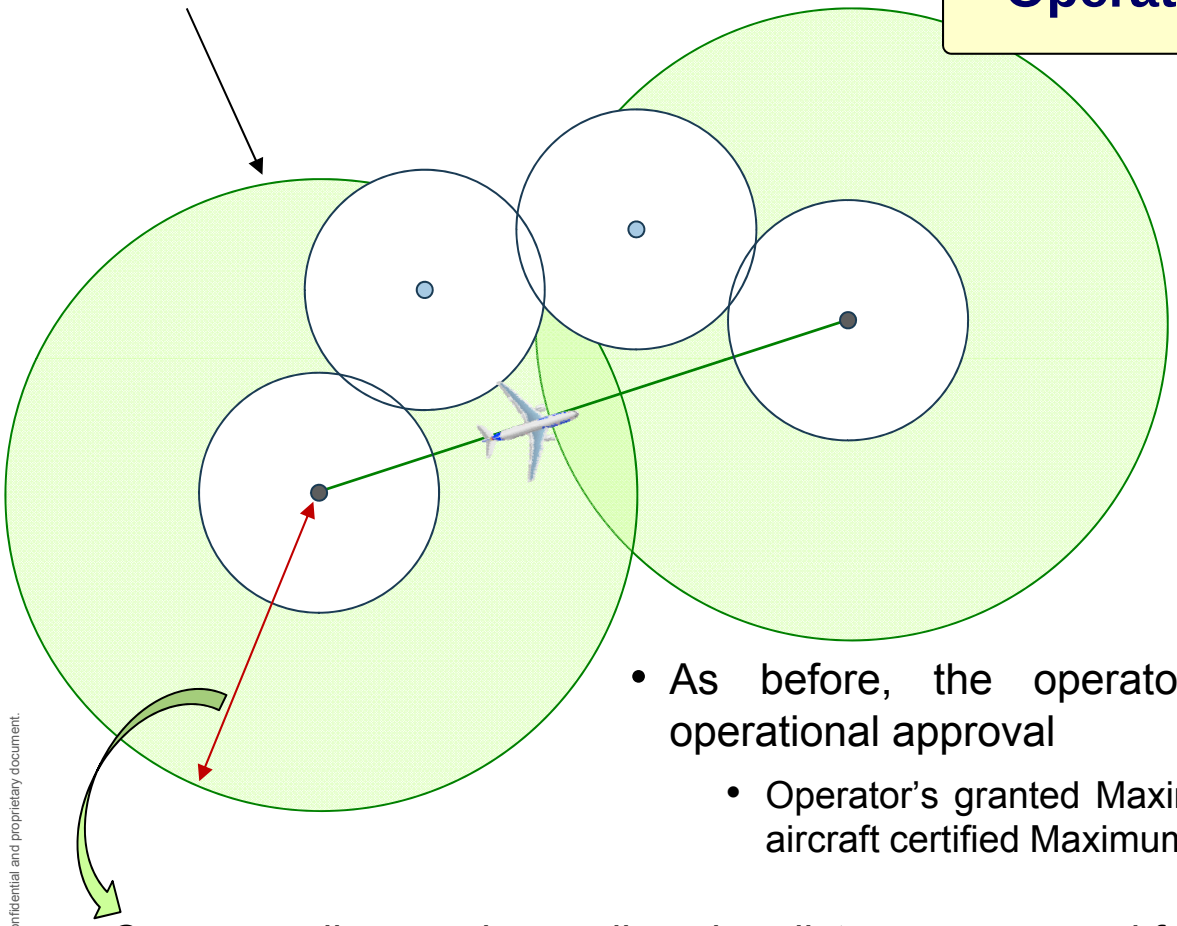
***AEO**: all-engine-operative*

- Threshold = distance measured from an adequate airport as follows:
  - **Twins: 60** min flying time considering **OEI speed**, ISA, Still Air
    - It corresponds to around **420 Nm** for Airbus twins
  - **Tris/Quads: 180** min considering **AEO speed** (OEI in FAA rule), ISA, Still Air
    - This 180 min value is proposed as an example in ICAO SL
    - It corresponds to around **1500 Nm** for Airbus quads

New ETOPS/LROPS/EDTO rules: main changes

Operational criteria main novelties

Approved area of operations



- As before, the operator is granted an ETOPS/EDTO operational approval
  - Operator's granted Maximum Diversion Time cannot exceed the aircraft certified Maximum Diversion Time

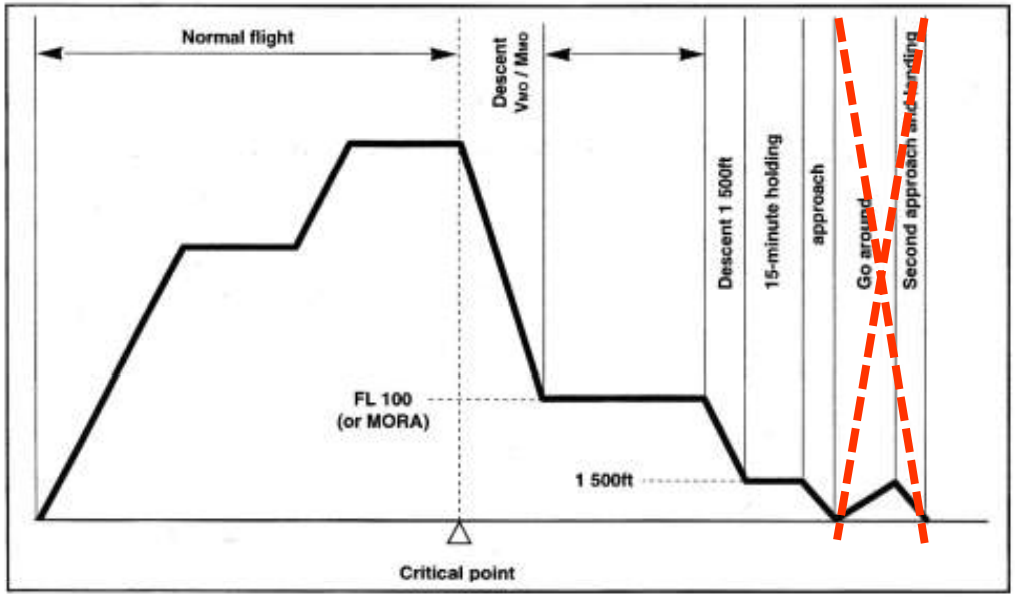
- Corresponding maximum diversion distance measured from an adequate airport is based on:
  - OEI speed, ISA, Still Air for **Twins**
  - AEO speed, ISA, Still Air for **Tris/quads** (OEI in FAA rule)

New ETOPS/LROPS/EDTO rules: main changes

Operational criteria main novelties

Reduced "ETOPS" Fuel Reserves (compared to first ETOPS requirements)

1. Fly to the alternate airport
2. 15-minute holding at 1500 ft
3. Instrument approach and landing
4. ~~Go-around~~
5. ~~Visual approach and landing~~



6. Reduced "Additional fuel" for:
   - error in wind forecasting
     (5% wind factor instead of 5% diversion fuel)
   - Icing
     (effect of [Anti Icing] for 100% exposure time or [AI+icing drag] for 10% of exposure time only)

It may lead to up to 10% reduction in the ETOPS Fuel Reserves

New ETOPS/LROPS/EDTO rules: main changes

Aircraft certification main novelties

Twins

With the new ETOPS regulations, ETOPS has become an aircraft type certification “optional” item.

- The new ETOPS certification rules are applicable to:
  - New Twins and any “current” Twins applying for ETOPS > 180 min certification
- Existing ETOPS ≤180 min approvals remain valid
  - No re-certification is required

Tris/Quads

- ICAO: no dedicated certification is required
- FAA: certification required only for pax aircraft manufactured after 2015

New ETOPS/LROPS/EDTO rules: main changes

Aircraft certification main novelties

• Electrical Power supply

- Number of independent electrical power sources:
  - As before, 3 independent electrical power sources are required for ETOPS.
    - ✓ Each power source must be able to power all the essential ETOPS functions identified by the safety analysis.
  - A fourth independent electrical power source is required for twins applying for an ETOPS beyond 180min certification

    - ✓ Must be able to power 1 fuel boost pump per main tank + the xfeed valve
    - ✓ EASA only: 4th power source not required if loss of the 3 independent power sources is shown to be extremely improbable.

