



ICAO | UNITING AVIATION

CELEBRATING 70 YEARS OF
THE CHICAGO CONVENTION



Workshop on PBN airspace Design

31 May - 04 June 2021





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70



En-route Airspace Design



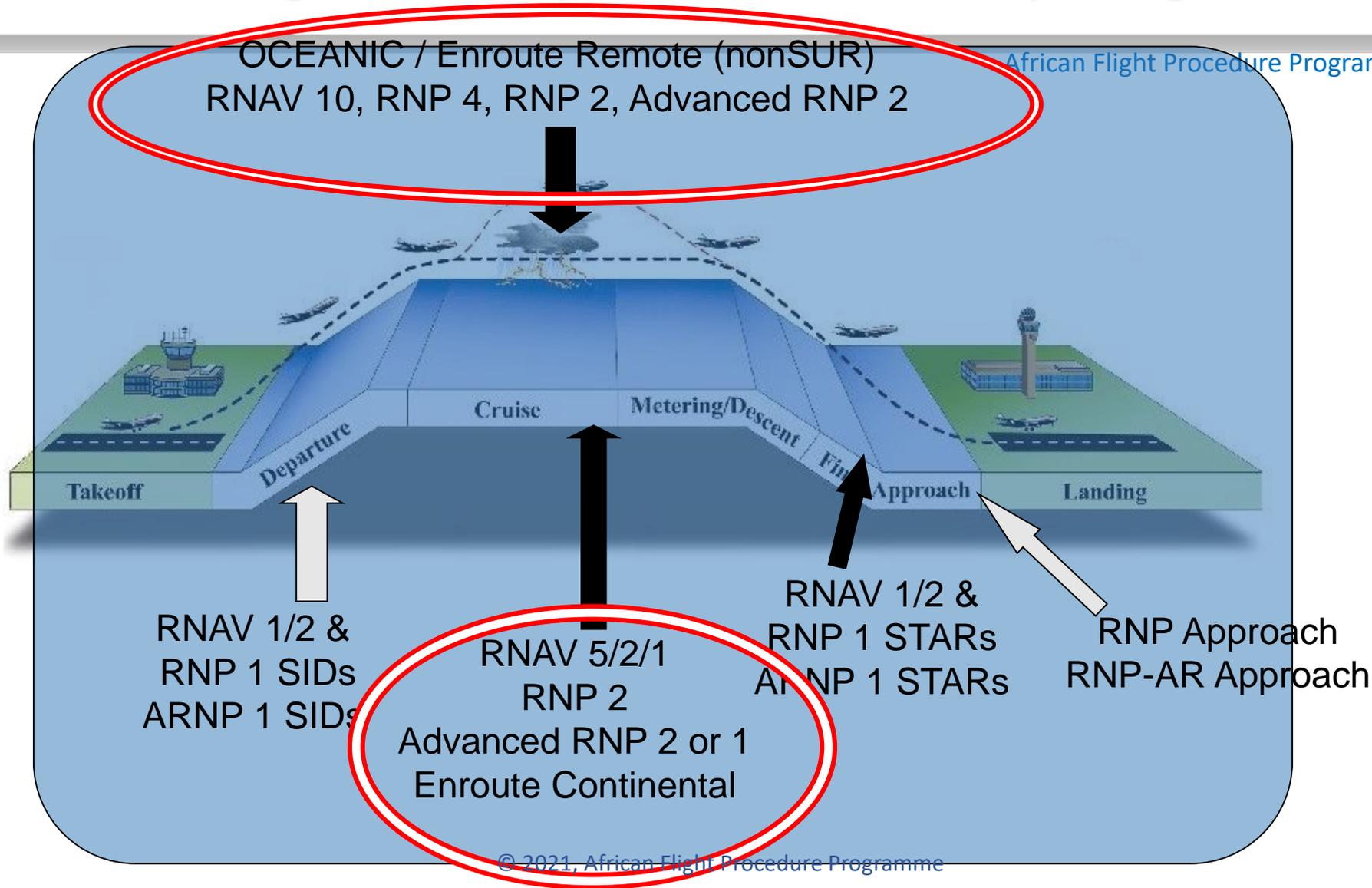


- General on en-route design**
- Route spacing**
- Network architecture**
- Planning of routes**
- Increasing sector capacity**
- Good design practices**



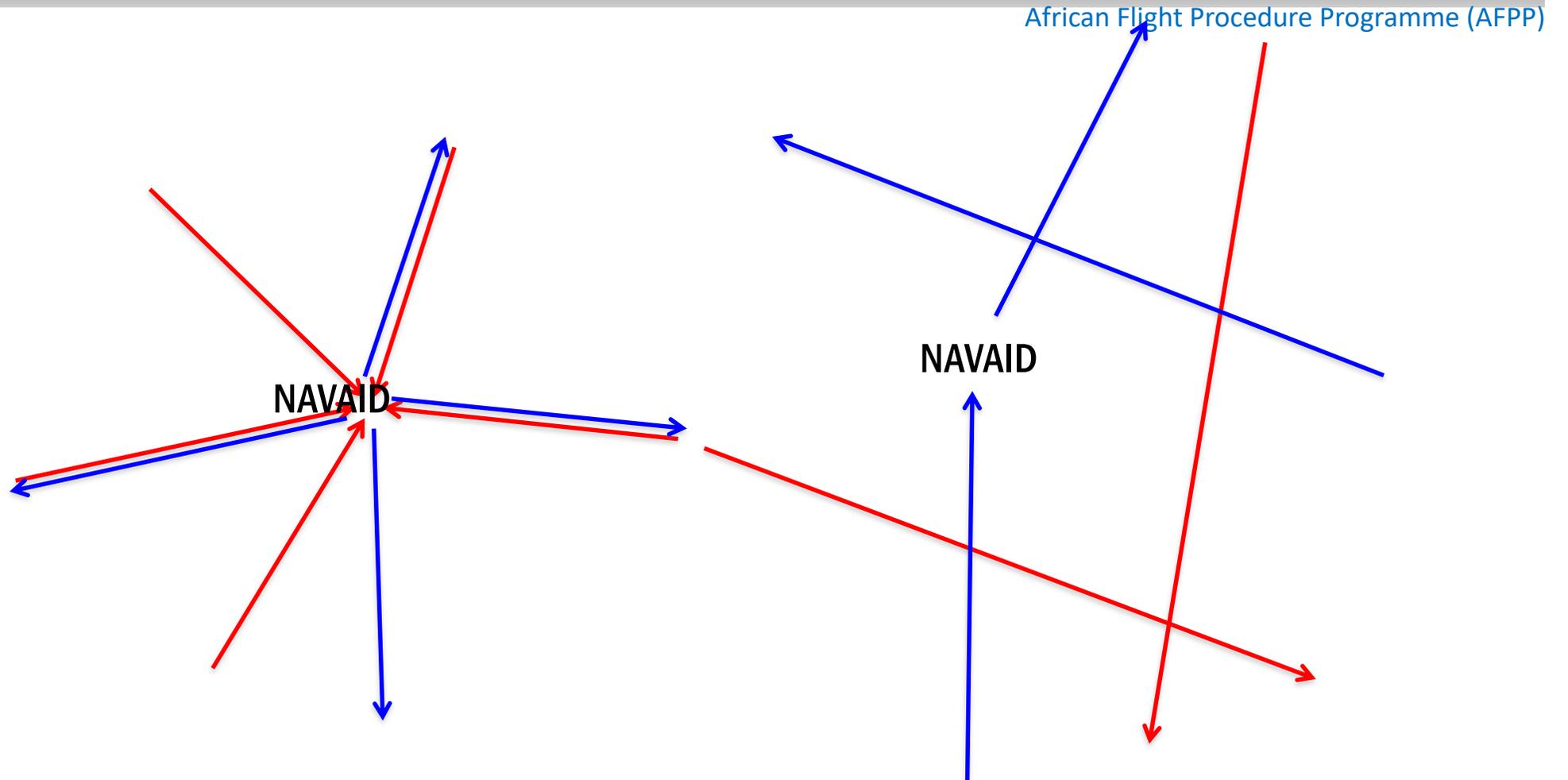
Navigation Specification by Flight Phase

African Flight Procedure Programme (AFPP)





NAVAID Centric vs PBN



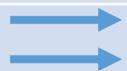


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Route Spacing

African Flight Procedure Programme (AFPP)

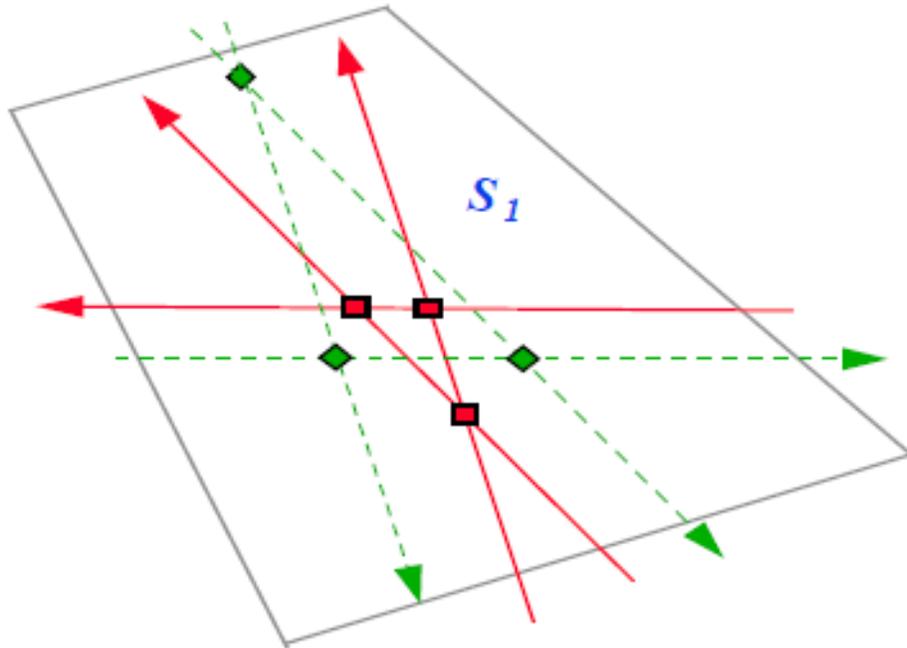
Navigation specification	Separation	
RNAV 10 (RNP 10)	93 km (50 NM)	
RNAV 5	30 NM	Without surveillance
	16.5 NM 	With surveillance
	18 NM 	
RNP 4	42.6 km (23 NM)	
RNP 2	27.8 km (15 NM)	



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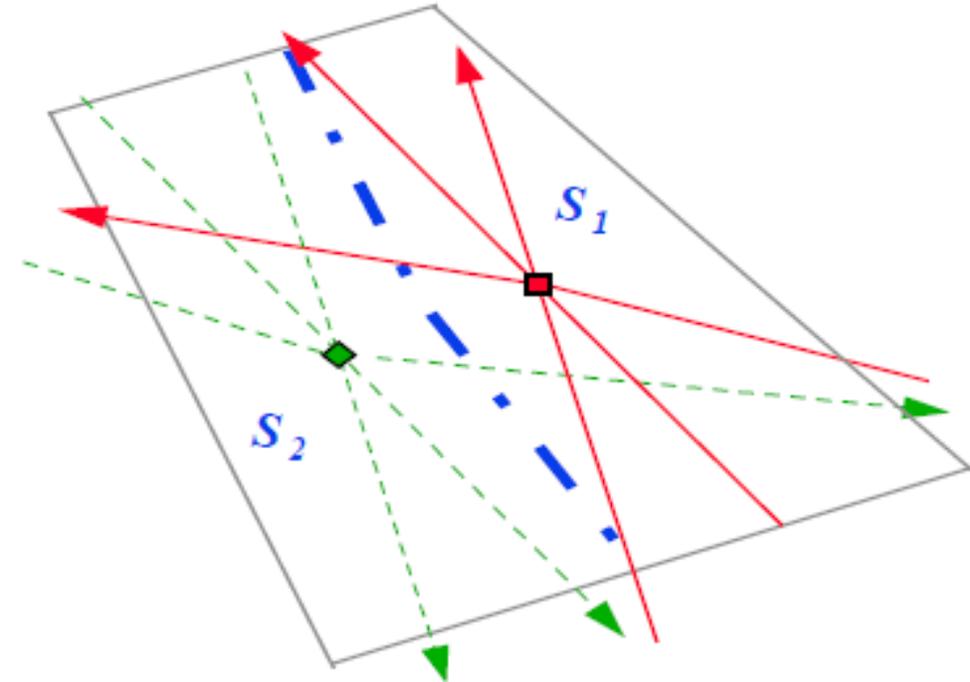
Network architecture

African Flight Procedure Programme (AFPP)



Direct routings :

Square shaped crossing points (even levels) and diamond shaped crossing points (odd levels) are complex and may result in an overloaded sector which cannot be split. (limited maximum capacity)



