PBN for Executives

DGCA Conference Mongolia

9 August 2017

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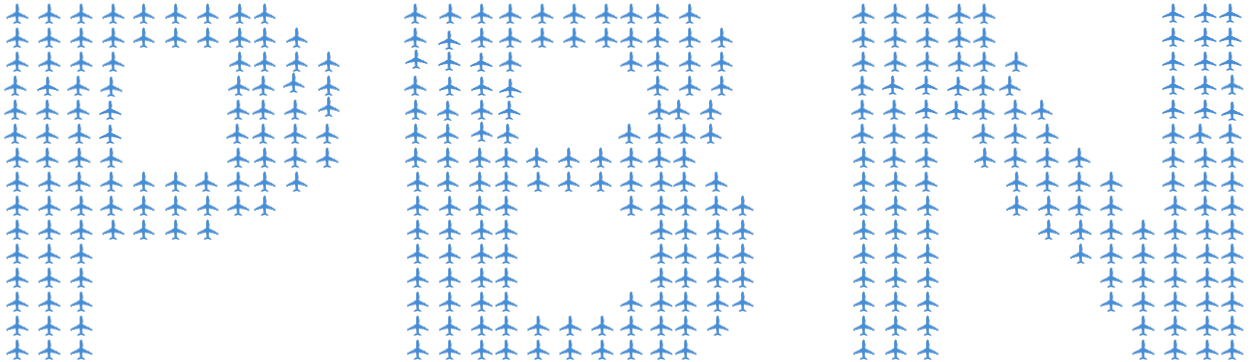
Chief of the ICAO Asia Pacific
Regional Sub-Office



Performance Based Navigation

Why presenting PBN today ?

Action Item 53/8 from last DGCA conference :

- The Conference recognized the need for training decision makers and executives and agreed to one hour training on PBN strategy and implementation at the DGCA Conference in 2017.

- To give an insight of PBN
- To highlight best practices to implement PBN

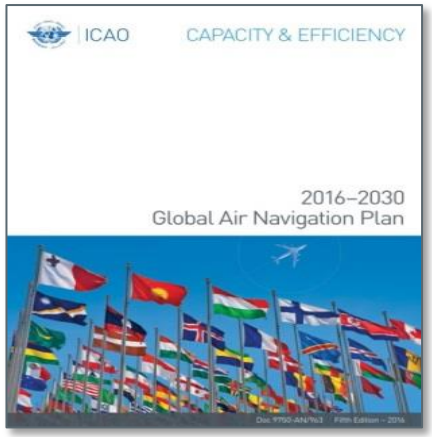
So that Decision Makers and Executives could allocate sufficient budget and resources for a successful implementation of PBN in APAC region

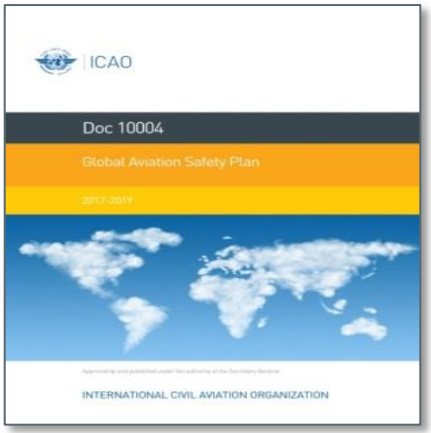
Content

- PBN a key enabler
- PBN concept
- PBN benefits
- PBN implementation
- PBN assistance provided by ICAO

Structure of Global Planning

GLOBAL STRATEGY
Global Air Navigation Plan (Doc 9750)
Global Aviation Safety Plan (Doc 10004)





GANP Priorities :

1. PBN as the highest priority
   - Enhance PBN functionality and PBN strategic development
   - ICAO assistance for implementation
2. Environmental gains through PBN terminal procedures – CDO and CCO
   - Significant fuel saving and environmental benefit
3. ATFM, as key enabler of ATM efficiency and effectiveness as well as safety and environmental sustainability

Assembly Resolution A37-11 (PBN)

In the 37th Session in 2010

1. State complete a PBN implementation plan as a matter of urgency
2. Publication of approach with vertical guidance for all instrument runway ends by 2016
3. PIRGs review States' PBN implementation status and report any deficiencies to ICAO annually

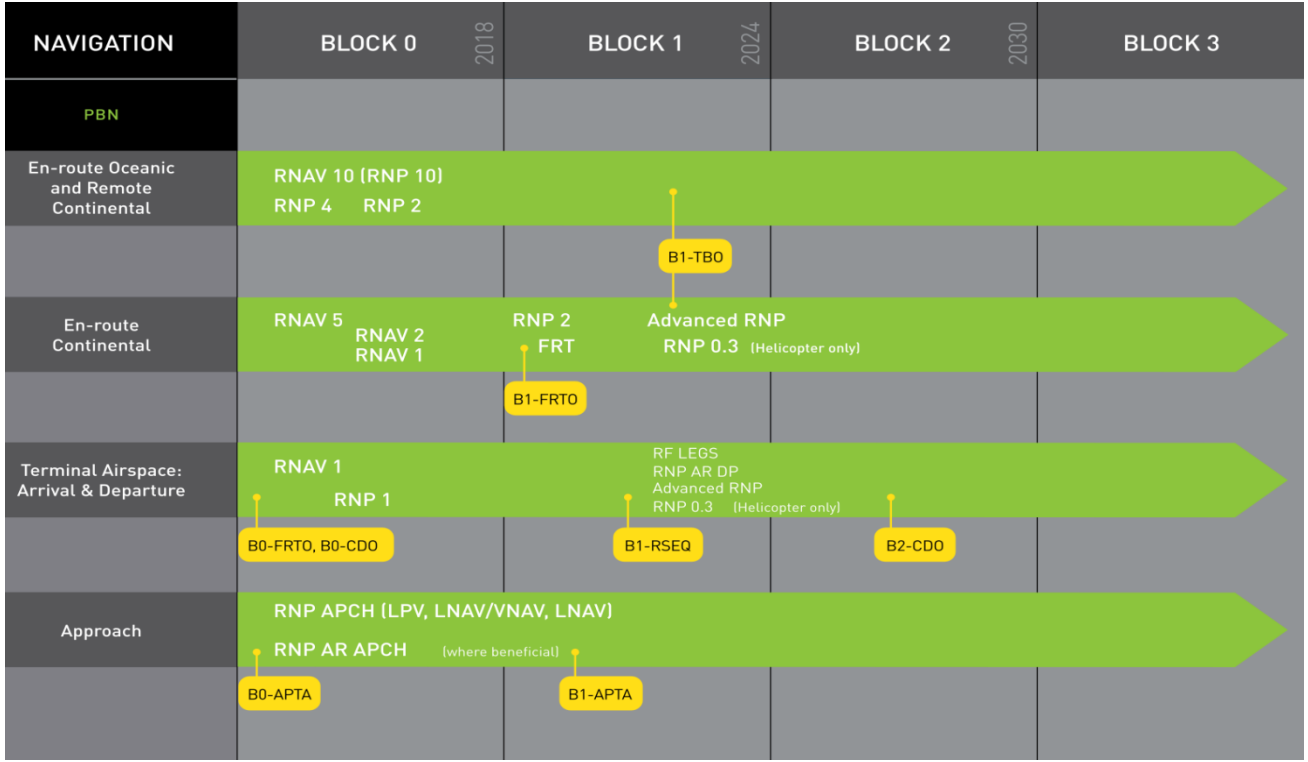
Status :

