



ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Twenty-Seventh Meeting of the AFI Planning and Implementation Regional Group (APIRG/27)

5 - 6 November 2024



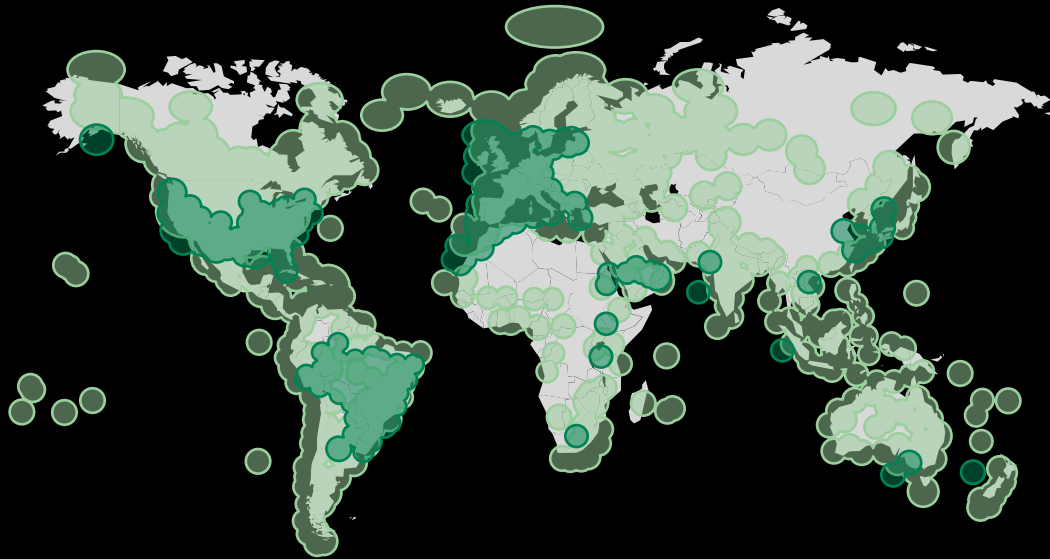
SPACE-BASED VHF

- Description of the SB-VHF concept.
- Initial analysis about the AFI Region VHF frequency use.

November 2024

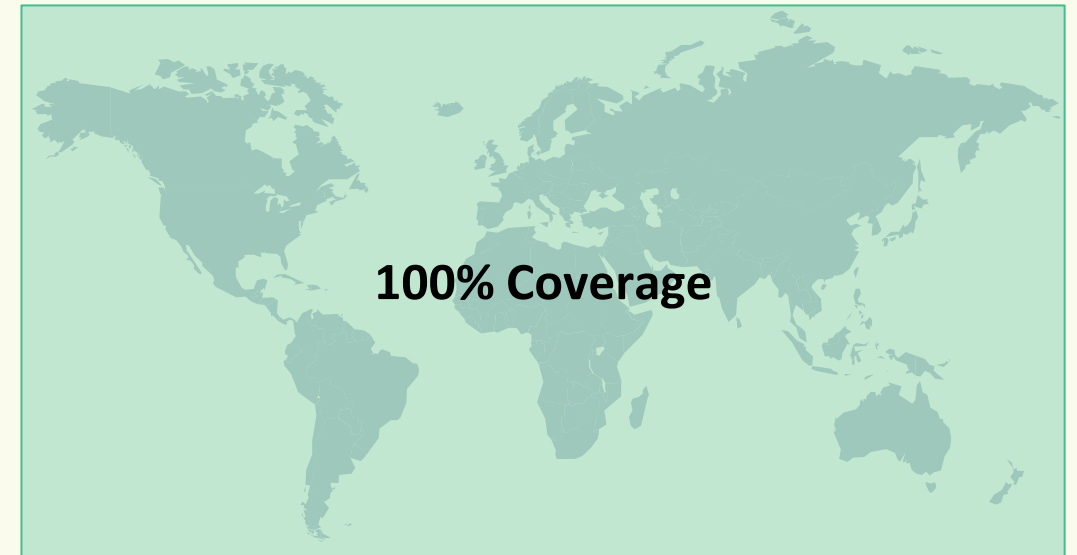
WHAT'S THE PROBLEM?

OCEANIC AND REMOTE AREAS HAVE LIMITED CNS INFRASTRUCTURE, WHICH CONDITIONS SEPARATION STANDARDS



To provide the same services all over the world without performance gaps, CNS services in oceanic & remote areas need to be the same as in continental areas

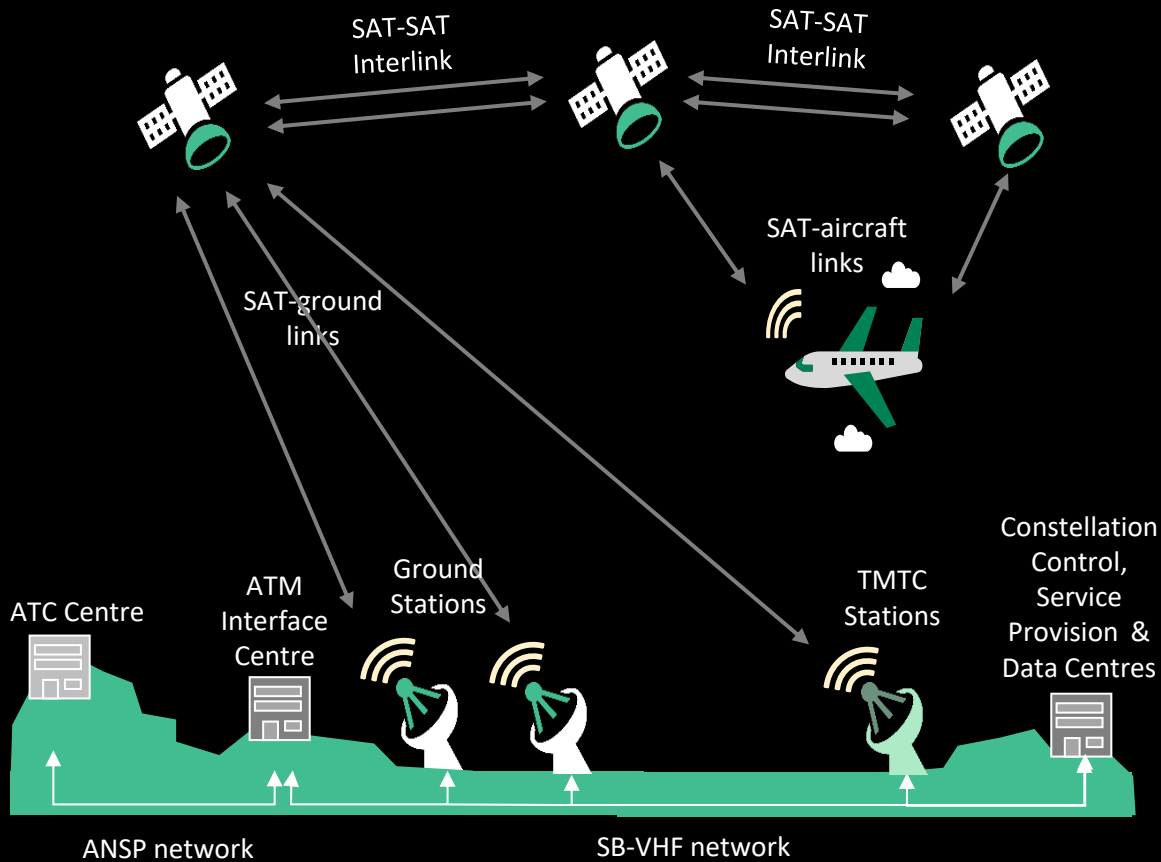
SB-VHF WILL PROVIDE GLOBAL COVERAGE OF VHF AMS(R) SERVICES & ADS-B INCLUDING OCEANIC AND REMOTE AREAS



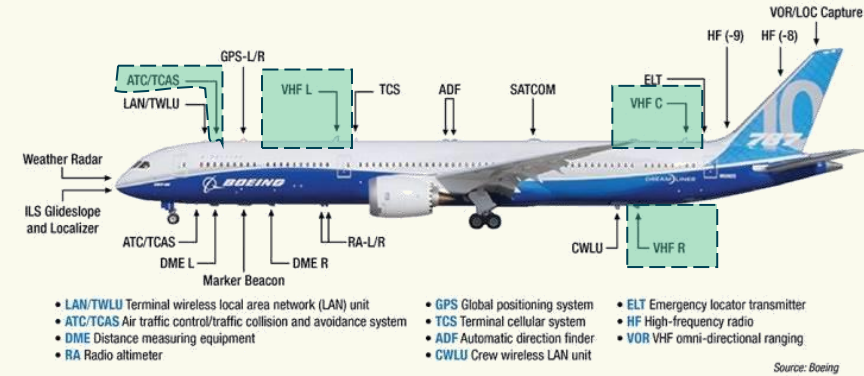
Global coverage is key to reduce separation of aircraft in oceanic and remote areas, thus reducing separation standards increasing efficiency and capacity while reinforcing the required level of safety. Additionally, it will serve as backup for continental areas.

WHAT'S OUR SOLUTION?