• Low Fuel Alert

- An alert must be displayed to the flight crew when the quantity of fuel available for use falls below that required to fly to the destination.
  - ✓ The alert must be given when there is enough fuel remaining to safely complete a diversion

New ETOPS/LROPS/EDTO rules: main changes

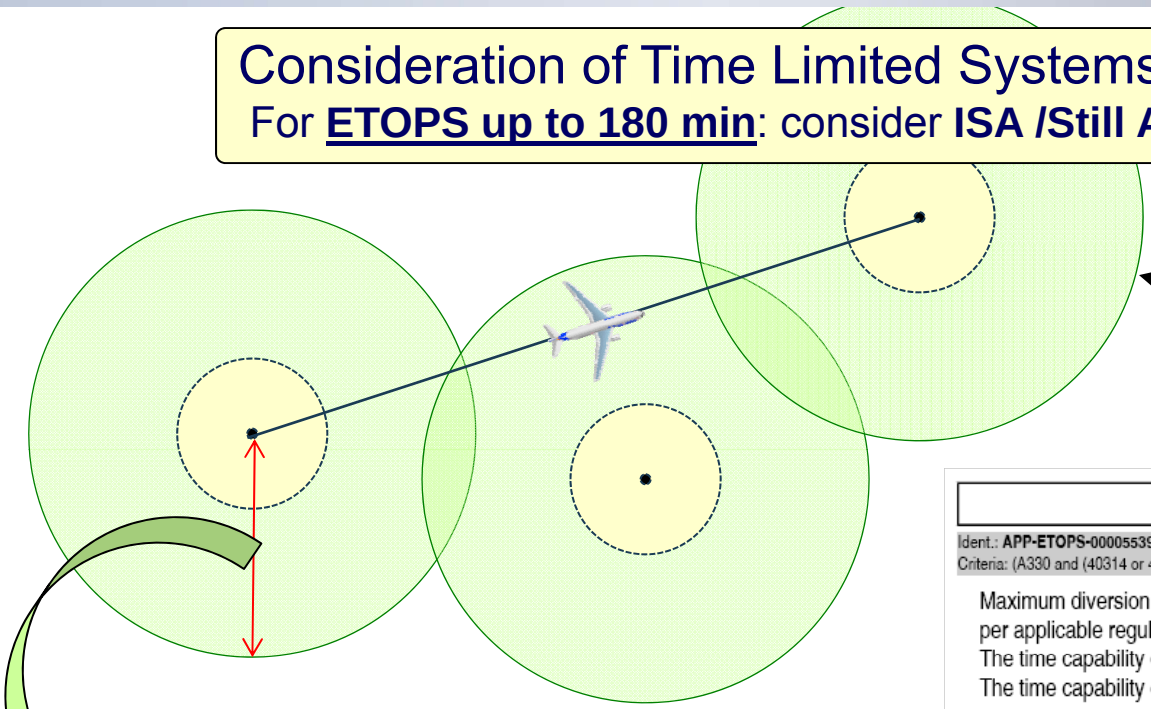
Aircraft certification main novelties

- **AFM, CMP document**
  - The AFM must list ETOPS limitations and the approved ETOPS procedures
  - The ETOPS/EDTO CMP Document must list the ETOPS limitations and the standards for configuration, maintenance and operations
- **ETOPS/EDTO Significant Time-Limited Systems**
  - The time-limited systems are the factors limiting the ETOPS diversion distance capability of the aircraft ⇨ i.e. it is no more set by the rule
    - Consideration of Time-limited system capability is mandated by operational rules.
  - There are two kinds of time-limited systems:
    - Time-limited system limited by capacity ⇨ e.g. Cargo fire protection system, Emergency Brake Accumulator
    - Time-limited system limited by “reliability” ⇨ Diversion time used in the analyses
  - Two Time-limited systems values shall be given in the AFM and CMP:
    1. The cargo fire protection time ⇨ to be checked at the all-engine-operating (AEO) speed
    2. The lowest time of all the other time-limited systems ⇨ to be checked at the one-engine-inoperative (OEI) speed

New ETOPS/LROPS/EDTO rules: main changes

Consideration of Time Limited Systems (TLS) at dispatch

For **ETOPS up to 180 min**: consider **ISA /Still Air conditions**



Exemple:

Operator's approved

Diversion Time (DT) is 120 min

LIMITATIONS

Ident.: **APP-ETOPS-00005539.0002001 / 26 NOV 09** **EASA APPROVED**

Criteria: (A330 and (40314 or 40487 or 45435))

Maximum diversion time at planning may not exceed 180 min or 207 min on a case by case basis (as per applicable regulations) at one engine cruising speed, under standard conditions and still air.
The time capability of the cargo fire suppression system is 260 min.
The time capability of all the other ETOPS significant systems exceeds 222 min.

Manufacturer must identify time limited system(s) capabilities and include corresponding values in the AFM and ETOPS CMP Document

Check that max DT for this flight , considering ISA /Still Air conditions, does not exceed the **TLS** as follows:

1. Cargo fire protection time ► it must be equal or greater than [max DT + 15 min]

2. Other most limiting system time capability ► it must be equal or greater than [max DT + 15 min]

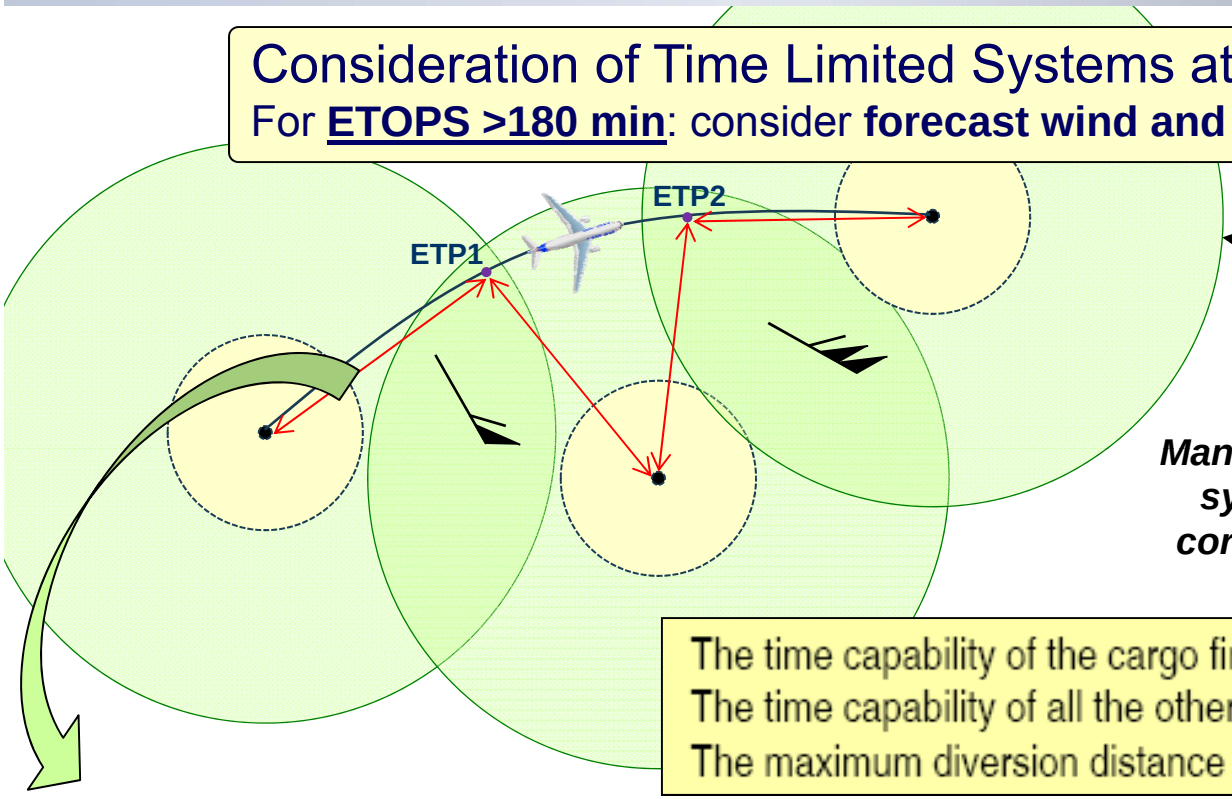
new!

New ETOPS/LROPS/EDTO rules: main changes

Consideration of Time Limited Systems at dispatch

For **ETOPS >180 min**: consider **forecast wind and temperature**

new!



Exemple:
Operator's approved
Diversion Time is 240 min

Manufacturer must identify time limited system(s) capabilities and include corresponding values in the AFM and ETOPS CMP Document:

The time capability of the cargo fire suppression system is 260 min.
The time capability of all the other ETOPS significant systems is 300 min.
The maximum diversion distance is 1 700 nm.