Only 71% of APAC States have published PBN implementation plan

Only 57 % of instrument runway ends of APAC International airports have PBN approaches

Not enough data are reported to get a clear view for domestic airports in APAC

PBN : a key enabler for ASBU implementation



ASBU modules supported by PBN :

APTA : Airport accessibility
CDO : Continuous descent Operations
FRTO : Free-route operations
RSEQ : Runway sequencing
TBO : Trajectory-based operations

Yellow	Modules
Green	Capabilities

Source : GANP

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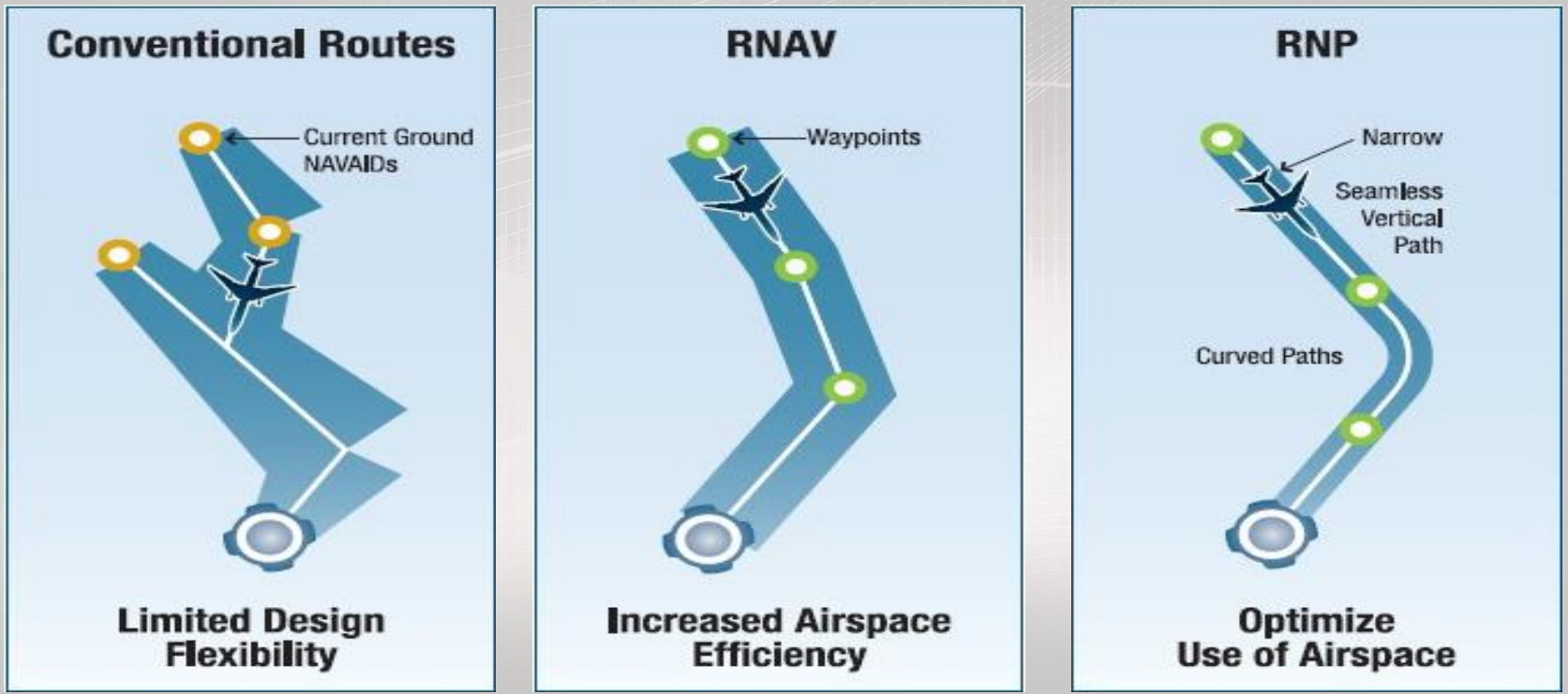
Navigation



RNAV = aRea NAVigation

RNP = Required Navigation Performance

RNP vs RNAV

RNAV 1

RNP 1

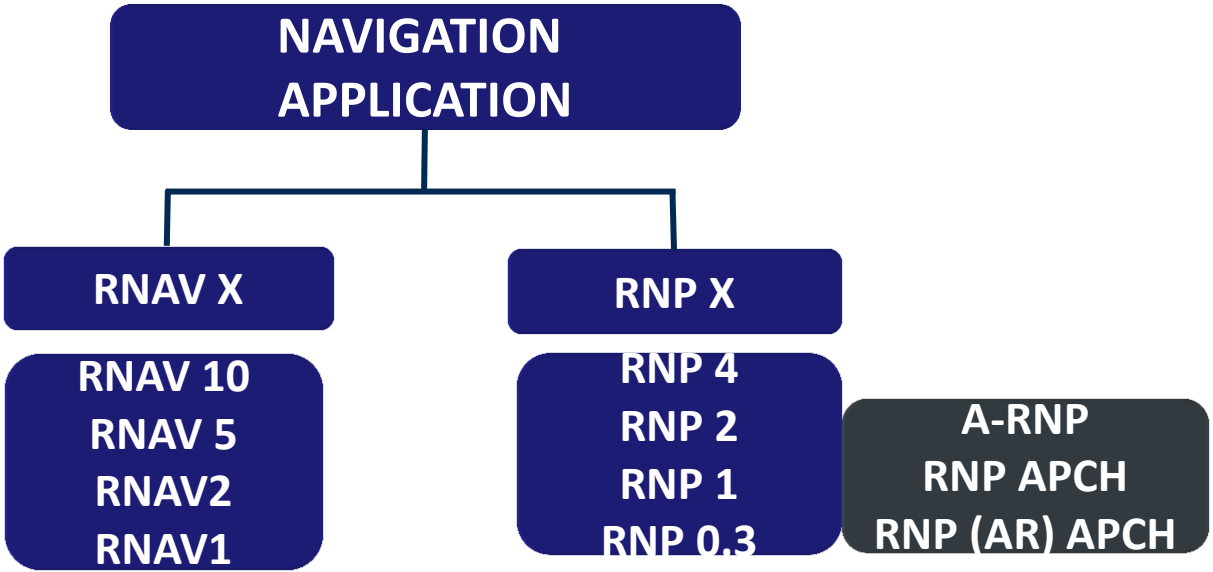
2*RNP
Alert to Pilot

RNP isn't "fundamentally different" from RNAV ,
But RNP is MORE than RNAV
The Key Difference : On-Board Performance Monitoring and Alerting