A CONSTELLATION OF 200+ SATELLITES



AIRCRAFT WILL NOT NEED ANY ADDITIONAL AVIONICS EQUIPMENT



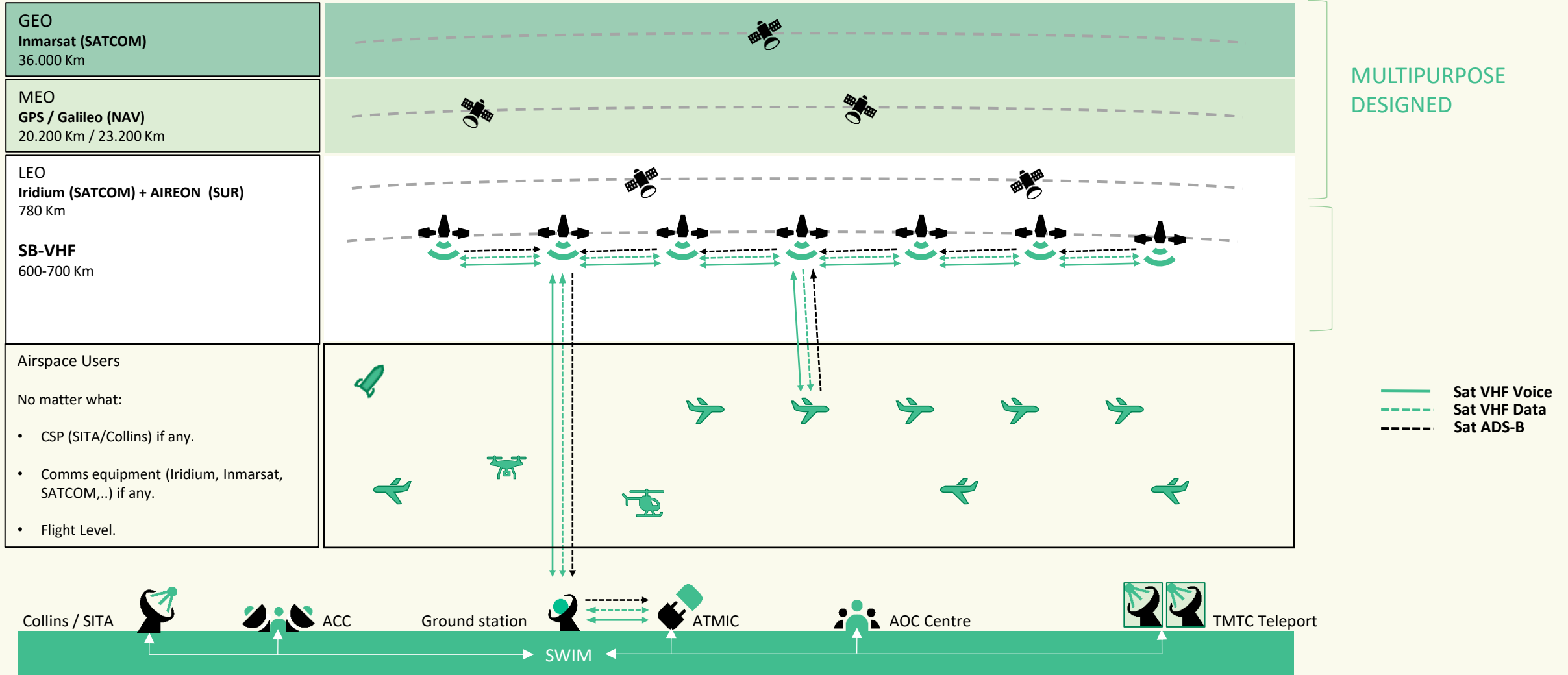
Avionics interfaced

ATCOs/PILOTS WILL NOT NEED ANY NEW TRAINING AND ADS-B/VHF DATA WILL BE PROCESSED AS USUAL BY ATC SYSTEMS



SB-VHF Service providers will own a constellation fully designed and developed for ATM purposes which will translate into controlled costs.

SB-VHF SOLUTION



Separation minima:
Radar-like or New RCP and RSP in PBCS

SB-VHF ENABLES AERONAUTICAL COM & SUR SERVICES FROM SPACE



ATS COMMUNICATIONS



VHF Voice

1001100
1010101
1100101

VHF Datalink



AOC COMMUNICATIONS

1001100
1010101
1100101

VHF Datalink

ADDED VALUE SERVICES

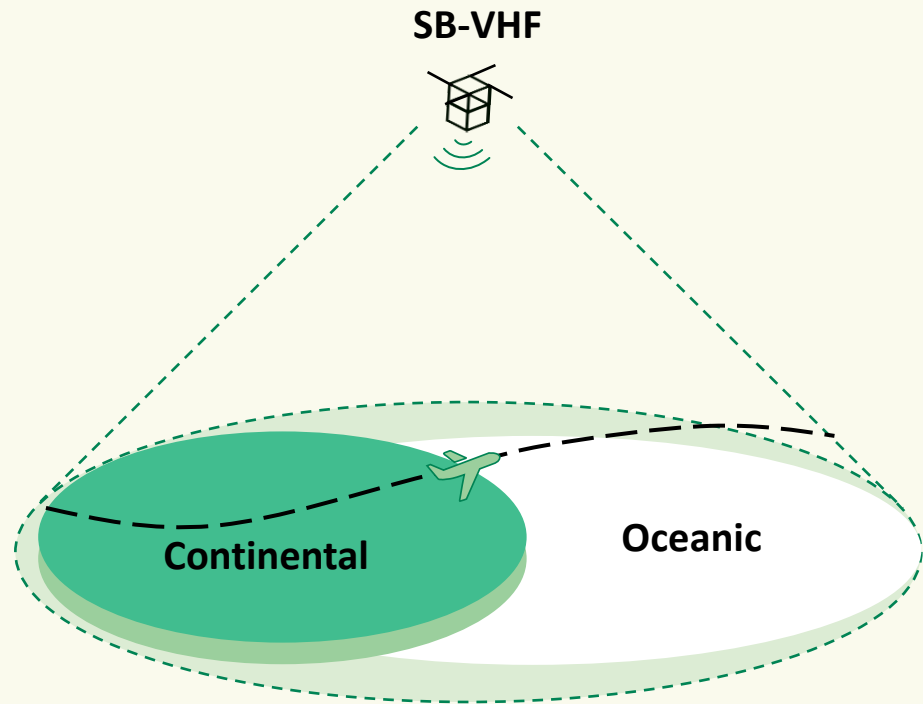


SURVEILLANCE



ADS-B

SB-VHF CONCEPT IS A GAME CHANGER THAT WILL BRIDGE THE GAP BETWEEN OCEANIC AND CONTINENTAL ATM SERVICES...



INCREASING CAPACITY

ERADICATING PROCEDURAL ROUTES

IMPROVING OPERATIONAL EFFICIENCY

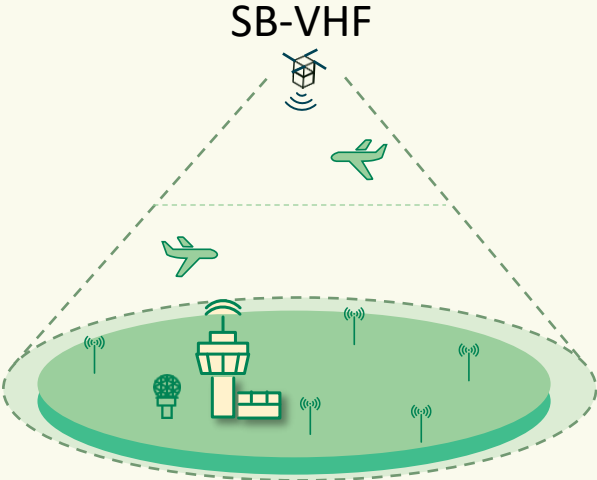
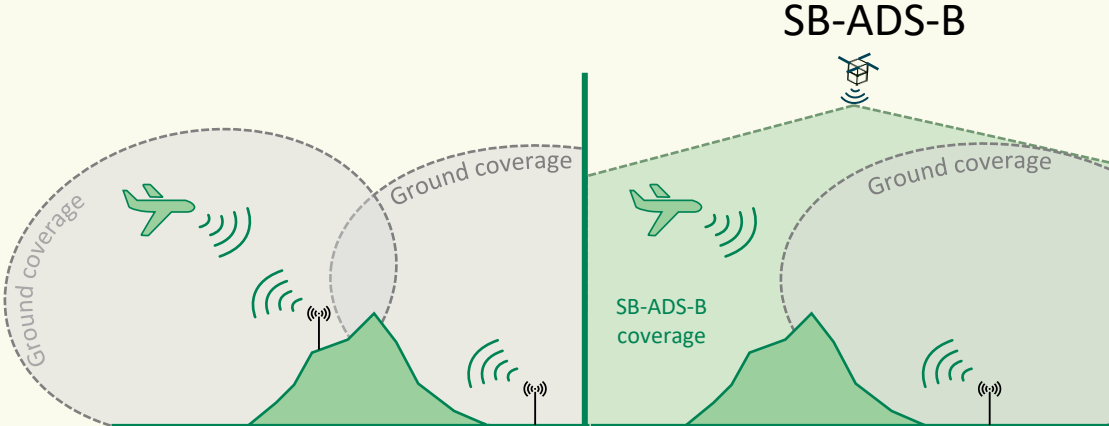
IMPROVING PREDICTABILITY AND REDUCING DELAYS

Overall, SB-VHF will enable a **unified service quality** in the entire airspace, allowing the ANSP charge the same unit rates to airlines for every region of the airspace

PROVIDE FULL COVERAGE OF COM AND SUR FROM SPACE TO GROUND LEVEL

OPTIMISE YOUR GROUND INFRASTRUCTURE

Satellite-based ADS-B can reduce the amount of ground ADS-B & SSR infrastructure required, especially if the ANSP has defined duplicity plans (i.e. double-triple coverage) or duplicities caused by terrain orography



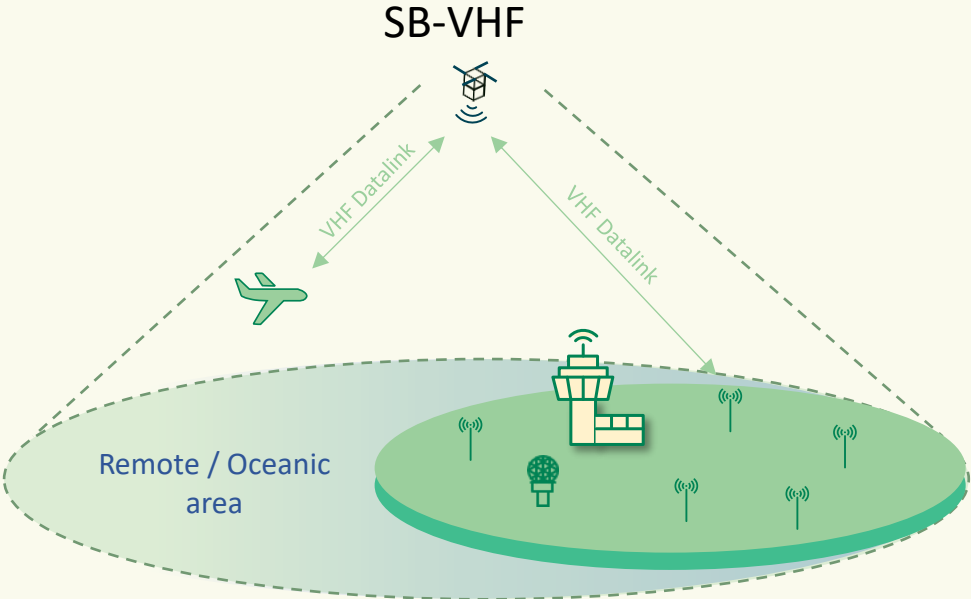
INCREASE YOUR RESILIENCE

Adding a new layer of infrastructure allow you to utilise SB-VHF infrastructure as a contingency measure in case of high demand or technical difficulties, increasing the resilience of your network

ENABLE DATALINK TO ALL AIRCRAFT ACROSS YOUR AIRSPACE AND REDUCE THE WORKLOAD OF YOUR CONTROLLERS

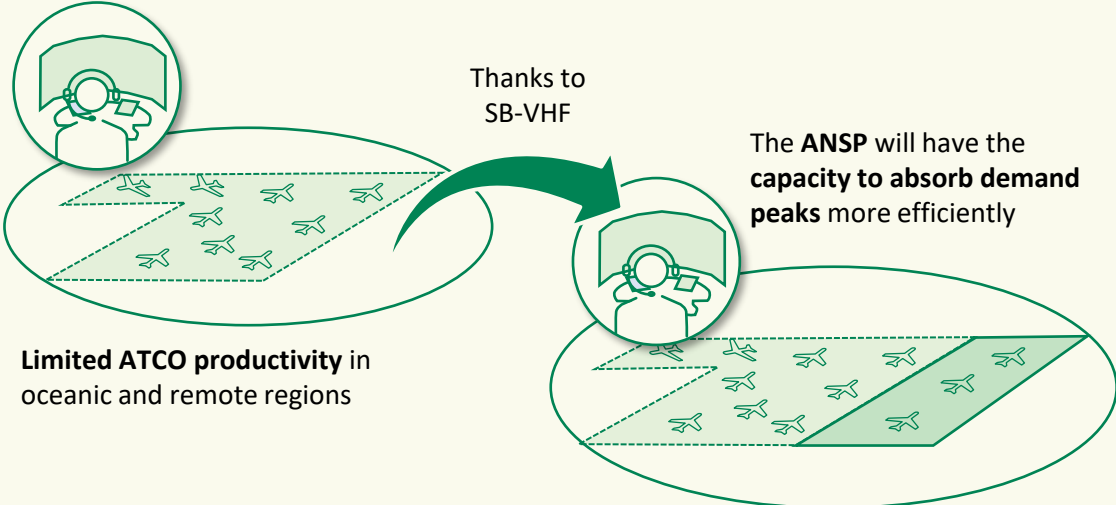
INCREASE CPDLC AVAILABILITY: VHF DATALINK

SB-VHF will **increase the availability of CPDLC** usage for all aircraft, reducing the amount of voice communications (which represents 30-50% of ATCO workload), therefore **reducing ATCO workload**.



