Arab Civil Aviation Commission (ACAC)
CNS/ATM Study Update & Strategic Planning
(2015–2030)

Revised Final Report

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Revision Record

Revision	Date	Description
1.0	30 June 2016	ACAC CNS/ATM Study Update & Strategic Planning Draft Final
2.0	30 October 2016	ACAC CNS/ATM Study Update & Strategic Planning Final
3.0	10 December 2016	ACAC CNS/ATM Study Update & Strategic Planning Revised Final

Executive Summary

This Final Report addresses the study activities and analyses conducted in support of the Air Navigation Committee (ANC) since initiation in May 2015.

The intent of the Communication, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) Study was to develop both near-term requirements and longer term strategic needs to formulate a master plan for regional air navigation service provision through 2030. The specific objectives to be highlighted in the Regional Concepts for the year 2030 and during the transition from today's system include:

- Improve airspace safety and efficiency
- Improve interoperability between air navigation service providers (ANSPs) to foster seamless services across borders
- Increase airspace capacity to meet future demand requirements
- Increase access to airports
- Reduce the environmental impact of increasing traffic by providing improved ATM operations

The Airbus ProSky Study Team has assessed the current state of aviation, conducted a gap analysis between the current state and future desired state, and made specific recommendations based on their findings in the gap analysis phase. The CNS/ATM Study was to be based on the Global Air Navigation Plan (GANP), Aviation System Block Upgrades (ASBUs), and relevant documents. It ensured the coverage of all ACAC Member States and considered the interaction with neighbouring areas, including Iran. The final outcome is directly linked to (1) input provided by ACAC Member States through the use of a questionnaire, (2) extensiveness of data provided, (3) the availability of publicly accessible data, and (4) input provided by regional flight operators through the use of a questionnaire.

The specific and key recommendations are aggregated into a set of four high-level recommendations that can be used in industry forums to describe regional recommendations at the fundamental level. Each summary recommendation includes the specific recommendations that comprise its core. Appendix J has the complete list of all the findings and recommendations.

1. Summary Recommendation 1

Develop airspace, route structures, and procedures that support advanced aircraft capabilities and a transition to regional Performance-Based Navigation (PBN) implementation.

Table 1 identifies the specific recommendations supporting Summary Recommendation 1.

Table 1: Recommendations Supporting Summary 1

Rec #	NT/FT	Recommendations Supporting Summary #1
9	NT	Ensure operational procedures and practices within the flight information region (FIR) utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services within the FIR. (PIA 1-4)
10	NT	Establish sector structures that utilise common features that are agreed upon with adjacent FIRs (e.g., uniform altitude strata, matching boundaries, routing connections) beginning with high-altitude sectors. (PIA-3,4)
11	NT	Develop and implement flight procedures and sector designs that foster continuous/optimised climb and descent to the maximum extent possible. (PIA-4)
12/14	NT/FT	Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed, continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation]
16	FT	To increase airspace capacity and efficiency, we recommend all States develop concepts and implementation strategies for: (NEW) • Dynamic Airspace Management procedures to strategically mitigate airspace design, traffic volume, or other operational constraints affecting efficiency and safety. • Flexible Use of Airspace plans that will result in the transition to integrated civil-military airspace management.
17	FT	Expand SID/STAR usage and design to extend SIDs from the airport to the top of the climb, and STARs from the top of descent to the airport.
18	FT	Identify locations where space-based ADS-B can be used to supplement current ground-based surveillance to enable full airspace surveillance.
26	NT	In High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., fast track/slow track capability.
27	NT	Utilise single direction routes bi-directionally when operationally feasible. The development of additional routes offset from primary routes that would allow a fast track/slow of offload track capability is not evident.
28	NT	Consider flexible point-to-point routing for high-altitude operations, to eliminate dog-legs common within the fixed route structure, except where structured routing is required. (PIA-3)
29	NT	Develop or enhance existing Flexible Use of Airspace (FUA) procedures to provide allocation (joint use, shared use, separate use) of airspace based on tactical needs within the FIR. (PIA-3)
30	FT	In Medium- and Low-activity areas where activity is forecasted to increase either within the FIR or on routes servicing High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., a fast track/slow track capability.

Rec = Recommendation **NT** = Near-term recommendation **FT** = Far-term recommendation
PIA = Performance Improvement Area

2. Summary Recommendation 2

Achieve as close as possible to one-hundred percent interoperability among adjacent facilities in information, data, and communications exchanges by creating interfaces where none exist and maximising those that do exist.

Table 2 identifies the specific recommendations supporting Summary Recommendation 2.

Table 2: Recommendations Supporting Summary 2

Rec #	NT/FT	Recommendations Supporting Summary #2
6	FT	If not currently under development, integrate various individual air navigation service providers' (ANSPs) strategic planning efforts into a Regional Airspace and ATM strategic plan.
7	FT	Implement automation and decision-support systems, including meteorological, flight data and alert functions that are fully interoperable and integrated with functionalities that share data with adjacent FIRs. (PIA-2)
22	FT	Plan for and implement the transition of separation methods from human-centric tactical Air Traffic Control (ATC)-developed instructions to the use of ground and airborne automation decision support. (PIA-3)

3. Summary Recommendation 3

Ensure the equipment and capabilities present today are being utilised to the maximum extent possible, and controllers are trained and understand their equipment's operational capabilities and the methods available to them to personally provide effective service delivery.

Table 3 identifies the specific recommendations supporting Summary Recommendation 3.

Table 3: Recommendations Supporting Summary 3

Rec #	NT/FT	Recommendations Supporting Summary #3
9	NT	Ensure operational procedures and practices within the FIR utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services within the FIR. (PIA 1-4) [This is both a near-term and far-term recommendation]
24	FT	At currently Low-activity airports that are forecasted to increase airport activity, improve airport throughput via the application of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. Developing and training on these techniques in simulation training will help prepare for a future increase in traffic. (Policy and Training).
25	FT	At currently Low-activity airports and Area Control Centre (ACC), increase airspace capacity via application of visual separation in the approach control and en-route environs. Developing and training on these techniques in simulation training will help prepare for a future increase in traffic. (Policy and Training).
42	FT	Where airports are forecasted to increase operations, develop procedures and training plans to routinely use mixed-use runway procedures in the event there are peak periods with higher numbers of arrivals or departures. (PIA 1,3)

Rec #	NT/FT	Recommendations Supporting Summary #3
43	FT	For those airports where demand is forecasted to exceed capacity, begin to develop procedures and training plans to leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1)
68		Develop or improve effective agency policy guidance that will govern decisional criteria affecting systems, personnel, procedures, actions, and reactions to defined metrics. The policy should be tailored to modern systems and training practices and be adaptable to future changing conditions. Policy categorisations would minimally fall into two groups: (1) Management and Administration Policy and (2) Operational Policy.
62		Develop or improve training programmes for procedure and airspace designers. A formal training programme will ensure consistency in procedural development. (Training)

4. Summary Recommendation 4

All facilities should adopt the principles of traffic flow management, and these principals should be incorporated into all ATC personnel training curriculums and responsibilities.

Table 4 identifies the specific recommendations supporting Summary Recommendation 4.

Table 4: Recommendations Supporting Summary 4

Rec #	NT/FT	Recommendations Supporting Summary #4
5	NT	Continue to move toward creating, strengthening, and revising existing agreements between adjacent FIRs. These agreements should incorporate: Holding responsibilities and procedures, and Traffic Flow Management (TFM) techniques (e.g., off-loading traffic to lower density routes when tracks threaten to become saturated, dynamic airspace procedures). (PIA-3)
6	NT	If not currently under development, integrate various individual air navigation service providers' (ANSPs) strategic planning efforts into a Regional Airspace and ATM strategic plan.
41	NT	Increase airport throughput and capacity through the application of global best practice procedures. For those airports where demand nears or exceeds capacity, leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1)
48	NT	Where high traffic exists, establish Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Establish as an additional duty, ATFM procedures within FIRs of lower traffic density. Incorporate ATFM procedures into all ATC training programmes. (PIA-3)
49	NT	Establish metrics that can assist in capturing current performance data such as sector and runway capacity, and delay statistics (i.e., minutes off-ground delay, taxi time, airborne holding, diversions reroutes, miles in trail [MIT] /minutes in trail [MINIT]), which can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3)
50	NT	Enhance departure constraint management capabilities, including tactical adjustments to flight levels, route assignments, etc. (PIA-1)

Rec #	NT/FT	Recommendations Supporting Summary #4
51	NT	Reduce static ATC restrictions, such as those embedded in agreements and standard operating procedures, with more strategic and tactical traffic flow management initiatives, i.e., MIT and restrictions ‘regardless of altitude’, or multiple routes ‘as one’. (PIA 1,3)
52	NT	Establish Collaborative Decision Making (CDM) capabilities and processes for exchanging strategic and tactical information and to enable decision-making between the ANSPs and stakeholders. (PIA-3)
53	NT	Establish CDM processes for making tactical decisions to adjust pre-departure flight trajectories to aid in minimising demand-capacity imbalances. (PIA-1)
54	NT	Where demand requires it, establish a process for the automated substitution of slot times between stakeholders. (PIA-2)
55	FT	Where needed, enhance Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. (PIA-1)
56	FT	Plan for and implement flight plan and trajectory information capabilities for ANSPs and stakeholders that support both strategic and tactical CDM. (PIA-3)
57	FT	Implement traffic situational display capability for ANSPs and stakeholders, including Airport Operators, which will provide a common situational awareness of aircraft within or destined for the FIR. (PIA-3)
58	FT	In FIRs where routine holding occurs, plan for and implement time-based trajectory management. (PIA-3)
59	FT	Anticipate changes to the homogenous areas based on forecast traffic levels and determine what changes in procedures and coordination would be required to accommodate the following: • Equipment and automation requirements • An effect on local operations • Coordination and communication with tier 2 and 3 facilities • Strategic and tactical planning documentation changes • Identification of regional support to affected ANSPs • Greater involvement and coordination with regional stakeholder support organisations (i.e., ACAC, flight operators)

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A/G..Air-to-Ground

AACO ....Arab Air Carriers Organization

ABDAA ....Airborne Detect and Avoid

ACAC ....Arab Civil Aviation Commission

ACAS.....................................Airborne Collision Avoidance System

ACC ....Area Control Centre

A-CDM/ACDM ....Airport Collaborative Decision Making

ADAC ....Abu Dhabi Airports Company

ADS..Automatic Dependent Surveillance

ADS-B....................................Automatic Dependent Surveillance - Broadcast

ADS-C....................................Automatic Dependent Surveillance - Contract

AFI ....Africa-Indian Ocean

AFS ....Aeronautical Fixed Service

AFTN ....Aeronautical Fixed Telecommunication Network

AIDC......................................ATS Inter-facility Data Communication

AIM..Aeronautical Information Management

AIP ....Aeronautical Information Publication

AIS ....Aeronautical Information Service

A-MAN/AMAN.....................Arrival Management System

AMET ....Atmospheric Model Evaluation Tool

AMHS....................................Automated Message Handling System

AMS.......................................Aeronautical Mobile Service

ANC ....Air Navigation Committee

ANP..Air Navigation Plan

ANS..Air Navigation Services

ANSP ....Air Navigation Service Provider

AOP..Airport Operations Planning

APC..Approach Control

APOC.....................................Airport Operations Centre

APS ....Airbus ProSky

APV..Approach Procedure with Vertical Guidance

ArcGIS ....ESRI Graphical Information System Software

ARNS.....................................Aeronautical Radio Navigation Services

ASBU.....................................Aviation System Block Upgrade

ASEP......................................Airborne Separation

ATC..Air Traffic Control

ATCT ....Airport Traffic Control Tower

ATFM ....Air Traffic Flow Management

ATFMU..................................Air Traffic Flow Management Unit

ATM.......................................Air Traffic Management

ATN ....Aeronautical Telecommunication Network

ATS..Air Traffic Service

ATSA ....Air Traffic Situational Awareness

AVG.......................................Average

C2...Control and Command

CANSO..................................Civil Air Navigation Services Organisation

CAP..Corrective Action Plan

CAT..Category

CCO ....Continuous Climb Operations

CDM ....Collaborative Decision Making

CE ....Critical Element

CDO ....Continuous Descent Operations

CIDIN ....Common ICAO Data Exchange Network

CLDT ....Calculated Landing Time

CMP ....Code Management Plan

CNS.......................................Communication, Navigation, and Surveillance

Cont'd. ....Continued

CPDLC..................................Controller-Pilot Data Link Communications

CTOT ....Calculated Take-off Time

DANS....................................Dubai Air Navigation Services

DATM...................................Digital Aeronautical Information Management

D-MAN/DMAN.....................Departure Management System

DME......................................Distance Measuring Equipment

DOM ....Domestic

DST ....Decision Support Tool

EI...Effective Implementation

E-MAN/EMAN......................Enterprise Management System

EUR.......................................Europe

EVS ....Enhanced Vision Systems

FANS ....Future Air Navigation System

FDP ....Flight Data Processing

FF-ICE ....Flight and Flow Information for a Collaborative Environment

FIC ....Flight Information Centres

FIR ....Flight Information Region

FIS...Flight Information Service

FIXM.....................................Flight Information Exchange Model

Ft. ....Feet

FT..Far Term

FTP..File Transfer Protocol

FUA.......................................Flexible Use of Airspace

GANP....................................Global Air Navigation Plan

GASP ....Global Aviation Safety Plan

GBAS....................................Ground-Based Augmentation System

GCAA ....General Civil Aviation Authority

GDP......................................Ground Delay Program

GDP......................................Gross Domestic Product

GLONASS ....Global Navigation Satellite System

GLS ....GBAS Landing System

GNSS ....Global Navigation Satellite System

GPS ....Global Positioning System

HF ....High Frequency

IAMSAR................................International Aeronautical and Maritime Search and Rescue

IATA.....................................International Air Transport Association

ICAO.....................................International Civil Aviation Organization

ICARD ....ICAO International Codes and Routes Designators

ICC..Inter-Centre Communication

ID ....Insufficient Data

IGA ....International General Aviation

ILS...Instrument Landing System

IPO ....Independent Parallel Operations

ISASI.....................................International Society of Air Safety Investigators

ISO ....International Organization for Standardization

KPI ....Key Performance Indicator

KSA.......................................Kingdom of Saudi Arabia

LNAV ....Lateral Navigation

LOA ....Letters of Agreement

MAEP ....Middle East Airspace Enhancement Programme

MENA....................................Middle East and North Africa region

MENASASI...........................Middle East and North Africa Society of Air Safety Investigators

MET.......................................Meteorological Services for Air Navigation

METAR..................................Meteorological Aviation Report

MID.......................................Middle East

MIDANPIRG.........................Middle East Air Navigation Planning and Implementation Regional Group

MIDeANP..............................Middle East Air Navigation Plan

MIN.......................................Minute

MINIT....................................Minutes-in-Trail

MIT ....Miles-in-Trail

MLAT ....Multilateration

MVA ....Minimum Vectoring Altitude

N/A..Not Applicable

NASAC..................................National Airspace Advisory Committee

NAT ....North America

NAVAID................................Navigational Aid

NDB ....Non-Directional Beacon

NCLB.....................................No Country Left Behind

NM / nm.................................Nautical Mile(s)

NT ....Near Term

NOPS ....Network Operations Plans

NOTAM.................................Notice to Airmen

OCO ....Optimised Climb Operation

OLDI ....On-Line Data Interchange

OMDB...................................Dubai International Airport

OPFL.....................................Optimum Flight Level

OSI ....Open Systems Interconnect

PA ....Pan Asia

PANS-OPS.............................Procedures for Air Navigation Services - Aircraft Operations

PBN.......................................Performance-Based Navigation

PIA ....Performance Improvement Area

PMO......................................Project Management Office

POC.......................................Point of Contact

POET.....................................Political, Operational, Economic and Technical

PSR ....Secondary Surveillance Radars

PTT ....Project Technical Team

Q/A..Question/Answer

RASG....................................Regional Aviation Safety Group Region

RATS ....Remote Airport Traffic Service

RCC.......................................Rescue Coordination Centre

RDP.......................................Radar Data Processing

RDPS.....................................Radar Data Processing System

Rec. ....Recommendation

RFP ....Request for Proposal

RNAV ....Area Navigation

RNP.......................................Required Navigation Performance

RPA.......................................Remotely Piloted Aircraft

RPA.......................................Remotely Piloted Aircraft

RPAS.....................................Remotely Piloted Aircraft System

RPK.......................................Revenue Passenger Kilometres

RSC.......................................Rescue Sub-Centre

RSOO....................................Regional Safety Oversight Organisation

RVSM ....Reduced Vertical Separation Minimum

SAA.......................................Special Activity Airspace

SADIS....................................Satellite Distribution System for Information Relating to Air Navigation / Secure Aviation Data Information Service)

SAR.......................................Search and Rescue

SARP.....................................Standards and Recommended Practice

SBAS.....................................Satellite-based Augmentation System

SI...Service Identifier

SID..Standard Instrument Departure

SIGMET.................................Significant Meteorological Information

SMAN...................................Surface Management

SMGCS.................................Surface Movement Guidance and Control System

SMS.......................................Safety Management Systems

SNET.....................................Safety Net

SOW......................................Statement of Work

SPECI....................................Special Report (Weather)

Sq. km...................................Square Kilometres

Sq. nm...................................Square Nautical Mile

Sq. sm....................................Square Statute Mile

SSR.......................................Secondary Surveillance Radars

STAR.....................................Standard Terminal Arrival Route

SUA.......................................Special Use Airspace

SURF.....................................Surface

SWIM....................................System-Wide Information Management

SZC.......................................Sheikh Zayed Air Navigation Centre

TACAN.................................Tactical Air Navigation

TAF.......................................Terminal Airport Forecast

TBD.......................................To be Determined

TBO.......................................Trajectory-Based Operations

TELCON...............................Telephone Conference

TEM ....Technical Exchange Meeting

TFM ....Traffic Flow Management

TIBA ....Traffic Information Broadcasted by Aircraft

TIM ....Technical Interchange Meeting

TMI ....Traffic Management Initiative

TMU..Traffic Management Unit

TWR..Tower

UAE ....United Arab Emirates

UHF...Ultra-High Frequency

UIR..Upper Flight Information Region

UML..Unified Modelling Language

US / USA ....United States

USOAP ....Universal Safety Oversight Audit Program

VHF...Very High Frequency

VA...Virginia

VNAV ....Vertical Navigation

VOIP ....Voice Over Internet Protocol

VOLMET................................French origin VOL (flight) and METEO (weather)

VOR ....VHF Omni-Directional Radio Range

WACAF ....Western and Central Africa

WAFS ....World Area Forecast System

WAM ....Wide Area Multilateration

WIFS ....Internet File Service

WS...Workshop

WXXM ....Weather Information Exchange Model

XML..Extensible Mark-Up Language

1 Introduction

Airbus ProSky (the ATM [Air Traffic Management] subsidiary of Airbus) is pleased to provide this Final Report of the ACAC CNS/ATM (Communication, Navigation, and Surveillance/Air Traffic Management) Study, including the recommended strategic plans to optimise ATM capabilities within the area under the Arab Civil Aviation Commission (ACAC) coverage.

This Final Report addresses the CNS/ATM Study's activities and analysis conducted in support of the Air Navigation Committee (ANC) since initiation of the study in May 2015.

2 Background

Since the previous study in 2004–2005, there have been significant changes in the global approach to Air Traffic Management (ATM) and for aviation in the Middle East. Most notably for ATM is the adoption of the International Civil Aviation Organization Global Air Navigation Plan (ICAO GANP) development of the Aviation System Block Upgrade (ASBU) approach to ATM evolution, implementation of formalised Safety Management System (SMS), and how Air Navigation Services (ANS) are provided.

The rapid growth of aviation in parts of the region is straining ATM capabilities and spurring various localised nation re-planning efforts. As a result, the Arab Civil Aviation Commission (ACAC) launched a Request for Proposals (RFPs) for a new study to get an update of the CNS/ATM status and quickly develop a new strategy to implement a more efficient modernisation of the ATM system in the region.

During the ANC meeting (ANC32) in Morocco, December 2014, the ANC's chairman, vice chairman, and secretary approached Airbus ProSky to discuss how Airbus ProSky could cooperate with them to conduct a CNS/ATM study. Airbus ProSky and Airbus Mid-East agreed that a study addressing the near-term and strategic ATM needs and requirements in the Middle East and North Africa would be extremely beneficial to the region, and further agreed to conduct such a study.

With the geopolitical environment in the region affecting aircraft routings and flows involving nations not represented by ACAC, Airbus recommended that the study take a larger geographic perspective that also included ATM aspects for the State of Kuwait (which later became a formal member of ACAC and whose information is included in this report) and the Islamic Republic of Iran. The Islamic Republic of Iran did not respond to any information requests, thus requiring the use of publically available data to develop the Iran – Country Profile Report. This document's principal study rationale and mutual benefits are as follows:

- This region of 21 countries, spread over the Middle East and North Africa, has one of the highest air traffic growths in the world with projections for sustained growth.
- Some nations are already experiencing or approaching greater aircraft activity levels than ATM capabilities and airspace route structures can support or will be able to support.
- Legacy operational agreements and procedures between nations lack the ability to prevent oversaturating the ATM capabilities of adjacent nation ATM facilities.
- Operators, such as Emirates Airlines, Etihad Airlines, and Egypt Air, have already expressed concerns about the limitation to airspace access and excessive delays.
- The Air Traffic Flow Management (ATFM) necessary to assist in managing the imbalance between demand and available capacity will be significantly more effective in a larger regional application.
- With no immediate actions, the region is due to have numerous bottlenecks that will have an immediate effect on aviation growth, economic growth, safety, and the environment.

- The aforementioned shortfalls have a direct impact on air traffic growth.

2.1 ACAC Membership

The ACAC Member States are listed in Table 5. The States not included in the study are denoted by an asterisk (*).

Table 5: ACAC Member States

State	State
The People's Democratic Republic of Algeria	The Kingdom of Morocco
The Kingdom of Bahrain	The Sultanate of Oman
The Arab Republic of Egypt	The State of Palestine
The Republic of Iraq	The State of Qatar
The Hashemite Kingdom of Jordan	Kingdom of Saudi Arabia
The State of Kuwait	The Republic of Sudan
The Republic of Lebanon	The Syrian Arab Republic
The Great Peoples Socialist Libyan Arab Jamahiriya	The Republic of Tunisia
The Islamic Republic of Mauritania	United Arab Emirates
The Republic of Yemen	The Republic of Djibouti*
	The Federal Republic of Somalia*

Since Airbus ProSky's initial recommendation on the study's scope, the State of Kuwait joined the ACAC organisation, making it an eligible participant in the study. A decision was made to separately address the Islamic Republic of Iran. Additionally, during the study period, the Republic of Djibouti and the Federal Republic of Somalia joined ACAC; however, these two States were not included in the study. <u>All future references to and depictions of the ACAC region within this document will refer only to those States contained within the study.</u>

2.2 ACAC Region Description

The ACAC Study's Member States geographic jurisdiction is illustrated in Figure 1. While the ACAC membership is geographically contiguous, its regulatory and oversight boundaries are apportioned among three ICAO administrative regions (Europe/North America [EUR/NAT], Middle East [MID], and Western and Central Africa [WACAF]).

Figure 1: ACAC Geographical Area

These administrative distributions have an impact on planning and implementation activities, as is discussed further in this document. The State distributions are indicated by region in Table 6. The identification of the countries in each ICAO region is in Appendix A.

Table 6: ICAO Regional Distribution of ACAC Member States

ICAO Region	ACAC State(s)	ICAO Region	ACAC Member States(s)	
EUR/NAT	Algeria	**MID**	Bahrain	Oman
	Morocco		Egypt	Qatar
	Tunisia		Iraq	Saudi Arabia
WACAF	Mauritania		Jordan	Sudan
			Kuwait	Syria
			Lebanon	UAE
			Libya	Yemen

2.3 Traffic Growth

The Middle East saw the most growth over the last year with a 12.1% increase in 2015. The region currently carries 14% of the world's revenue passenger kilometres (RPKs), and this number is anticipated to grow at the percentages depicted in Figure 2.

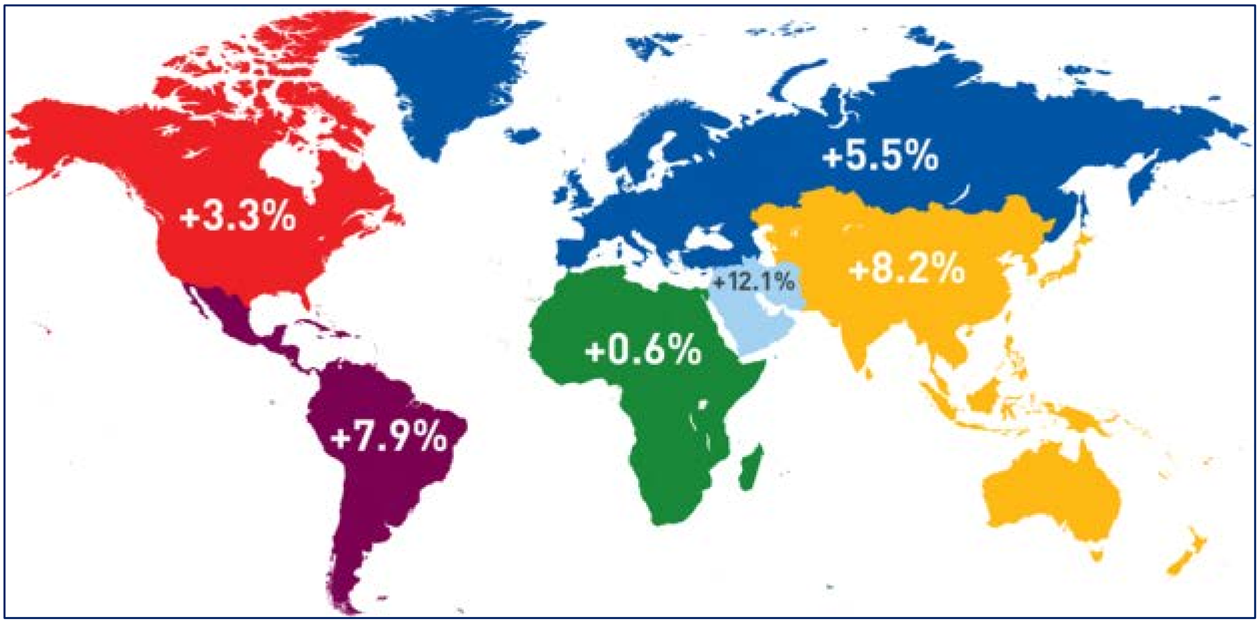


Figure 2: Middle East 2015 Traffic Increases

Airlines in the Middle East are forecasted to require 3,180 new airplanes over the next 20 years, with rapid fleet expansion in the region driving an estimated 70% of that demand, see Appendix I for the regional fleet mix. [36]

Air traffic in the Middle East is expected to grow 5.9% annually during the next 20 years. Approximately 80% of the world's population lives within an eight-hour flight of the Arabian Gulf. This geographic position, coupled with diverse business strategies and investment in infrastructure is allowing carriers in the Middle East to aggregate traffic at their hubs and offer one-stop service between many city pairs that would not otherwise enjoy such direct itineraries. [36]

The Middle East growth can be partly attributed to the continued development of airport hub operations as focal points between the East and West and supplemented by the rise of trade links between Africa, the Middle East, and Asia.

Figure 3 illustrates the estimated trend of the next two decades' annual growth: regional +5.9% versus global +4%, which is an increase in passengers from 125M to 377M. [AFI/MID ASBU Work Shop].

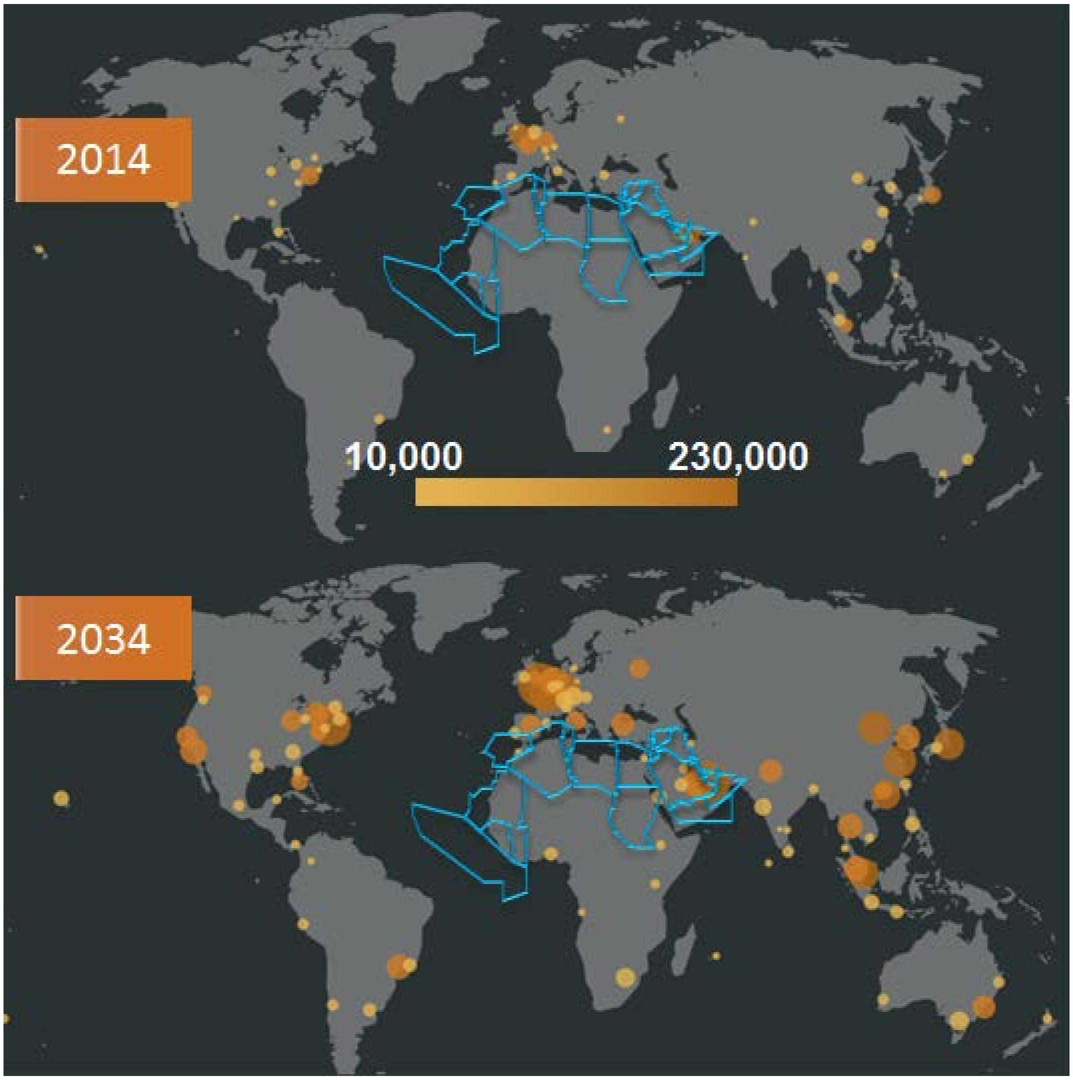


Figure 3: World Aviation Mega-City Expansions
(Source: Airbus Global Market Forecast 2014–2034)

2.4 Problem Statement

While all ACAC Member States are expected to grow substantially through the period of time that the GANP is to be implemented through the ASBU incremental approach, there are substantial differences among the States in the current and expected density of air traffic. There are also substantial differences in current capabilities and projected needs among the States; in essence, "one size doesn't fit all". However, the interdependency of traffic flows in the region necessitates a well-coordinated integrated approach to ensure that there are no gaps in capabilities as traffic crosses state borders and that "no country is left behind".

Further complicating the efforts to achieve the needed capabilities and capacities across the region is that aviation operations are being affected by economic and political challenges in several North African and Middle East markets (Libya, Syria, Yemen and Iraq). [Canso]

2.5 Prior ACAC CNS/ATM Study

The ACAC CNS/ATM Study was conducted by Sofreavia in the 2004–2006 timeframe as part of ACAC's effort to address the future of ATM and CNS in the region through 2020. That study is an excellent accounting, aggregation, and projection of equipment, capabilities, and concepts that would advance the ACAC technical and operational needs—often through a comparative baseline scenario. The initial report extensively detailed equipment placement and types, and their expansion timelines; it also addressed cost-benefit analysis, training programs, and institutional issues.

Some of the most notable aspects of that study that are of particular relevance to the current study are:

- Harmonisation and standardisation of procedures, policies, and operations across air navigation service provider (ANSP) flight information region (FIR) boundaries
- Development and implementation of formal regional and local ATFM capabilities and systems
- Aeronautical Information Publication (AIP) and Aeronautical Information Service (AIS) availability to all applicable stakeholders
- Identification of training issues and their vital connection to a successful regional Air Traffic Control (ATC) system
- Creation of three homogenous areas that reflect different fundamental traffic flows and operational air traffic density

This project recognised the value of the original study's aggregated data and supplemented that information with an operational- and human-centric focus. This approach resulted in series of recommendations intended to improve the implementation and adaptation of the equipment and capabilities contained in both studies, as illustrated in Figure 4. Each of the recommendations, especially the key recommendations, is intended to become either individual advancement projects or elements of advancement projects.

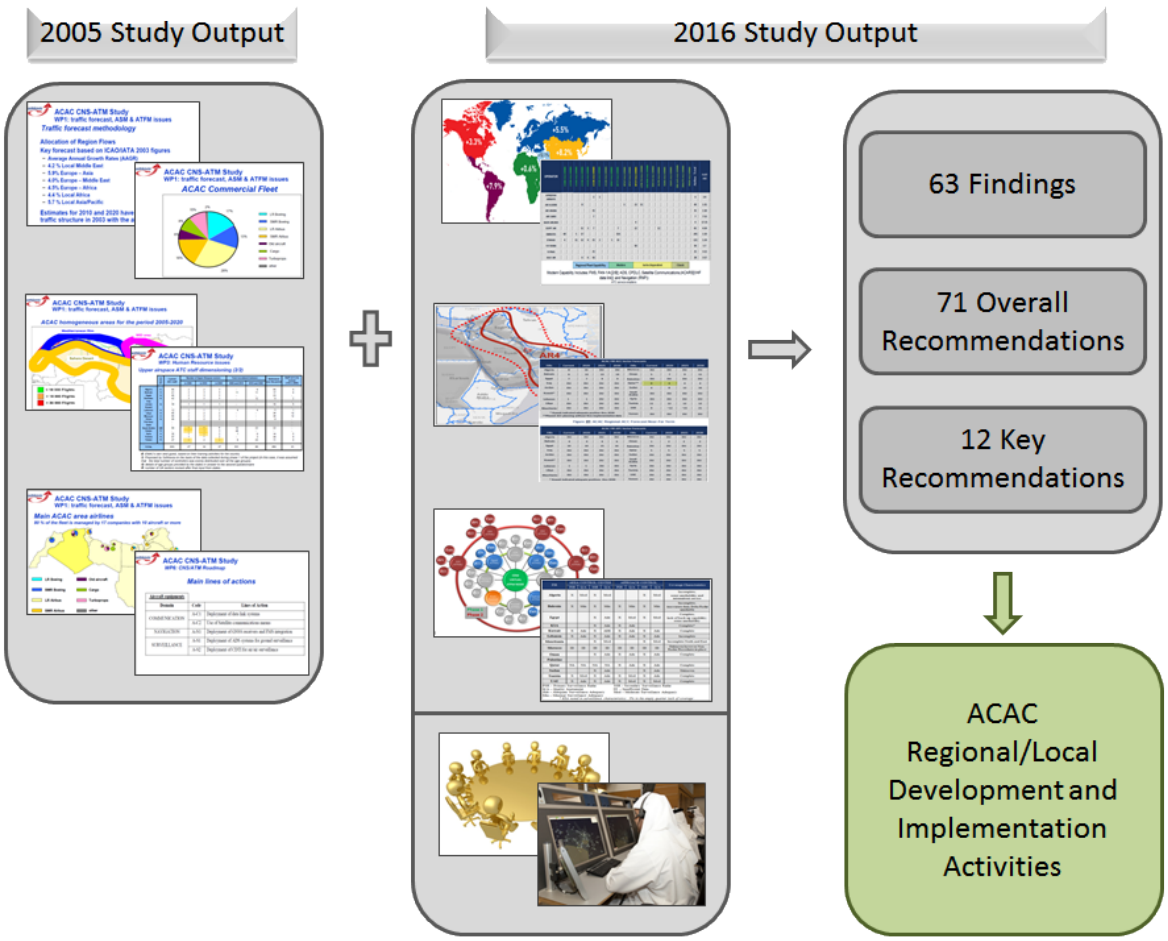


Figure 4: Study Output Comparisons

3 Project Objectives, and Scope of Work

This section of the Statement of Work (SOW) identifies what the Airbus ProSky Study Team (also referred to as "the Team") understands to be the overall objectives to the ACAC study effort along with the Team's approach and methodology to meeting those objectives.

3.1 Project Objectives

The intent of the CNS/ATM Study is to develop both near-term requirements and longer term strategic needs to formulate a master plan for regional air navigation service provision through 2030. Included will be a recommended systematic process to prioritise and balance investments intended to optimise CNS/ATM for the Arab Middle East and Northern Africa area.

The air navigation service providers (ANSPs) and civil aviation authorities have developed strategic plans to address the growing needs. However, there are substantial challenges in being able to effectively accommodate the anticipated aviation growth and expectations of its stakeholders. Some aspects of the current regional CNS/ATM system are already experiencing extended periods of airborne holding or ground departure delays. The need to increase airspace capacity, provide increased access to airports, improve efficiency for both aviation system customers and ANSPs, and reduce environmental impacts while continuing to maintain, foster, and promote safety is paramount. The specific objectives to be highlighted in the Regional Concepts for the year 2030 and during the transition from today's system include:

- Improve airspace safety and efficiency
- Improve interoperability between ANSPs to foster seamless services across borders
- Increase airspace capacity to meet future demand requirements
- Increase access to airports
- Reduce the environmental impact of increasing traffic by providing improved CNS/ATM operations

The CNS/ATM Study successfully provides a pivotal element towards meeting the strategic goals and objectives of the regional aviation sector and supporting a vibrant regional economy.

3.2 Scope of Work

The initial scope of the study is defined as follows:

- Time Scale: Traffic forecasting (traffic growth scenario for the coming 15 years) and issues analysis is required for a 15-year time horizon (2015–2030). The planning period will be initially segmented between a 5-year horizon through 2020 for identification of near-term Global Best Practices recommendations and strategic reference of the regional environment and needs in the 2025 and 2030 timeframes.
- Key performance areas: The primary focuses of the planning process will be on safety, capacity, airspace access, flight efficiency, routing flexibility, predictability, equity,

collaboration, interoperability, and ensuring security and environmental impact and best value solutions.

- Geographically: The study will cover ACAC area (19 Arab States as illustrated in Table 5 (see section 2.1), but primarily only the regional aspect is to be considered. The national aspect is included only as it pertains to cross-border and regional ATM plans and requirements.

The CNS/ATM Study is to be based on the GANP, ASBUs, and relevant documents. It will ensure the coverage of all ACAC Member States and consider the interaction with neighbouring areas, including Iran.

3.3 Key Study Elements

Key elements of the CNS/ATM Study included:

- Establish reusable databases with data collected during the study from ANSPs and involved / concerned stakeholders.
- Provide an up-to-date picture of CNS/ATM developments and needs in the ACAC region through 2030.
- Link ICAO GANP and relevant ASBU with regional planning and individual State activities to identify areas where ACAC could look to coordinate harmonised ATM.
- Identify gaps in CNS/ATM in the region and set pragmatic objectives to build the capability to solve the issues identified.
- Formulate solid recommendations to enable ACAC to enhance its coordination and planning for the region, giving objective justification for regional initiatives by ACAC.
- Support the implementation of the capacity and efficiency priorities, such as Performance-Based Navigation (PBN), Continuous Descent Operations/Continuous Climb Operations (CDO/CCO), ATFM, and Aeronautical Information Management (AIM), as well as the regional air navigation priorities defined in the Middle East region air navigation strategy

3.4 Study Phases

The Airbus ProSky Study Team conducted the study in three distinct phases. Phase 1 of the study was an assessment of the current regional airspace, ATM procedures, and CNS infrastructure. Phase 2 provided an analysis of gaps between the current system and the uncertainty of projected system demands, how to best deal with this uncertainty, and planned capabilities at defined future timeframes. Phase 3 of the study provided the formulation of recommendations to address the gaps identified in Phase 2.

In each study phase, the Team examined the ACAC Area aviation system from the following required dimensions:

1. Route Structure
2. Airspace Structure

3. Airspace Sectorisation
4. ATM Procedures
5. Terminal Operations
6. CNS Infrastructure

Table 7 lists the major study elements and key aspects that were examined.

Table 7: Study Elements and Key Aspects

Study Element	Capacity & Efficiency (Delays, Fuel)	Airport Access (Terminal Cap.)	Safety (E-R, Term)	Environment
Airspace	(Demand)-(Capacity)=Gap Routes, sectors	(Demand)-(Capacity)=Gap Routes, sectors	(Reqd Safety)-(Est Safety)= Gap OEs, MACs	(Rqd Exposure)-(Est Exposure)= Gap Emissions, noise
ATM Procedures	(Demand)-(Capacity)=Gap ATM paradigm, separation, staffing	(Demand)-(Capacity)=Gap ATM paradigm, separation, staffing	Combined with above	Combined with above
CNS Infrastructure	(System Load)-(Capacity)=Gap Coverage, accuracy, bandwidth, etc.	(System Load)-(Capacity)=Gap Coverage, accuracy, bandwidth, etc.	(Reqd Perf)-(Est Perf)=Gap Availability, accuracy, integrity	Combined with above

4 Study Approach

The Airbus ProSky approach is focused on both 2030 needs and the nearer term requirements that could be realised by 2020 and 2025. The overall approach to the CNS/ATM Study is shown in Figure 5. In the following sections, we provide further detail on our approach and how we conducted study activities.

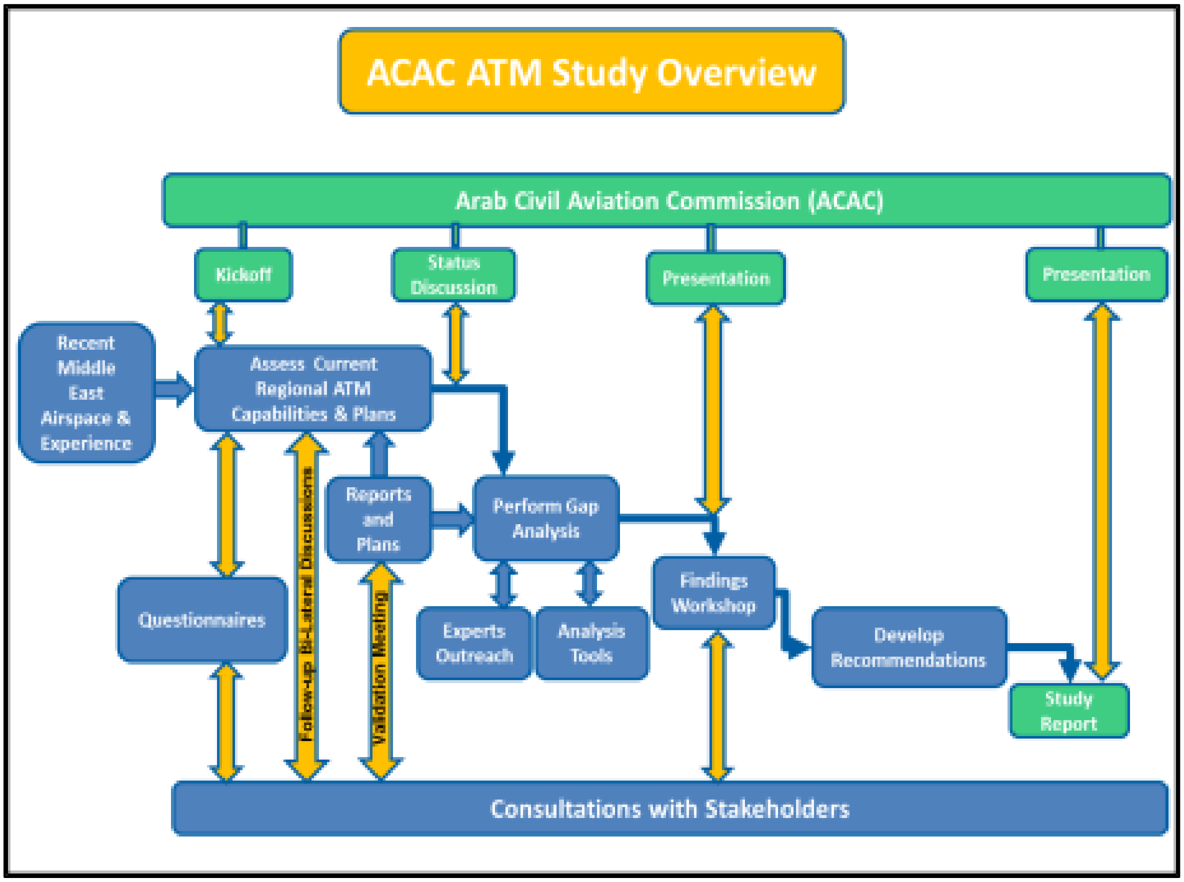


Figure 5: ATM Study Approach

4.1 Kick-off

At the kick-off, we presented the ACAC with a project plan, a draft presentation, and questions for the first round of stakeholder sessions. We prepared to work on site with the ACAC to finalise the draft presentation and questions and prepare for scheduling discussions and coordinating stakeholder sessions.

Terms of reference, roles, and responsibilities of the Team and ACAC were discussed and fundamentally agreed to. In addition, according to the "No Country Left Behind" approach, the insufficient data being collected from some concerned States (due to the political situation in the region) was recognised as a risk. More specifically, a risk that could lead to delay, limits the study's scope, or results in difficulties in the development or acceptance of the study conclusions.

4.2 Stakeholder Consultation

From the onset of this study's update, stakeholder interaction and support have been identified as two of the most critical factors in identifying and collecting the necessary data to successfully advance this project. Realising the project constraints (time and resources), the Team supplemented ACAC-Member-State-provided data with data recently collected from regional air traffic control and air traffic management in support of a major UAE regional ATM airspace and procedure redesign effort. This leveraging of information assisted the Team by providing a highly detailed perspective of a segment of the overall ACAC jurisdictional environment.

In both studies, the ACAC overall region and the localised UAE questionnaires were a major source of information. When possible, the questionnaires were supplemented with on-site work group and workshop activities. The workshop activities were more prevalent within the localised UAE project, which included the countries of the UAE (and its major flight operators—Emirates Airlines and Etihad Airways), Bahrain, Oman, Qatar, and Saudi Arabia. In both studies, information was not provided by any military authority.

Operator representation was sought and support was offered by the largest regional ACAC operator representative body—the Arab Air Carriers Organization (AACO). To leverage this unique opportunity, a separate operator-focused questionnaire was developed to obtain significant first-hand information, from a customer's perspective, on ACAC FIR service availability and its delivery. This parallel organisational and operational environment provided a natural nexus of the service provider and the service customer where exchanges of meaningful project information could be obtained. This unique jurisdictional overlap is illustrated in Figure 6. The questions developed were intended to provide the Team with the necessary data to obtain an overall customer perspective of ATC operations and flow management within the ACAC region. Responses were received from Etihad Airways, Qatar Airlines, Fly Dubai, and Gulf Air and are included in this report. The questionnaire was available online through the AACO website: http://www.aaco.org

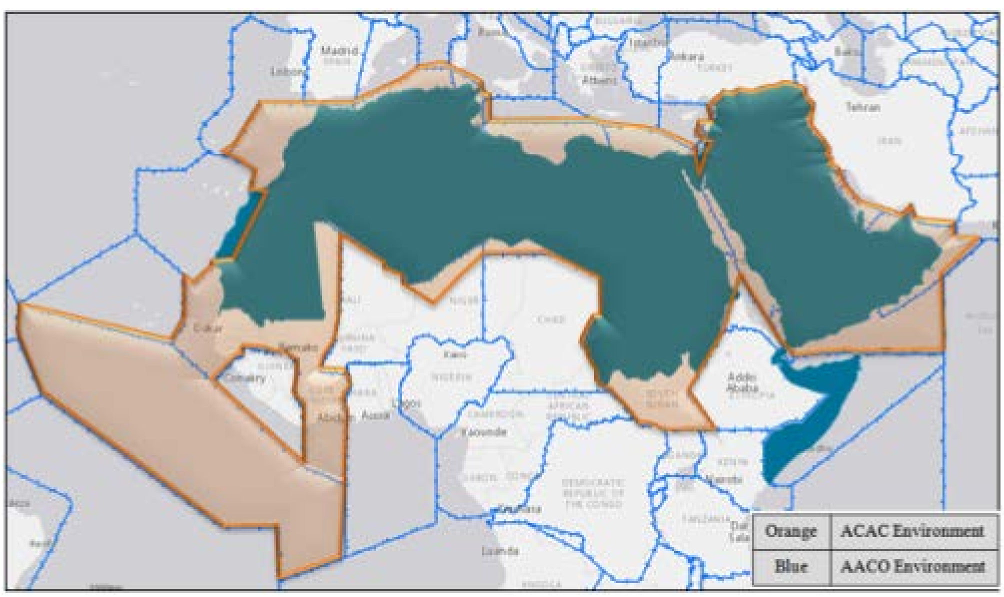


Figure 6: Jurisdictional Overlap

4.3 Stakeholder Data Gathering

The assessment's outcome is directly linked to three things: (1) input provided by ACAC Member States through the use of a questionnaire, (2) extensiveness of data provided, and (3) the availability of publicly accessible data. The team conducted a careful review of the supplied data and available public source data. In order to be able to conduct a timely and meaningful analysis, the Team was required to judge which FIRs provided sufficient and effective data.

Table 8 depicts which States were included in the study and which were not, as determined by the following criteria:

- Category 1 States – those States *included* in the study.
- Category 2 States – those States *not included* as they did not submit data or the data was received too late in the study for consideration.