Check before dispatch that diversion time (DT) from each ETP, considering forecasts winds / temperatures, does not exceed the **TLS** as follows:

1. Cargo fire protection time ► it must be equal or greater than [DT min + 15 min] at **AEO speed**
2. Other most limiting system time capability ► it must be equal or greater than [DT min + 15 min] at **OEI speed**

New ETOPS/LROPS/EDTO rules: main changes

FAA

Passenger Recovery Plan (FAA only)

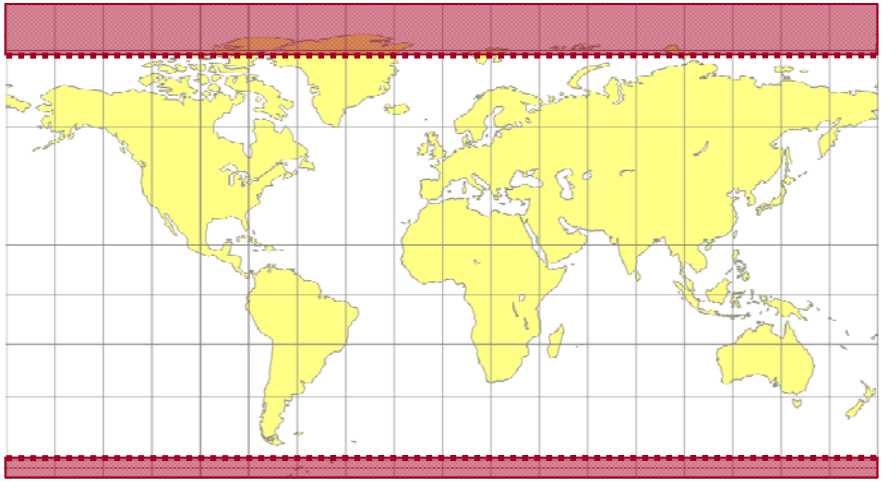
- For ETOPS beyond 180 min, the operator has to develop a passenger recovery plan for each ETOPS alternates
  - Note: this requirement also applies to designated alternates in the frame of Polar operations (except for cargo operations)
- This plan should validate the acceptability of airport infrastructure and services, taking into account:
  - Medical care
  - Physiological needs
  - Communications
- The evacuation of passengers and crew has also to be covered
  - Recovery of the passengers within 48 hours may be viewed as meeting the requirement to provide for the care and safety of the passengers

New ETOPS/LROPS/EDTO rules: main changes

FAA

Polar areas (FAA)

- Definition of “polar area”:
  - North Polar area
    - North of latitude N 78°00



  - South Polar area
    - South of latitude S 60°00
- All operators applying for operations on a route entering the South or North Polar area must comply with Polar operations requirements
  - Fuel freeze strategy & monitoring / Crew exposure to solar radiation / etc…

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ICAO proposed EDTO criteria: milestones

- Initial State Letter circulated in 2007 (ref SP 59/4-07/47)
  - Generated many questions from States and International organizations
- Special Operations Task Force (SOTF) set-up in 2008
  - Involved representatives from States and International organizations
  - Tasked to review comments and propose revised EDTO criteria
  - **Two meetings** (November 2008 and August 2010) and **over 20 teleconferences**
  - SOTF proposed EDTO material finalized end 2010
- Second State Letter, with revised EDTO provisions circulated in June 2011 (ref SP 59/4.1-11/8)
  - Planned timeline:
    - Nov 2011: Final review by ANC.
    - May 2012: Adoption by Council
    - July 2012: Effective date.
    - Nov 2012: Applicable date

ICAO proposed EDTO criteria: summary

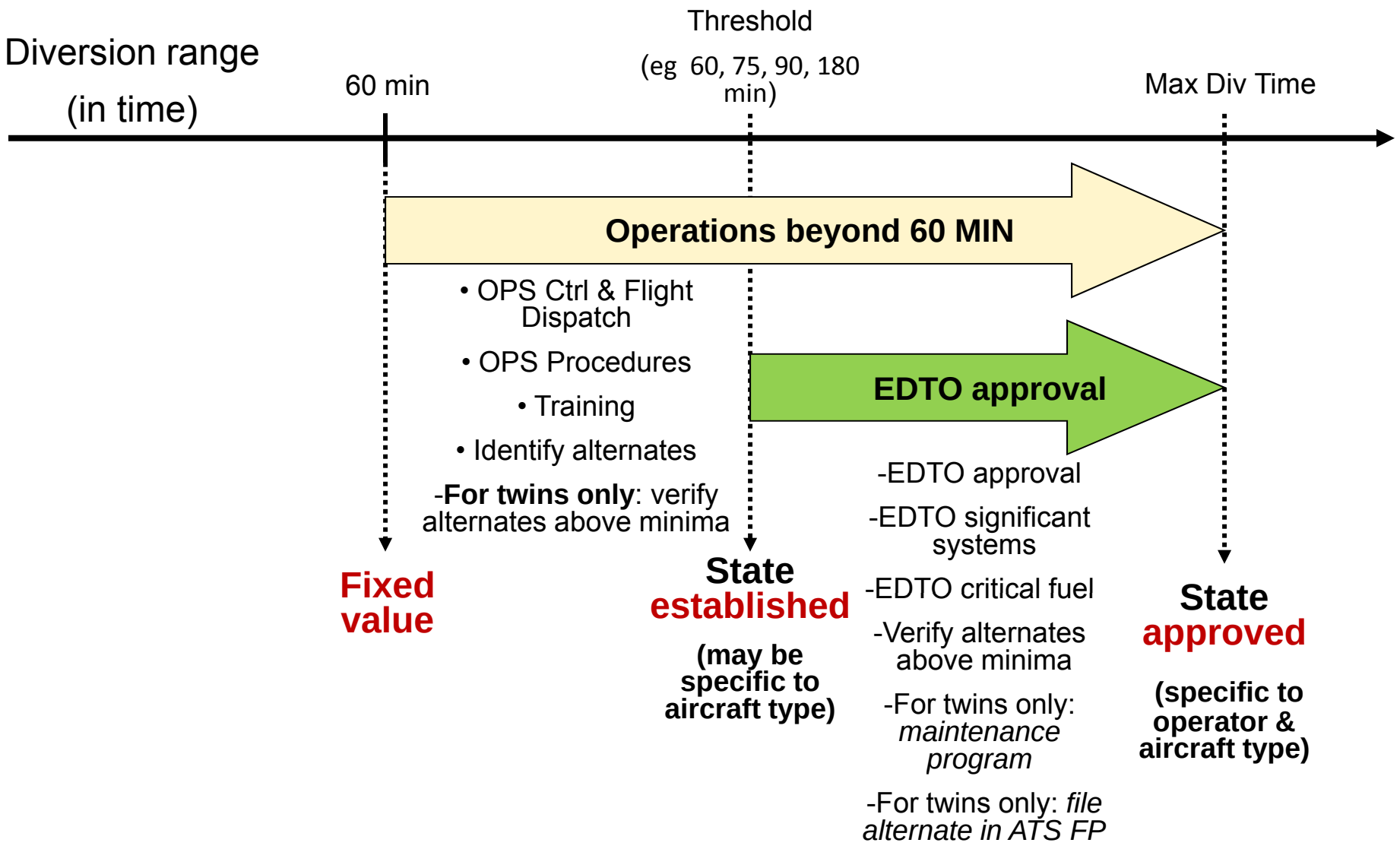
- Amendment proposal primarily based on existing ETOPS provisions
  - Basic concepts are unchanged / Evolutions introduced mainly to address operations with higher diversion times
- Requirements for Twins remains mostly unchanged
  - Adapted criteria for higher threshold/diversion times, e.g. >180 min
- Requirements for Tris and Quads are based on “Industry Good Practices”
  - No change for the vast majority of current long-range operators
  - No additional maintenance requirements nor additional certification requirements
  - Main novelties: consideration of Time Limited System / identification of en-route alternates and verification of weather
- Guidance material is proposed in new Attachment “D”
  - Very comprehensive and detailed content