INCREASE YOUR FLEXIBILITY TO MANAGE DEMAND PEAKS

The reduction of the ATCO workload will entail an **increment on the ATCO productivity**, which will allow the ANSP enhance the capacity to manage demand peaks



ENABLE OPTIMAL ROUTES FOR YOUR USERS THANKS TO SWIFT VOICE AND DATA COMMUNICATIONS

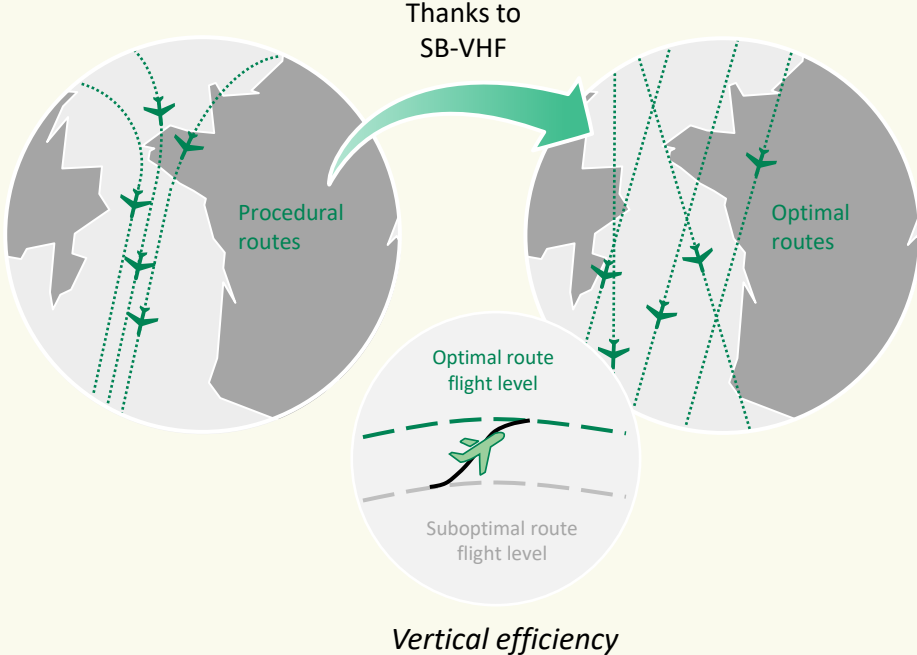
MOVE FROM PROCEDURAL OPERATIONS TO USER PREFERRED ROUTES

User Preferred Routes (UPR) or free route airspace

Wind optimal routes

Seamless operations in Oceanic and Continental

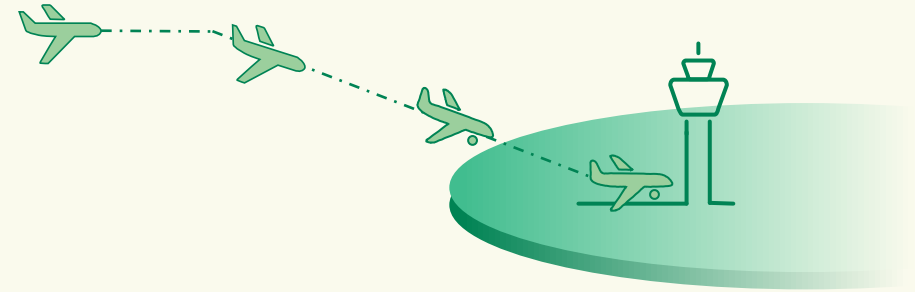
Tactical control, instead of procedural control



IMPROVE YOUR PREDICTABILITY AND REDUCE DELAYS

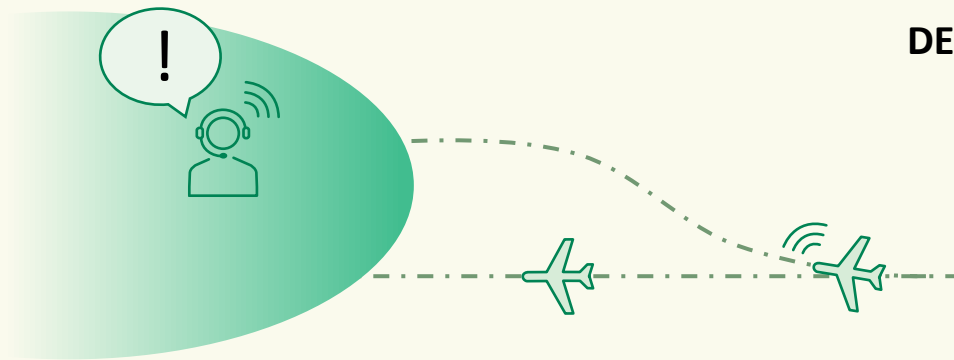
ENHANCED ATC COM & SUR SERVICES WILL INCREASE PREDICTABILITY LEVELS

ATCOs will be able to track aircrafts with more **frequency** and **precision**, therefore reducing **uncertainty** in the flight duration and **variability** between predicted and actual times. This will allow **airports** to optimize the management of arrivals and increase airport throughput.



DELAYS WILL ALSO BE REDUCED THANKS TO A BETTER COM & SUR SERVICE

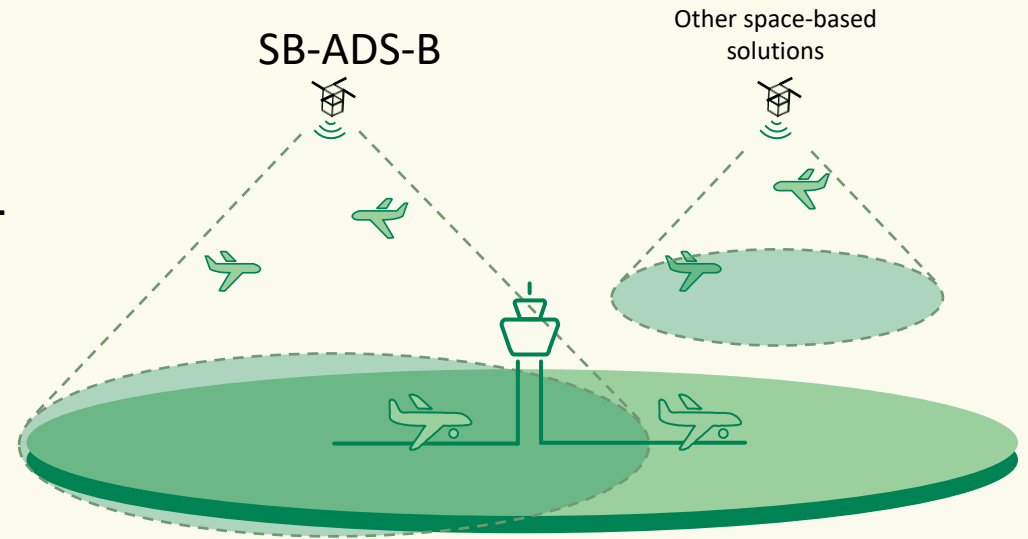
68% of en-route ATFM delays are caused by ATC capacity and ATC staffing. SB-VHF can directly contribute to reducing these delays by allowing more flexible routes (hence, **increasing capacity**) and reducing **ATCO workload** (therefore increasing ATCO productivity).



ENRICH YOUR SITUATIONAL AWARENESS OF SURROUNDING AIRSPACE LOAD, IMPROVE YOUR FORECAST AND PLANNING

OUTPACING COMPETITORS WITH ADS-B COVERAGE UP TO GROUND LEVEL

Space-based ADS-B service is able to offer a high refresh rate and quality signal up to ground level, allowing airlines to get aircraft data even in airports of during ascend/descend operations



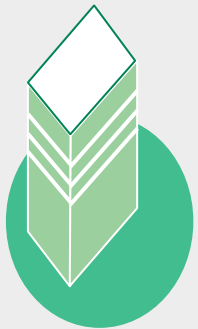
ENSURING THE VERIFICATION OF THE SIGNAL THANKS TO MULTILATERATION

Dedicates solutions for ATM shines from other ADS-B space-based solutions as is able to triangulate the position of aircraft ensuring that no fraudulent flights are introduced into the system

HAVE AT YOUR DISPOSAL A CERTIFIED SERVICE THAT WILL GUARANTEE A QUALITY STANDARD

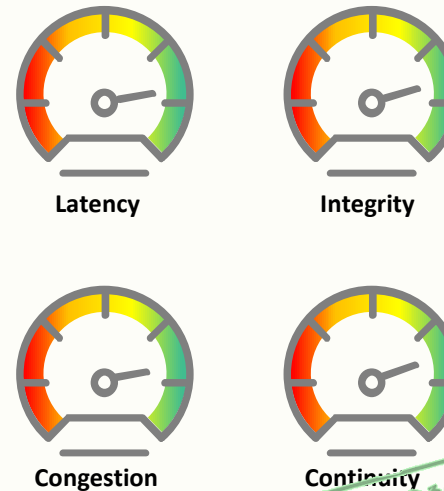
SB-VHF ENVISAGES IN ITS VALUE CHAIN A UNIT SPECIALISED IN MONITORING THE QUALITY OF THE SERVICE

Service Provision Unit (SPU)



Ground segment actor that analyses and ensures the quality of the service. It performs constant checks of the signal and has the responsibility to ensure the service can be used by final users according to regulation. Service Provision Unit also helps in the certification process of the services

Signal monitoring



Permanent consciousness of **availability and quality** of the service provided

Forget about the numerous pilot **attempts to communicate** with ATC

KEEPING AND EVEN INCREASING SAFETY FOR ALL YOUR AIRSPACE USERS

SB-VHF will enable...