Table 8: State Study Inclusion Status

Category 1 (included)		Category 2 (not included)
Algeria	Oman	Iraq
Bahrain	Palestine	Jordan
Egypt	Qatar	Libya
Kuwait	Saudi Arabia	Syria
Lebanon	Sudan	Yemen
Mauritania	Tunisia	
Morocco	UAE	

Category 1 and 2 States and the study area are illustrated in Figure 7.

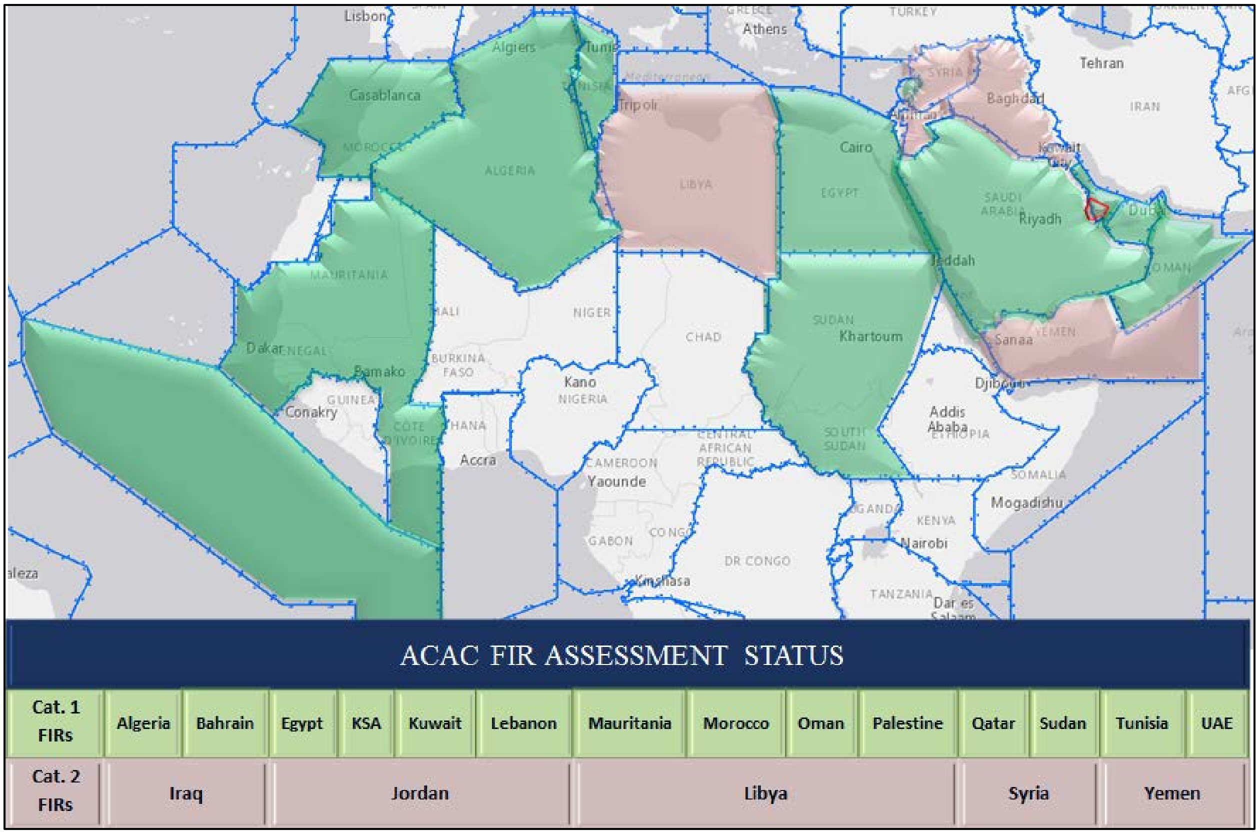


Figure 7: Category 1 and 2 State Illustration

Appendix B provides the responses obtained for both the initial and supplemental questionnaires and the effectiveness of the data provided.

4.4 CNS/ATM Assessment

The Airbus ProSky Study Team leveraged their expert understanding of airspace, ATM procedures, and CNS infrastructure, and demonstrated-ability to work closely with diverse stakeholders to assess the current and projected CNS/ATM capabilities in the ACAC region. The Team reviewed the Aeronautical Information Publications (AIPs) applicable to each of the ACAC Member States.

The Team relied heavily on the input of stakeholders using the Team members' earlier experiences in the region as a reference point in compiling and analysing stakeholder input. The assessments addressed a comprehensive breadth of airspace, ATM procedures, and CNS infrastructure aspects.

Following the stakeholder sessions, we analysed the information from the stakeholder sessions in combination with the information from the reference reports and plans. A briefing was generated and presented to the ACAC prior to starting the subsequent Gap Analysis Phase.

4.5 Gap Analysis and Findings

The key to a gap analysis is deciding on the points in time the gap will be assessed against. The Team proposed to base the gap assessment on current capabilities and compare those to ICAO Block Update 1, 2, and 3 capabilities and timeframes.

The Team evaluated gaps in the capabilities to meet forecasted activity demand and expected ASBU functionality. The assessment included a Comparative Analysis relative to:

- Global Best Practices as derived from various aviation domains
- GANP and supports ASBUs

The Team compiled the output from our experts' observations and the stakeholder consultations into a complete study describing an assessment of current Middle East ATM and North Africa gap analysis and recommendations for optimisation. We delivered the study to the ACAC and other stakeholders through interim updates and as a draft and final version.

4.6 Final Report

The Team developed and integrated this Final Report containing pertinent information from the previous deliverables. The draft of the report was provided for ACAC review prior to the completion. Once comments from the review were received, the Team updated this Final Report.

4.7 Stakeholder and Executive Presentation

Understanding the importance of stakeholder involvement to the ACAC, the Team proposed to close the collaboration loop with stakeholders to address how their input was reflected in the Final Report. We recommended that consideration also is given to making the presentation's key aspects available throughout the Middle East and North Africa civil aviation authorities, ANSPs, and stakeholder representative organisations.

4.8 ACAC Coordination

Airbus ProSky believes that a close-working relationship with the ACAC and routine interactions are essential to a successful study effort. Our approach was to provide a "quick look" briefing at the completion of all intermediate phases. For the Final Report, we are coordinated findings and recommendations with the ACAC prior to the associated stakeholder sessions. The matrix of findings and recommendations is provided in Appendix J.

5 Phase 1: Current Assessment

Our assessment process details are provided in Appendix D. This section details the current situation and the findings.

5.1 Current Capabilities and Assessment

This section does two things: (1) describes the current capabilities of the region as determined by ACAC-Member-State-provided information and other publically available data sources, and (2) provides a discernible operational assessment of those capabilities. The assessment utilises the categorisation methodology, described in Appendix E, which is used to organise the ACAC region into a series of unique derivative groupings based on current capabilities, and airspace and airport densities. The resulting groupings can be used by ACAC to determine where current or future resources may be needed to enhance or elevate local capabilities.

The ICAO and Regional Sub-Group requirements and guidelines were compared to the current and proposed FIR abilities and capabilities—as they pertain to the core operational topics of communication, navigation, surveillance, automation, and air traffic management. These requirements and guidelines were collected from sources which included: Middle East Air Navigation Plan (MIDeANP), CNS Sub-Group Reports, GANP, Civil Air Navigation Services Organisation key performance indicators (CANSO KPIs), etc.

The Team approached the assessment process by first determining if the capability was available and then assessing the current usage of the capability or the quality of service. Capabilities include equipment, systems, or procedures. The quality of service is an assessment of how the equipment, system, or procedures are currently being used in the day-to-day operation. Based on the survey results and other available data, an assessment was assigned to the capabilities reported by each responding State, and when available, to the quality of service, as determined by the Team. For example, if a State reported that Controller Pilot Data Link Communications (CPDLC) was available, the Team assessed the State as Highly Capable for that system. However, if the system is not operational, the quality of service was assessed as No Service Provided. Definitions for capabilities and quality of service values are defined in Table 9 and Table 10.

Table 9: Capability Definitions

Capability	Definition
Highly Capable	The subject system/method provides most of the modern era communication capabilities needed, and at a high level of reliability that results in efficient air traffic services.
Moderately Capable	The subject system/method provides many of the modern era communication capabilities needed, and at a medium level of reliability that results in satisfactory air traffic services.
Minimally Capable	The subject system/method does not provide any of the modern era operational capabilities needed, and at a poor level of reliability that results in inconsistent air traffic services.

Capability	Definition
No Capability	The subject system/method is unavailable.
No data	An assessment was not possible because either no data was provided or the data was insufficient to perform an assessment

Table 10: Quality of Service Definitions

Quality of Service	Definition
Good Quality of Service	The subject system/method provides stakeholders (service providers and operators) with routinely predictable, repeatable, and uncomplicated services that routinely result in efficient air traffic services.
Marginal Quality of Service	The subject system/method provides stakeholders (service providers and operators) with intermittently predictable, repeatable, and uncomplicated services that usually result in efficient air traffic services.
Substandard Quality of Service	The subject system/method provides stakeholders (service providers and operators) with unpredictable, unrepeatable, and complicated services that routinely result in inefficient air traffic services.
None	No service provided.
No Data	An assessment was not possible because either no data was provided or the data was insufficient to perform an assessment.

5.2 Current Capability

Consistent with the defined scope of this study, the assessment of the current capabilities in the Region are generally presented as high-level observations based on the data provided by the individual States in the study area. The assessment outcome is directly linked to the input provided by ACAC Member States through the use of two questionnaires and the extensiveness of the responses. Additionally, the Team used publicly available data.

We failed to find any meaningful data on specific operational policies and practices; therefore, we were reliant on what was provided. With few exceptions, internal documents such as Standard Operating Procedures were not provided. There were great variations in the completeness of the surveys. We received responses from approximately 50% of the States surveyed. Some of these States submitted both surveys, while some submitted only one of the surveys. Since the project scope did not include interfacing with the operational stakeholders, the assessment is based on the Team's interpretation of the survey responses. The shortfall of specific facility data precluded full regional assessments.

Within the FIRs studied, there are significant differences in traffic density. This affects the current capabilities. Those with the greater need seem to have the greater capability, which is consistent with the global navigation plan. However, increases in traffic activity levels in the Region are expected to be among the highest in the world through the 2030 timeframe and beyond with the Middle East FIRs expected to experience the greatest increase in total traffic activity. Considering these projected increases in traffic for this region of the world, emphasis should be placed on maximising current capabilities by ensuring internal procedures and working practices are as efficient as they can be, even if the current activity is low.

Assessments of the communication, navigation, surveillance, and automation, and Air Traffic Management capabilities within the Region are in the following sections.

5.2.1 Communication

Upon review of the data provided in the area of Communication, the following assessments were made:

- All the FIRs that provided data have very high frequency (VHF) and ultra-high frequency (UHF) capability. However, the quality of the air/ground voice communication was rated as marginal in one High-activity FIR and one Medium-activity FIR and substandard in one High-activity FIR. Deficiencies are believed to be caused by equipment limitations or radio coverage limitations.
- High-frequency (HF) communications are present in three of the FIRs assessed. Of those that reported HF capability, the quality of HF performance was reported to be good in one Low-activity FIR, marginal in one Medium-activity FIR, and substandard in one High-activity FIR.
- Controller Pilot Data Link Communications (CPDLC) capabilities are being pursued by FIRs and most facilities reported to currently have CPDLC capability. Very few facilities currently have operational CPDLC.
- No data was provided to assess emergency communications back-up capabilities
- Air Traffic Services' point-to-point communication facilities (landlines, network circuits) were assessed as highly capable, except in two High-activity FIRs where it was assessed as moderate capability.
- Search and Rescue (SAR) procedures are in place but no data was received that indicated SAR agreements with surrounding facilities have been established and are in place.
- The number of inter/intra-facility ATC coordination communication lines was assessed as substandard in one High-activity FIR and marginal in one High-activity FIR, one Medium-activity FIR, and one Low-activity FIR. The remaining FIRs that submitted data indicated adequate lines available.
- Of the FIRs that responded, data link and landline performance were assessed as substandard in one High-activity FIR and marginal in the remaining FIRs, with one exception. One Medium-activity FIR assessed performance as good.
- Most FIRs responding to the surveys indicated contingency and nominal communications procedures are in place.
- The timeliness and accuracy of Metrological data reception were assessed as good throughout most of the FIRs responding to the survey but as marginal in one High-activity FIR and one Medium-activity FIR.

- Manual coordination and excessive coordination constraints cause impact in the form of airborne holding, departure stops, speed restriction, altitude restriction, mile-/minute-in-trail (MIT/MINIT) restriction, and re-routes.
- Of the FIRs assessed, all did not respond to an assessment of the impacts caused by coordination constraints. Of those that did respond, the impact in the following areas exists:
    - Amount of coordination – causes moderate impact.
    - Airborne holding – coordination constraints result in moderate impact except within one High-activity FIR and one Medium-activity FIR where no impact was reported.
    - Departure stops – coordination constraints result in moderate impact except within one High-activity FIR and one Medium-activity FIR where no impact was reported.
    - Speed restrictions – coordination constraints result in moderate impact except within one High-activity FIR and one Medium-activity FIR where no impact was reported.
    - Altitude restrictions – coordination constraints result in moderate impact except within one High-activity FIR and one Medium-activity FIR where no impact was reported.
- Mile/Minute in trail restrictions – coordination constraints result in high and moderate impact. Automatic Dependent Surveillance - Contract (ADS-C) may be being used in some North African FIRs to fill in coverage gaps.
- ATS Inter-facility Data Communication/On-Line Data Interchange (AIDC/OLDI) capabilities are being deployed with many FIRs and some currently have the capability, but testing, implementation, and operational use have not been reached because of adjacent FIR capabilities.

5.2.2 Navigation

Upon review of the data provided in the area of Navigation, the following assessments were made:

- All FIRS have area navigation (RNAV) routes and some plan to implement Required Navigation Performance (RNP) approaches in the near term.
- Ground-based navigation capabilities are inferred as adequate by responding FIRS. However, the ground-based route structure is highly constrained due to the relatively small number of ground navigational aids (NAVAIDs), thereby limiting options to classic capability aircraft.
- Limited migration to GLS (Ground-Based Augmentation System Landing System) was reported.
- There is high-Instrument Landing System (ILS) capability at major airports throughout the Region.

- Little data received on airport lighting systems.
- Airport and En Route Ground-based navigation systems (e.g., VHF omni-directional radios [VORs], distance measuring equipment [DME], tactical air navigation [TACAN], and non-directional beacon [NDB]) are available throughout the FIRs assessed. Not enough data was submitted to assess the quality of service of these systems.
- Published approach and departure procedures are available throughout the FIRs assessed.
- No data was received regarding system status monitoring capabilities.
- System outage and/or service limitation notification process (i.e., Notices to Airmen [NOTAMs]) are in place and published in a timely manner for stakeholder notification and planning.
- Collaboration with stakeholders when developing navigation procedures generally is not present.
- Documentation of system outage and restoration metrics and analysis of the same were not available.
- Of those that responded, adequate system failure or degradation contingency planning is in place.
- The majority of the ACAC FIRs either have or are developing PBN implementation planning as depicted in Figure 8.

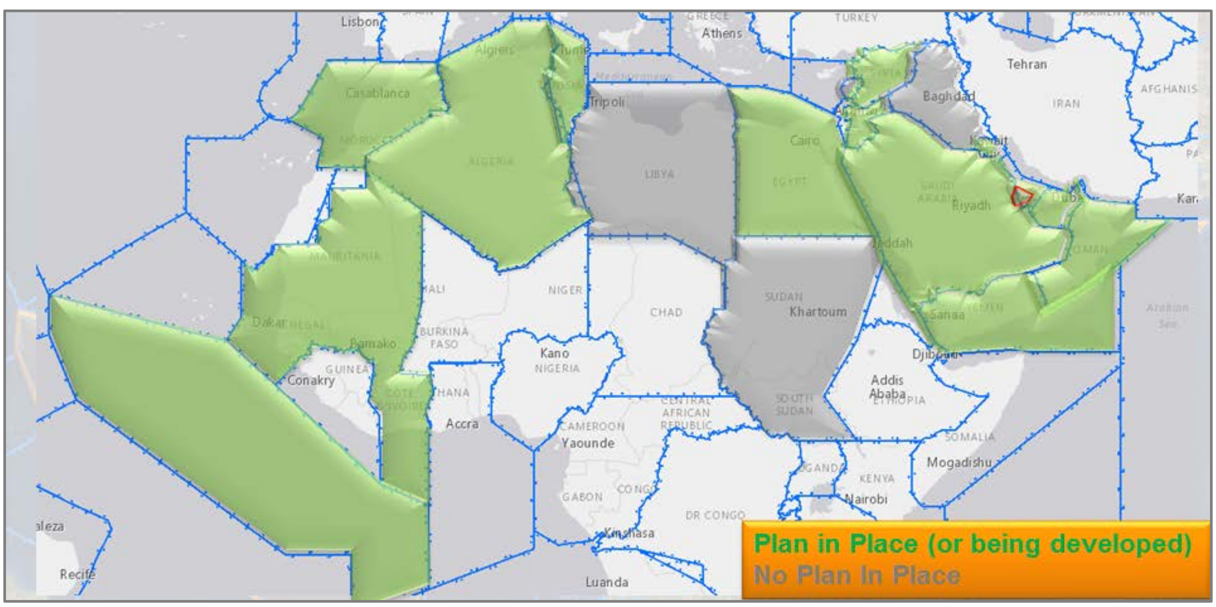


Figure 8: ACAC Regional FIR PBN Planning (Source: ICAO Air Nav Report 2015 and Surveys)

- PBN approach procedures have been implemented at international airports to a percentage of the instrument runways. Current capability among the High-activity FIRs ranges from 44% to 100%; among the Medium-activity FIRs, two have achieved 100% implementation with the remainder having achieved less than 20%.

- Regional implementation of PBN procedures has a percentage of instrument runways at international airports with approach procedure with vertical guidance (APV) or lateral navigation (LNAV)-only procedures, as depicted in Figure 9 [34].

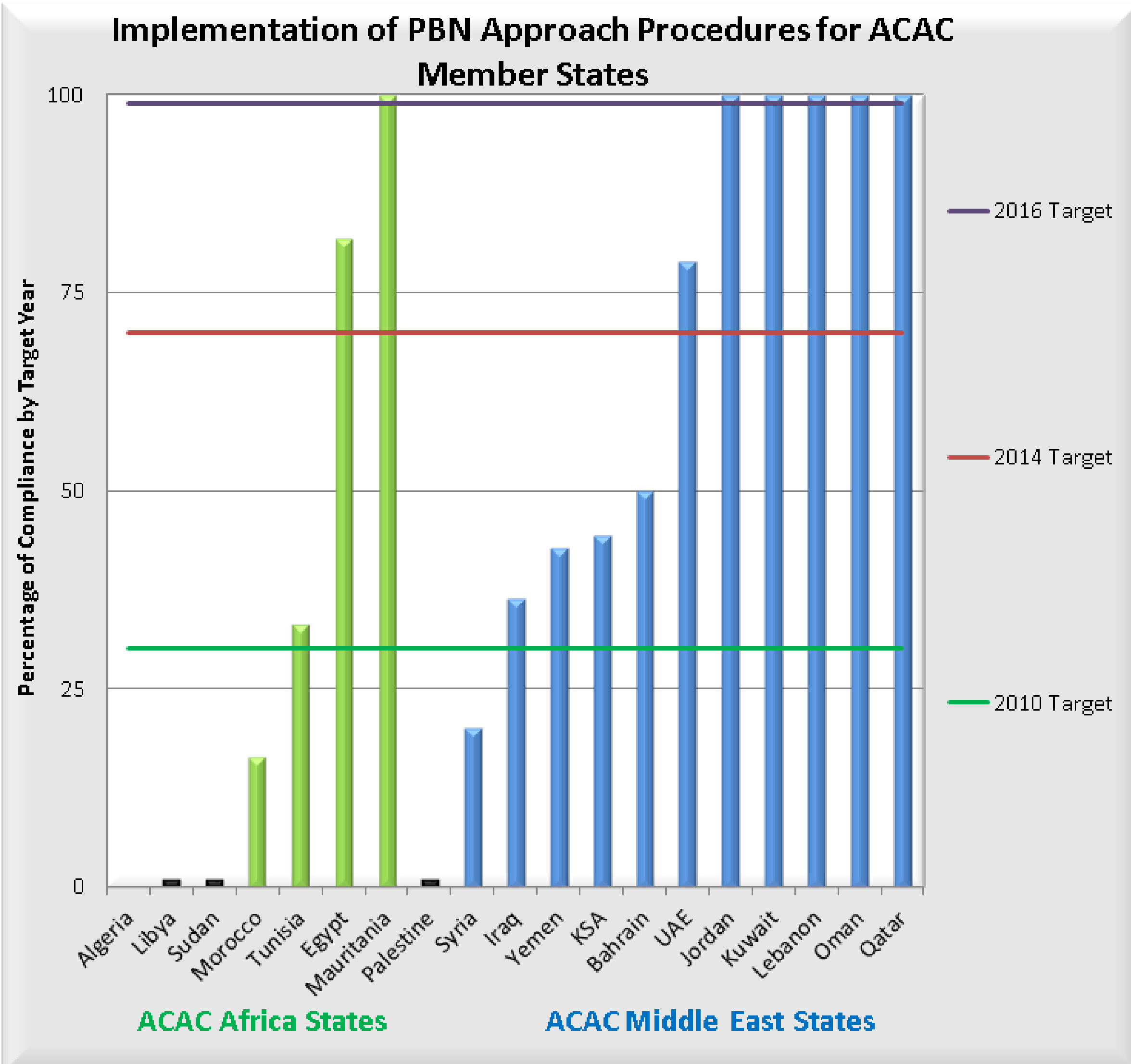


Figure 9: Implementation of PBN Approach Procedures for the ACAC Member States

The current status of Air Navigation compliance for ALL of Africa is depicted in Figure 10. [34], [37]

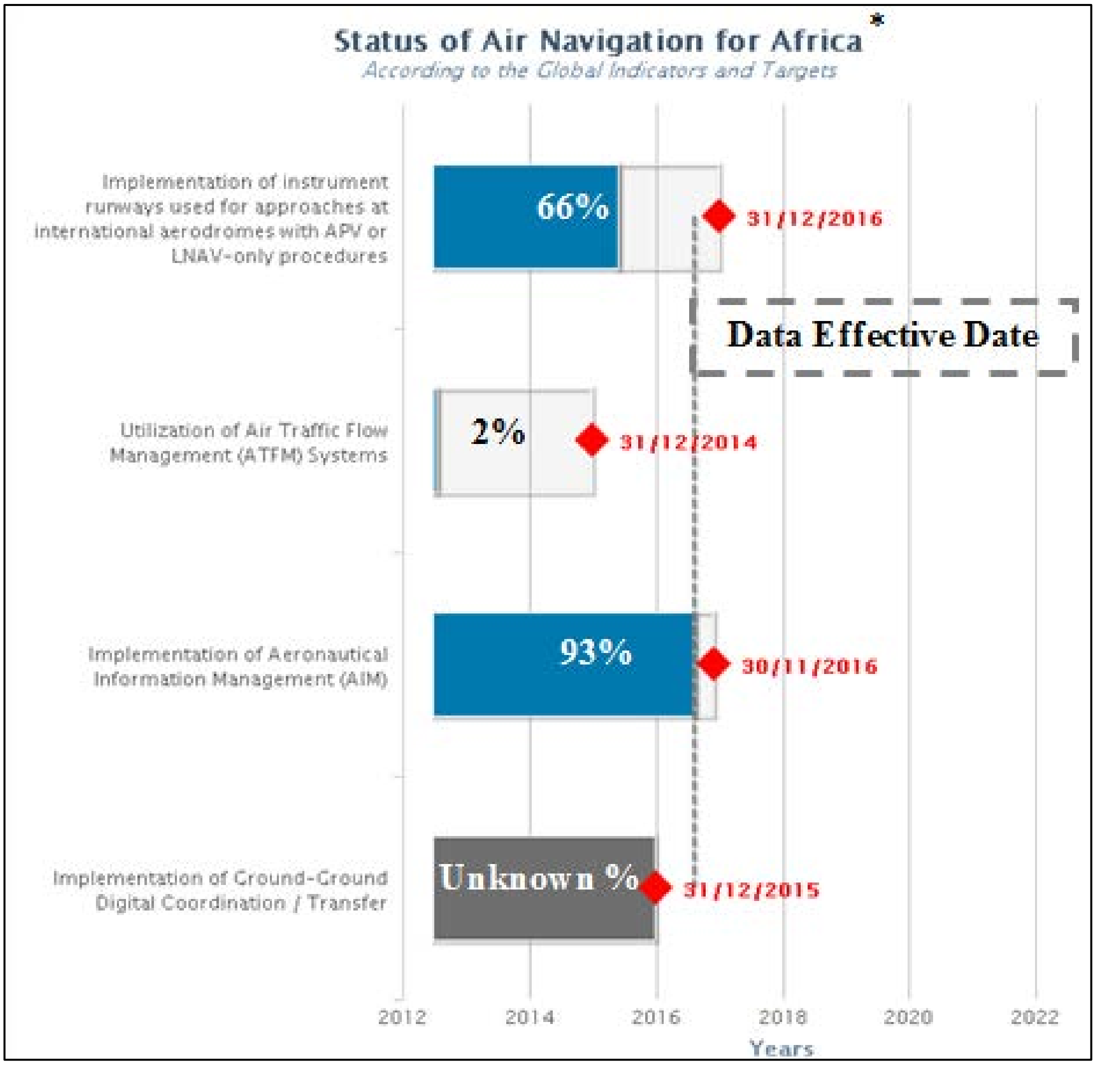


Figure 10: Status of Air Navigation for Africa

*Data Effective Date: August 9, 2016

See Appendix C for a listing of each of the African States considered in the development of the overall African status values.

- The current status of Air Navigation compliance for ALL of the Middle East is depicted in Figure 11.

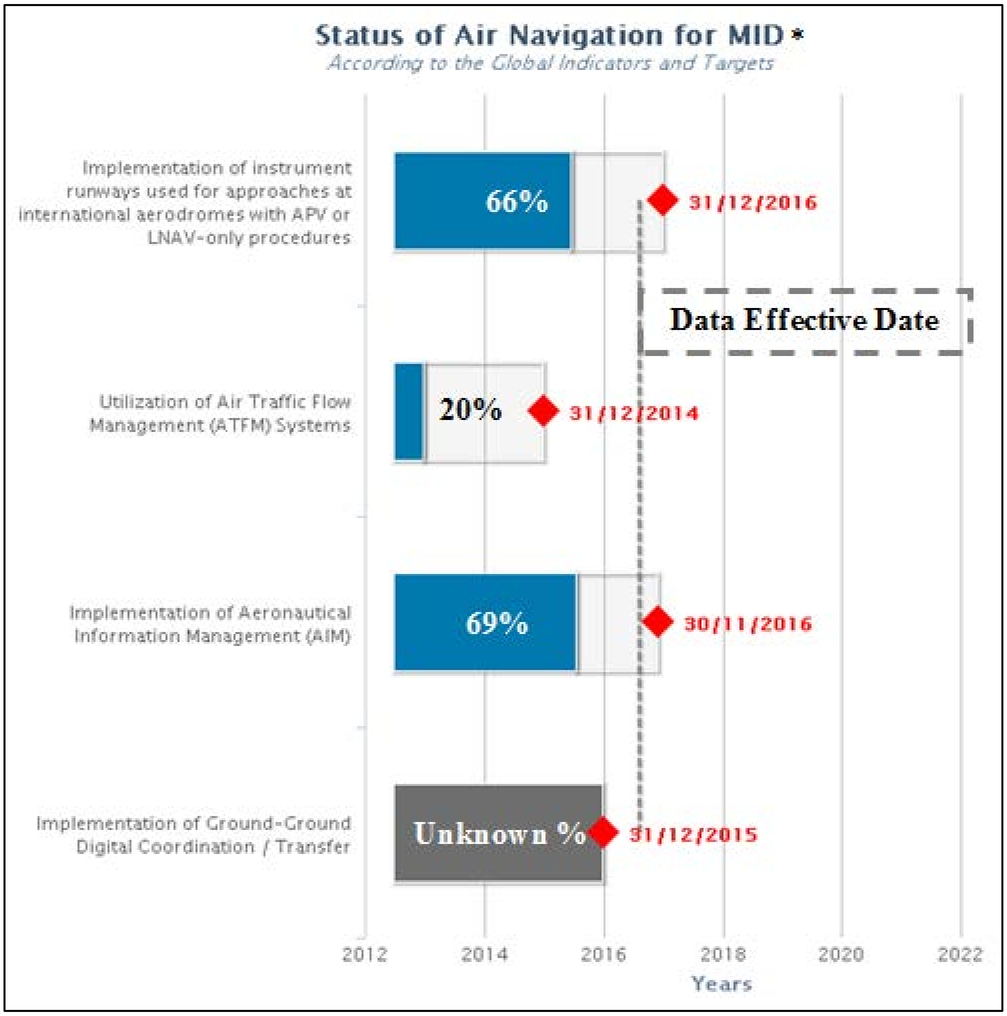


Figure 11: Status of Air Navigation for the Middle East

*Data Effective Date: August 9, 2016

See Appendix C for a listing of each of the Middle Eastern States considered in the development of the overall Middle East status values.

5.2.3 Surveillance and Automation

Upon review of the data provided in the area of Surveillance and Automation, the following assessments were made:

- Most FIRs possess primary and secondary radar. One Low-activity FIR reported no primary surveillance radar, but it does have secondary surveillance radar. The gaps in coverage were reported as unreliable or having intermittent coverage in at least one High-activity FIR. Table 11 lists and Figure 12 depicts the States that have reported their surveillance capabilities and adequacies.

Table 11: Radar Coverage Characteristics

FIR	AREA CONTROL CENTER				APPROACH CONTROL				Coverage Characteristics
	PSR	Q/A	SSR	Q/A	PSR	Q/A	SSR	Q/A	
Algeria	X	Mod	X	Mod			X	Mod	Incomplete; some unreliability and intermittent service
Bahrain	X	Min	X	Min	X	Min	X	Min	Complete; some inaccurate data; Doha Radar unreliable
Egypt			X	Ade	X	Mod	X	Mod	Complete; lack of back-up capability; some unreliability
Iraq	ID	ID	ID	ID	ID	ID	ID	ID	Unknown
Jordan	ID	ID	ID	ID	ID	ID	ID	ID	Unknown
KSA			X	Ade	X	Ade			Complete*
Kuwait	X	Ade	X	Ade	X	Ade	X	Ade	Complete
Lebanon	X	Ade	X	Ade	X	Ade	X	Ade	Incomplete
Libya	ID	ID	ID	ID	ID	ID	ID	ID	Presumed no coverage
Mauritania			X	Mod			X	Mod	Incomplete North and East
Morocco	ID	ID	ID	ID	ID	ID	ID	ID	Unknown, however Non-Radar Procedures in place
Oman			X	Ade	X	Ade	X	Ade	Complete
Palestine					ID	ID	ID	ID	Unknown
Qatar	N/A	N/A	N/A	N/A	X	Ade	X	Ade	Complete
Sudan			X	Ade			X	Ade	Incomplete
Syria	ID	ID	ID	ID	ID	ID	ID	ID	Unknown
Tunisia	X	Mod	X	Ade	X	Mod	X	Ade	Complete
UAE	X	Ade	X	Ade	X	Mod	X	Mod	Complete
Yemen	ID	ID	ID	ID	ID	ID	ID	ID	Unknown

PSR – Primary Surveillance Radar
SSR – Secondary Surveillance Radar
Q/A – Quality Assessment
ID – Insufficient Data
Ade – Adequate Surveillance Adequacy
Mod – Moderate Surveillance Adequacy
Min – Minimal Surveillance Adequacy
N/A – Not Applicable

***** *KSA noted in surveillance characteristics: 3% in the empty quarter lack of coverage*

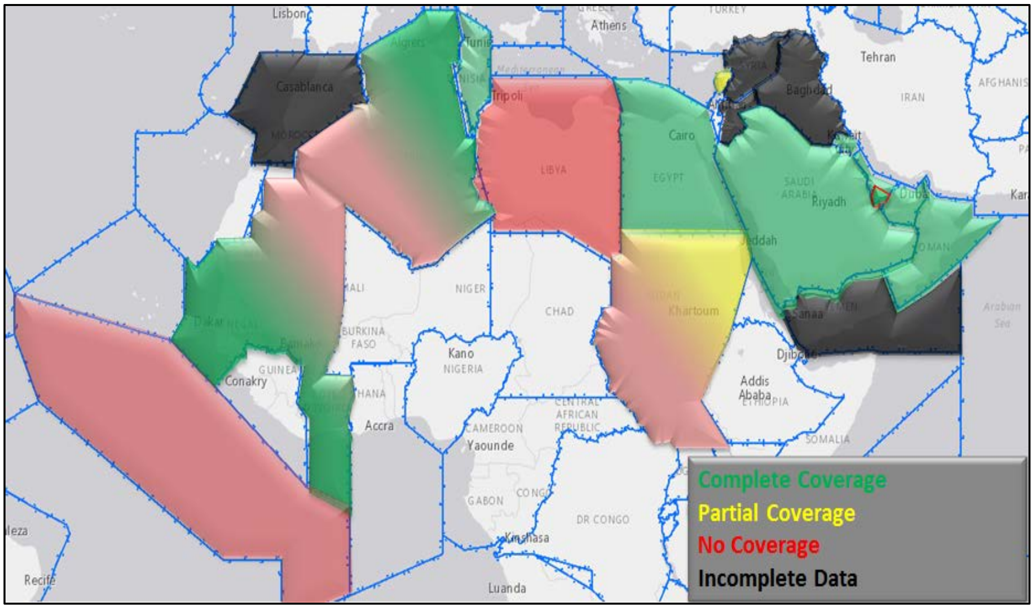


Figure 12: Radar Coverage Depiction

- Backup radar capabilities are limited.
- No outages record or data was provided to determine the impact from a loss of radar.
- All FIRs responding to the surveys seem to have the ability to filter surveillance data to fit controller needs.
- Most FIRs reported moderate or better weather display and filtering capabilities. One High-activity FIR indicated that its ability is minimal.
- Interfaces with bordering facilities allowing coordination and automated transfer of data are minimal or non-existent throughout the Region.
- No data was provided regarding space-based Automatic Dependent Surveillance - Broadcast (ADS-B) capability awareness and planning development.
- Ground-based ADS-B capability is being pursued at most FIRs for Area Control Centres (ACCs) and some Approach Facilities. It is expected to be operational by 2020 for most of those that were planned, as shown in Figure 13.

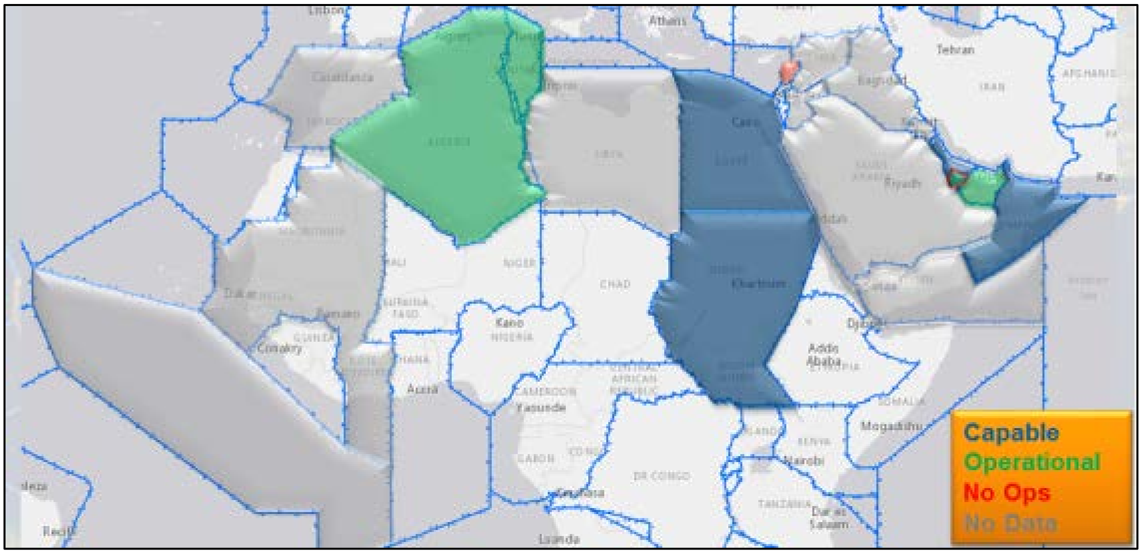


Figure 13: ACAC FIRs' Ground-Based ADS-B-Out Capability (Source: Surveys, ICAO 2014)

- ADS-C capability is operational in two larger FIRs, as shown in Figure 14.

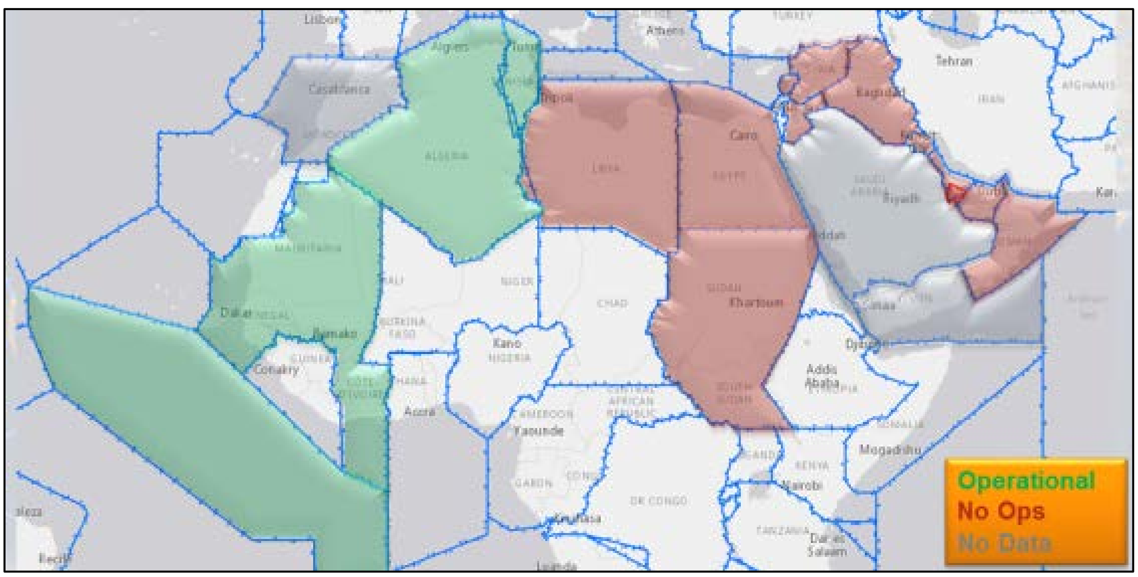


Figure 14: ACAC FIRs ADS-C Capability (Source: Surveys, ICAO 2014)

- The responses indicated that adjacent facility procedures and/or agreements are minimal throughout the Region.
- The High-activity FIRs that responded indicated ICAO flight compliance. Among the Medium-activity FIRs that responded, one is compliant and one is not. Only one of the Low-activity FIRs provided a response and it indicated compliance.
- Most FIRs reported the lack of automated inter-facility handoffs.
- All FIRs that responded indicated that controllers have access to automation depicting pertinent radar and flight data and have the ability to filter surveillance data to fit controller needs.

- Automated partial or complete flight data processing available is in most FIRs that provided information.
- Automated flight coordination with adjacent airspace is very limited throughout the Region.
- Automated point-out capabilities generally are not available throughout the Region.
- Automation provides electronic flight strip displays throughout most of the FIRs that provided information, with the exception of one Medium-activity FIR.
- Of the FIRs that provided information, automation that enables multiple separation standard recognition capability is available at two High-activity FIRs, one Medium-activity FIR, and one Low-activity FIR. It is operational within three of the FIRs that provided information.
- The capability for the automation to apply variable separation minima based on individual aircraft equipage is not available among the FIRs that provided information.
- Traffic replay is available throughout the Region
- Automation is capable of tracking high volumes of targets. There was no indication that systems were approaching their capacity or of a loss of data due to the volume of targets.
- Generally, automation does not support merging and spacing decisions except for one High-activity FIR and one Medium-activity FIR that reported this asset.
- Flow management automated information and future traffic levels automation are available in some High-activity and Medium-activity FIRs.
- Of the FIRs that provided information, surface surveillance is currently available within two High-Activity FIRs and one Medium-activity FIR.
- Some, but limited, sharing of surveillance data exists among FIRs.
- Inter/intra-facility contingency plans for a loss of radar or automation are in place within the FIRs that provided information.
- The broad use of non-radar procedures in a radar environment across the Region limits the benefits provided by surveillance capabilities and adds to the workload of controller and flight crews.
- Substantial increases in the automation capabilities to support the GANP capabilities are for the most part in process or being planned.
- ANSPs do not have access to adjacent ANSP surveillance and automation information.
- Most FIRs possess highly capable automation systems but lack inter-facility integration.
- Space-based ADS-B capabilities are expected to be operationally available in 2018; however, little planning information was provided in this area.

5.2.4 Air Traffic Management

Upon review of the data provided in the area of Air Traffic Management, the following assessments were made:

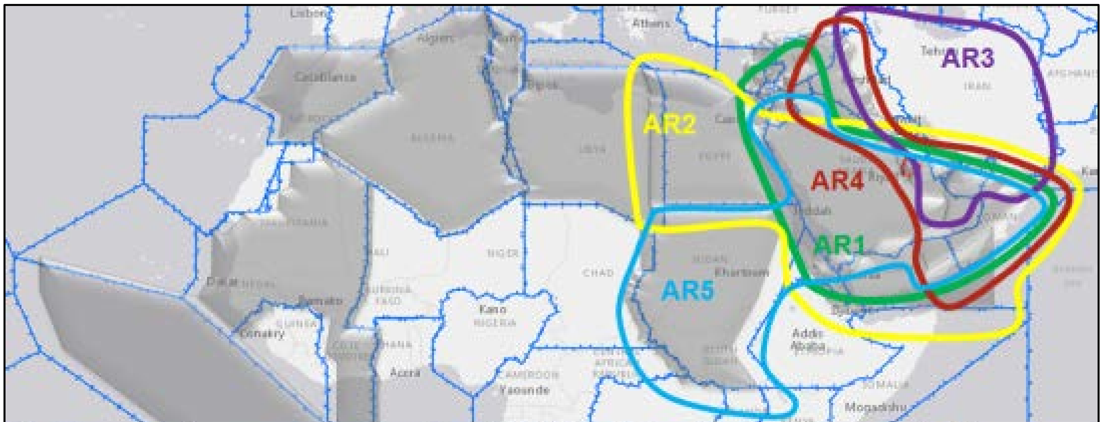
- Middle East traffic projections are the world's highest, resulting in sudden increases in the traffic volume now impacting the ability of many FIRs to efficiently accommodate demand. Advancements and efforts are being made in recognising future demand capacity imbalances in several local FIRs and developing airspace modifications to accommodate traffic projections.
- Regionally, the ATM systems are modern and highly capable but lack the necessary integration to fully realise seamlessness and obtain maximum efficiencies in operations.
- Air traffic management at the local levels are moderately effective, yet when viewed as an integrated element within the region, their effectiveness becomes minimally effective. Collaborative Decision Making (CDM) activities at the operational level are expanding in select FIRs.
- Air traffic service provision and procedures in many cases are not commensurate to modern aircraft capabilities.
- On-hand staffing levels are a concern, especially in those facilities where the traffic volume is already high, suggesting that service provision may be impacted.
- Demand rates and delay data are not readily available, suggesting inconsistent metrics identification, collection, and analysis processes.
- Operational situational awareness is mostly resident to the local facility with minimal capability or mechanism to obtain or convey data.
- Inter-facility space requirements substantially limit airspace capacity and efficiency.
- Service provision is meeting the nominal demands of the responded FIRs; however, peak and unanticipated capacity imbalances are problematic to all stakeholders.
- Airspace efficiency ranged from moderately adequate to adequate.
- Operational impacts to services resulting from agreements and lack of agreements noted.
- Little 'regional' impact is attributed to Special Activity Airspace (SAA); however on the micro-regional level, SAA operations such as the UAE (OMR54) provide significant operational impact beyond the UAE FIR and require greater use of Flexible Use of Airspace (FUA).
- This is no indication that Visual separation is used other than at Airports. Visual separation is an effective tool for controllers (en-route and approach control) and can increase airspace capacity, especially in the approach areas.
- Staffing ranges from very good (Egypt) to very poor (Bahrain).
- Documentation currency variations exist among some FIRs.

5.2.5 Air Traffic Flow Management

Upon review of the data provided in the area of Air Traffic Flow Management, the following assessments were made:

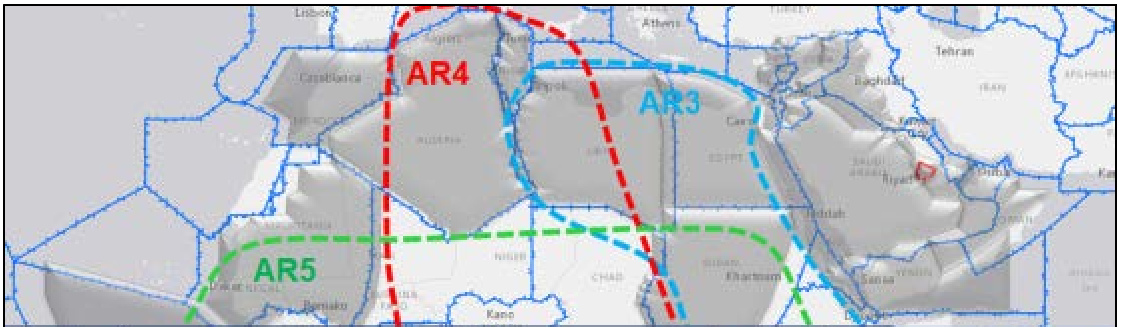
- An integrated ATFM system/capability as a formal definition does not exist within the region.
- Capacity-limiting Traffic Management Initiatives (TMIs) appear to be embedded in Agreements and procedures making them in effect regardless of demand.
- Limited ATFM functionality is being managed or planned through AMAN/DMAN.
- The ground stop support for adjacent facility saturation.
- Capacity limiting requirements in Letters of Agreement (LOAs).
- Local initiatives that are often used to mitigate local concerns without a holistic view of their impact on adjacent or distant FIR operations.
- Demand rates and delay data are not readily available, suggesting inconsistent metrics identification, collection and analysis processes.
- Metrics to identify the areas of strength and weakness, e.g., Sector capacities and Route demand are not well defined.
- Limited or no CDM is evident at the operational facility level. Minimal processes exist to modify static local initiatives to accommodate real-time needs and to collaboratively develop and disseminate local flow related information. Especially, Stakeholder engagement in identifying focus areas and when considering procedure changes and/or establishing traffic management initiatives is absent.
- Locally available decision support tools are not efficiently utilised and their output is not available to other regional FIRs to foster regional level decisions.
- Several high-demand FIRs not large enough for strategic and pre-tactical ATFM application.
- Regional ATFM capability would be advantageous to help manage capacity To effectively manage demand – capacity imbalances, especially, considering rapid growth will increase strain on available capacities and delays on when capacity enhancements may be available
- Homogeneous operating areas exist within the Middle East region and Africa region, as respectively depicted in Figure 15 and Figure 16. These areas require common detailed plans that foster the implementation of interoperable ATM systems and procedures that extend well beyond tier 1 facilities. Local impacts of regional changes include:
    - Future local operations being impacted by distant facility operations that may not impact operations today.
    - Future relationships (CDM) required with stakeholders that may have minimal involvement/interest in current day local operations.

- o Substantially modified regional planning documentation and implementation strategies are probable.
- o Regional support to local FIRs that require additional resources to streamline and reduce regional constraints through select airspace may be needed.
- o Organisations, such as ACAC, are needed to foster and facilitate long distance interoperability harmonisation.