ICAO proposed EDTO criteria: summary

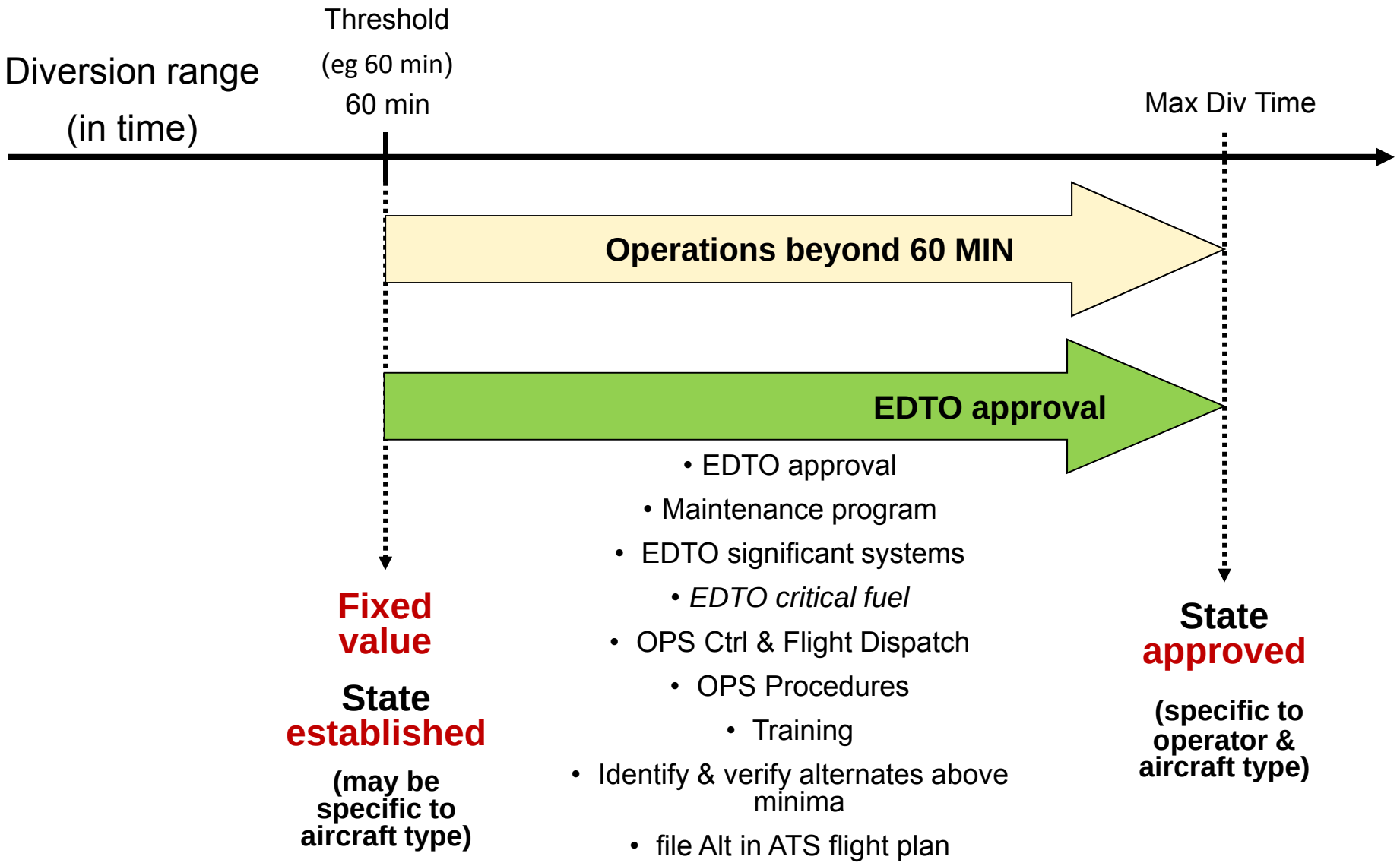
- The proposed amendment sets requirements for:
  - All operations beyond 60 min
    - These operations do not require an EDTO approval
  - Operations beyond state established threshold
    - Only these operations requires an EDTO operational approval

- See on next pages the graphic representation of the applicability of the different element of the amendment proposal.

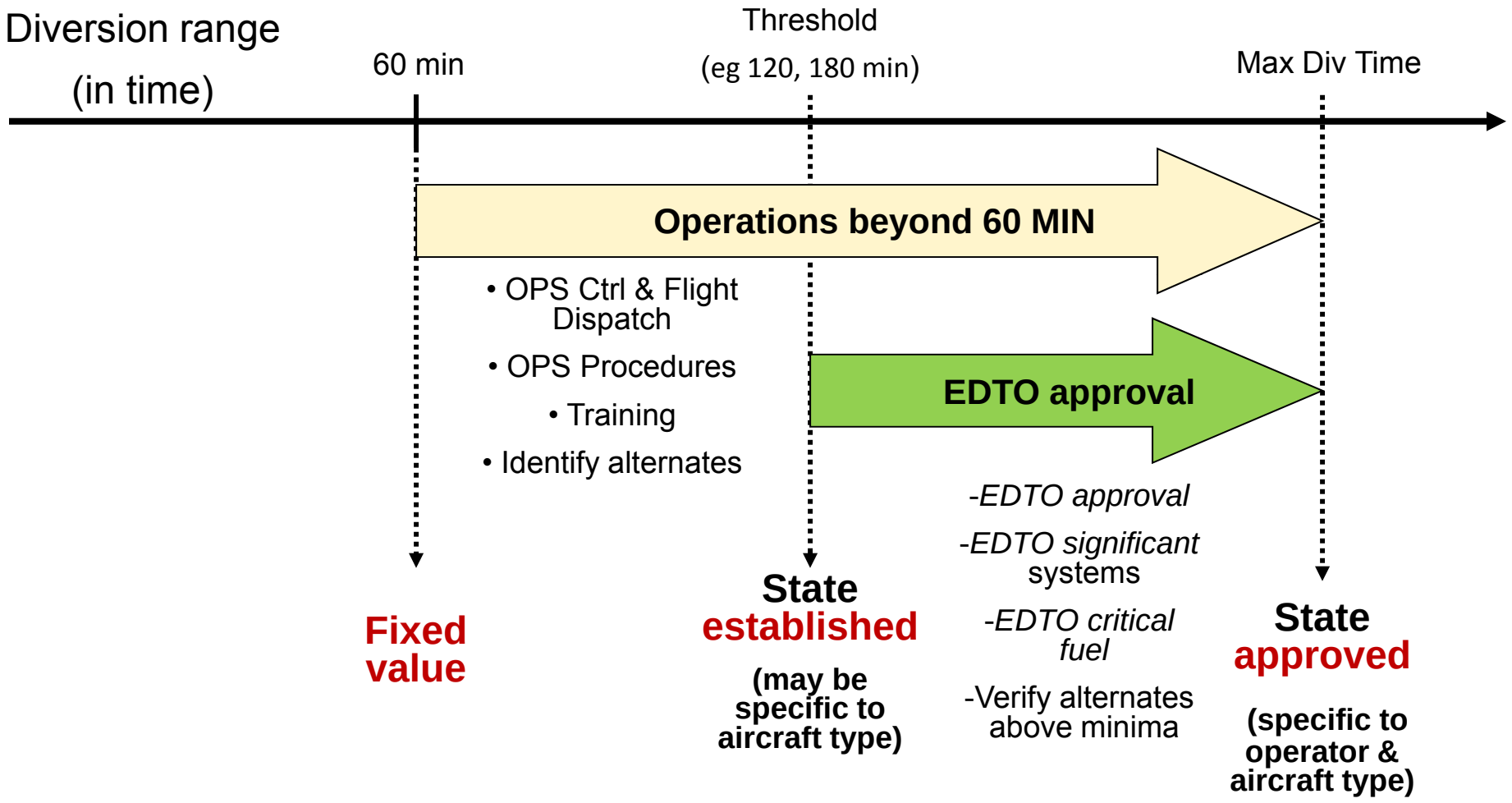
ICAO proposed EDTO criteria : summary *(graphic)*



ICAO proposed EDTO criteria : summary *(graphic)* Twin engine aircraft



ICAO proposed EDTO criteria : summary *(graphic)* Aircraft with more than 2 engines