Real time tracking

**Increased situational awareness and
broadcast comm. service**

**Ensured communications
(redundancy)**

Certified service

Global coverage

Alerting service

Improved response time



**THIS FEATURES WILL REDUCE
RISKS, INCREASING SAFETY
LEVELS**

SB-VHF CONCEPT IS THE OPTIMAL SOLUTION FOR ANY ANSP

SOLUTIONS AND ADVANTAGES FOR ANSPs

1



DEPLOY/RENEW GROUND
INFRASTRUCTURE

SB-VHF would directly reduce the costs related with deploying/renewing ground **COM and SUR infrastructure**

2



ENHANCE ATC SERVICE QUALITY

SB-VHF would reduce **ATCOs workload**, therefore increasing their productivity and overall ATS service performance

3



ENABLE BETTER
OPERATIONAL PROCEDURES

SB-VHF would allow the implementation of **new optimal procedures** allowing airlines to fly more flexible routes

4

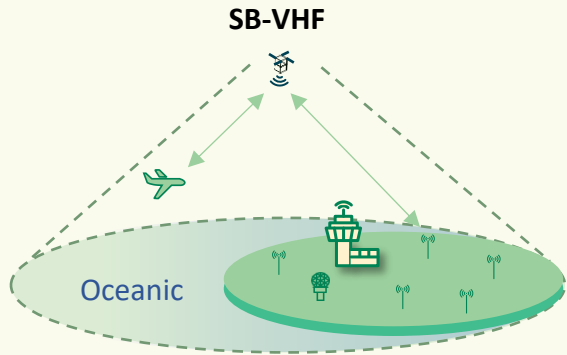


EXPAND IN OCEANIC/REMOTE
REGIONS

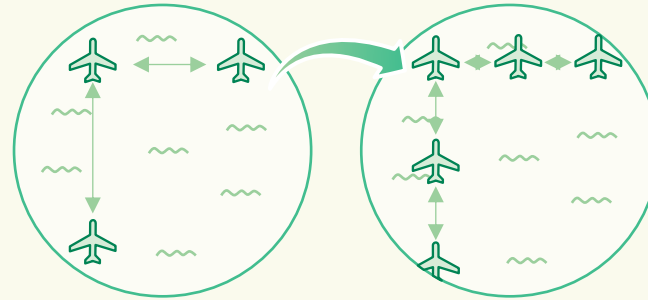
SB-VHF would increase the **capacity** of this uncovered areas by enhancing ATS services, hence reducing separation minima

BENEFITS AT A GLANCE

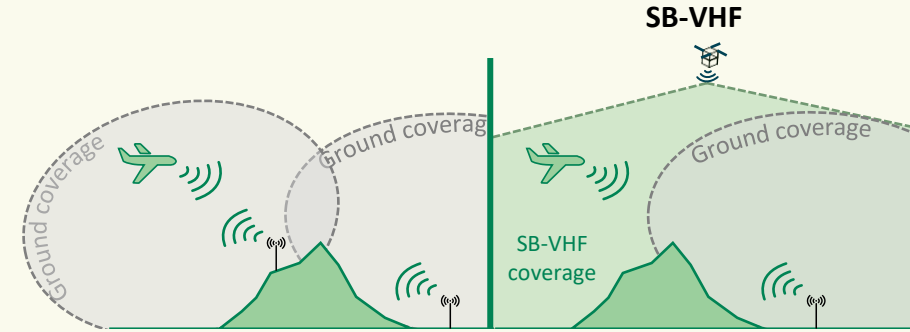
BENEFITS OF THE SATELLITE-BASED SOLUTION



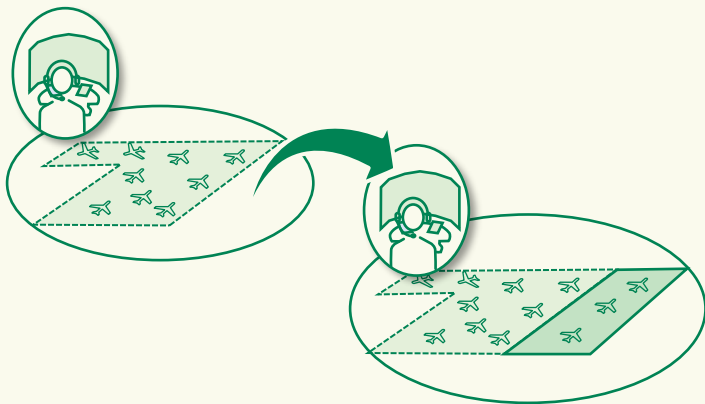
Seamless airspace



Separation Reduction



Optimization of Ground Infrastructures



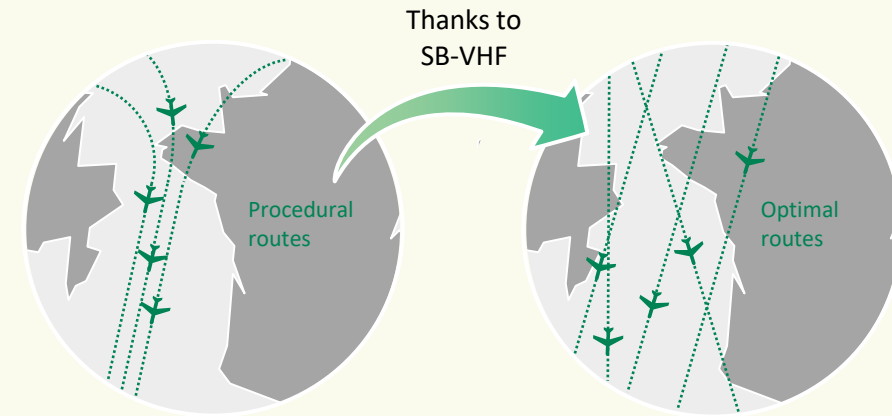
Productivity



Vertical Efficiency



Eco friendly

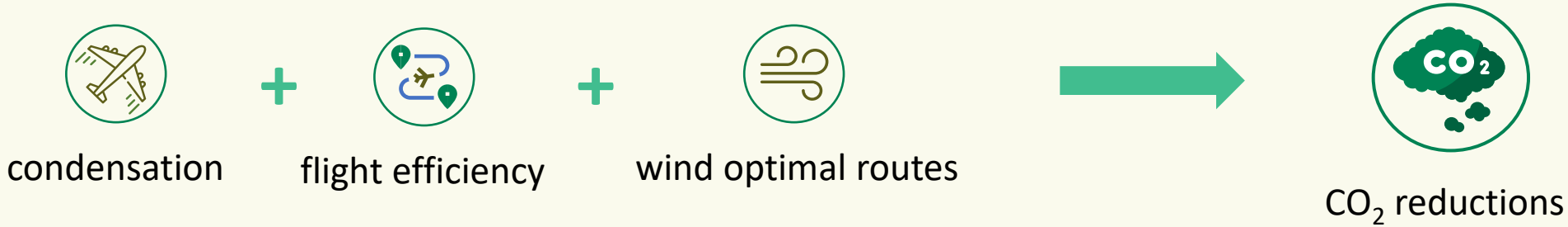


Horizontal Efficiency

ENVIRONMENTAL BENEFITS

REDUCED CO₂ FOOTPRINT

The model estimates a reduction of ~13 Mt CO₂ emissions in the first 3 years of operation with a market penetration of 10% accounting for the main CO₂ emitters



SB-VHF&ADS-B NEW SERVICES

SPACE BASED INFRASTRUCTURE CAN PROVIDE THE FOLLOWING SERVICES AND IMPROVEMENTS

- **ADS-B advantages compared to existing solutions**
 - Global coverage
 - Coverage up to ground level
 - With a maximum latency level of 1,5 seconds
 - Use of multilateration techniques to validate integrity, triple coverage
- **SB-VHF global voice and data coverage**
 - VHF voice and data is a new service on remote and oceanic areas
 - Space-Based infrastructure may avoid the need to deploy certain ground stations in specific areas
- **Certified Service from Satellite**
 - QoS levels to allow new ATC procedures and new routes in remote and Oceanic areas
- **Space-Based Services proposal:**
 - Global coverage including oceanic areas
 - No avionics software upgrades required
 - Contingency and increased redundancy
 - Certified services

ADDED VALUE FOR ANSPs AND AIRLINES

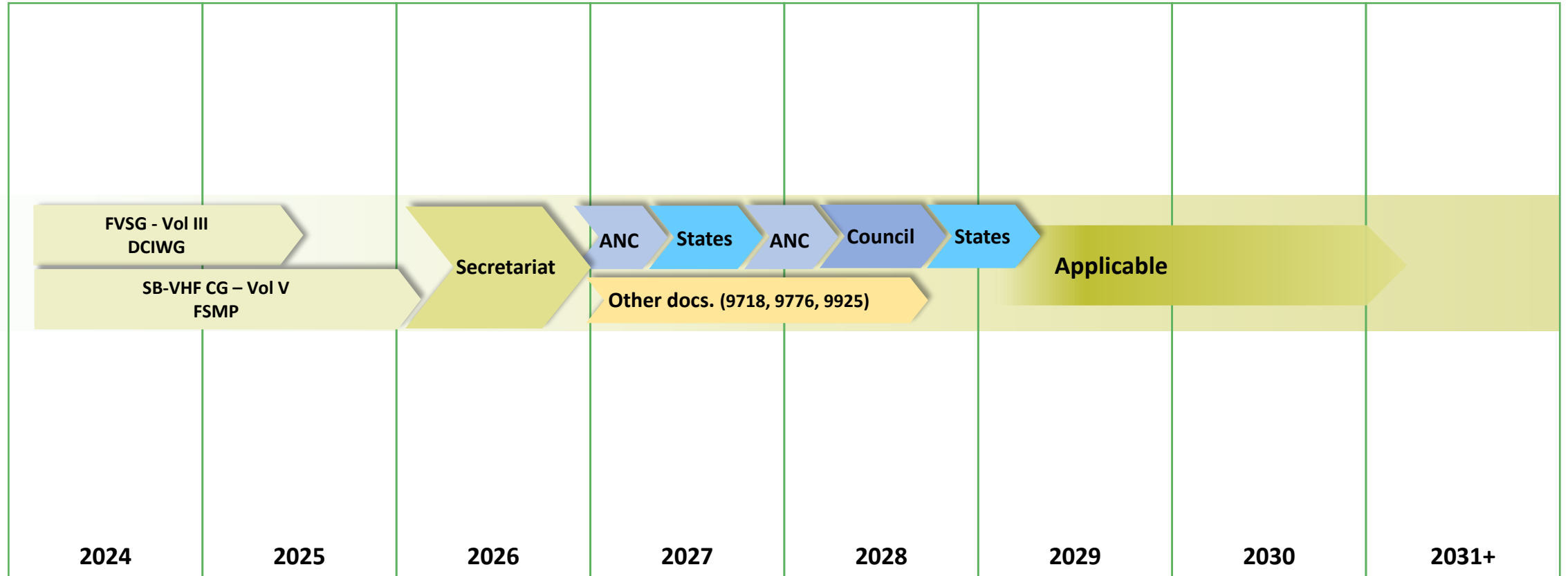
- Improving performance of **ATC communications**
- Allowing the creation of **flexible procedures**
- Optimizing **infrastructure** deployment/renewal
- Increasing **airspace capacity**
- Increasing **resilience** by adding a new infrastructure layer
- Optimizing **ANSP controllers** rostering



- Providing **oceanic coverage** with no additional equipment required
- Allowing aircraft to fly **optimal routes**
 - Reducing **Flight Operating Costs**
 - Reducing **fuel consumption**
 - Reducing **CO2 emissions**
- Reducing **delays** and improving **predictability levels**
- Increasing **safety levels**
- Providing enhanced **AOC service**