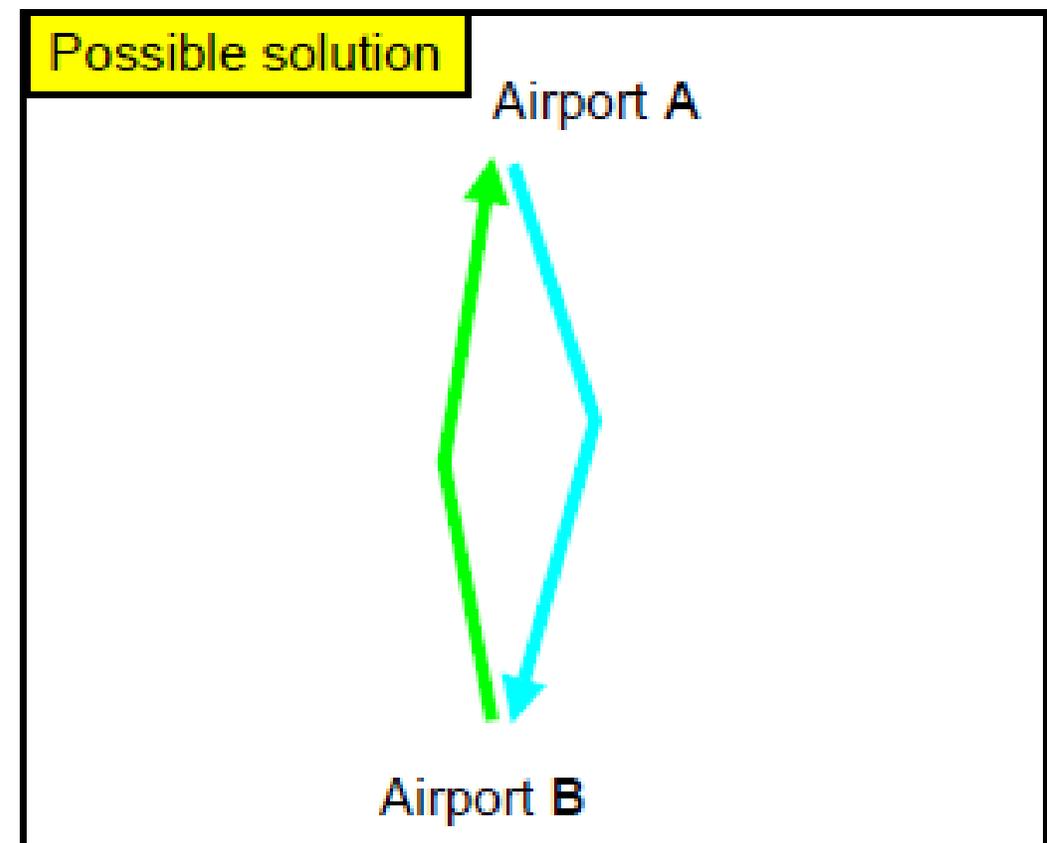
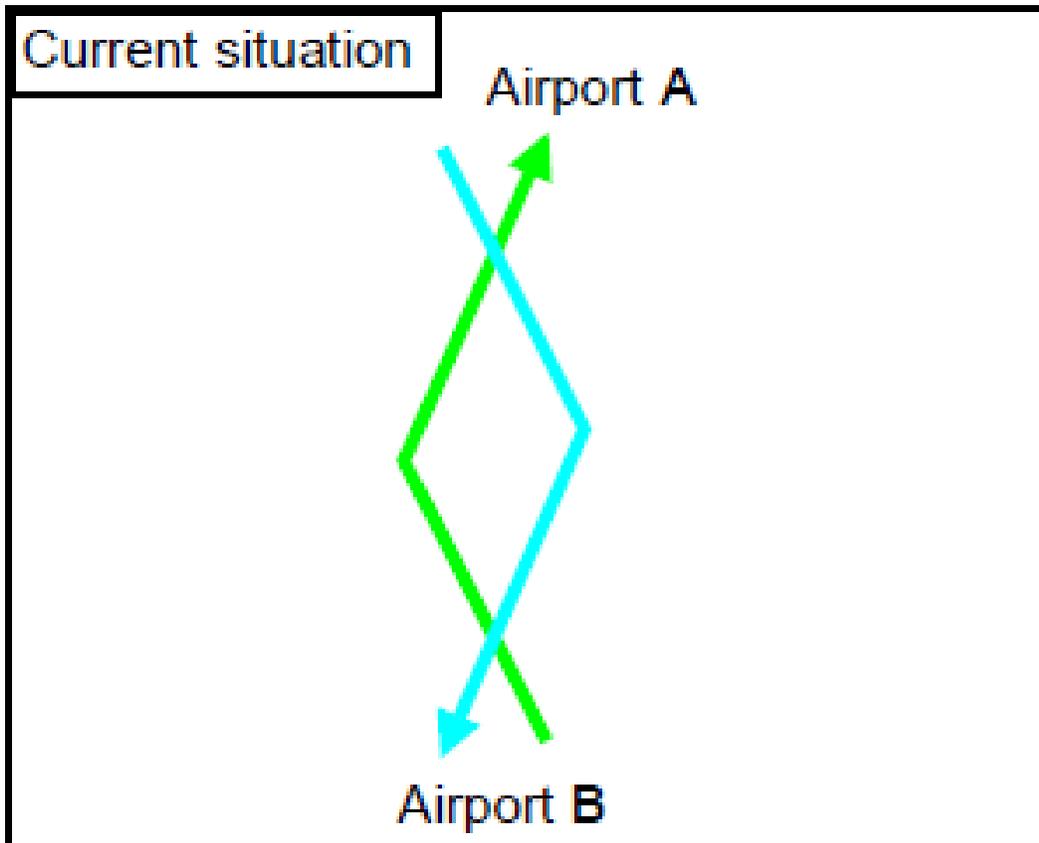
Structured routings with "Roundabouts" :

The resulting location of the actual crossing points makes it possible to split the former sector into two sectors and enhance the maximum capacity.



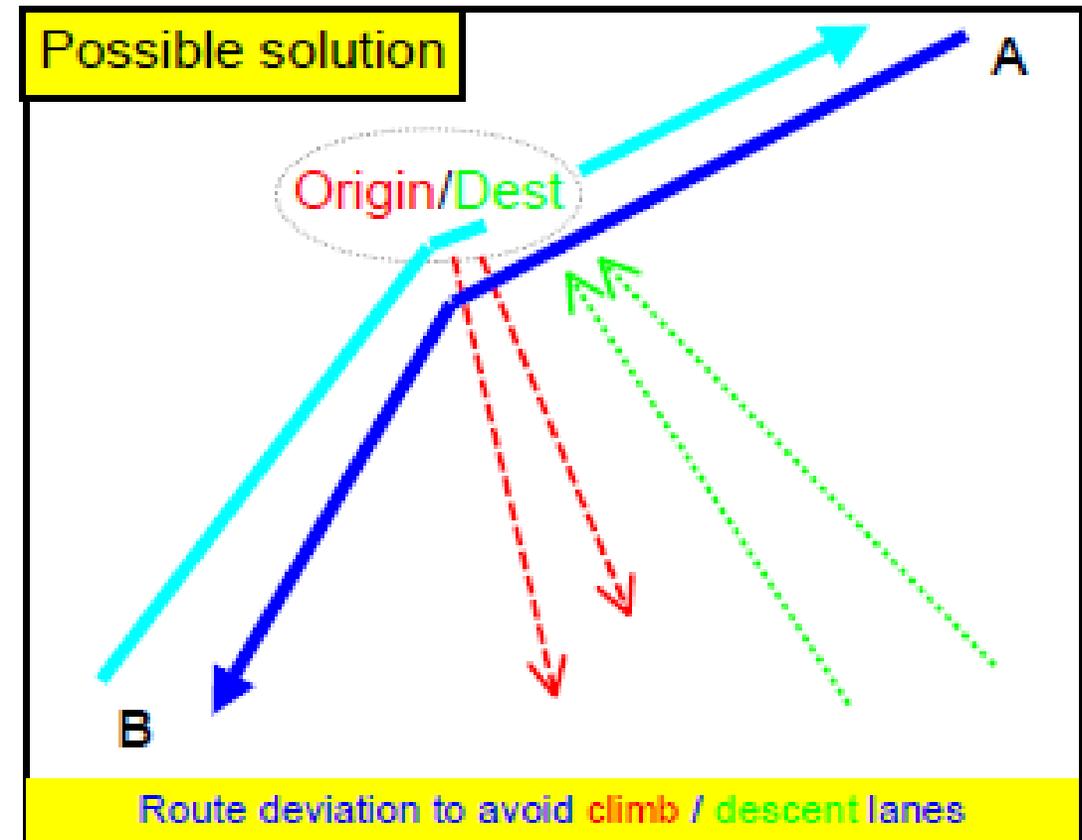
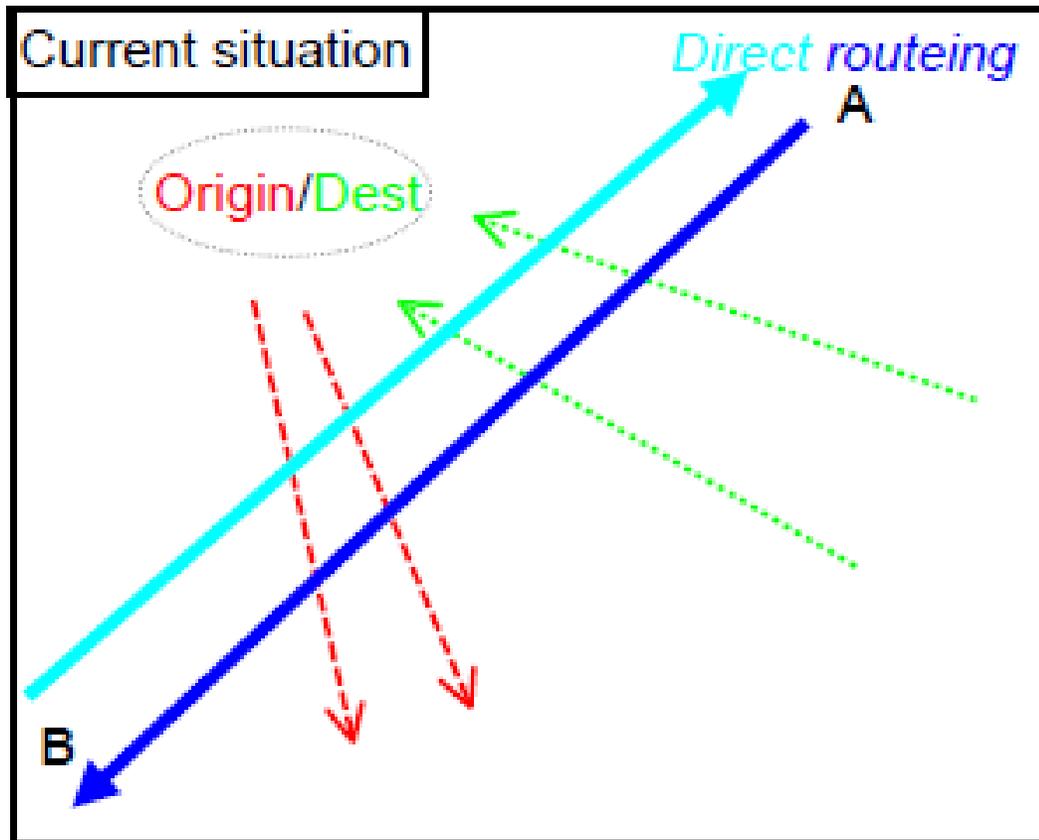
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Planning of routes



Planning of routes

African Flight Procedure Programme (AFPP)

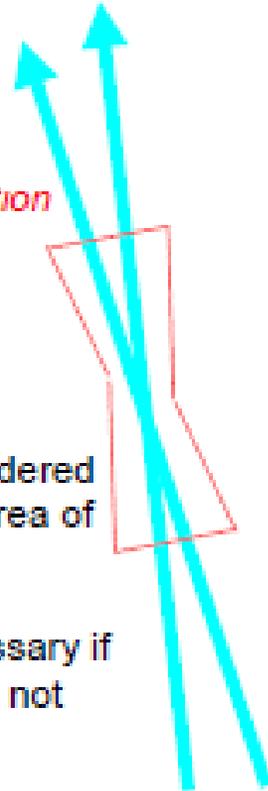


Current situation

Area of non-separation

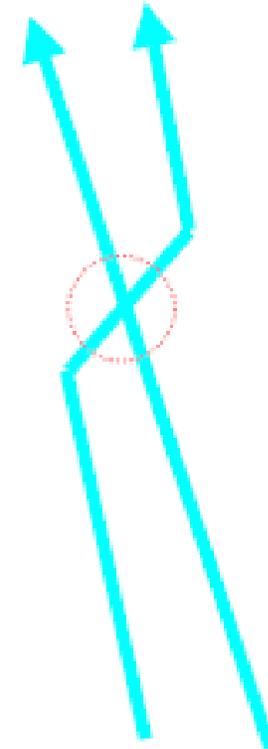
The two routes are considered as a single route in the area of non-separation.

FL change may be necessary if longitudinal separation is not sufficient.



Possible solution

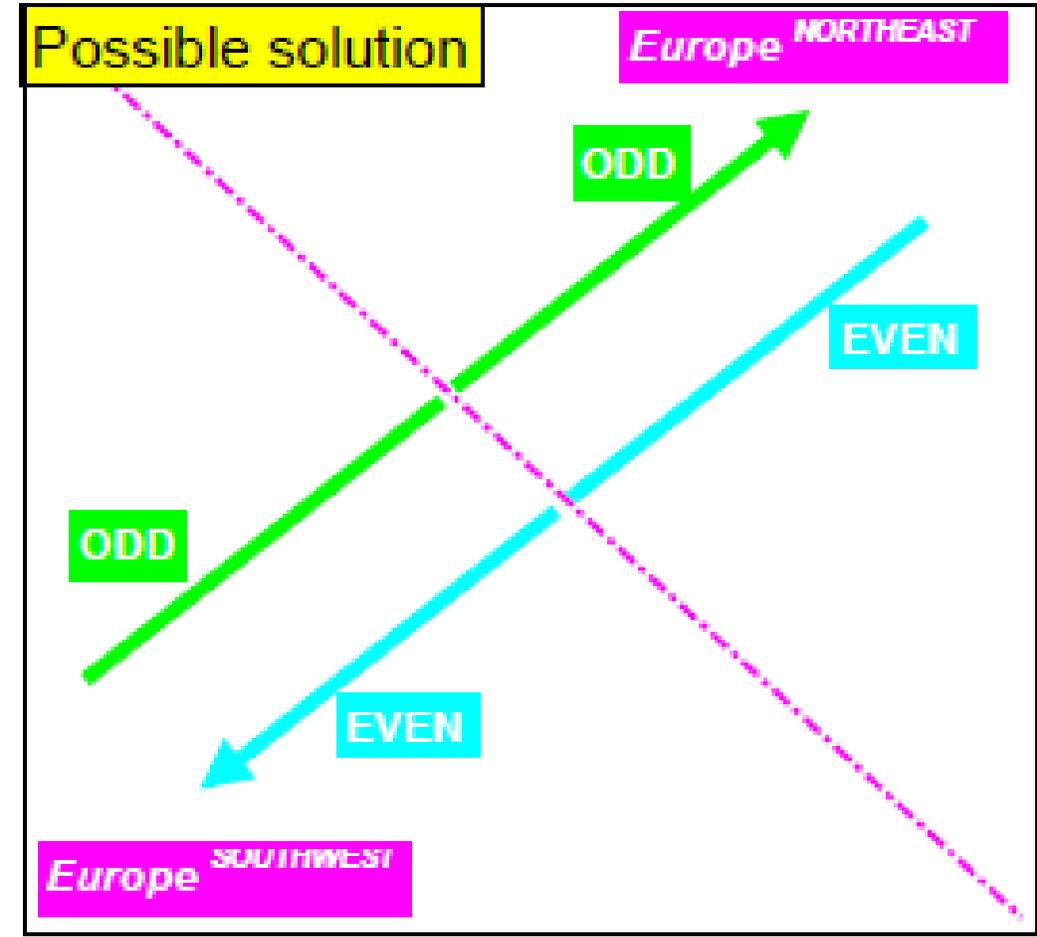
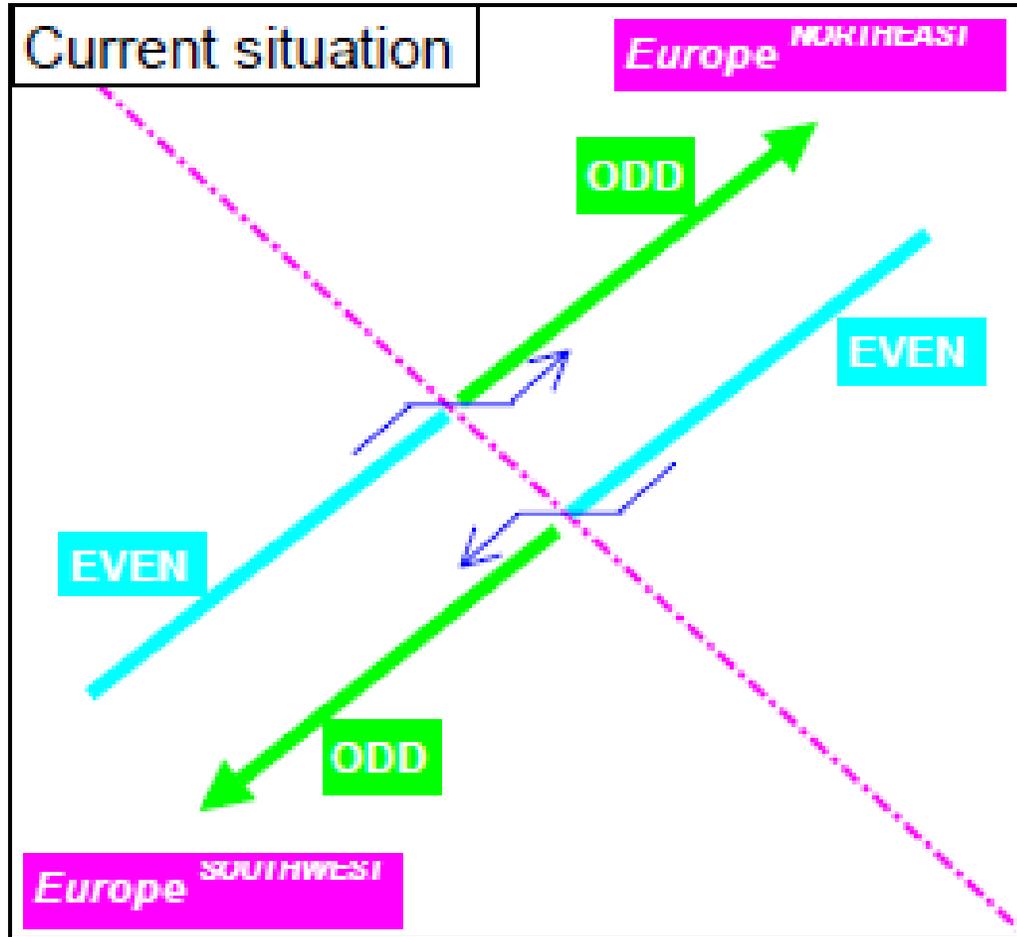
Conflicts are solved rapidly with no consideration of longitudinal separation or overtaking