Rtg.	Homogenous areas	Affected FIRs	Type of Operation	Remarks
AR1	Asia and Europe, Asia and the Middle East, Europe and the Middle East, via the northern Arabian Peninsula and Eastern Med	Amman, Bahrain, Beirut, Damascus, Emirates, Jeddah, Kuwait, Muscat	Continental high density	Mainly intraregional and MID to/from ASIA and EUR. Some overflying EUR/ASIA traffic
AR2	Libya, Egypt and the southern Arabian Peninsula to/from Europe, Africa ,Asia and North Africa	Bahrain, Cairo, Emirates, Jeddah, Muscat, Sana'a, Tripoli	Remote continental and oceanic low density (but seasonally high)	Major traffic flow mainly landing and departing the MID region. Some EUR/AFI traffic and North AFI
AR3	Asia and Europe, Asia and the Middle East, Europe and the Middle East, north of the Gulf	Emirates, Teheran	Continental high density	Major traffic flow ASIA/EUR
AR4	Gulf, Asia (Indian subcontinent) to/from North of Europe	Baghdad, Bahrain, Emirates, Kuwait, Muscat	Continental high density	MID to/from Asia and EUR
AR5	Gulf Area to/from Eastern, Central and West Africa	Bahrain, Emirates, Jeddah, Khartoum, Muscat	Continental low density (Seasonal high density)	Traffic flow intraregional. Seasonal pilgrim flights to/from, East, Central, and West AFI

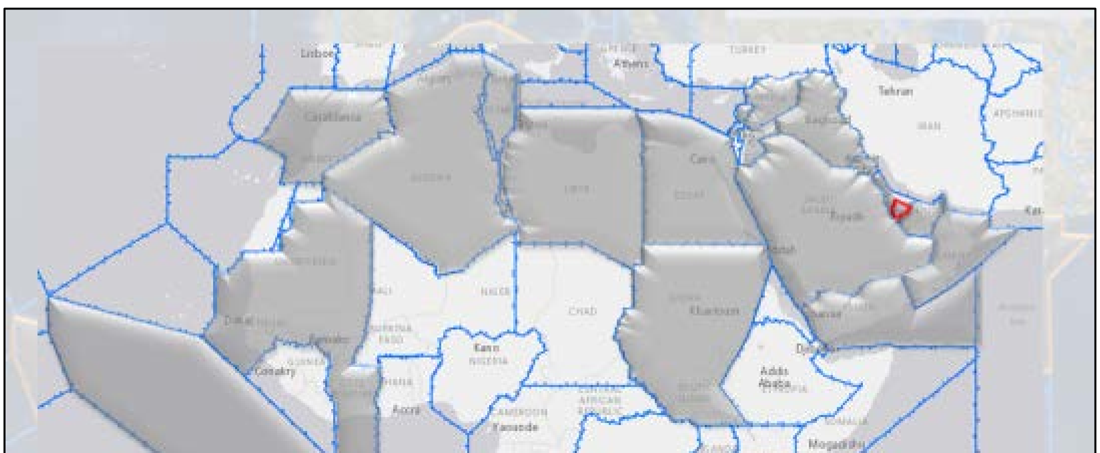
Figure 15: Middle East Homogenous Operating Areas (Source: MIDeANP)



Rtg.	Homogenous areas	Affected FIRs	Type of Operation	Remarks
AR1	Europe — South America (EUR/SAM) (oceanic)	Atlantico 1, Canarias, Casablanca, Dakar Oceanic, Recife, Sal Oceanic	Oceanic en route low density in southern part and oceanic high density in northern part	Major traffic flow EUR/SAM
AR2	Atlantic Ocean interface between the AFI, NAT and SAM	Accra, Dakar, Johannesburg, Luanda, Sal	Oceanic en route low density	Homogeneous ATM area AFI/NAT/SAM
AR3	Europe — Eastern Africa routes including the area of the Indian Ocean	Addis Ababa, Antananarivo, Asmara, Cairo, Dar es-Salaam, Entebbe, Khartoum, Mauritius, Mogadishu, Nairobi, Seychelles, Tripoli	Continental en route/ oceanic low density	Major traffic flow AFI/EUR
AR4	Europe to Southern Africa	Algiers, Beira, Brazzaville, Cape Town, Gaborone, Harare, Johannesburg, Kano, Kinshasa, Lilongwe, Luanda, Lusaka, N'Djamena, Niamey, Tripoli, Tunis, Windhoek	Continental en route low density	Major traffic flow AFI/EUR
AR5	Continental Western Africa including coastal areas	Accra, Addis Ababa, Brazzaville, Dakar, Dar-es-Salaam, Entebbe, Kano, Khartoum, Kinshasa, Nairobi, Ndjamena, Niamey, Roberts	Continental/oceanic low density	Homogeneous area AFI (growing traffic, developing into major traffic flow)
AR6	Trans-Indian	Antananarivo, Bombay 1, Johannesburg Male 1, Mauritius, Melbourne 1, Seychelles	Oceanic high density	Homogeneous ATM area FI/ASIA

Figure 16: Middle East Homogenous Operating Areas (Source: AFI/MID ASBU WS)

- Traffic Flow Management capabilities and services are not being fully realised and are accomplished on a tactical basis rather than pre-tactical/strategic, as depicted in Figure 17.



Current Operations Tactical-All FIRs	ATFM Operations Strategic/Pre-Tactical – No FIRs
• Static MIT, Ground Stop • Limited Time Base Metering • AMAN/DMAN • ATFM conducted at sector/incorporated into local procedures	• Dedicated TMU (personnel/positions) • Clear definition of capacities • Response is to pre-tactical, tactical and strategic conditions • Decision support tools in place with providing effective use and common situational awareness • Thorough data analysis conducted • Dynamic initiatives are developed only when needed

Figure 17: ATFM Capability usage (Source: Surveys, ICAO 2014)

5.2.6 Global Navigation Satellite System (GNSS)

The Global Navigation Satellite System (GNSS) is a worldwide position, navigation, and time determination system which includes one or more satellite constellations, aircraft receivers, and system integrity monitoring augmented as necessary to support the required navigation performance for the intended operation. Core global navigation constellations in GNSS are the U.S. GPS and the Russian Global Navigation Satellite System (GLONASS). Two additional global systems are in varying stages of development and fielding: the European Galileo system and Chinese BeiDou system [44].

GNSS service can be introduced in stages as the technology and operational procedures develop. However, the implementation of GNSS service by stages may be affected by various factors, including the:

- Existing navigation services
- Availability of design criteria for GNSS procedures
- Level of air traffic services supporting GNSS operations
- Aerodrome infrastructure
- Extent of aircraft equipage
- Completeness of relevant regulations

Depending upon these factors, States may adopt different implementation strategies and derive different benefits from the various stages of implementation.

The introduction of augmentation systems enhances service and eliminates most limitations. Depending on traffic volume and airspace structure, States can choose their level of involvement in the development and implementation of satellite-based augmentation system (SBAS) and/or ground-based augmentation system (GBAS). These implementation efforts require a high level of cooperation among States in order to deliver maximum operational advantages to aircraft operators. [45]

GNSS implementation requires States to consider and act on various elements such as:

- Planning and organisation
- Procedure development
- Air traffic management (airspace and air traffic control (ATC) considerations)
- Aeronautical information services
- System safety analysis
- Certification and operational approvals
- Anomaly/interference reporting
- Transition planning

In assessing the current study region's GNSS capability, the States were asked to provide data consistent with planning activities for future time frames, current ground-based abilities supporting airport approach procedures, current fleet capabilities, and ASBU Block compliance.

The following study area GNSS assessments were made:

- Aircraft equipage within the responding states show the follow capabilities, illustrated by Table 12, a comparison of the percentage of respondents to the percentage of a specific capability within their area of jurisdiction:

Table 12: ACAC Study Area GNSS Capabilities

GNSS Fleet Capability							
% of Reporting Facilities With Identified Capabilities	Percentage of Fleet in Airspace With Capability						
Capability	0–14%	15-29%	30-44%	45-59%	60-74%	75-89%	90-100%
Performance Based Navigation (PBN)			14%			42%	28%
RNP 10*						56%	42%
RNP 5	14%					42%	42%
RNP 2	28%	42%					14%
RNP 1	14%		56%			14%	28%
Global Positioning System (GPS)	14%						84%
Global Navigation Satellite System (GNSS)	14%					14%	70%
Ground-Based Augmentation System (GBAS)	70%						14%
Area Navigation							100%
Controller Pilot Data Link Communications (CPDLC)					56%	28%	14%
ADS-B Out	14%		84%				

GNSS Fleet Capability							
% of Reporting Facilities With Identified Capabilities	Percentage of Fleet in Airspace With Capability						
Capability	0–14%	15-29%	30-44%	45-59%	60-74%	75-89%	90-100%
ADS-B IN	14%		84%				
ADS-C			70%				28%
*Explanation (line 2): 56% of respondents to this question indicated that between 75-89% of their fleet is RNP-10 equipped, and 42% of respondents to this question indicated that 42% of their fleet is 90-100% RNP-10 equipped.							

- GNSS ASBU Block 0/1 compliance – half of the study area States have indicated they are at least 50% compliant, and in several cases will be fully compliant by 2018.
- Six of the responding fourteen States stated they have a GNSS strategic plan in place.
- Eight of the responding States stated they provide RNAV (GNSS) approach procedures at least two or more of their airports.

5.3 Safety

For the purposes of studies such as this one, safety is nominally referred to within the aviation domain as aspects affecting or related to service provision, equipment, procedures, practices, error/accident rates, trend analysis, licensing, airworthiness, and other oversight areas. However, for this study, there is another safety-constraining factor that affects several of the ACAC jurisdictional FIRs. This factor is the airspace safety Risk Classification for civil flights which is based on two scenarios (1) risk of shoot down, inadvertent or intentional, and (2) an aircraft emergency requiring a landing.

Each of these conditions is addressed in this section and indicates the current status of safety from these two perspectives.

5.3.1 Aviation Safety [2], [4], [33]

Aviation and flight safety are fundamental working principles within the ACAC FIR ANSPs, flight operators and groups and sub-groups that constitute the ACAC jurisdictional airspace. The region has accepted and is working towards safety improvements by pursuing the following coordinated activities:

- Policy and Standardisation initiatives
- Monitoring of key safety trends and indicators
- Safety Analysis
- Implementing programmes to address safety issues

The effectiveness of the questionnaire-supplied safety data required additional external resources to be able to make a qualified regional safety assessment. This external data was obtained from various ICAO safety reports and statistics and is the primary basis for this section.

The ACAC jurisdictional FIRs are aggregated among three ICAO statistical groupings (Figure 18), referred to as Regional Aviation Safety Group Regions (RASG-EUR, RASG-MID, and RASG-AFI).

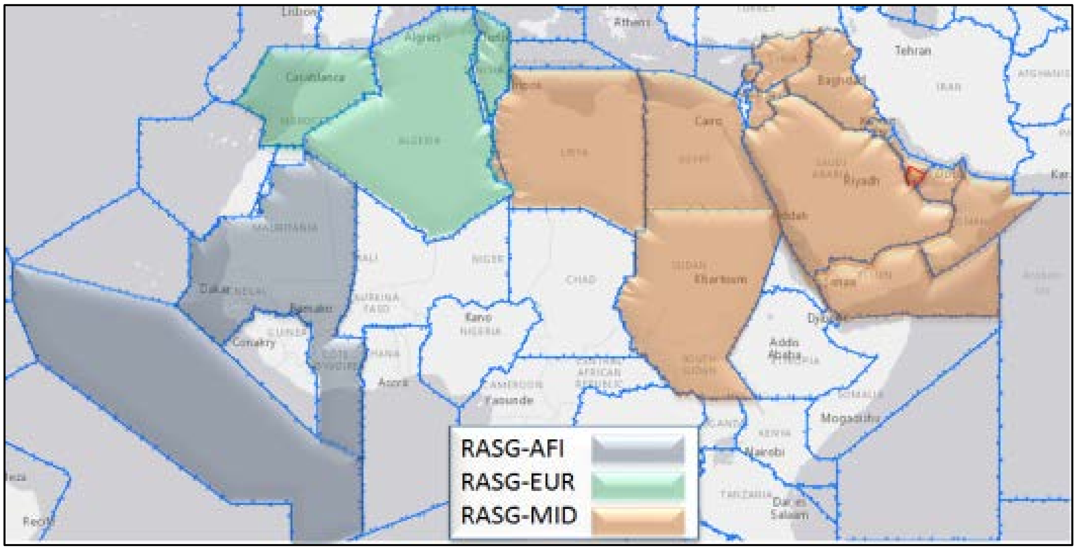


Figure 18: ACAC State Distribution among ICAO RASG Regions

Within the RASGs, the Universal Safety Oversight Audit Program (USOAP) measures the Effective Implementation of protocols that cover the entire spectrum of a State's civil aviation oversight activities. Using established data collection, monitoring, and implementation procedures, the USOAP is able to determine a State's capability to provide effective safety oversight. The global average (62%) is used as an identification benchmark that indicates an effective safety implementation capability. Figure 19 illustrates those ACAC Member States above and below the global average [2].

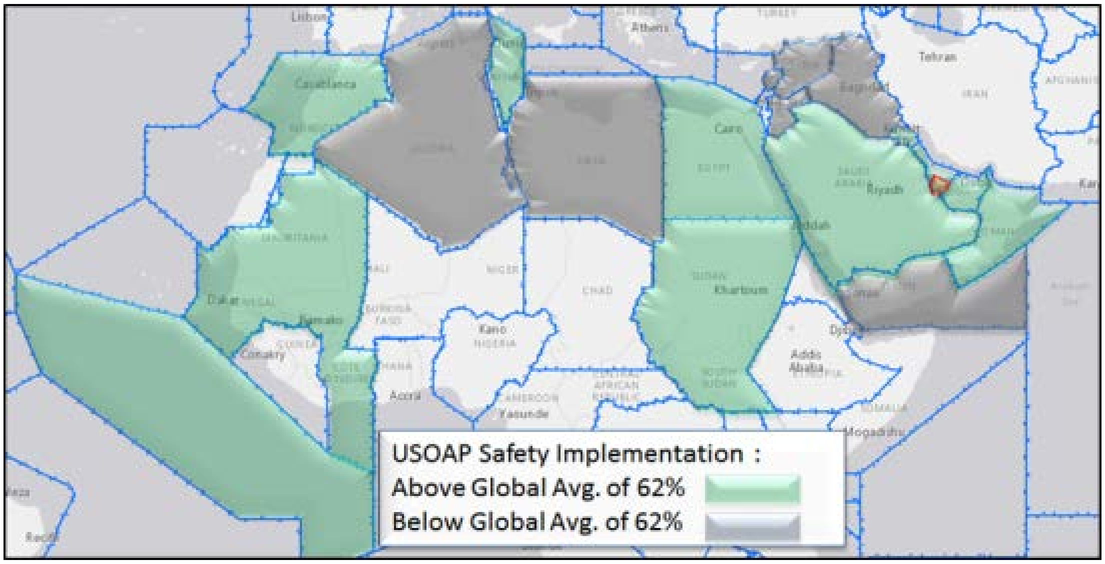


Figure 19: ACAC State Distribution Relative to Global Safety Implementation Averages

A further analysis depicts a safety parameter, as portrayed in regional accident statistics of commercial air transport within each RASG region. Table 13 and Table 14 depict the RASG accident rates of commercial aircraft per million departures, and respectively further indicates the RASG's share of traffic compared to its share of accidents.

Table 13: RASG Accident Rate

RASG	Est. Depts. *(in millions)*		Number of Accidents		Accident Rate *(per million depts.)*		Fatal Accidents		Fatalities	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
AFI	0.7	0.7	0.7	6	12.9	8.6	1	1	33	118
APAC	8.6	10.2	8.6	18	2.2	1.8	1	3	49	449
EUR	7.9	8.9	7.9	26	2.7	2.9	2	1	71	298
MID	1.1	3.0	1.1	7	1.8	2.3	0	2	0	39
PA	13.8	9.9	13.8	41	2.8	4.1	5	0	20	0
WORLD	32.1	33	32.1	98	2.8	3.0	9	7	173	904

Table 14: RASG Traffic/Accident Comparison

RASG	Share of traffic		Share of Accidents	
	2014	2015	2014	2015
AFI	2%	2%	10%	6%

RASG	Share of traffic		Share of Accidents	
	2014	2015	2014	2015
APAC	31%	31%	21%	18%
EUR	27%	27%	23%	27%
MID	9%	9%	3%	7%
PA	30%	30%	43%	42%

While it is worth noting that the Africa-Indian Ocean (AFI) and Pan Asia (PA) RASG regions' accident distribution is considerably higher relative to their traffic segments, the only ACAC Member State within the AFI region is Mauritania, and thus the percentage ratio may not accurately reflect that State's operation.

Figure 20 depicts the percentage of accidents and related fatalities by RASG region.

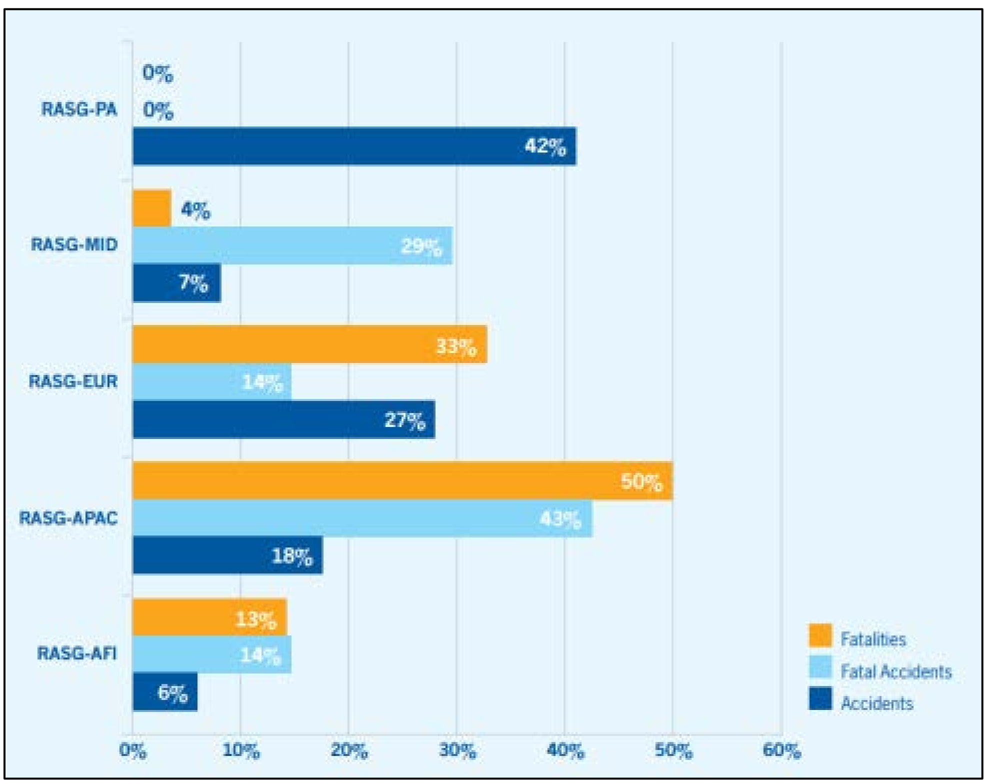


Figure 20: Percentage of Accidents and Fatalities per RASG Region

The following safety and air navigation capacity and efficiency strategic objectives are derived from using a set of indicators and targets based on the regional implementation of the Global Aviation Safety Plan (GASP) and the Global Air Navigation Plan (GANP). The critical elements (CEs) that form a State Safety Oversight System are identified in Table 15.

Table 15: Critical Element Identification

Critical Element #	Critical Element Description
CE-1	Legislation
CE-2	Regulations
CE-3	Organisation
CE-4	Technical Staff & Qualified Training
CE-5	Technical Guidance & Tools
CE-6	Licensing, Certification Approval
CE-7	Continuous Surveillance
CE-8	Resolution of Safety Concerns

Figure 21 depicts the Effective Implementation (EI) values of each of the USOAP global indicators and targets per ACAC region (Africa Member and Middle East Member States), relative to their regional average and the current ICAO world safety audit average. Table 16 depicts a subset of the overall Safety Audit depicting each ACAC Member States' current (August 9, 2016) CE value.

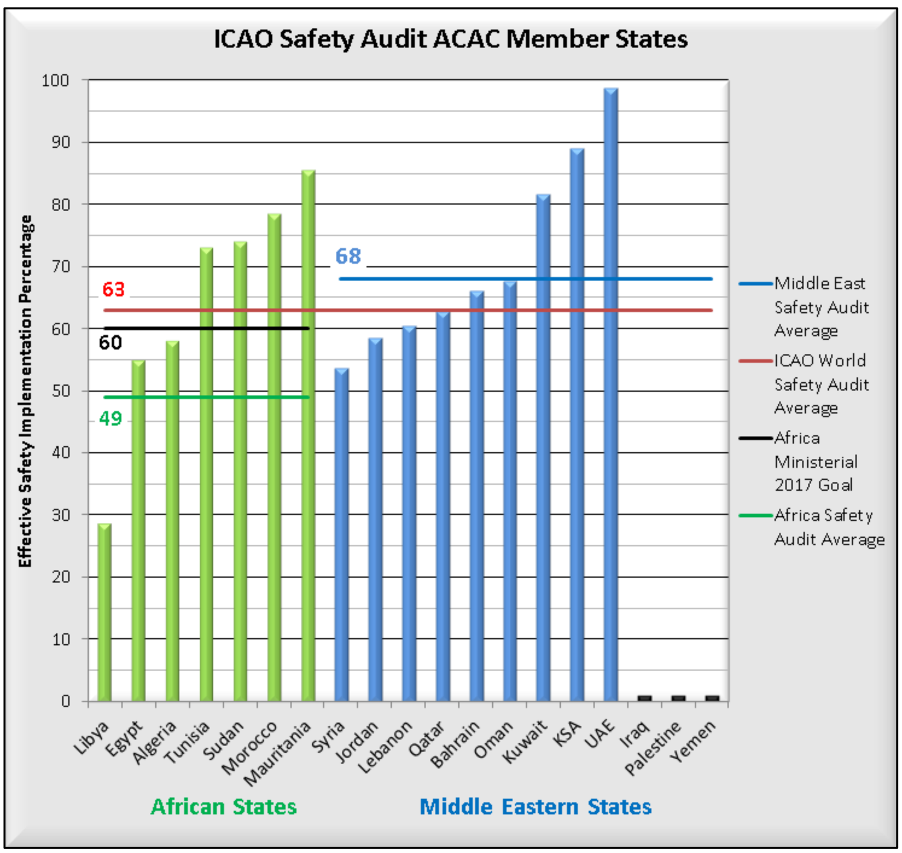


Figure 21: ACAC Member State Safety Audit Average [34]

The Global Aviation Safety Plan calls for all States to have implemented effective safety oversight capabilities by 2017. The 2012 Ministerial Meeting in Africa set a target for all African States to attain 60% effective implementation [35]. Those African States that have not achieved either an individual CE or an average CE of 60% effective implementation or higher have their respective data elements highlighted (**bolded**) in Table 16.

Table 16: ACAC State CE Values (August 9, 2016) [34]

Geo. Region	State	CE1	CE2	CE3	CE4	CE5	CE6	CE7	CE8	State AVGs
Africa ACAC States*	Algeria	**53**	**58**	**43**	**11**	68	77	61	**46**	**52**
	Egypt	**52**	74	68	**34**	75	**45**	**41**	**37**	**53**
	Libya	**53**	**36**	**35**	**5**	**20**	**37**	**27**	**16**	**29**
	Mauritania	100	87	95	86	93	82	72	68	85
	Morocco	60	68	88	73	83	87	65	77	75
	Sudan	93	84	86	**53**	87	78	**46**	**42**	71
	Tunisia	71	83	68	68	79	79	57	53	70
Middle East ACAC States	Bahrain	71	81	47	33	79	72	65	60	63
	Iraq	No Data Available								
	Jordan	63	80	58	64	62	55	38	35	57
	KSA	94	93	96	66	95	92	86	83	88
	Kuwait	87	81	78	91	77	84	78	83	82
	Lebanon	52	74	31	14	72	80	57	55	54
	Oman	74	83	64	40	71	80	50	47	64
	Palestine	No Data Available								
	Qatar	71	64	51	26	67	84	58	36	57

Geo. Region	State	CE1	CE2	CE3	CE4	CE5	CE6	CE7	CE8	State AVGs
	Syria	67	80	45	22	46	65	86	40	56
	UAE	97	98	98	100	100	99	99	100	99
	Yemen	**No Data Available**								
CE- AVGs		**72**	**76**	**66**	**49**	**73**	**75**	**61**	**55**	**66**

***** The African States that have their values **bolded** indicate those CEs that have not achieved the Ministerial goal of 60%

The current status of safety compliance for ALL of Africa is depicted in Figure 22. [28]

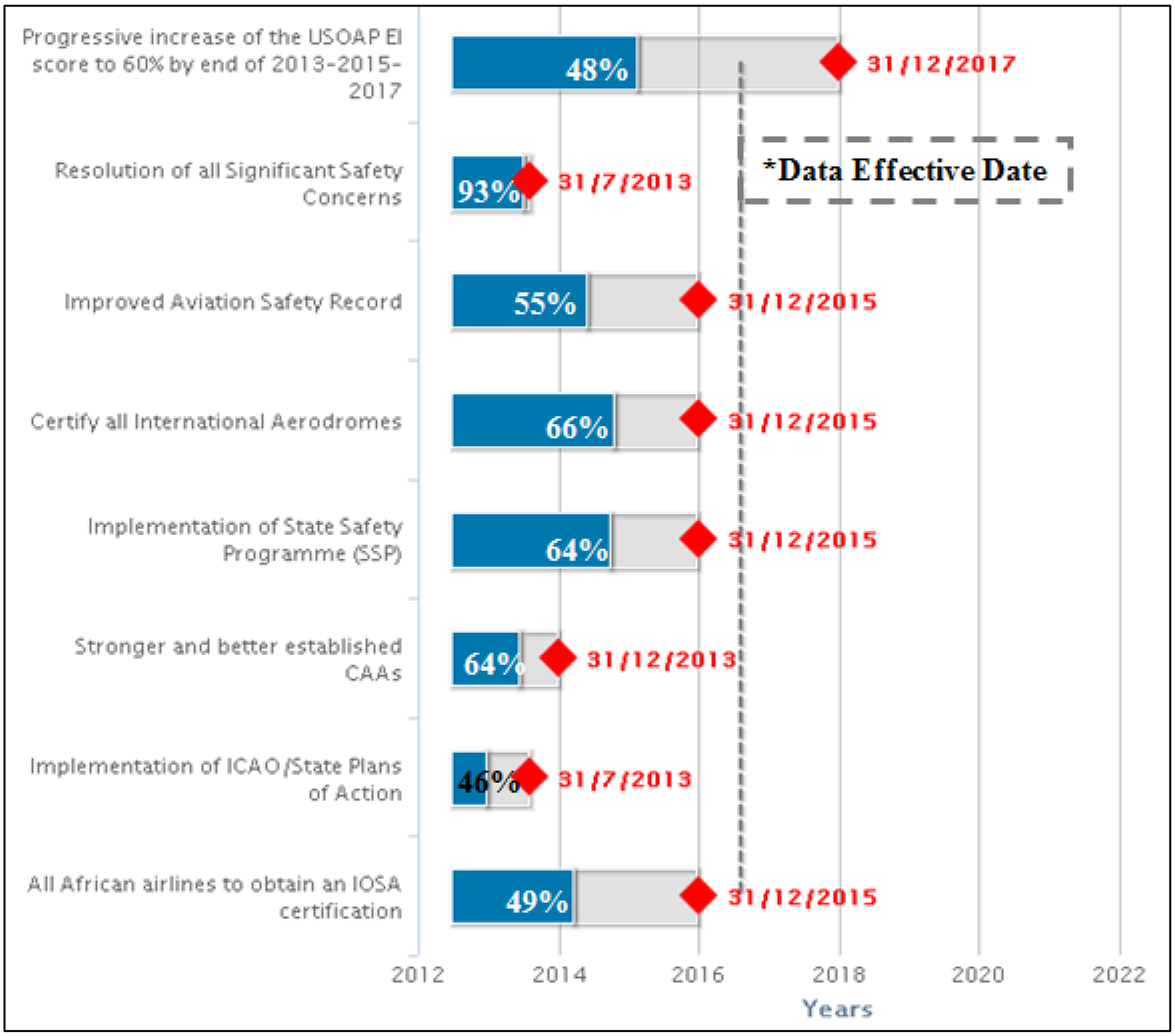


Figure 22: Africa Safety Status (August 9, 2016)

*Data Effective Date: August 9, 2016

See Appendix C for a listing of each of the African States considered in the development of the overall African status values.

The current status of safety compliance for ALL of the Middle East is depicted in Figure 23. [28]

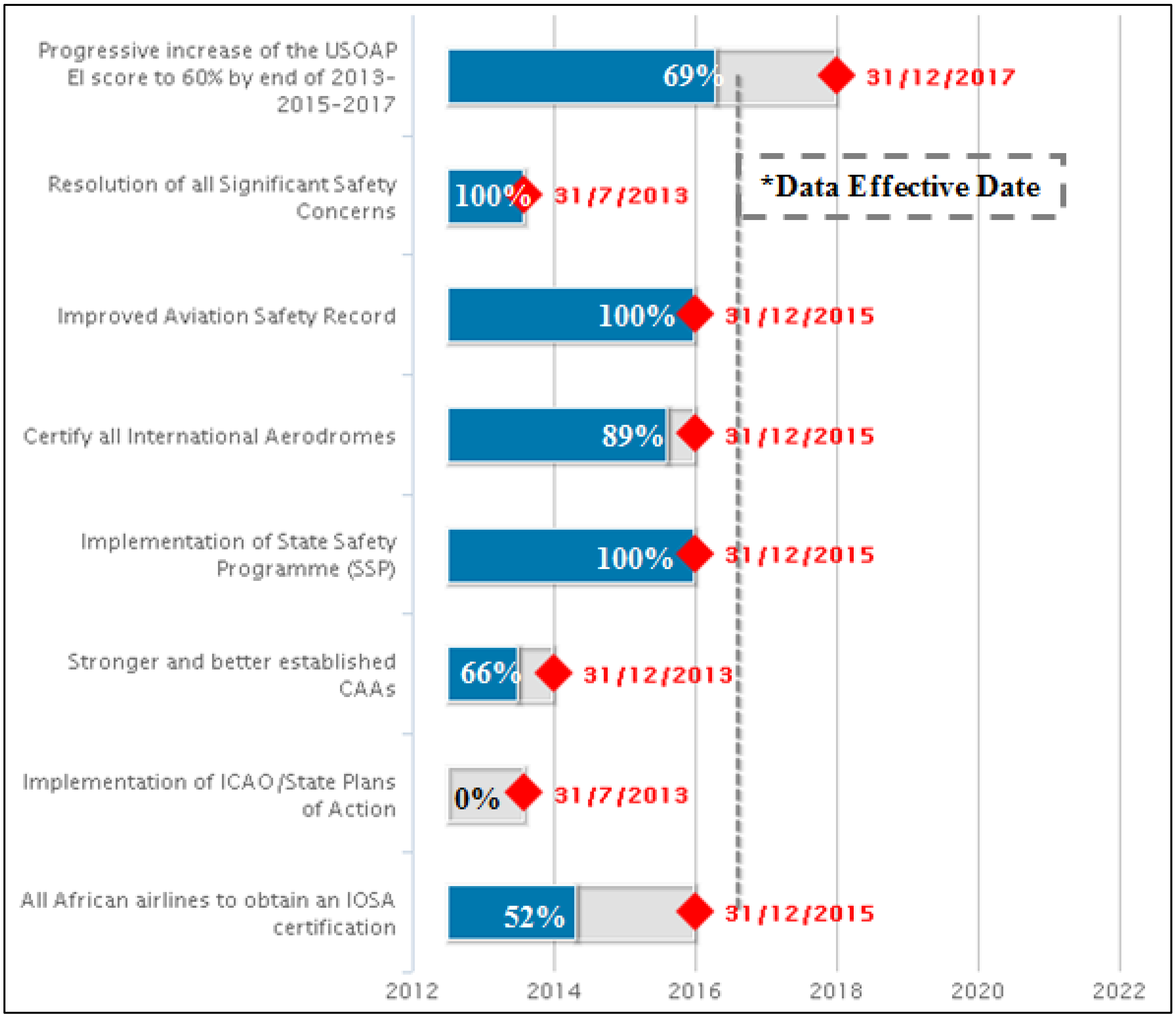


Figure 23: Middle East Safety Status (August 9, 2016)

*****Data Effective Date: August 9, 2016

See Appendix C for a listing of each of the Middle Eastern States considered in the development of the overall Middle East status values.

5.3.2 Airspace Safety Risk Classification [3]

Significant numbers of ACAC Member State FIRs have been classified based upon an assessment of the risk of flying over each country's borders. Risk has been assessed based on two potential scenarios: (1) risk of shoot down, inadvertent or intentional, and (2) aircraft emergency requiring a landing within the classified FIR. Classifications have been group into three levels:

- **Level 1 – Moderate Risk to Flight** – No Fly recommended; basis for risk assessment is the highly unstable current events on the ground and in all cases, the ground factions having access to weaponry potentially affecting aviation operations.

- **Level 2 – Assessed Risk** – basis for risk assessment for specific portions of airspace or airspace below certain altitudes.
- **Level 3 – Caution** – applies to countries that do not have multiple current airspace warnings.

The ACAC Member States FIRs that are categorised within these definitions are respectively listed in Table 17 and depicted in Figure 24.

Table 17: Risk Category Assessments

Classification	Assessment	ACAC Classified States
Level 1	Moderate Risk – NO FLY*	Iraq, Libya, Syria, Yemen**
Level 2	Assessed Risk	Saudi Arabia, Sudan, Egypt
Level 3	Caution	None of the ACAC Member States

*The *No Fly* phrasing is a recommendation made by the Flight Service Bureau,
** The Oceanic portion of the Sana'a FIR, including Airways N315, UL425, UM551 and R401, is excluded from most warnings, by nature of being offshore.

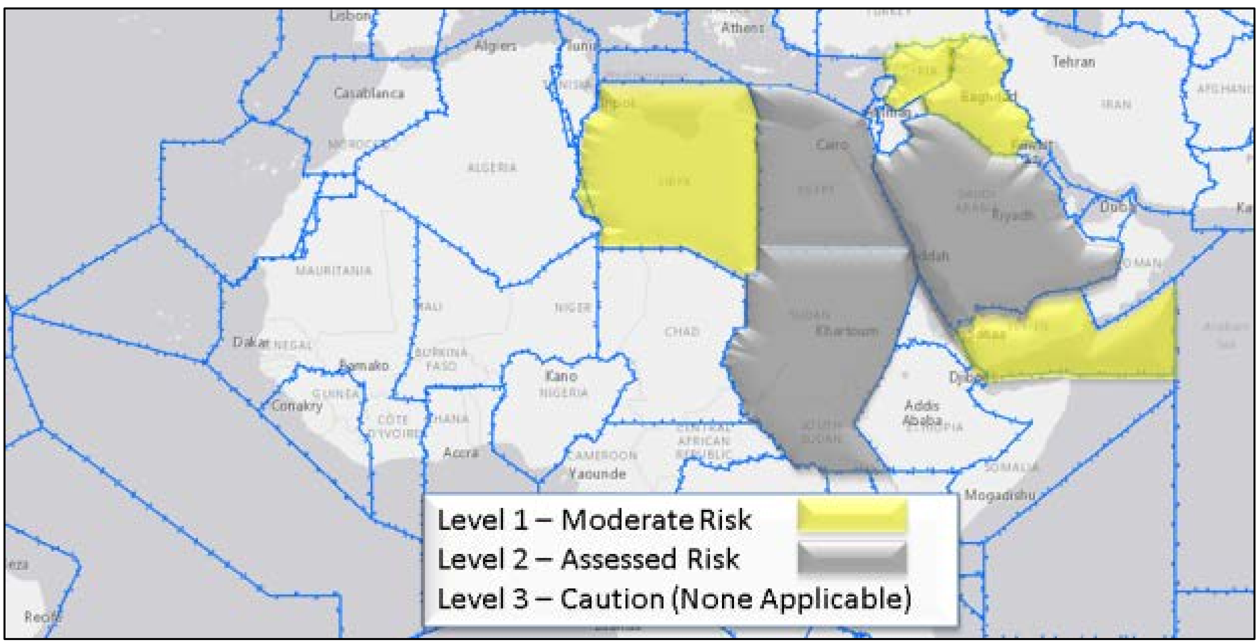


Figure 24: Risk Category Illustration

Data received on internal statistics regarding accidents, incidents, and operational errors or pilot deviations were not provided to the Team. A few States provided their Target Levels of Safety. The data contained in this section was found in *ICAO Safety Reports 2014 and 2015 Editions*.

Recognised in the *ICAO Safety Report 2015* is the United Arab Emirates (UAE) for significant contributions in improving the coordination of accident and incident investigation activities in the ACAC Member States. Holding workshops in 2012 and 2013 and attended by representatives from Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, and the UAE, led to the establishment of the Middle East and North Africa

Society of Air Safety Investigators (MENASASI), affiliated as a regional chapter of the International Society of Air Safety Investigators (ISASI). The goal is to promote cooperation and to act proactively in establishing cooperation in air accident investigation across the Middle East and the ACAC Member States [4].

The ACAC Member States primarily fall into the MID Regional Aviation Safety Group with the exception of Mauritania which falls into the AFI group; and Tunisia, Algeria and Tunisia which fall into EUR-NAT group.

5.4 FIR Categorisation

5.4.1 FIR Categorisation Determinations

Utilising the criteria described in Appendix E, Table 18 depicts the resulting ACAC FIR categorisations.

Table 18: FIR Categorisations

FIR	Categorisation	FIR	Categorisation
Bahrain	High	Tunisia	Low
Egypt	High	Iraq	Low
Qatar*	High	Jordan	Low
Saudi Arabia	High	Lebanon	Low
UAE	High	Mauritania Domestic	Low
Algeria	Medium	Mauritania Oceanic	
Oman	Medium	Syria	Low
Kuwait	Medium	Sudan	Low
Morocco	Medium	Libya	Unable To Determine
		Palestine	Unable To Determine
		Yemen	Unable To Determine

***** Denotes Approach Control Airspace (Qatar)

Table 19 depicts the aggregation of the elements used to establish the FIR categories used in this study as well as the density of operations calculated for each FIR based on the FIR's area and ACC activity.

Table 19: Aggregated Data Elements

ACAC FIR Categorisations (Current)							
FIR	FIR Sq. NM	2014 Activity (ACC)	2014 Density (ACC)	2015 Major Airport Activity (1,000s)			FIR Categorisation
				>180	>80	>30	
Bahrain	22,973	573,400	24.96		1		High
Egypt	384,374	569,300	1.48		1	2	High
Qatar*	8,760	220,400	25.16	1			High
Saudi Arabia	618,218	643,157	0.95	1	1	2	High
UAE	36,706	873,000	23.78	1	1	3	High
Algeria	728,983	156,400	0.21			2	Medium**
Oman	171,490	395,500	2.31		1		Medium
Kuwait	10,389		0.00		1		Medium
Morocco	236,869		0.00		1	1	Medium
Tunisia	70,409	132,300	1.88			1	Low
Iraq	127,231		0.00			2	Low
Jordan	27,785		0.00			2	Low
Lebanon	6,279	65,514	10.43			1	Low
Mauritania Domestic	867,501		0.00			2	Low
Mauritania Oceanic	1,455,403		0.00	N/A	N/A	N/A	
Syria	55,663		0.00			1	Low
Sudan	732,093	53,300	0.07			1	Low
Libya	579,196		0.00				No Data
Palestine							No Data
Yemen	348,180		0.00				No Data

***** Denotes Approach Control Airspace (Qatar)

****** Major airport traffic activity was within in 1% of minimum Medium Categorisation definition

6 Phase 2: Gap Analysis and Findings

6.1 Gap Analysis

This section describes the gaps between current operational capabilities versus future desired state. The methodology used to determine the gaps is described in Appendix F. Gaps are presented in this report in two ways: (1) by comparing the ICAO ASBU methodology to the States current status in meeting the targets in the performance areas and (2) in an itemised list of the Team's observations in the areas described in the following subsections.

6.1.1 Status of ASBU Block 0 and Block 1 for Performance Improvement Areas 1-4:

Table 20 to Table 27 describe the ASBU's four performance improvement areas modules for Blocks 0 through 3 and the current status and/or targets that the studied States reported in the surveys. Block 0 is comprised of technologies and capabilities in existence today. The Modules are characterised by operational improvements that have already been implemented in many parts of the world. These are near-term elements with an implementation period of 2013 through 2018. Block 1 Modules introduce new concepts and capabilities that support the future ATM system. The Block 1 Modules are intended to be available in the 2018 timeframe. Consecutive Blocks (2 and 3) follow the same module's thread in the performance area with targets in 2023 through 2028 and onward timeframe.

Table 20, Table 21, Table 22, and Table 23 present the status of ASBU Block 0 and Block 1 for Performance Improvement Areas 1–4.

Table 20: PIA 1 – ASBU 0, 1

Performance Improvement Area 1: Airport Operations			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
APTA	**Optimisation of Approach Procedures including Vertical Guidance** • PBN and GLS procedures enhance the reliability and predictability of approaches to runways • Uses global navigation satellite system (GNSS), Baro-vertical navigation (VNAV), satellite-based augmentation system (SBAS)	**Optimised Airport Accessibility** • Universal implementation of Performance-based Navigation (PBN) approaches • PBN and GLS (CAT II/III) procedures	• APTA Block-0/1 applies to all areas. • Progress towards implementation of the APTA Block-0 module ranges from 20% to 80% among the high-traffic-density FIRs. • Medium- and low-density FIRs range from 100% implementation to approx. 40%. No implementation of APTA-Block 1

Performance Improvement Area 1: Airport Operations			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
WAKE	**Increased Runway Throughput through Optimised Wake Turbulence Separation** • Revision of current ICAO wake vortex separation minima and procedures • Improves throughput on departure and arrival runways through optimised wake turbulence separation minima	**Increased Runway Throughput through Dynamic Wake Turbulence Separation** • Dynamic management of wake turbulence separation minima • Based on the real-time identification of wake turbulence hazards	• WAKE Block-0/1 applies to all areas. • The WAKE Block0/1 modules have not been implemented within the FIRs assessed.
RSEQ	**Improved Traffic Flow through Sequencing (AMAN/DMAN)** • Manage arrivals and departures (including time-based metering) to efficiently utilise the inherent runway capacity • Used at multi-runway airport or multiple dependent runways at closely proximate airports	**Improved Airport Operations through Departure, Surface and Arrival Management** • Extension of arrival metering • Integration of surface management with departure sequencing	• RSEQ Block-0/1 applies to high-density areas. • The RSEQ Block-0 module has not been implemented within the FIRs assessed with the exception of one medium-density FIR where partial implementation has been accomplished. • No implementation of RSEQ Block-1.
SURF	**Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)** • Provide surveillance and alerting of aircraft and vehicle movement at the airport • Uses basic A-SMGCS and ADS-B	**Enhanced Safety and Efficiency of Surface Operations – SURF, SURF-IA and Enhanced Vision Systems (EVS)** • Enhancements for surface situational awareness including both cockpit and ground elements • Use of surface moving maps with traffic information and runway safety alerting logic	• SURF Block-0/1 applies to all areas. The majority of the -activity FIRs have full implementation of the SURF Block-0 module. One will accomplish partial implementation by the end of the year. • The moderate-activity FIRs have achieved partial implementation currently or by the end of next year. • No implementation reported within the Low-activity FIRs. • No implementation of SURF-Block-1

Performance Improvement Area 1: Airport Operations			
	ASBU Block 0	ASBU Block 1	ACAC Status
A-CDM	**Improved Airport Operations through Airport-CDM** • Collaborative applications allow sharing of surface operations data among the different stakeholders on the airport • Improve surface traffic management reducing delays on movement and manoeuvrings areas	**Optimised Airport Operations through A-CDM Total Airport Management** • Enhances the planning and management of Airport Operations using performance targets compliant with those of the surrounding airspace • Implement collaborative airport operations planning (AOP) and where needed, an airport operations centre (APOC)	• A-CDM Blocks 0/1 apply to all areas. • There has been no implementation of the A-CDM Block-0/1 modules. The High-activity and one Medium-activity FIRs have developed implementation plans and expect to be operational in the 2017-18 time-frames.
RATS	N/A	**Remotely Operated Airport Control** • Provides a safe and cost-effective air traffic services (ATS) from a remote facility • For airports where dedicated, local ATS are no longer sustainable or cost-effective	• RATS Block-1 applies to all areas. • No implementation of RATS Block-1

Table 21: PAI 2 – ASBU 0, 1

Performance Improvement Area 2: Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management			
	ASBU Block 0	ASBU Block 1	ACAC Status
FICE	**Increased Interoperability, Efficiency, and Capacity through Ground-Ground Integration** • Improved coordination of ground-ground data communication between ATSUs. • Use ATS inter-facility data communication (AIDC)	**Increased Interoperability, Efficiency and Capacity through Flight and Flow Information for a Collaborative Environment Step-1 (FF-ICE/1) application before Departure** • Provide ground-ground exchanges before departure • Use using a common flight information reference model Flight Information Exchange Model (FIXM) and extensible mark-up language (XML) standard formats	• FICE Block-0/1 applies to all areas. • All FIRs with the exception of one Low-Activity FIR, have partially implemented the FICE Block-0 module. • Work with adjacent units to fully implement is ongoing. • No implementation of FICE Block-1

Performance Improvement Area 2: Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
DATM	**Service Improvement through Digital Aeronautical Information Management** • Initial introduction of digital aeronautical information service processing and management of information • Aeronautical information management (AIM) implementation • Use of aeronautical exchange model (AIXM) • Migration to electronic aeronautical information publication (AIP)	**Service Improvement through Integration of all Digital ATM Information** • Integrate all ATM information, using common formats • Unified Modelling Language (UML)/XML and Weather Information Exchange Model (WXXM) for meteorological information • FIXM for flight and flow information	• DATM Block-0/1 applies to all areas • All but one Low-activity FIR has achieved full or partial implementation of the DATM Block-0 module. Those with partial implementation have targets for full implementation in the 2017-2018 timeframe. • No implementation of DATM Block-1.
SWIM	**N/A**	**Performance Improvement through the Application of System-Wide Information Management (SWIM)** • SWIM services based on standard data models and Internet-based protocols • Creates the aviation Intranet to maximise interoperability	• SWIM Block-1 applies to all areas. • No implementation of the SWIM Block-1 module among the assessed FIRs.
AMET	**Meteorological Information Supporting Enhanced Operational Efficiency and Safety** • Weather Information Exchange • Forecasts provided by world area forecast centres • Concise information on meteorological conditions that could adversely affect all aircraft at an airport • SIGMETs to provide information on occurrence or expected occurrence of specific en-route weather phenomena	**Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-term Service)** • Full ATM-Meteorology integration Meteorological information is included in the logic of a decision process • Impact of the meteorological conditions (constraints) is automatically calculated and taken into account • Promotes the establishment of Standards for global exchange of the information	• AMET Blocks-0/1 applies to all areas. • Full implementation of the AMET Block-0 module among the High-activity FIRs. • Partial or no implementation among the remaining FIRs. • No implementation of AMET Block-1.

Table 22: PIA 3 – ASBU 0, 1

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
FRTO	**Improved Operations through Enhanced En-route Trajectories** • Allow the use of airspace which would otherwise be segregated (i.e., Special Use Airspace [SUA]) • Allows flexible routing adjusted for specific traffic patterns	**Improved Operations through Optimised ATS Routing** • Provides closer and consistent route spacing, curved approaches, parallel offsets and the reduction of holding area size. Through Performance-based Navigation (PBN) • Allows the sectorisation of airspace to be adjusted more dynamically	• FRTO Block-0/1 applies to all areas. • One - activity FIR has completed FRTO Block-0. • The remaining High-activity FIRs have begun development of procedures and creating agreements for FUA. • The Medium- and Low-activity FIRs report little or no progress towards implementation. • No implementation of FRTO Block -1
NOPS	**Improved Flow Performance through Planning based on a Network-wide view** • Air traffic flow management (ATFM) is used to manage the flow of traffic in a way that minimises delays and maximises the use of the entire airspace • Regulate peak flows involving departure slots • Managed rate of entry into a given piece of airspace, requested time at a waypoint or an FIR/sector boundary along the flight • Use of miles-in-trail to smooth flows • Re-routing of traffic to avoid saturated areas	**Enhanced Flow Performance through Network Operational Planning** • Enhanced processes to manage flows or groups of flights in order to improve overall flow	• NOPS Block-0/1 applies to Medium- and High-activity areas. • Among the High-activity FIRs, one reports the full implementation of the Block-0 module. • The remaining High-activity FIRs report they are in the progress of working or plan to work with adjacent units and users and have implementation targets in the 2017-18 timeframe. • The remaining Medium- and Low-activity FIRs report a range from full to partial implementation. No implementation of NOPS Block-1.

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	ASBU Block 1	ACAC Status
ASUR	**Initial Capability for Ground Surveillance** • Provides initial capability for lower cost ground surveillance such as traffic information, search and rescue and separation provision • Supported by ADS-B OUT and/or wide area multilateration (MLAT) systems	**N/A**	• ASUR Block 1 applies to Medium- and High-activity areas. • Among the High-activity FIRs ASUR is N/A at one. Among the remaining FIRs implementation ranges from none to full. • NOTE: This capability is characterised by being dependent/cooperative (ADS-B OUT) and independent/cooperative (MLAT). • The overall performance of ADS-B is affected by avionics performance and compliant equipage rate
ASEP	**Air Traffic Situational Awareness (ATSA)** • ATSA applications will enhance safety and efficiency • AIRB (Enhanced Traffic Situational Awareness during Flight Operations) • VSA (Enhanced Visual Separation on Approach)	**Increased Capacity and Efficiency through Interval Management** • Improves the organisation of traffic flows and aircraft spacing • Precise management of intervals between aircraft with common or merging trajectories	• ASEP Block-0 applies to aircraft; ASEP Block-1 applies to Medium- and High-activity areas. • ASEP Block-0 is cockpit-based applications which can be used by any suitably equipped aircraft. This is dependent upon aircraft being equipped with ADS-B OUT. • No implementation of ASEP Block-1
OPFL	**Improved Access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B** • In Trail Climb/Descent Procedures • Enables aircraft to reach a more satisfactory flight level for flight efficiency or to avoid turbulence for safety	**N/A**	• OPFL Block-0 applies to all areas • No implementation of OPFL module among the FIRs studied.

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
ACAS	**Airborne Collision Avoidance Systems (ACAS) Improvements** • Improvements to existing systems • Reduce trajectory deviations and increase safety in cases where there is a breakdown of separation	**N/A**	• ACAS applicable to aircraft. • Provides short-term improvements to existing airborne collision avoidance systems (ACAS) to reduce nuisance alerts while maintaining existing levels of safety. This will reduce trajectory deviations and increase safety in cases where there is a breakdown of separation.
SNET	**Increased Effectiveness of Ground-based Safety Nets** • Monitors the operational environment during airborne phases of flight • Provides timely alerts on the ground of an increased risk to flight safety	**Ground-based Safety Nets on Approach** • Reduces the risk of controlled flight into terrain accidents on final approach through the use of an approach path monitor (APM)	• SNET Block-0 applies to all areas. • SNET Block-1 applies to medium- and high-density areas. • SNET Block-0 is implemented among all the High-activity FIRs except one. • Among the Medium- and Low-activity FIRs implementation ranges from full to partial. • No implementation of SNET Block-1.

