

TERMINAL AIRSPACE REDESIGN IN THE CURAÇAO FIR I

Context and conceptual approach

Thursday 8 December 2022

In coordination
with

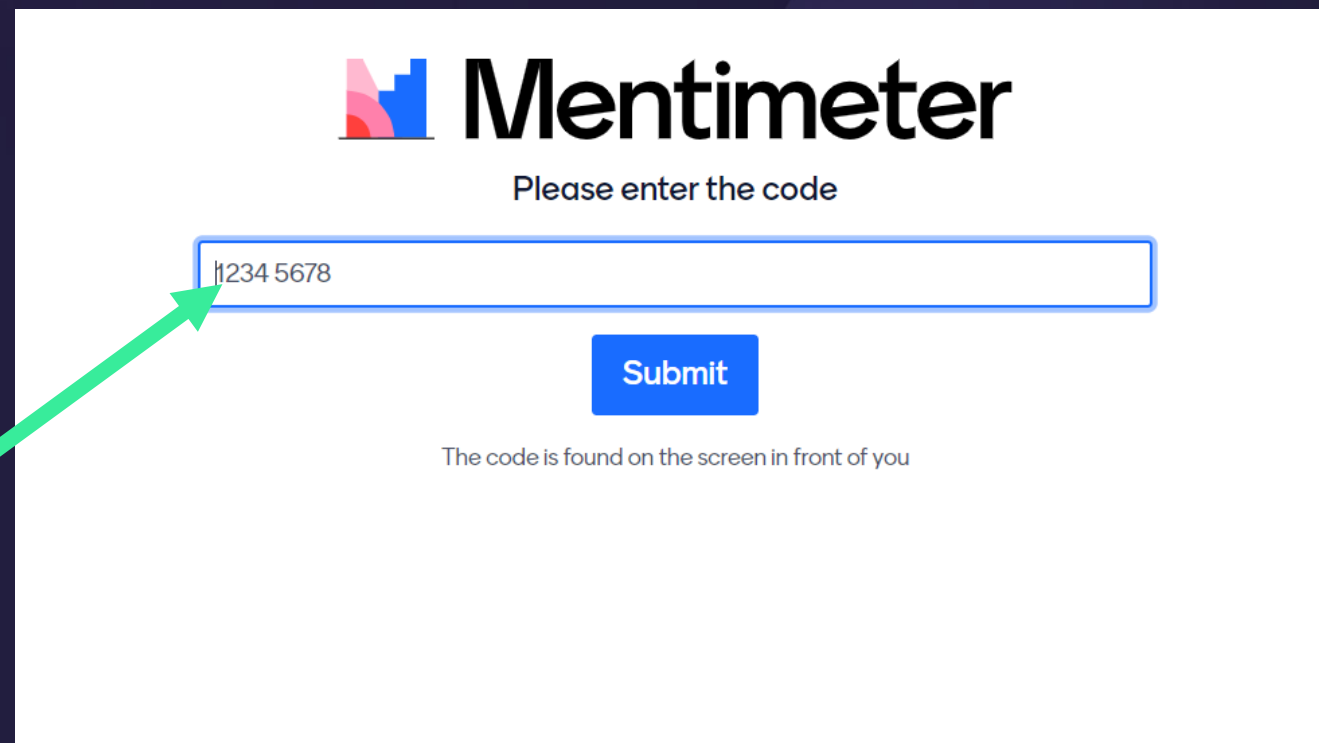



moving
dot

BEFORE WE START

- We would like to make the workshop interactive because your opinion and experience is important for us!
- Please go to www.menti.com and enter the code:

8725 0655



 **Mentimeter**

Please enter the code

Submit

The code is found on the screen in front of you



EN: During the presentation, we will indicate with this symbol when a question needs to be answered in mentimeter

ES: Durante la presentación se indicará con este símbolo aquellas preguntas que deberán responderse en mentimeter

BEFORE WE START

English or Spanish?

- El workshop tendrá lugar en inglés, así como la información contenida en las diapositivas.
- En todo momento será posible hacer preguntas en español que serán respondidas en español en la medida de lo posible (Diego y Alejandra son nativos).
- Las preguntas incluidas en *mentimeter* se encontrarán en ambos idiomas para facilitar la participación de todos.

Audience



Please go to *mentimeter* and let us know who you are:

- CAA / Government
- ANSP
- Airport Operator
- Industry
- Other

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Who we are



Services



Airspace & ATC procedure design



Safety Management



Regulatory Compliance Support



ATM Strategy Development



Flight Procedure Design



Unmanned operations



From planning to realization



Regional CAR/SAM PBN implementation plan

Short Term (until 2010)

Short Term (until 2010)	
Airspace	RNAV or RNP navigation specification
Route (Oceanic or Remote)	RNP 10 Corridor EUR/SAM and Santiago/Lima/AORRA/WATRS
Route (Continental)	RNAV 5 in selected airspaces
TMA	RNAV-1 in radar environment and with adequate ground navigation infrastructure.
	RNP 1 – No radar environment and/or without appropriate DME coverage.
Approach	RNP APCH in most possible airports and in all international airports.
	RNP AR APCH in airport where there are operational benefits.
<ul style="list-style-type: none">• Non compulsory installation of RNAV equipment on board of non equipped aircraft in TMA and APP• Mixed Operations (equipped and non equipped aircraft) in TMA and APP• Required RNAV 2 equipment above FL350 for flights to/from United States.	