Planning of routes

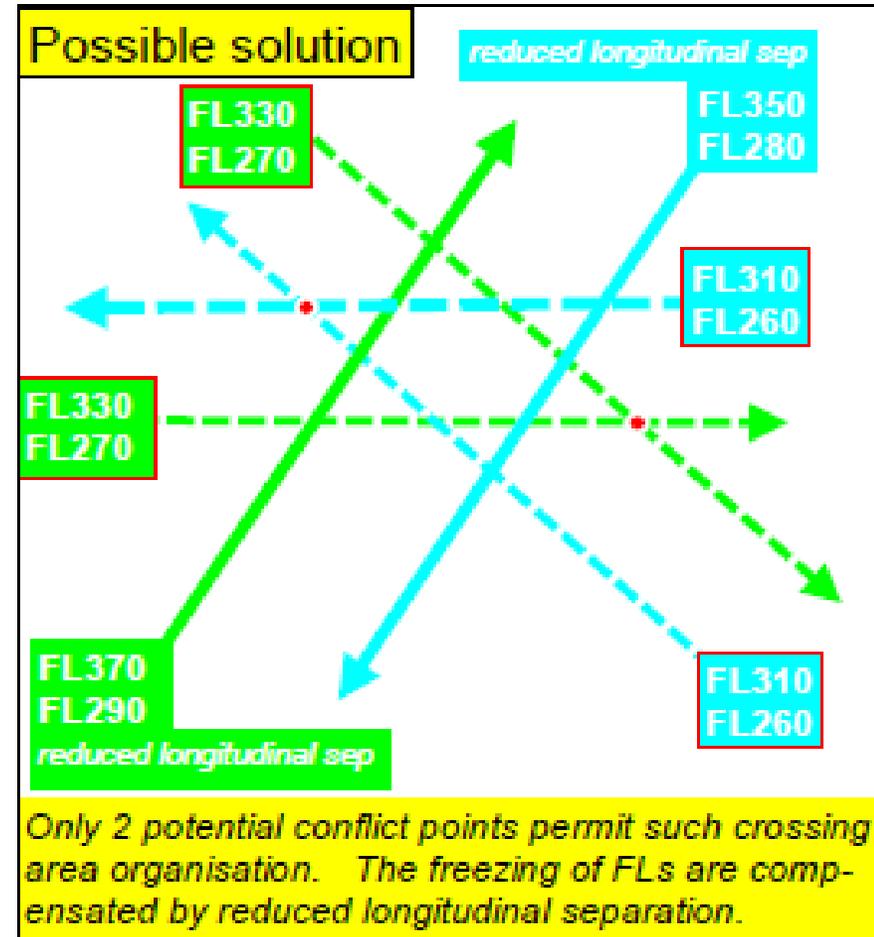
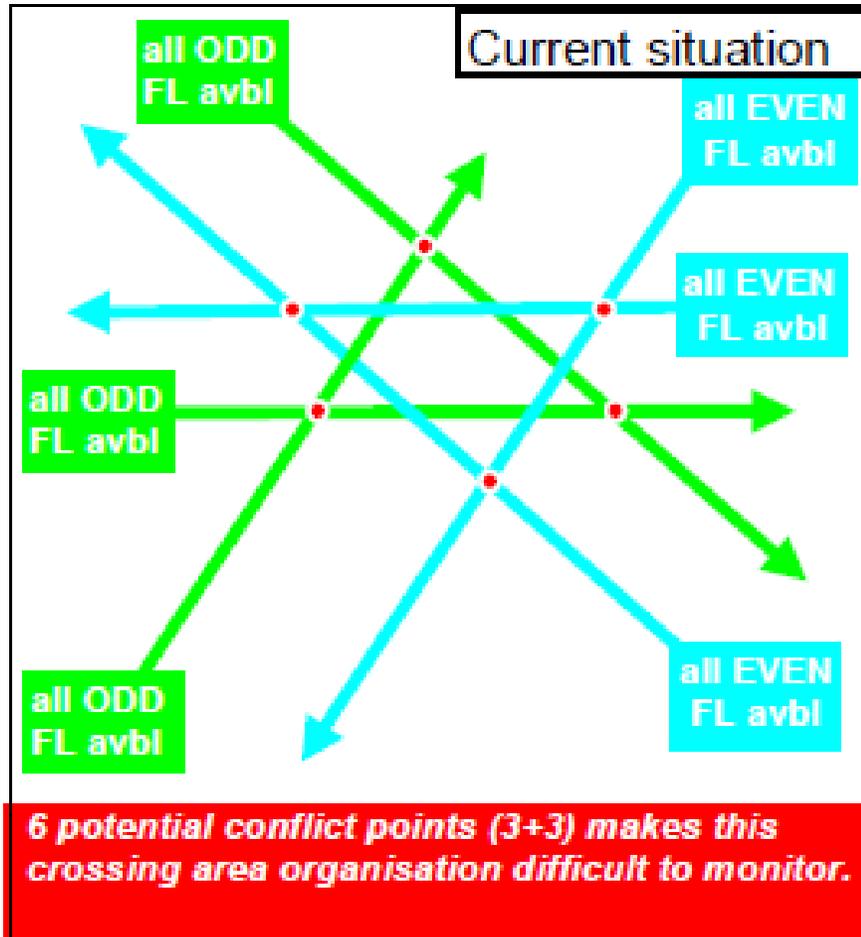
African Flight Procedure Programme (AFPP)





Planning of routes

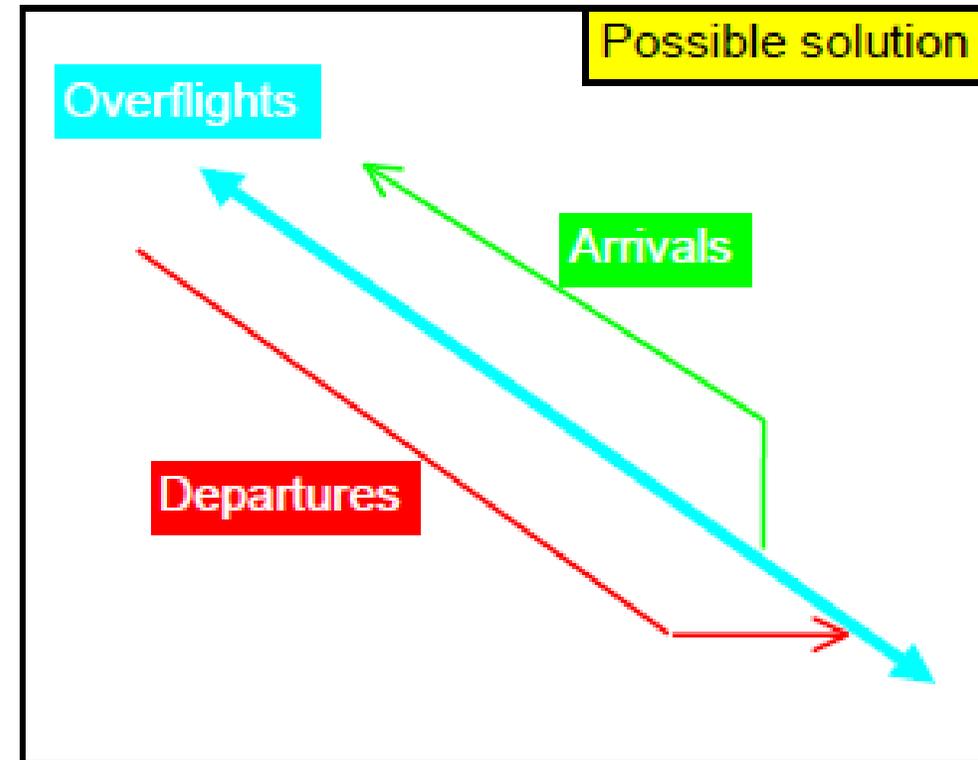
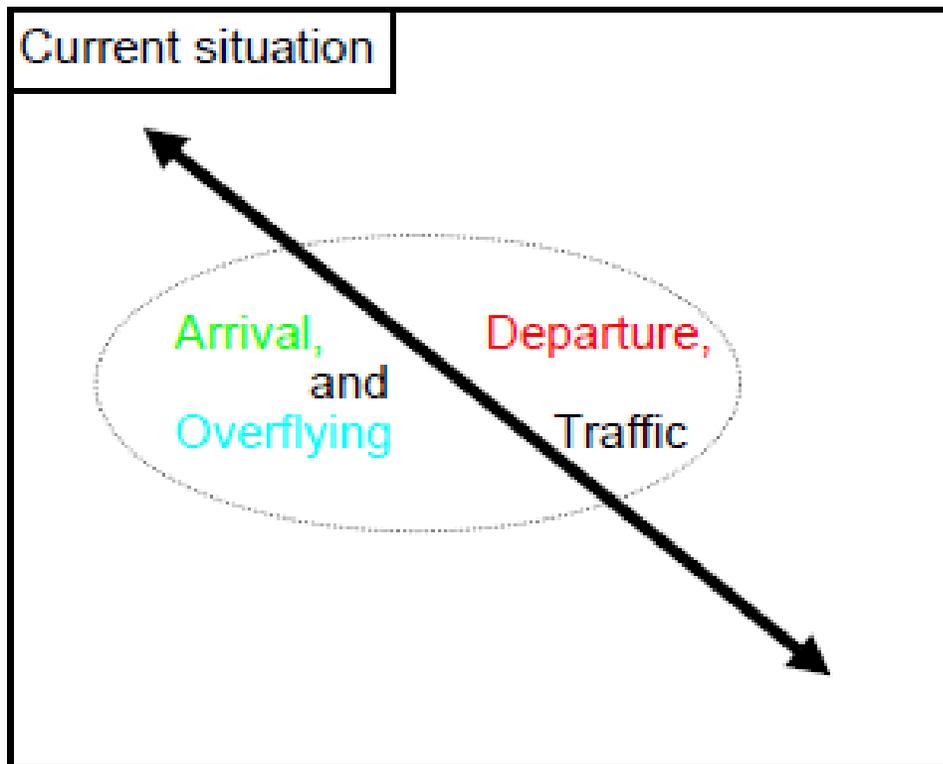
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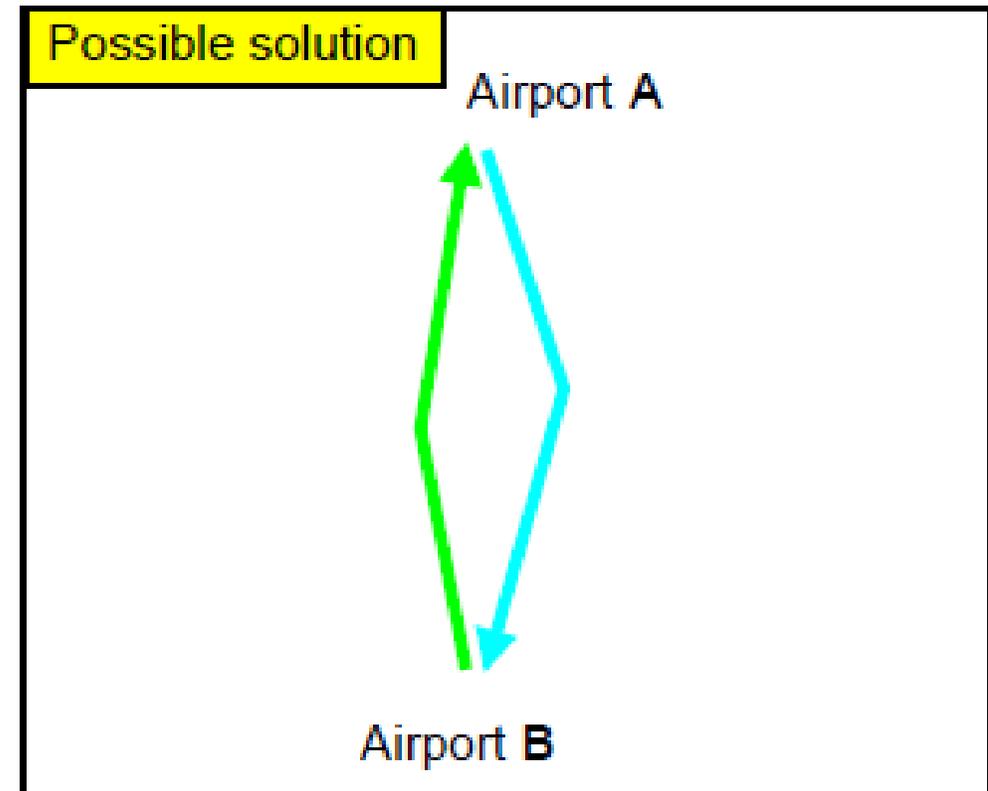
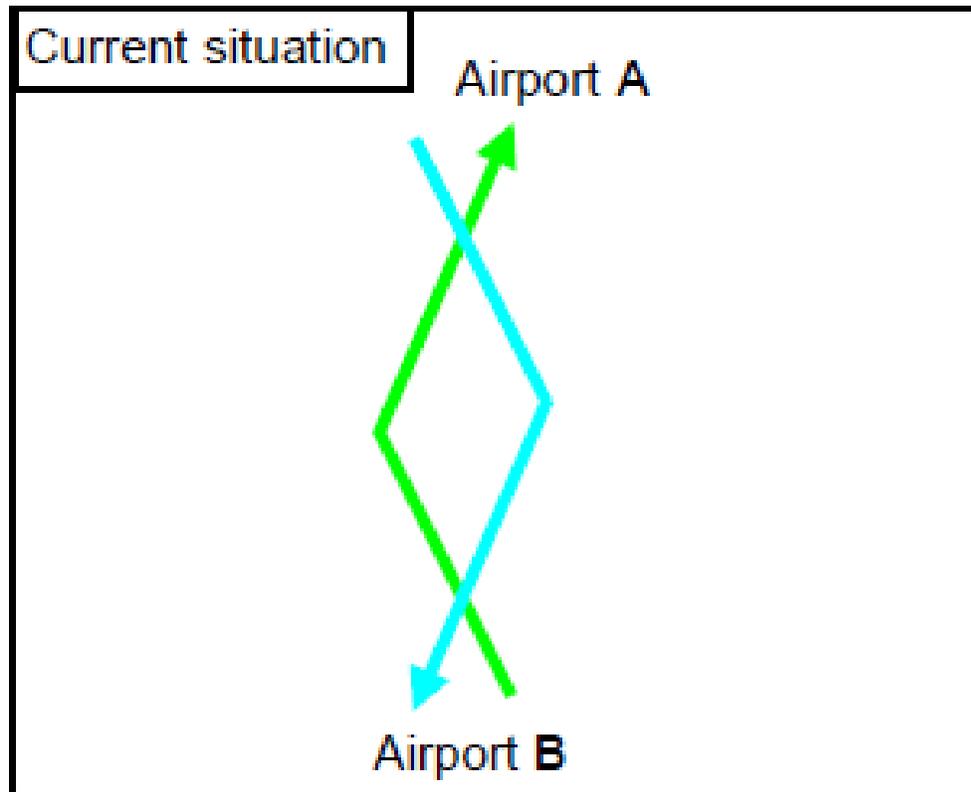
Specialization of routes