The need for PBN

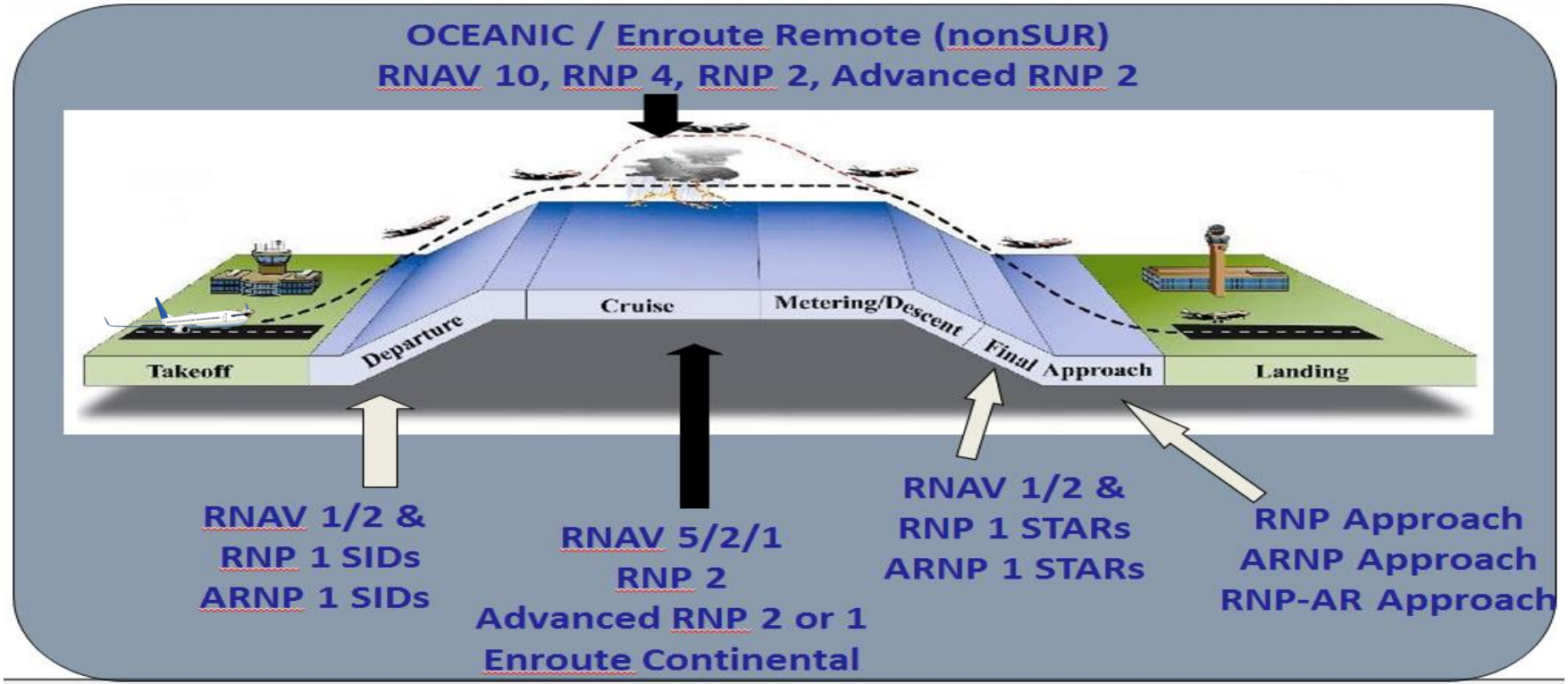
- RNAV and RNP being applied inconsistently across the globe
  - Originated with technology on-board the aircraft
- No central focus or control
- Need for standardization and provisions
- No requirement for new equipment
  - Based on existing functionality, but with standardized implementation

PBN Navigation Specification



X = Navigation Accuracy in NM 95% of flight time

Performance based navigation



Performance based navigation

 needs to ensure that his aircraft is able to comply with these requirements before flying the air route.

In case of outage / loss of navigation performances, the  needs to inform the 

Which infrastructure to support PBN ?

Navigation = Position + Navigation Database

Position is computed with the following infrastructure :

- **DME/DME**
- **VOR/DME**
- **But mainly relies on satellites, complemented sometimes by inertial systems**

Satellite constellations

- GPS
- Glonass
- Galileo
- Beidou

Several types of errors :

- Satellite clock
- Ionosphere
- Troposphere

And lack of integrity

Need to elaborate corrections

Global Navigation Satellite System (GNSS)

GPS

Glonass

Galileo

Beidou

Three types of augmentations

ABAS — Aircraft Based Augmentation System

GBAS — Ground Based Augmentation System

SBAS — Satellite Based Augmentation System

Future : Development of dual frequency multi constellation receiver. Great improvement of PBN coverage all over the globe, especially for the vertical.

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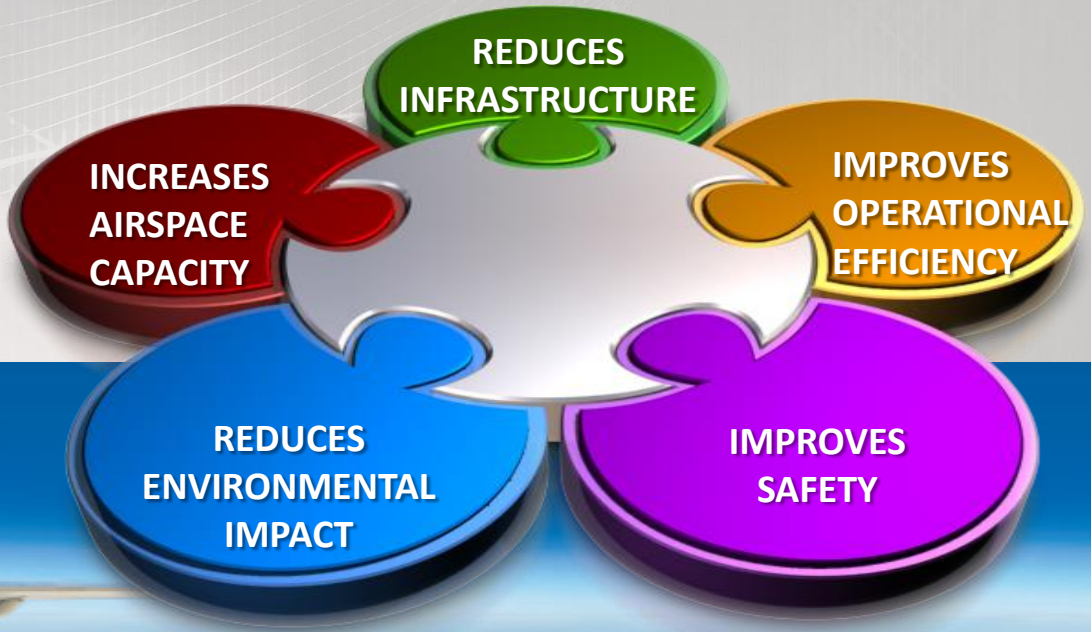
What are the PBN Benefits ?