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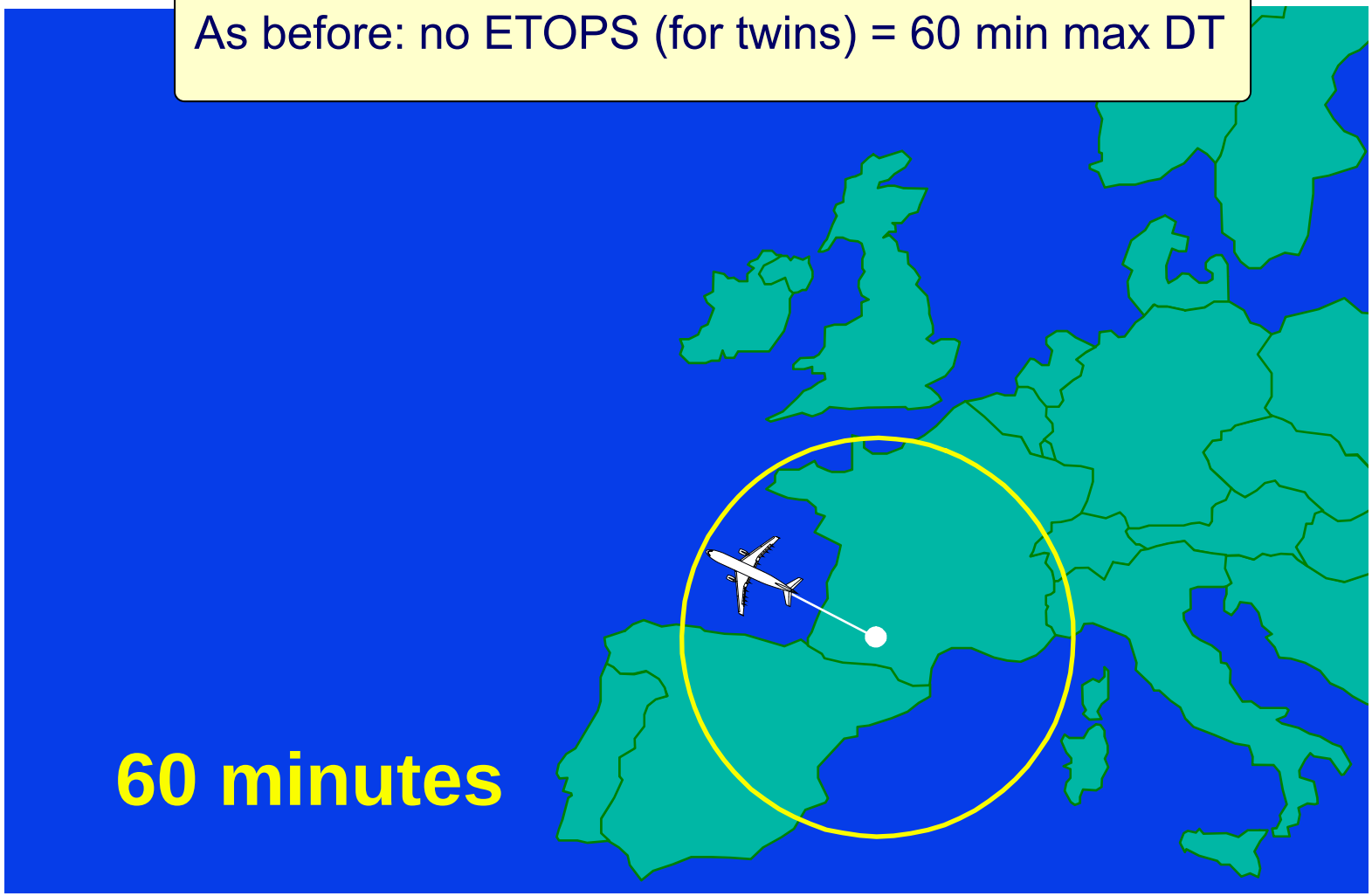
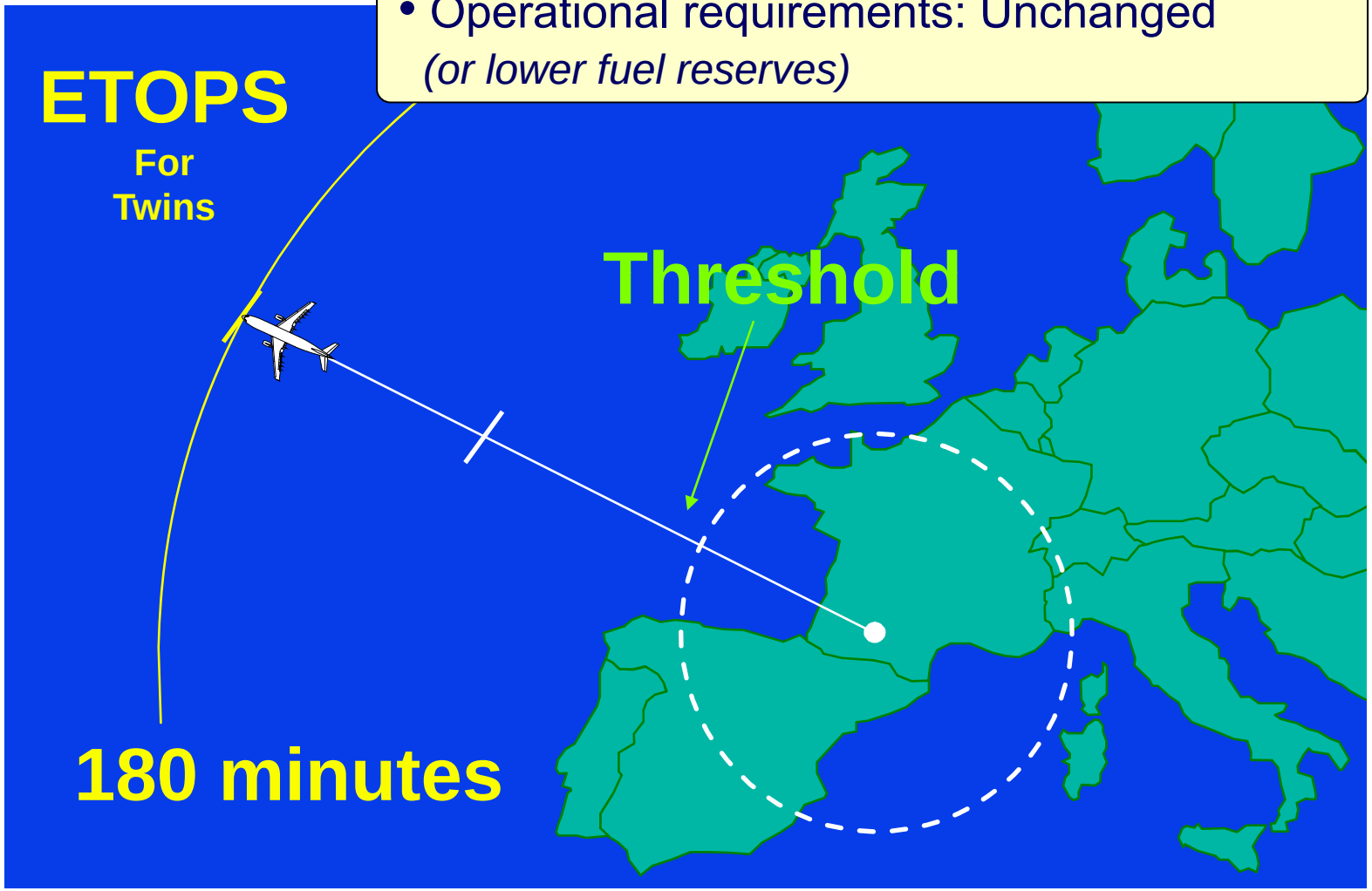
The “new” ETOPS world (twins)

As before: no ETOPS (for twins) = 60 min max DT



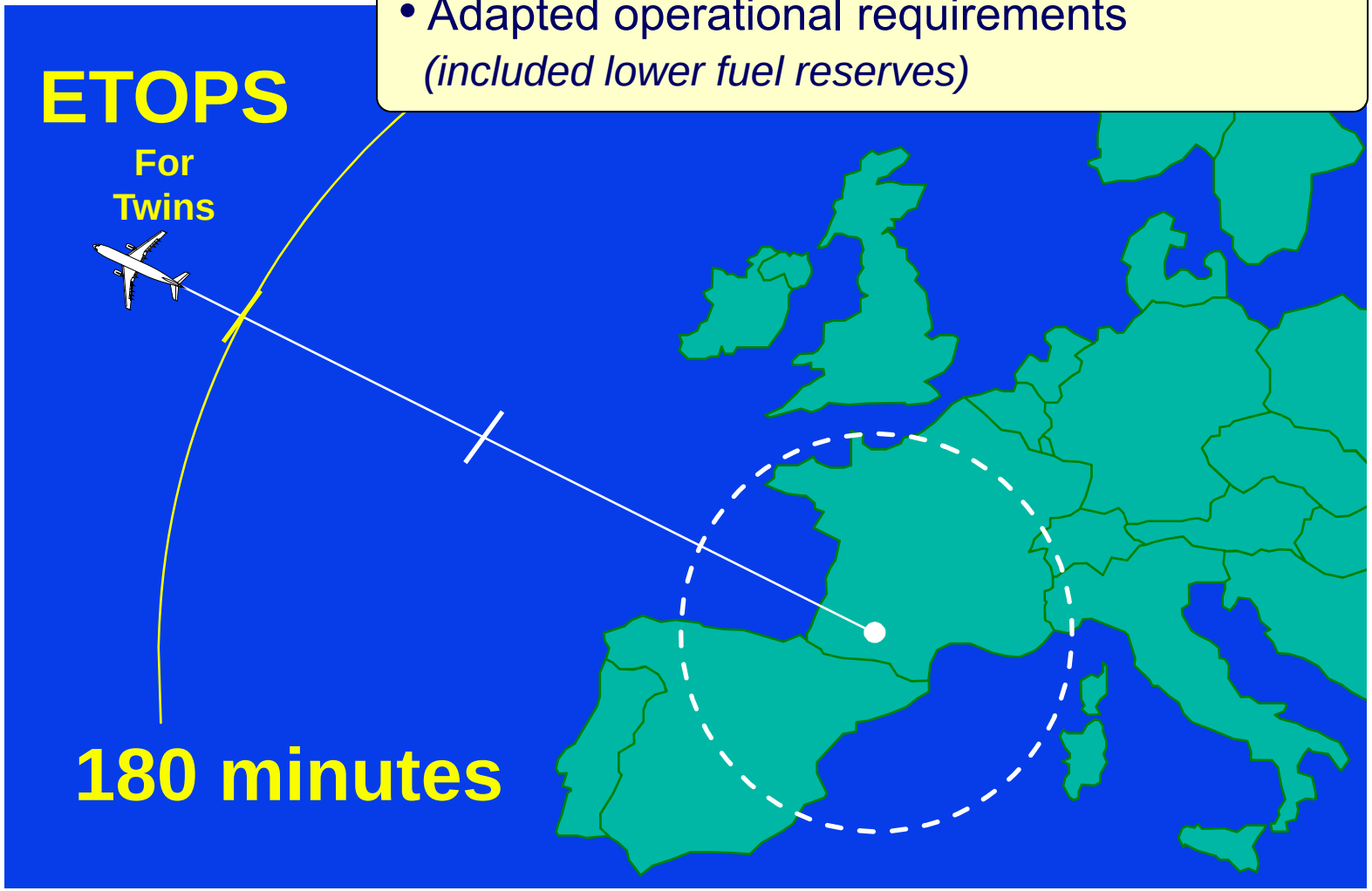
The “new” ETOPS world (twins)