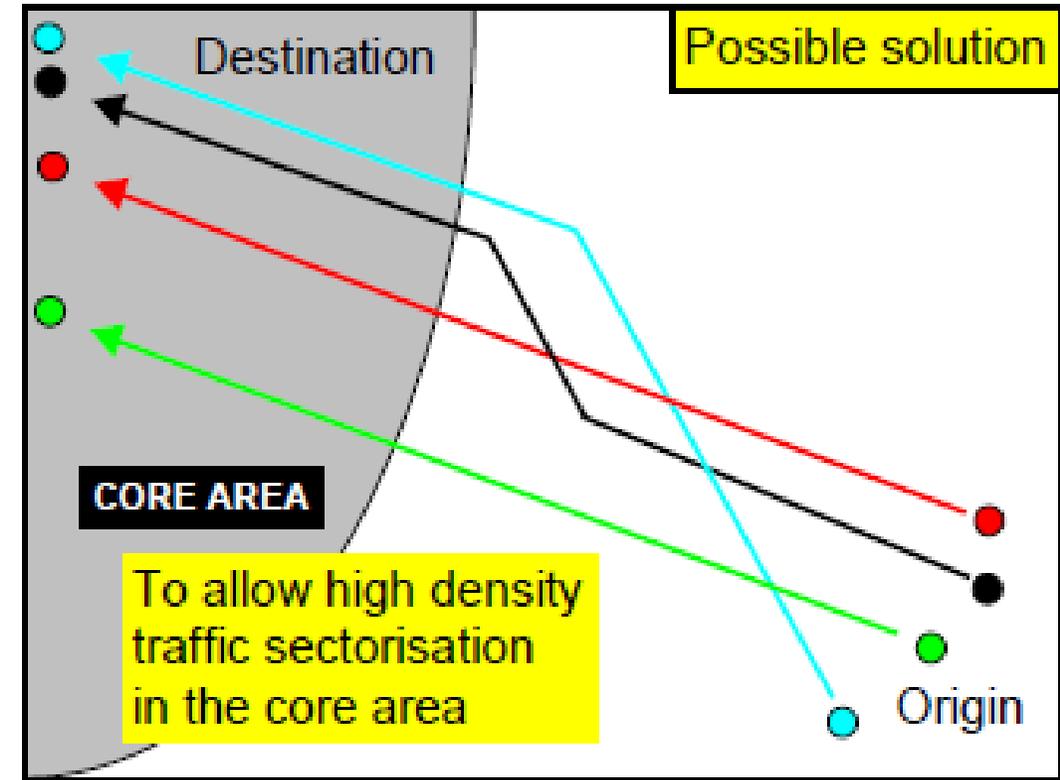
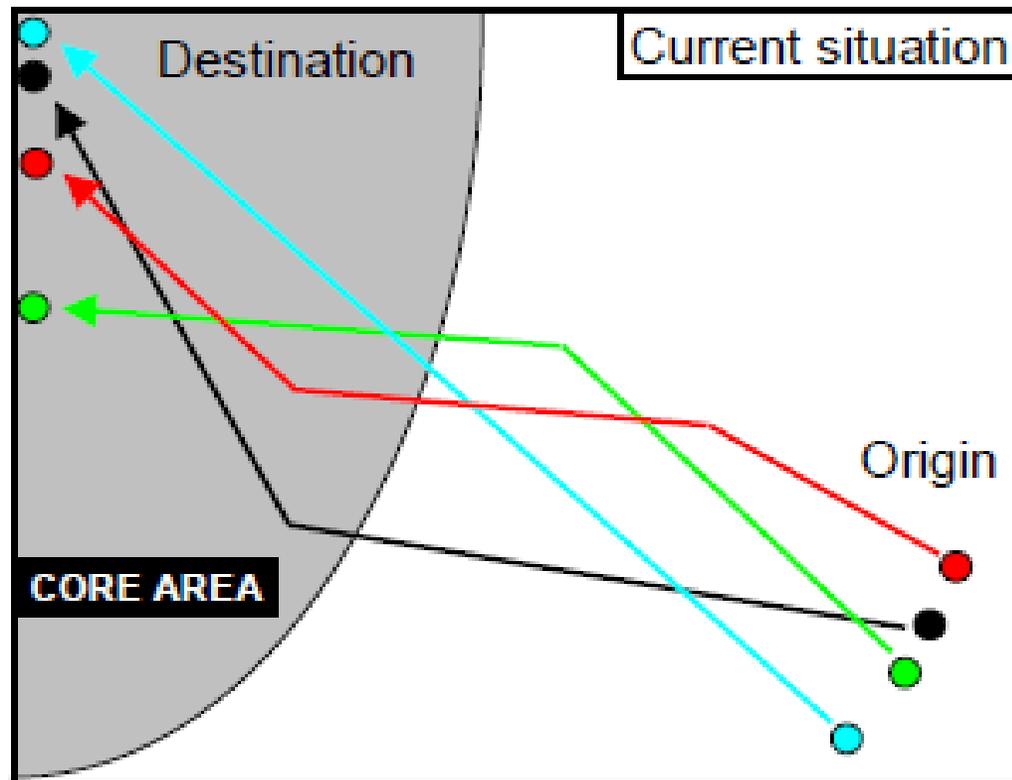
Increasing sector capacity

African Flight Procedure Programme (AFPP)

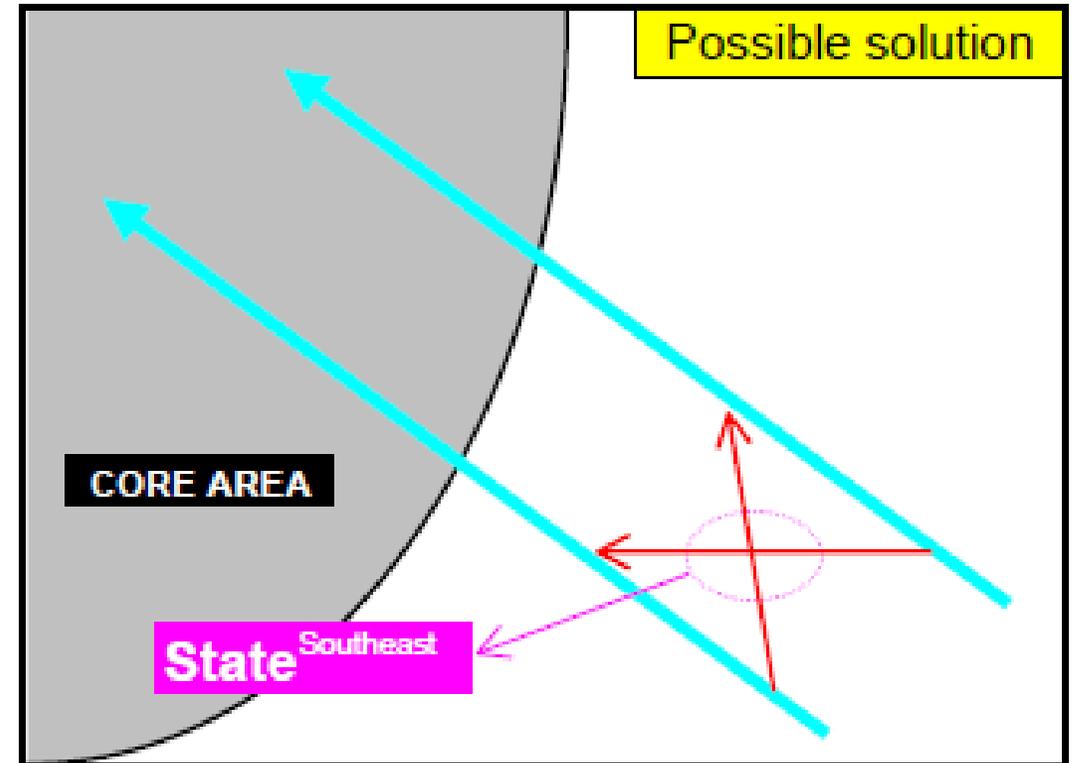
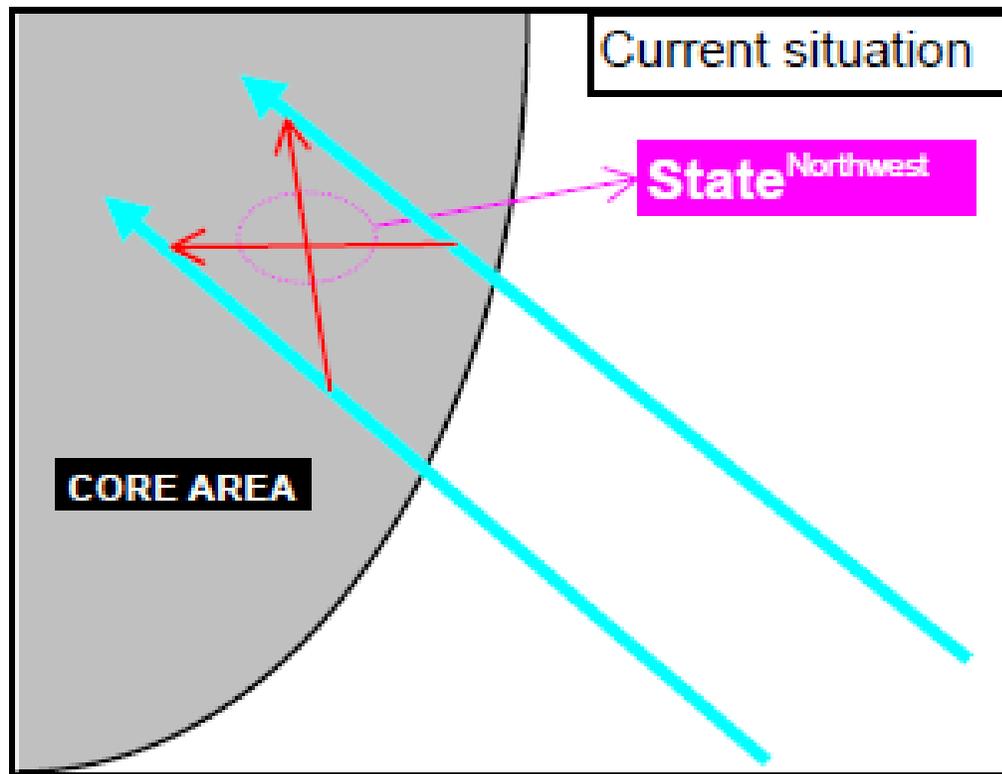
De-confliction of traffic flows (elimination of unnecessary cross-overs)



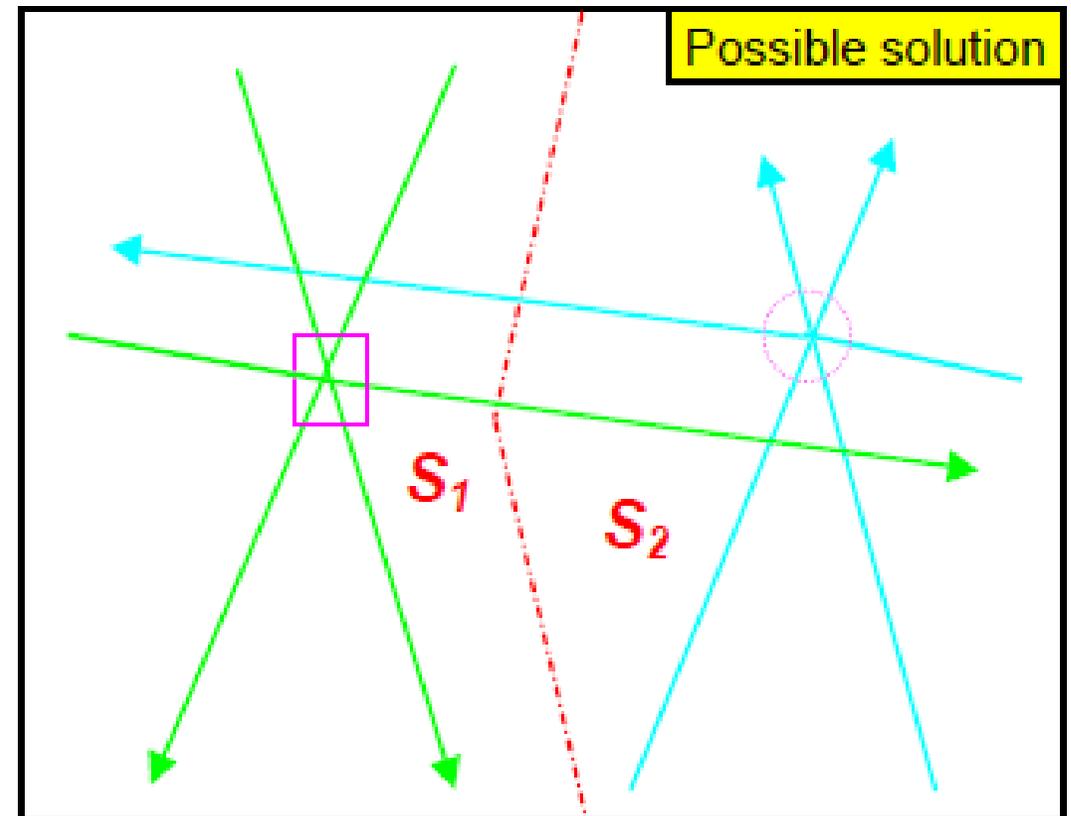
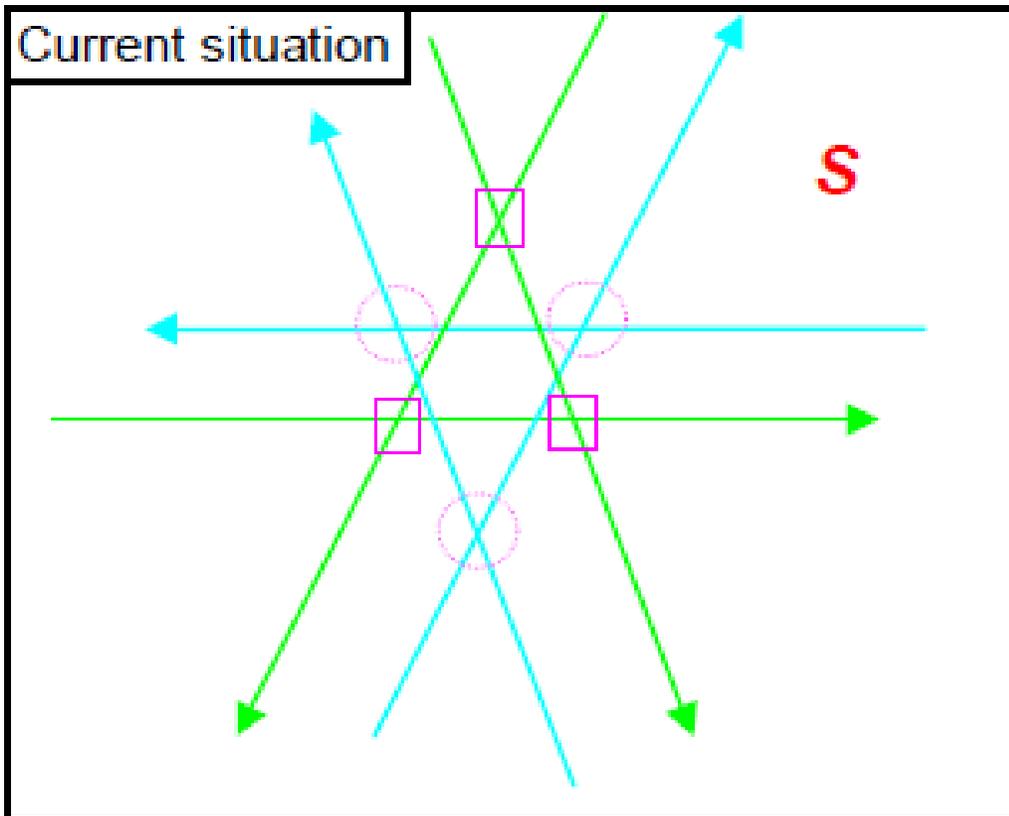
Organization of traffic flows (segregation of main traffic flows)