PBN Benefits

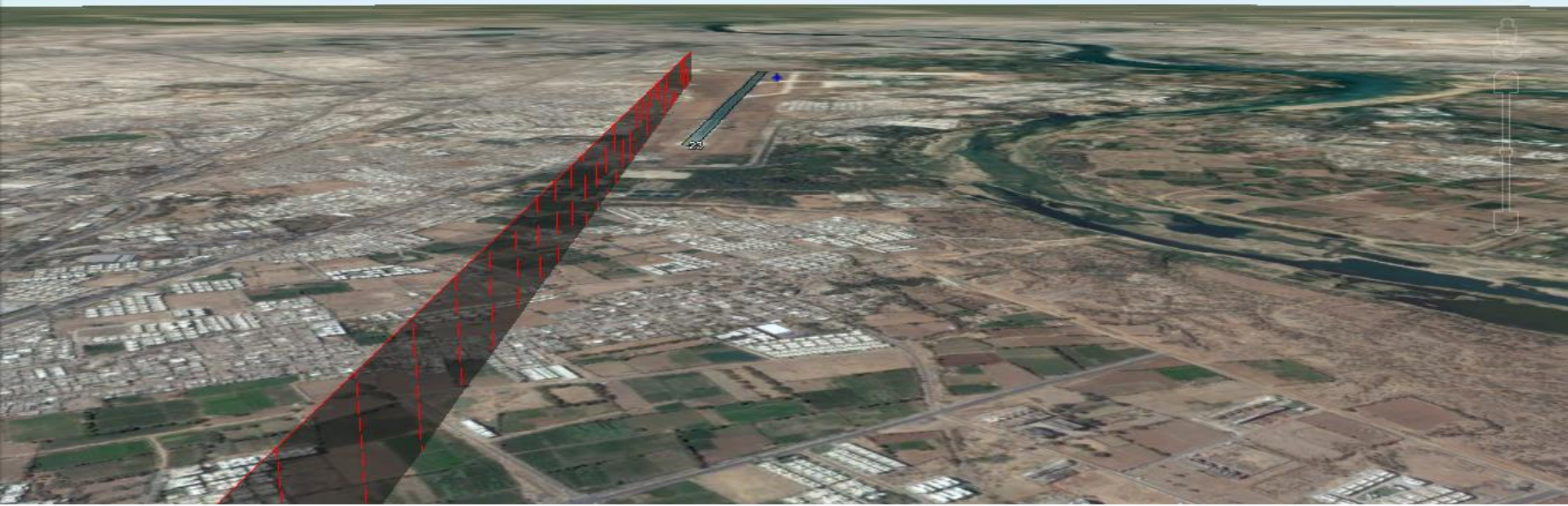


Improve accessibility :
Establish approach procedures to runways
that do not currently have an instrument approach