Regional CAR/SAM PBN implementation plan

Medium Term (2011-2015)

Medium Term (2011-2015)	
Airspace	RNAV or RNP navigation specification
Route (Oceanic or Remote)	RNP 4 in the oceanic airspace
Route (Continental)	RNP 2 in selected airspace
TMA (SID/STAR)	Expansion of RNAV-1 or RNP-1 application Compulsory RNAV 1 or RNP 1 approval for aircraft operating in greater air traffic density TMAs (exclusionary airspace)
Approach	Expansion of RNP APCH and RNP AR APCH application Application of GBAS procedures**
<ul style="list-style-type: none">• RNP2 required equipment over FL290 for flights to/from United States. <p>** GBAS procedures are currently not covered under the PBN concept</p>	

ICAO – PBN-states-plan

ICAO Regional Office : NACC (21)

Count= 21	Count= 0	Implementation plan?
Antigua and Barbuda	State	Yes
Bahamas	State	Yes
Barbados	State	Yes
Belize	State	Yes
Canada	State	Yes
Costa Rica	State	Yes
Cuba	State	Yes
Dominican Republic	State	Yes
El Salvador	State	Yes
Grenada	State	Yes
Guatemala	State	Yes
Haiti	State	Yes
Honduras	State	Yes
Jamaica	State	Yes
Mexico	State	Yes
Nicaragua	State	Yes
Saint Kitts and Nevis	State	Yes
Saint Lucia	State	Yes
Saint Vincent and the Grenadines	State	Yes
Trinidad and Tobago	State	Yes
United States of America	State	Yes

ICAO Regional Office : SAM (14)

Count= 14	Count= 1	Implementation plan?
Argentina	State	Yes
Bolivia (Plurinational State of)	State	Yes
Brazil	State	Yes
Chile	State	Yes
Colombia	State	Yes
Ecuador	State	Yes
France	French Guyana	Territory
Guyana	State	Yes
Panama	State	No
Paraguay	State	Yes
Peru	State	Yes
Suriname	State	No
Uruguay	State	Yes
Venezuela (Bolivarian Republic of)	State	Yes

How far are you with the PBN implementation plan?

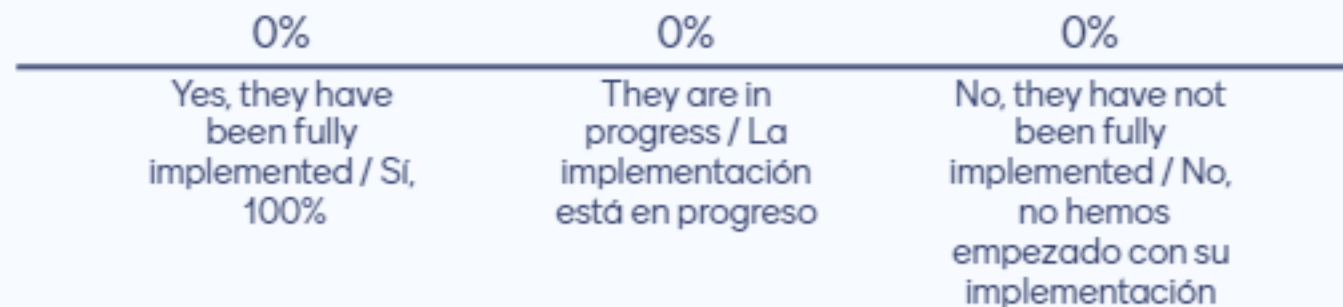


Please go to *mentimeter* to answer these questions:

- **ENR phase** – ATS routes (e.g. RNAV 5) based on PBN?
 - Yes, they have been fully implemented
 - No, they are not fully implemented
 - They are in progress
- **Terminal phase** – SIDs (e.g. RNP 1 or RNAV 1) based on PBN?
 - Yes, they have been fully implemented
 - No, they are not fully implemented
 - They are in progress

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Are your ATS routes based on PBN?



Are your SIDs (departures) based on PBN?



How far are you with the PBN implementation plan?



Please go to *mentimeter* to answer these questions:

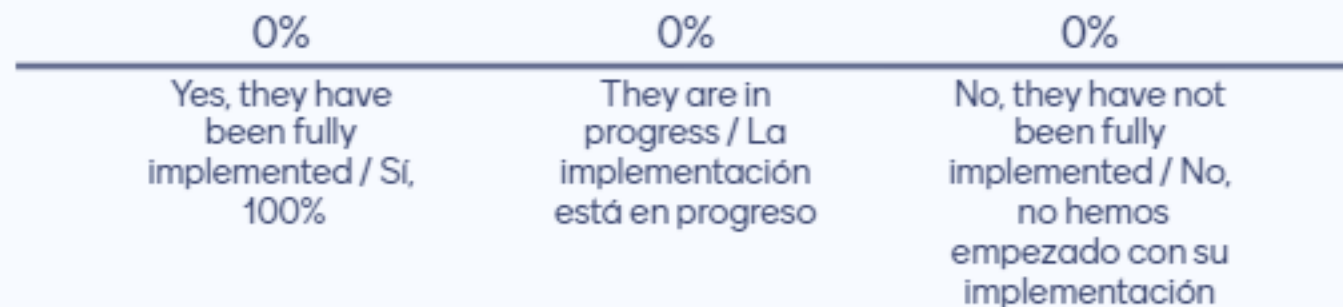
- **Terminal phase** – STARs (e.g. RNP 1 or RNAV 1) based on PBN?
 - Yes, they have been fully implemented
 - No, they are not fully implemented
 - They are in progress
- **Approach phase** – Instrument approaches (e.g. RNP APCH) based on PBN?
 - Yes, they have been fully implemented
 - No, they are not fully implemented
 - They are in progress

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Are your STARs (arrivals) based on PBN?



Are your approaches based on PBN?



Use case:

Airspace redesign Curaçao FIR

Why?