Appropriate relocation of crossing points, where possible

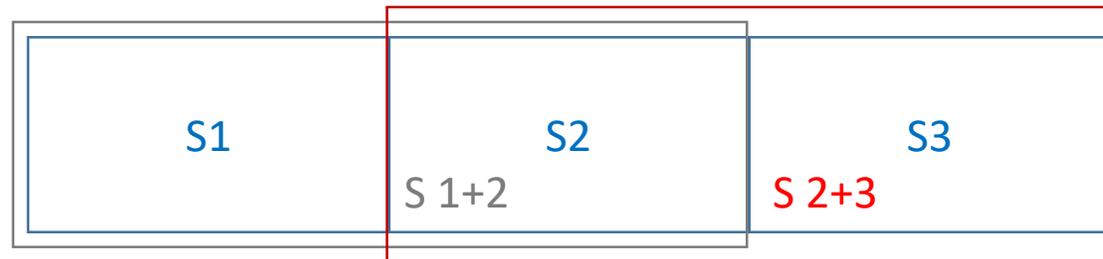


Rationalization of crossing points, where possible

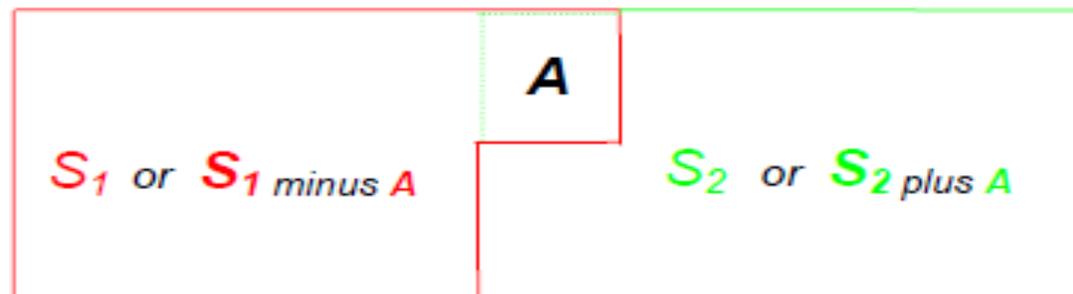


General Criteria Applicable to Sector Development

The combination of sectors to balance varying demands.

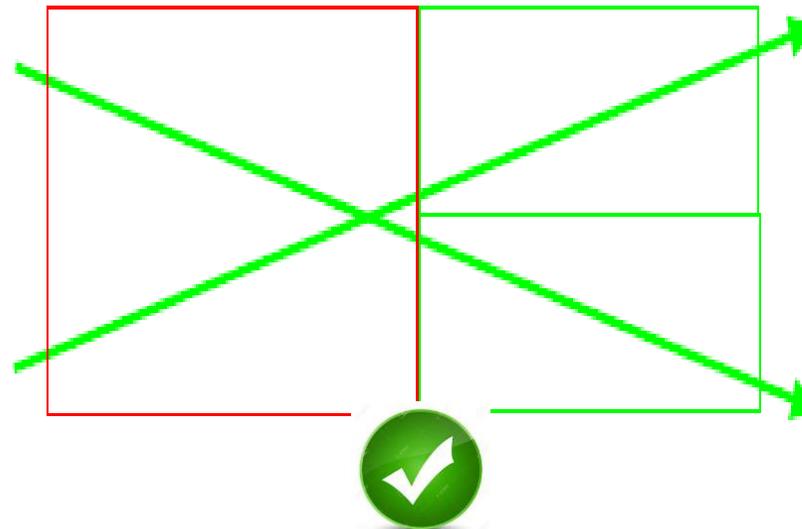
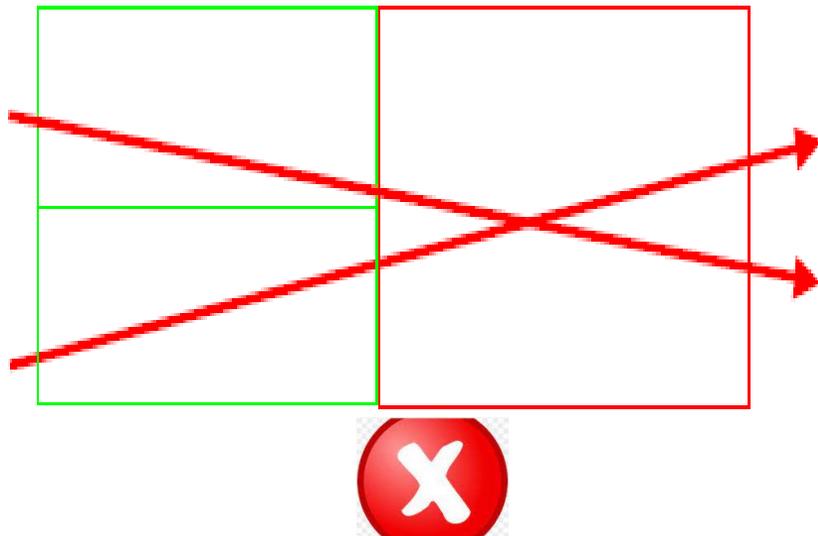


The reconfiguration of sector boundaries through use of air blocks to match prevailing traffic flows.



Specific Criteria to Enhance Sector Capacity:

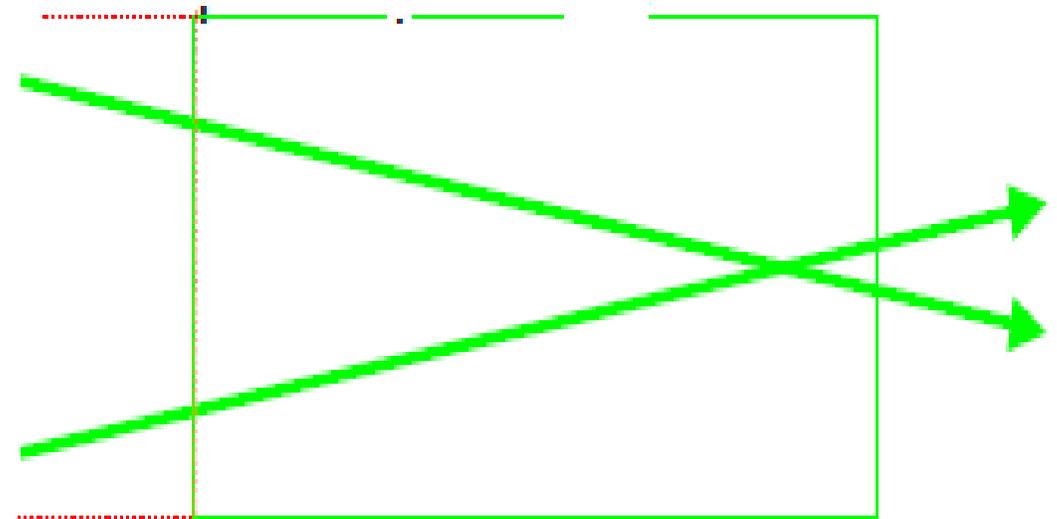
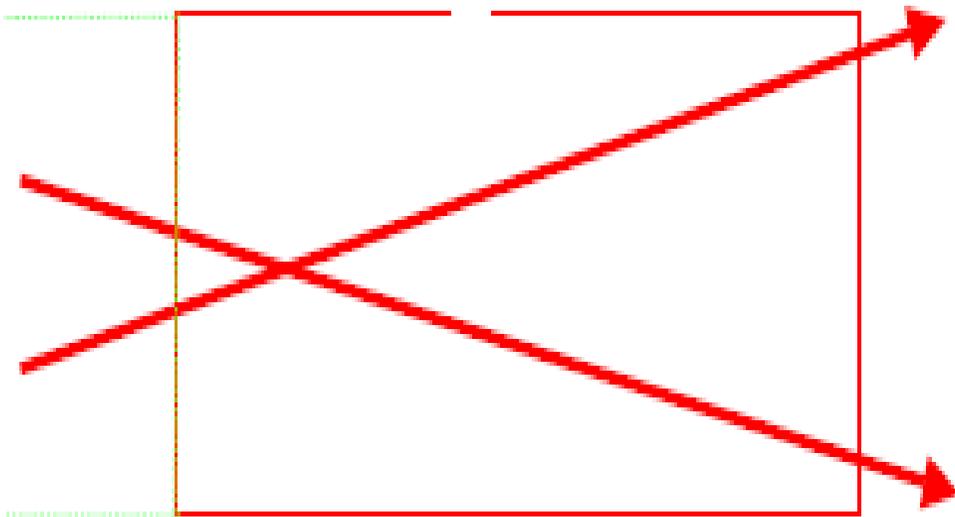
Avoid different sectors feeding the same sector with converging traffic, when action to separate individual aircraft is required (two different co-ordinations for the receiving sector)



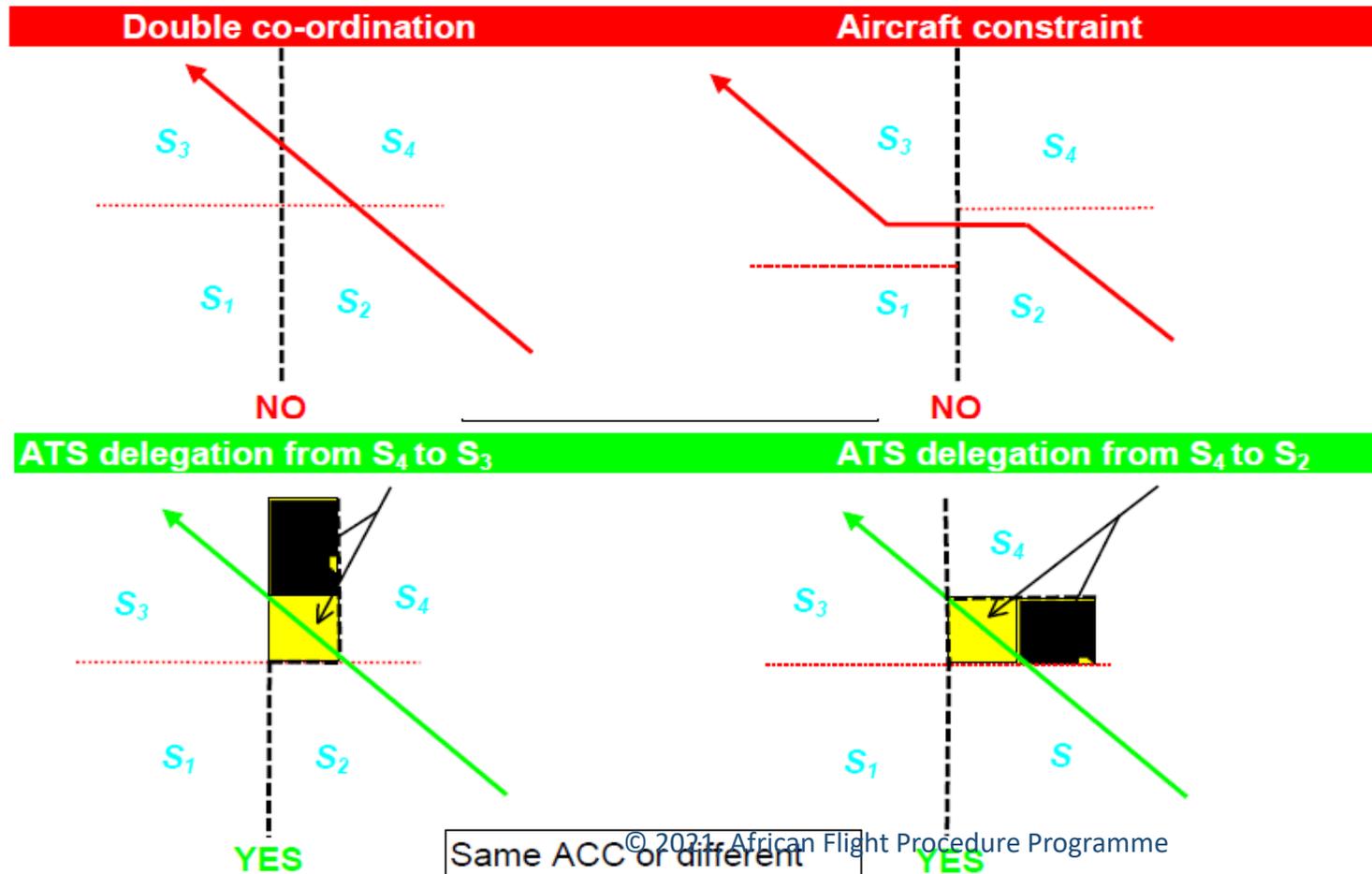
Increasing sector capacity

African Flight Procedure Programme (AFPP)

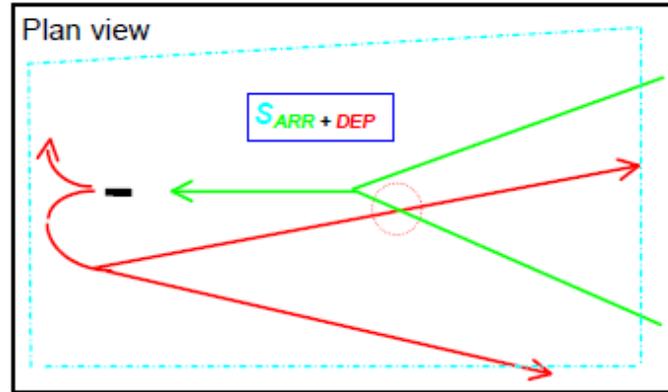
Avoid conflict points close to the boundary of a sector for entering traffic (increasing workload because of excessive co-ordination/no anticipation possible)



Sector boundaries/ Sector shape

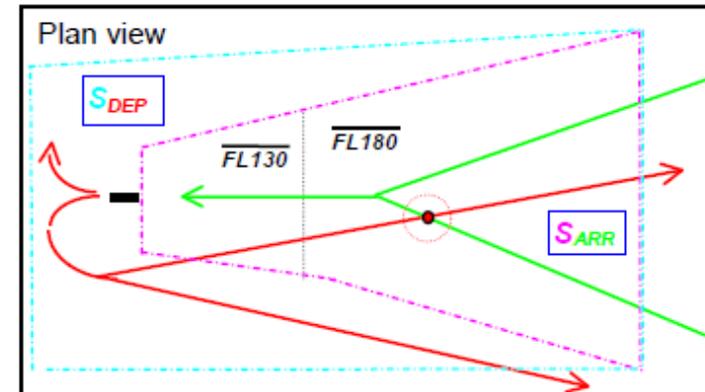


Specialized sectors



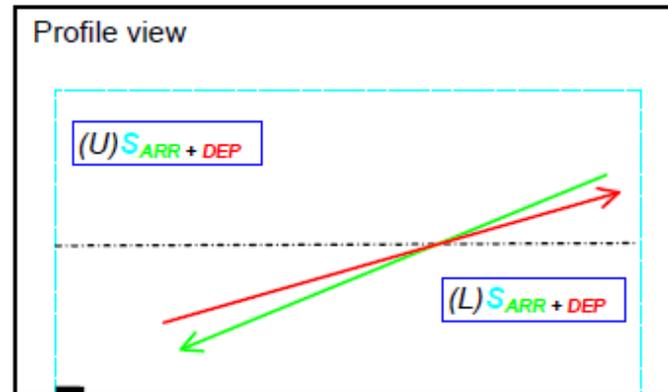
NO

(non-specialised sector)