More accurate and more reliable lateral and vertical paths

approach procedures aligned with the runway axis

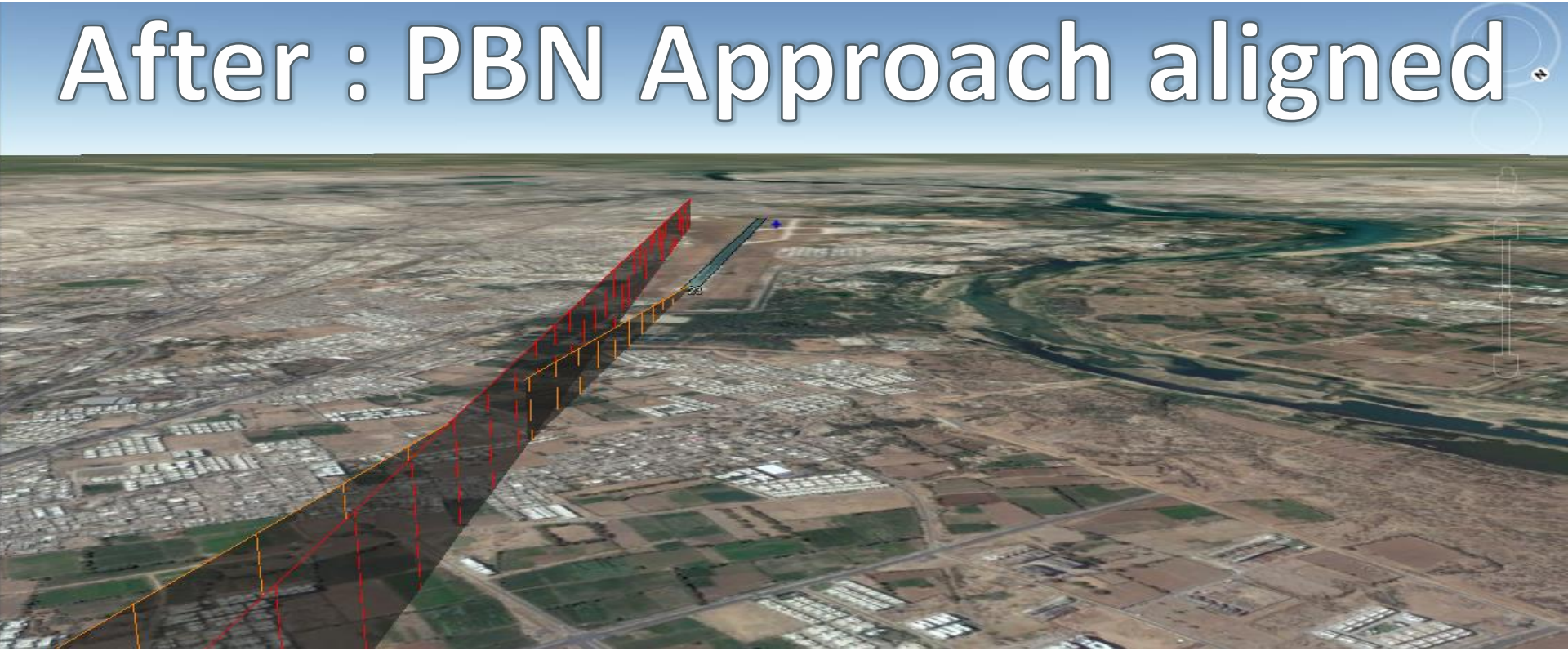
Before : approach to a navaids



ICAO SAFETY

approach procedures aligned with the runway axis

After : PBN Approach aligned



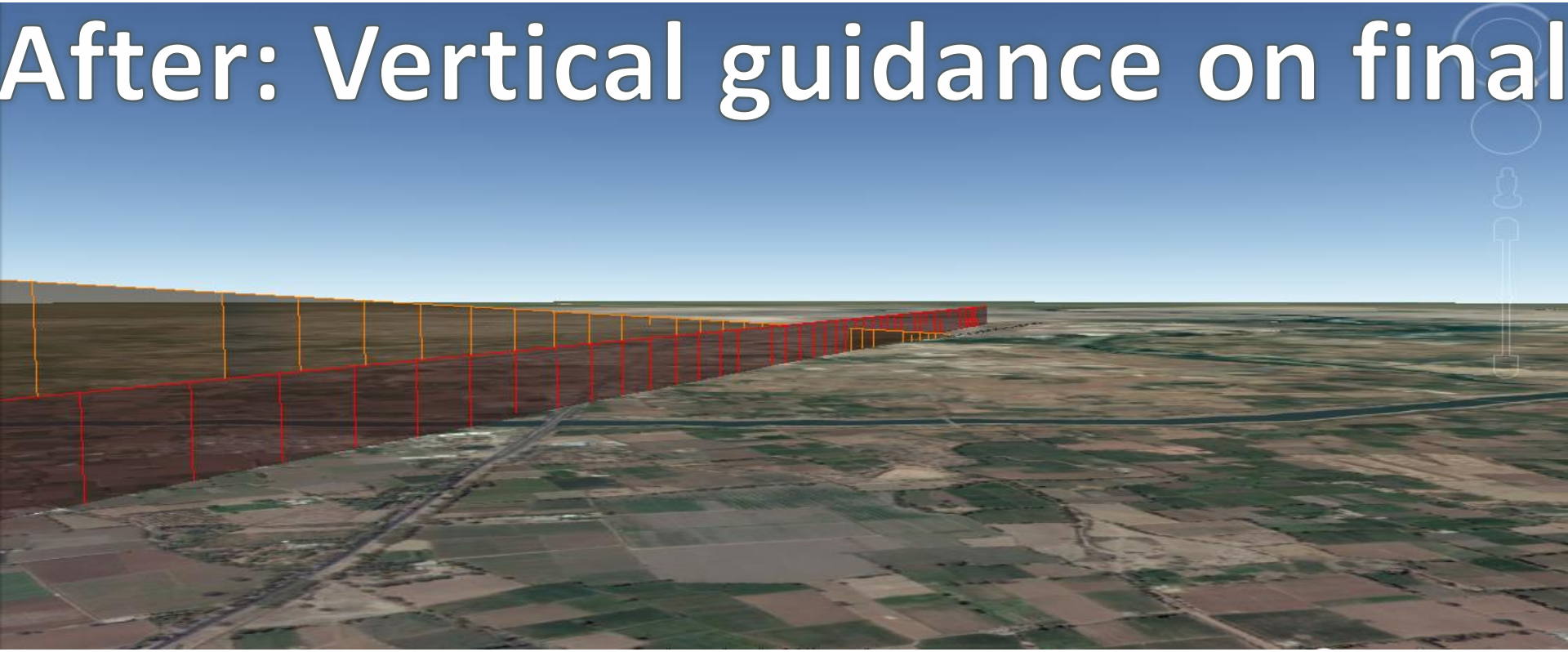
ICAO SAFETY

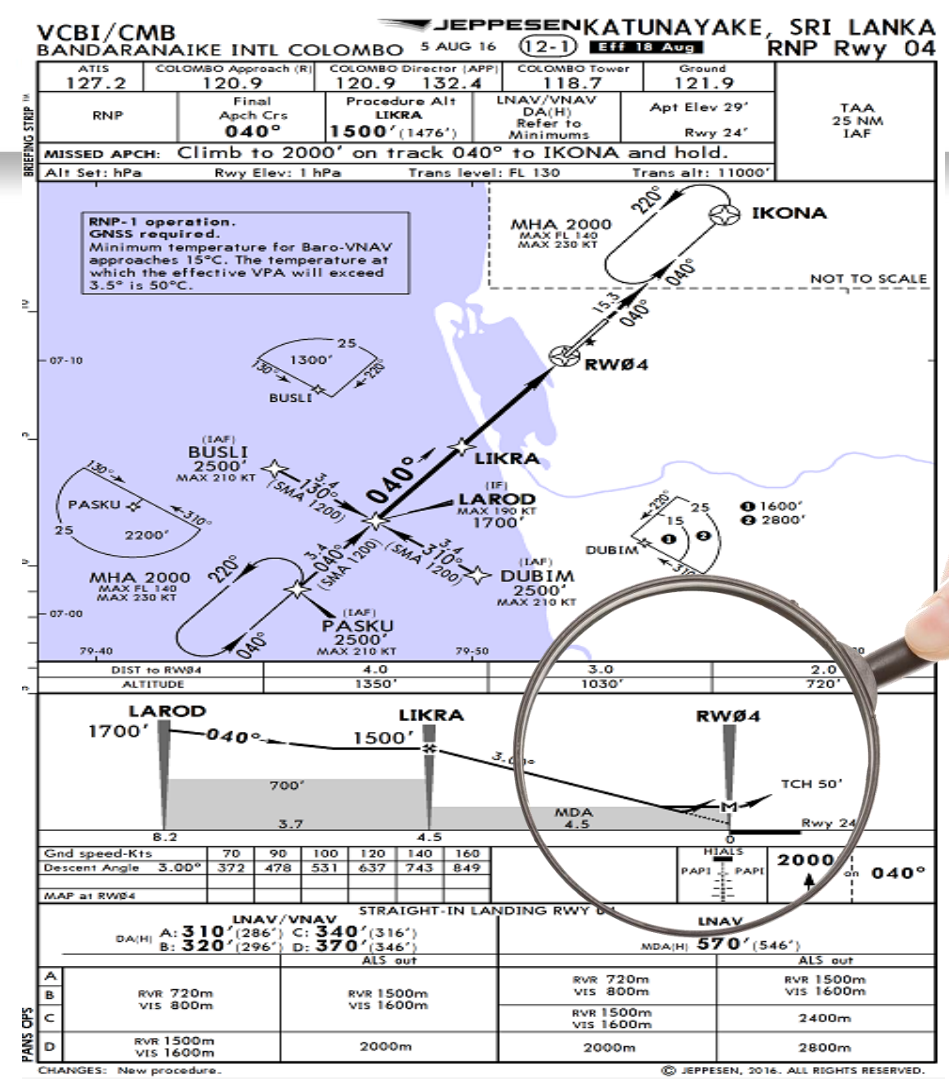
Approach procedures with vertical guidance (APV)

Before : min vertical altitude

ICAO SAFETY

Approach procedures with vertical guidance (APV)