Table 23: PIA 4 – ASBU 0, 1

Performance Improvement Area 4: Efficient Flight Paths			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
CDO	**Improved Flexibility and Efficiency in Descent Profiles using Continuous Descent Operations (CDOs)** • Performance-based airspace and arrival procedures Continuous Descent Operations • Allows aircraft to fly their optimum profile using continuous descent operations (CDOs)	**Improved Flexibility and Efficiency in Descent Profiles (CDO)** • Enhanced vertical flight path precision during descent and arrival • Enables aircraft to fly an arrival procedure not reliant on ground-based equipment for vertical guidance	• CDO Block-0/1 applies to all areas. • One Low-activity FIR reports the full implementation of CDO Block-0. • The remaining FIRs have partial implementation and/or targets for full or partial implementation in the 2016-2018 time-frames. • No implementation of CDO Block-1.

Performance Improvement Area 4: Efficient Flight Paths			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
TBO	**Improved Safety and Efficiency through the Initial Application of Data Link En-route** • For surveillance and communications in air traffic control • Supports flexible routing, reduced separation and improved safety	**Improved Traffic Synchronisation and Initial Trajectory-based Operation (TBO)** • Optimise the approach sequence through the use of 4DTRAD capability and airport applications, e.g., D-TAXI • Improves the synchronisation of traffic flows at en-route merging points	• TBO Block-0 applies to all areas. TBO Block-1 applies to Medium and High-activity areas. • No implementation of TBO Block-0/1. • Requires good synchronisation of airborne and ground deployment to generate significant benefits, in particular to those equipped. Benefits increase with the proportion of equipped aircraft.
CCO	**Improved Flexibility and Efficiency Departure Profiles – Continuous Climb Operations (CCO)** • Implements continuous climb operations (CCO) in conjunction with Performance-based Navigation (PBN) • Provides opportunities to optimise throughput, improve flexibility, enable fuel-efficient climb profiles, and increase capacity at congested terminal areas	**N/A**	• CCO Block-0 applies to all areas • One Low-activity FIR reports the implementation of CCO Block-0. • The remaining FIRs have established targets for implementation in the 2016-2019 time frames.
RPAS	**N/A**	**Initial Integration of Remotely Piloted Aircraft (RPA) into Non-segregated Airspace** • Implementation of basic procedures for operating RPA in non-segregated airspace, including detect and avoid	• RPAS Block-1 applies to all areas. • No implementation of RPAS Block-1

6.1.2 Status of ASBU Block 2 and Block 3 for Performance Improvement Areas 1-4:

ASBU Blocks 2 and 3 follow the same module's thread as in Block 0 and 1 in each of the four Performance Improvement Areas with targets in 2023 through 2028 and onward timeframe. These are **far-term** elements.

Table 24, Table 25, Table 26, and Table 27 describe the modules within the performance area and to what level of activity FIR they apply. The FIRs that responded to the surveys indicate no implementation of the Block 0 and 1 modules.

Table 24: PIA 1 – ASBU 2, 3

Performance Improvement Area 1: Airport Operations			
		ASBU Block 3	**ACAC Status**
WAKE	**Advanced Wake Turbulence Separation (Time-based)** • Application of time-based aircraft-to-aircraft wake separation minima • Changes to the procedures the ANSP uses to apply wake separation minima	**N/A**	• WAKE Block-2 applies to all areas. • No implementation
RSEQ	**Linked Arrival Management and Departure Management (AMAN/DNAM)** • Integrated AMAN/DMAN to enable dynamic scheduling and runway configuration • Integrates arrival and departure management • Better accommodation of arrival/departure patterns	**Integration AMAN/DMAN/SMAN** • Integrated arrival, en-route, surface, and departure management	• RSEQ Block-2/3 applies to High-activity areas. • No implementation
SURF	**Optimised Surface Routing and Safety Benefits (A-SMGCS Level 3-4 and SVS)** • Queuing for departure runways is reduced to the minimum necessary to optimise runway use and taxi times are also reduced • Low-visibility conditions have only a minor effect on surface movement	**N/A**	• SURF Block-2 applies to High-activity areas. • No implementation

Table 25: PIA 2 – ASBU 2, 3

Performance Improvement Area 2: Globally Interoperable Systems and Data			
	ASBU Block 2	**ASBU Block 3**	**ACAC Status**
FICE	**Improved Coordination through Multi-centre Ground-Ground Integration (FF-ICE, Step 1 and Flight Object, SWIM)** • Exchange and distribution of information using flight object implementation and interoperability (IOP) standards. • Extension of use of FF-ICE after departure, supporting trajectory-based operations	**Improved Operational Performance through the Introduction of Full FF-ICE** • Data for all relevant flights systematically shared between the air and ground systems using SWIM • Supports collaborative ATM and trajectory-based operations	• FICE Blocks 2/3 applies to all areas. • No implementation
SWIM	**Enabling Airborne Participation in Collaborative ATM through SWIM** • Allows the aircraft to be fully connected to an information node in SWIM • Enables full participation in collaborative ATM processes with exchange of data including meteorology	**N/A**	• SWIM Block 2 applies to all areas. • No implementation
AMET	**N/A**	**Enhanced Operational Decisions through Integrated Meteorological Information (Near-term and Immediate Service)** • Tactical avoidance of hazardous meteorological conditions in especially the 0-20 minute time frame; • Greater use of aircraft-based capabilities to detect meteorological conditions (e.g., turbulence, winds, and humidity) Display of meteorological information to enhance situational awareness	• AMET Block-3 applies to all areas. • No implementation

Table 26: PIA 3 – ASBU 2, 3

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 2	**ASBU Block 3**	**ACAC Status**
NOPS	**Increased User Involvement in the Dynamic Utilisation of the Network** • CDM applications supported by SWIM that permit airspace users to manage competition and prioritisation within ATFM constraint mitigation solutions • CDM applications by which ATM will be able to offer/delegate to the users the optimisation of solutions to flow problems	**Traffic Complexity Management** • Complexity management to address events and phenomena that affect traffic flows, including physical limitations and economic reasons • Exploits the more accurate and rich information environment of SWIM-based ATM	• NOPS Block 2 applies to all areas. • No implementation. • NOPS Block 3 applies to High-activity areas. • No implementation
ASEP	**Airborne Separation (ASEP)** • Temporary delegation of responsibility to the flight deck for separation provision with suitably equipped designated aircraft, thus reducing the need for conflict resolution clearances • Controller retains responsibility for separation from aircraft that are not part of these clearances.	**N/A**	• ASEP applies to Medium- to High-activity areas • No implementation
ACAS	**New Collision Avoidance System** • Implementation of the airborne collision avoidance system (ACAS) adapted to trajectory-based operations with improved surveillance function supported by ADS-B • Adaptive collision avoidance logic aiming at reducing nuisance alerts and minimising deviations	**N/A**	• ACAS Block-2 applies to Aircraft Only

Table 27: PIA 4 – ASBU 2, 3

Performance Improvement Area 4: Efficient Flight Paths			
	ASBU Block 2	**ASBU Block 3**	**ACAC Status**
CDO	**Improved Flexibility and Efficiency in Continuous Descent Profiles (CDOs) Using VNAV, Required Speed and Time at Arrival** • Use of arrival procedures that allow the aircraft to apply little or no throttle in areas where traffic levels would otherwise prohibit this operation • Considers airspace complexity, air traffic workload, and procedure design	**N/A**	• CDO Block 2 applies to High-activity areas. • No implementation
TBO	**N/A**	**Full 4D Trajectory-based Operations** • Advanced concepts and technologies supporting four-dimensional trajectories to enhance global ATM decision-making • Integrates all flight information to obtain the most accurate trajectory model for ground automation	• TBO Block-3 applies to all areas. • No implementation
RPAS	**Remotely Piloted Aircraft (RPA) Integration in Traffic** • Continuing to improve the remotely piloted aircraft (RPA) access to non-segregated airspace • Continuing to improve the remotely piloted aircraft system (RPAS) approval/certification process • Standardising the command and control (C2) link failure procedures • Agreeing on a unique squawk code for C2 link failure • Detect and avoid technologies, to include automatic dependent surveillance – broadcast (ADS-B)	**Remotely Piloted Aircraft (RPA) Transparent Management** • Improve the certification process for remotely piloted aircraft (RPA) in all classes of airspace • Develops a reliable command and control (C2) link • Developing and certifying airborne detect and avoid (ABDAA) algorithms for collision avoidance • Integrates RPA into airport procedures	• RPAS Block 2/3 applies to all areas. • No Implementation

6.2 Study Findings

Findings are categorised by the observation areas used as listed below:

ACAC ANSP Regional Input:

- ANSP Interoperability
- Airspace Policy/Procedures
- Separation Standards
- Routing
- Contingency and Growth Planning
- Civil-Military
- Airport Policy/Procedures
- Airport Physical Infrastructure
- Traffic Flow Management/Collaborative Decision Making
- Technical and Administrative Expertise, Proficiency and Training
- Safety
- Other Dynamics

AACO Operator Input:

- Present day operations
    - Ability to fly user-preferred trajectories
    - Ability to obtain desired cruise altitude
    - Ability to operate at flight planned speed
    - Bottlenecks in the en-route, approach control and/or terminal areas
- Areas where service could be enhanced
- Communications with ANSPs
- Airspace access

6.2.1 ACAC ANSP Regional Findings

The following findings address the Team's findings in current capabilities and services. Much of these findings were derived from the surveys provided by the individual States and a review of any internal documents that were submitted by the States. Additional data sources were obtained from background and presentation materials associated with the Global Ministerial Aviation Summit (Cairo, August 2016). The Team relied primarily on the responses to the questions in the surveys, ICAO documents, and the limited amount of internal documentation that was provided because we were unable to conduct a direct observation of the air traffic operations resident in the participating States. Web searches for detailed air traffic control policies and procedures, as well as working practices, were attempted but yielded little result.

Those States that provided candid responses to the survey allowed the Team the best opportunity to attempt to assess the picture of the current state of the day-to-day air traffic control operation. The following findings apply to all assessed States based on their existing and forecast traffic density. Where there is a tie either directly or indirectly to the Block Upgrade modules it is indicated at the end of the statement. I.e., PIA – 3 refers to Performance Improvement Area 3: Optimum Capacity and Flexible Flights – Through Global Collaborative ATM.

6.2.1.1 ***ANSPs Interoperability***

1. Various individual air navigation service providers' (ANSPs) strategic planning efforts are advancing with insufficient adjacent ANSP acceptance and integration.
2. A common framework for increasing the level of cooperation in conducting accident investigations appears to be in development. There is no mention of a framework for increasing communications and cooperation for conducting other safety analysis. (PIA-3)
3. AIP data is not uniformly available across all ACAC Member States. (PIA-2)
4. There is no clear indication that standardisation, consistency, and uniformity practices exist in the development and application of Air Traffic procedures. (All PIAs)
5. CDM organisation and processes vary among the ACAC members, ranging from full and effective inter- and intra-agency participation to minimal participation. (PIA-3)
6. Insufficient effective procedures exist for the inter-facility coordination of traffic and constraint information to prevent oversaturation of operational sectors. As an example, in Gulf region FIRs where routine holding occurs, there are instances where inter-facility procedures and responsibilities are not as thoroughly defined as they should be. (PIA-3)
7. Operational sectors become oversaturated, very often at predictable times and flows. (PIA-3)
8. Individual operating and support systems are not fully interoperable nor share common functionalities and flight data with adjacent FIRs. (PIA-2)
9. Current staffing levels at select facilities are inadequate for the required service provision, as illustrated in Table 28.

10. Geopolitical and security uncertainty (Lebanon, Libya, Iraq, Syria, and Yemen) are affecting ANSP interoperability, airspace and route usage, as indicated in Figure 25.

Figure 25: Flight Avoidance of Geopolitically Constrained Regions

Table 28: Regional Staffing Needs

Facilities	Current Needs				Current On Hand				2020				2025				2030			
Required ATC Staffing:	AC	AP	AD	FS	AC	AP	AD	FS	AC	AP	AD	FS	AC	AP	AD	FS	AC	AP	AD	FS
Algeria	179	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Bahrain	124	29	45	DU	73	29	26	DU	124	29	45	DU	DU	DU	DU	DU	DU	DU	DU	DU
Egypt	145	371		35	145	371		35	147	371		35	147	436		50	198	436		65
Iraq	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Jordan	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Kuwait	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Lebanon	35	DU	30	14	20	DU	20	6	51	DU	34	18	DU	DU	DU	DU	DU	DU	DU	DU
Libya	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Mauritania	30	36	36	10	14	20	20	2	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Morocco	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Oman	132	35	43	DU	103	35	43	DU	155	50	63	DU	177	61	73	DU	200	66	78	DU
Palestine	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Qatar	DU	50	51	DU	DU	50	51	DU	75	56	56	10	75	56	56	10	75	56	56	10
Sudan	50	15	25	DU	50	15	25	DU	55	40	32	DU	60	40	27	DU	65	45	32	DU
Saudi Arabia																				
Syria																				
Tunisia	75	379		35	68	370		35	78	383		35	187	448		50	198	451		65
UAE*	DU	DU	DU	DU	DU	61	72	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Yemen																				

RED Highlighted Values Indicate Current Staffing Deficiency DU – Data Unavailable * Partial: Dubai Air Navigation Services (DANS)

6.2.1.2 ***Airspace Policy/Procedures***

11. Airspace design among ANSPs, while generally effective for local operations, do not always provide seamlessness with adjacent FIR airspace designs. (PIA-3,4)
12. Coordination procedures are limited to manual capabilities among many regional ANSPs.
13. Based on available information existing and authorised ATC procedures are not being utilised to their fullest capabilities (e.g., radar separation, automated flight data transfer, visual separation). (PIA 1-4)
14. Sector designs are often based on legacy aircraft capabilities, and thus have become inefficient relative to modern aircraft capabilities and operator desires. (PIA-4)
15. PBN advancement in the en-route environment is continuing; however, there was no clear indication provided that these advancements are being extended beyond the local FIR boundary in an integrated effort. (PIA-1)
16. Significant changes to homogenous area traffic flows are expected that will have substantial effects on current airspace design and procedures as sequentially depicted in Figure 26. An example of a significant change to a homogeneous area in the ACAC Region is illustrated in Figure 27.
17. Insufficient data to determine the use of effective aircraft ground staging. (Training)

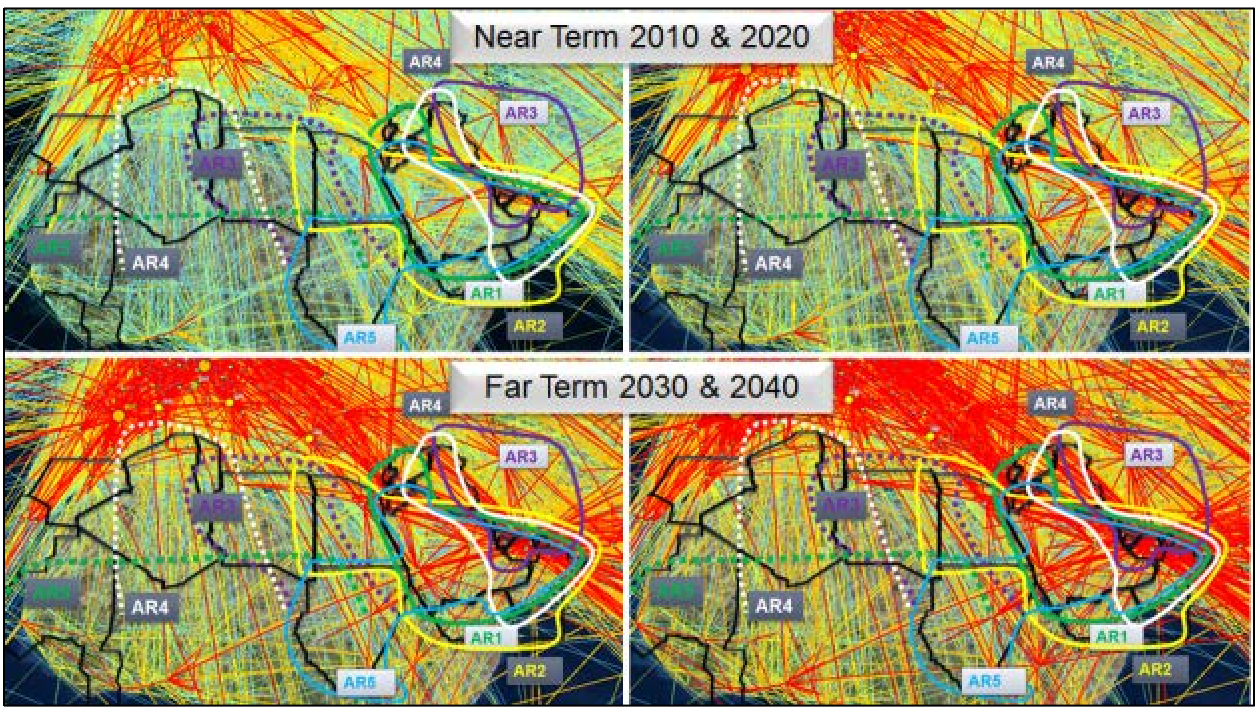


Figure 26: Near-Far Term Homogenous Area Traffic Impacts

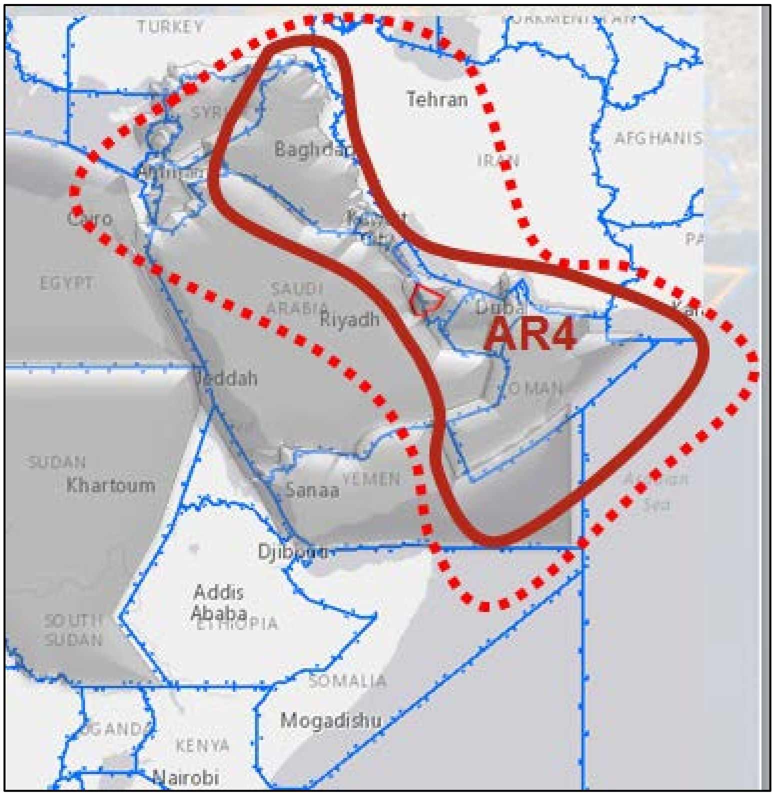


Figure 27: AR4 Middle East Homogenous Area Expansion

6.2.1.3 *Separation Standards*

18. The application of separation standards exceeds the minimum standard required for the operational environment (i.e., using significantly increased values within and across ANSP boundaries). (PIA-3)
19. ATC conflict alert or conflict resolution advisory features are not available in all ANSP operating systems. (PIA-3)
20. There was no clear indication available to determine if there is an effective use of terminal aircraft ground staging. (training)
21. There was no clear indication available to determine if there is an effective use of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. (Training)
22. Based on available information, existing and authorised ATC procedures are not being utilised to their fullest capabilities (e.g., visual separation, parallel runway operations, and diverging departure headings.). (Policy and Training). (PIA 1-4)

6.2.1.4 *Routing*

23. Regional North Africa States have route structures that largely consist of single routes between city pairs and general en-route airspace overflights.
24. Regional North Africa route structures are largely based on conventional ground-based

NAVAIDs, with limited RNAV routes, leading to route bottlenecks at NAVAIDs.

25. It is not uncommon for the North Africa ANSPs to have multiple routes converge into a single route at an adjacent FIR boundary fix—presuming a procedural requirement by that ANSP. *NOTE: Finding is often consistent with the State's national boundary.*
26. The use of full-time single direction routes could have a negative effect on the overall efficiency of the airspace and controller resources; this is most noticed in the Gulf Region States.
27. Regional Middle East States have route structures that largely consist of closely spaced parallel RNAV routes within the majority of their airspace.
28. Regional Middle East (KSA and Gulf States) route structures are largely based on RNAV capabilities. The major national airlines in the gulf region are bringing increased levels of technology and sophistication to their operations. Capabilities are being added to not only improve monitoring their flights but also to help manage the impacts of capacity limitations in the system. While such investments lead to internal efficiency improvements, what is not evident are significant CDM procedures and technology to improve common situational awareness and share these data points between the operators, airports, and the ANSP.
29. If SAA is adversely affecting commercial operations, then there is an immediate need to develop and/or enhance existing Flexible Use of Airspace (FUA) procedures to provide an allocation of airspace based on tactical needs within the FIR. (PIA-3)

6.2.1.5 *Bottlenecks*

Those States that have provided bottleneck data are depicted in Table 29 and illustrated in Appendix G indicating locations and directions of constraints (were provided). The scope of this project did not enable the analysis of bottlenecks as they relate to airspace or sector design; the bottlenecks of two States (Egypt and UAE) were further elaborated on in Appendix G.

Table 29: FIRs Providing Bottleneck Data

ACAC FIR Bottleneck Data		
High-Activity FIRs	**Medium-Activity FIRs**	**Low-Activity FIRs**
Bahrain	Algeria	Lebanon
Egypt	Oman	Tunisia
KSA	—	—
UAE	—	—

6.2.1.6 *Contingency and Growth Planning*

30. Several States have conducted a detailed analysis of operational position needs within each State through 2030, and are developing a plan to meet those needs with optimum

effectiveness and efficiency. Growth planning is critical for continued safe and efficient operations; however, many States did not respond to this data request, and thus there is a great amount of uncertainty as to whether the regional as a whole is prepared to accommodate projected traffic growth. Figure 28 and Figure 29 respectively denote regional ANSP ACC Sector and APC Sector forecasts through the near term and far term.

ACAC FIR ACC Sector Forecasts									
FIRs	Current	2020	2025	2030	FIRs	Current	2020	2025	2030
Algeria	8	16	DU	DU	Morocco	DU	DU	DU	DU
Bahrain	6	12	13	14	Oman	5	7	9	11
Egypt	7	7	9	9	Palestine	DU	DU	DU	DU
Iraq	DU	DU	DU	DU	Qatar**	0	4	4	4
Jordan	DU	DU	DU	DU	Sudan	4	8	12	16
Kuwait*	DU	DU	DU	DU	Saudi Arabia	DU	DU	DU	DU
Lebanon	1	1	DU	DU	Syria	DU	DU	DU	DU
Libya	DU	DU	DU	DU	Tunisia	11	12	12	12
Mauritania	DU	DU	DU	DU	UAE	9	~12	~15	21
* Kuwait indicated adequate position thru 2030 **Phased ACC planning without firm implementation data					Yemen	DU	DU	DU	DU

Figure 28: ACAC Regional ACC Forecast Near–Far Term

ACAC FIR APC Sector Forecasts									
FIRs	Current	2020	2025	2030	FIRs	Current	2020	2025	2030
Algeria	DU	DU	DU	DU	Morocco	DU	DU	DU	DU
Bahrain	4	4	4	6	Oman	1	2	2	2
Egypt	10	10	15	16	Palestine	DU	DU	DU	DU
Iraq	DU	DU	DU	DU	Qatar	5	5	5	5
Jordan	DU	DU	DU	DU	Sudan	DU	DU	DU	DU
Kuwait*	DU	DU	DU	DU	Saudi Arabia	DU	DU	DU	DU
Lebanon	1	1	DU	DU	Syria	DU	DU	DU	DU
Libya	DU	DU	DU	DU	Tunisia	DU	DU	DU	DU
Mauritania	DU	DU	DU	DU	UAE	DU	DU	DU	DU
* Kuwait indicated adequate positions thru 2030					Yemen	DU	DU	DU	DU

Figure 29: ACAC Regional APC Forecast Near–Far Term

31. A determination could not be made if all regional facilities could ensure continuity of operations in the event of a system failure. NOTE: The UAE in particular, is fully capable to indefinitely sustain such an event.

32. From the reporting ANSPs, there are several significant facility expansion needs and planning through 2020 as indicated inTable 30.

Table 30: ACAC ANSP Facility Expansion Needs

Facilities	Current				2020				2025				2030			
Facility Type:	AC	AP	AD	FS	AC	AP	AD	FS	AC	AP	AD	FS	AC	AP	AD	FS
Algeria	1	5	36	36	2	5	36	36	DU	DU	DU	DU	DU	DU	DU	DU
Bahrain	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2
Egypt	1*	8	21	8	1	7	7*	8	1	7	7*	8	1	7	7*	8
Iraq	1	1	7		DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Jordan	1	2	3		DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Kuwait**	1	1	1		DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Lebanon	1	1	2	1	1	1	2	1	DU	DU	DU	DU	DU	DU	DU	DU
Libya	1	3	8		DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Mauritania***	1	2	3	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Morocco	1	7	22	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Oman	1	2	2	1	1	3	6	1	1	3	6	1	1	3	6	1
Palestine	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Qatar	0	1	2		1	0	2	DU	1	0	2		1	0	2	DU
Saudi Arabia	2	6	10	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Sudan	1	5	7	DU	1	6	8	DU	1	6	8	DU	2	6	8	DU
Syria	1	3	7	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU
Tunisia	1	3	7	1	1	3	7	1	1	3	8	1	1	4	8	1
UAE	1	4	25	DU	1	4	25	DU	1	3	DU	DU	1	2	DU	DU
Yemen	1	1	9													

Green Highlighted Values Indicate an Increased Facility Need Red Highlighted values Indicate a Reduced Facility Need --- DU Data Unavailable
* Egypt reported international airports only
** Kuwait reported sector capacity is exceeded,
*** Mauritania reported sector design is a constraint to its operation

6.2.1.7 *Civil-Military*

33. Limited data was submitted regarding the development of high-level agreements and plans that would result in a transition to integrated civil-military airspace management. (PIA 1-4)
34. Limited data was submitted regarding enhancing Flexible Use of Airspace procedures to provide an allocation of airspace based on tactical needs. (PIA-3)
35. While limited data was provided, through assumptions and involvement with the UAE Airspace Study, there does not appear to be Region-wide involvement in negotiations, for the provision of air navigation services and information sharing for the civilian use of SAA between representative parties of ANSPs, Military stakeholders, and commercial operators. (PIA 1-4)

6.2.1.8 *Airport Policy/Procedures*

36. A determination could not be made regarding the routine use of mixed-use runway procedures when there are peak periods with higher numbers of arrivals or departures. (PIA 1,3)

6.2.1.9 *Airport Physical Infrastructure*

37. Airport planning project information was insufficient to reach a meaningful finding or identify a gap.
38. Based on current and forecasted airport demand, it is unsure from the data received that any accelerated planning and construction for rapid exit taxiways to be optimally located to minimise runway occupancy time for typical aircraft is underway. (PIA-1) At least one ANSP reported current inadequacy in runway, taxiway, gate, terminal and other airport infrastructure.

6.2.1.10 *TFM/CDM*

39. Limited information was provided indicating the establishment of Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Generally, centralised ATFM functions do not exist within facilities. (PIA-3)
40. There appears to be insufficient identification and collection of metrics that can assist in capturing current performance data such as sector and runway capacity, which can aid in determining the need, cost, or benefit of procedure modification or development and equipment acquisition. (PIA 1,3)
41. Many reporting ANSPs did not indicate whether an implemented traffic situational display capability exists or is planned for ANSPs and stakeholders, including Airport Operators, which will provide a common situational awareness of aircraft within or destined for the FIR. (PIA-3)
42. In FIRs where routine holding occurs, data did not indicate planning for and implementation of time-based trajectory management. (PIA-3)

43. Many ANSPs have A-MAN/D-MAN/Enterprise Management System (E-MAN) capabilities; however, implementation of fully integrated capabilities of the systems has not been realised. (PIA-1)

44. No indication that enhanced departure constraint management capabilities exist which include tactical adjustments to flight levels, routes, and broad stakeholder substitution automation capabilities. (PIA-1)

45. Many static MITs exist within the region that appear to be embedded in agreements and standard operating procedures; additionally, some MIT restrictions appear to be ‘regardless of altitude’ restrictions. (PIA 1,3) Table 31 depicts those State flow restrictions that were provided.

Table 31: Static Restrictions

ACAC Static Restrictions				
Providing ANSP	**Receiving ANSP**	**Restriction**	**Receiving ANSP**	**Restriction**
Bahrain-OBBB	Internal	5NM	OKBK (Kuwait)	20 NM no closing 10 minutes at TASMI
	OIII (Tehran, Iran)	20NM -40NM	OTHH (Doha – Qatar)	10 NM
	OEJN (Jeddah, Saudi Arabia)	10 NM for at least 5 minutes inside OEJN	OMAE (UAE FIR)	10 NM for at least 5 minutes inside OMAE
Egypt-HECC	Internal	5–10 NM	Riyadh	10 NM
Oman-OOMM	Internal Muscat ACC	5NM MSSR, PSR or PSR w/SSR or MSSR 16 NM SSR only		
Saudi Arabia-OEJD	Internal	10–30 NM	UAE (Empty Qtr.) OMAA FIR	10 minutes
	Kuwait (OKAC) FIR	30 NM	Oman (Empty Qtr.) OMAA FIR	10 minutes
	Amman (OJAC) FIR	30 NM	Yemen – South (Sana’s FIR)	10 minutes
	Cairo (HEEC) FIR	30NM	Asmara (HHAS) FIR	10 minutes
	Bahrain (OBBB) FIR	20 NM	Addis Ababa (HAAB) FIR	10 minutes
Saudi Arabia-OEJD	Baghdad (ORBB) FIR	10 minutes	Khartoum (Sudan) (HSSS) FIR	10 minutes
Sudan-HSSS	internal	10 minutes		
Tunisia- DCCT	Internal	5–10 NM	Roma FIR	10NM
Kuwait	ANSP indicates it is highly impacted by MIT restrictions, specific data was not available			

ACAC Static Restrictions				
Providing ANSP	Receiving ANSP	Restriction	Receiving ANSP	Restriction
Mauritania	ANSP indicates it is highly impacted by MIT restrictions, specific data was not available			

46. There is limited indication that CDM processes are utilised for flight plan and trajectory information exchanges. Examples of the types of situations where CDM would provide opportunities for improved efficiency and situational awareness: (PIA-3)
    a. It could not be determined if information or data to indicate capabilities and processes for exchanging strategic and tactical information and decision-making are available between the ANSPs and stakeholders. (PIA-3)
    b. It could not be determined if regional CDM processes existed to disseminate the information collected in (a) above to affected stakeholders.
47. No data supplied or other information indicates airports of major demand airports have established process for the automated substitution of slot times between stakeholders. (PIA-2)

6.2.1.11 *Technical and Administrative Expertise, Proficiency and Training*

Based on a review of regional charters for various projects affecting operation and administration (ARNOP, MID FPP, NCLB, VTC, RSOOP), we draw the following findings based on the backgrounds of the project charters.

48. From a regional perspective, there are insufficient numbers of trained and experienced procedure designers. [27]
49. For those States that have procedure designers, there is often insufficient design work or refresher training to attain or maintain adequate proficiency. [27]
50. Regionally there is a lack of airspace and procedure training covering the following required training concentrations: initial, OJT, and recurrent. [27]
51. There is a lack of skilled expertise to effectively integrate procedure design with airspace development and to then perform an appropriate quality assurance assessment/report. [27]
52. There is a lack of skilled expertise to oversee the process leading to procedure documentation. [27]

6.2.1.12 *Safety*

53. The region is advancing under the guidelines established in the Global Aviation Safety Plan, utilising the USOAP protocols and audit procedures to monitor and judge compliance with global indicators and targets.

54. The ICAO world member States safety audit result is at 63%, the ACAC geographic Africa State average is 49%, and the Middle East geographic State average is 68% (based on August 9, 2016, data).
55. The ACAC Africa geographic States have largely met (Tunisia, Sudan, Morocco, and Mauritania) the 2012 Africa Ministerial target of a 60% Effective Implementation target by 2017, three States have not and may not by 2017 (Libya, Egypt, and Algeria).
56. Six of the ACAC Middle East geographic States (the UAE, KSA, Kuwait, Oman, Bahrain, and Qatar) exceeded the ICAO world safety audit average of 63% Effective Implementation. Three States (Syria, Jordan, and Lebanon) are within a range of ~53-60% Effective Implementation, while no data is available for Iraq, Syria, and Yemen. There was insufficient data to determine if a Ministerial target is in place for the Middle East geographic area.
57. As the majority of ACAC Member States have attained Effective Implementation of more than 60%, and other States approach that benchmark, they will be required to begin the development and implementation phase of the State Safety Programmes, an area in which virtually all the MENA States require assistance.
58. Critical Element 4 (technical staff and qualified training) and Critical Element 8 (resolution of safety concerns) represent the lowest ACAC Regional Effective Implementation values at 44% and 55%, respectively.
59. It is uncertain, but likely, that the number of Regional Aviation Safety Groups (3 – EUR, AFI, and MID) responsible for geographic and administrative ACAC jurisdictional States may have a constraining regional impact on the development, coordination, data collection and implementation of ACAC regional safety enhancements.
60. Geopolitical and safety uncertainty within the region has resulted in several ACAC jurisdictional ANSPs (Iraq, Libya, Syria and portions of Yemen) being included in the highest level (Level 1) risk classification as identified in the Flight Service Bureau [3] Airspace Safety Risk Classification publication. Other ACAC State ANSPs are identified at a lesser risk classification.
61. Recognised in the *ICAO Safety Report 2015* is the United Arab Emirates (UAE) for significant contributions in improving the coordination of accident and incident investigation activities in the ACAC Member States. Holding workshops in 2012 and 2013 and attended by representatives from Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, and the UAE led to the establishment of the Middle East and North Africa Society of Air Safety Investigators (MENASASI), affiliated as a regional chapter of the International Society of Air Safety Investigators (ISASI), whose goal is to promote cooperation and to act proactively in establishing cooperation in air accident investigation across the Middle East and ACAC Member States [4].

6.2.1.13 ***Other Dynamics***

62. The capabilities of the regional training organisations are constrained by the differences of regulatory requirements for recognition of credits, certificates, diplomas, or degrees among ACAC Member States.[5]

63. Of the ACAC study States, only Mauritania has made formal arrangements to develop a Memorandum of Agreement (MOA) for ConOps development with the space-based ADS-B service provider. No other ACAC member has either entered into a contract or MOA to develop a ConOps, as illustrated in Figure 30 , and enhanced in Figure 31 (Green signifies formal space-based ADS-B contract agreement, Blue signifies Memorandum of Agreement for space-based ConOps development, and Grey signifies no formal agreement with the space-based ADS-B service provider). As depicted in these figures, the 17 States that compromise the Agency for the Security of Aviation in Africa and Madagascar (ASECNA) have entered into an MOU with an ADS-B Space-Based service provider. [39] A clear opportunity exists to harmonise surveillance among the two organisations (ACAC and ASECNA).

[NOTE: On June 20, 2016, a Space-Based ADS-B MOU has been signed with AZIMUT—Russia's provider of CNS, and ATM Automation, and INFOCOM-Avia—Russia's designated operator of aviation information services. This addition is not reflected in the depictions below]. [40]

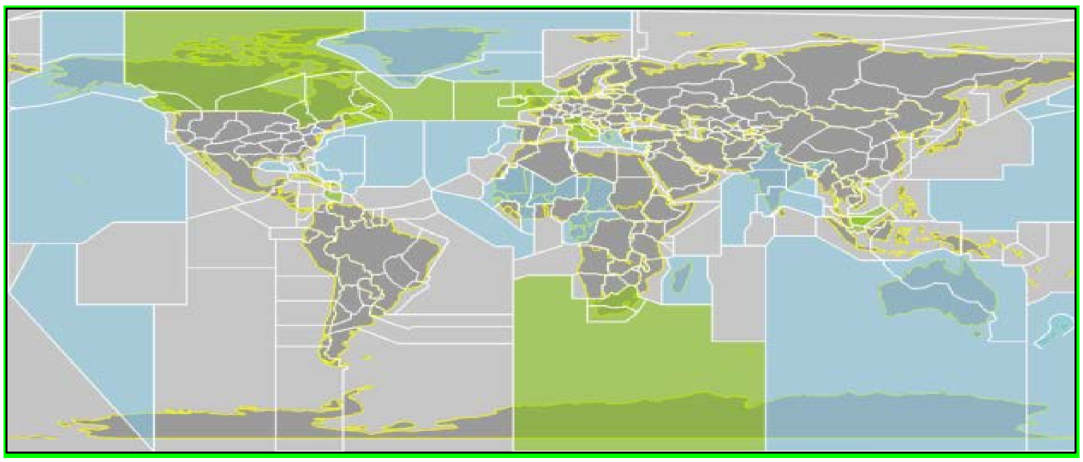


Figure 30: Space-Based ADS-B Agreements

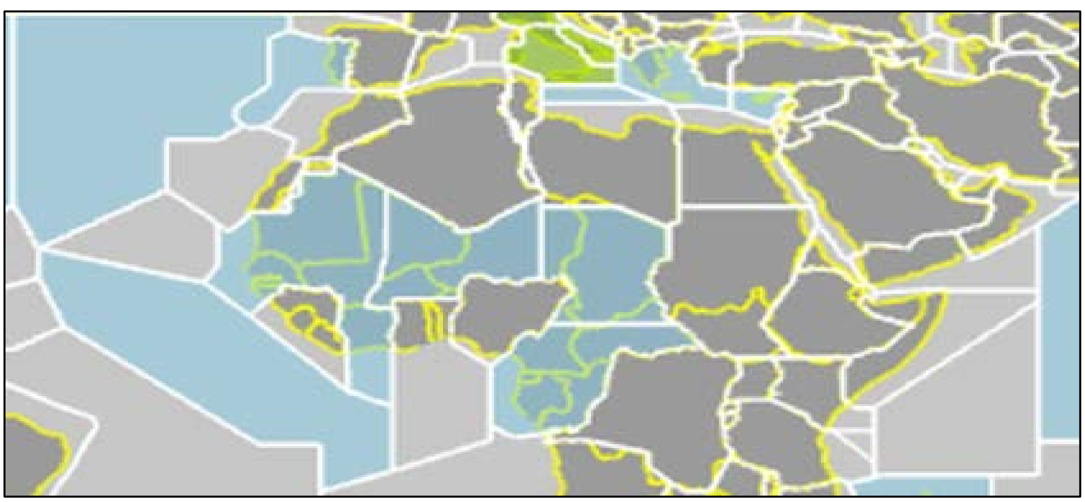


Figure 31: Enhanced View of ACAC Regional Space-Based ADS-B Agreements

6.2.2 Arab Air Carrier Organization (AACO) Operator Input

AACO members were invited to complete an airline operator focused questionnaire developed to obtain first-hand information, from a customer's perspective on ACAC FIR service availability and its delivery. The study team hoped to add an additional data point that can be used by ACAC to assist in developing near and long term strategic planning for regional air navigation service provisions. AACO's air carrier membership consists of 32 airlines servicing the ACAC region. Four airlines responded to the survey. The respondents are referred to by the numbers 1 through 4. The questionnaire focused on the following areas:

- Present day operations
  - Ability to fly user-preferred trajectories
  - Ability to obtain desired cruise altitude
  - Ability to operate at flight planned speed
  - Bottlenecks in the en-route, approach control, and/or terminal areas

    NOTE: Bottlenecks are areas where some or all of the following occur: re-routing, holding, route structure, excessive vectoring).
- Areas where service could be enhanced
- Communications with ANSPs
- Airspace access

The following sections contain the feedback provided by the four air carriers in these areas.

6.2.2.1 *Present Day Operations*

Operators were asked in which FIRs do they experience the greatest and least ability to fly user-preferred trajectories to obtain desired cruise altitude and to operate at flight planned speed, and where they experience the greatest and least bottlenecks.

NOTE: Many of the following operator responses conflict as an example, respondents # 3 and 4 reported the greatest ability to fly user-preferred trajectories in some of the same areas that respondents # 1 and 2 reported the least ability. This inconsistency follows through each of the below examples.

The following tables reflect the feedback provided by the four respondents to the questionnaire:

6.2.2.1.1 Ability to Fly User-Preferred Trajectories

Greatest Ability:

Greatest Ability to Fly User-Preferred Trajectories					
Respondent #	FIR	FIR	FIR	FIR	FIR
1	Beirut (OLBB)	Muscat (OOMM)	Khartoum (HSSS)	Cairo (HECC)	
2	None				

Greatest Ability to Fly User-Preferred Trajectories					
Respondent #	FIR	FIR	FIR	FIR	FIR
3	Bahrain (OBBB)	Amman (OJAC)	Kuwait (OKAC)	Jeddah (OEJD)	Emirates (OMAE)
4	Bahrain (OBBB)	Kuwait (OKAC)	Beirut (OLBB)	Jeddah (OEJD)	

Respondent comments:

- No comments received.

Least Ability:

Least Ability to Fly User-Preferred Trajectories							
Respondent #	FIR	FIR	FIR	FIR	FIR	FIR	FIR
1	Bahrain (OBBB)	Baghdad (ORBB)	Amman (OJAC)	Kuwait (OKAC)	Jeddah (OEJD)	Emirates (OMAE)	Sanaa (OYSC)
2	Bahrain (OBBB)	Muscat (OOMM)	Jeddah (OEJD)				
3	Baghdad (ORBB)	Muscat (OOMM)					
4	Cairo (HECC)	Amman (OJAC)	Muscat (OOMM)	Khartoum (HSSS)	Sanaa (OYSC)		

Respondents' comments:

Respondent # 1:

- OBBB – Although not faultless, OBBB is an FIR where we are normally given preferred trajectories.
- HECC – Very little deviation from planned and preferred routes.
- ORBB – We only fly fixed routes to destinations in Iraq. So, in effect we are mandated to be given preferred trajectory. No recent overflight experience.
- OJAC – Due to constraints of no-fly areas (ORBB, OSTT and LLLL), we have no exposure to OJAC overflight. Terminal routing is more often than not on our preferred trajectory.
- OKAC – Currently impossible to judge as we are not using OKAC for overflight, but merely to get to KWI. Trajectory management for flights to KWI is a mixed bag.
- OLBB – Deviations from preferred and filed routes (for flights to OLBA) are rare. No overflight experience.
- OOMM – Similar to OBBB, OOMM are reliable in provision of preferred trajectory.
- OEJD – OEJD is a challenge regarding preferred trajectories. Despite published preferred tracks in the AIP, we cannot rely on being given them and we are sometimes routed on completely different, and longer tracks. If we try to file a route outside of the preferred tracks, we are often reprimanded. Having said that, the ATCOs are very proactive in giving direct routes.
- HSSS – Due to ATC environment, preferred and filed trajectories are normally flown.
- OMAE – No overflight experience due to home base, but deviations for traffic flow into DXB are very common.
- OYSC – Very little ATC control and we are mandated by our own regulator to fly certain routes, so in effect preferred trajectory is a given.

Respondent # 2:

- None (FIRs) offer user-preferred trajectories.
- OBBB – The ANSP has standard routings with level restrictions that must be strictly followed.
- OOMM – The ANSP has preferred routings that needs to be complied with.
- OEJD – The ANSP has published more preferred routing options that must be complied with but the most efficient routes are not published as preferred routes.

Respondent # 3:

- No comments received.

Respondent # 4:

- OEJD – They are very good in giving preferred trajectories and shortcuts.

Initial Deduction:

There is little that can be concluded from these responses without further study partially due to inconsistency in the comments. For example, Respondents # 3 and 4 reported the greatest ability to fly user-preferred trajectories in some of the same areas that respondents # 1 and 2 reported the least ability. Because these users have varying degrees of interface with these FIRs based on the routes they use and the time of day they operate, it is logical to conclude that the ability to obtain a user-preferred trajectory is related to the flight planned destination and perhaps the time of day that the user is accessing the airspace. In the high-density areas, the FIRs' route restrictions are likely to be restrictive due to the need to control volume through sectors and to prevent over loading. In low- and moderate-density areas, the reasons are less clear. We can also speculate that market shifts may have made the current route structure obsolete.

6.2.2.1.2 Ability to Obtain Desired Cruise Altitude

Greatest Ability:

Greatest Ability to Obtain Desired Cruise Altitude					
Respondent #	FIR	FIR	FIR	FIR	FIR
1	Cairo (HECC)	Baghdad (ORBB)	Khartoum (HSSS)	Sanaa (OYSC)	
2	Amman (OJAC)	Casablanca (GMMM)	Tunis (DTCC)	Alger (DAAA)	
3	Bahrain (OBBB)	Jeddah (OEJD)	Emirates (OMAE)		
4	Bahrain (OBBB)	Kuwait (OKAC)	Beirut (OLBB)	Jeddah (OEJD)	Emirates (OMAE)

Respondents' Comments:

Respondent # 1:

- Desired cruise altitude is normally achieved.

Respondent # 2:

- No issues with obtaining desired cruise altitude based on Crew Reports.

Respondent # 3:

- No comments received.

Respondent # 4:

- Doha controllers are very good; OMAE airspace is very congested but ATC tries to accommodate altitude requests.

Least Ability:

Least Ability to Obtain Desired Cruise Altitude					
Respondent #	FIR	FIR	FIR	FIR	FIR
1	Bahrain (OBBB)				
2	Bahrain (OBBB)	Muscat (OOMM)	Jeddah (OEJD)		
3	Muscat (OOMM)				
4	Cairo (HECC)	Amman (OJAC)	Muscat (OOMM)	Khartoum (HSSS)	Sanaa (OYSC)

Respondents' Comments:

Respondent # 1:

- Inability to obtain desired altitude is presumed to be caused by UAE arrival/departure restrictions.

Respondent # 2:

- OBBB – Published level restrictions prevent aircraft from accessing optimum flight levels.
- OOMM – Uses flight level allocation scheme on some routes which prevent access to optimum levels.
- OEJD – Has level restrictions not officially documented.

Respondent # 3:

- No comments received.

Respondent # 4:

- No comments received.

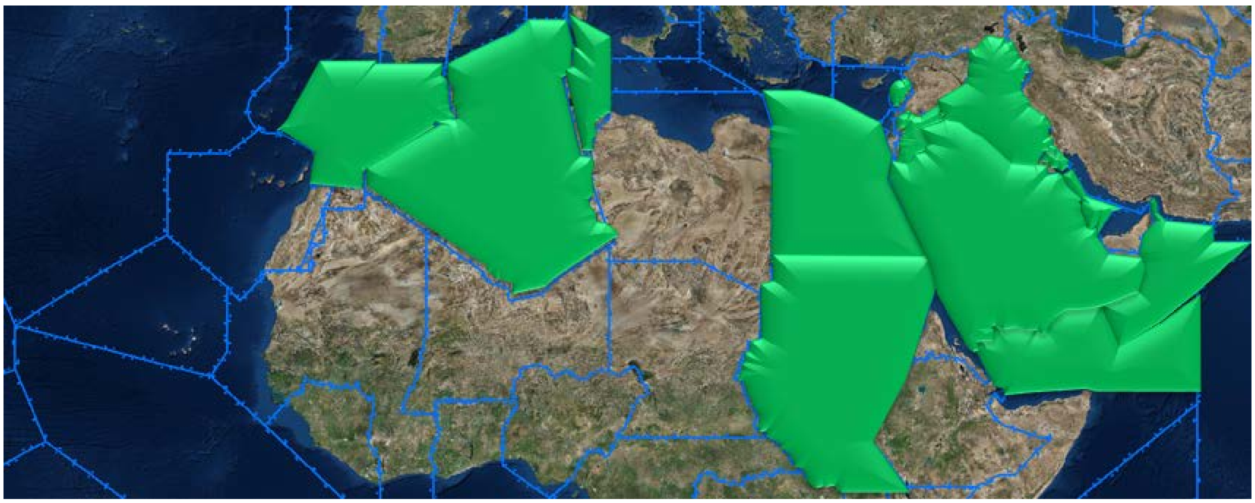
Initial Deduction:

Like the feedback regarding trajectory assignment, there is little we can conclude from these responses without further study. In some cases, areas where the greatest ability to achieve requested altitude for some respondents, conversely are the areas where the least ability exists for others. We can conclude for the most part that in the high-density FIRs, the ability to obtain desired cruise altitudes is related to the flight planned destination and the time of day that the user is accessing the airspace. In the low- and moderate-density FIRs, the reasons are less clear.

6.2.2.1.3 *Ability to operate at Flight Planned Speed*

Greatest Ability:

Greatest Ability to Operate at Flight Planned Speed									
Respondent #	FIR	FIR	FIR	FIR	FIR	FIR	FIR	FIR	FIR
1	Cairo (HECC)	Baghdad (ORBS)	AMAN (OJAC)	Kuwait (OKAC)	Beirut (OLBB)	Khartoum (HSSS)	Sanaa (OYSC)		
2	Alger (DAAA)	Amman (OJAC)	Casablanca (GMMM)	Tunis (DTTC)					
3	Bahrain (OBBB)	Cairo (HECC)	Baghdad (ORBS)	Amman (OJAC)	Kuwait (OKAC)	Beirut (OLBB)	Muscat (OOMM)	Jeddah (OEJD)	Khartoum (HSSS)
4	Bahrain (OBBB)	Kuwait (OKAC)	Beirut (OLBB)	Jeddah (OEJD)					



Respondent Comments:

- No comments received.

Least Ability:

Least Ability to Operate at Flight Planned Speed				
Respondent #	FIR	FIR	FIR	FIR
1	Bahrain (OBBB)	Muscat (OOMM)	Jeddah (OEJD)	Emirates (OMAE)
2	Bahrain (OBBB)			
3	None noted			
4	Cairo (HECC)	Amman (OJAC)	Khartoum (HSSS)	Sanaa (OYSC)

Respondent Comments:

- No comments received.

Initial Deduction:

It would be expected to see speed control used in high-density areas during peak periods as a means of flow control. Without further study, it is not possible to draw any conclusions regarding its frequency of use or possible alternatives.