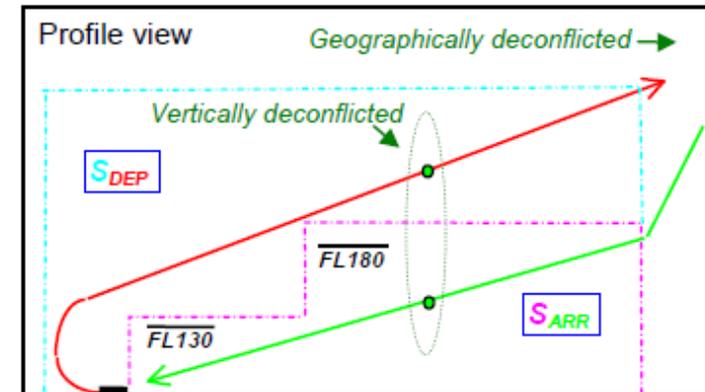
YES

(specialised sectors to meet profile demand)



NO

(non-specialised sector)



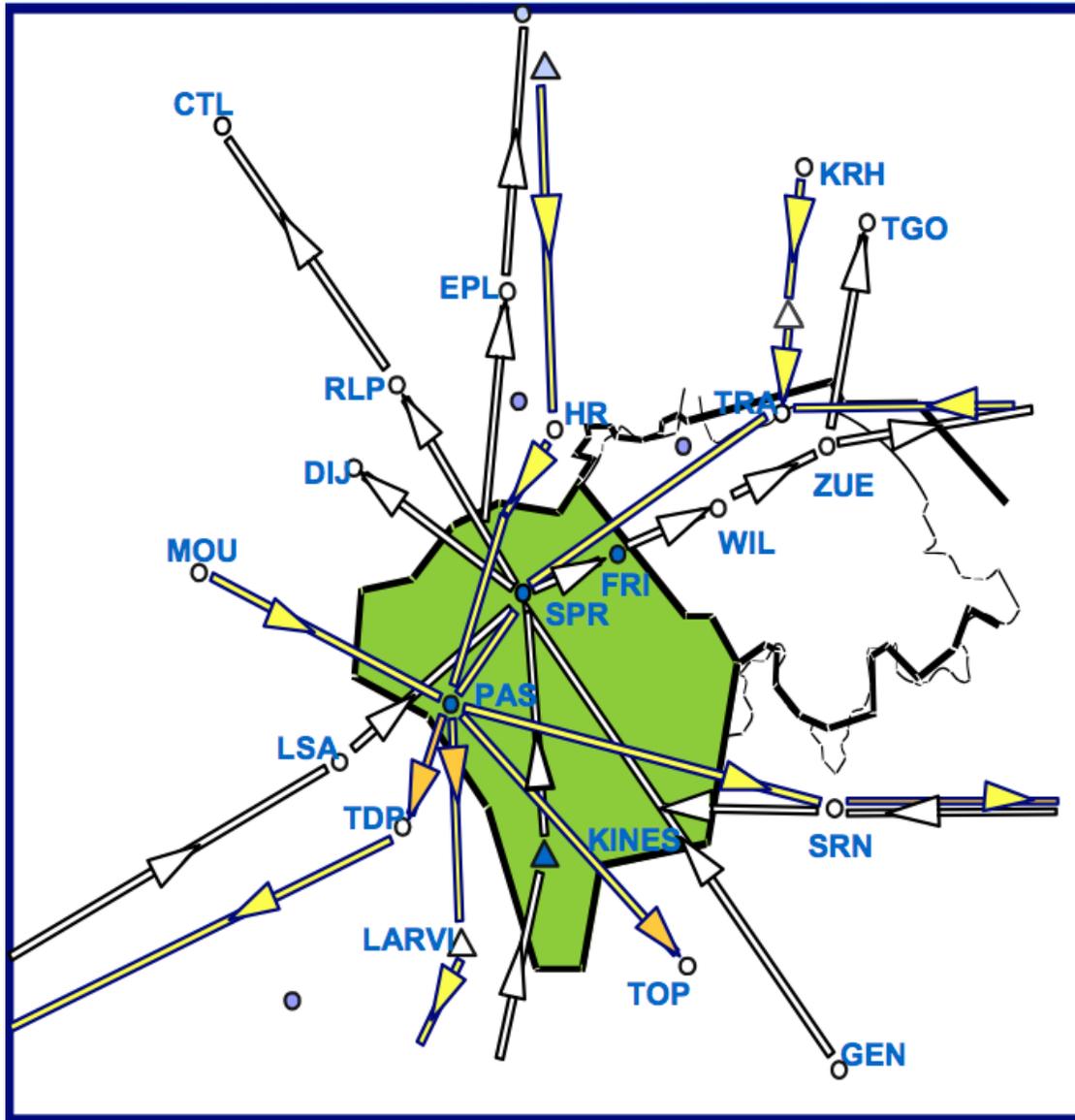
YES

S_{DEP} superimposes S_{ARR} to meet the profile demand; and to deconflict vertically the tracks which cannot be deconflicted geographically.

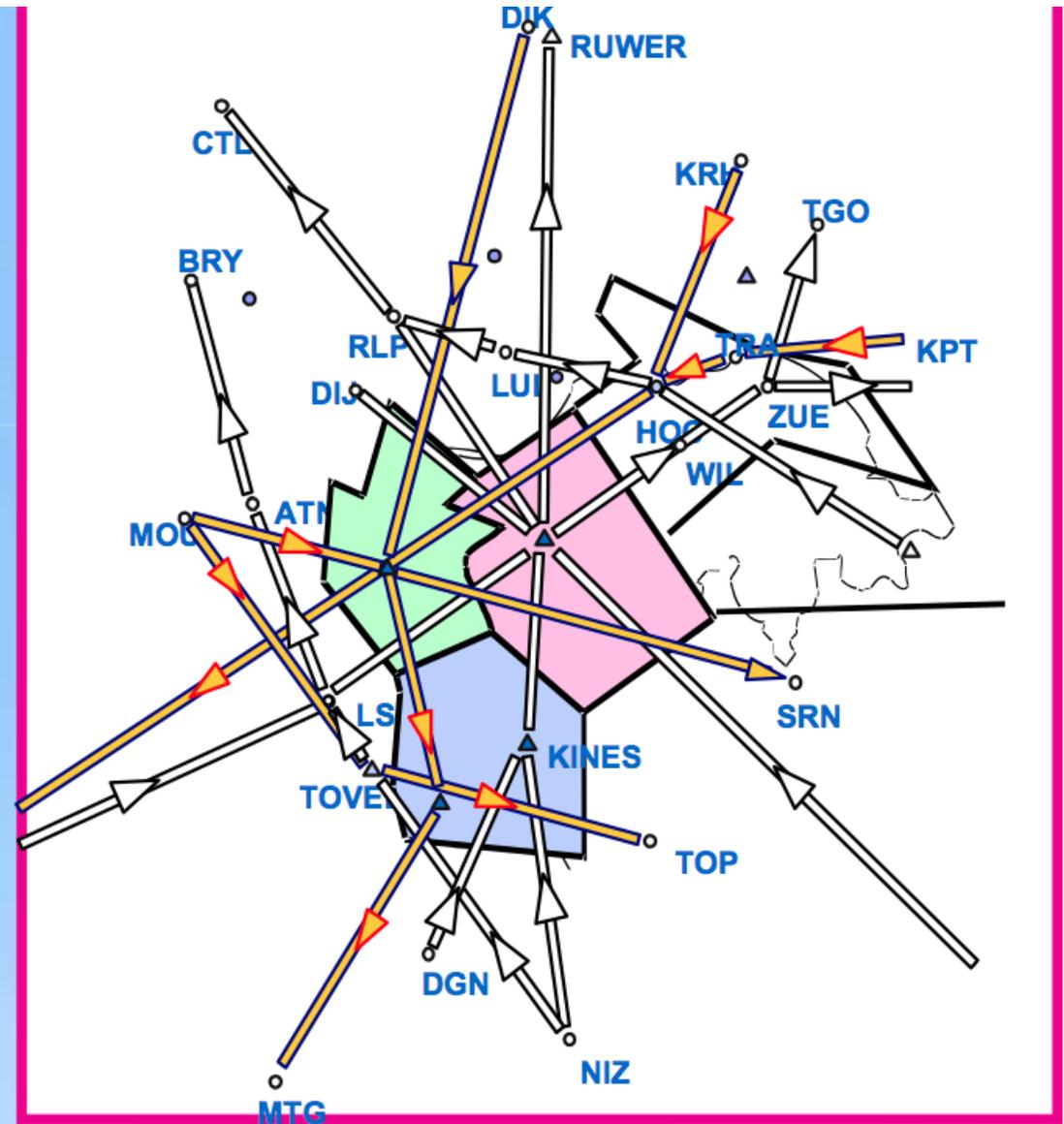


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Before RNAV 5



After RNAV 5





EMIRATES FIR En-Route Chart

Bearings are magnetic
 Altitudes & ELEV in FT
 Distances in NM
 RNAV 5 mandatory above 10,500 FT and in the Dubai and Fujairah CTA,
 Only upper and lower CTA levels are shown. For internal boundaries refer ENR 2.1
 Refer ENR 6-2 for vertical limits of Prohibited, Restricted & Danger areas,

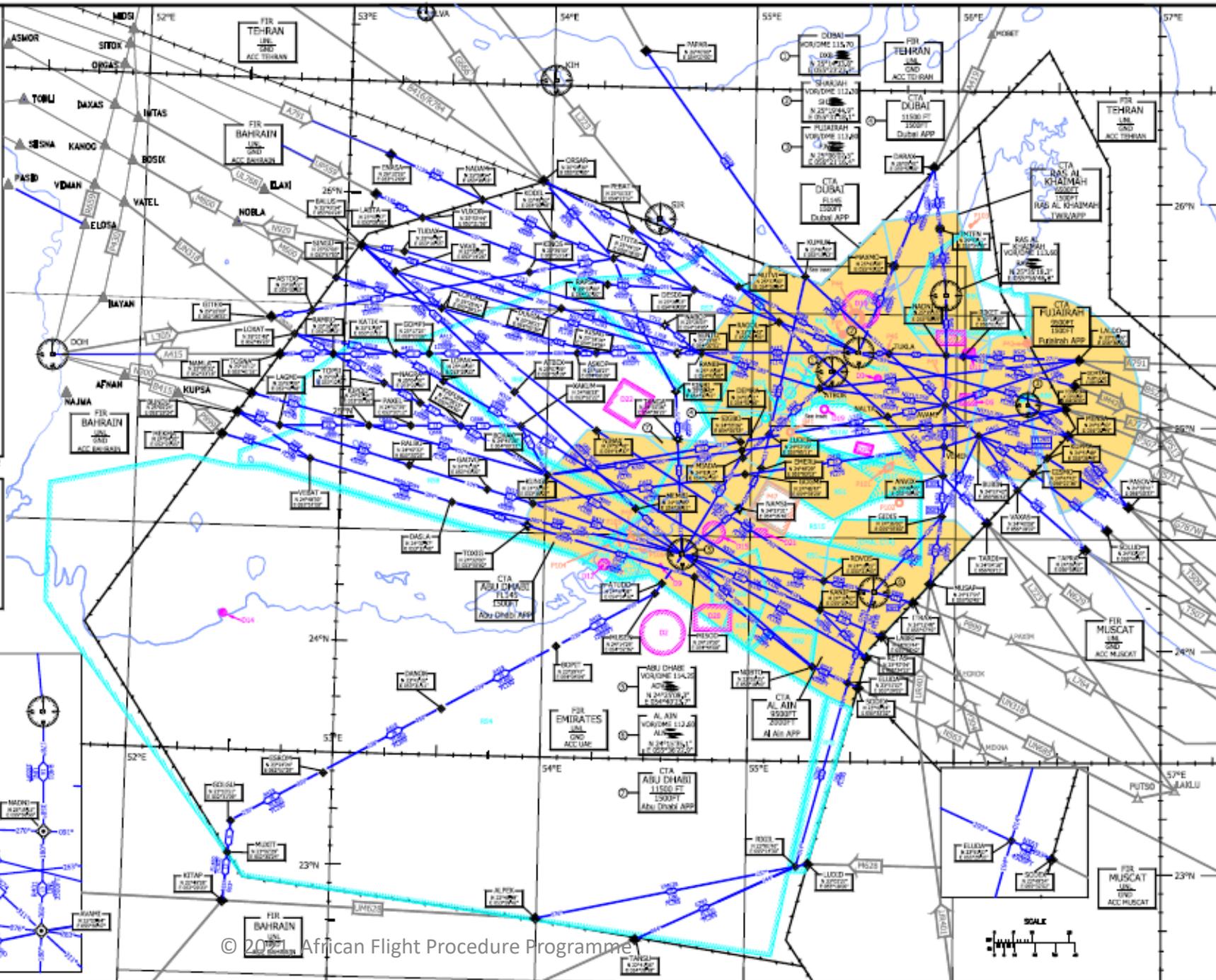
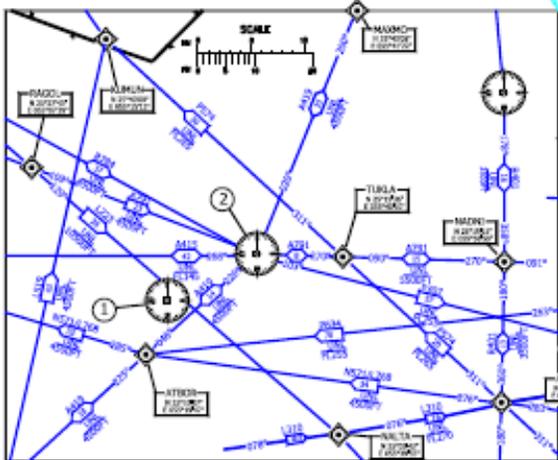
LEGEND

- ◆ Fly-by significant point
- ◆ Fly-by compulsory reporting point
- Fly-over significant point