TIMELINE

THE ROAD TO SATELLITE-BASED SERVICES

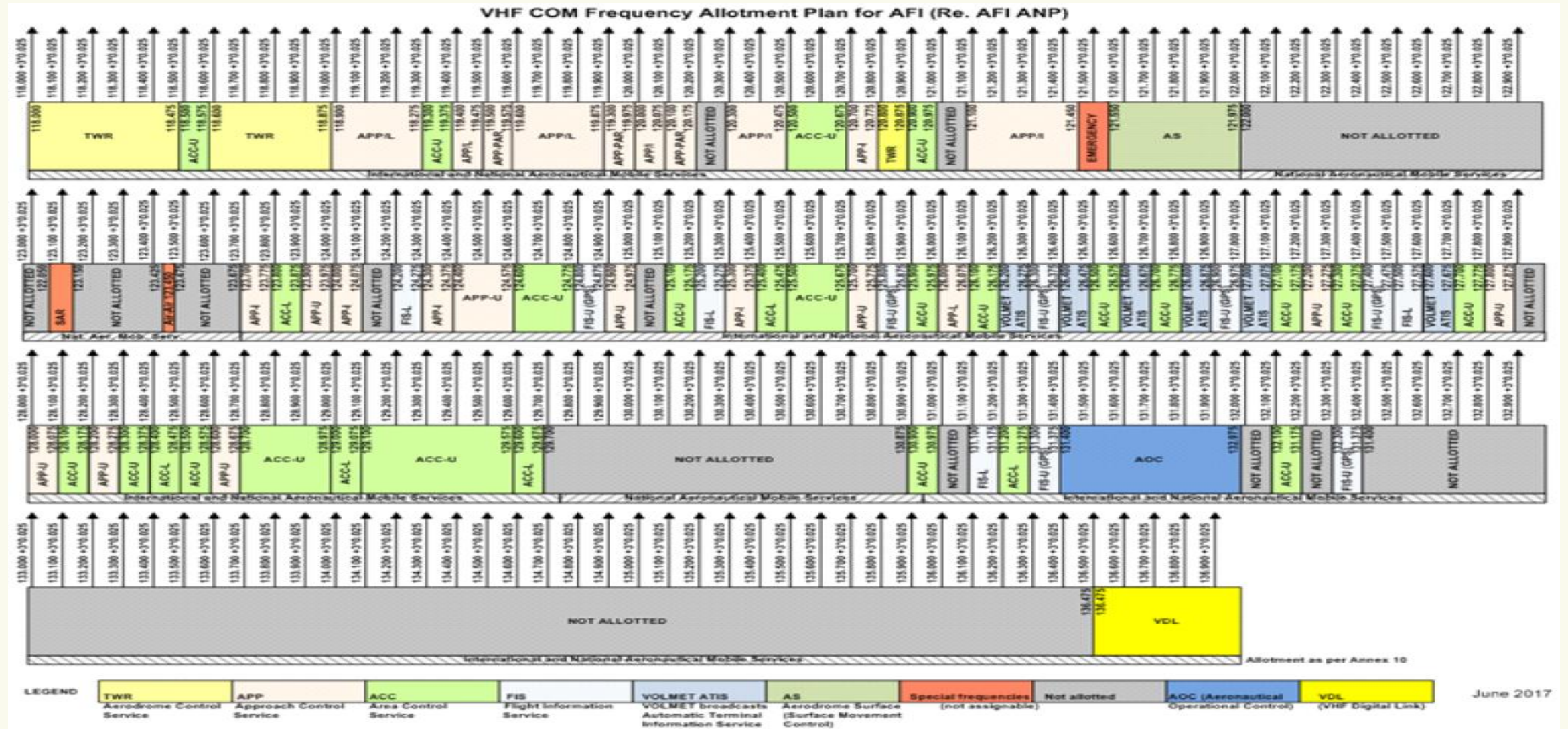




INITIAL ANALYSIS ABOUT THE AFI REGION VHF
FREQUENCY USE

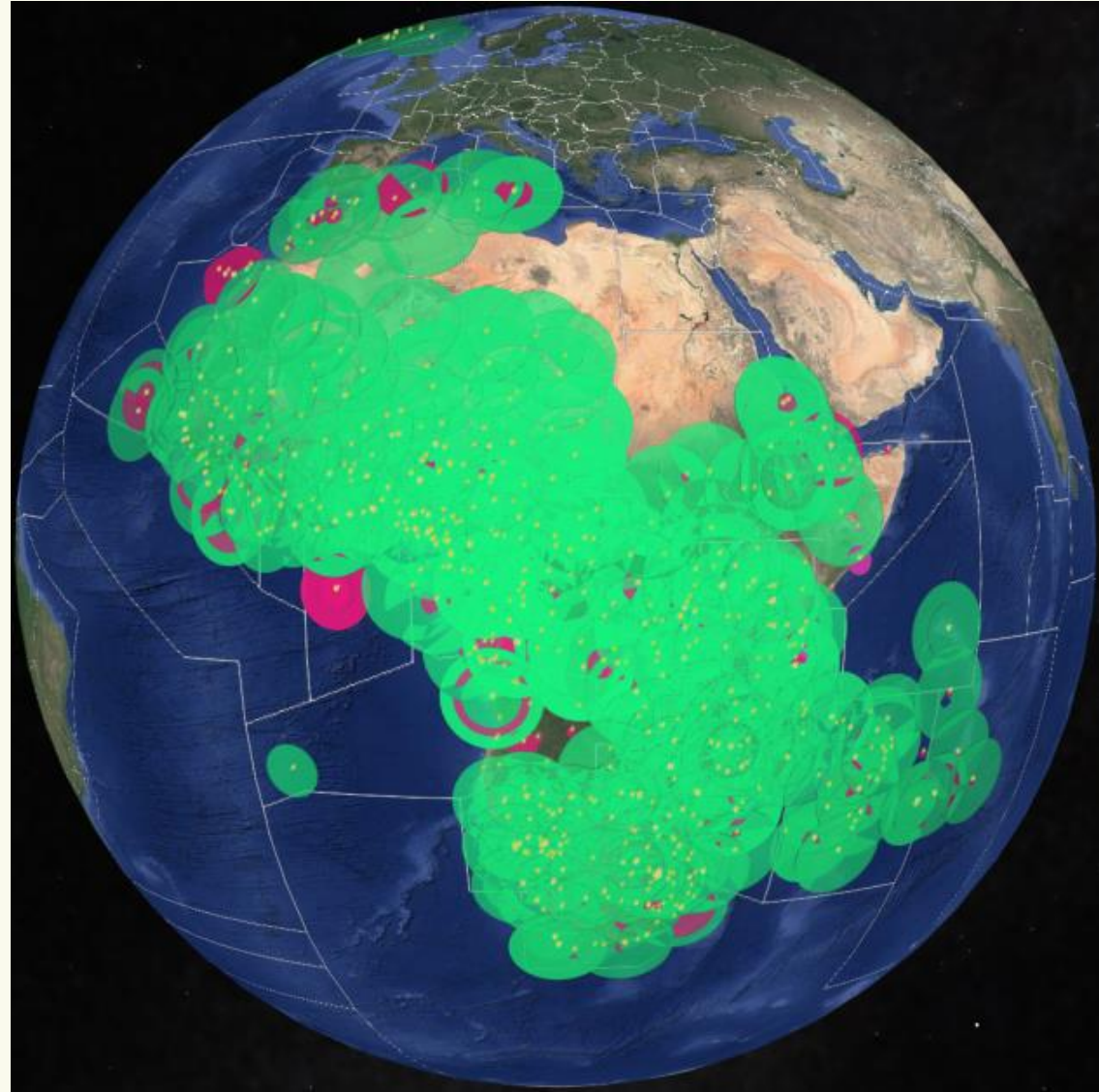
ICAO Doc. 9718 HANDBOOK - Vol II

ICAO AFI Region Allotment



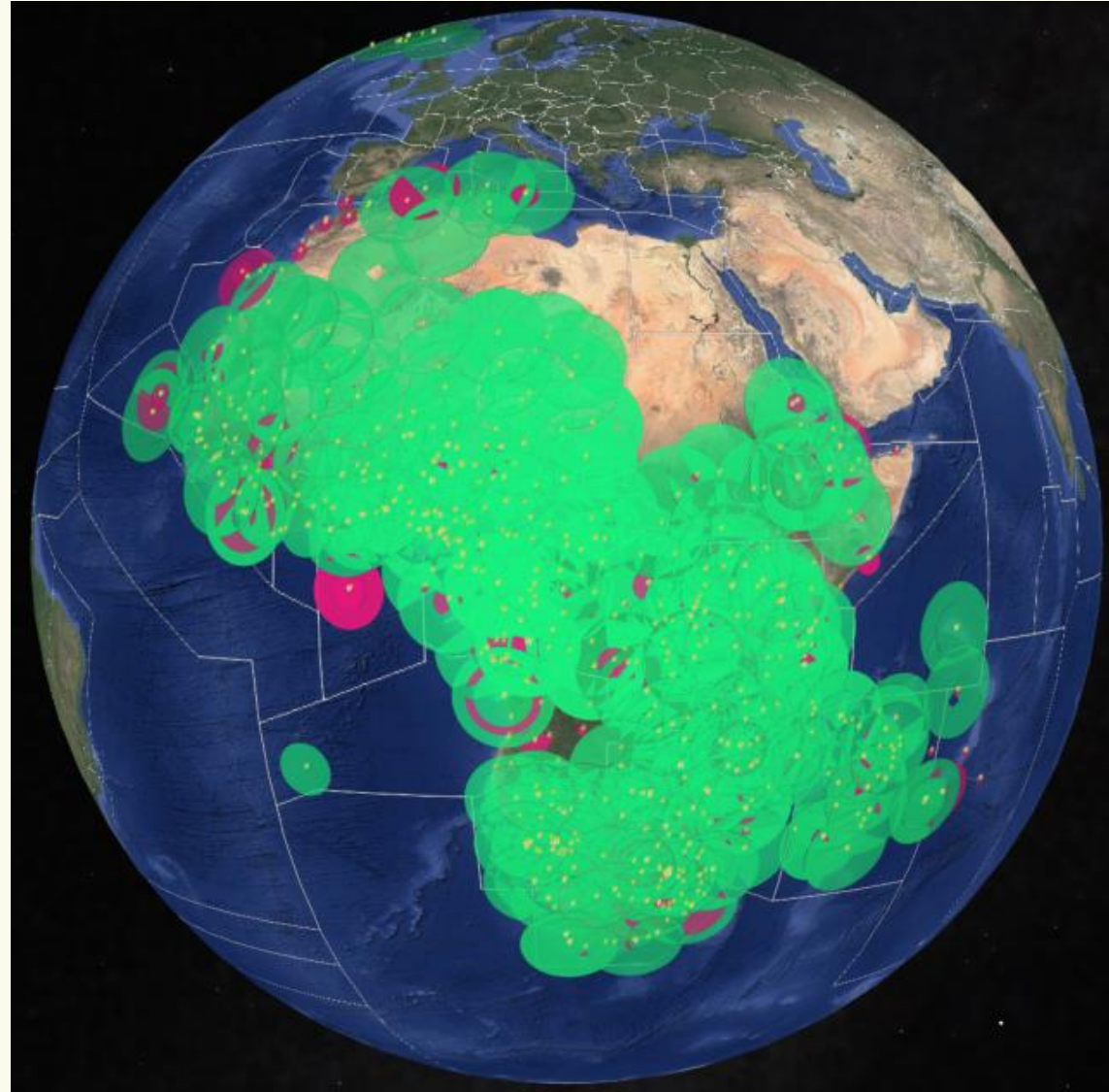
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 117.975-137 MHz (761 CHANNELS)