VCBI/CMB
BANDARANAIKE INTL COLOMBO
JEPPESEN
5 AUG 16
12-1
Eff 18 Aug
KATUNAYAKE, SRI LANKA
RNP Rwy 04
ATIS 127.2
COLOMBO Approach (R) 120.9
COLOMBO Director (APP) 120.9 132.4
COLOMBO Tower 118.7
Ground 121.9
RNP
Final Apch Crs 040°
Procedure Alt LIKRA 1500′ (1476′)
LNAV/VNAV DA(H) Refer to Minimums
Apt Elev 29′
Rwy 24′
TAA 25 NM IAF
MISSED APCH: Climb to 2000′ on track 040° to IKONA and hold.
Alt Set: hPa
Rwy Elev: 1 hPa
Trans level: FL 130
Trans alt: 11000′
RNP-1 operation.
GNSS required.
Minimum temperature for Baro-VNAV approaches 15°C. The temperature at which the effective VPA will exceed 3.5° is 50°C.
MHA 2000
MAX FL 140
MAX 230 KT
IKONA
NOT TO SCALE
RWØ4
BUSLI
(IAF)
BUSLI
2500′
MAX 210 KT
LIKRA
(IF)
LAROD
MAX 190 KT
1700′
PASKU
2200′
MHA 2000
MAX FL 140
MAX 230 KT
(IAF)
PASKU
2500′
MAX 210 KT
DUBIM
(IAF)
DUBIM
2500′
MAX 210 KT
1600′
2800′
DIST to RWØ4
4.0
3.0
2.0
ALTITUDE
1350′
1030′
720′
LAROD
1700′
040°
LIKRA
1500′
3.00°
700′
MDA
4.5
TCH 50′
RWØ4
Rwy 24
8.2
3.7
4.5
0
Gnd speed-Kts
70
90
100
120
140
160
Descent Angle 3.00°
372
478
531
637
743
849
MAP at RWØ4
HIALS
PAPI
PAPI
2000
on 040°
STRAIGHT-IN LANDING RWY 04
LNAV/VNAV
DA(H) A: 310′(286′) C: 340′(316′)
B: 320′(296′) D: 370′(346′)
LNAV
MDA(H) 570′(546′)
ALS out
ALS out
A
B
RVR 720m
VIS 800m
RVR 1500m
VIS 1600m
RVR 720m
VIS 800m
RVR 1500m
VIS 1600m
C
RVR 1500m
VIS 1600m
2400m
D
RVR 1500m
VIS 1600m
2000m
2000m
2800m
CHANGES: New procedure.
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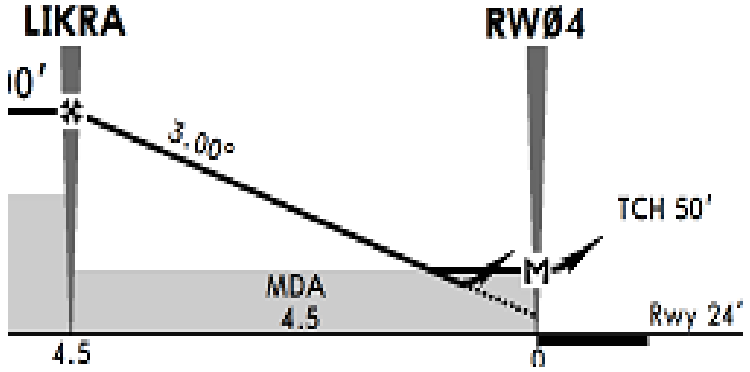
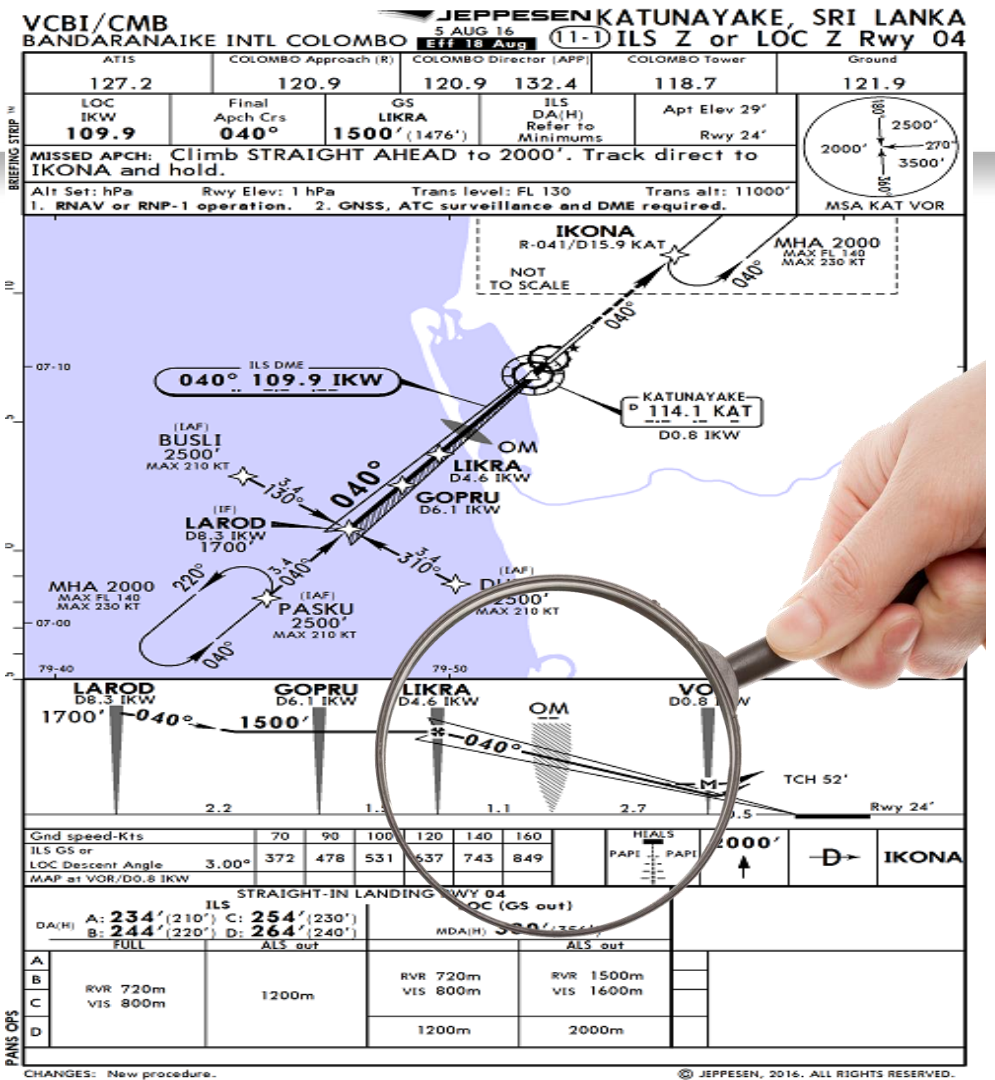
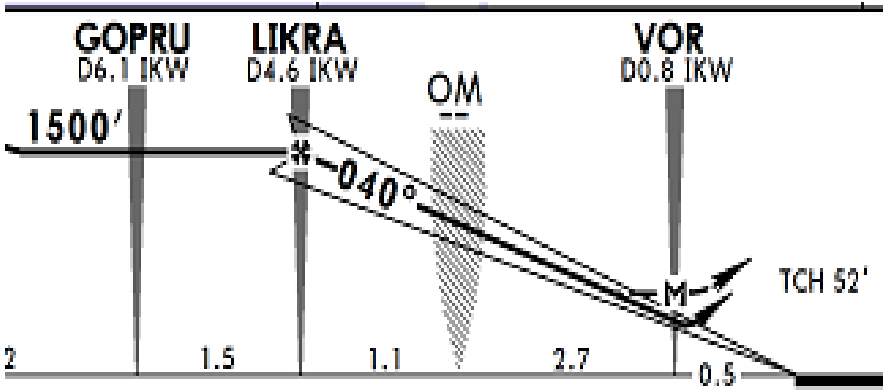
BRIEFING STRIP
PANS OPS