Curaçao FIR in numbers



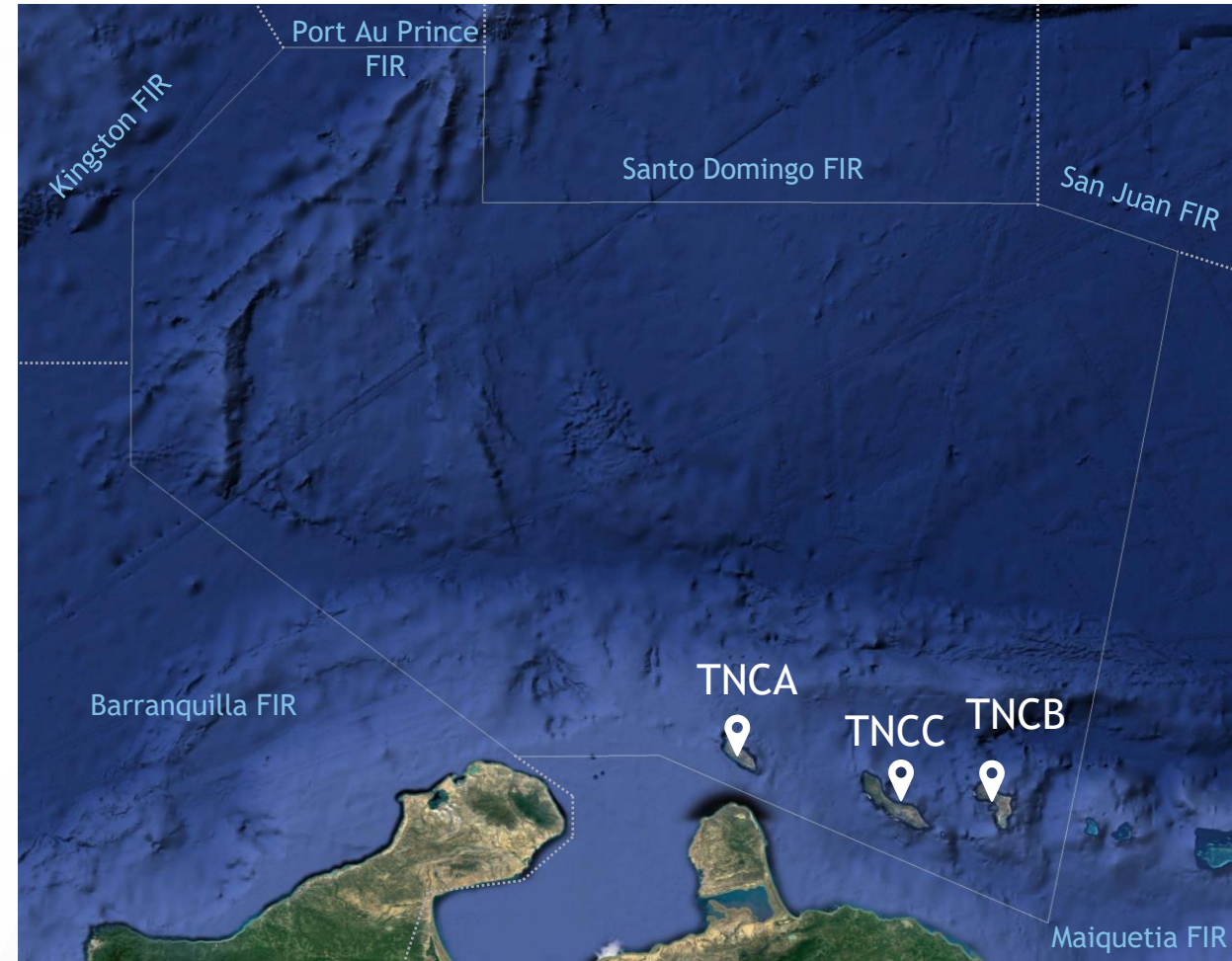
- Curaçao (Hato Intl Airport, TNCC)
- Aruba (Queen Beatrix Intl Airport, TNCA)
- Bonaire (Flamingo Intl Airport, TNCB)



- 6 different adjacent centres
- 2 different ANSPs: DC-ANSP and ANSA



- ~200.000 operations/year
 - 80% of the traffic is en-route traffic, transiting above FL245
 - Most of the international traffic comes from the North
 - The inter-island flights are normally VFR traffic



Problem statement

Airspace redesign

Need to improve the efficient deployment of ATCOs in their area of responsibility while simultaneously improving operational safety and flight efficiency.

Goals

Airspace redesign

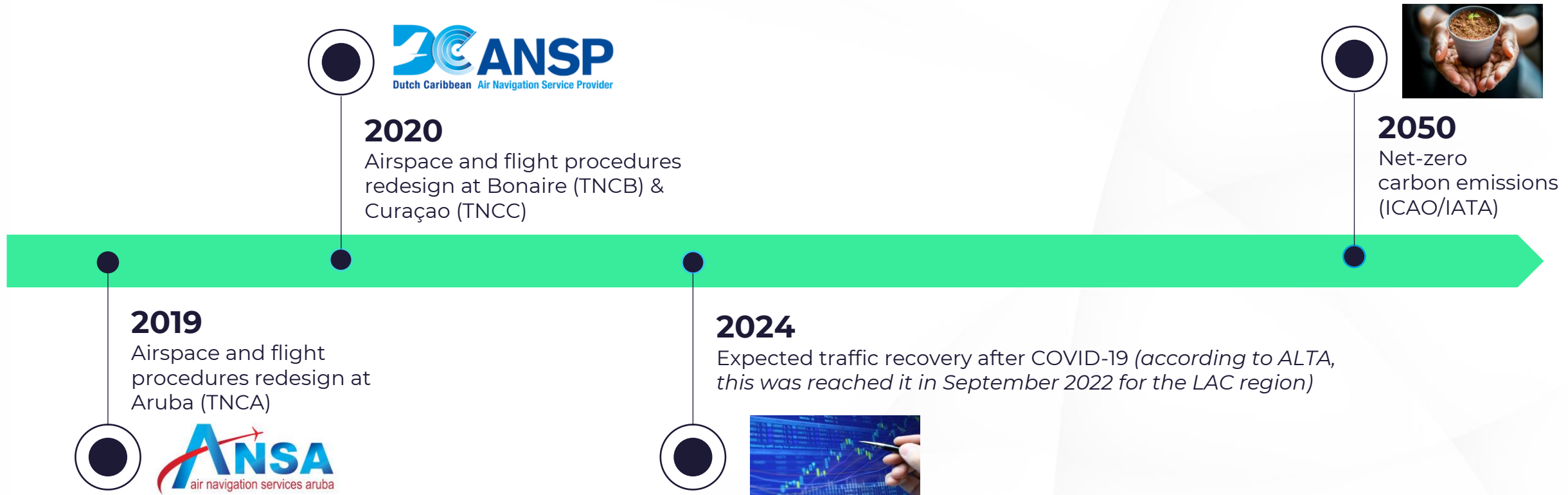
- Balance the workload of the ATCos in Curaçao's upper, lower airspace and TMA by means of re-sectorization;
- Reduce pilots' and ATCos' workload;
- Simplify the traffic flows by standardization and deconfliction;
- Improve flight efficiency by supporting continuous climb and descent operations.