- Certification requirements: Unchanged
- Operational requirements: Unchanged
  (or lower fuel reserves)



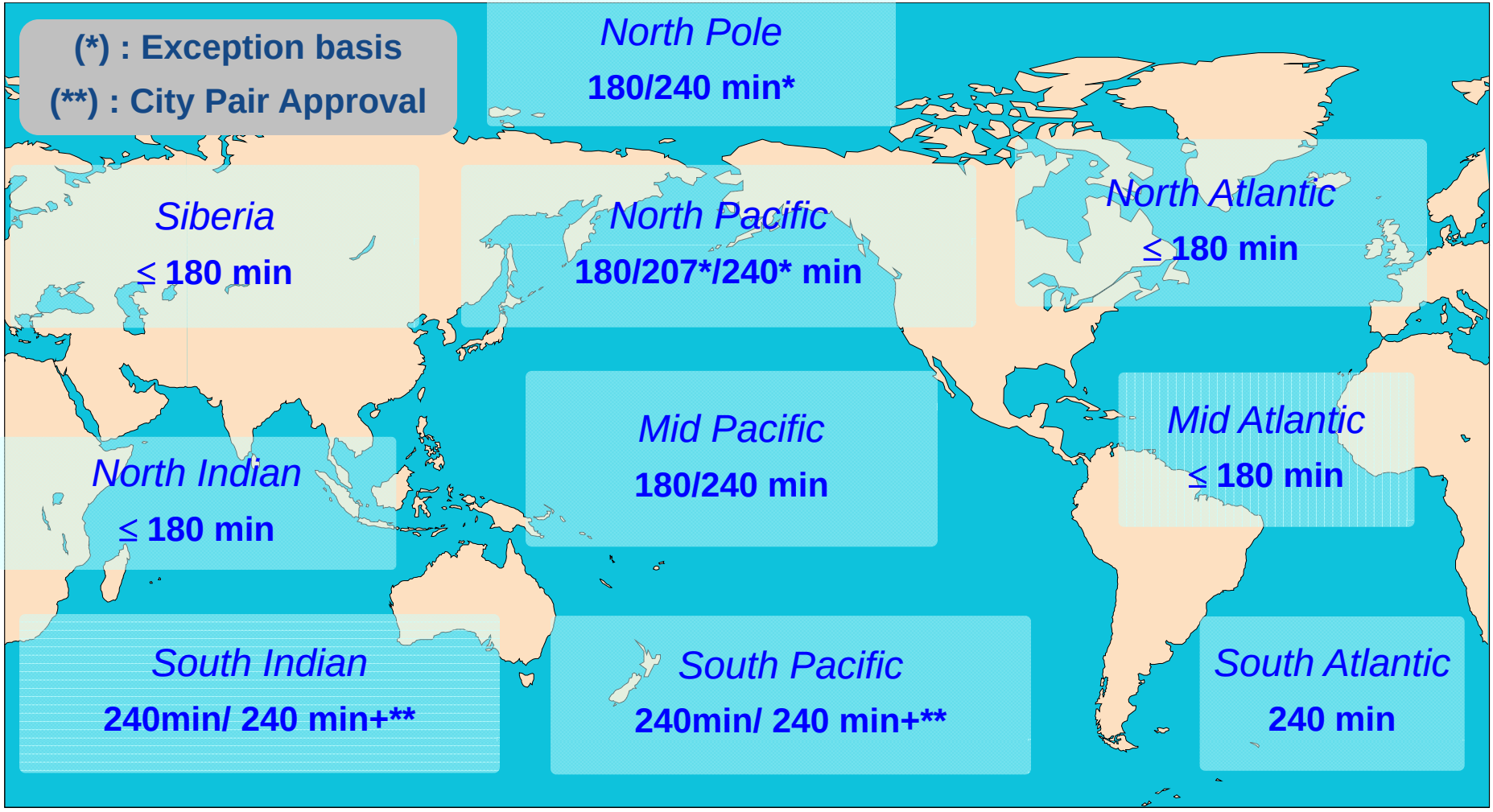
The “new” ETOPS world (twins)

- Additional certification requirements *(minor)*
- Adapted operational requirements
  (included lower fuel reserves)



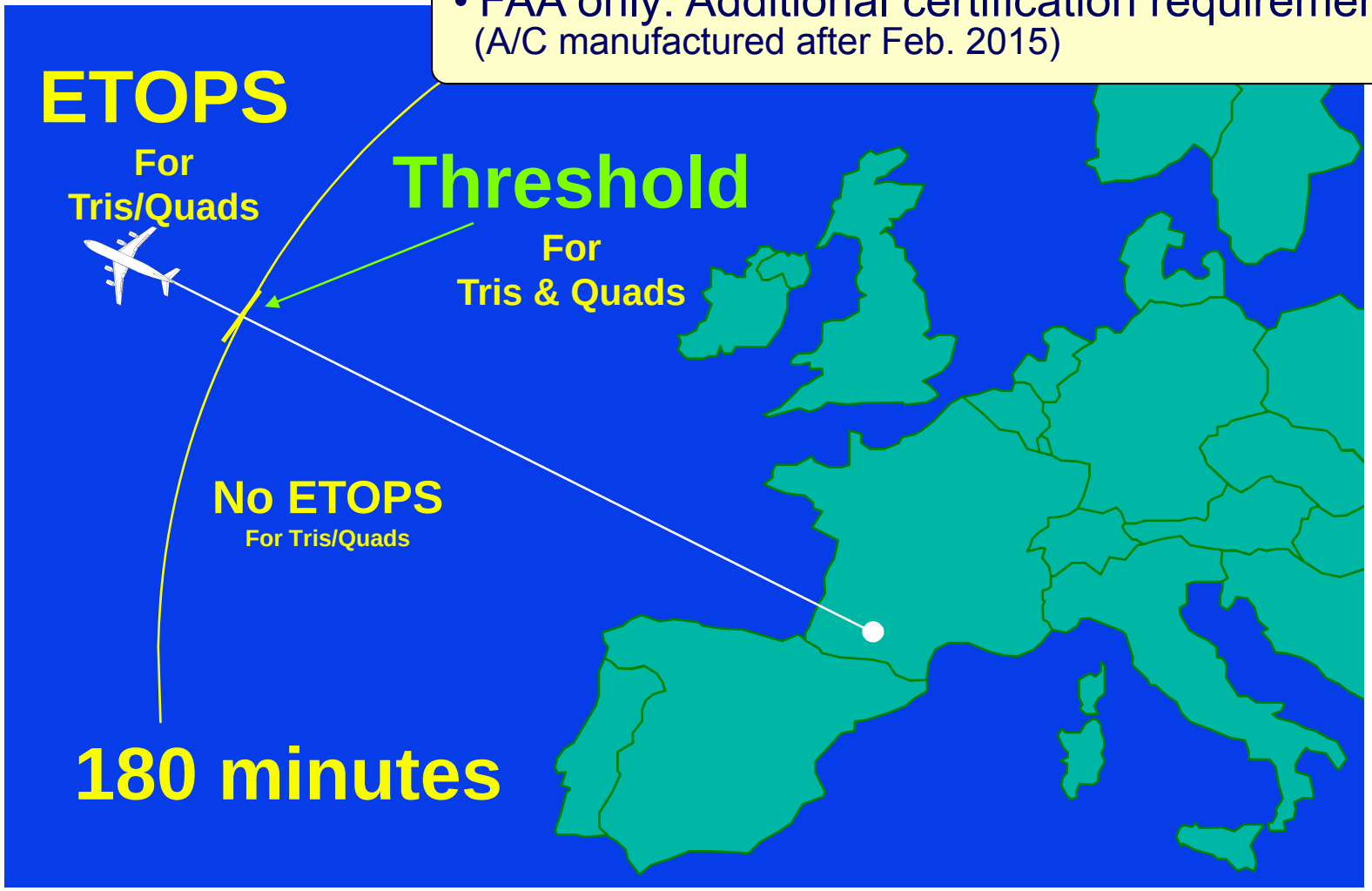
Tomorrow's ETOPS for twins

Maximum ETOPS Diversion Time by Geographical zones (FAA view)