LIKRA
RWØ4
10′
3.00°
TCH 50′
MDA
4.5
M
Rwy 24′
4.5
0

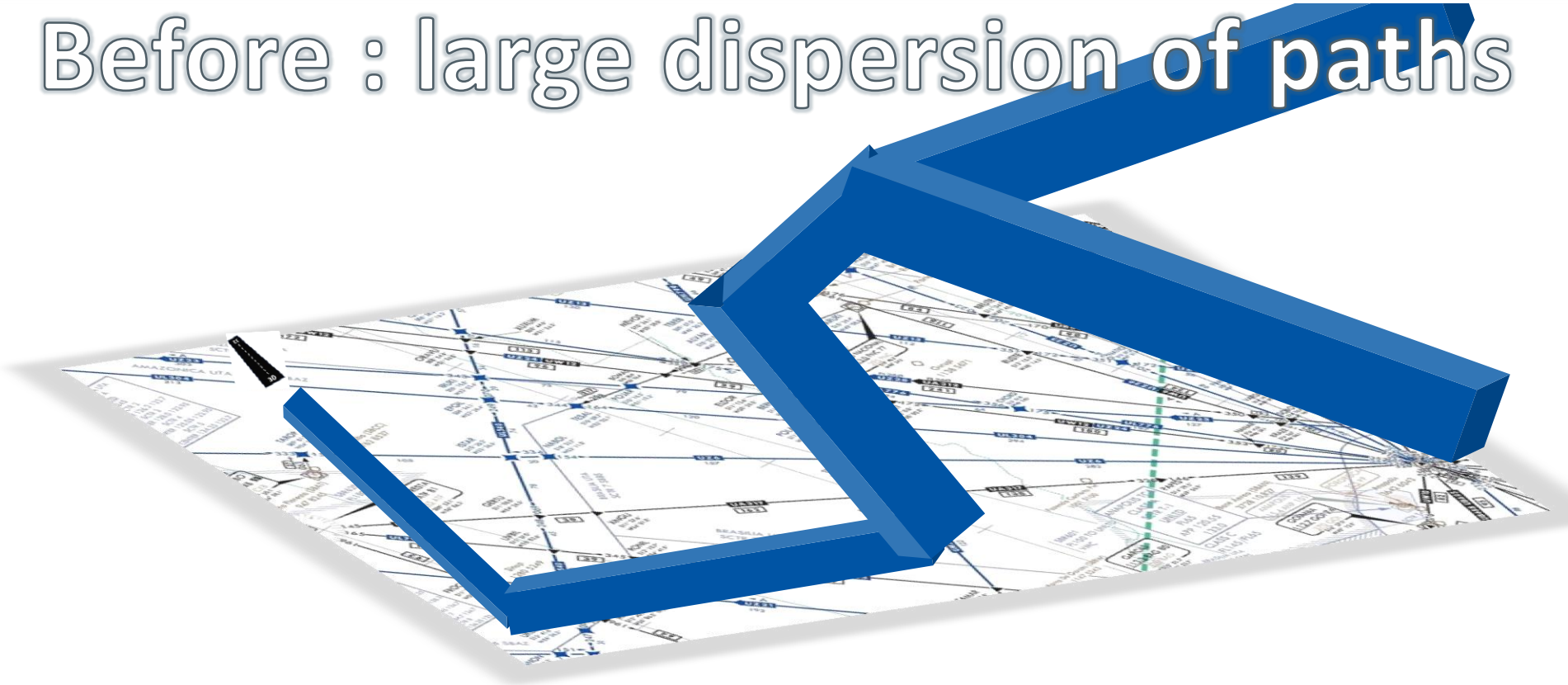


NO COUNTRY LEFT BEHIND

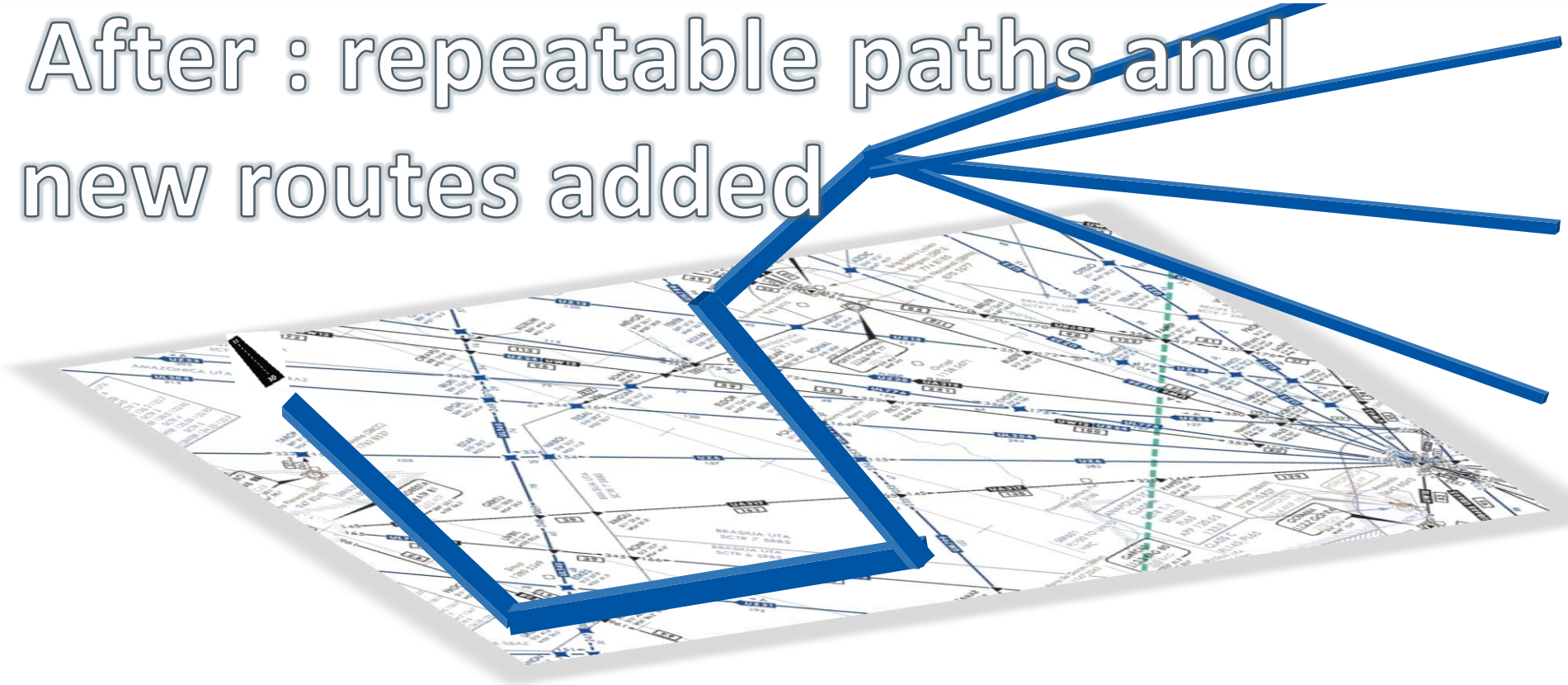
RNAV to ILS



Before : large dispersion of paths



After : repeatable paths and new routes added



And also new airways in En-Route

Improved trajectory and throughput

reduced noise, fuel burn and CO_2 emissions

ICAO Fuel Savings Estimation Tool
IFSET

http://applications.icao.int/ifset

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PBN Implementation

Set up good foundation

Then develop all your projects

Three pillars you need to rely on

PBN Implementation

Appoint a PBN coordinator at national level

- Conduct regular meetings with all stakeholders to review the airspace user needs and adopt planning of PBN development with the ANSP

PBN Implementation

Status :

71% of APAC States have provided their PBN implementation plan

To Regional Office

PBN Implementation

Update national regulatory material with :

- **Oversight of Procedure Design :**
  - Last ICAO criteria from PANS OPS (Doc 8168)
  - Approval process between Project Leader / Airport / ANSP and Regulator (Doc 9906) Bottleneck

- **Airborne (Operational approval) (Doc 9997):** Bottleneck
  - PBN requirements for aircraft airworthiness & pilot training

Operational Approval

- The PBN operational approval authorizes an operator to carry out defined PBN operations with specific aircraft in designated airspace.
- It is issued after having demonstrated compliance with the relevant airworthiness, continued airworthiness and flight operations requirements.

PBN Implementation

PBN Implementation

Best practices :

- Appoint a person at national level to manage the planning and resources (human/finance) of PBN projects
- Organize local meeting with all stakeholders
- High quality aeronautical information is CRITICAL
  - Develop and implement Regulations Covering ALL Stakeholders(Annexes 4 & 15)
  - Implement Quality Management Processes underscored by formal agreements between all stakeholder
- Provide adapted training to Air Traffic Controllers

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PBN assistance provided by ICAO

- Regional Office in Bangkok