Operational challenges in the region

1	No continuous Climb/Descent	Arrival/departure routes did not support Continuous Climb/Descent Operations
2	Inefficient SIDs/STARs	'Direct to' from FIR boundary to IAF Fuel efficiency loss (planned vs. realized)
3	ATC	No predictable trajectories High workload for ATCos
4	Inter-island traffic	Mixed VFR and IFR traffic between the three islands, and no standard VFR procedures

! Everyone is focusing on the traffic recovery after COVID-19 but the environmental targets shall not be forgotten!

Timeline



Implementation challenges

CNS equipment

Main navigation specifications required:

- RNAV 5 equipped fleet → ATS routes
- RNAV / RNP 1 equipped fleet → SIDs and STARs
- RNP APCH equipped fleet → Approaches

- For aircraft operators, there must be a clear benefit or mandate in order to have their fleet PBN approved.
- It is not only about equipping the aircraft but also the crew must be PBN endorsed.
- Most commercial aircraft are already PBN approved but the situation for general aviation is different. The investment costs are their main barrier.
- States can decide to mandate specific equipment to be able to operate in their airspace.

Implementation challenges

CNS equipment

Whose problem is checking the PBN approval?

It is the responsibility of the pilot to ensure that, where the flight is intended to operate on a route or in an area where a navigation specification is prescribed, it has an appropriate PBN approval and that all the conditions applying to the approval will be satisfied.

Implementation challenges

CNS equipment

- For an optimum use and deployment of PBN procedures, it is necessary that a big percentage of the fleet is approved for the navigation specification requirements.
- What is a big percentage? The target is state-dependent but at least 70-80% of the fleet should be equipped.
- Sources of CNS information:
 - Flight plan data
 - Airlines (current and future fleet plans)
 - Online monitoring portal (?)

Implementation challenges

CNS equipment

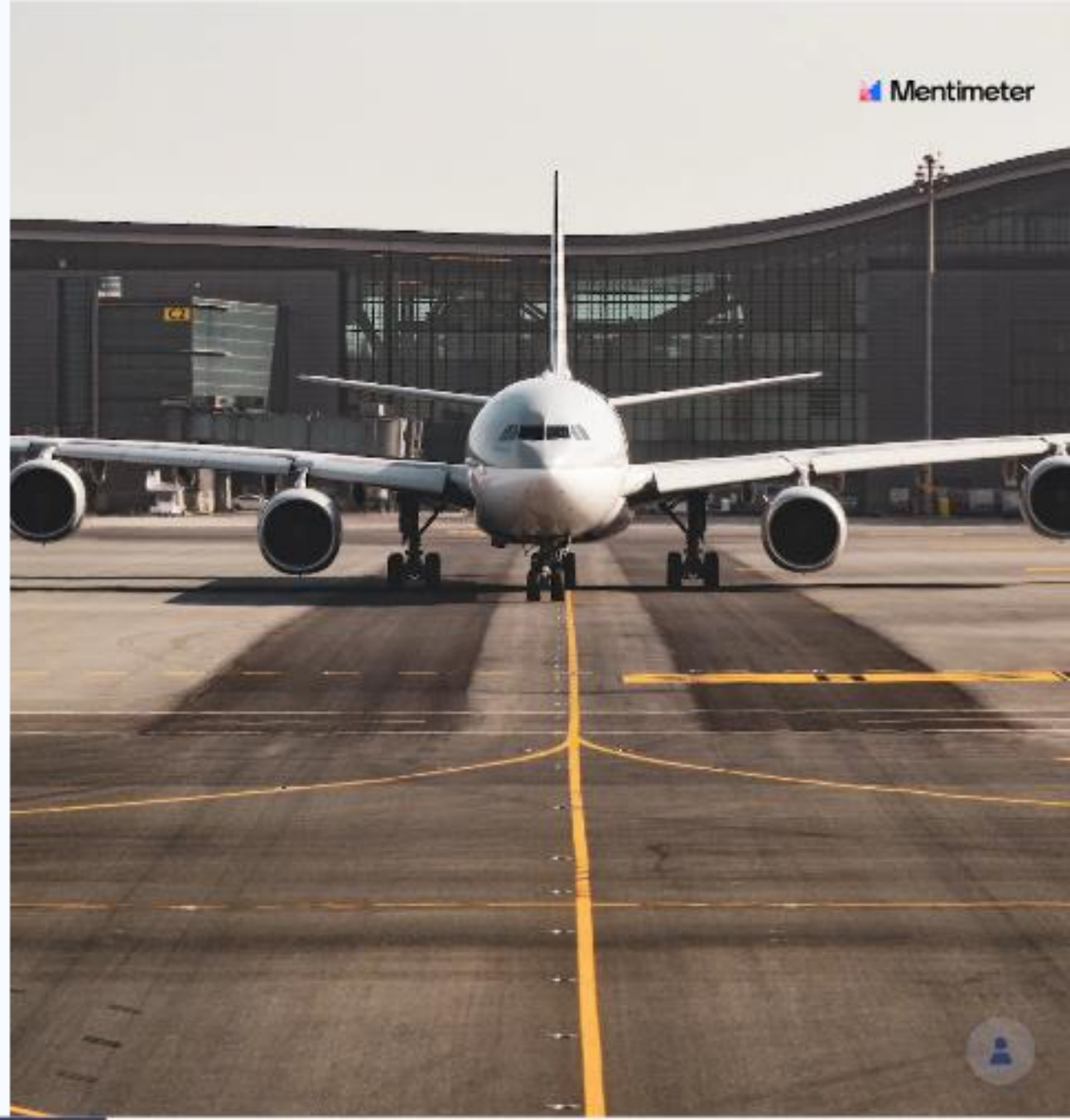
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- Are you aware of the PBN equipment rate of the fleet operating in your airspace?
- Where would /did you get that information?