Route, altitude, and speed control are necessary air traffic tools to maintain safety and orderliness and to ensure airspace and airport capacity are not exceeded. There are times when each of these is needed. Without further data and study regarding when these restrictions are in place, the underlying reasons for the restrictions and the flows they are affecting, we cannot draw any specific conclusions. If these restrictions are static and in place permanently then the tools are probably being over used and causing an unnecessary impact to the users.

6.2.2.1.4 Bottleneck Locations

Bottleneck Locations: Area Control Centres

Area Control Centres (ACCs) – Greatest Number of Bottlenecks				
Respondent #	FIR	FIR	FIR	FIR
1	Emirates (OMAE)	Bahrain (OOMM)		
2	Cairo (HECA)	Jeddah (OEJD)	Bahrain (OBBB)	
3	None noted			
4	Muscat (OOMM)	Jeddah (OEJD)	Cairo (HECC)	Sanaa (OYSC)

Respondents' Comments:

Respondent # 1:

- OMAE – When entering the UAE for Dubai Intl Airport.
- OOMM – When entering from the UAE during Muscat flow periods.

Respondent # 2:

- HECA – Overflights experience a lot of re-routing due to traffic congestion at KITOT.
- OBBB – Traffic from Bahrain FIR and UAE FIR to Ankara FIR merge at ROTOX resulting in en-route vectors and FL capping to accommodate demand.
- OKAC – When Iraq airspace is available, the RNAV 1 routings within Bahrain FIR feed more traffic to the conventional airways in Kuwait FIR. This creates a bottleneck.

Respondent # 3:

- No comments received.

Respondent # 4:

- No comments received.

Area Control Centres (ACCs) – Fewest Number of Bottlenecks				
Respondent #	FIR	FIR	FIR	FIR
1	None noted			
2	Alger (DAAA)	Casablanca (GMMM)	Amman (OJAC)	
3	Emirates (OMAE)			
4	Bahrain (OBBB)	Kuwait (OKAC)	Beirut (OLBB)	Jeddah (OEJD)

Respondents' Comments:

- No comments received.

Bottleneck Locations: Approach Controls

Approach Control (APC) – Greatest Number of Bottlenecks			
Respondent #	APC	APC	APC
1	Dubai (OMDB)	Kuwait (OKBK)	
2	Doha (OTHH)		
3	None noted		

Approach Control (APC) – Greatest Number of Bottlenecks			
Respondent #	**APC**	**APC**	**APC**
4	Cairo (HECC)	Khartoum (HSSS)	Emirates (OMAE)

Respondents' Comments:

Respondent # 1:

- OMDB - Vectoring and holding due to capacity constraints.
- OKBK - No CDA and often lengthy vectors on arrival.

Respondent # 2:

- OTHH - Aircraft are subjected to airborne holding during peak periods.

Respondent # 3:

- No comments received.

Respondent # 4:

- Congested airspace.

Approach Control (APC) – Fewest Number of Bottlenecks				
Respondent #	**APC**	**APC**	**APC**	**APC**
1	Queen Alia International Airport, Jordan (OJAI)	Rafic Hariri International Airport, Lebanon (OLBA)	Kuwait International Airport (OKBK)	Khartoum International Airport (HSSS)
2	None noted			
3	Khartoum International Airport (HSSS)			
4	None noted			

Respondent Comments:

- No comments received.

Bottleneck Locations: Airports

Airports – Greatest Number of Bottlenecks			
Respondent #	Airport	Airport	Airport
1	Dubai International Airport (OMDB)		
2	None noted		
3	None noted		
4	Cairo (HECA)	Khartoum (HSSS)	Emirates (OMAE)

Respondent # 1, 2, and 3:

- No comments received.

Respondent # 4:

- OMAE Congested airspace

NOTE: Respondent # 4 has named an FIR in this category; therefore, the identity of the airports they refer to are unknown.

Airports – Fewest Number of Bottlenecks					
Respondent #	Airport	Airport	Airport	Airport	Airport
1	Queen Alia International Airport, Jordan (OJAI)	Rafic Hariri International Airport, Lebanon (OLBA)	Kuwait International Airport, Kuwait (OKBK)	Khartoum International Airport, Sudan (HSSS)	Juba Airport, Sudan (HSSJ)
2	None noted				
3	Khartoum International Airport, Sudan (HSSS)	(OKAC)			
4	None noted				

Respondent Comments:

- No comments received.

Initial Deduction:

The comments from the respondents regarding current bottlenecks in the region (ACC, APC, and ATCT) are supported by the data provided in this report in Appendix G.

6.2.2.2 *Service Enhancements*

Respondents to the questionnaire were asked to identify enhancements to services, systems, or procedures they recommend in specific Area Control Centres (ACCs), Approach Control (APC), and Airport facilities in the Region. The following is a consolidation of the responses from the four participants:

ACC/APC	Focus Area	Specific Details
OBBB ACC	**Collaboration**	• It is important that this ACC collaborates with the adjacent FIRs to enhance traffic flow and reduction imposed restrictions.
OOMM ACC	**Separation**	• It is desired to see reduction in separation for traffic transiting to/from Arabia Sea/Indian Ocean. • More coordination with Mumbai FIR (VABF) to allocate flight levels. • Lift restrictions, increase capacity, add routes. • Better radar service over Muscat.
OEJD ACC	**Civil/Military Cooperation/Airspace Optimisation**	• Civil/Military cooperation should be prioritised for this FIR to optimise the airspace and enhance its capacity. Implement efficient.
OKAC ACC **OKBK Approach**	**PBN/Efficiency/Procedures**	• This ACC should implement RNAV 1/RNP 1 routes to enhance airspace capacity. • Introduce CDAs and more efficient arrival procedures where we could accurately predict track miles.
HECC ACC	**Separation/Communication/Airspace optimisation**	• It is desired that separation standards in this airspace be aligned with the regional plan. • There are still areas with communication gaps; this needs to be improved. • Need to speak clearer and slower • Implement efficient routings in the airspace.
HSSS ACC	**Communication**	• Prioritise communication in this airspace.

ACC/APC	Focus Area	Specific Details
OMAE ACC and Approach	**Airspace/Efficiency/Procedures**	• Airspace is very congested. Continue the UAE airspace restructure project. • Holding, vectors, no continuous descent approach (CDA), speed control. • A lot of work is ongoing to address issues within the UAE. It will be difficult to solve without a wider MENA solution.
HECC Approach Control	**Communications/Procedures**	• Speak clearer and slower. • Insufficient ATC instructions.

Airport	Focus Area	Specific Details
OTHH	**A-CDM**	• Implement Airport CDM to enhance Operational efficiency of the airport.
HEBA	**PBN**	• Implement RNAV APCH on RWY 14.
GMMX	**PBN**	• Implement RNAV APCH on RWY 28.
ORNI/ORMM	**PBN**	• Implement RNAV APCH on RWY 10 (NJF) and both RWY in ORMM.
OEAH	**Air Traffic service**	• Upgrade from flight information service (FIS) to full air traffic service.
OEJD	**Traffic Information Broadcast by Aircraft (TIBA)**	• There are many airfields in Saudi working under TIBA rules. We would like to see this reduced and more stringent control put in place, which would enhance safety. • Consider establishing remote tower where currently without a tower.
OMDB	**Capacity**	• Capacity issues but this is a known issue continually being worked by the aviation community.
HSSS	**Procedural Control**	• Move towards a safer and more efficient radar environment. • Runway condition (asphalt) and apron signage are not up to standard.
OEJN	**Communication**	• Pre-Departure Clearance (PDC) to be introduced.
OERK	**Communication**	• PDC required.
OMAA	**Capacity/Delays**	• Capacity is a known issue and work to increase is ongoing. • AMAN, Airport CDM, Independent Parallel Operations (IPO) (all currently in progress).

6.2.2.3 *ANSP Communication and Relationship*

Respondents to the questionnaire were asked for feedback regarding their relationship with ANSPs. Specifically, they were asked if ANSPs understand the user's business goals and if they consider those goals when managing the air traffic system. Responses noted there is a great variation between ANSPs. Some ANSPs are very proactive and cooperative while others are the opposite. However, great improvement in ANSP/Airline communication was noted by one respondent. Users were also asked how they communicate their issues to the ANSP and to indicate if they communicate through a single point of contact (POC) trained in air traffic management. Responses indicate their communication is directly to the ANSP or industry organisations such as IATA.

Specific detail was not provided; however, from the four responses, we conclude a formal and/or informal communication process and collaborative decision-making techniques are not standard throughout the Region with all ANSPs.

6.2.2.4 *Airspace Access*

Users were asked to provide feedback regarding access to the airspace. Three responses were provided. Generally, these users consider access to the airspace to be fair and equitable across all operators; however, one response indicated that sometimes airspace access is unfairly allocated due to political or other preferences. The respondent did not provide specific detail on this comment. Additionally, one user commented that in some areas, access to airspace is limited for some operators due to old agreements for traffic situations that have changed or have not been altered to reflect advancements in the CNS/ATM environment.

7 Recommendations

This section describes the recommendations proposed to mitigate the gaps identified in the previous section. Recommendations are structured into two groupings: (1) specific near-/far-term recommendations, and (2) key recommendations.

Specific near-/far-term recommendations are framed into two time periods: Near-term (NT) recommendations and Far-term (FT) recommendations. For the purposes of this study, the recommendation periods are defined in a manner that takes the available data and its fidelity, and mirrors it to an ASBU Blocks combination. This combination takes the ASBU Blocks 0 and 1 and sequentially merges their activity periods of 2013–2018 into the near-term recommendations period, and then sequentially merges the ASBU Blocks 2 and 3 and similarly sequentially merges their activity periods of 2023–2028+ into the far-term recommendations period. This is illustrated in Figure 32. While the Team attempted to frame the recommendations into 5-year increments through 2030, the fidelity of the available data prevented such a detailed delineation.

Specific recommendations are categorised by the same observation areas used in identifying the findings as listed below, and then further individualised by time period (NT – FT) as shown in Figure 32:

ACAC ANSP Recommendations:

- ANSP Interoperability
- Airspace Policy/Procedures
- Separation Standards
- Routing
- Contingency and Growth Planning
- Civil-Military
- Airport Policy/Procedures
- Airport Physical Infrastructure
- Traffic Flow Management/Collaborative Decision Making
- Technical and Administrative Expertise, Proficiency and Training
- Safety
- Other Dynamics

AACO Operator Recommendations:

- Communication and Collaboration
- Separation
- Civil/Military Cooperation
- Airspace Optimisation
- Efficiency and Capacity
- Air Traffic Procedures
- Air Traffic Service

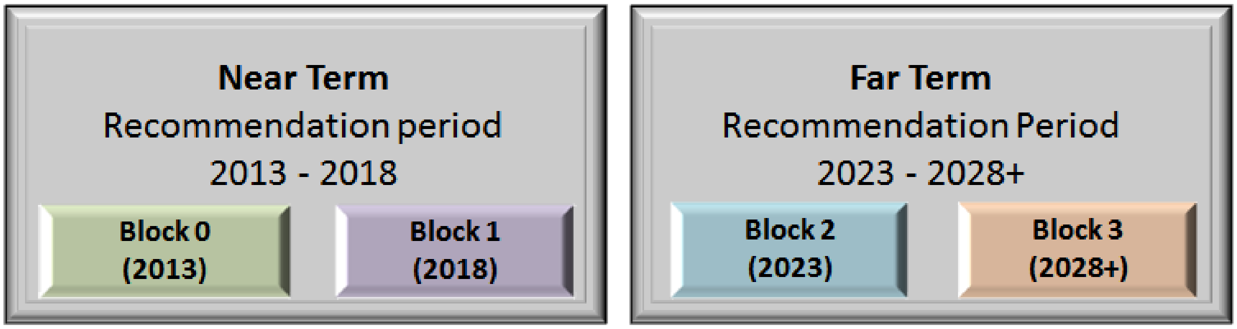


Figure 32: Recommendation Period Definitions.

NOTE: The recommendations contained within this document are intentionally meant to be "living", whereby as changes to the current operational conditions take place, the effect of such a change could likely result in a corresponding change to the recommendation(s) identified in this project. It is essential that planning and implementation activities are (1) aware of industry changes, and then (2) able to effectively and efficient analyse, and as appropriate, adapt to those changes. Influences on these recommendations could be affected by any State, Regional or overseeing regulatory authority.

7.1 ACAC ANSP Recommendations

7.1.1 ANSP Interoperability

7.1.1.1 *Near-Term recommendations*

1. Establish a common framework for conducting internal safety analysis (PIA-3) similar to the work that has been done for external accident and incident analysis. For example, establish a common policy/template to be used as the mainstay of an internal and regional Quality Assurance process. The process should include goals such as a non-punitive self-reporting system (for the operator and ANSP), investigation guidelines, trend monitoring procedures, and a follow-up process that includes training and briefings for all personnel.
2. Implement a Region-wide joint aviation information responsibility that monitors, gathers and distributes AIP information to the member States and external interests. (PIA-2). Establish a regional data gathering function to track important metrics about safety, efficiency, etc.
3. Encourage standardisation consistency and uniformity in the development and application of air traffic procedures wherever possible. (All PIAs)
4. Increase frequency and span of communications between adjacent FIRs. Focus on improving the capabilities and efficiency of operations within the region and between

adjacent facilities. Work groups should be developed to include operational and staff support level participants. (PIA-3)

5. Continue to move toward creating, strengthening, and revising existing agreements between adjacent FIRs. These agreements should incorporate: Holding responsibilities and procedures, and TFM techniques (e.g., off-loading traffic to lower density routes when tracks threaten to become saturated, dynamic airspace procedures). (PIA-3)

7.1.1.2 *Far-Term recommendations*

6. If not currently under development, integrate various individual air navigation service providers' (ANSPs) strategic planning efforts into a Regional Airspace and ATM strategic plan.
7. Implement automation and decision-support systems, including meteorological, flight data and alert functions that are fully interoperable and integrated with functionalities that share data with adjacent FIRs. (PIA-2)

7.1.2 Airspace Policy/Procedures

7.1.2.1 *Near-Term recommendations*

8. Ensure operational procedures and agreements contain handoff and transfer of control/communication points that are acceptable to affected facilities to avoid unplanned holding. (Best Practice)
9. Ensure operational procedures and practices within the FIR utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services within the FIR. (PIA 1-4) [This is both a near-term and far-term recommendation]
10. Establish sector structures that utilise common features that are agreed upon with adjacent FIRs (e.g., uniform altitude strata; matching boundaries, routing connections), beginning with high-altitude sectors. (PIA-3,4)
11. Develop and implement flight procedures and sector designs that foster continuous/optimised climb and descent to the maximum extent possible. (PIA-4)
12. Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed, continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation]

7.1.2.2 *Far-Term recommendations*

13. Base airspace access, procedural development, and flight prioritisation planning are on a shift in policy towards Best Capable–Best Served during congested periods, accommodating exceptions to that policy will reduce over time. (PIA-1,3)
14. Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment where plans have been or are being developed, continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation]

15. Ensure operational procedures and practices across FIR boundaries utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services with internal facilities and adjacent ANSPs. (PIA 1-4) [This is both a near-term and far-term recommendation)

16. To increase airspace capacity and efficiency, we recommend that all States develop concepts and implementation strategies for:

    - Dynamic Airspace Management procedures to strategically mitigate airspace design, traffic volume, or other operational constraints affecting efficiency and safety.

    - Flexible Use of Airspace plans that will result in the transition to integrated civil-military airspace management.

17. Expand Standard Instrument Departure / Standard Terminal Arrival Route (SID/STAR) usage and design to extend SIDs from the airport to top of the climb, and STARs from the top of descent to airport.

18. Identify locations where space-based ADS-B can be used to supplement current ground-based surveillance to enable full airspace surveillance.

7.1.3 Separation Standards

7.1.3.1 *Near-Term recommendations*

19. At High- and Medium-activity airports, increase airport throughput via application of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. (Training)

20. At High- and Medium-activity airports and ACCs increase airspace capacity through the application of visual separation in the approach control and en-route environs. (Policy and Training)

21. At High- and Medium-activity airports increase airport throughput via application of diverging departure heading separation procedures for both same runway and parallel runways. (Policy and Training)

7.1.3.2 *Far-Term recommendations*

22. Plan for and implement the transition of separation methods from human-centric tactical ATC-developed instructions to the use of ground and airborne automation decision support. (PIA-3)

23. Provide enhanced system monitoring and alerting of separation and spacing that supports multiple separation modes and standards between aircraft with trend analysis. (PIA-3)

24. At currently Low-activity airports that are forecasted to increase airport activity, improve airport throughput via the application of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. Developing

and training on these techniques in simulation training will help prepare for a future increase in traffic. (Policy and Training).

25. At currently Low-activity airports and ACC, increase airspace capacity via application of visual separation in the approach control and en-route environs. Developing and training on these techniques in simulation training will help prepare for a future increase in traffic. (Policy and Training).

7.1.4 Routing

7.1.4.1 *Near-Term recommendations*

26. In High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., fast track/slow track capability.
27. Utilise single direction routes bi-directionally when operationally feasible. The development of additional routes offset from primary routes that would allow a fast track/slow of offload track capability is not evident.
28. Consider flexible point-to-point routing for high-altitude operations, to eliminate dog-legs common within the fixed route structure, except where structured routing is required. (PIA-3)
29. Develop or enhance existing Flexible Use of Airspace (FUA) procedures to provide allocation (joint use, shared use, separate use) of airspace based on tactical needs within the FIR. (PIA-3).

7.1.4.2 *Far -Term recommendations*

30. In Medium- and Low-activity areas where activity is forecasted to increase either within the FIR or on routes servicing High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., a fast track/slow track capability.
31. Revise current route structures and develop new route structures to ensure that the routes are contiguous across FIR boundaries, especially in North Africa connecting to Central & South Africa.
32. Consider development of a regional grid system that is formed through the definition of points created by the intersection of lines (latitude and longitude) from the Geographic Coordinate System onto a repeating matrix of regionally defined parameters, (i.e., an intersection every 30 seconds of latitude and every 2 degrees of longitude).

7.1.5 Contingency and Growth Planning

7.1.5.1 *Near-Term recommendations*

33. Ensure contingency plans exist and include agreements with adjacent FIRs in the event of technical failures such as communication and/or surveillance. Conduct a vulnerability and risk assessment study to ensure a continuity of operations is provided should system failure(s) occur.

34. Ensure contingency plans for potential expansion of temporary and/or sudden geopolitical uncertainty or security constraints are in place. An example, as illustrated in Figure 33, shows the potential loss of overflight approval over Iran. This example would then result in immense volumes of traffic routing through Egypt, Jordan, Saudi Arabia, and the Gulf States (as outlined in green), requiring intense preparation and coordination to support air traffic operations.

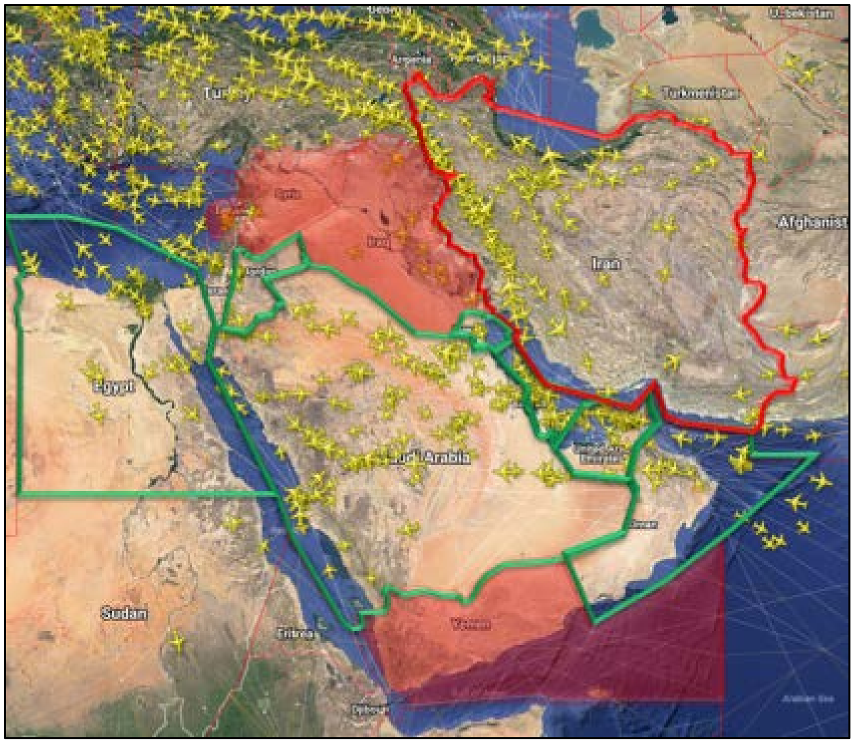


Figure 33: Contingency Example - Geopolitical Constraint Expansion

7.1.5.2 *Far-Term recommendations*

35. Conduct detailed analysis of operational position (workstation) needs within each State through 2030 and develop a plan to meet those needs with optimum effectiveness and efficiency.

36. Establish collaborative constraint analysis processes to understand how projected annual traffic growth will translate to hourly time frames and airspace sector traffic levels.

7.1.6 Civil-Military

7.1.6.1 *Near-Term recommendations*

37. Enhance Flexible Use of Airspace procedures to provide an allocation of airspace based on tactical needs, by developing high-level agreements and plans that will result in the transition to an integrated civil-military airspace management. (PIA 1-4)

7.1.6.2 *Far-Term recommendations*

38. Develop and implement region-wide Enterprise Architecture for the provision of air navigation services and information sharing, including with the military. Establish processes to ensure common standards and requirements for air navigation service provision within each FIR. (PIA 1-4)

7.1.7 Airport Policy/Procedures

7.1.7.1 *Near-Term recommendations*

39. At High-activity airports, routinely use mixed-use runway procedures when there are peak traffic periods with higher numbers of arrivals or departures. (PIA 1,3)
40. Review airport procedures and master plans to ensure they support minimising operations on runways for other than actual take-offs and landings.
41. Increase airport throughput and capacity through the application of global best practice procedures. For those airports where demand nears or exceeds capacity, leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1)

7.1.7.2 *Far-Term recommendations*

42. Where airports are forecasted to increase operations, develop procedures and training plans to routinely use mixed-use runway procedures in the event there are peak periods with higher numbers of arrivals or departures. (PIA 1,3)
43. For those airports where demand is forecasted to exceed capacity, begin to develop procedures and training plans to leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1)
44. Develop daily planning actions to ensure that any project activities are coordinated with all stakeholders. This will ensure capacity and efficiency impacts are understood and mitigated to the maximum extent possible. (PIA-1)

7.1.8 Airport Physical Infrastructure

7.1.8.1 *Far-Term recommendations*

45. Ensure future airport planning projects are coordinated with all stakeholders to ensure capacity and efficiency impacts are understood and mitigated to the maximum extent possible. (PIA-1)
46. Based on current and forecasted airport demand, accelerate planning and construction of rapid exit taxiways to be optimally located so that they will minimise runway occupancy time for typical aircraft. (PIA-1)

7.1.9 TFM/CDM

Regulating air traffic flow through the application of Air Traffic Flow Management (ATFM) measures such as Ground Delay Programs (GDP) is a known and explored operational concept. Many States in the ACAC jurisdictional region and other regions understand the need for ATFM and have, or are planning to, implement domestic ATFM. However, harmonised Cross-Border ATFM implementation has yet to be widely explored or acted upon. Although specific information regarding cross-border coordination was limited in the provided study data, the Team is assuming that ACAC members recognise the urgent need and the challenges of implementing cross-border ATFM to address the imbalance of capacity and demand to ensure smooth flow of air traffic across the region through the principles of Air Traffic Flow Management based on *ICAO Manual on Collaborative ATFM* (*Doc 9971*).

TFM applications can be accomplished using multiple approaches, such as (1) use existing ATFM frameworks that are operated fundamentally on a centralised management of air traffic flow which adequately addresses domestic ATFM needs, or (2) use an alternative framework solution using a decentralised distributed multi-nodal network system addressing both domestic and cross-border needs. A brief description and depiction of a distributed multi-nodal network system are provided in Appendix H. ATFM could be of an existing framework or multi-nodal framework design.

7.1.9.1 ***Near-term recommendations***

47. Future traffic projections indicate there is a need for enhanced Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways.
48. Where high traffic exists, establish Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Establish as an additional duty, ATFM procedures within FIRs of lower traffic density. Incorporate ATFM procedures into all ATC training programmes. (PIA-3)
49. Establish metrics that can assist in capturing current performance data such as sector and runway capacity, and delay statistics (i.e., minutes off-ground delay, taxi time, airborne holding, diversions reroutes, MIT / MINIT), which can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3)
50. Enhance departure constraint management capabilities, including tactical adjustments to flight levels, route assignments, etc. (PIA-1)
51. Reduce static ATC restrictions such, as those embedded in agreements and standard operating procedures, with more strategic and tactical traffic flow management initiatives, i.e., MIT and restrictions ‘regardless of altitude’, or multiple routes ‘as one’. (PIA 1,3)
52. Establish Collaborative Decision Making (CDM) capabilities and processes for exchanging strategic and tactical information and to enable decision-making between the ANSPs and stakeholders. (PIA-3)
53. Establish CDM processes for making tactical decisions to adjust pre-departure flight trajectories to aid in minimising demand-capacity imbalances. (PIA-1)

54. Where demand requires it, establish process for the automated substitution of slot times between stakeholders. (PIA-2)

7.1.9.2 *Far-Term recommendations*

55. Where needed, enhance Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. (PIA-1)
56. Plan for and implement flight plan and trajectory information capabilities for ANSPs and stakeholders that support both strategic and tactical CDM. (PIA-3)
57. Implement traffic situational display capability for ANSPs and stakeholders, including Airport Operators, which will provide a common situational awareness of aircraft within or destined for the FIR. (PIA-3)
58. In FIRs where routine holding occurs, plan for and implement time-based trajectory management. (PIA-3)
59. In anticipation of changes to the homogenous areas based on forecasted traffic levels develop and empower multi-national ANSP work groups from the affected areas to identify and design changes in procedures and airspace that are necessary to accommodate the flows of traffic. Design characteristics would include:
    - Equipment and automation requirements
    - An effect on local operations
    - Coordination and communication with tier 2 and 3 facilities
    - Strategic and tactical planning documentation changes
    - Identification of regional support to affected ANSPs
    - Greater involvement and coordination with regional stakeholder support organisations (i.e., ACAC, flight operators)

7.1.10 Technical and Administrative Expertise, Proficiency and Training

7.1.10.1 *Near-Term recommendations*

Based on review of regional charters for various current projects affecting operation and administration (ARNOP, MID FPP, NCLB, VTC, RSOOP), our findings support the following initiatives: 60 - 64

60. Provide full support to the MID Flight Procedure Program (MIDD FPP). The projects assist States in developing sustainable capabilities in: instrument flight procedure (IFP) design, PBN airspace design, and PBN OPS approval, including regulatory oversight. The objective is to meet State commitments under Assembly Resolutions A37-11 for Performance Based Navigation (PBN) implementation and the regional requirements, and comply with ICAO provisions related to flight procedure design and PBN. [27]
61. Provide full support to the Virtual Training Centre project that will support staff training activities. [31]

62. Develop or improve training programmes for procedure and airspace designers. A formal training programme will ensure consistency in procedural development. (Training)

7.1.11 Safety

7.1.11.1 *Near-Term recommendations*

63. Provide full support to the No Country Left Behind (NCLB) Initiative, whose objectives are assisting States in enhancing their oversight capabilities through conducting ICAO assistance missions to States, providing required training—particularly the Government Safety Inspector courses, and supporting the certification of international airports. [27]
64. Provide full support to the Regional Safety Oversight Organisation Project (RSOO) whose core objective is to assist member States in meeting their safety oversight obligation. [30]
65. Consider an engagement process with Agência Nacional de Aviação Civil (ANAC), European Aviation Safety Agency (EASA), the Federal Aviation Administration (FAA), and Transport Canada Civil Aviation (TCCA) for expansion of and inclusion in the Certification Management Team (CMT) established May 2016. The CMT oversees and manages collaboration efforts to permit the development and implementation of regulatory and policy solutions common to certification issues and support greater harmonisation of systems. CMT strategic focus areas are (1) Partnership Leveraging, (2) Continued Confidence Building, (3) Global Leadership, and (4) Certification Policy Alignment. [38]

7.1.12 Other Dynamics

66. Identify conditions and locations where technical simulation capabilities would be beneficial to simulate ATC procedures and flight deck capabilities in support of significant changes to operational systems, services and requirements, if not already in use.
67. Identify conditions where non-technical simulation (table-top exercises) would be beneficial to simulate ATC procedures, if not already engaged in the process. (Best Practice)
68. Develop or improve effective agency policy guidance that will govern decisional criteria affecting systems, personnel, procedures, actions, and reactions to defined metrics. Policy should be tailored to modern systems and training practices and is adaptable to future changing conditions. Policy categorisations would minimally fall into two groups:
    - Management and Administration Policy
    - Operational Policy
69. It is recommended that a dedicated regional study focused on surveillance availability, coverage, continuity, and reliability be conducted.
70. Develop a ConOps for the use of space-based ADS-B to supplement existing ground-based equipment that would lead to the provision of full regional/State surveillance coverage where needed (i.e., in remote and oceanic non-surveyed airspace). A resulting

concept should include elements such as surveillance coverage that would be expanded to (1) entire airspace volumes (i.e., surface to unlimited), or (2) select volumes of airspace that could be classified as exclusionary to those aircraft that are not yet equipped, (i.e., an airspace band FL340 and above to accommodate equipped overflight traffic, while non-equipped traffic would still have access to high-altitude airspace while they transition to ADS-B equipage). *NOTE: A prominent ADS-B vendor provides a comparison chart of its services relative to the ICAO Aviation System Block Upgrades, it is available at:* [41] http://aireon.com/resources/block-upgrades/ (website accessed 10/17/2016)

71. Through potential Space-Based ADS-B interest/adoption, an opportunity can be created to harmonise surveillance capabilities, systems, procedures, and services among the two core organisations (ACAC and ASECNA) that have the greatest regional impact in working towards a single African sky reality

7.2 AACO Operator Recommendations

The following recommendations were derived either directly or indirectly from the four AACO Operator questionnaires that were returned. The recommendations of the AACO Operators support the recommendations that were developed and contained in Section 0.

- Low- and moderate-density FIRs may have a route structure that is not user friendly to the markets being serviced today. It is recommended that a close examination of the existing route structure, with input from the system users, is needed.
- Conduct a review of altitude restrictions that are either embedded in directives or have become standard operating procedure, and ensure they are imposed when conditions require and are not static. Additionally, ensure users are aware of the reasons altitude restrictions are in place; they (pilots) may be able to offer solutions that will accomplish the needs of the ANSP and reduce user impact.
- High-density FIRs should engage in discussions with system users allowing them to have input into what is important to them. For example, users may regard routing to be secondary to the ability to achieving the most efficient cruise altitude.
- If not doing so already, ensure when a pilot-requested altitude is not assigned or partially assigned, the original request is coordinated along the route of flight so that if the altitude becomes available, the user can benefit.
- Work to establish a minimum user communication process. Communication processes may include telecons conducted routinely with users, routine user meetings to discuss future planning and collecting user feedback, or post-event telecons or meetings to discuss a past event that resulted in high impact to the users. Ensure each ANSP has notified users of the identified points of contact that are responsible for user communications.
- Attempt to practice collaborative decision-making with the users for issues that affect their business goals.
- Create or strengthen agreements with adjacent FIRS to enhance traffic flow and reduce imposed restrictions. For example, agreements between Mumbai FIR (VABF) and Muscat FIR (OMAN) regarding allocation of flight levels.

- Examine procedures for transitioning from oceanic control to domestic control for opportunities to reduce separation—specifically, for traffic transiting to/from Arabian Sea/Indian Ocean.
- Civil/Military cooperation should be prioritised to optimise airspace and enhance its capacity wherever possible.
- Implement procedural efficiencies that utilise the capabilities of modern era aircraft, such as:
  - I RNAV 1 / RNP 1 routes and RNAV approach procedures to enhance airspace capacity.
  - Continuous/Optimised Arrival and Climb procedures.
  - Implement Pre-Departure Clearance (PDC).
- Improve the following communications deficiencies:
  - Establish ground-based communications capabilities in those locations where there are operational communications gaps.
  - Prioritise communications in high-density activity airspace to reduce frequency congestion.
- Ensure standard air traffic phraseology is used by controllers, and that clearances and other instructions are complete, heard, and understood by the user.
- In congested airspace, implement airspace redesign that will improve efficiency, eliminate or reduce airborne holding and excessive vectoring, and allow continuous descent approaches.
- Consider an upgrade from FIS to full air traffic service in areas where air carrier operations exist.
- In areas where TIBA rules are in place, replace these with more stringent air traffic control. Consider virtual towers as an alternative.
- Move towards a safer and more efficient radar environment where currently unavailable.
- Examine airport runway conditions and airport signage to ensure minimum standards are met.
- Where needed, implement delay reduction procedures such as AMAN and Independent Parallel Operations (IPO).

7.3 Key Recommendations

Key recommendations are those recommendations that the Team has identified as areas where timely and focused attention is warranted. The key recommendations provided in this section represent aspects across the entire operational domain to include air traffic services (ACC/APC), airports, policy and procedures, equipment and infrastructure, new technologies and operators.

The key recommendations listed in Table 32 will inform ACAC of those areas where timely focused attention is required.

Table 32: Key Recommendations

#	Recommendation	Comments/Next Steps
3	Encourage standardisation and uniformity in the development and application of air traffic procedures wherever possible. (All PIAs)	The degree of consistency among facilities was based on data submitted, supplemented by our interpolation. We encourage to the maximum extent possible that the application of operational procedures and practices be consistent especially between adjacent facilities. This can be critical in areas where communications and radar services are limited. Standard formats should include handoff and transfer of control/communication points that are acceptable to affected facilities to avoid unplanned holding. Additionally, a standard format for Standard Operations Procedure directives and Letters of Agreement developed for the Region could be beneficial. Finally, we encourage ANSPs share documents that detail standard operating procedures to begin gathering "best practices".
4	Increase frequency and span of communications between adjacent FIRs. Focus on improving the capabilities and efficiency of operations within the region and between adjacent facilities. (PIA-3)	Due to the physical size and degree of operational interaction of the FIRs that comprise the Region it is recommended that opportunities to improve the ability of computer systems or software to exchange and make use of operational data be closely examined. Interoperable systems such as decision-support systems that provide meteorological, flight data and alert functions are valuable in both tactical and strategic planning and serve as the basis for increasing the frequency and span of communications between FIRs while reducing the amount of human interface when coordinating thereby improving efficiency. If not doing so already, we suggest both inter and intra ANSP workgroups be created that encompass the Homogenous Areas with the focus on improving communications and identifying the tools and interfaces that will support sharing data.

#	Recommendation	Comments/Next Steps
5	Continue to move toward creating, strengthening and revising existing agreements between adjacent FIRs. These agreements should incorporate; Holding responsibilities and procedures, TFM techniques (e.g., off-loading traffic to lower density routes when tracks threaten to become saturated, dynamic airspace procedures). (PIA-3)	If not currently in effect expand agreements for real time communications, such as a CDM process, between adjacent facilities and other stakeholders that require ongoing strategic and tactical planning to ensure airport and airspace capacity are not exceeded. Incorporate into these agreements techniques such as traffic off-loading to alternate routes; final altitude restrictions that will separate short range flights from long range flights; utilisation of single direction routes bi-directionally.
12	Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation]	A great deal has already been accomplished to take advantage of advanced navigation avionics in some areas but should be expanded to all with a focus on tying the areas together by ensuring routes are consistent across FIR boundaries.
16	To increase airspace capacity and efficiency, we recommend all States develop concepts and implementation strategies for: • Dynamic Airspace Management procedures to strategically mitigate airspace design, traffic volume, or other operational constraints affecting efficiency and safety. • Flexible Use of Airspace plans that will result in the transition to integrated civil-military airspace management.	Airspace management techniques such as Dynamic Airspace Management and FUA can provide opportunities to increase airspace capacity and efficiency. These can strategically mitigate airspace design, traffic volume or other operational constraints affecting efficiency and safety. This can allow the airspace system to meet real time changing constraints caused by weather, traffic congestion and complexity as well as a diverse aircraft fleet. Equipment, training and willingness are often the constraining limitations to these techniques.

#	Recommendation	Comments/Next Steps
18	Identify locations where space-based ADS-B can be used to supplement current ground-based surveillance to enable full airspace surveillance and develop a concept of operations (ConOps) for its use.	A ConOps for the use of space based ADS-B to supplement existing ground-based equipment can lead to the provision of full regional/state surveillance coverage where needed (i.e. in remote and oceanic non-surveilled airspace). A resulting concept should include elements such as surveillance coverage that would be expanded to (1) entire airspace volumes (i.e. surface to unlimited), or (2) select volumes of airspace that could be classified as exclusionary to those aircraft that are not yet equipped, (i.e. an airspace band FL340 and above to accommodate equipped overflight traffic, while non-equipped traffic would still have access to high altitude airspace while they transition to ADS-B equipage). NOTE: A prominent ADS-B vendor provides a comparison chart of its services relative to the ICAO Aviation System Block Upgrades, it is available at: [41] http://aireon.com/resources/block-upgrades/
21	At High- and Medium-activity aerodromes increase airport throughput via application of diverging departure heading separation procedures for both same runway and parallel runways. (Policy and Training)	The information provided did not allow an in-depth assessment of the current control techniques in use at high and medium activity aerodromes that can improve efficiency. We recommend the use of diverging headings and ground staging of aircraft prior to departure to reduce subsequent departures over the same departure fix or routes if not in use currently.
48	Where high activity exists, establish Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Establish as an additional duty, ATFM procedures within FIRs of lower traffic density. Incorporate ATFM procedures into all ATC training programmes. (PIA-3)	We recommend that the traffic flow management function be a dedicated function performed by a core of properly trained personnel in high activity facilities. Additionally, the traffic corridor in the Gulf states is of sufficient volume and complexity to benefit from the creation of a joint traffic management function.
49	Establish metrics that can assist in capturing current performance data such as sector and runway capacity, delay statistics (i.e. minutes of-ground delay, taxi time, airborne holding, diversions reroutes, MIT / MINIT), which can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3)	The delay data provided for this study was limited to a few participants. Additionally, one high activity FIR indicated they tracked no performance data. We recommend all ACCs develop metrics and track performance data daily.

#	Recommendation	Comments/Next Steps
51	Reduce static ATC restrictions, such as those embedded in agreements and standard operating procedures, with more strategic and tactical traffic flow management initiatives, i.e. MIT and restrictions 'regardless of altitude', or multiple routes 'as one'. (PIA 1,3)	Although generally letters of agreement between adjacent facilities and facility Standard Operating Procedures directives were not provided, we concluded from the surveys that overall, traffic flow control is embedded in those agreements and directives. This is not the most desirable method of controlling demand. We encourage these static restrictions be replaced with tactical flow control initiatives.
52	Establish Collaborative Decision Making (CDM) capabilities and processes for exchanging strategic and tactical information and to enable decision making between the ANSPs and stakeholders. (PIA-3)	We recommend a process for daily ongoing real-time collaboration with system stakeholders be developed and implemented if not currently in use.
59	In anticipation of changes to the homogenous areas based on forecasted traffic levels develop and empower multi-national ANSP work groups from the affected areas to identify and design changes in procedures and airspace that are necessary to accommodate the flows of traffic. Design characteristics would include: • Equipment and automation requirements • Effect on local operations • Coordination and communication with tier 2 and 3 facilities • Strategic and tactical planning documentation changes • Identification of regional support to affected ANSPs • Greater involvement and coordination with regional stakeholder support organisations (i.e., ACAC, flight operators)	We believe this Region could benefit from projects devoted to airspace and procedures redesign that cross ANSP boundaries and mirror the homogenous areas.

7.4 Validation Process

As for the recommendations transition from concepts to implementable actions, it is imperative that a comprehensive validation process exists within each State. Such a process ensures the applied capabilities will address the shortfalls and the proposed actions can be successfully developed and deployed. The process should include a series of validation activity levels and validation perspectives as indicated in Table 33.

Table 33: Validation Process Elements

Validation Process	
Validation Activity Levels	**Validation Perspectives**
Level 1: Discussions with Users and User Surveys	Performance and Operational Benefits
Level 2: Literature Reviews and Audits of Current and Planned Systems	Operational Feasibility and Policy Considerations
Level 3: Functional Presentations to Subject Matter Experts	Technical Feasibility
Level 4: Analysis and Modelling	
Level 5: Storyboard Exercises with Stakeholders	
Level 6: Human-In-The-Loop Exercises	
Level 7: Operational Demonstrations	

7.5 Prioritisation Process

A prioritisation process is submitted for ACAC and its member States to regionally determine a prioritised subset of the initial key recommendations listed above in section Key Recommendations 7.3, Table 32.

7.5.1 Definitions

The prioritisation has been accomplished by a numerical comparison of the:

1. Potential Operational Impact of Implementation (Op-IOI) based on a rough order of magnitude (ROM), to the
2. Anticipated Implementation Level of Effort (Im-LOE).

Based on this process, the output is a subset of the highest priority recommendations that have been further categorised as either a Category A, Category B, or Category C project priority, further defined below.

The following definitions are used to explain the variables in developing an overall priority strategy:

Operational Impact of Implementation (Op-IOI)

For the purposes of this project, the Op-IOI is not a factor of fiscal impact/availability or fiscal benefits. Rather it is defined within the three categories listed below as a measure of operational impact to the overall ACAC environment as either a local implementation or part of a regional implementation. This categorisation will assist the ACAC organisation and their member States in making capital investment, administrative, and operational decisions.

Op-IOIs:

1. **Level One** – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides **transformational and compelling** operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the State's jurisdiction and the region's Air Traffic Control services. (Weight value '4')

2. **Level Two** – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides **significant** operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the local jurisdiction and the State's Air Traffic Control services. (Weight value '3')

3. **Level Three** – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides **high** operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the State's jurisdiction and the region's Air Traffic Control services. (Weight value '2')

Implementation Level of Effort (Im-LOE)

A numerical value determined from a consideration of the:

(1) Operational and administrative implementation factors required (listed below),
(2) Ability and level of implementation autonomy available to ACAC and its member States, and
(3) Level of external (international) involvement required to implement a recommendation.

Initially stakeholders will need to determine the level of autonomy they individually have in developing and implementing a particular recommendation. Factors to consider in reaching this determination include the following:

(1) Identified Implementation Factors:

1. Airspace/Airway Design
2. Procedure Development
3. Documentation Preparation
4. Stakeholder Engaged CDM
5. Requirements Identification
6. Funding Acquisition
7. Organisational Coordination/Approval Process
8. Equipment Life Cycle Status
9. Adjacent ANSP Capabilities
10. Technical Capabilities (Current and Future)
11. Political Considerations
12. Safety Analysis
13. Stakeholder Training and Training Material Development

14. Business Case Development
15. Others as locally/regionally determined

These implementation factors, when combined, create an implementation LOE Class of one (1), two (2), or three (3) as defined below.

(2) Implementation LOEs (Im-LOE):

1. **Class One (1)** – The ability to complete a specific recommendation's implementation factors in **a nearly autonomous environment with no or minimal required external support** and/or approvals (technical, operational, administrative, or fiscal). The end state of the desired recommendation rests nearly entirely within the State's jurisdiction. (Weight value '3')

2. **Class Two (2)** – The ability to complete a specific recommendation's implementation factors with **required moderate support from external entities** to provide support and/or approvals. The end state of the desired recommendation rests within the collaboration of the affected parties. (Weight value '2')

3. **Class Three (3) –** The ability to complete a specific recommendation's implementation factors with **required extensive support from external entities** to provide support and/or approvals. This level could significantly affect the end state of the desired recommendation. (Weight value '1')

7.5.2 Methodology

An aggregation of the Operational Impact of Implementation (Op-IOI) and the Implementation Level of Effort (Im-LOE) will yield an Aggregated Priority Value (APV) that when compared to the Priority Category Range (CR) will produce an overall Priority Category (PC) as indicated in Table 34 below:

(Op-IOI) + (Im-LOE) = APV

APV◀ CR = PC (A, B, C)

(3) Priority Category:

1. **Category A –** indicates a high priority recommendation of transformational and compelling value to the domain. (Category range 6-7)

2. **Category B –** indicates a significant value to the domain. (Category range 4-5)

3. **Category C –** indicates a high value to the domain**.** (Category range 3)

Table 34: Category Determination

Operational IOI (Op-IOI)	Weight Value	Implementation LOE (Im-LOE)	Weight Value	Aggregated Priority Value (APV)	Category Range (CR)	Priority Category (PC)
Op IOI Level 1	4	LOE Class 1	3	7	6-7	**A**

Operational IOI (Op-IOI)	Weight Value	Implementation LOE (Im-LOE)	Weight Value	Aggregated Priority Value (APV)	Category Range (CR)	Priority Category (PC)
Op IOI Level 2	3	LOE Class 2	2	5	4-5	B
Op IOI Level 3	2	LOE Class 3	1	3	3	C

7.5.3 Example

This prioritisation example uses the existing Key Recommendation #12 developed by the project team, which is further illustrated in Appendix G. The salient details needed to perform the prioritisation process are summarily restated below to provide reader context.

Key Recommendation #12: Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed continue towards implementation.

Project Specifics:

a) **What the problem is:** Workload and inefficiencies associated with the convergence and sequencing of multiple arrival (TO: HECA & HEAX), departure (FROM: HECA & HEAX), and overflight flows (FROM: OTBD, OMDB, OMAA, OMSJ, etc.), into a single flow of traffic through HECC.

b) **What States to be included**: Egypt & Kingdom of Saudi Arabia

c) **What is the solution:** A multi-layered approach that would have the end state being the implementation of multiple parallel routes through the affected airspace without the need to engage in excessive sequencing, vectoring, and MIT restrictions.

e) **What problems would be mitigated:** A parallel route structure that deconflicts and significantly reduces sequencing will reduce workload and complexity, this should result in reduced enroute spacing requirements, HECA/HEAX departure restrictions, and inter-facility restrictions.

f) **What types of benefits to be expected:** The types of anticipated benefits would include:

i. ATC operational benefits - would be immediately realised at the ATC level by reduced complexity and workload resulting from deconflicted routes and associated procedures.

ii. Airspace utilisation - improvements would extend to improved airspace efficiency and possibly increased sector capacity values due to reduced workload.

iii. Improved management - of capacity/demand imbalances resulting in better use of airspace capacity.

iv. Reduced delays - would be realised with the probability of reduced restrictions between internal and external facilities.

v. Operator predictability - provided by reduced delay causal factors in the airspace. Stakeholder confidence that regional airspace service is being optimally provided.

vi. Transition - to new capabilities and facilitate being able to meet future aviation growth.

vii. Environmental improvements - derived from less aircraft flight time, thus producing less environmental gas emissions.

g) **Implementation Process:** See Appendix G for specfic details

ACAC/ANSP Project Op-IOI and Im-LOE Determinations

Table 35: Option Determination Working Table

Prioritisation Process	
ACAC/ANSP Selection	**Op-IOI Options**
X	**Level One** – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides transformational and compelling operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the State's jurisdiction and the region's Air Traffic Control services. (**Weight value '4')**
	Level Two – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides significant operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the local jurisdiction and the State's Air Traffic Control services. (Weight value '3')
	Level Three – The operational impact of a specific recommendation's implementation to ACAC and its stakeholders that provides high operational improvements, added efficiencies, system harmonisation, regional leadership, or safety enhancements to the State's jurisdiction and the region's Air Traffic Control services. (Weight value '2')
ACAC/ANSP Selection	**Im-LOE Options**
	Class One (1) – The ability to complete a specific recommendation's implementation factors in a nearly autonomous environment with no or minimal required external support and/or approvals (technical, operational, administrative, or fiscal). The end state of the desired recommendation rests nearly entirely within the State's jurisdiction. (Weight value '3')

Prioritisation Process	
ACAC/ANSP Selection	**Op-IOI Options**
X	**Class Two (2)** – The ability to complete a specific recommendation's implementation factors with required moderate support from external entities to provide support and/or approvals. The end state of the desired recommendation rests within the collaboration of the affected parties. **(Weight value '2')**
	Class Three (3) – The ability to complete a specific recommendation's implementation factors with required extensive support from external entities to provide support and/or approvals. This level could significantly affect the end state of the desired recommendation. (Weight value '1')

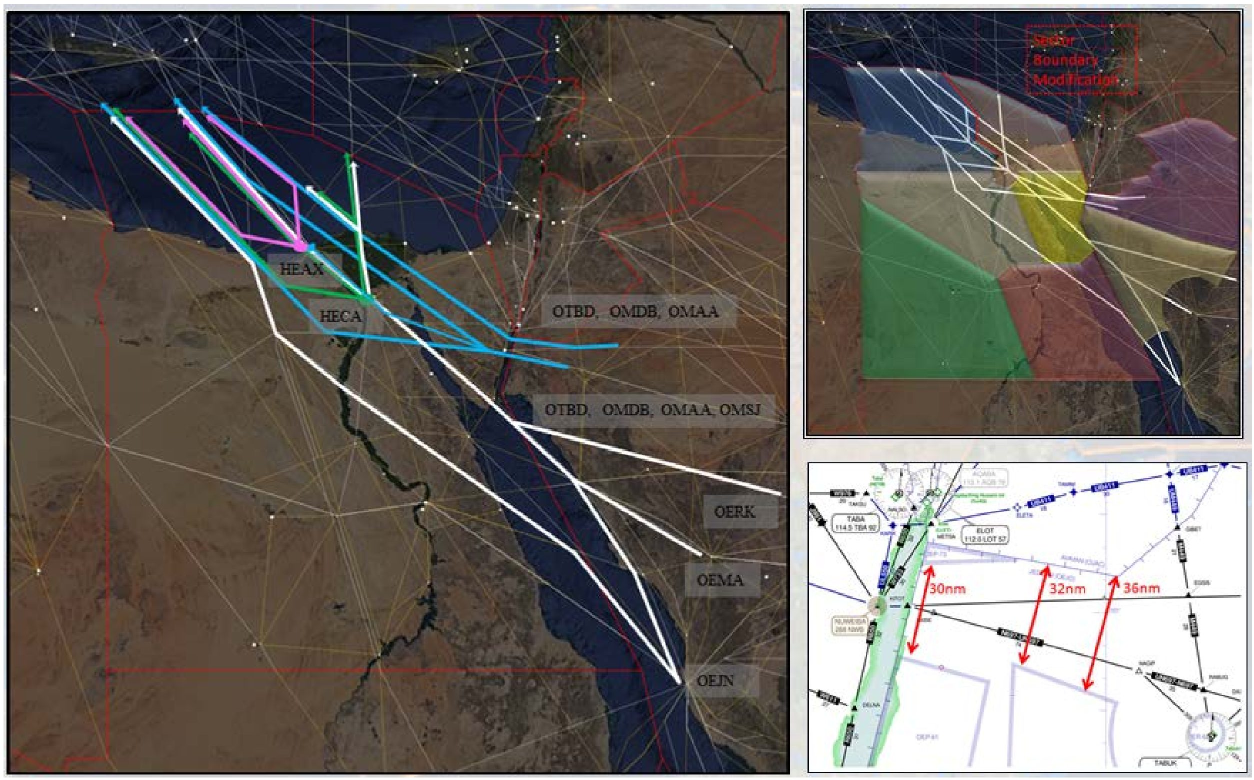
Once the Op-IOI and Im-LOE and been determined and their values entered into the Table 36 below, a priority category can be determined for this Key Recommendation and its supporting specific project. (NOTE: To fully satisfy this Key Recommendation may require the identification, development and implementation of many projects such as illustrated below and expanded on in Appendix G).