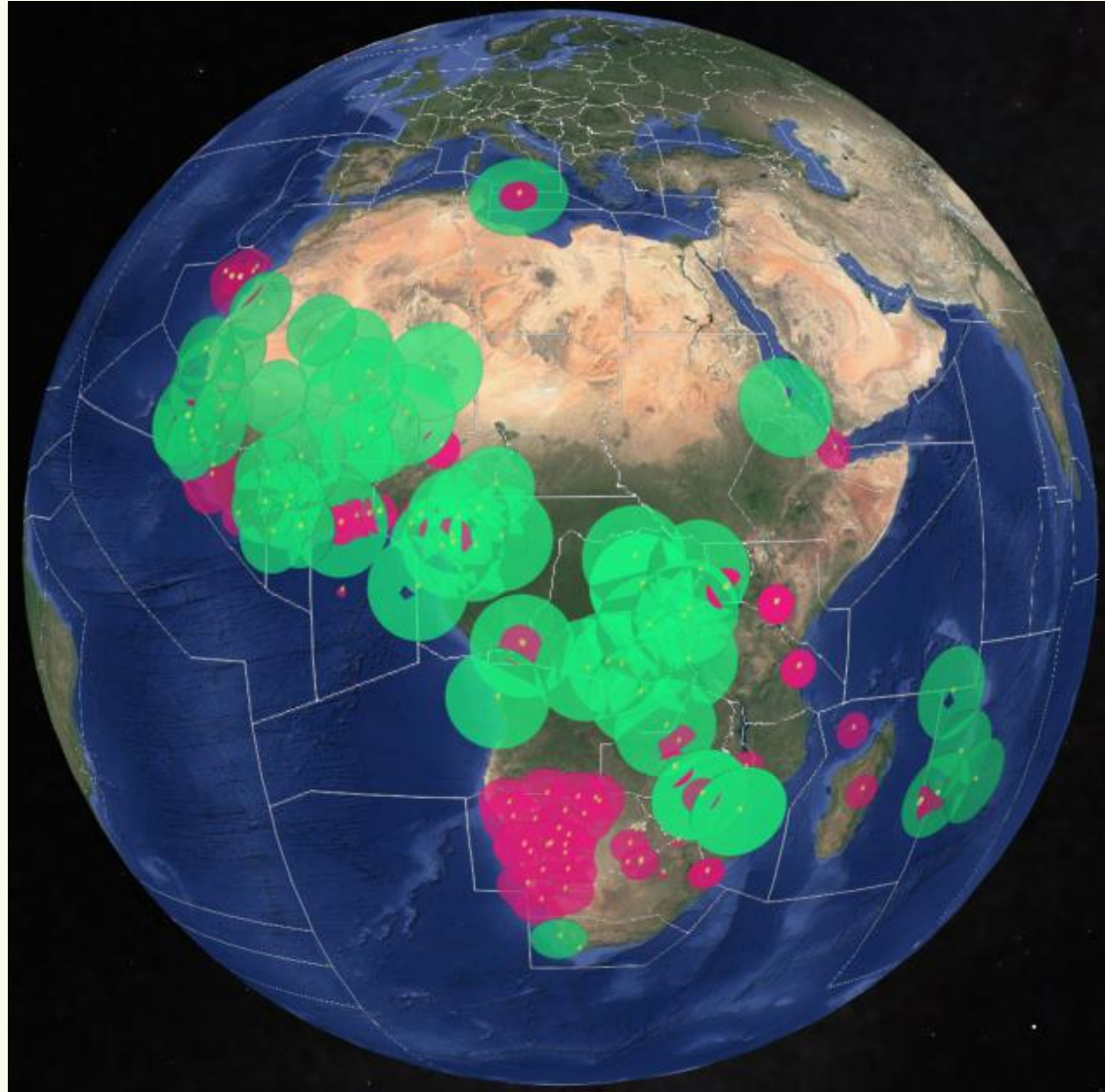
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 117.975-129 MHz (441 CHANNELS)



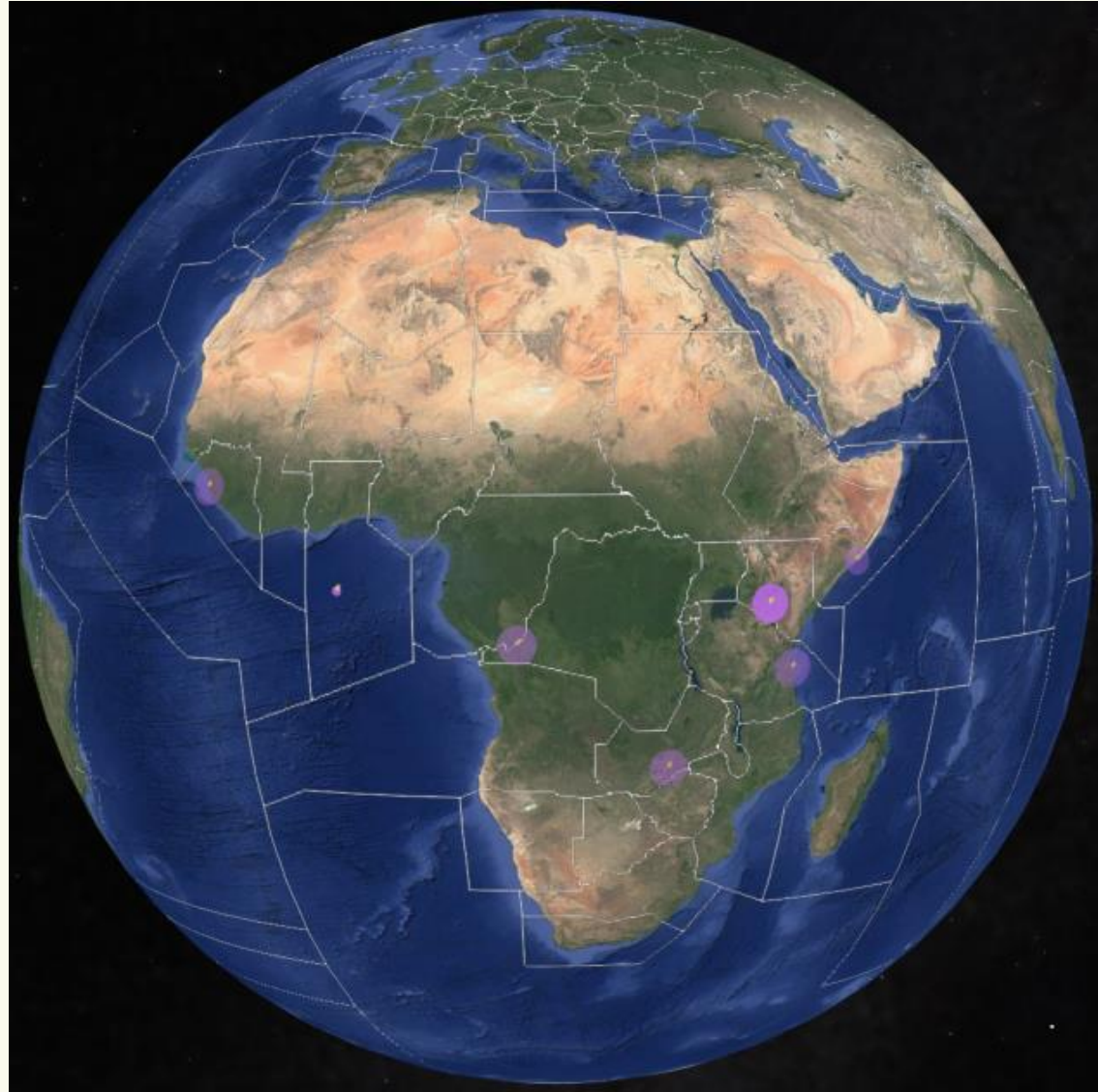
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 129-132 MHz (120 CHANNELS)



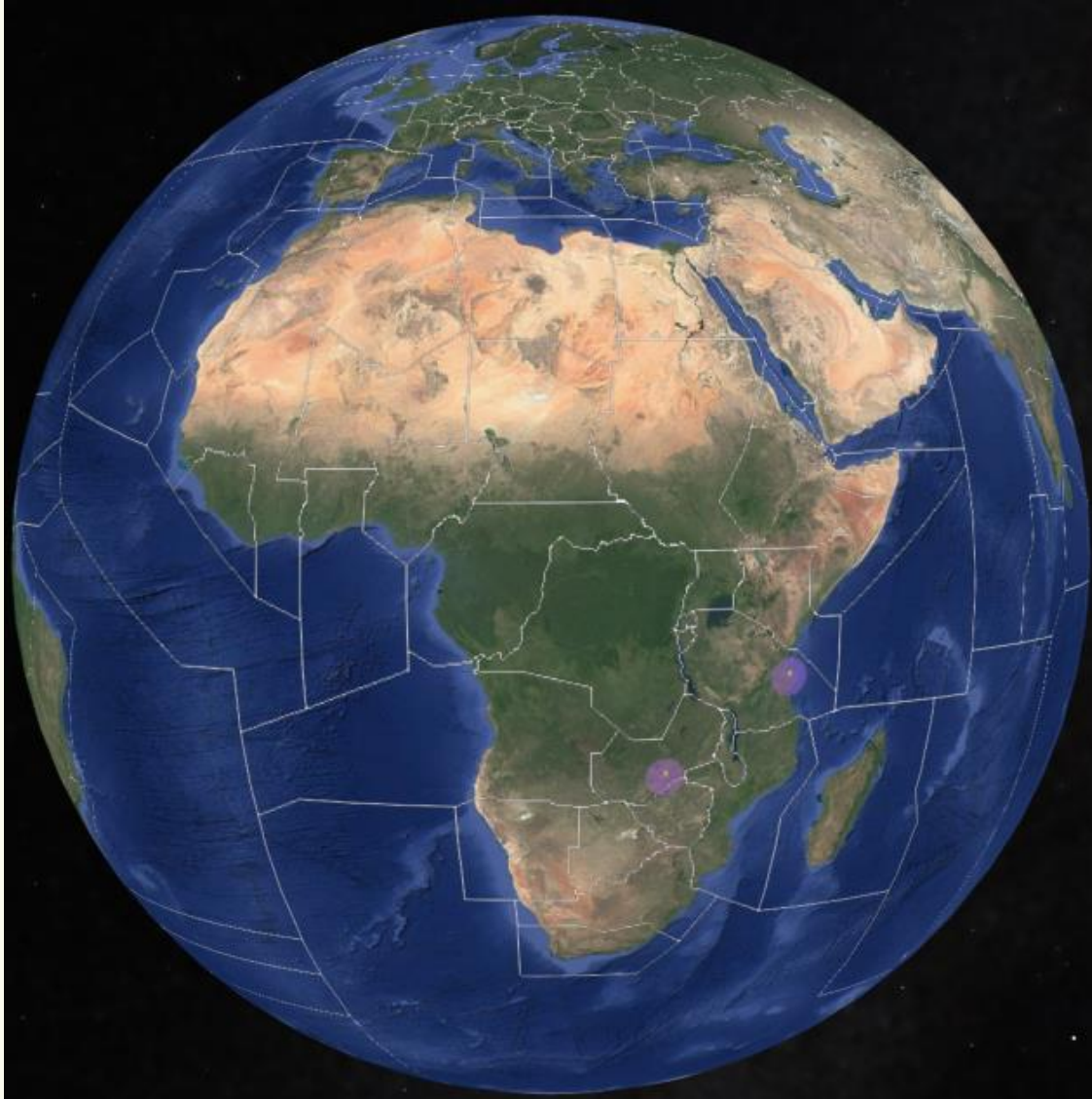
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 132-133 MHz (40 CHANNELS)