Are you aware of the
PBN equipment rate of
the fleet operating in
your airspace?

- Yes
- No
- Partly



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PER EQUIPMENT RATE

Mentimeter

Where would / did you get that information?

- Flight plan data / De la información del plan de vuelo
- Airline feedback / A través de la aerolínea
- Online monitoring portal / A través de un portal que lo monitorea
- Other source of information / Otra fuente de información



CNS equipment information

Curaçao FIR – Flight Plan information

- PBN approved: 91.1%
 - GBAS: 7.2%
 - LPV: 7.6%
 - GNSS: 93.6%
- Specific PBN information:
 - No info 8.9%
 - RNAV 5 88.8%
 - RNAV 1 88.2%
 - RNP APCH 82.8%



Implement PBN Procedures
Reconsider implementing LPV procedures

Information gathered between August 2021 and October 2022

Implementation challenges

Recent obstacle survey

Conform ICAO specifications,

*On a periodic basis (periodicity determined by the State, but **no longer than five years**) the State must ensure that all changes to obstacles, aerodrome, aeronautical and navaid data are assessed.*

Implementation challenges

Recent obstacle survey

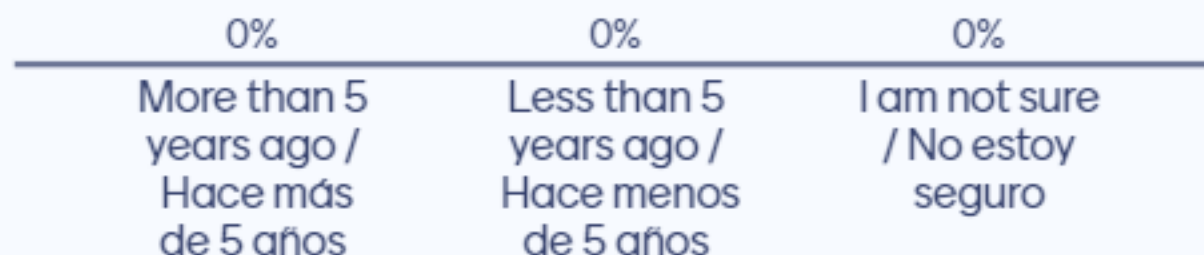
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- When was the last time that your country/airspace updated the obstacle database?
- Do you do it at regular intervals? If yes, please indicate the time interval

When was the last time your country / airspace updated the obstacle database?



Do you update your obstacle
database at regular intervals?
Please indicate the time interval



Obstacle survey

Curaçao FIR

- Latest obstacle survey available:

2016



Monitor and re-survey obstacles



Implementation challenges

Lack of training

- Specific PBN training for Air Traffic Controllers is advised **before** the implementation of PBN procedures.
- Include and plan (in advance) the required PBN Training in your change process.
- The training shall provide fundamental and most critical information necessary for ATCos to facilitate their understanding with respect to PBN.
- ATC (among others) need to feel 'comfortable' with the new procedures and understand the benefits and implications of PBN in their airspace.



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Did you consider PBN Training for ATCos before the implementation of PBN procedures?

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Did you consider PBN Training for ATCos before the implementation of PBN procedures?

- Yes
- No
- I am not sure / No estoy seguro



Implementation challenges

Lack of training

- Apart from the pre-implementation PBN training, it is important to develop a complete training plan for the actual implementation of the new procedures.
- It is really important to engage your ATCos and other OPS personnel in the implementation of new PBN procedures.
- In our experience:
 - Start with simulator training (if possible) for a reduced group of ATCos.
 - Train the trainers
 - Train the entire workforce

Implementation challenges

Environmental mitigation

- PBN allows routes to be placed in the most strategically beneficial location to ensure strategic de-confliction of flight paths thereby reducing the need for ATC intervention.
- It may generate some form of nuisance (visual intrusion, noise, emissions) around new locations: the placement of routes in the vicinity of an airport (SIDS/STARs) is a hugely contentious issue in airport neighboring communities.
- Operationally, the freedom provided to the airspace designer by PBN whereby routes can be placed anywhere, is actually a limited freedom.
- The sensitivity of airport neighborhoods and environmental pressures mean that route placement is increasingly becoming a political issue, sometimes to the detriment of the operational benefit of strategic de-confliction.
- It is important to inform communities about the implementation of new procedures to manage their expectations.

Implementation challenges

Post-implementation monitoring performance and safety assessments

- It is necessary that new flight procedures are monitored after implementation to ensure that safety is maintained.
- It is recommended that post-implementation safety assessments are conducted to ensure the application and maintenance of the established target level of safety.
- These analysis are often forgotten but they can provide useful insight about the implementation of the new flight procedures and room for further optimization in the future.