Table 36: Priority Category Working Table

Operational IOI (Op-IOI)	Weight Value	Implementation LOE (Im-LOE)	Weight Value	Aggregated Priority Value (APV)	Category Range (CR)	Priority Category (PC)
Op IOI Level 1	4	LOE Class 1	2	6	6-7	A
Key Recommendation #12: Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed continue towards implementation. (PIA-1)						

Operational IOI (Op-IOI)	Weight Value	Implementation LOE (Im-LOE)	Weight Value	Aggregated Priority Value (APV)	Category Range (CR)	Priority Category (PC)
Op IOI Level 1	4	LOE Class 1	2	6	6-7	A

Specific Project: A multi-layered approach that would redesign arrival, departure and overflight routes and procedures for traffic between Cairo and Alexandria.



This process can be utilised by ACAC and its member States to modify these or future recommendations in a post-Phase 1 environment as local and regional conditions evolve/change.

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Appendix A ICAO Regional Descriptions

Figure 34 illustrates ICAO regional distribution of ACAC Member States.

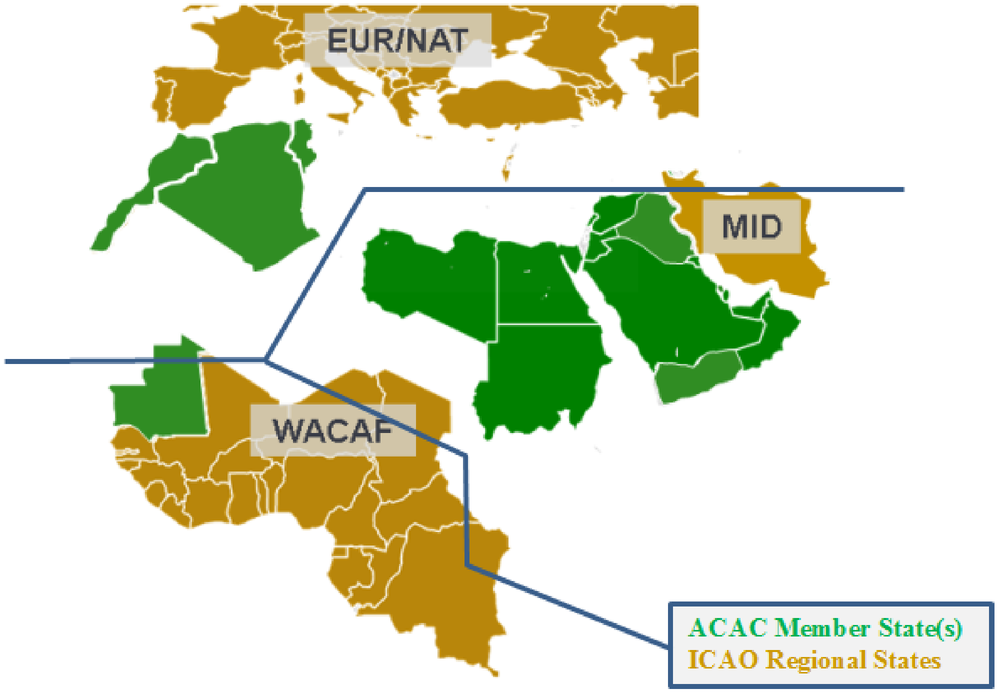


Figure 34: Visualisation – ICAO Regional Distribution of ACAC Member States

Each State within its corresponding ICAO Region is listed below. The ACAC Member States are in **bold** font.

EUR/NAT: Azerbaijan, Uzbekistan, Cyprus, Georgia, Israel, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan, Armenia, Bulgaria, Austria, Belarus, Belgium, Bosnia and Herzegovina, Denmark, Finland, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, Ukraine, United Kingdom of Great Britain and Northern Ireland, Albania, Russian Federation, Andorra, **Morocco, Tunisia, Algeria**

WACAF: Chad, Benin, Togo, Burkina Faso, Cameroon, Cabo Verde, Central African Republic, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, **Mauritania**, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone, Cote d'Ivoire

MID: Bahrain, Yemen, Iran, **Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Iraq, Egypt, Libya, Sudan**

Appendix B FIR Data Response Status

Table 37 provides the data status response from the member States.

Table 37: FIR Data Response Status

	Initial Questionnaire (Part #s)				Supplemental Questionnaire (Section #s)												
ACAC State	**I**	**II**	**III**	**IV**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Algeria	DP	DP	P	P	P	DP	DP	DP	DP	P	P	DP	DP	DP	P	P	P
Bahrain	ND	ND	ND	ND	P	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	P
Egypt	DP	DP	DP	P	DP	DP	DP	DP	DP	P	DP	DP	DP	DP	DP	DP	DP
Iraq	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Jordan	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Kuwait	DP	DP	DP	DP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lebanon	ND	ND	ND	ND	P	DP	P	P	DP	DP	DP	DP	DP	DP	DP	DP	DP
Libya	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mauritania	DP	DP	DP	DP	DP	DP	DP	P	DP	DP	ND	P	DP	P	DP	DP	ND
Morocco	DP	DP	DP	DP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oman	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP
Palestine	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Qatar	DP	DP	DP	DP	P	DP	DP	DP	DP	DP	DP	P	DP	P	DP	DP	DP
Saudi Arabia	DP	DP	P	DP	DP	DP	P	DP	DP	DP	DP	DP	DP	DP	DP	DP	DP
Sudan	ND	ND	ND	ND	DP	DP	DP	P	DP	P	P	DP	DP	P	P	DP	P
Syria	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tunisia	DP	DP	DP	P	P	DP	DP	DP	DP	P	DP	DP	DP	DP	P	DP	DP
UAE*	DP	DP	DP	DP	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*	DP*
Yemen	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Data Status: DP – Data Provided, P – Partial Data Provided, ND – No Data Provided
*Data derived from the UAE airspace redesign project.

Appendix C Africa and the Middle East Group Composition

The following list of countries represents those whose data was aggregated to determine the current status of Air Navigation in Africa, followed by a subset listing of those participating in the ACAC Member States

C.1 Overall Africa Group Composition:

Chad, Angola, Benin, Botswana, Djibouti, Egypt, Togo, Burkina Faso, Burundi, Cameroon, Canary Islands, Cabo Verde, Central African Republic, Comoros, Congo, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Saint Helena, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tunisia, Uganda, United Republic of Tanzania, Western Sahara, Zambia, Zimbabwe, Bouvet Island, Algeria, Cote d'Ivoire

C.2 Africa ACAC Member State Participants:

Algeria, Egypt, Libya, Mauritania, Morocco, Sudan and Tunisia

C.3 Overall Middle East Group Composition:

Bahrain, Yemen, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Iran (The Islamic Republic of), Egypt, Libya, Sudan

C.4 Middle East ACAC Member State Participants:

Bahrain, Yemen, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, Egypt, Libya, Sudan

C.5 Africa and the Middle East Group Composition

Appendix D Assessment Process and Criteria

This section describes the process and criteria that were used to assess the current operations.

D.1 Assessment Process

The assessment process consisted of three core activities; (1) data identification and collection, (2) data processing, and (3) assessment of data. The process is depicted in Figure 35.

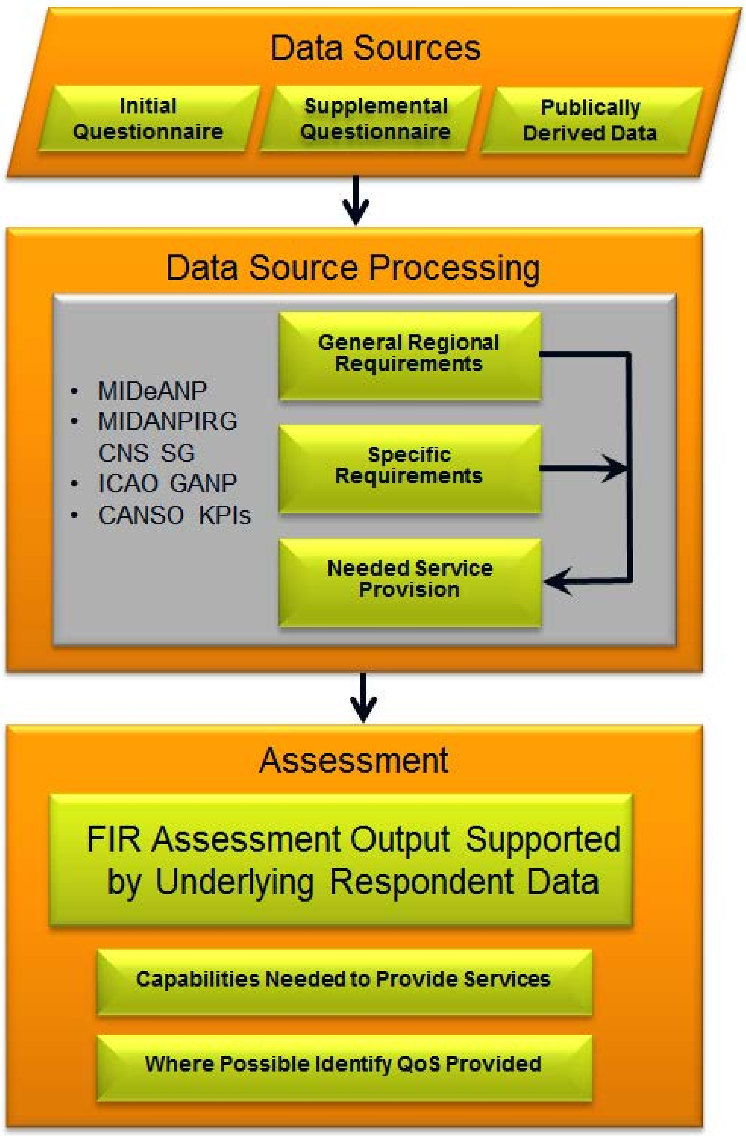


Figure 35: Assessment Process

D.1.1 Data Identification and Collection:

The assessment process commenced with activities that would determine the identification of the type of data required, a review of where that data resides, and the development of a method of retrieving that data. The output of this process indicated that operational, analytical, and administrative data from each ACAC Member State FIR would be required. Data types would include but not be limited to; operation communication, navigation, and surveillance, ATM/ATFM, automation, separation, airspace, staffing, and capacity.

The process to collect the identified data from the ACAC Member States was constrained by the scope of the project contract, and thus required the extensive use of indirect and time-consuming methods to accomplish the task.

Data collection was obtained by way of stakeholder input through a questionnaire. Initially, one questionnaire was developed; however, with the scope of this project not including direct stakeholder interface, the project contractor in consultation with ACAC decided as an appropriate course of action to supplement that initial questionnaire with another to solicit greater detail covering more subject matter. For the purposes of this project, the two questionnaires are referred to as the 'initial questionnaire' and the 'supplemental questionnaire'. Both questionnaires are available through ACAC as companion documents to this report. In addition to questionnaire supplied data, the Team derived additional data from publically available sources and used it to help augment missing or insufficient data provided by questionnaire respondents.

D.1.2 Data Processing:

The processing activity commenced using the data collected from the; (1) Initial Questionnaire, (2) Supplemental Questionnaire, and (3) data derived from publically available sources which include (a) ICAO directives, (b) ICAO regional work group meeting minutes, (c) aviation industry documentation, and (d) other aggregated data that was used to develop Team country profiles (contained in companion document titled *ACAC Final Report Supplement ATC Country Profiles*). Core to the data processing phase was the identification of regional operational and administrative requirements and guidelines that define and recommend operational processes and service provisions for the ACAC regions' (Africa and the Middle East) ANSPs. These requirements are listed in great detail in the following sections (D.1.3 and D.2).

D.1.3 Data Assessment:

As the process in Figure 35 shows, the assessment process provides, at a regional perspective, the regions'; (1) requirements (general and specific), and (2) needed service provision, compared to the regions' current and future abilities and capabilities to comply and support those requirements and services. Additionally, to the extent that data was provided and analysis could substantive, a quality of service level was provided.

Assessment outcome is directly linked to (1) input provided by ACAC Member States through the use of the questionnaires, (2) extensiveness of the questionnaire data provided, and (3) the availability of publicly accessible data.

D.2 Assessment Criteria: ICAO Technological and Procedural Requirements

A major element in conducting the assessment of the current operation was to gather and compare the ICAO and Regional Sub-Group requirements and guidelines as they pertain to the core operational topics of communication, navigation, surveillance, automation, and air traffic management. These requirements and guidelines were collected from sources which include: MIDeANP, CNS Sub-Group Reports, GANP, CANSO key performance indicators (KPIs), etc. The operational topics were further sub-divided, although not uniformly and across all operational topics, into sections that included categories:

1. General Regional Requirements
2. Specific Requirements
3. Current Provided Services
4. Current Capabilities
5. Quality of Services

The following sections describe the criteria utilised by the Team to assess each State's current capability and quality of services provided in the areas of Communication; Navigation; Surveillance and Automation and Air Traffic Management.

D.2.1 Communications

i. General Regional Communications Requirements

Aeronautical Fixed Service (AFS)

The aeronautical fixed service (AFS) should satisfy the communication requirements of ATS, AIS/AIM, Meteorological Services for Air Navigation (MET) and Search and Rescue (SAR), including specific requirements in terms of system reliability, message integrity and transit times, with respect to printed as well as digital data and speech communications. If need be, it should, following an agreement between individual States and aircraft operators, satisfy the requirements for airline operational control.

The Aeronautical Telecommunication Network (ATN)

The ATN of the Region(s) should have sufficient capacity to meet the minimum requirements for data communications for the services mentioned above and be able to support:

a. Applications carried by the existing networks;
b. Gateways enabling interoperation with existing networks; and
c. Ground-ground communications traffic associated with air-to-ground (A/G) data link applications.

Aeronautical Mobile Service (AMS)

Air-to-ground communications facilities should meet the agreed communication requirements of the air traffic services (ATS), as well as all other types of communications which are acceptable on the AMS to the extent that the latter types of communications can be accommodated.

Air-to-ground communications for ATS

Air-to-ground communications for ATS purposes should be so designed to require the least number of frequency and channel changes for aircraft in flight compatible with the provision of the required service. They should also provide for the minimum amount of coordination between ATS units and provide for the optimum economy in the frequency spectrum used for this purpose.

Air-to-ground data link communications

Air-to-ground data link communications should be implemented in such a way that they are regionally and globally harmonised and make efficient use of available communication means and ensure optimum economy in frequency spectrum use and system automation.

Contingency planning

States should prepare their contingency plans in advance and ensure their availability or accessibility to the ICAO Regional Office. The plans should be reviewed at regular intervals and updated as required.

ii. Specific Regional Communications Requirements

Aeronautical Fixed Service (AFS)

Where ATS speech and data communication links between any two points are provided, the engineering arrangements should be such as to avoid the simultaneous loss of both circuits.

Special provisions should be made to ensure a rapid restoration of ATS speech circuits in case of an outage, as derived from the performance and safety requirements.

Data circuits between ATS systems should provide for both high capacity and message integrity.

The Inter-Centre Communication (ICC), consisting of ATS Inter-facility Data Communication (AIDC) application and the Online Data Interchange (OLDI) application, should be used for the automated exchange of flight data between ATS units to enhance the overall safety of the ATM operation and increase airspace capacity.

Specific Meteorological (MET) requirements

In planning the ATN, account should be taken of changes in the current pattern of distribution of meteorological information resulting from the increasing number of long-range direct flights and the trend towards centralised flight planning.

Specific Aeronautical Information Management (AIM) requirements

The aeronautical fixed service should meet the requirements to support efficient provision of aeronautical information services (AISs) through appropriate connections to area control centres (ACCs), flight information centres (FICs), airports and heliports at which an information service is established.

Specific Aeronautical Mobile Service (AMS) requirements

A high-grade aeronautical network should be provided based on the ATN, recognising that other technologies may be used as part of the transition. The network needs to integrate the various data links in a seamless fashion and provide for end-to-end communications between airborne and ground-based facilities.

Airports having a significant volume of International General Aviation (IGA) traffic should also be provided with appropriate air-to-ground communication channels.

States should ensure that no air/ground frequency is utilised outside its designated operational coverage and that the stated operational requirements for coverage of a given frequency can be met for the transmission sites concerned, taking into account terrain configuration.

iii. Current Aeronautical Telecommunication/Datalink Provided Services

Classification of the aeronautical teleconmunication services supporting Air Traffic Services are categorised by (1) ground-based stations and (2) satellite-based services and are defined below.

Aeronautical Broadcasting Service

A broadcasting service intended for the transmission of information relating to air navigation.

Aeronautical Fixed Service

A teleconmunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air services that include:

a. ATS direct speech circuits and networks;
b. Meteorological operational circuits, networks and broadcast systems, including World Area Forecast System – Internet File Service (WAFS WIFS) and/or Satellite Distribution System for Information Relating to Air Navigation (SADIS);
c. The aeronautical fixed teleconmunications network (AFTN);
d. The common ICAO data interchange network (CIDIN);
e. The air traffic services (ATS) message handling services (AMHS); and
f. The inter-centre communications (ICC).

Aeronautical Fixed Telecommunication Network Service

A worldwide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communication characteristics.

Aeronautical Telecommunication Network Service

An inter-network that allows ground, air ground and avionics data sub-networks to inter-operate by adopting common interface services and protocols based on the International Organization for Standardization (ISO) Open Systems Interconnect (OSI) reference model.

Aeronautical Mobile Service

A mobile service between aeronautical ground stations and aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on distress and emergency frequencies. This service does not include ground stations that are provided for other than ATS purposes.

Other

Any teleconmunication service which processes or displays air traffic control data (including aviation meteorological data) for use by an ATS provider.

iv. Current Aeronautical Telecommunication/Datalink Facilities

Classification of Facilities (Capabilities)

The following list classifies the kinds of aeronautical teleconmunication facilities used that meet the general/specific regional requirements. The data received from the State questionnaires will be compared and evaluated to assess these facilities.

Facilities (Capabilities)

1. Very-high-frequency (VHF) air/ground voice communication facilities/coverage and overlap;
2. Ultra-high frequency (UHF) air/ground voice communication facilities/coverage and overlap;
3. High-frequency (HF) air/ground voice communication facilities/coverage overlap;
4. Emergency back-up capabilities;
5. ATS point to point communication facilities;
6. Ground to ground data interchange networks AMHS capable / interconnected [ATS Messaging Handling System]);
7. Inter/intra-facility operational procedures;
8. SAR Agreements with surrounding facilities;
9. Harmonised Inter/intra-facility communications capability;
10. CPDLC capabilities - Air/ground data links;
11. AIDC/OLDI Capable / Implemented;
12. Human Machine Interface systems, including Tower Consoles, ATS Work Stations, and Display facilities;
13. Uninterruptible and emergency power supplies;
14. Essential systems are contained in buildings and in equipment shelters housing facilities (electrical power supplies, air-conditioning, and security facilities);
15. Available maintenance and restoration facilities;
16. Maintenance and restoration documentation processes;
17. Spectrum analysis procedures are in place;
18. Adjacent facility interoperability procedures/agreements;

v. Current Aeronautical Telecommunication/Datalink Quality of Services

Quality of Services

The following list classifies the kinds of aeronautical teleconmunication services provided that meets the general regional/specific requirements. The data received from the State questionnaires will be compared and evaluated to assess the quality of these services.

Services

1. VHF air/ground voice communication quality performance;
2. UHF air/ground voice communication quality performance;
3. HF air/ground voice communication quality performance;
4. Minimal number of frequency changes;
5. Acceptable number of inter-intra-facility ATC coordination communication lines;
6. Acceptable data link and landline latency;
7. Documented communications procedures (nominal and contingency use and maintenance);
8. Timeliness and accuracy of MET data reception;
9. Timeliness and accuracy of MET data analysis and impact translation;
10. SAR support procedures in place;
11. Operational impact to services resulting from interoperability agreements/procedures;
12. Operational impact to services resulting from LACK of interoperability agreements/procedures;

D.2.2 Navigation

i. General Regional Navigation Requirements

Navigation

Planning of aeronautical radio navigation services should be done on a total system basis, taking full account of the navigation capabilities as well as cost effectiveness. The total system composed of station-referenced navigation aids, satellite-based navigation systems and airborne capabilities should meet the performance-based navigation (PBN) requirements for all aircraft using the system and should form an adequate basis for the provision of positioning, guidance, and air traffic services.

Account should be taken of the fact that certain aircraft may be able to meet their navigation needs by means of self-contained or satellite-based aids, thus eliminating the need for the provision of station-referenced aids along the ATS routes used by such aircraft, as well as the need to carry on board excessive redundancies.

Navigation Infrastructure

The navigation infrastructure should meet the requirements for all phases of flight from takeoff to final approach and landing. NOTE: Annex 10 to the Convention on International Civil Aviation—Aeronautical Telecommunications, Volume I — Radio Navigation Aids, Attachment B, provides the strategy for introduction and application of non-visual aids to approach and landing.

Reference: The MID Region PBN Implementation Plan provides guidance to ANSPs, airspace operators and users, regulators, and international organisations, on the expected evolution of the regional air navigation system in order to allow planning of airspace changes, enabling ATM systems and aircraft equipage. It takes due account of the operational environment of the MID Region.

PBN Transition Strategy

- During transition to performance-based navigation (PBN),
- Sufficient ground infrastructure for conventional navigation systems should remain available. Before existing ground infrastructure is considered for removal.
- Users should be given reasonable transition time to allow them to equip appropriately to attain a performance level equivalent to PBN.
- States should approach removal of existing ground infrastructure with caution to ensure that safety is not compromised.
- This should be guaranteed by conducting safety assessments and consultations with the users.

Use of specific navigation aids

Where, within a given airspace, specific groups of users have been authorised by the competent authorities to use special aids for navigation. The respective ground facilities should be located and aligned so as to provide for full compatibility of navigational guidance with that derived from the Standards and Recommended Practices (SARPs).

States should ensure and oversee that service providers take appropriate corrective measures promptly whenever required by a significant degradation in the accuracy of navigation aids (either space-based or ground-based, or both) is detected.

NAVAID Frequency Usage

Special provisions should be made, by agreement between the States concerned, for the sharing and the application of reduced protection of non-ATS frequencies in the national sub-bands, so as to obtain a more economical use of the available frequency spectrum consistent with operational requirements.

States should ensure that no air/ground frequency is utilised outside its designated operational coverage and that the stated operational requirements for coverage of a given frequency can be met for the transmission sites concerned, taking into account terrain configuration. Radio navigation aids for Aeronautical Radio Navigation Services (ARNS)

Frequencies should be assigned to all radio navigation facilities taking into account agreed geographical separation criteria to Instrument Landing System (ILS) localiser, VOR and GBAS, X and Y channels to DME, in accordance with the principles laid out in *Annex 10*, *Volume V* and *ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718) Volumes I and II*. Also, the need for maximum economy in frequency demands and in radio spectrum utilisation and a deployment of frequencies which ensures that international services are planned to be free of interference from other services using the same band, need to be considered.

The principles used for frequency assignment planning for radio navigation aids serving international requirements should, to the extent possible, also be used to satisfy the needs for national radio aids to navigation.

Visual aids for low-visibility airport operations

At airports where there is a requirement to conduct low-visibility operations, the appropriate visual and non-visual aids should be provided.

Non-precision approach aids

Where required by the topographic and/or environmental situation of an airport, improved track guidance during departure and/or approach by specific non-visual and/or visual aids should be provided even if such aids would not normally be required in accordance with the SARPs.

Evaluating GNSS vulnerabilities

Ground- and space-based NAVAIDs should be free from Intentional or unintentional interference.

States should assess the GNSS vulnerability in their airspace and select appropriate mitigations depending on the airspace in question and the operations that must be supported. These mitigations can ensure safe operations and enable States to avoid the provision of new terrestrial navigation aids, reduce existing terrestrial navigation aids, and discontinue them in certain areas.

There are three principal aspects to be considered in the evaluation of GNSS vulnerabilities.

a. Interference and atmospheric (ionosphere) effects are of primary concern. Operational experience is the best way to assess the likelihood of unintentional interference. Each State must consider the motivation to intentionally interfere with GNSS-based on the potential safety and economic impacts on aviation and non-aviation applications. Atmospheric effects are unlikely to cause a total loss (outage) of GNSS but may impact some services (e.g., approaches with vertical guidance in equatorial regions). The likelihood of specific effects can be categorised as negligible, unlikely or probable.

b. All operations and services dependent on GNSS should be identified and considered together since GNSS interference can potentially disrupt all GNSS receivers at the same time over a certain area. GNSS is used for navigation services as well as other services such as precision timing with communications and radar systems, and may also be used for Automatic Dependent Surveillance (ADS) services. In these cases, GNSS represents a potential common point of failure.

c. The impact of a GNSS outage on an operation or service should be assessed by considering the types of operations, traffic density, availability of independent surveillance and communications and other factors. The impact can be categorised as none, moderate or severe.

By considering these aspects as a function of airspace characteristics, ANSPs can determine whether mitigation is required and, if so, at what level.

System Responsiveness

States should ensure and oversee that service providers take appropriate corrective measures promptly whenever required by a significant degradation in the accuracy of navigation aids (either space-based or ground-based, or both) is detected.

ii. Specific Regional ATM Requirements

States should develop a Corrective Action Plan (CAP) for each air navigation deficiency.

iii. Current Navigation Provided Services

Services provided to air traffic during all phases of operations including air traffic management, communication, navigation and surveillance, meteorological services for air navigation, search, and rescue and aeronautical information services.

- Provision of air navigation services comprised of:
- Ground-based radio navigation equipment (e.g., VOR, TACAN, DME and NDB),
- Precision approach and landing aids (e.g., ILS equipment)
- GNSS (GPS) capability that enables all non-precision approaches to be flown as “precision-like” approaches
- Runway and Approach (instrument and visual) Lighting Systems - Airport lighting systems (e.g., Approach, Precision Approach Path Indicators, Visual Approach Slope Indicator, Runway, Runway End Identifier Lights, Taxiway)
- Airport Markings – Precision and Non-Precision surface markings

iv. Current Navigation Facilities (Capabilities)

Classification of Facilities (Capabilities)

The following list classifies the kinds of Navigation facilities (capabilities) used that meet the general/specific regional requirements. The data received from the State questionnaires will be compared and evaluated to assess these facilities.

Facilities (Capabilities)

1. Airport Instrument Landing Systems;
2. Airport Visual Landing Systems;
3. Airport Lighting Systems;

4. Airport Ground-Based Navigation Systems (e.g., VOR, DME, TACAN, NDB);
5. En Route Ground-Based Navigation Systems (e.g., VOR, TACAN, DME, NDB);
6. Published Approach/Departure Procedure;
7. System Status Monitoring Capabilities;
8. System outage or service limitation notification process (e.g., NOTAM);
9. Documented System Restoration Procedures;
10. Documented System Outage/Restoration Metrics and Analysis;
11. Uninterruptible and emergency power supplies;
12. Essential services in buildings and in equipment shelters housing facilities providing adequate security and weather avoidance (electrical power supplies, air-conditioning, and security facilities);
13. System Failure or Degradation Contingency Planning;

v. Current ATM Quality of Services

Quality of Services

The following list classifies the kinds of Navigation services provided that meets the general regional/specific requirements. The data received from the State questionnaires will be compared and evaluated to assess the quality of these services.

Services

1. NAVAIDs are operating within specified service volumes;
2. NAVAIDs operating outside of specified service volumes are doing so with appropriate expanded services volume approvals and flight checks;
3. System outages or service limitations are published in a timely manner for stakeholder notification and planning;
4. Appropriate navigational guidance and coverage are available to stakeholders from take-off to landing;
5. Services are available and provided to stakeholders in an open and non-restrictive manner;
6. Procedures are developed in a collaborative manner with stakeholders;
7. Formalised procedures are documented and available to stakeholders;
8. System restoration is accomplished within acceptable time parameters identified by FIR;

D.2.3 Surveillance

i. General Regional Surveillance Requirements

Surveillance

Planning of aeronautical surveillance systems should be made based on a system approach concept, where collaboration and sharing of data sources should be considered in support of an efficient use of the airspace. An important element of modern air navigation infrastructure required managing safely increasing levels and complexity of air traffic is aeronautical surveillance systems.

System Approach

Planning of surveillance systems should be made based on a system approach concept, where collaboration and sharing of data sources should be considered in support of an efficient use of the airspace.

Surface Surveillance

At each international airport, specific minimal visibility for take-off should be established, regulating the use of intersection take-off positions. These minima should permit the appropriate ATC unit to maintain a permanent surveillance of the ground movement operations, and the flight crews to constantly secure their position on the manoeuvring area, so as to exclude any potential risk of confusion as to the identification of the aircraft and intersections used for take-off. The minima should be consistent with the surface movement guidance and control system (SMGCS) provided at the airport concerned.

Beacon Code Management

When operating Mode S radars, States should coordinate with their respective ICAO Regional Office the assignment of their corresponding interrogator identifier (II) codes and surveillance identifier (SI) codes, particularly where areas of overlapping coverage will occur.

Surveillance Harmonisation

States should ensure that implementation of Surveillance technologies is harmonised, compatible and interoperable with respect to operational procedures, supporting data link and ATM applications.

Surveillance Capacity Improvements

Surveillance Improvement

There is a need to encourage the application of improved surveillance techniques that will reduce separation minima, enhance safety, increase capacity, and improve flight efficiency in a cost-effective manner. These benefits can be achieved by providing surveillance in areas that lack primary or secondary radar when profitability models warrant it. In airspaces with radar coverage, improved surveillance could further reduce separation minima between aircraft and, in areas with high-traffic density; it could improve the quality of surveillance information both on the ground and in the air, thus increasing safety levels.

Automatic Dependent Surveillance-Broadcast (ADS-B)

States should identify sub-regional areas where there is no radar coverage followed by areas where the implementation of ADS-B would result in a positive cost/benefit in the near term while taking into account overall Regional developments and implementation of ADS-B in adjacent homogeneous ATM areas.

Surveillance Systems for Surface

The implementation of surveillance systems for surface movement at airports where it is justified due to meteorological conditions and capacity considerations will also improve safety and efficiency, while the display of traffic information in the cockpit and the associated procedures will permit the pilot to participate in the ATM system and improve safety through a better situational awareness.

Remote and Oceanic Airspace Areas

In remote and oceanic airspace where ADS-C is used, many air transport aircraft have Future Air Navigation System (FANS) capabilities that could be incorporated into commercial aircraft. ADS-B can be used to improve traffic surveillance in domestic airspace. In this regard, it should be noted that extended squitter 1090 is an available option that should be adopted as the preferred option worldwide for ADS-B data links.

Terrain and Obstacle Databases

In terminal areas and airports surrounded by significant terrain and obstacles, the availability of terrain and obstacle databases of an assured quality, made up of digital data sets that depict the ground surface in terms of continuous elevation values, and digital datasets on obstacles that constitute terrain features that have vertical significance in relation to adjacent and surrounding features and which are considered a hazard to air navigation, will improve situational awareness and will contribute to a general reduction in the number of associated controlled flight into terrain events.

Radar Data Processing

Implementation of radar data processing (RDPS) and ADS ATS surveillance systems, and exchange of radar/ADS data, including mono-radar, multi-radar, and radar data sharing; the radar (RDPS) and ADS ATS surveillance data processing system, and radar/ADS data exchange, including mono-radar, multi-radar and radar data sharing.

ii. Specific Regional Surveillance Requirements

The surveillance systems to be used in the ACAC Region are:

a. Secondary Surveillance Radars (SSR) Mode A, C and S in terminal and en-route continental airspace

b. Primary Surveillance Radars (PSR) mainly in terminal airspace;

c. Automatic Dependent Surveillance – Broadcast (ADS-B) and Multilateration (MLAT) in terminal areas;

d. ADS-B and Wide Area Multilateration (WAM) in most of the airspace;

e. Automatic Dependent Surveillance – Contract (ADS-C) in some parts of the oceanic and remote continental airspace.

iii. Current Surveillance Provided Services

Surveillance and alerting service are provided to aircraft on the surface and airborne using an integrated and harmonised system that allows for the mutual reliable and accurate exchange of surveillance data among intra/inter-facility ANSPs. Cooperation between States is effectively in place or ongoing to achieve the harmonised sharing of surveillance data to enhance safety, increase efficiency and achieve seamless surveillance.

iv. Current Surveillance Facilities (Capabilities)

Classification of Facilities (Capabilities)

The following list classifies the kinds of surveillance facilities (capabilities) used that meet the general/specific regional requirements. The data received from the State questionnaires will be compared and evaluated to assess these facilities.

Facilities (Capabilities)

1. Primary surveillance radar facilities;
2. Secondary surveillance radar facilities;
3. ADS-B surveillance capabilities;
4. Area Control Centre (ACC)
5. Approach Control
6. Terminal
7. Ability to filter surveillance data to fit controller needs;
8. Intra/Inter-facility contingency procedures;
9. Weather display and filtering capabilities;
10. Controllers have access to automation depicting pertinent radar and flight data (data block);
11. Interfaces with bordering facilities allow coordination and automated transfer of data;
12. Backup radar system available;
13. Uninterruptible and emergency power supplies;
14. Essential systems are contained in buildings and in equipment shelters housing facilities (electrical power supplies, air-conditioning, and security facilities);
15. Available maintenance and restoration facilities;
16. Maintenance and restoration documentation processes;
17. Space-based ADS-B capability awareness and planning development;
18. Adjacent facility interoperability procedures/agreements;

v. Current Surveillance Quality of Services

Quality of Services

The following list classifies the kinds of surveillance services provided that meets the general regional/specific requirements. The data received from the State questionnaires will be compared and evaluated to assess the quality of these services.

Services

1. Target and data presentation quality;
2. Increased use of data radar derived data;
3. Improved efficiency and safety through sharing ATS surveillance data across FIR boundaries;
4. Surveillance coverage extends to the dimensions of the airspace that the FIR has control jurisdiction within each of the following operational environments;
   a. ACC
   b. Approach Control
   c. Terminal – Surface surveillance
5. In cases where full surveillance is not possible, coverage is in place to maximise contiguous coverage and/or use of ADS-B on major routes/terminal areas;
6. Acknowledge the development of other airspace segments that should consider incremental introduction of new surveillance technologies;
7. Planning is in place to identify and implement surveillance capabilities on a local basis, but in compliance with regional planning needs and documents;
8. Surveillance systems provide coverage overlap to support preferred system failure;
9. Surveillance systems are integrated to provide controllers with a mosaic display;
10. System maintenance and restoration metrics collected and analysed;
11. Satisfactory system restoration times;
12. Maximised contiguous coverage and use of ADS-B on major routes/terminal areas;

D.2.4 ATM

i. General Regional ATM Requirements

To facilitate air navigation systems planning and implementation, homogenous ATM areas and/or major traffic flows/routing areas have been defined for the Region. While these areas of routing do not encompass all movements in the Region, they include the major routes. This includes the domestic flights in that particular area of routing.

Homogeneous ATM area

The method of identifying homogeneous ATM areas involves consideration of the varying degrees of complexity and diversity of the worldwide air navigation infrastructure. Based on these considerations, planning could best be achieved at the global level if it was organised based on ATM areas of common requirements and interest, taking into account traffic density and the level of sophistication required.

State Jurisdiction

The description of the current FIR/Upper Information Regions (UIR), as approved by the ICAO Council.

States should ensure that the provision of air traffic services (ATS) covers its own territory and those areas over the high seas for which it is responsible.

Regional ATS Routes and organised track structures

States should adhere to MIDANPIRG and EANPG optimisation responsibilities of the traffic flows through the continuous improvement of the regional ATS route network and organised track systems and implementation of random routing areas and free route airspace in the Region. NOTE: States' AIPs and other States publications should be consulted for information on the implemented ATS routes.

ICARD Global Database

The five-letter name-codes assigned to significant points should be coordinated through the ICAO Regional Office and obtained from the ICAO International Codes and Routes Designators (ICARD) Global Database.

Aircraft Identification - SSR Code Assignments

Appropriate management of Secondary Surveillance Radar (SSR) States and ANSPs should apply the SSR Code Management Plan (CMP) approved by MIDANPIRG and ORCAM User Group for the North Africa States in order to ensure continuous and unambiguous aircraft identification.

States should inform the ICAO MID/ ICAO EUR/NAT and ICAO ESAF Regional Offices promptly of any deviation from the Plan or proposed changes considered necessary with respect to their code allocations, relevant to ATS infrastructure developments and/or the guidance material provided in the MID SSR CMP and ORCAM User Group.

Performance-based Navigation (PBN)

States' PBN implementation Plans should be consistent with the MID, EUR/NAT, and AFI Regional PBN Plans.

Flexible Use of Airspace

States should implement civil/military cooperation and coordination mechanisms to enhance the application of the Flexible Use of Airspace concept. States should arrange for close liaison and coordination between civil ATS units and relevant military operational control and/or air defence units in order to ensure integration of civil and military air traffic or its segregation if required. Such arrangements would also contribute to increasing airspace capacity and to improving the efficiency and flexibility of aircraft operations.

Search and Rescue

Each Contracting State should ensure that the provision of search and rescue services covers its own territory and those areas over the high seas for which it is responsible for the provision of those services.

The three volumes of the *IAMSAR Manual (Doc 9731)* provide guidance for a common aviation and maritime approach to organising and providing SAR services. States are invited to use the IAMSAR Manual to ensure the availability of effective aeronautical SAR services and to cooperate with neighbouring States.

States which rely on military authorities and/or other sources for the provision of SAR facilities should ensure that adequate arrangements are in place for coordination of SAR activities between all entities involved.

Arrangements should be made to permit a call to any national services likely to be able to render assistance on an ad-hoc basis, in those cases when the scope of SAR operations requires such assistance.

In cases where the minimum SAR facilities are temporarily unavailable, alternative suitable means should be made available.

In cases where an SAR alert is proximate to a Search and Rescue Region (SRR) boundary (e.g., 50 NM or less), or it is unclear if the alert corresponds to a position entirely contained within an SRR, the adjacent Rescue Coordination Centre (RCC) or Rescue Sub-Centre (RSC) should be notified of the alert immediately.

Meteorological observations and reports

NOTE: Tables referenced are contained in MID (MIDeANPvII), AFI and EUR/NAT e ANP ICAO documentation.

Routine observations, issued as a Meteorological Aviation Report (METAR), should be made throughout the 24 hours of each day at intervals of one hour or, for RS and AS designated airports1, at intervals of one half-hour at airports as indicated in Table MET II-2. For airports included on the VHF VOLMET broadcast as indicated in Table MET II-3, routine observations, issued as METAR, should be made throughout the 24 hours of each day.

At airports that are not operational throughout 24 hours, METAR should be issued at least 3 hours prior to the airport resuming operations in the ACAC Region.

Meteorological Forecasts

NOTE: Tables referenced are contained in MID (MIDeANPvII), AFI and EUR/NAT e ANP ICAO documentation.

In the ACAC Region, an airport forecast, issued as a Terminal Airport Forecast (TAF), should be for the airports indicated in Table MET II-2.

In the ACAC Region, the period of validity of a routine TAF should be of 9-, 24-, or 30- hours to meet the requirements indicated in Table MET II-2.

In the ACAC Region, the forecast maximum and minimum temperatures expected to occur during the period of validity, together with their corresponding day and time of occurrence, should be included in TAF at airports indicated in Table MET II-2.

In the ACAC Region, landing forecasts (prepared in the form of a trend forecast) should be provided at airports indicated in Table MET II-2.

Meteorological Requirements for and use of Communications

NOTE: Tables referenced are contained in MID (MIDeANPvII), AFI and EUR/NAT e ANP ICAO documentation.

Operational meteorological information prepared as METAR, special (SPECI), and TAF for airports indicated in Table MET II-2, and SIGMET messages prepared for FIRs or control areas indicated in Table MET II-1, should be disseminated to the international OPMET databanks designated for the MID Region (namely Jeddah and Bahrain (backup) Regional OPMET Centres) and to the centre designated for the operation of the aeronautical fixed service satellite distribution system (SADIS) and the Internet-based service (Secure SADIS file transfer protocol [FTP]) and/or WIFS in the ACAC Region.

SIGMET messages should be disseminated to other meteorological offices in the ACAC Region.

Special air-reports that do not warrant the issuance of a Significant Meteorological Information (SIGMET) message should be disseminated to other meteorological offices in the ACAC Region.

In the ACAC Region, meteorological information for use by aircraft in flight should be supplied through VOLMET broadcasts.

In the MID Region, the airports for which METAR and SPECI are to be included in VOLMET broadcasts, the sequence in which they are to be transmitted and the broadcast time, is indicated in Table MET II-3

Aeronautical Information Management (AIM)

States should ensure that the provision of aeronautical data and aeronautical information covers its own territory and those areas over the high seas for which it is responsible for the provision of air traffic services.

Airport Capacity Assessments

States should ensure that adequate consultation and, where appropriate, cooperation between airport authorities and users/other involved parties are implemented at all international airports to satisfy the provisions of airport capacity assessment and requirement

Runway selection procedures and standard taxi routes at airports should ensure an optimum flow of air traffic with a minimum of delay and a maximum use of available capacity. They should also, if possible, take account of the need to keep taxing times for arriving and departing aircraft as well as apron occupancy time to a minimum. The airport collaborative decision-making (A-CDM) concept should be implemented to improve airport capacity as early as possible.

The declared capacity/demand condition at airports should be periodically reviewed in terms of a qualitative analysis for each system component and, when applicable, the result of the qualitative assessment upon mutual agreement be used for information.

The future capacity/demand, based on a forecast for the next five years, should be agreed upon after close cooperation between airport authorities and affected users.

Operators should consult with airport authorities when future plans indicate a significantly increased requirement for capacity resulting in one of the elements reaching a limiting condition.

Airport capacity should be assessed by airport authorities in consultation with the parties involved for each component (terminal/apron/aircraft operations) using agreed methods and criteria for the level of delays.

Where restrictions in airport capacity are identified, a full range of options for their reduction or removal should be evaluated by the airport authority, in close cooperation with the operators and other involved parties. Such options should include technical/operational/procedural and environmental improvements and facility expansion.

At many airports, airspace capacity has an influence on the airport capacity. If the declared capacity of a specified airspace has an influence on airport operations, this should be indicated and action is undertaken to reach a capacity in this airspace corresponding to the airport capacity.

Aviation System Block Upgrades (ASBUs), Modules and Roadmaps

Guided by the GANP, ICAO MID regional and the North Africa States, sub-regional and State planning should identify Modules which best provide the needed operational improvements.

Collaborative Decision Making (CDM)

The States and the Regions should evolve towards a collaborative approach to capacity management.

ii. Specific Regional ATM Requirements

Working Principles for the Construction of Air Routes

ATS routes should be developed based on the ICAO SARPS and Procedures for Air Navigation Services–Aircraft Operations (PANS-OPS) and PANS-ATM criteria and parameters, the following should be taking into consideration for the management of MID Region and North Africa States ATS route Network:

a. Where possible, routes should be established to increase efficiency, reduce complexity and provide additional benefits to users;
b. Separation assurance principles should apply;
c. Routes should be established with sufficient separation to operate independently;
d. Where possible, routes in a radar environment should be procedurally (laterally) separated;

e. Segregated tracks should be established on medium-/high-density routes and be determined by set criteria;

f. Where required, routes should be constructed to support terminal area management procedures, e.g., Standard Instrument Departures/ Standard Terminal Arrival Route (SIDs/STARs) and flow management techniques, as applicable;

g. Holding patterns should be laterally separated from other tracks, and tolerances captured within a single sector;

h. A maximum of two routes containing high-traffic density should be blended at a single point. Inbound tracks should be blended at <90 degrees. Up to three low-traffic density routes may be blended at a single point;

i. Multiple crossing points involving major traffic flows should be avoided.

j. En-route crossings should be minimised. Where crossings are inevitable, they should, where possible, be established for cruise configuration. Such crossings should occur, wherever possible, within radar coverage;

k. Airspace sectorisation should take account of the route structure, and workload considerations. If necessary, airspace should be re-sectorised to accommodate changes to air route configuration;

l. Routes should be constructed so as to reflect the optimum navigation capabilities of the principle users (e.g., RNAV or conventional);

m. The prime determinant should not be the number of track miles. A small increase in track miles may optimise traffic flows, avoid unpredicted delays or avoid holding requirements. Consideration should also be given to the provision of a range of routes which will permit operators to choose cost-efficient routes over the range of expected seasonal wind patterns;

n. Due allowance should be given to existing and future flight data processing (FDP) and radar data processing (RDP) capability (e.g., notification of messages for auto hand-off);

o. Periodic safety audit and review process of routes should be conducted to test demand against capacity criteria, and the principles. This should ideally be done in parallel with the annual sectorisation review; and

p. Routes that can no longer be justified should be deleted.

Meteorological observations and reports

NOTE: Tables referenced are contained in MID (MIDeANPvII), AFI and EUR/NAT e ANP ICAO documentation.

In the ACAC Region, operational meteorological information during the Pilgrimage Season should be issued as indicated in Table II-MID-1.

ATM Communication Requirements

Where ATS speech and data communication links between any two points are provided, the engineering arrangements should be such as to avoid the simultaneous loss of both circuits.

Special provisions should be made to ensure a rapid restoration of ATS speech circuits in case of an outage, as derived from the performance and safety requirements.

Data circuits between ATS systems should provide for both high capacity and message integrity.

The Inter-Centre Communication (ICC), consisting of ATS Inter-facility Data Communication (AIDC) application and the Online Data Interchange (OLDI) application, should be used for the automated exchange of flight data between ATS units to enhance the overall safety of the ATM operation and increase airspace capacity.

Where Voice over IP (VOIP) is planned or implemented between ATS units for voice communications, it should meet the ATS requirements.

iii. Current Surveillance Provided Services

Air Traffic Management consists of a series of expectations identified within *Appendix D* of the *Global Air Traffic Management Operational Concept (Doc 9854)*, that when acted upon lead to a harmonised service. The expectations are paraphrased below. The list of ATM services follows the list of expectations.

ATM Expectations

Access and equity

A global ATM system should provide an operating environment that ensures that all airspace users have the right of access to the ATM resources needed to meet their specific operational requirements and that the shared use of airspace by different users can be achieved safely. The global ATM system should ensure equity for all users that have access to a given airspace or service.

Capacity

The global ATM system should exploit the inherent capacity to meet airspace user demands at peak times and locations while minimising restrictions on traffic flow. To respond to future growth, capacity must increase, along with corresponding increases in efficiency, flexibility, and predictability, while ensuring that there are no adverse impacts on safety and giving due consideration to the environment. The ATM system must be resilient to service disruption and the resulting temporary loss of capacity.

Cost-effectiveness

The ATM system should be cost-effective while balancing the varied interests of the ATM community. The cost of service to airspace users should always be considered when evaluating any proposal to improve ATM service quality or performance. ICAO policies and principles regarding user charges should be followed.

Efficiency

Efficiency addresses the operational and economic cost-effectiveness of gate-to-gate flight operations from a single flight perspective.

Environment

The ATM system should contribute to the protection of the environment by considering noise, gaseous emissions, and other environmental issues in the implementation and operation of the global ATM system.

Flexibility

Flexibility addresses the ability of all airspace users to modify flight trajectories dynamically and adjust departure and arrival times, thereby permitting them to exploit operational opportunities as they occur.

Global interoperability

The ATM system should be based on global standards and uniform principles to ensure the technical and operational interoperability of ATM systems and facilitate homogeneous and non-discriminatory global and regional traffic flows.

Participation by the ATM community

The ATM community should have a continuous involvement in the planning, implementation and operation of the system to ensure that the evolution of the global ATM system meets the expectations of the community.

Predictability

Predictability refers to the ability of airspace users and ATM service providers to provide consistent and dependable levels of performance. Predictability is essential to airspace users as they develop and operate their schedules.

Safety

Uniform safety standards and risk and safety management practices should be applied systematically to the ATM system. In implementing elements of the global aviation system, safety needs to be assessed against appropriate criteria and in accordance with appropriate and globally standardised safety management processes and practices.

Security

Security refers to the protection against threats that stem from intentional acts (e.g., terrorism) or unintentional acts (e.g., human error, natural disaster) affecting aircraft, people or installations on the ground. Adequate security is a major expectation of the ATM community and of citizens. The ATM system should, therefore, contribute to security, and the ATM system, as well as ATM-related information, should be protected against security threats. Security risk management should balance the needs of the members of the ATM community that require access to the system, with the need to protect the ATM system. In the event of threats to aircraft or threats using aircraft, ATM shall provide the authorities responsible for appropriate assistance and information.

ATM Provided Services

Airspace Organisation and Management

Dynamic, flexible and increasingly tactical airspace organisation and management. When subject to uncontrollable or unpredictable events, ATM service providers react to these events by redistributing or reorganising airspace to maintain maximum efficiency.