- Regional Sub-Office (RSO) in Beijing

- Two ICAO programs :
  - Flight Procedure Program (FPP)
  - Cooperative Development of Operational Safety & Continuing Airworthiness Programs (COSCAP- NA,SEA,SA)
- PBN Go team
- 

and online training courses

PBN assistance provided by ICAO

State

PBN IMPLEMENTATION

REPORTING

PBNICG

ACTIONS

GAP ANALYSIS

State

State

iSTARS
integrated Safety Trend Analysis and Reporting System

PBN GO TEAM

PBN assistance provided by ICAO

- **PBN Go Team :**
  - On State's request
  - Objective of the Go team assistance
    - Diagnose why the PBN implementation progress is slow
    - Provide specific guidance to the visited States to address the issues detected
  - A team of 4-5 PBN experts
  - 4-5 day visit in the State
  - Cost recovery principle

PBN assistance provided by ICAO

- **Workshop :**
  - **At APAC level :**
    - **PBN for ATC by RSO**
    - **Air Space Management by RSO**
    - **Operational Approval by COSCAP**
  - **On State’s request**

PBN assistance provided by ICAO

Training by Flight Procedure Programme (FPP):

- Procedure Design courses : PBN and refresher courses, quality assurance, helicopter ,…
- Members of FPP :
  - 10 Active States/ Administration :
    - China
    - Hong Kong, China
    - Macao, China
    - French Polynesia(France)
    - Philippines
    - Rep. of Korea
    - Singapore
    - Sri Lanka
    - Thailand
    - Australia
  - 8 User States :
    - DPR Korea
    - Fiji
    - Laos
    - Mongolia
    - Myanmar
    - Pakistan
    - Tonga
    - Vietnam
- Agreement to launch Phase 3 : 2018-2020

Conclusion

Two bottlenecks are limiting the PBN implementation in the APAC region :

Conclusion

- **Regulators should ensure that :**
  - **Bottlenecks are removed**
  - **All stakeholders are involved**
  - **Allocate sufficient funding and human resources**

to sustain PBN implementation

ENJOY YOUR FLIGHT

rguillet@icao.int


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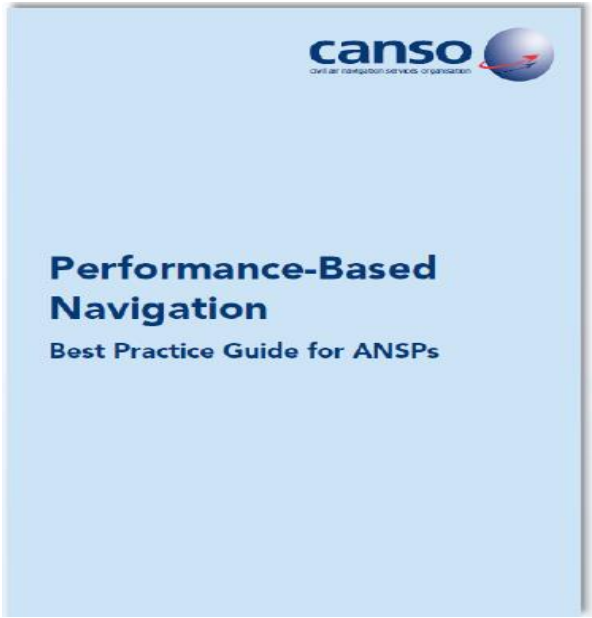
THANK YOU!

Back up slides

Source : ICAO PBN Manual - Doc 9613

Back up slides

Material for ANSPs developed by CANSO



https://www.canso.org/performance-based-navigation-best-practice-guide-ansps


PBN