Use case:

Airspace redesign Curaçao FIR

Conceptual approach

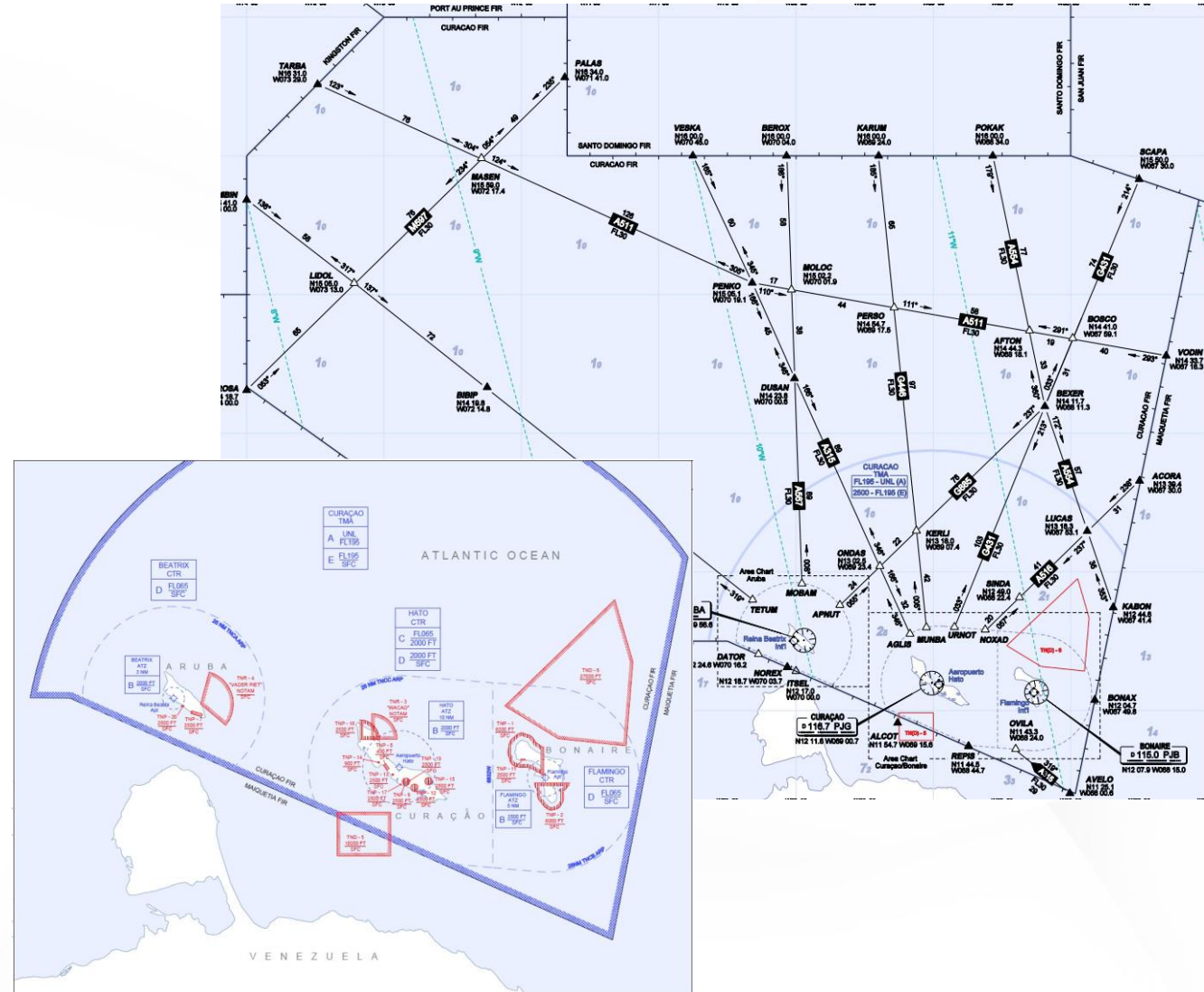
Building blocks

- ConOps was structured in different building blocks:
 1. Re-sectorization of the ACC and APP areas, aiming for dynamic airspace use and staff
 2. Redesign of SIDs and STARs, deconflicted by design and closer to actual flight tracks
 3. Design of standard VFR Procedures

Airspace structure

Before the redesign

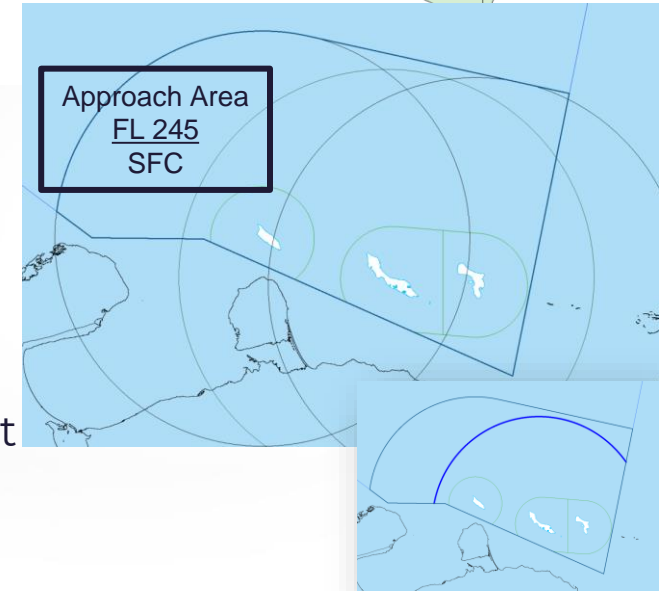
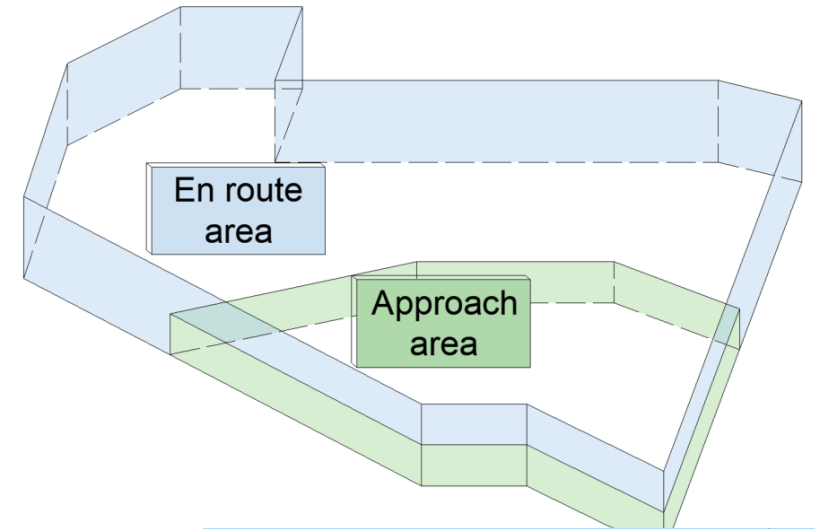
- one FIR where area control is provided using radar and procedural separation,
- one TMA with a 100 NM radius from Curaçao VOR with radar services,
- three CTR's surrounding the airports of Aruba, Bonaire and Curaçao with surveillance services and procedural control,
- three Aerodrome Traffic Zone (ATZ's) for each airport.