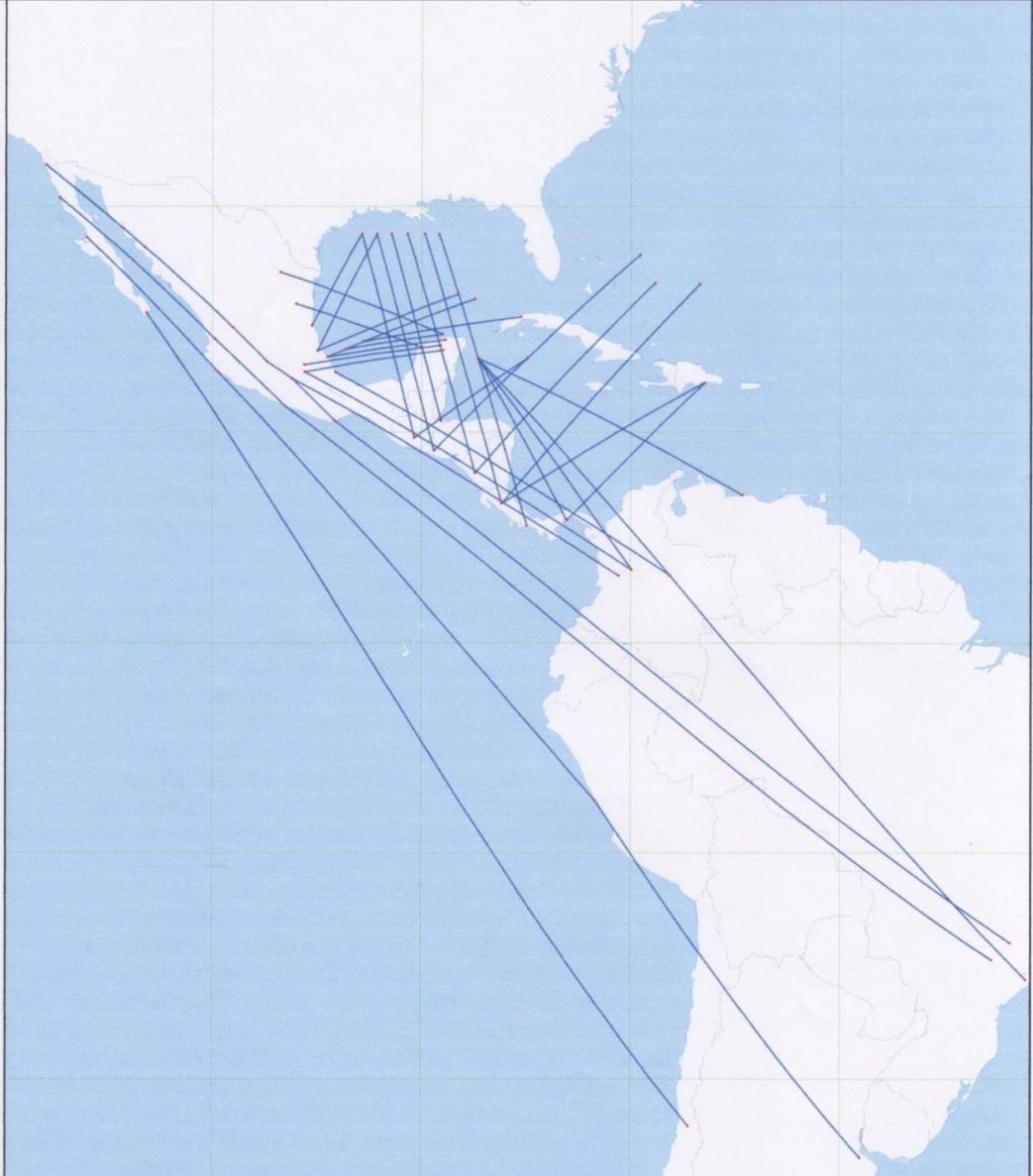
Consult NOTAM for current information
 Not intended as authoritative guidance for routes in external FIRs

GENERAL CIVIL AVIATION AUTHORITY ABRAC 95 effective 26 JUL 12

Amendment Record		
Nr	Date	Entered by



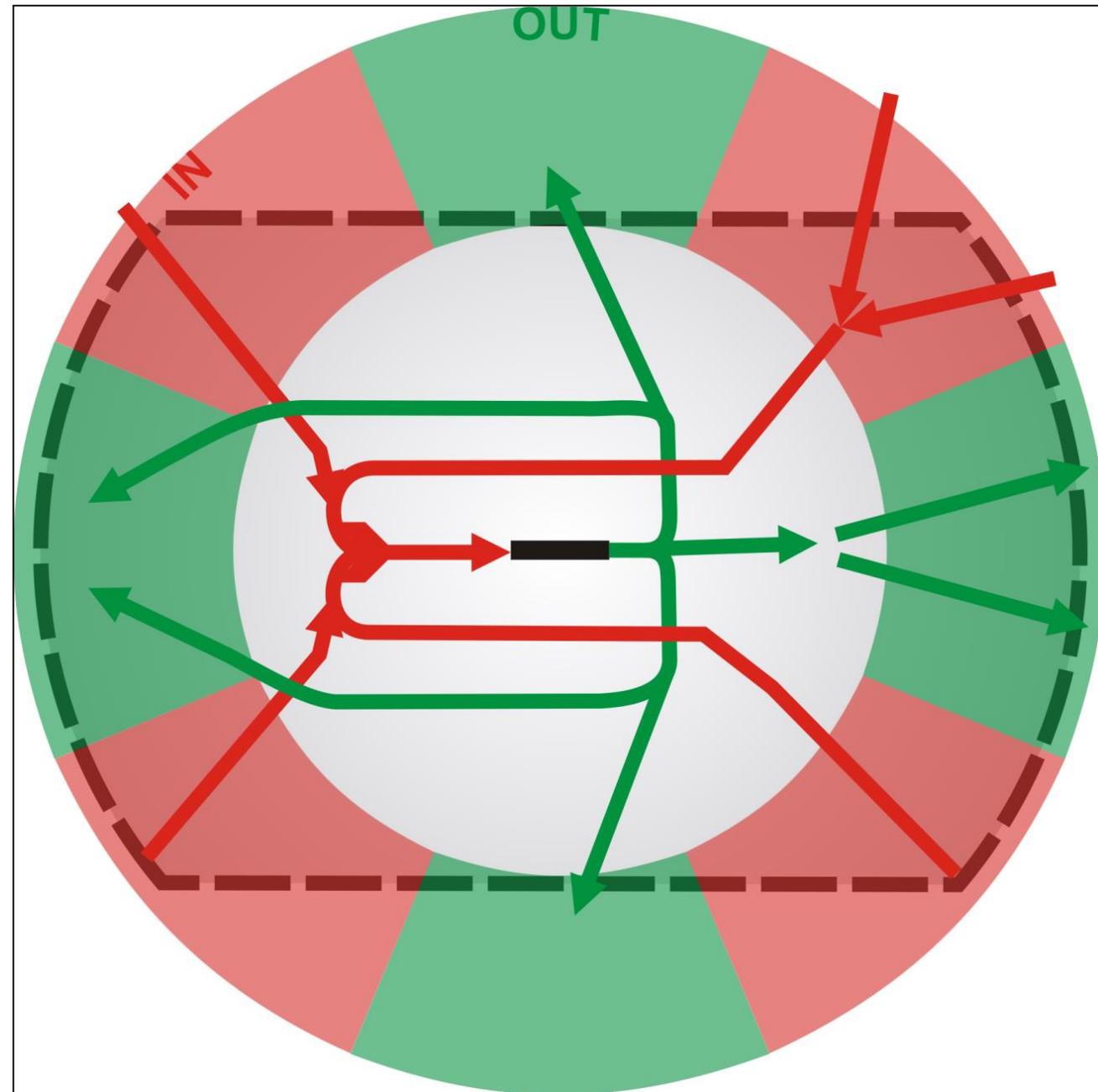
Regional ATS route Network

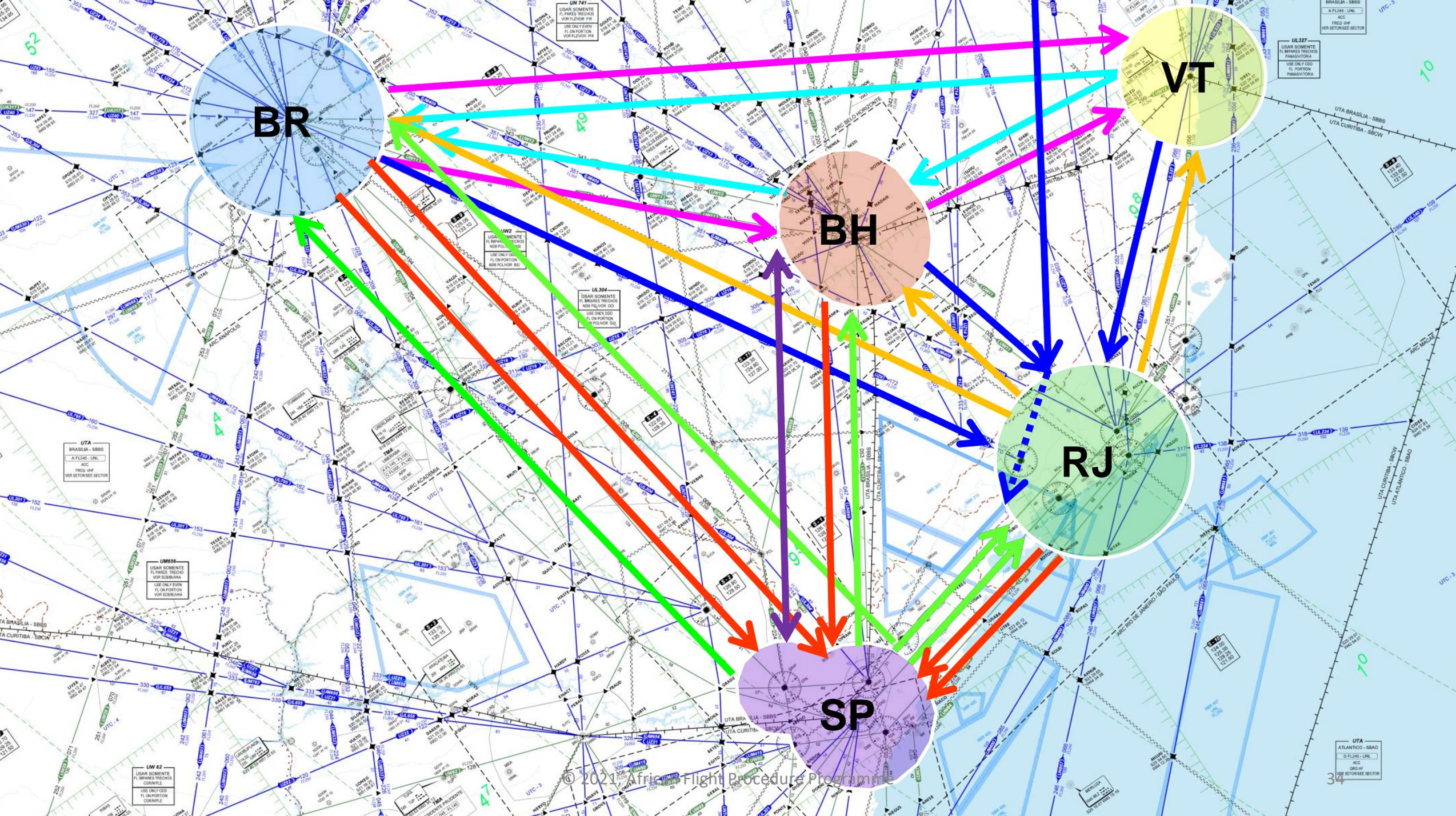


Good Design Practice

Corner-post:

- Flows by quadrant, segregate Arrivals laterally and vertically from Departures





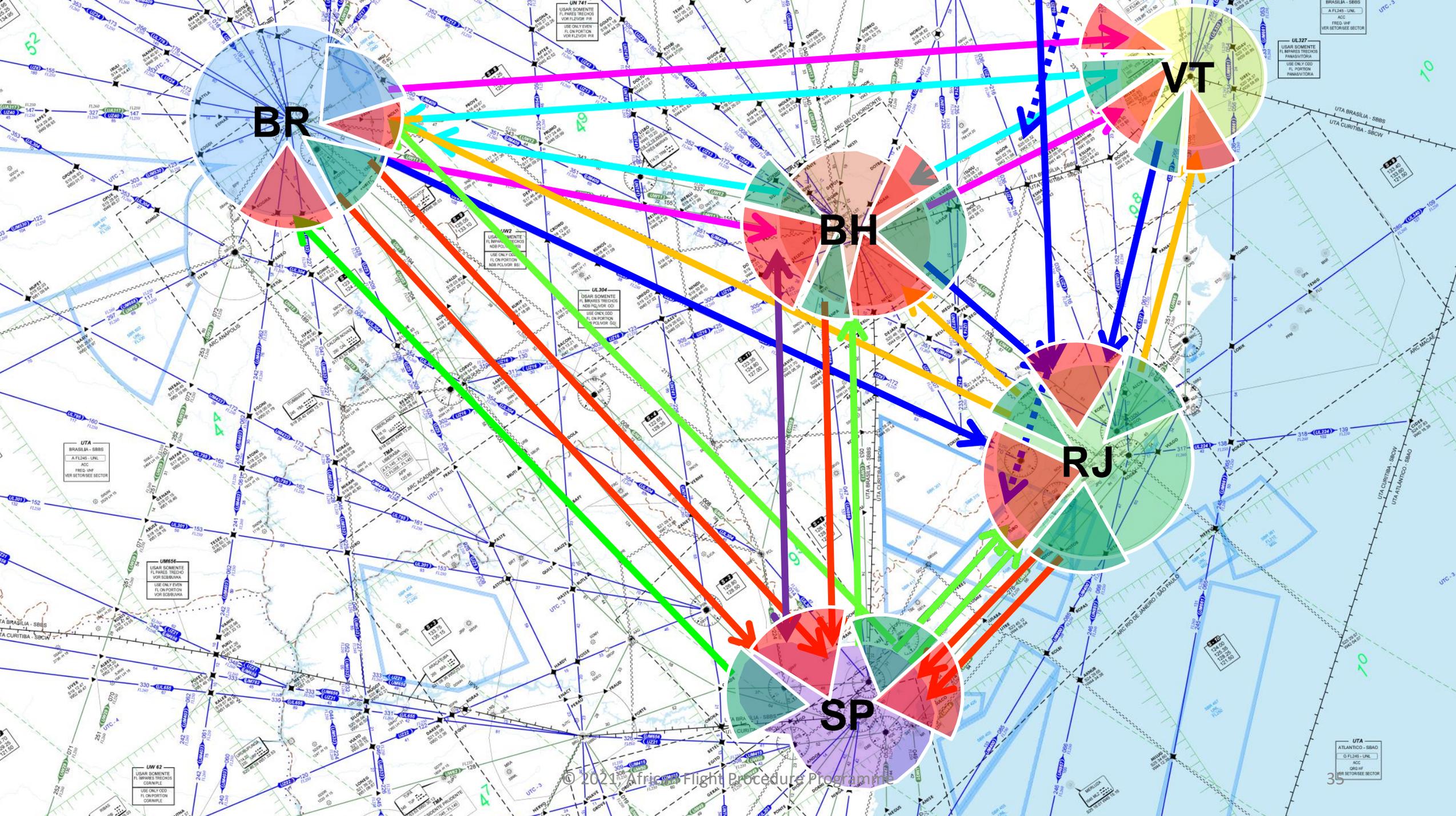
BR

VT

BH

RJ

SP



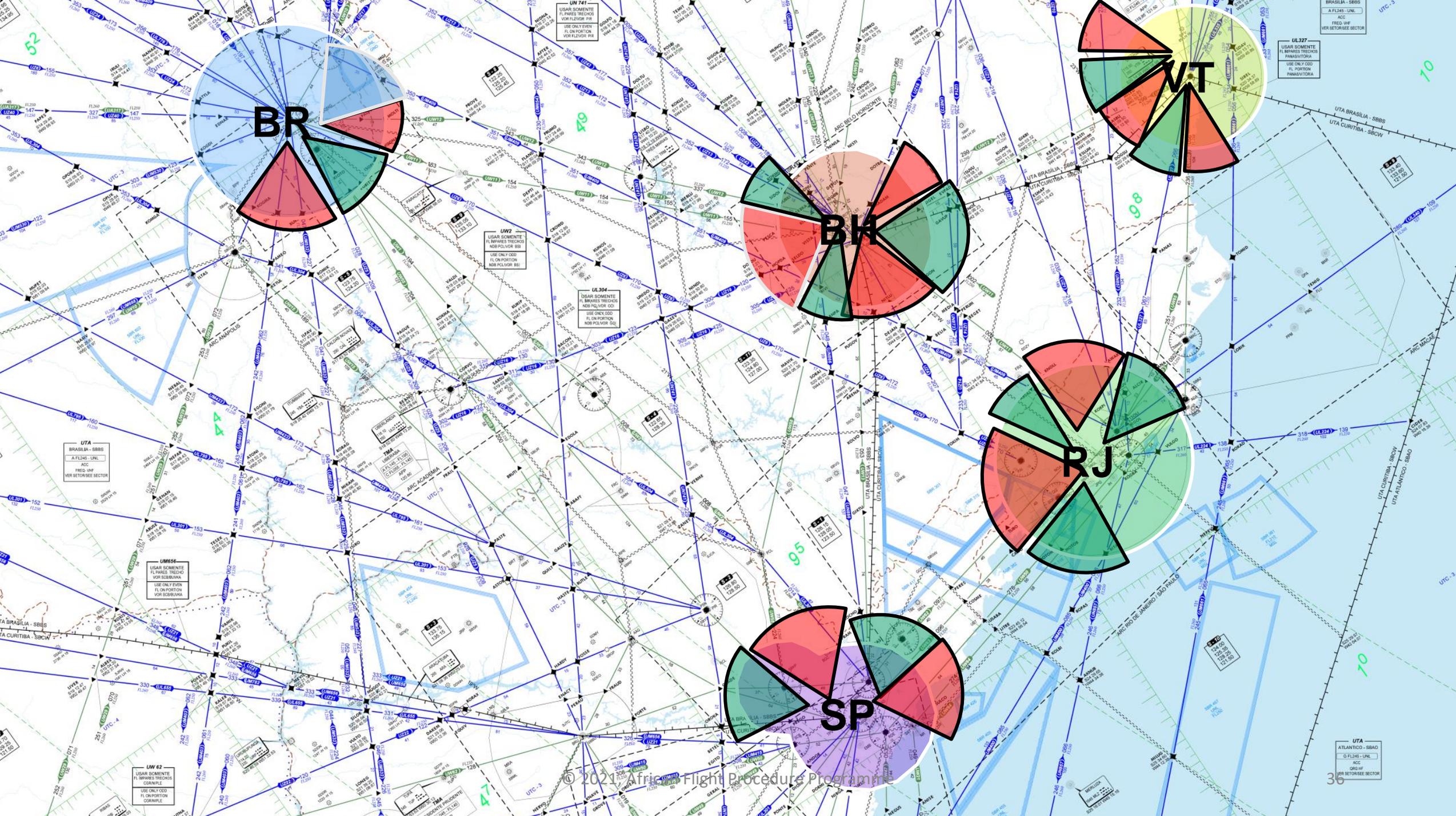
BR

VT

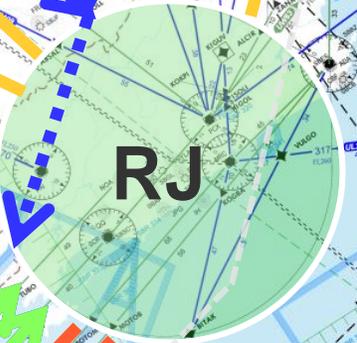
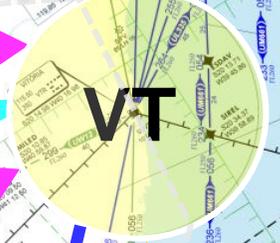
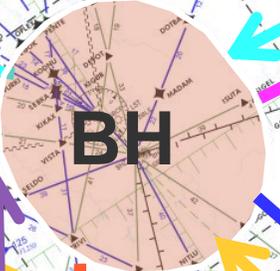
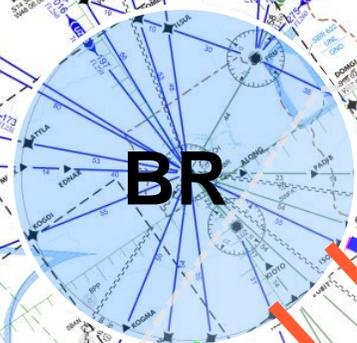
BH

RJ

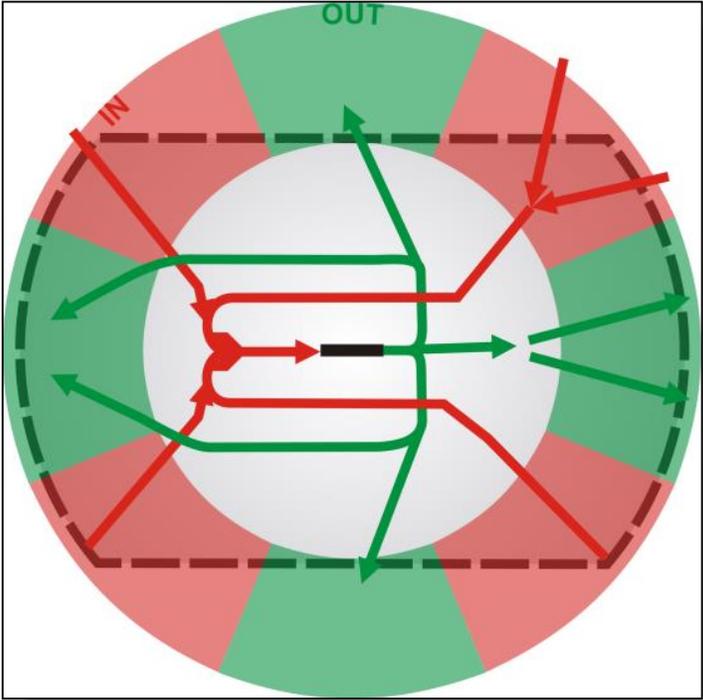
SP



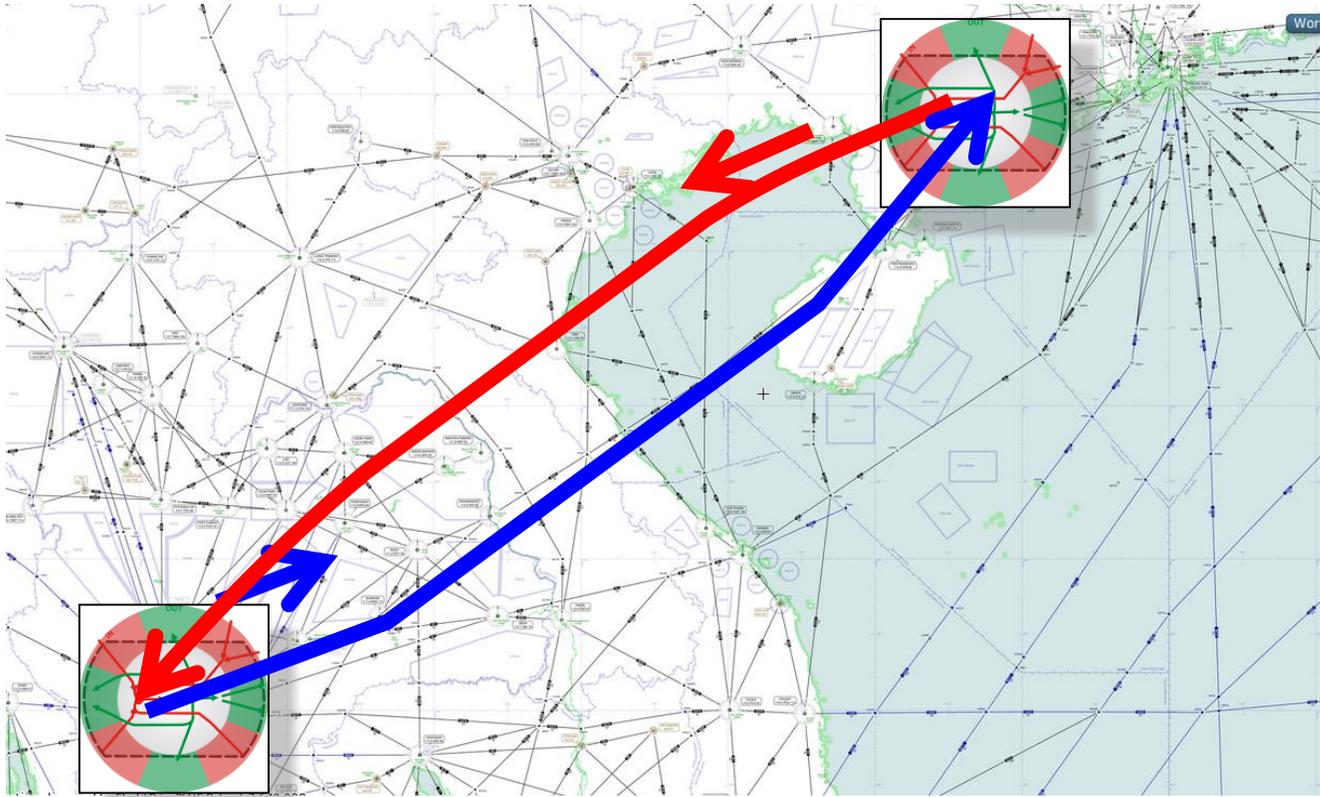
AREA CIRCULATION
PBN RNAV 5
2012



Crossing routes:
Climb/Descent in
TMA/APP



Crossing routes:
In ACC??

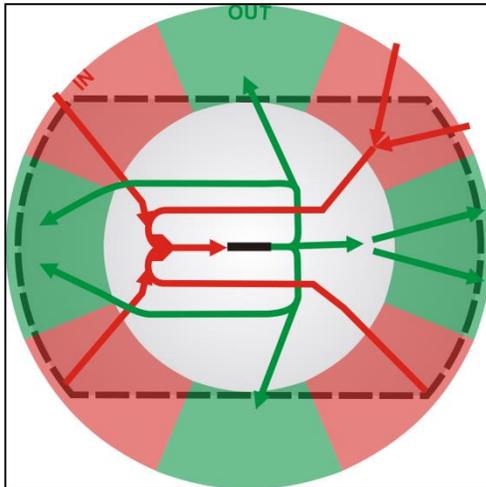


Good Design Practice

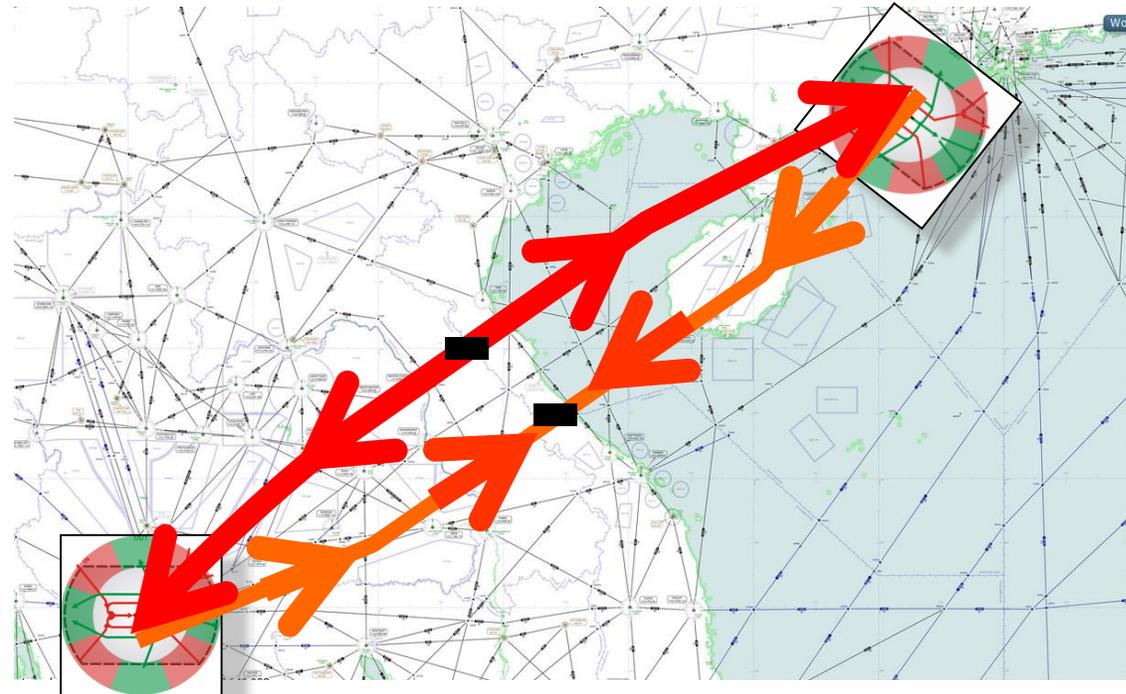
Crossing routes:

African Flight Procedure Programme (AFPP)

In TMA/APP

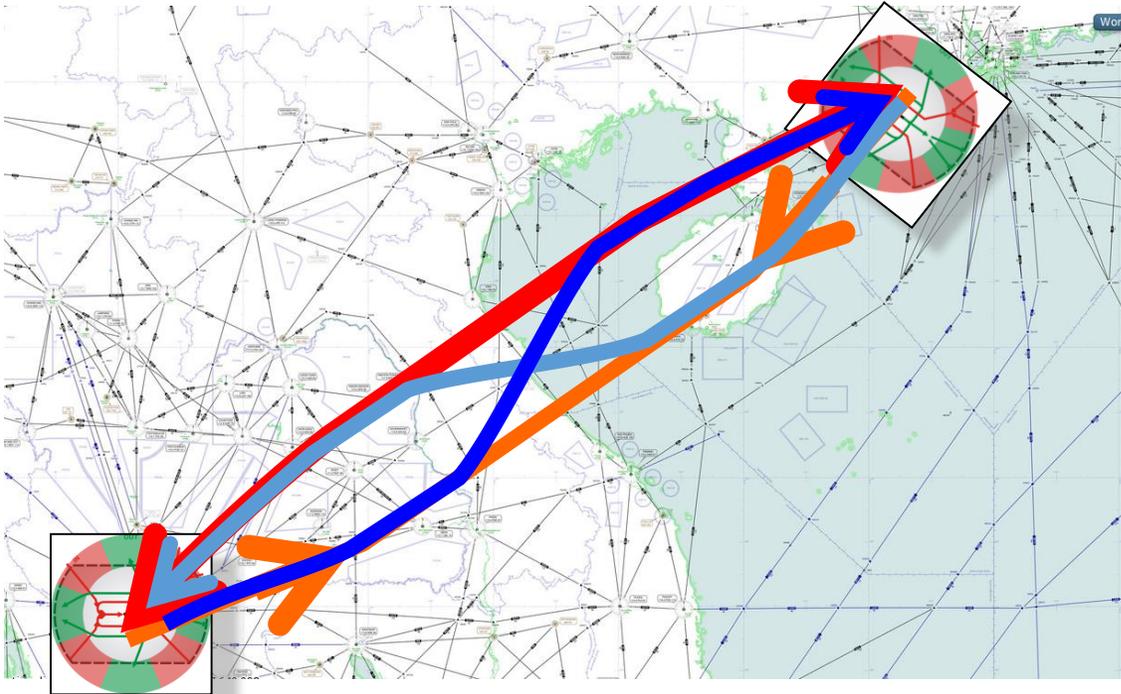
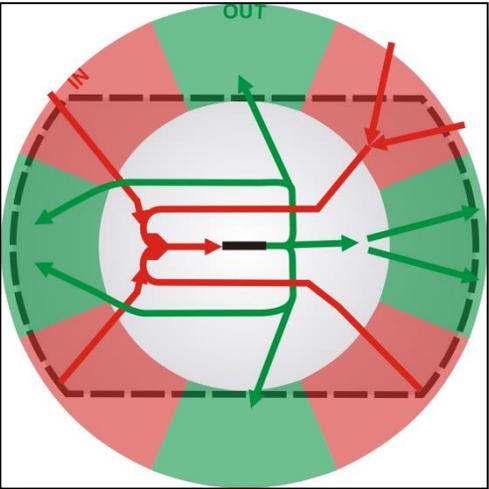


Enroute



Crossing routes in ACC – Cross when level

In TMA/APP





Questions:

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