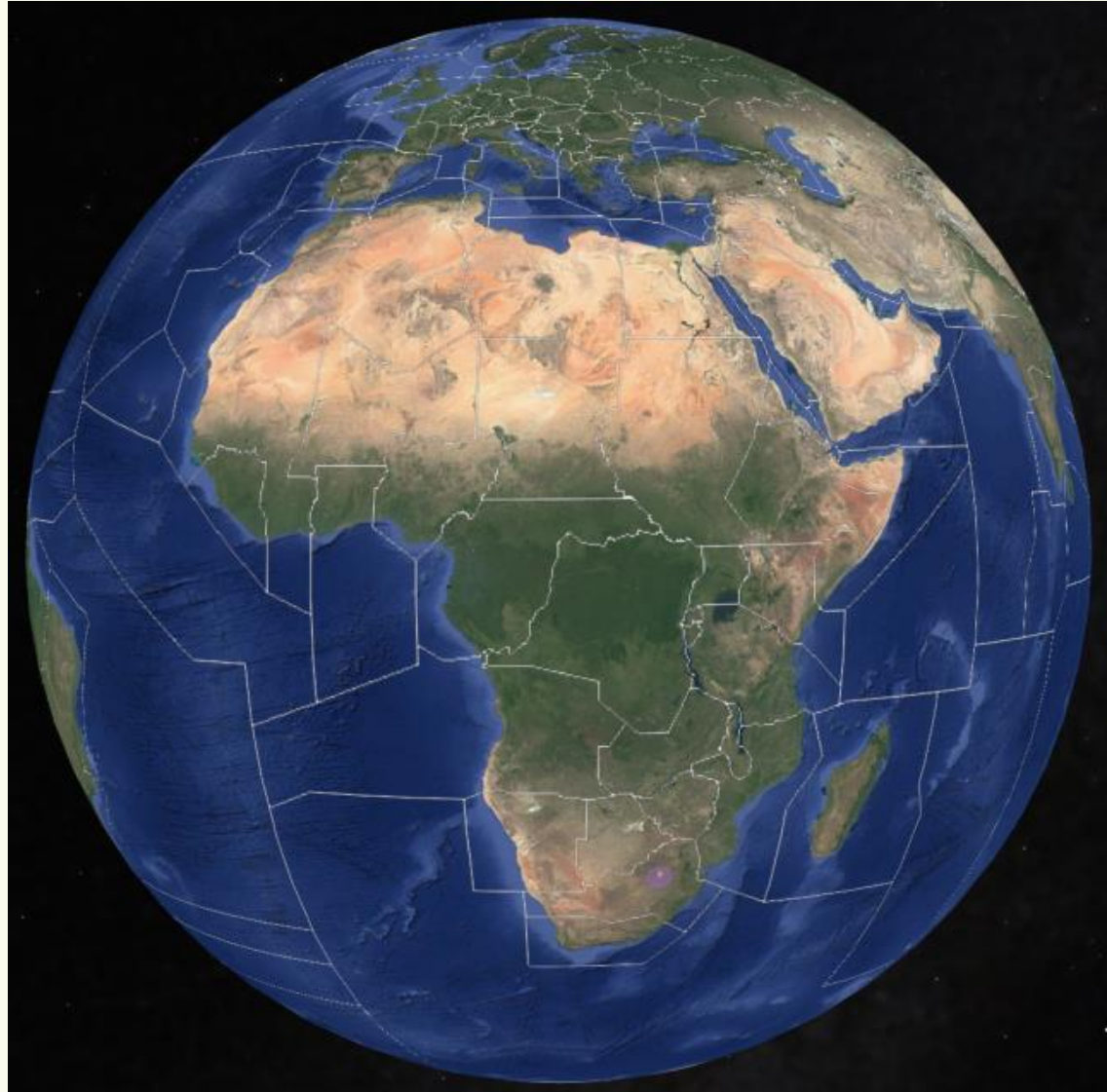
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 133-134 MHz (40 CHANNELS)



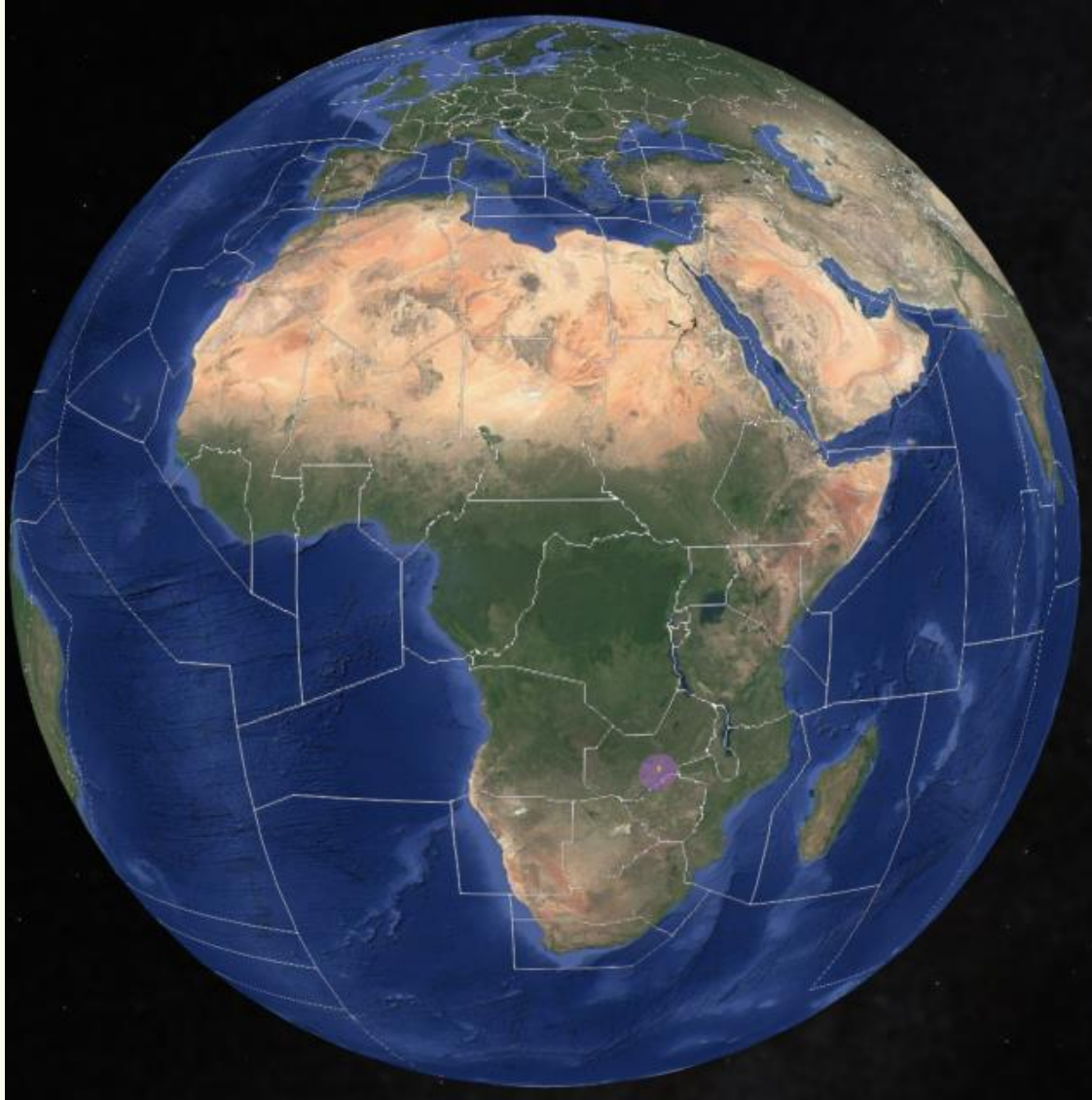
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 134-135 MHz (40 CHANNELS)



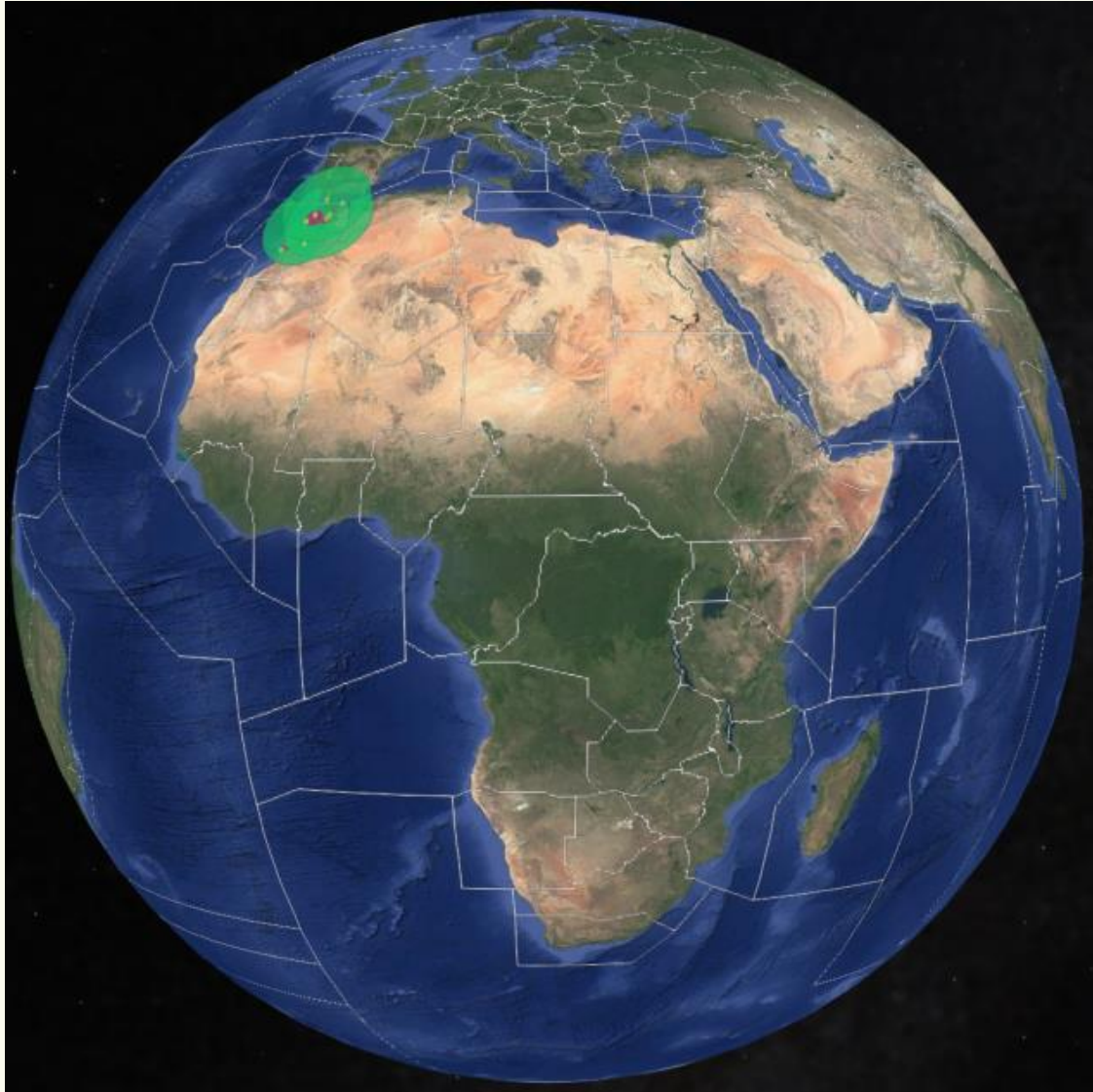
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 135-136 MHz (40 CHANNELS)