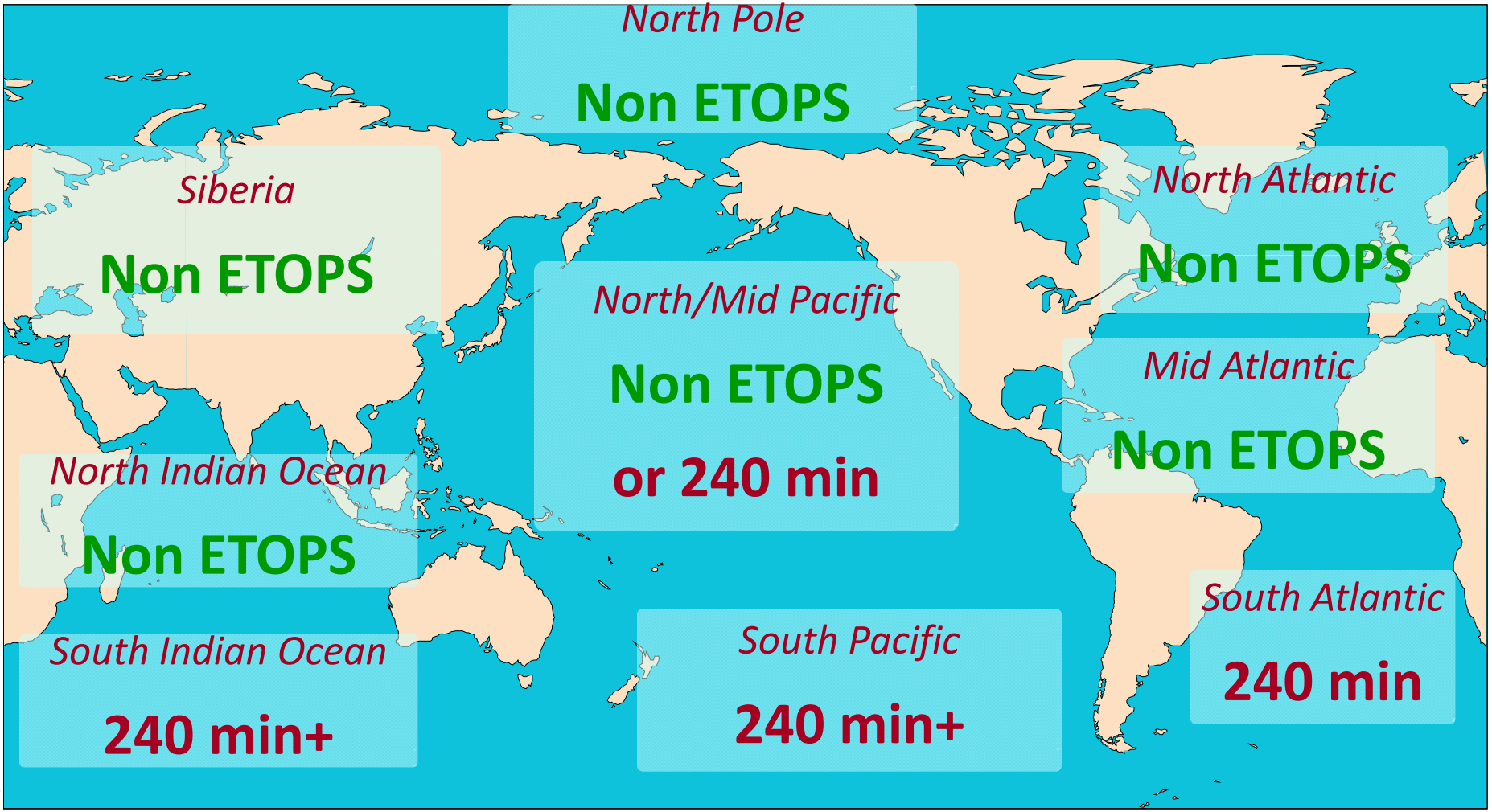
The “new” ETOPS world (Tris/Quads)

- Minor new operational requirements
  (no additional maintenance)
- FAA only: Additional certification requirements
  (A/C manufactured after Feb. 2015)



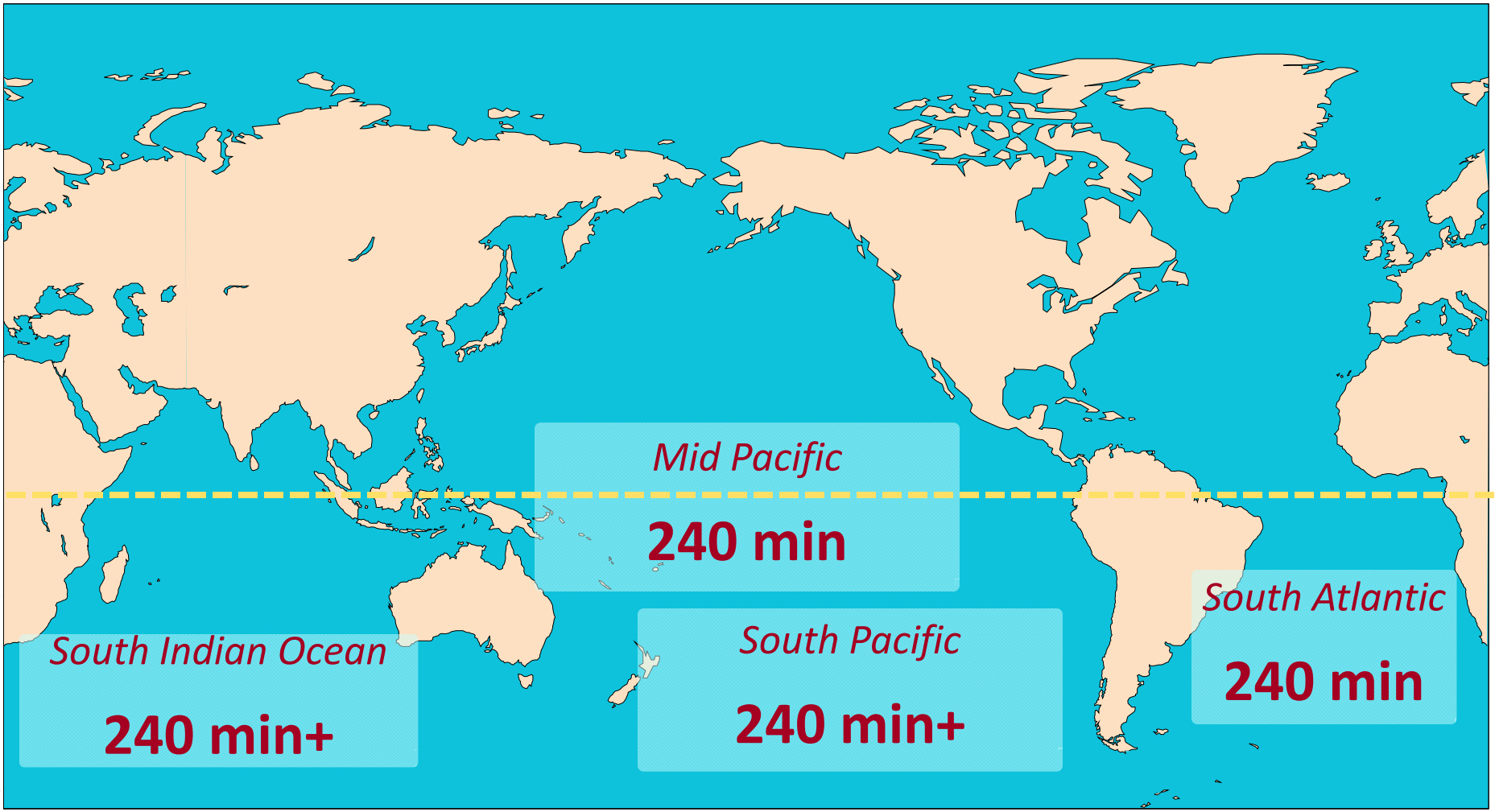
Conditional tomorrow's for Quads

ETOPS approval required for DT>180 min



Conditional tomorrow's for Quads

Only operations in the southern hemisphere may be impacted



Overview of New EDTO rules

- **Introduction**
  - Foreword / Airbus experience
  - Applicability / Acronyms
  - Evolution of the rules – major milestones
  - Recall: intent & content of initial ETOPS regulations

- **New ETOPS / LROPS / EDTO Regulations**
  - Why new rules?
  - New rules (ICAO, EASA and FAA): overview of main changes
  - Focus on EDTO proposed amendment (State Letter of June 2011)
  - Recap: impact of the new rules on existing and future long range operations

- **Conclusions**

- *Appendix*
  - ETOPS/LROPS department / contacts
  - Airbus ETOPS Support / ETOPS facts

Conclusions

- **ETOPS is considered as one of the major contributor to the global aviation safety** in the last 20 years by introducing:
  - Higher aircraft & engine design and reliability standards
  - Robust operational and maintenance practices
- The **new EDTO/ETOPS/LROPS regulations**:
  - allows “Unlimited” ETOPS operations for twins
    - based on propulsion reliability and overall operational safety of current ETOPS Twins
  - introduce similar ETOPS precaution to operations of Tris/Quads
    - additional operational requirements based on good practice, no additional maintenance
- **Continued commitment to ETOPS / LROPS / EDTO concepts** (twins design and reliability standards / enhanced operational practices) is necessary to ensure safe and reliable ETOPS/LROPS/EDTO operations, and in particular for the twins to maintain their remarkable ETOPS safety records.