Concept of Operations

Airspace re-sectorization

- The imbalance in workload could be addressed by:
 - creating an area of responsibility for ACC
 - creating an area of responsibility for lower ACC / Approach control
- Horizontal and vertical limits defined based on:
 - the distance to the three airports from the boundary, to give the APP controller enough airspace to sequence traffic,
 - the descent and climb profiles of the aircraft flying in and out of TNCA, TNCB and TNCC,
 - the crossing of inbound and outbound traffic, keeping the potential conflict far enough from any traffic hand-over point to prevent misunderstandings on controller responsibility,
 - evolving traffic to and from Venezuela, that could possibly fly through the new Approach Area (briefly).

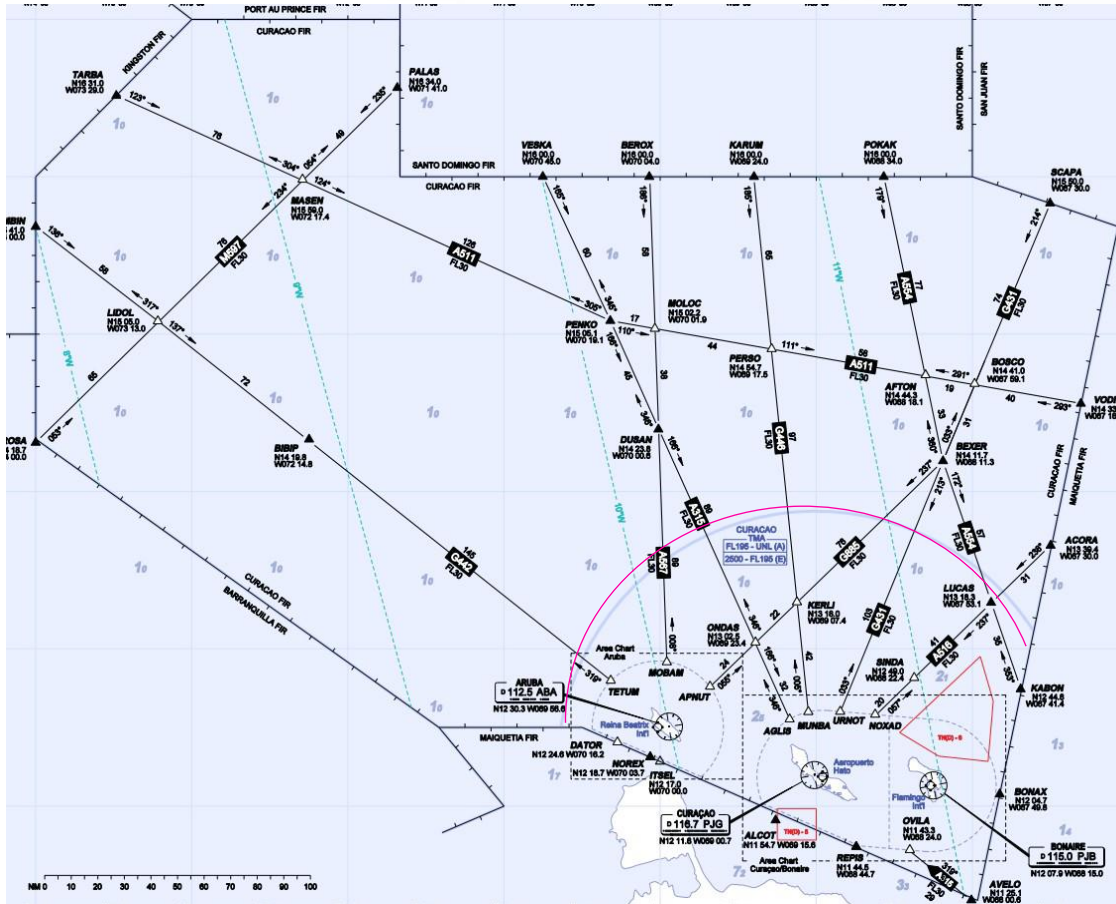


Concept of Operations

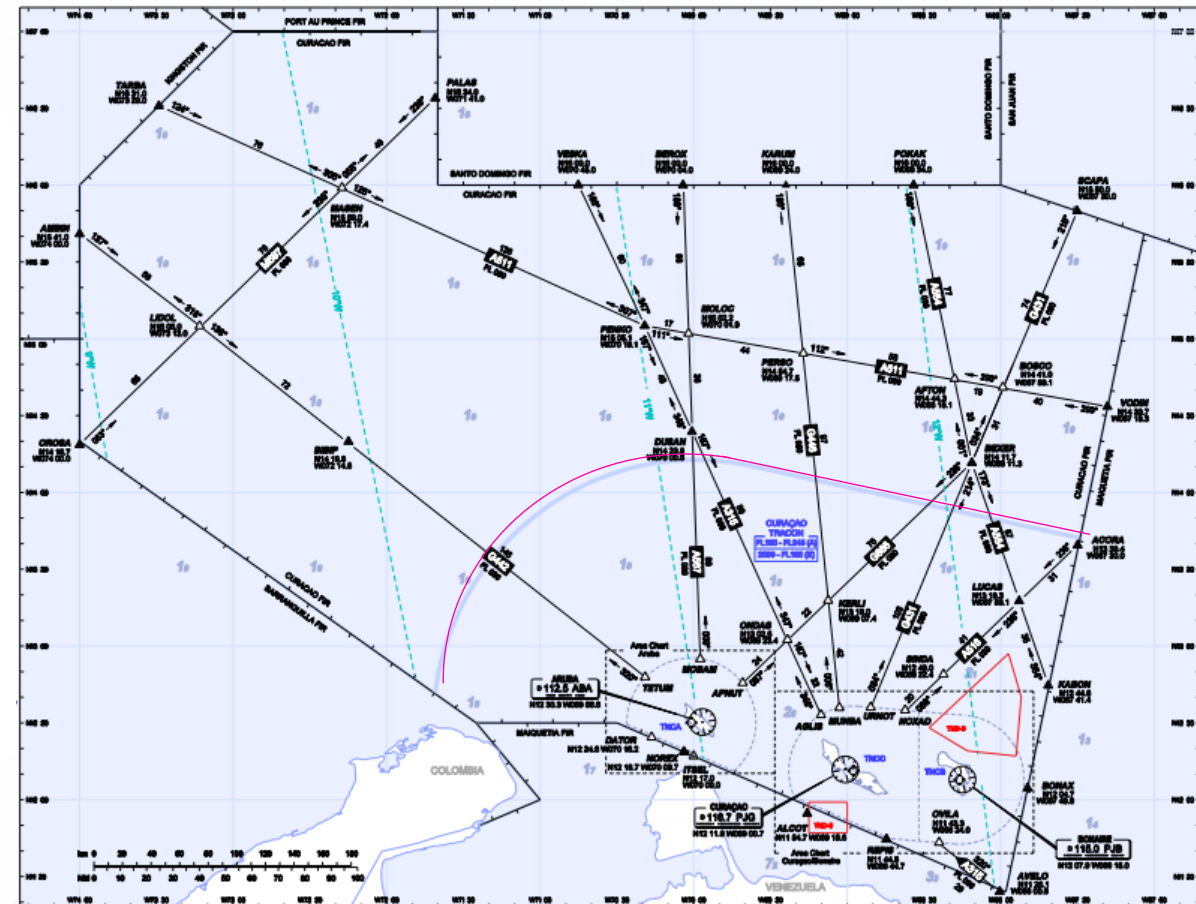
Dynamic airspace use and ATCo staff

- Initiative for the DC-ANSP Terminal controllers to be licensed for area control (ACC), and training of controllers for tower only. This would enable to have a group of ACC ATCos that can provide services in both areas.
- Dynamic deployment of ATCOs depending on predicted traffic.
- With the new airspace structure:
 - The En-route ATCo can focus on working only in the En-route Area
 - The Terminal controllers can split/merge depending on traffic conditions

Airspace structure: before and after



Curaçao TMA up to UNL



Curaçao Terminal up to FL245