Airport Operations

Constraints on flights moving from the runway to parking locations are minimised. Constraints are minimised by the provision of:

1. Effective communications capabilities
2. Automation aids for dynamic planning of surface movements
3. Integrated surface and arrival/departure automation systems
4. Decision support tools to integrate operator and service provider operational preferences

Demand and Capacity Balancing

Demand and capacity balancing actions provide an agreed system capacity level aimed at ensuring safety, equity, and access, and are done in a process in where the collection, collation, and analysis of data to produce an accurate picture of the demands and constraints that affect any particular airspace volume are done using collaborative decision-making.

Traffic Synchronisation

Traffic synchronisation is the establishment and maintenance of a safe, orderly and efficient flow of air traffic in all phases of flight below:

1. Departure phase of flight - traffic is synchronised to integrate into the airborne traffic environment
2. The en-route phase of flight - traffic is synchronised to involve the sequencing, integration, and spacing of en-route flows.
3. Arrival phase of flight – traffic is synchronised to achieve optimum spacing and sequencing of the arrival flows

Airspace User Operations

ATM system design

ATM restrictions on users are required for safety or ATM system design.

All airspace users are expected to participate or have representation in collaborative decision-making processes that affect their missions, including ATM system design processes.

The ATM system is designed to accommodate a wide variety of mission requirements, including a wide range of aircraft types and performance.

Cooperation

Cooperation within the stakeholder permits an acceptable level of information and airspace resource sharing.

Trajectory negotiation

Automation systems are capable of developing, transmitting and processing 4-D flight trajectories.

Service provider negotiates with the user and, through collaborative decision-making, when the requested trajectory is not available.

Performance incentive and assistance

The service provider offers services to airspace users to mitigate real-time aircraft performance limitations.

Conflict management

Tactical management

Negotiated 4-D trajectories will receive the only minimal tactical intervention.

Aircraft surface movement aims to be conflict free.

Separation provision

Single defined separation criterion is commonly used intra/inter-facility. Where different separation criteria are used it is required due to safety or ATM design.

ATM Service Delivery Management

CDM processes are in place to achieve the best outcomes for the ATM community. Meetings are scheduled on the regular and recurring basis, and on an ad-hoc basis when needed.

1. ATM service delivery management ensures that flights can get to the runway in time for their take-off slot and, at the same time, for integrating them with all the other departing and arriving flights in order to ensure safety and to optimise the use of the parking locations, ramps, taxiways, and runways.
2. ATM service delivery management matches ATM service capabilities with demand, e.g., traffic flow characteristics, by a range of means, including, dynamic re-sectorisation in ATM service centres, changes to route structures or airspace organisation, or changes to conflict management modes.

Collaborative Decision-Making

Collaborative decision-making is in place that allows all members of the ATM community, especially airspace users, to participate in the ATM decision-making that affects them.

Processes are in place that allows for collaborative decision-making to occur among airspace users directly, without any involvement of an ATM service provider.

iv. Current ATM Facilities (Capabilities)

Classification of Facilities (Capabilities)

The following list classifies the kinds of ATM facilities (capabilities) used that meet the general/specific regional requirements. The data received from the State questionnaires will be compared and evaluated to assess these facilities.

Facilities (Capabilities)

A local PBN plan is in place and coordinated and consistent with the regional plan

1. Introduction of PBN procedures;
2. Airspace realignments are conducted to accommodate flows and routes;
3. Accommodations are made for user-preferred trajectories within airspace that can accommodate such operations;
4. Metrics in place to comply, monitor and be modified as necessary to ensure the routing system and airspace fit the complexity, volume, and efficiency of the operation;
5. Effective and inclusive CDM procedures are in place;
6. Homogeneous areas are in place as defined by MIDeANP, AFIeANP and EUR-NAT eANP;
    a. Operational work groups and procedures are in place with adjacent ANSPs to identify and implement homogenous procedures. (e.g., matching adjacent sector to harmonise flows – similar altitude schemes);
    b. Airspace and route accommodate the current volume, type, city pair of traffic;
7. Well-defined Flexible Use of Airspace (FUA) procedures in place;
8. On-site military liaison official present at the operational and/or administrative levels;
9. The airspace is Reduced Vertical Separation Minimum (RVSM) compliant;
10. SAR procedures in place that define responsibilities between ATC units and SAR agencies, and there are methods of quick communication between affected stakeholders;
11. FIR maintains current AIM documents (e.g., AIP, Q/A, Operational procedures, mapping, Minimum Vectoring Altitude [MVA] data);
12. Terminal facility procedures are in place that provide efficient surface movements to/from runways/ramp areas;
13. Airport capacity issues and mitigations (e.g., construction, frequency interference, tower (TWR) visibility limitations) are collaboratively addressed;
14. Terminal metrics (e.g., delay) are being defined, collected, analysed and acted upon;
15. The FIR coordinates (CDM) with stakeholders to assess, develop, monitor and modify airport capacity;
16. FIR forecasts traffic out to at least 5 years;
17. CDM process in place to modify forecast data;
18. FIR supports an operational Air Traffic Flow Management unit (ATFMU);
19. FIR supports ASBU planning schedule and is in compliance with previously agreed to block upgrades;
20. Adjacent facility interoperability procedures/agreements;
21. ATC facilities possess sufficient staffing to efficiently service demand;
22. Intra/inter-facility spacing requirements are not increased above the standard separation minima;

23. ANSPs have access to and utilise effective decision support tools (e.g., conflict probe and alert, weather display, access to NOTAM/SIGMET information);
24. ANSPs have operational traffic management tools (AMAN, DMAN, SMAN, EMAN);
25. ANSPs have the technical capabilities to conduct logical and physical assignments and reassignments of controller workstations;
26. ANSPs are capable of implementing new software and hardware in a timely manner;

v. Current ATM Quality of Services

Quality of Services

The following list classifies the kinds of ATM services provided that meets the general regional/specific requirements. The data received from the State questionnaires will be compared and evaluated to assess the quality of these services.

Services

1. Numbers of requested flights (demand) are being accommodated (capacity);
    a. Percentage of flights departing on-time;
    b. Percentage of flights arriving on-time;
    c. Average departure delay per flight;
    d. Percentage of flights with normal flight duration;
    e. Total number of minutes to actual gate arrival time exceeding planned arrival time;
2. Delays are not exceeding accepted tolerances agreed to be stakeholders;
3. System predictability values are within tolerances;
    a. Capacity variation;
    b. Flight plan time variation;
    c. Flight plan distance variation;
4. Airport metrics (Out, Off, On and In) are within acceptable limits;
5. Number of yearly CDM meetings covering planning, implementation, and operations rea acceptable to the needs of the regional stakeholders;
6. Noise exposure and emission values mitigation plans are effective;
7. Accident/incident rates are closely monitored and mitigated;
8. Reduced number of filed differences with ICAO SARPs;
9. High level of compliance of ATM operations with ICAO CNS/ATM plans and global interoperability requirements;
10. Operations are not negatively impacted by staffing policies or constraints;

11. Effective and consistent use of minimum separation standards across boundaries (intra/inter-facility);
12. Traffic management tools are effectively and efficiently utilised;
13. Controller decision support tools (e.g., conflict probe/alert, weather displays) are effectively and efficiently utilised;

Appendix E FIR Categorisation

Each State in the study area was asked to provide current and forecasted operational traffic data. These were collected and analysed to develop an operational overview of the current and projected air traffic activity in the FIRs. Data included aggregate values that when analysed and combined allowed the Team to create three categorisations of air traffic operations within each FIR—High; Medium and Low. This methodology supports the concept of 'one size does not fit all' and is similar to the philosophy of the ICAO Aviation System Block Upgrade methodology.

These categorisations are a result of a combination of the number of operations in the ACC(s); the density of operations in the ACC(s); the number of major airports in the FIR; and the total arrival and departure activity at the major airports. These elements were evaluated for the current activity (2013 data was supplied) and for years 2020, 2025 and 2030. In those cases where data was not provided or was insufficient to draw conclusions, the Team attempted to supplement and/or collect data from available public sources; however, only airport data from public sources was available. Similarly, if no data or insufficient future activity data was provided, an increase factor of 7% was used to forecast activity for the out years. Definitions of the traffic elements utilised follows:

- **The density of Operations –** the amount of traffic that exists within the FIR airspace within a one-year period. The values are based on total operations compared to the square nautical mileage of the FIR.
- **Area Control Centre Facility Activity –** activity within a one-year period in the en-route environment as reported in the surveys.
- **Major Airports –** for the purposes of this study a major airport is one with more than thirty thousand total operations per year.
- **Airport Activity –** activity within a one-year period for major airports as reported in the surveys and on public websites if not reported by the State.

For the purposes of this study, the Team defines a High-, Medium-, and Low-Activity FIR as follows, and depicted in Table 38.

- **High-Activity FIR –** an FIR that reported more than five hundred thousand but less than one million total ACC operations and/or contains at least one airport with greater than one hundred and eighty thousand total operations.
- **Medium-Activity FIR –** an FIR that reported more than two hundred thousand but less than five hundred thousand total ACC operations and/or contains at least one airport that reported a range of eighty thousand to one hundred and eighty thousand operations.
- **Low-Activity FIR –** an FIR that reported greater than fifty thousand but less than two hundred thousand total ACC operations and/or contains at least one airport that reported a range of thirty thousand operations to eighty thousand operations.

Airspace density values, while providing useful data, were not used in the determination of an FIR's category. The value of density operations is especially best suited when coupled with delay *information (no delay information was provided). Density data serves as an indicator for the possible need for re-sectorisation, additional frequencies; new procedures that build in separation; staffing adjustments and other workload factors indicative of high-density operations.*

Table 38: Categorisation Criteria by Activity

Categorisation	ACC Traffic Activity Range		Major Airport Traffic Activity
High	500k +	and/or	180K +
Medium	200k – 499k	and/or	80k – 179k
Low	50k – 199k	and/or	30k – 79k

E.1 Airspace Size

The study area includes the ACAC Member States illustrated in Table 5 (see section 2.1). Figure 36 illustrates the ACAC organisation jurisdictional airspace which includes approximately 6,800,000 sq. nm of airspace (~23,000,000 Sq. Km, ~9,000,000 Sq. Sm).

Figure 36: ACAC Member State Illustration

This is an airspace volume greater than that of all of Europe (~6,400,000 sq. nm) which also includes the oceanic FIR airspace of Santa Maria (Portugal), Shanwick (United Kingdom), Reykjavik (Iceland) and Bodo (Norway), as illustrated in Figure 37. The physical size of each FIR has an effect on the number of sectors, controllers and the route structure required to support the airspace volume. These factors when considered with the addition of airspace density assist in portraying an operational categorisation that would be useful in identifying future resource needs and organisational attention.

Figure 37: ACAC Jurisdictional Airspace Comparison with Europe

E.2 Traffic Density (operations per sq. nm mile)

Traffic density is a measure of the amount of traffic that exists within a unit of volume over a given unit of time. Traffic density more efficiently and meaningfully is further sub-divided into two values: (1) raw traffic density—the ratio of the number of aircraft (or flight hours) to the airspace volume, and (2) adjusted traffic density—the ratio between the hours of interactions and flight hours [1]. The scope of this study necessitates that the raw density value will be calculated for those FIRs where sufficient data was provided, or otherwise obtained through public sources, to accomplish the calculation. The values presented are **the number of aircraft per square nautical mile.**

The resulting values indicate a raw density level that could be used to define a regional (ACAC), or if desired, local (specific ANSP) range that could be used to determine what airspace volumes could presently, or in the future, require ACAC/ANSP oversite to ensure continued safe and efficient operations. The operational reality being, that in dense airspace, controllers are required to provide services to higher levels of traffic, within their operational capabilities which include: controller experience and competence, sector design, route structure, automation capabilities, data transfer capabilities, traffic variations (seasonal & special event), military activity constraints, aircraft equipage, etc. Where low-density values could, but not in every case, indicate volumes of airspace where minimal oversite is required. The values that are depicted are En Route (ACC) values, EXCEPTION: the Qatar values represent an approach control environment, and are illustrated with an asterisk. The raw densities for the ACAC region for 2014, 2020, 2025, and 2030 time frames are presented in two formats:

1. Figure 38 illustrates the range of raw density values in line graph format. The values indicate the number of aircraft operations per sq. nm.

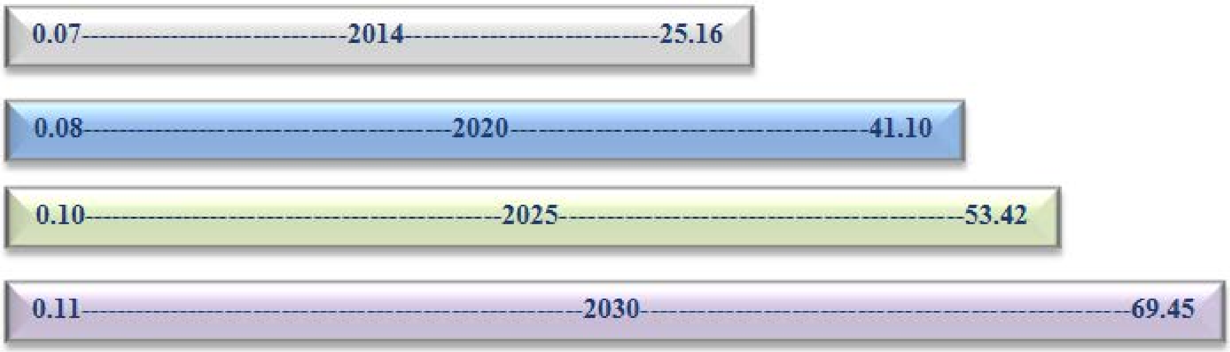


Figure 38: Illustration of Raw ACAC Jurisdictional Airspace Density Value Ranges 2015–2030

2. Table 39 depicts the supporting density values in table format along with the associated traffic levels and approximate FIR airspace volume in square nautical miles. (NOTE: traffic values for the KSA and Egypt beyond the ANSP-provided base year have been extrapolated into 2020, 2025, and 2030 using a 7.5% annual traffic projection increase).

Table 39: Data Supporting Raw Density Values

ACAC Regional En Route Traffic and Airspace Density Projections									
FIR (ACC)	FIR Sq. nm	2014 Activity	2014 Density	2020 Activity	2020 Density	2025 Activity	2025 Density	2030 Activity	2030 Density
Algeria	728,983	156,400	0.21	209,600	0.29	267,400	0.37	341,300	0.47
Bahrain	22,973	573,400	24.96	815,000	35.48	1,088,000	47.36	1,400,000	60.94
Egypt	384,374	569,300	1.48	817,353	2.13	1,173,415	3.05	1,684,589	4.38
Oman	171,490	395,500	2.31	629,200	3.67	835,100	4.87	1,124,500	6.56
Qatar*	8,760	226,400^	25.16	360,000	41.10	468,000	53.42	608,400	69.45
Saudi Arabia	618,218	643,157	1.04	923,335	1.49	1,325,567	2.14	1,903,023	3.08
Sudan	732,093	53,300	0.07	61,000	0.08	76,000	0.10	81,000	0.11
Tunisia	70,409	132,300^	1.88	120,000	1.70	150,000	2.13	185,000	2.63
UAE	36,706	873,000	23.78	1,205,800	32.85	1,532,470	41.75	2,185,810	59.55
Lebanon	6279	65,514	10.43						
^ Data activities for years 2020 and beyond were extrapolated at a rate of 7% per year *Denotes Approach Control Airspace (Qatar)									

ACAC Regional En Route Traffic and Airspace Density Projections									
FIR (ACC)	FIR Sq. nm	2014 Activity	2014 Density	2020 Activity	2020 Density	2025 Activity	2025 Density	2030 Activity	2030 Density
Iraq**	127,231								
Jordan**	27,785								
Kuwait**	10,389								
Libya**	579,196								
Mauritania Domestic**	867,501								
Mauritania Oceanic**	1,455,403								
Morocco**	236,869								
Palestine**									
Syria**	55,663								
Yemen**	348,180								
**Data was not available to calculate the raw density values for the above-listed FIRs									

E.3 Major Airport Activities

An accounting of airport activity indicated that the number of ACAC Member States airports is in excess of 200. To be able to determine a measurable level of operational impact, the Team reviewed the airport activities for each of these airports. An educated judgment was made that those airports that did not have an activity level of at least 10,000 (10k) operations per year (primarily based on 2014 data) would not be included in the ACAC FIR categorisation criteria. Those airports that exceed the 10k minimum activity level were then sub-divided into the following four activity classifications: >180k, >80k, >30k and >10k. Table 40 depicts the (1) numbers of airports within each FIR that meets the classification criteria, and (2) the two highest specific airports with their respective traffic activity.

Table 40: Major Airport Activities

Movements per Year	Number of Airports				Top 2 Major Airport Traffic Counts			
	> 180,000	> 80,000	> 30,000	> 10,000	Airport	Latest Counts	Airport	Latest Counts
Algeria			2	3	ALG	76,764	HME	24,383
Bahrain		1			BAH	96,193		

Movements per Year	Number of Airports				Top 2 Major Airport Traffic Counts			
	> 180,000	> 80,000	> 30,000	> 10,000	Airport	Latest Counts	Airport	Latest Counts
Egypt		1	2	3	CAI	142,576	HRG	46,334
Iraq			2		EBL	19,658	BGW	11,372
Jordan			2		AMM	73,125	ADJ	45,048
Kuwait		1			KWI	91,992		
Lebanon			1		BEY	68,885		
Libya				1	TIP	13,960	BEN	4,552
Mauritania				2	NKC	4,686	NDB	1,982
Morocco		1	1	2	CMN	82,180	RAK	34,881
Oman		1		1	MCT	82,563	SLL	12,286
Palestine								
Qatar	1				DOH	218,204		
Saudi Arabia	1	1	2	3	JED	182,887	RUH	163,383
Sudan*			1		KRT	48,972		
Syria *			1		DAM	38,992	ALP	8,320
Tunisia			1	4	TUN	52,903	DJE	13,156
UAE	1	1	3	2	DXB	357,339	AUH	154,821
Yemen				1	SAH	20,853	ADE	7,076
*** Latest data 2009, all other movements are derived from either 2014 or 2015 data**								

Appendix F Gap Analysis Methodology

The Airbus ProSky Study Team evaluated gaps in capabilities to meet forecasted activity demand and expected ASBU functionality, as illustrated in Figure 39.

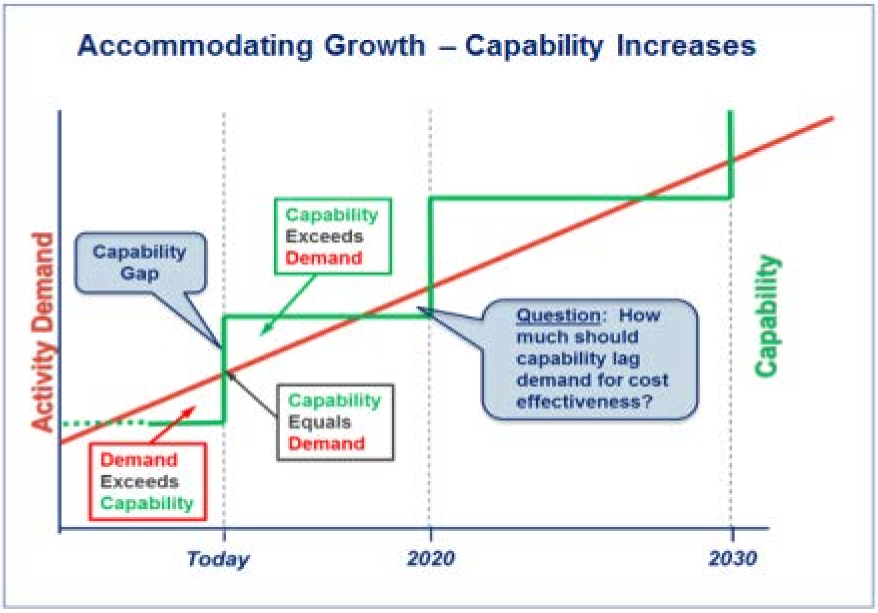


Figure 39: Growth Accommodation

Gaps/Findings in the CNS/ATM in the Region are a compilation of the State's objectives and status in ICAO Global Air Navigation Plan and ICAO's Block Upgrade methodology; the survey data provided by the States as it pertains to the adequacy of elements of their communication, navigation, surveillance capabilities and Team's understanding and assumptions of how those capabilities are currently being utilised.

Utilising data provided by States in the surveys, we analysed the progress made towards reaching the objectives in the GANP ASBU plan in the following performance areas: Airport operations; globally interoperable systems and data; optimum capacity and flexible flights and efficient flight paths. The ACAC block data is presented in a format that shows the ACAC status of each module in each of four Performance Improvement Areas (PIAs) within each of the ASBU blocks, as illustrated in Figure 40.

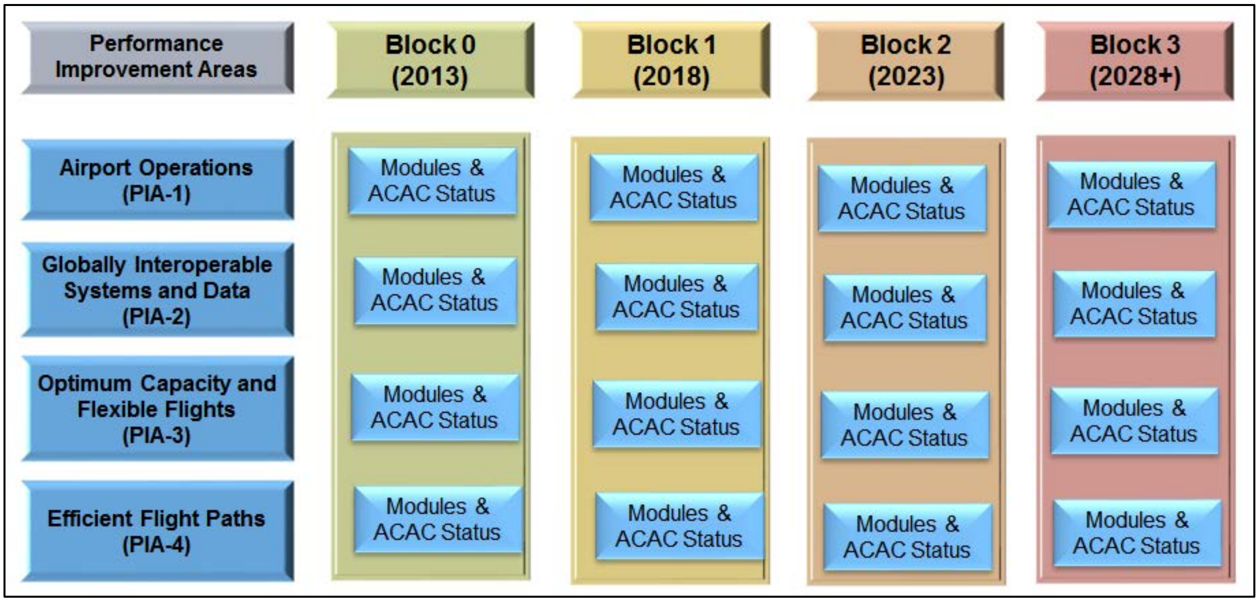


Figure 40: ACAC ASBU Comparison Format

The ASBU methodology includes 4 performance improvement areas:

PIA 1 - Airport Operations

PIA 2 - Globally-interoperable Systems and Data

PIA 3 - Optimum Capacity and Flexible Flights

PIA 4 - Efficient Flight Paths

Within each PIA contains the following modules:

PIA 1 - Modules include:

- APTA – Optimisation of Approach Procedures including Vertical Guidance;
- WAKE – Increased Runway Throughput through Optimised Wake Turbulence Separation
- SURF – Safety and Efficiency of Surface Operations
- ACDM – Improved Airport Operations through Airport-CDM
- RSEQ – Improved Traffic Flow through Sequencing
- RATS – Remotely Operated Airport Control

PIA 2 - Modules include:

- FICE – Increased Interoperability, Efficiency and Capacity through Ground to Ground Integration
- DATM – Service Improvement through Digital Aeronautical Information Management

- SWIM – Performance Improvement through the Application of System-Wide Information Management
- AMET – Meteorological Information Supporting Enhanced Operational Efficiency and Safety

PIA 3 - Modules include:

- FRTO – Improved Operations through Enhanced En-route Trajectories
- NOPS – Improved Flow Performance through Planning based on a Network-wide view
- ASUR – Initial Capability for Ground Surveillance
- ASEP – Air Traffic Situational Awareness
- OPFL – Improved Access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B
- ACAS – Airborne Collision Avoidance System Improvements
- SNET – Increased Effectiveness of Ground-Based Safety Nets

PIA 4 - Modules include:

- CDO – Improved Flexibility and Efficiency in Descent Profiles using Continuous Descent Operations
- TBO – Improved Safety and Efficiency through the Initial Application of Data Link En-route
- CCO – Improved Flexibility and Efficiency Departure Profiles – Continuous Climb Operations
- RPAS – Initial Integration of Remotely Piloted Aircraft into Non-segregated Airspace

The block upgrade modules are aimed at achieving a fully-harmonised global air navigation system. The Block Upgrade methodology allows each State to consider and adopt the modules appropriate for their operational needs. In this report we have followed the same methodology by assigning each State studied a categorisation of High, Medium or Low based on its current operational activity in the en-route environment; the density of operations based on total operations compared to the square mileage of the FIR and the activity at the major airports. This methodology supports the concept that “one size doesn’t fit all”. The gaps discerned in the high-density environments will ultimately have a greater impact on the efficiency of the entire region.

Likewise, gaps discerned in the low-density environments will have less impact on the region. Regardless of the current volume of operations in any individual FIR, there are best practices that all should strive to achieve in order to be prepared for the future. These are also included in this report.

Appendix G FIR Bottlenecks

The following illustrations depict the State provided bottleneck areas within their control jurisdiction. The RED stars indicate the constrained fix location and the RED arrows indicate the direction of the constrained flow(s).

Two of the States (Egypt and UAE) that have provided bottleneck data have had their constraints reviewed and initial analysis offered, in the case of (1) Egypt, notional options have been provided that could mitigate several bottleneck areas, and (2) UAE has its bottlenecks identified with several examples of its corresponding operational impact, along with the identification of ongoing efforts to redesign airspace and procedures.

Egypt: Northwest Flow over Cairo

(Data Date - September 28, 2016)

d) **What the problem is:** Workload and inefficiencies associated with the convergence and sequencing of multiple arrival (TO: HECA & HEAX), departure (FROM: HECA & HEAX), and overflight flows (FROM: OTBD, OMDB, OMAA, OMSJ, etc.), into a single flow of traffic through HECC (Sectors 1 & 2), only to then exit HECC airspace on divergent routes.

e) **Where the problem is:** The primary area of convergence exists between the airports of HECA and HEAX, as shaded in red, and as illustrated in Figure 41, however the effects of the primary area are realised as far away as 300nm east, and 200nm southeast as shaded in yellow. Figure 41 also shows graphical depiction of the affected flows and their visualised convergence impact. Table 41 depicted the affected route segment through the ANSP airspace.

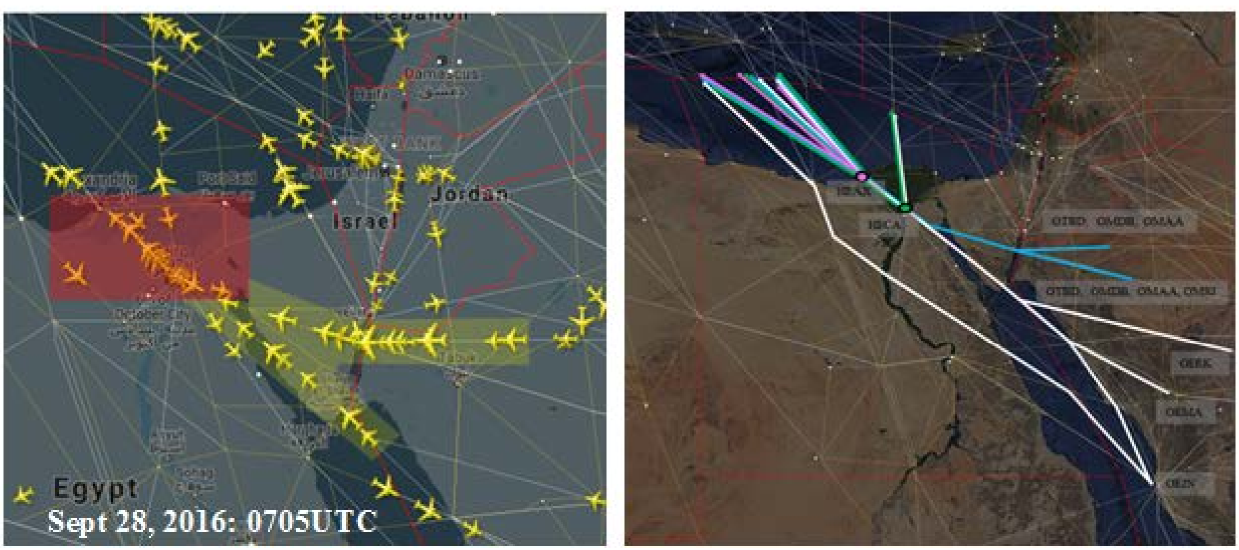


Figure 41: Egypt Traffic Convergence

Table 41: Affected Route Segments

Current Route Structure					
ANSP	**Affected Routes**	**Route Segments**	**ANSP**	**Affected Routes**	**Route Segments**
HECC	UL677	SHM..UL677..CVO	**OEJD**	UL550	OBNAK..UL550..KITOT
	A1-A727	CVO..A1(A727)..NOZ		N697-UN697	SOBAS..N697-UN697..KITOT
	A16	CVO..A16..RASDA			
	UL607	NOZ..UL607..PAXIS			
	UL617	NOZ..UL617..TANSA			
	A1	NOZ..A1..METRU			

f) **What States to be included**: As is typical with complex ATC operations in a highly dynamic region, while the primary constraint resides within a single ANSP – HECC, its solution requires the full support of its adjacent ANSP – OEJD, as listed in Table 42 and depicted in Figure 42.

Table 42: Affected States & Sectors

Affected: States/ANSPs/Sectors		
State	**ANSP**	**Sectors**
Arab Republic of Egypt	HECC	1,2,3,4
Kingdom of Saudi Arabia	OEJD	North, West

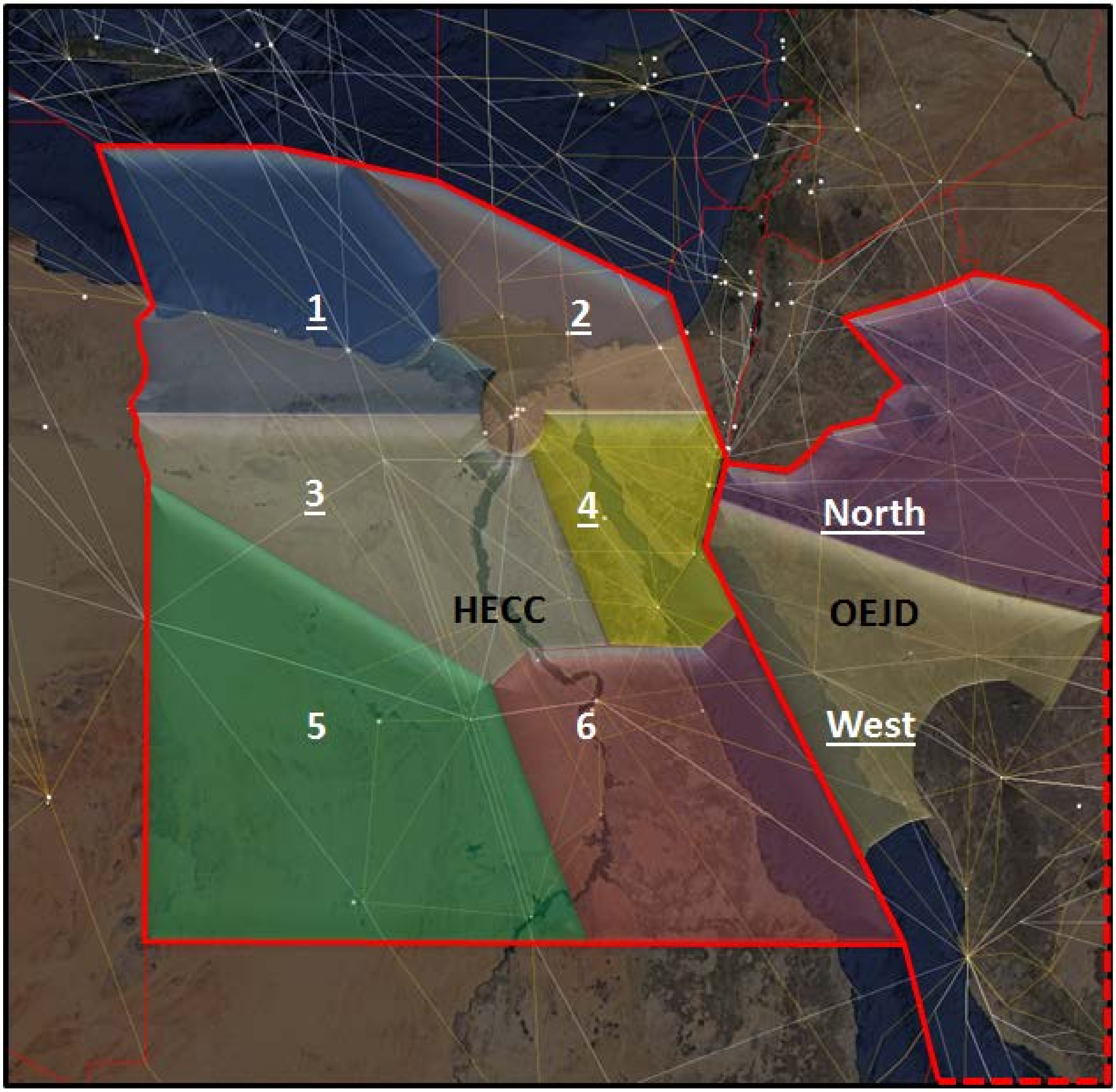


Figure 42: Illustrated Affected States & Sectors

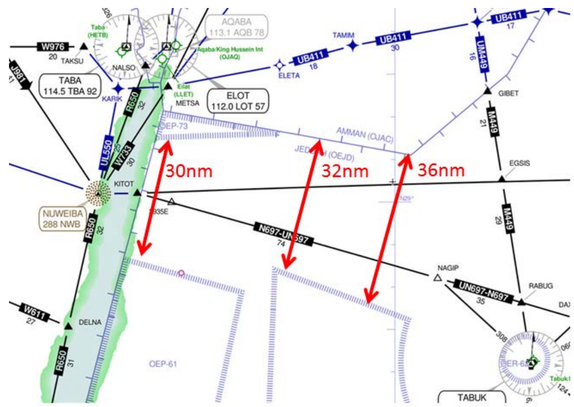
g) **What is the solution:** The solution consists of a multi-layered approach that would have the end state being the implementation of multiple parallel routes through the affected airspace without the need to engage in excessive sequencing, vectoring, and MIT restrictions. This would be accomplished by:

  i. Procedurally separating (via route structure) the flows of traffic by type of operation – arrival/departure traffic from overflight traffic

  ii. Then further procedurally separate (via route structure) overflight flows via designated routes to their regional destinations

The following figures, as listed in Table 43, illustrate (1) the overall route structure, (2) a series of the individual routes changes that comprise the overall structure, and (3) a graphic comparison of the revised structure to the current structure.

Table 43: Route Structure Depiction Description

Route Structure Depictions		
Figure #	**Description**	**Operational Comments**
Figure 43	Depiction of the entire route structure	
Figure 44	Depiction of the overflight structure for flights entering HECC from the east from OEJD with a comparison depicting the current operation	The available airspace to add a route between the volume of airspace bounded by: OJAC, HECC and OEJD (to include: OEP-73, OEP-61, & OER-79), indicates available airspace to insert another radar route. 
Figure 45	Departure structure from OEJN, OEMA, and OERK transitioning to (1) arrivals to HECA/HEAX, and (2) overflights to the north/northwest	
Figure 46	HECA northbound departures	Structure includes four (4) transition options to the overflight flows
Figure 47	HEAX northbound departures	Structure includes three (3) transition options to the overflight flows
Figure 48	New route structure depicted with: current sector boundaries (sector 1 & 2) and potential modifications	

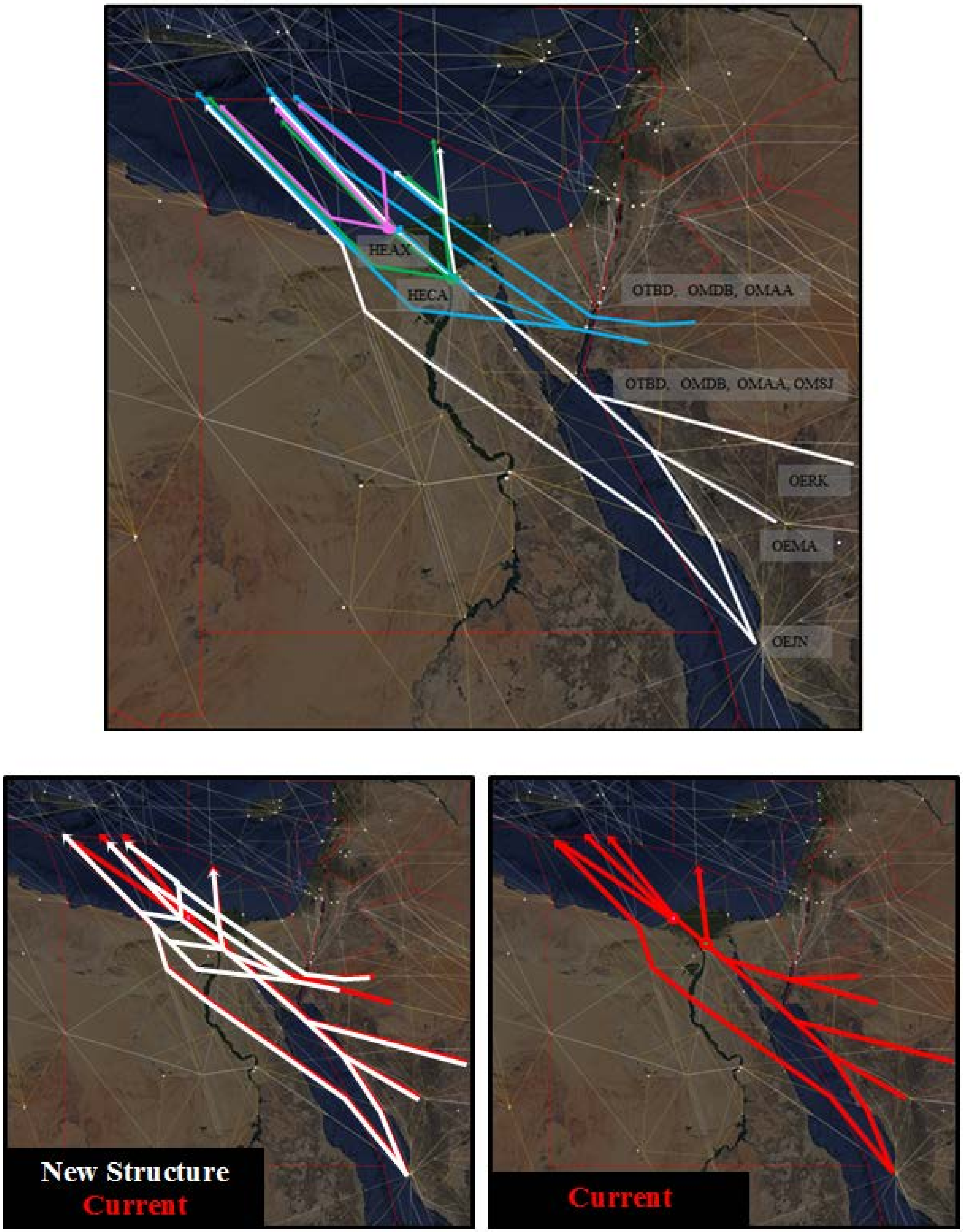


Figure 43: Complete Route Structure with comparison and overlay to current structure

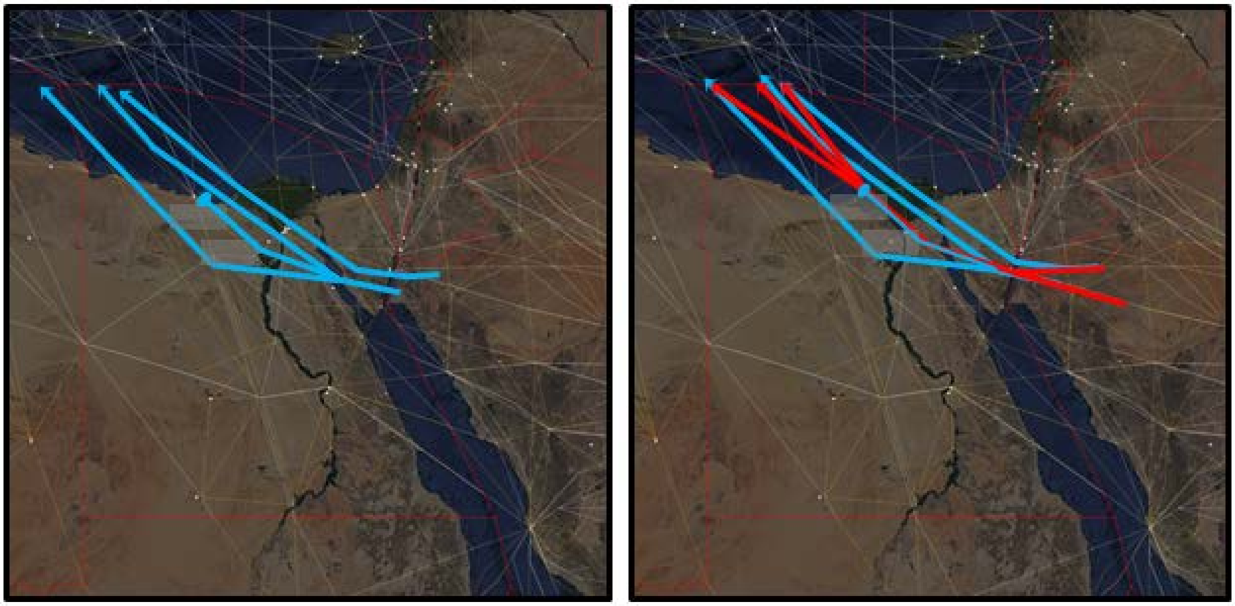


Figure 44: Overflight routes with comparison to current operation

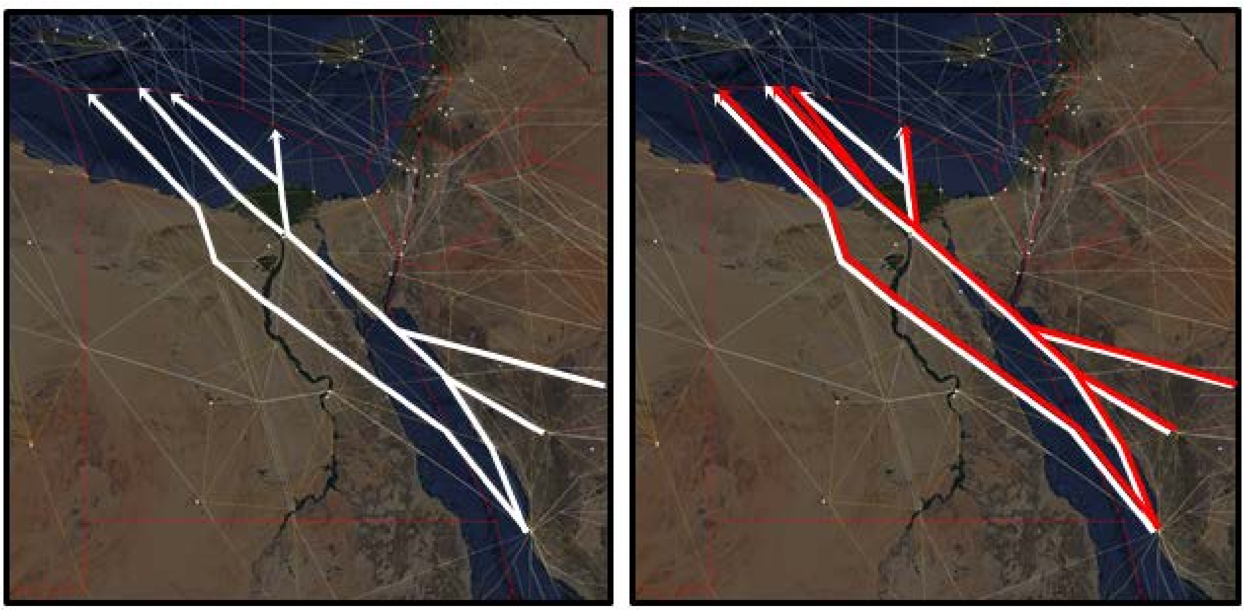


Figure 45: Saudi Arabia departure to HECA/HEAX and overflights with comparison

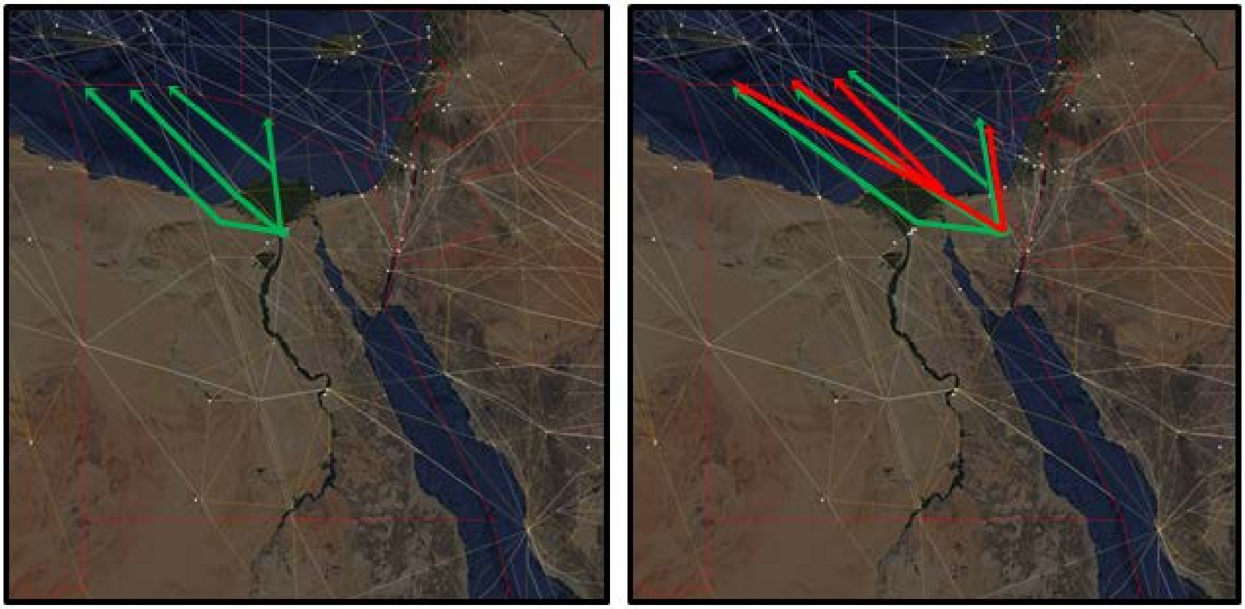


Figure 46: HECA departures and overflights with comparison

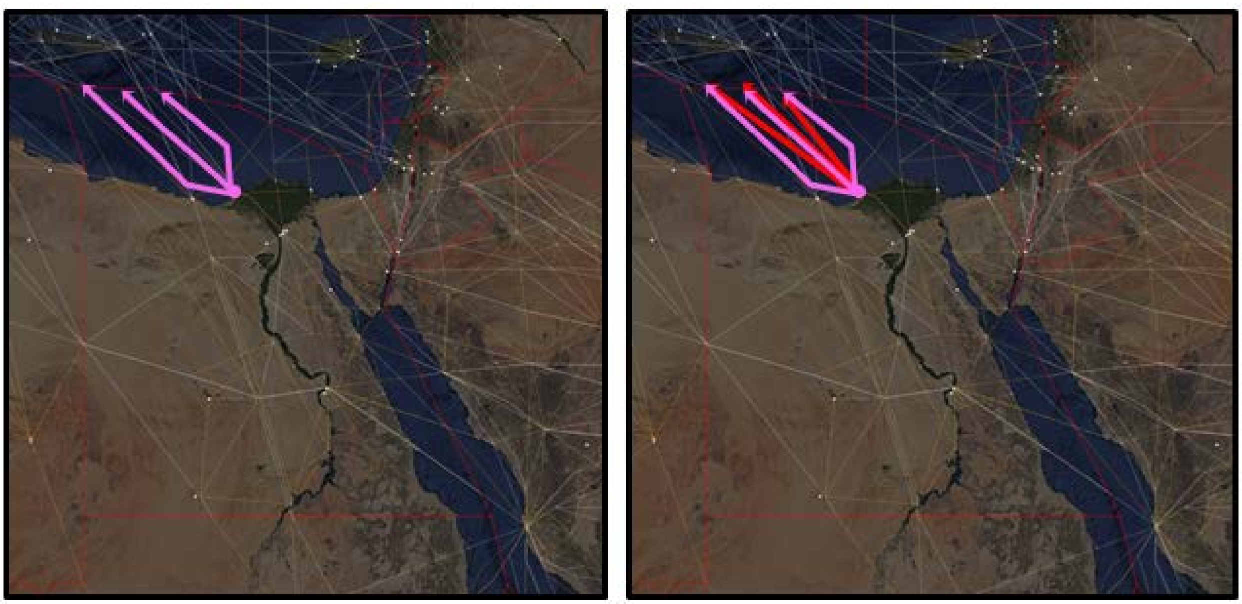


Figure 47: HEAX departures and overflights with comparison

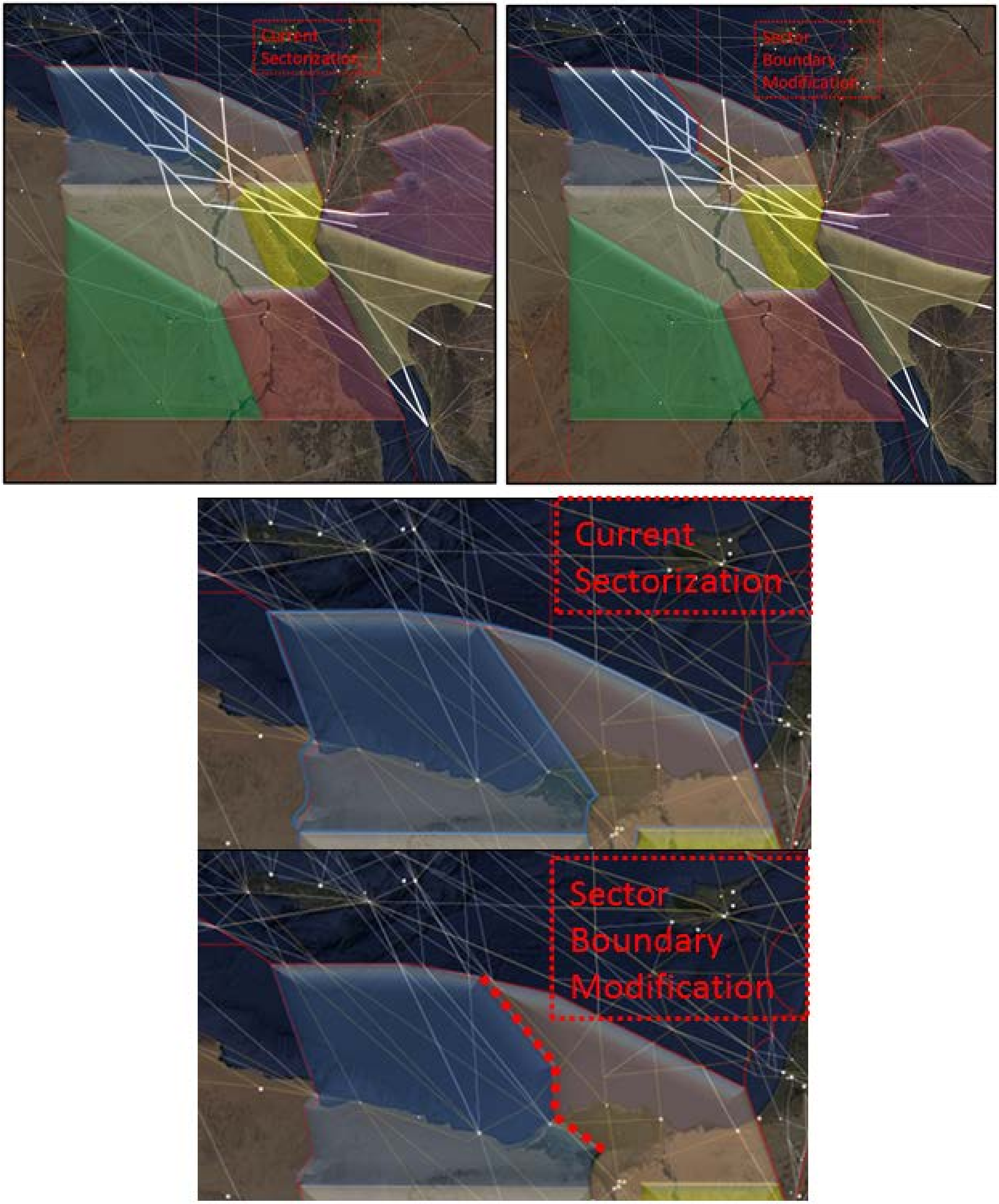


Figure 48: Current and potential Sector 1 & 2 sector boundary

h) **What problems would be mitigated:** A parallel route structure that deconflicts and significantly reduces sequencing will reduce workload and complexity, this should result in reduced: enroute spacing requirements, HECA/HEAX departure restrictions, inter-facility restrictions.

i) **What types of benefits to be expected:** The types of anticipated benefits would include:

   i. ATC operational benefits - would be immediately realised at the ATC level by reduced complexity and workload resulting from deconflicted routes and associated procedures.

   ii. Airspace utilisation - improvements would extend to improved airspace efficiency and possibly increased sector capacity values due to reduced workload.

   iii. Improved management - of capacity/demand imbalances resulting in better use of airspace capacity.

   iv. Reduced delays - would be realised with the probability of reduced restrictions between internal and external facilities.

   v. Operator predictability - provided by reduced delay causal factors in the airspace. Stakeholder confidence that regional airspace service is being optimally provided.

   vi. Transition - to new capabilities and facilitate being able to meet future aviation growth.

   vii. Environmental improvements - derived from less aircraft flight time, thus producing less environmental gas emissions.

j) **Implementation process:** Progressing an effort such as the route modification illustrated above would require a disciplined development approach that is defined and industry accepted and is inclusive of the airspace customers. Many world aviation organisations that provide air navigation service provision maintain their own planning documentation or have accepted others meeting their internal criteria. For this project the “Euro-Control Manual for Airspace Planning” [43] is a process manual that can be used. This product in particular follows the design principles as indicated in Figure 49. A project such as this could be accomplished in approximately 18-22 months from commencement.