Overview of New EDTO rules

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- **Conclusions**

- ***Appendix***
  - ETOPS/LROPS department / contacts
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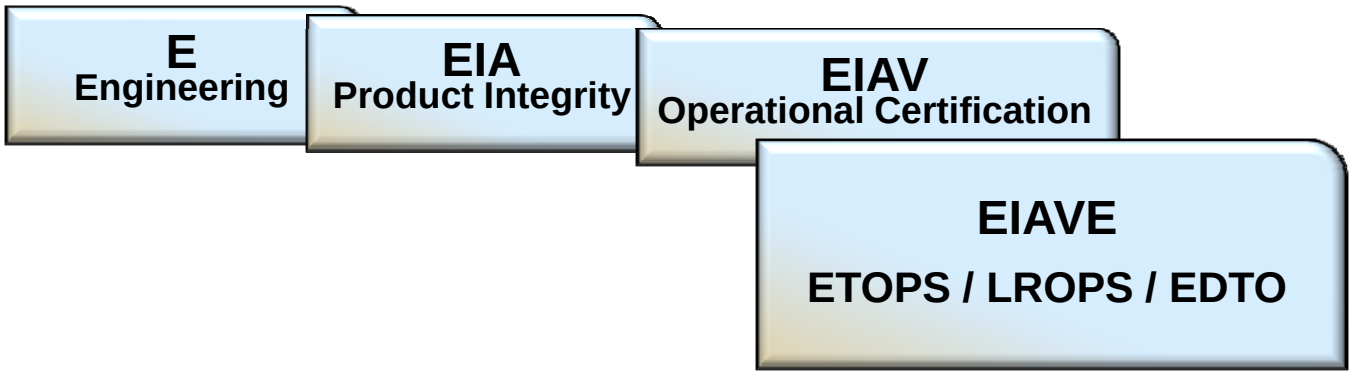
Airbus ETOPS Organization



Process-owner for ETOPS/LROPS/EDTO Certifications and support to customers, EIAVE dept. ensures Airbus ETOPS/LROPS/EDTO Programs management. It includes the following activities:

- ETOPS / LROPS / EDTO Certification, Continued Airworthiness and Aircraft Deliveries
- ETOPS / LROPS / EDTO Source of expertise and focal point within Airbus
- ETOPS / LROPS / EDTO Support to Operators
- Participation in ETOPS / LROPS / EDTO regulatory discussions (EASA / FAA / ICAO /…)

EIAVE also manages inter-directorate actions for ETOPS related affairs, mainly with:

Design office, Flight test, Training, Flight Operations and Technical support, Marketing…

Airbus ETOPS / LROPS Department

- **Airbus ETOPS/LROPS/EDTO Department (EIAVE) - contacts:**
  - **Eric FORTUNATO** (H.O. ETOPS/LROPS/EDTO Programs)
    - email: eric.fortunato@airbus.com
    - Phone: +33 (0)5.61.93.47.99 / Fax: +33 (0)5.61.93.42.71
    - Mobile: +33 (0)6.79.69.04.67
  - **Michaël BOLIS** (ETOPS/LROPS/EDTO Programs Engineer)
    - email: michael.m.bolis@airbus.com
    - Phone: +33 (0)5.61.93.93.48 / Fax: +33 (0)5.61.93.42.71
    - Mobile: +33 (0)6.08.43.09.12
  - **Sandrina MUCHAO** (ETOPS/LROPS/EDTO Programs Engineer)
    - email: sandrina.muchao@airbus.com
    - Phone: +33 (0)5.67.19.15.29 / Fax: +33 (0)5.61.93.42.71
  - N.N. (ETOPS/LROPS/EDTO Programs Engineer)
    - email:
    - Phone:

Airbus ETOPS Support

- **ETOPS Briefing**
  - 1 to 2 days
  - Typically 3 Sessions
- **ETOPS Training**
  - Maintenance training
  - Flight Crew training
  - Dispatch training
- **ETOPS Assistance**
  - Typically 2 to 3 on-site visits

Airbus ETOPS Support: 1-ETOPS Briefing

- **Standard ETOPS briefing (1/2 to 2 days) consists of 3 sessions:**
  - Session 1: ETOPS Approval overview
    - introduction to ETOPS
    - overview of the manufacturer side of the ETOPS approval
    - overview of the airline side of the ETOPS regulation (ETOPS operational approval).
  - Session 2: ETOPS Maintenance aspects
    - question/answer session to cover the Engineering and Maintenance aspects
      - organization / processes
      - manuals, programs, training...
  - Session 3: ETOPS Flight Ops aspects
    - question/answer session to cover the Flight Ops aspects:
      - organization / processes
      - manuals, programs, training...

Airbus ETOPS Support: 2-ETOPS Assistance

- Basic package of assistance comprises:
  - review of the operator's schedule
  - assessment of its organization and available means
  - proposal of an approval program based on this review
  - establishment of customized documents, e.g.:
    - ETOPS Maintenance Manual
    - Application Letter and attachments
    - ETOPS TechLog
    - Aircraft Compliance Status Report, ...
- These documents, which are necessary to support the approval process, are created and fully customized in their format and content:
    - based on Airbus generic documents (validated processes)
    - operators inputs and requests/comments from the Authority.

Airbus ETOPS Support: 2-ETOPS Assistance
(cont'd)

- There are consultation visits at various stages of the program:
  - Typically 1 to 2 visits (more meetings may be arranged, e.g. for complex accelerated ETOPS programs) by an ETOPS team
  - follow-up correspondence.
- The visits are for approximately 3 to 5 days each and have the following objectives:
  - Familiarization with ETOPS and its requirements
  - Review of ETOPS manuals which are in the process of or already customized by the company
  - Review of the ETOPS strategy and validation methods proposed
  - Joint program review with the national authority.
  - Review of final program prior to EIS of ETOPS
- This Airbus ETOPS assistance is a pay service
  - ETOPS Training is not included (see next page)

Airbus ETOPS Support: 3- ETOPS Training

- Airbus Training organization provides following ETOPS trainings:
  - ETOPS Line-Maintenance & Engineering training
  - ETOPS Dispatchers training
  - ETOPS Flight Crew Training
  - ETOPS Flight Crew Line Training
- These training sessions have to be purchased from Airbus Training.

Airbus ETOPS Certification status

- **ETOPS capabilities of Airbus aircraft (EASA Approvals)**

  - **A300B2/B4 capable of 90 min D.T.**

  - **All A310/A300-600 (22 models): 180 min D.T.**
    - **A300-600ST (“Beluga”): 180 min D.T.**

  - **A320/A319/A321/A318 (29 models): 180 min D.T.**
    - **A318 PW ETOPS approval granted on 16th November 2010**

  - **All A330 (pax / 14 models): ETOPS>180 min D.T.**
    - **A330-200F (2 models) are approved for 180 min ETOPS**

Airbus ETOPS operations*

* data as of 2nd QTR 2011

- Airbus ETOPS twins have accumulated over 11 million ETOPS FH:
  - A310/A300-600: 24 years - 2,800,000 FH / 474,000 flights
    (A310/A300-600: 2.5+0.3 / 415+59)
  - A320 family: 19 years - 755,000 FH / 211,000 flights
    (A320/A321/A319: 608+33+114 / 180+08+23)
  - A330: 16 years - 7,561,146 FH / 1,070,995 flights

- Airbus ETOPS operations:
  - A310/A300-600: ~10 operators (~ 65 aircraft)
    (A310/A300-600: 7+3 / 37+26)
  - A320 family: ~20 operators (~ 160 aircraft)
    (A320/A321/A319: 10+4+6 / 111+30+28)
  - A330: 70+ operators (~ 750 aircraft)

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