Concept of Operations

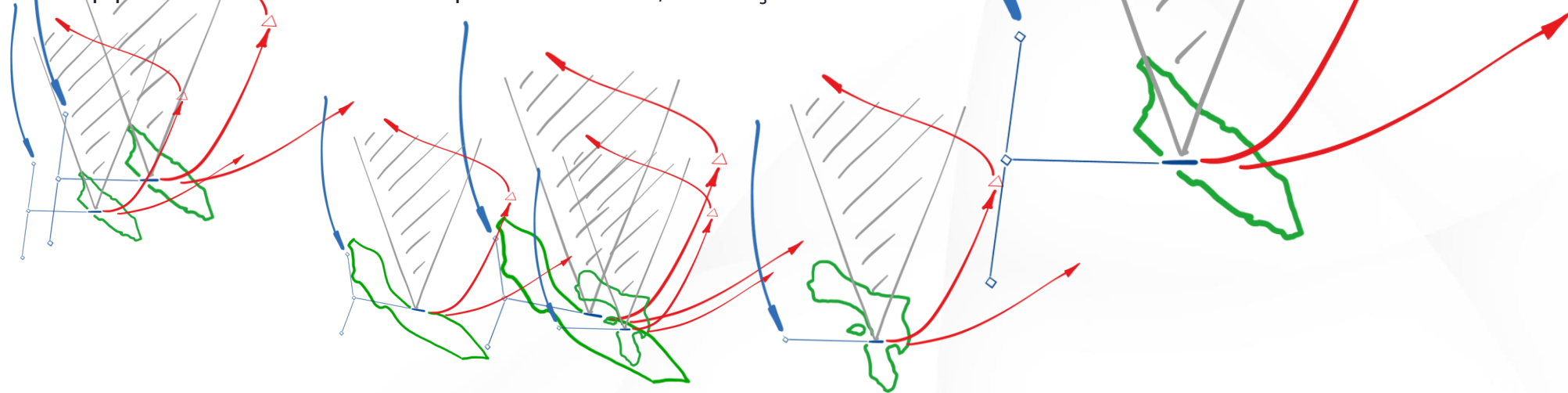
Strategic deconfliction enhanced by PBN

- SIDs and STARs can be strategically deconflicted
 - Inside terminal airspace, they are separated by a 45 degree sector
 - Outside terminal airspace, they are separated vertically
- The same concept is applied at the three airports: Aruba, Curaçao and Bonaire

Note:

The provision of SIDs and STARs geographically separated is only possible due to the flexibility of PBN (locating waypoints anywhere)

Additional waypoints with altitude restrictions are strategically placed to ensure vertical separation



Concept of Operations

Design guidelines for PBN procedures

- Routes based on actual tracks : direct route to the IAF or FIR exit point
 - Shorter routes
 - More predictable
- Overlay conventional procedures when designing PBN procedures: transparent for ATC
 - Transparent operation for ATC
 - Consistency
- Support Continuous Climb / Descent Operations
 - Optimized vertical profile
 - Nuisance (noise and emissions) reduced



QUESTIONS AND ANSWERS

Go to www.menti.com and use the code ✨

Questions?

No questions from the audience!

Incoming questions will show up here so that you can answer them one by one.

Mentimeter



If you would like to know more, please contact us:



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Henk Waltman

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Experts in air traffic
management



THANK YOU





BREAK