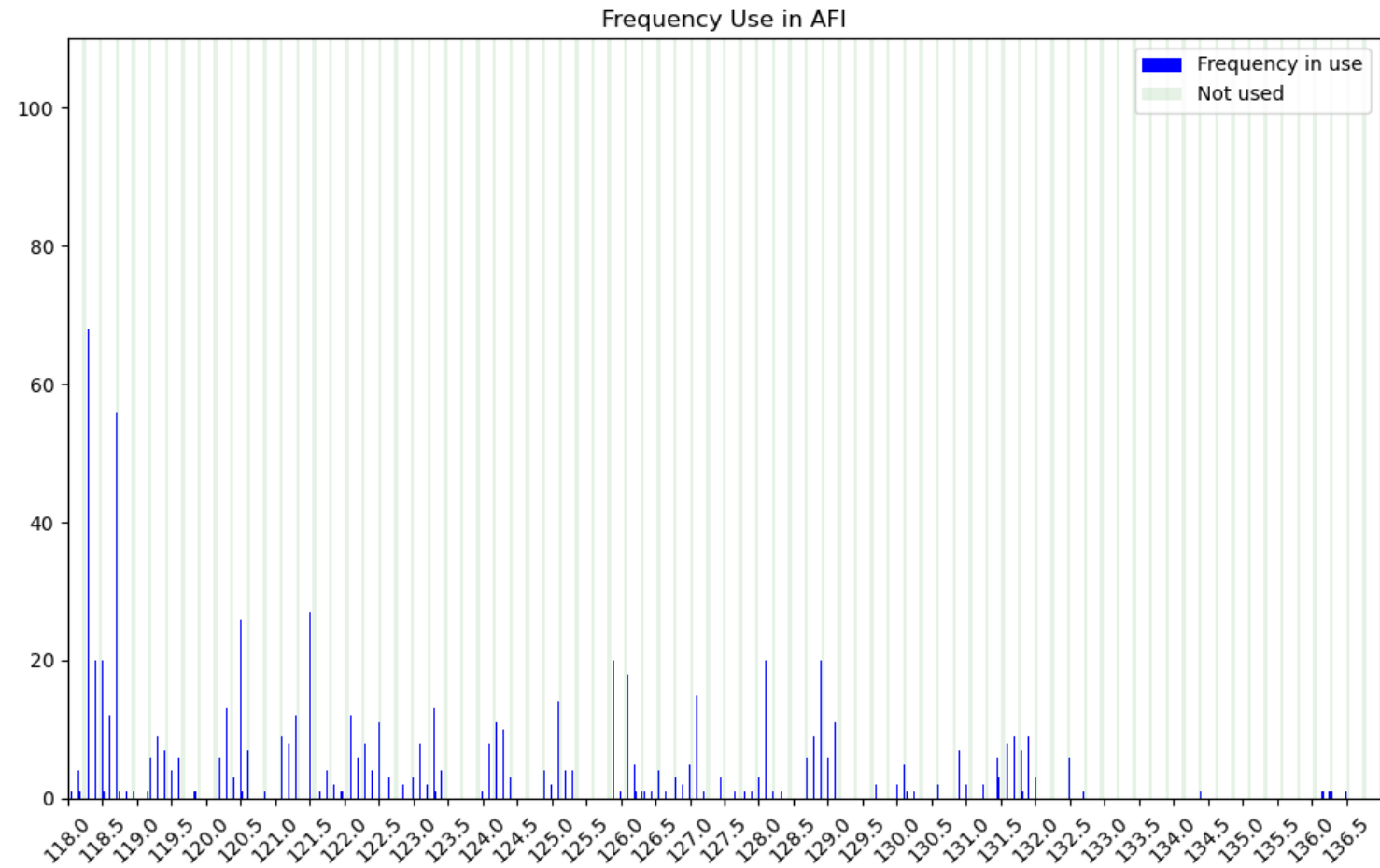
AFI FREQUENCY FINDER DATA BASE IN 3D

ICAO AFI FF 136-137 MHz (40 CHANNELS)



AFI FREQUENCY FINDER DATA BASE STATISTIC

ICAO AFI FF 117.975-137 MHz – Frequencies used / not used



AFI FREQUENCY FINDER DATA BASE STATISTIC

ICAO AFI FF 117.975-137 MHz – Frequency Channel no used

List o Frequency channels not used in ICAO AFI Region

118,075	119,575	120,75	121,875	123,125	124,225	125,25	126,325	127,625	128,675	129,675	130,575	132,075	132,95	133,775	134,55	135,3	136,1
118,225	119,625	120,775	121,925	123,175	124,25	125,275	126,375	127,675	128,725	129,725	130,625	132,125	132,975	133,8	134,575	135,325	136,125
118,275	119,65	120,825	122,025	123,225	124,275	125,325	126,425	127,725	128,75	129,75	130,65	132,15	133,025	133,825	134,6	135,35	136,325
118,375	119,675	120,875	122,075	123,275	124,325	125,35	126,475	127,75	128,775	129,775	130,675	132,175	133,05	133,85	134,625	135,375	136,375
118,425	119,725	120,925	122,125	123,35	124,35	125,375	126,525	127,775	128,825	129,8	130,7	132,225	133,075	133,875	134,65	135,4	136,4
118,475	119,75	120,95	122,15	123,375	124,375	125,425	126,575	127,825	128,85	129,825	130,725	132,25	133,125	133,9	134,675	135,425	136,425
118,625	119,775	120,975	122,175	123,425	124,425	125,45	126,625	127,875	128,875	129,85	130,75	132,275	133,15	133,925	134,7	135,45	136,45
118,675	119,875	121,025	122,275	123,45	124,45	125,475	126,675	127,925	128,925	129,875	130,775	132,325	133,175	133,95	134,725	135,475	136,475
118,725	119,925	121,05	122,325	123,475	124,475	125,525	126,725	127,95	128,95	129,9	130,8	132,35	133,2	133,975	134,75	135,5	136,525
118,775	119,95	121,075	122,35	123,525	124,525	125,55	126,75	127,975	128,975	129,925	130,825	132,375	133,225	134	134,775	135,525	136,55
118,825	119,975	121,125	122,375	123,55	124,55	125,575	126,775	128,025	129,025	129,95	130,875	132,4	133,25	134,025	134,8	135,55	136,575
118,875	120,025	121,15	122,425	123,575	124,625	125,625	126,825	128,05	129,05	129,975	130,925	132,425	133,275	134,05	134,825	135,575	136,6
118,925	120,05	121,175	122,45	123,625	124,65	125,65	126,875	128,075	129,075	130,025	130,95	132,45	133,325	134,075	134,85	135,6	136,625
118,975	120,075	121,225	122,475	123,65	124,675	125,675	126,925	128,125	129,125	130,05	130,975	132,475	133,35	134,1	134,875	135,625	136,65
119,025	120,125	121,25	122,525	123,675	124,725	125,725	126,975	128,15	129,15	130,075	131,025	132,525	133,375	134,125	134,9	135,65	136,675
119,05	120,175	121,275	122,55	123,725	124,75	125,75	127,025	128,175	129,175	130,125	131,05	132,55	133,4	134,15	134,925	135,675	136,7
119,075	120,225	121,325	122,575	123,75	124,775	125,775	127,075	128,225	129,225	130,175	131,075	132,575	133,425	134,175	134,95	135,7	136,725
119,125	120,275	121,35	122,625	123,775	124,825	125,825	127,125	128,25	129,25	130,2	131,125	132,6	133,45	134,2	134,975	135,725	136,75
119,175	120,325	121,375	122,675	123,825	124,85	125,85	127,175	128,275	129,275	130,225	131,15	132,625	133,475	134,225	135	135,75	136,775
119,225	120,35	121,4	122,725	123,85	124,875	125,875	127,225	128,35	129,325	130,275	131,175	132,65	133,5	134,25	135,025	135,775	136,8
119,25	120,375	121,425	122,75	123,875	124,925	125,925	127,25	128,375	129,35	130,3	131,225	132,675	133,525	134,275	135,05	135,8	136,825
119,275	120,425	121,45	122,775	123,925	124,95	125,95	127,275	128,425	129,375	130,325	131,275	132,725	133,55	134,3	135,075	135,825	136,85
119,325	120,45	121,475	122,825	123,95	124,975	125,975	127,325	128,45	129,425	130,35	131,325	132,75	133,575	134,325	135,1	135,85	136,875
119,35	120,475	121,525	122,875	123,975	125,025	126,025	127,35	128,475	129,45	130,375	131,35	132,775	133,6	134,35	135,125	135,875	136,9
119,375	120,55	121,55	122,925	124,025	125,05	126,05	127,375	128,525	129,475	130,425	131,375	132,8	133,625	134,375	135,15	135,9	136,925
119,425	120,575	121,575	122,95	124,05	125,075	126,075	127,425	128,55	129,525	130,45	131,575	132,825	133,65	134,425	135,175	135,925	136,95
119,45	120,625	121,625	122,975	124,075	125,125	126,125	127,475	128,575	129,55	130,475	131,675	132,85	133,675	134,45	135,2	135,95	136,975
119,475	120,65	121,675	123,025	124,125	125,15	126,15	127,525	128,6	129,575	130,5	131,925	132,875	133,7	134,475	135,225	136,025	
119,525	120,675	121,725	123,05	124,15	125,175	126,175	127,55	128,625	129,625	130,525	132,025	132,9	133,725	134,5	135,25	136,05	
119,55	120,725	121,775	123,075	124,175	125,225	126,275	127,575	128,65	129,65	130,55	132,05	132,925	133,75	134,525	135,275	136,075	

537 25 kHz Channels
not used in ICAO CAR
Region !