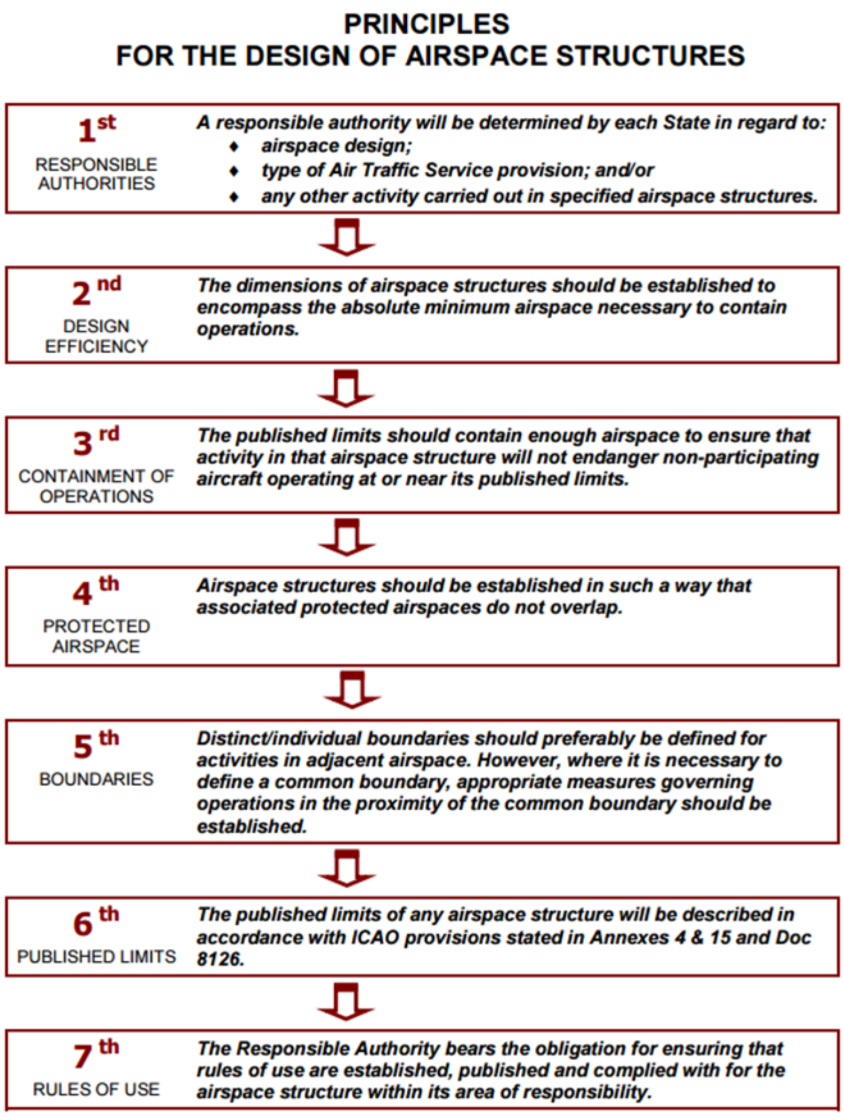


Figure 49: EuroControl Airspace Design Principles

k) **Consequences of non-implementation:** Operations certainly are expected to grow within the region, the importance and efficiency of this airspace to Egypt, its surrounding tier one regional States, and to adjacent tier 2 and 3 States is obvious, especially when linked to contingency planning that may suddenly require a hugely expanded demand for this airspace resource. Consequences of non-implementation include:

- Inefficiencies and delays with system-wide implementations
- Continued losses of capacity and perpetuation of delays, resulting in overall reduced operational efficiency and losses of potential revenue
- Wasted capacity and operational uncertainty increasing the potential for greater system saturation and for system errors

- Added stress factors to existing consistency planning
- Potential for exceeding controller capabilities to safely manage sector traffic
- Provide less than optimal use of the nation's available airspace

United Arab Emirates

UAE (Data Date - September 5, 2016)

Figure 50, Figure 51, and Figure 52 depict locations within UAE airspace where major traffic congestion causes bottlenecks to occur. These situations are further illustrated by flight trajectories captured via Flight-Aware© and Flight-Radar24© tracking technologies. These bottlenecks are the subject of an extensive and ongoing airspace redesign project that will mitigate their existence.

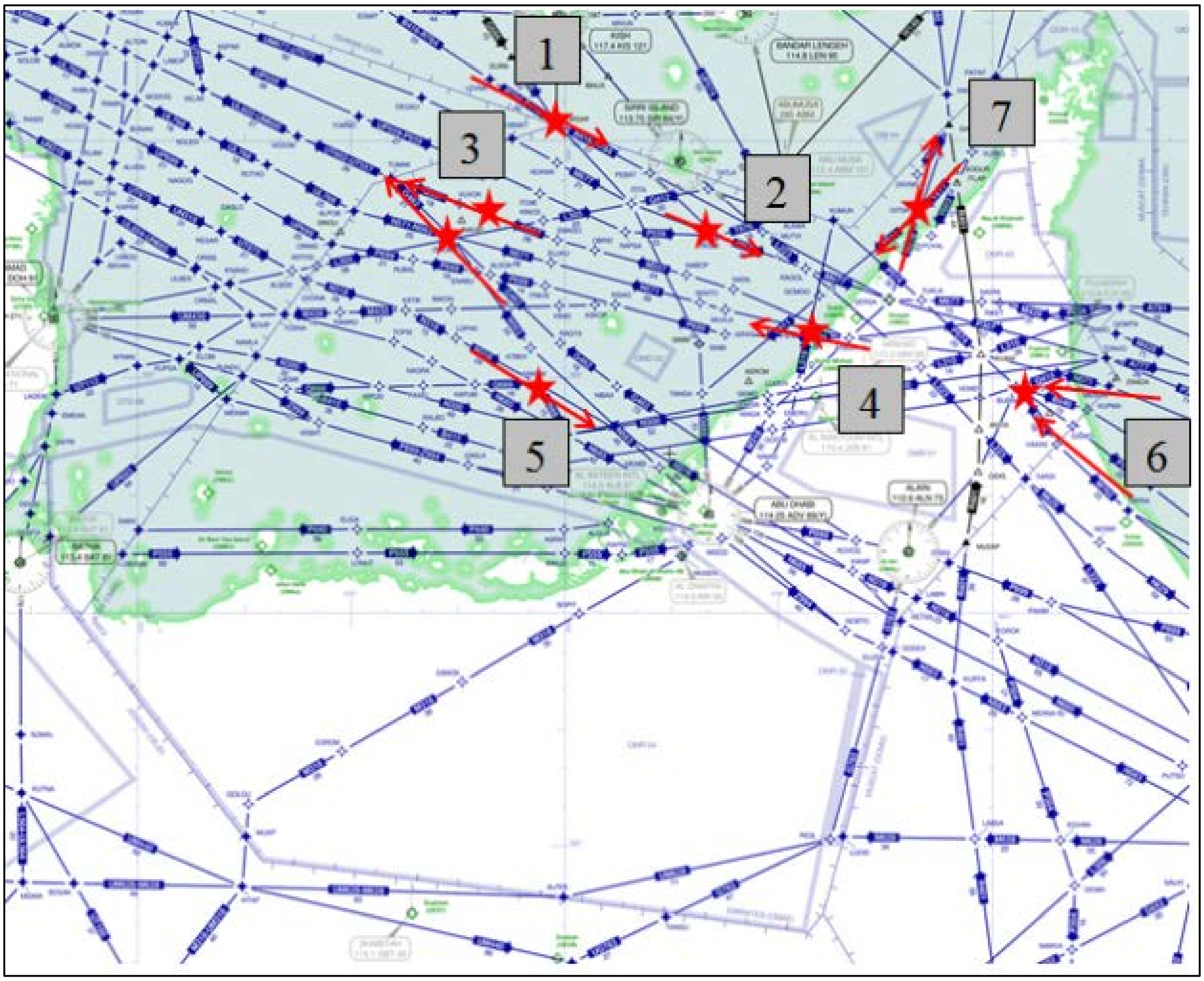


Figure 50: UAE Bottleneck Locations

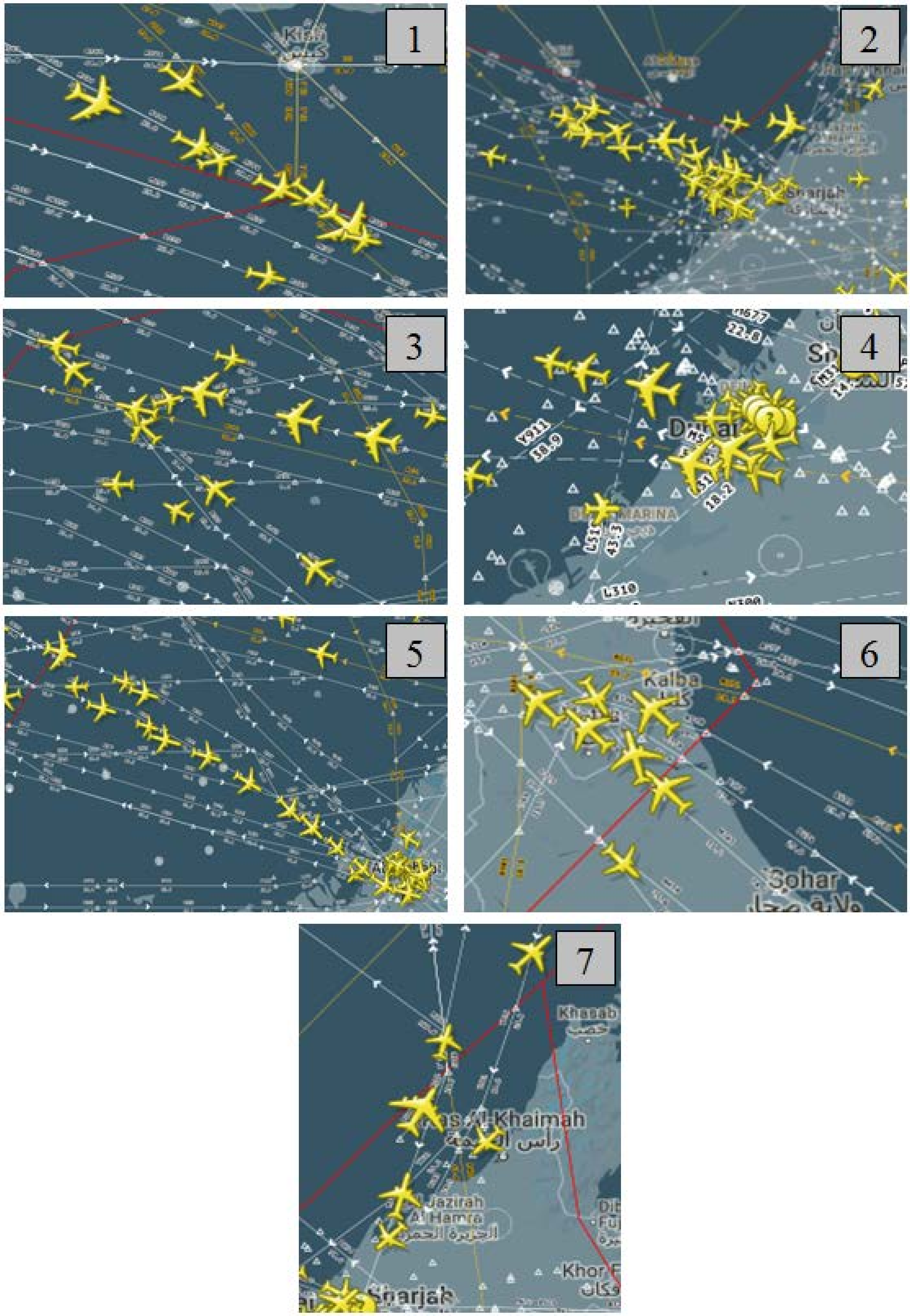


Figure 51: Illustration of Impacts Created by Bottlenecks

September 5, 2016, 15:35Z, OMAA Arrivals

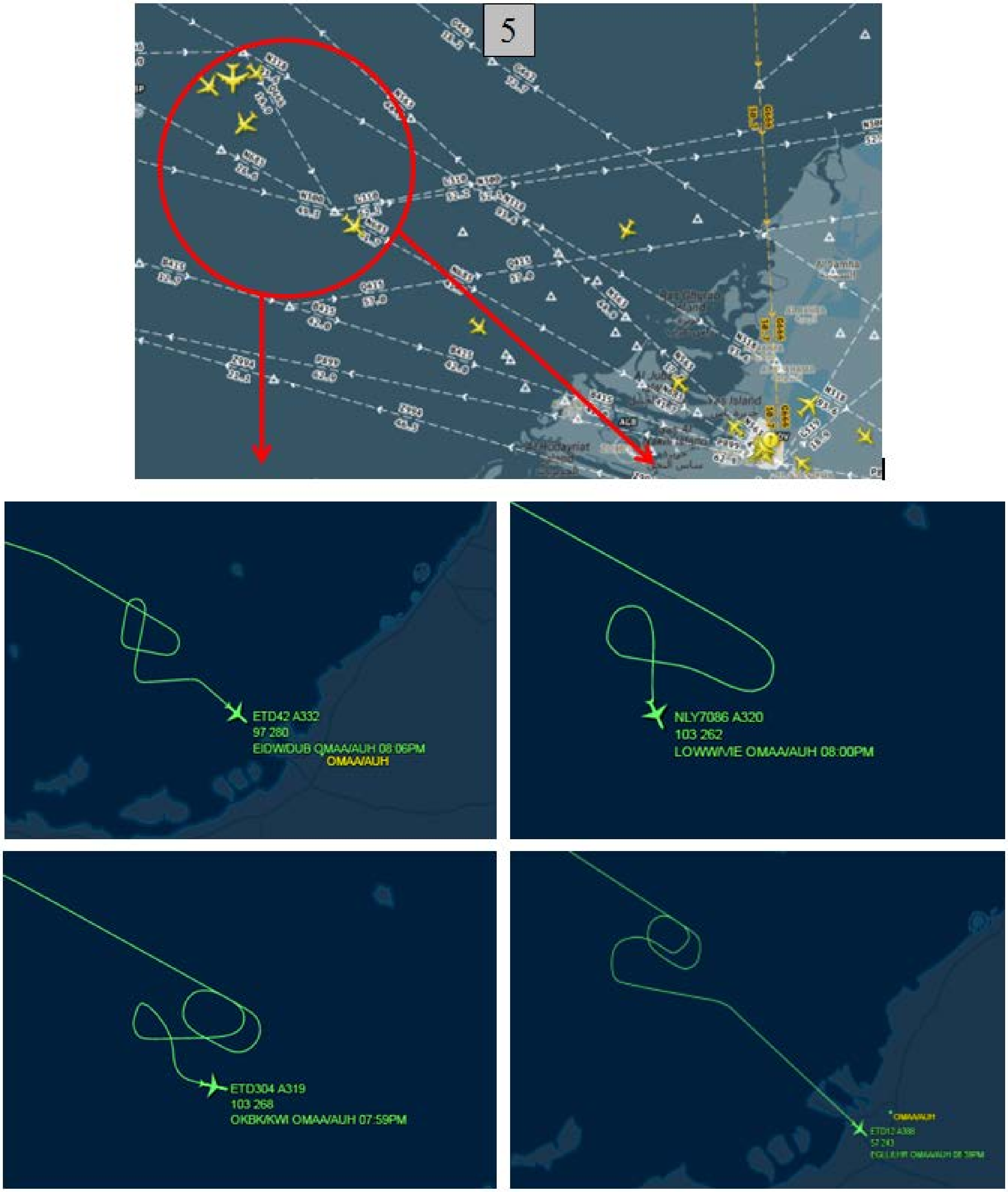


Figure 52: Expansion of Bottleneck Area #5

Bahrain

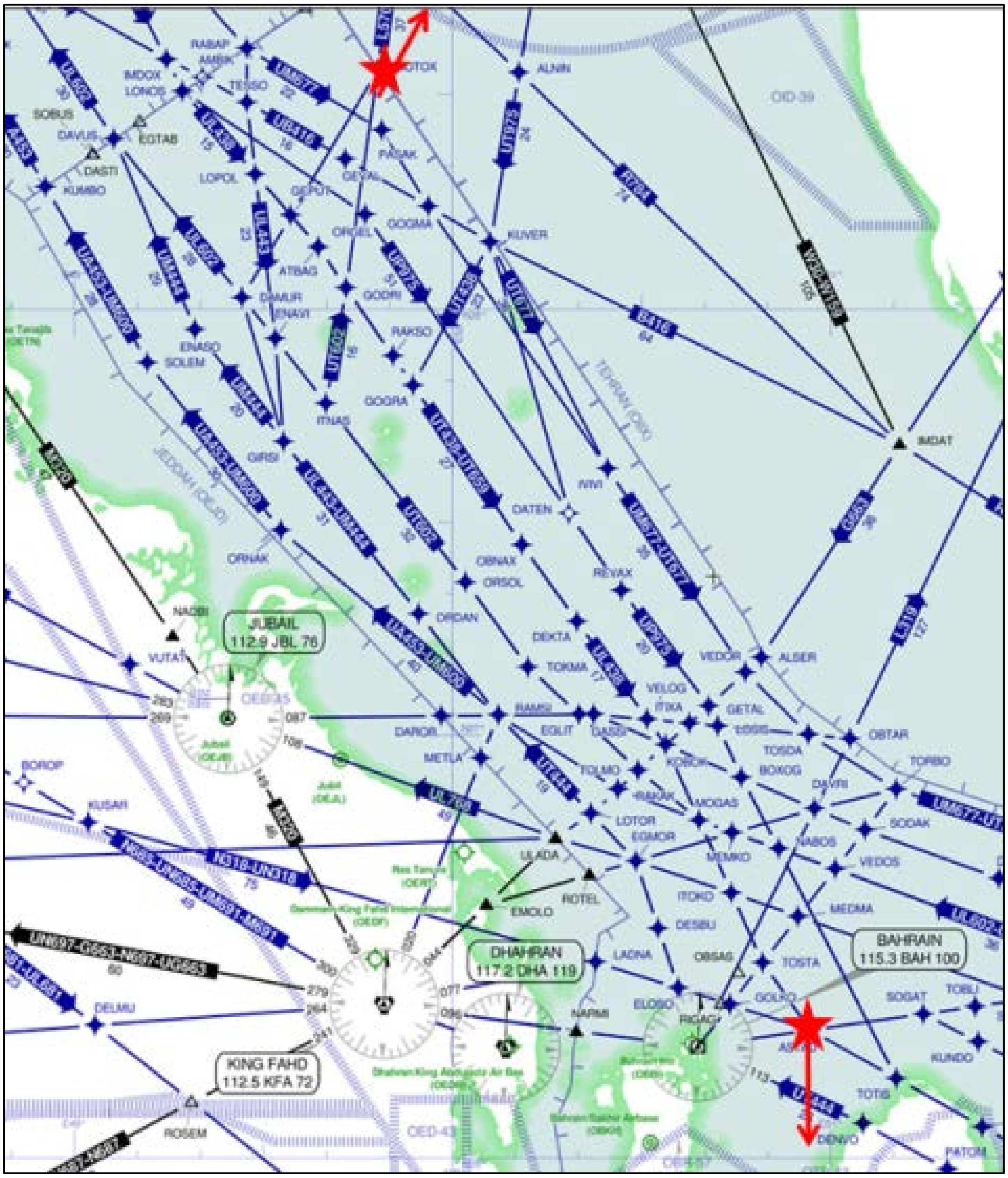


Figure 53: Bahrain Bottleneck Areas

Algeria

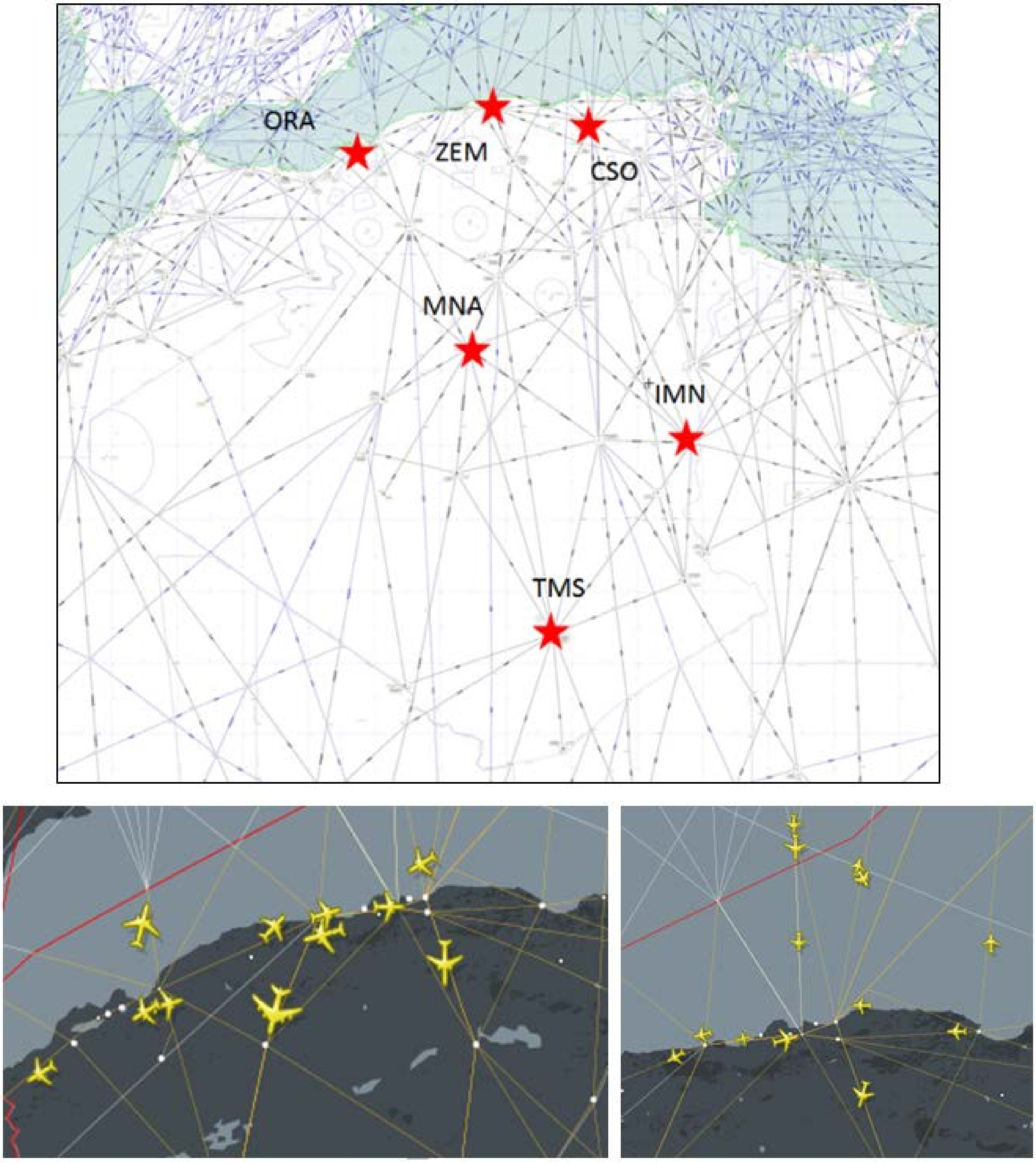


Figure 54: Algeria Bottleneck Areas

Oman

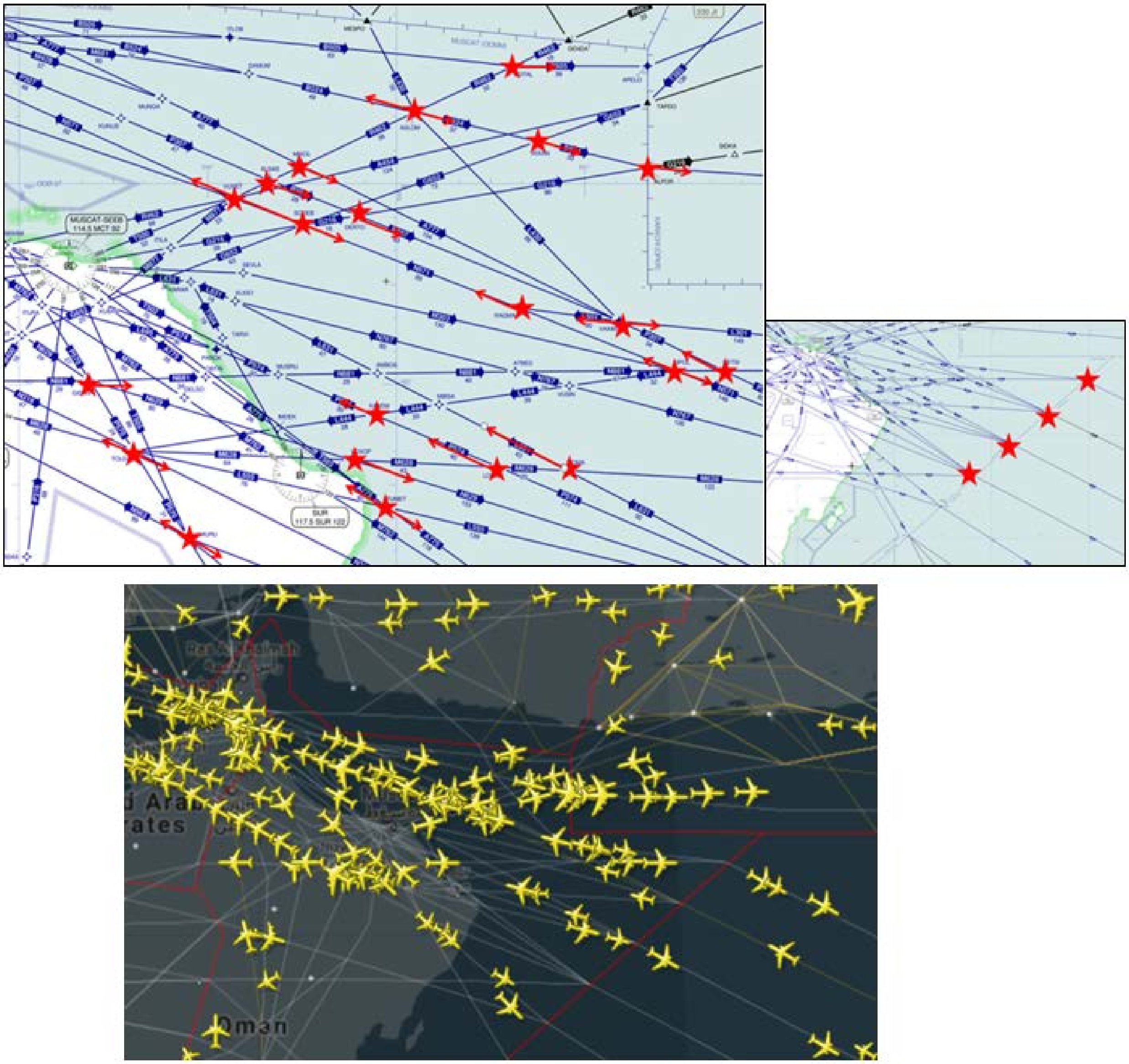


Figure 55: Oman Bottleneck Areas, data date 9/18/2016 0045Z

Lebanon

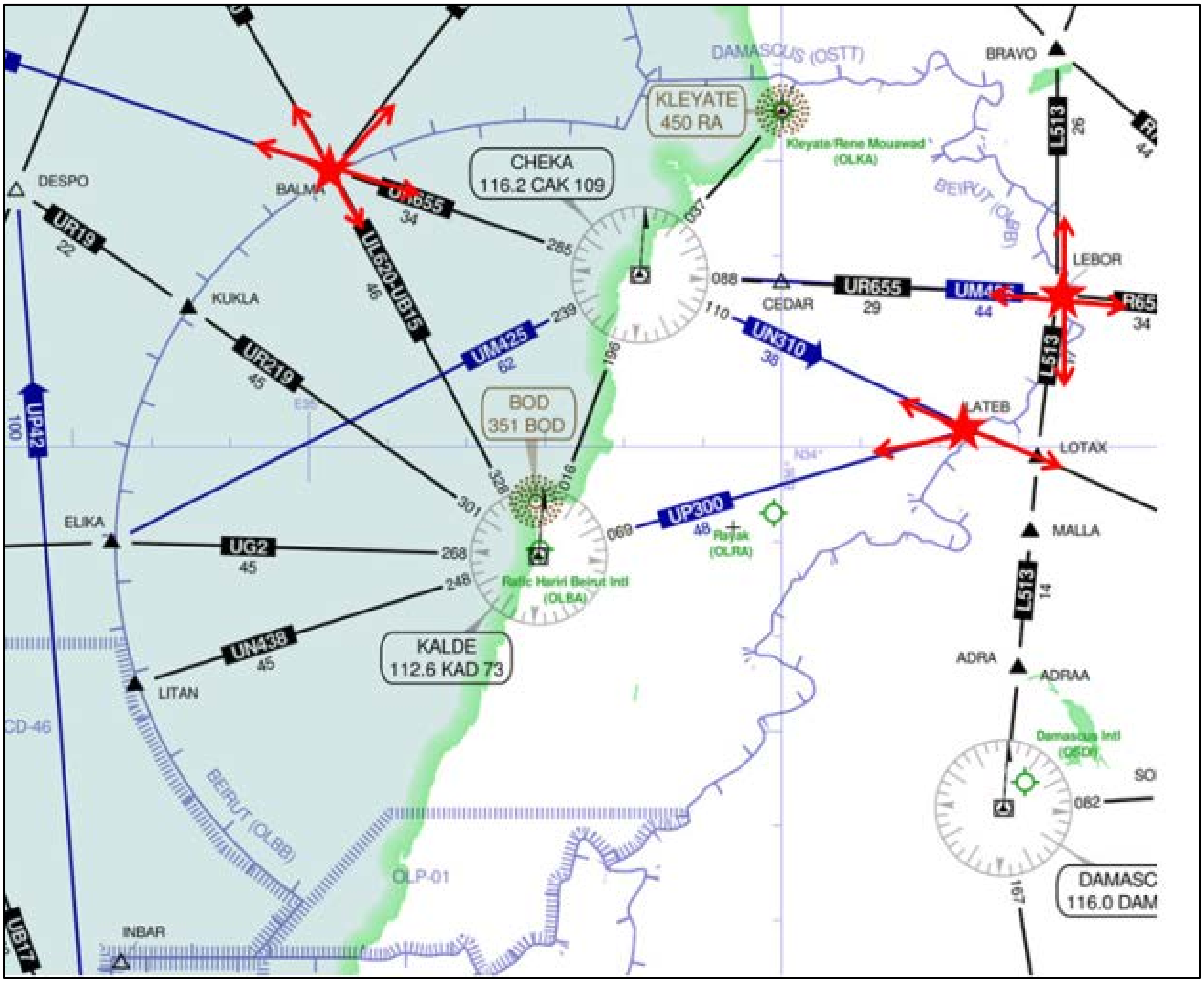


Figure 56: Lebanon Bottleneck Areas

Tunisia

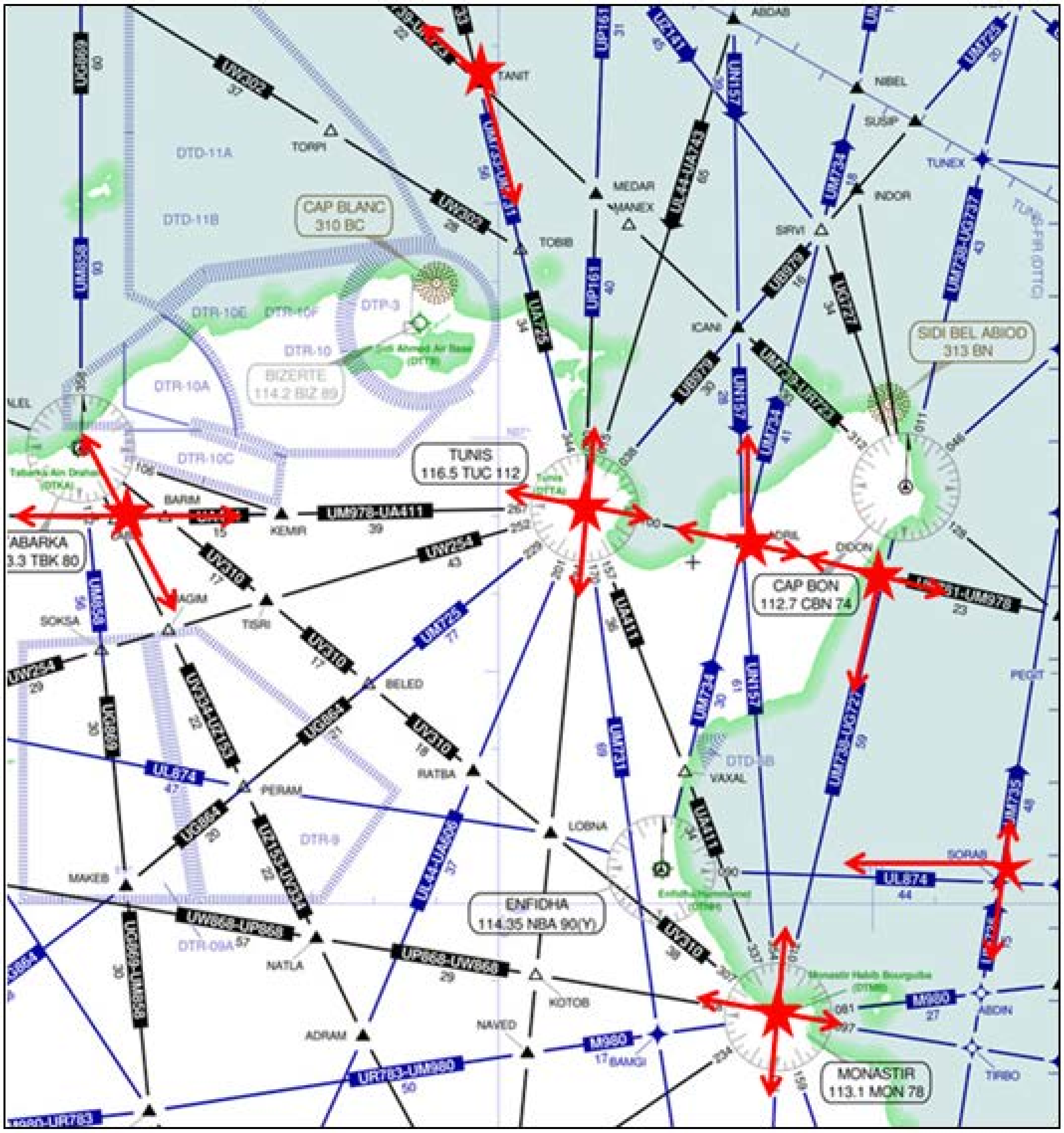


Figure 57: Tunisia Bottleneck Areas, data date September 19, 2016 1000Z

Mauritania

Although no specific locations were identified (via survey) as bottlenecks, survey indicated multiple route crossings are causing complexity issues, along with airspace design, volume, staff and equipment that do not meet mid-shift operations. The following bottlenecks in Figure 58 and Figure 59 were observed via flight trajectory replay web sites.

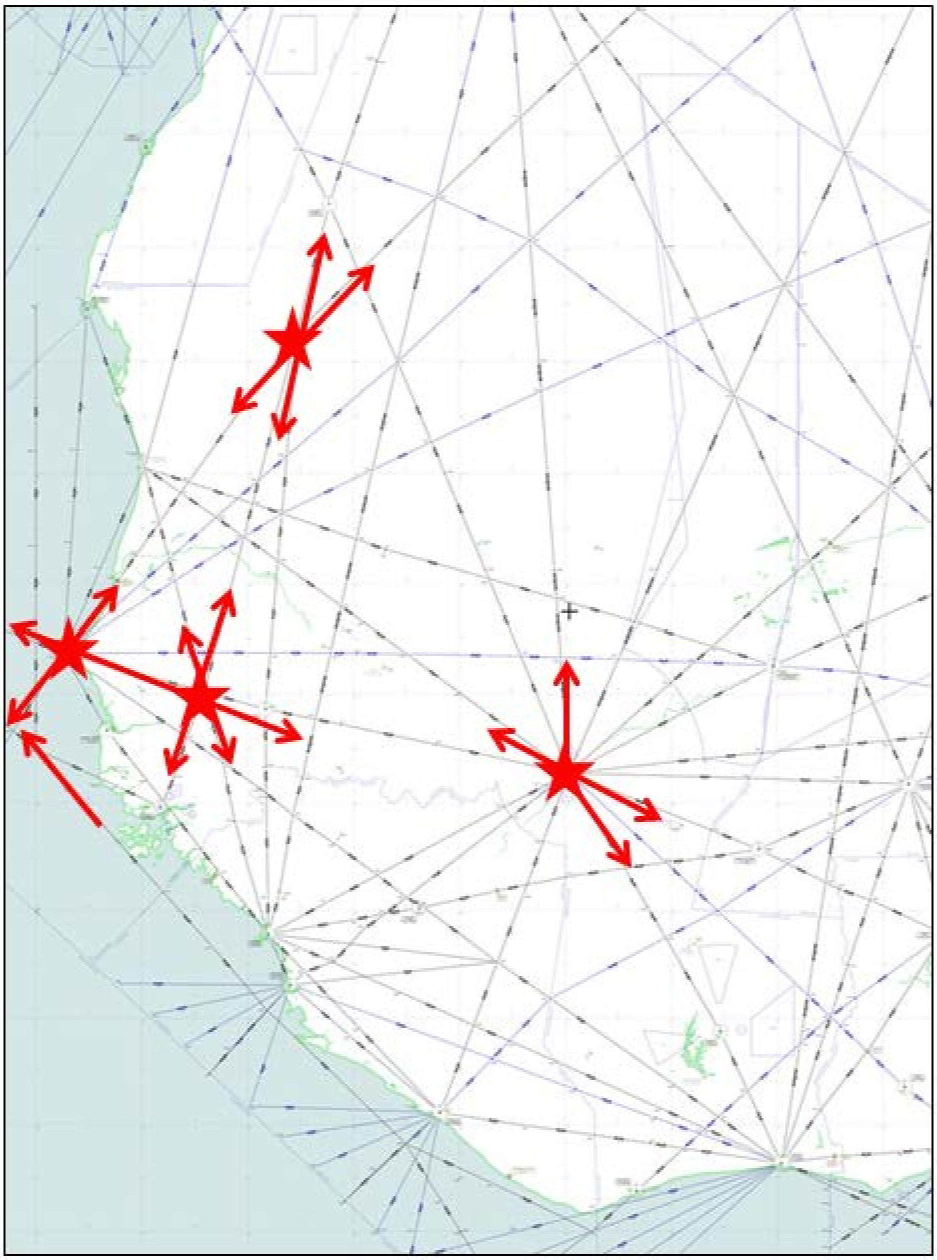


Figure 58: Mauritania bottlenecks (per flight trajectory replay web sites)

Saudi Arabia

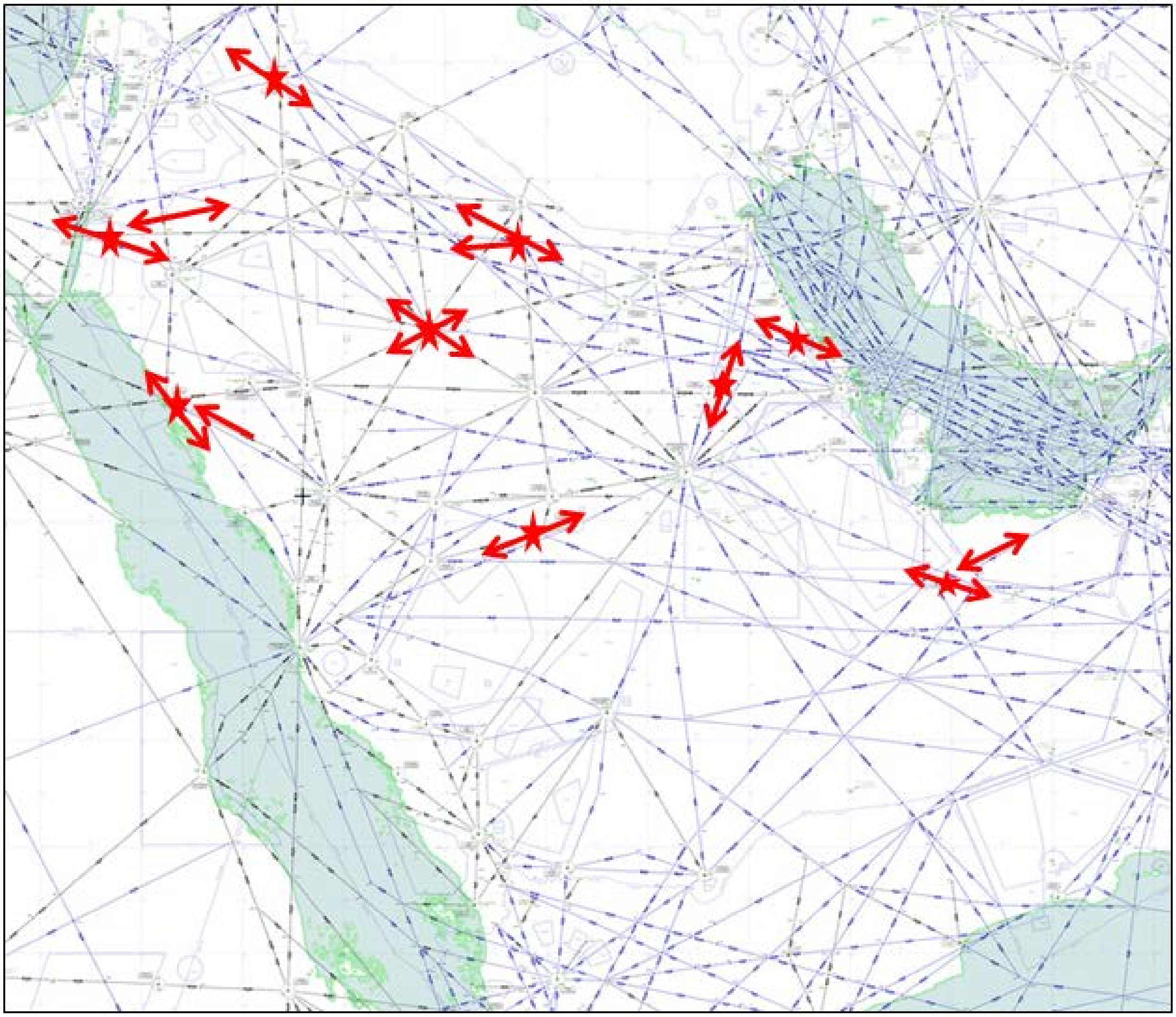


Figure 59: Saudi Arabia bottlenecks (per flight trajectory replay web sites)

Appendix H Air Traffic Flow Management Description

Regulating air traffic flow through the application Air Traffic Flow Management (ATFM) measures such as Ground Delay Programs (GDP) is a known and explored operational concept. Many States in the ACAC jurisdictional region and other regions understand the need for ATFM and have, or are planning to, implement domestic ATFM. However, harmonised Cross-Border ATFM implementation has yet to be widely explored or acted upon. Although specific information regarding cross-border coordination was limited in the provided study data, the Team is assuming that ACAC members recognise the urgent need and the challenges of implementing cross-border ATFM to address the imbalance of capacity and demand to ensure smooth flow of air traffic across the region through the principles of Air Traffic Flow Management based on *ICAO Manual on Collaborative ATFM (Doc 9971)*.

TFM applications can be accomplished using multiple approaches, such as (1) use existing ATFM frameworks that are operated fundamentally on a centralised management of air traffic flow which adequately addresses domestic ATFM needs, or (2) use an alternative framework solution using a decentralised distributed multi-nodal network system addressing both domestic and cross-border needs. A brief description and depiction of a distributed multi-nodal network system are provided.

The concept involves multiple ANSPs leading and operating an independent, virtual ATFM/CDM node supported by an interconnected information sharing framework. The flow of air traffic will be managed based on a common set of agreed principles among participating stakeholders. An ATFM Node comprising ANSP, ACCs, APCs, associated airports (Airport Traffic Control Towers [ATCTs]) and Airspace Users manages demand and capacity through adjustments in aircraft Calculated Landing Time (CLDT) which in turn determines the Calculated Takeoff Time (CTOT) issued to aircraft prior to departures from airports of origin. Balancing demand and capacity by the issuance of CTOT transfer the delay from the airborne phase of the flight to a ground delay, bringing significant benefits to all stakeholders such as reduced: fuel usage, airspace congestion, carbon emission and ATC/pilot workloads.

Airspace Users play a fundamental role in collaborative decision-making by specifying delay absorption intent and additional information regarding the flights indicating the capability of compliance to CTOTs. Additionally, ensuring up to date flight details are entered into the ATFM system, and being involved in the ATFM operations, Airspace Users will be able to receive advance CTOT information which will, in turn, allow for improved flight operations and optimisation of available resources.

Airport Operators, contribute to CDM by providing accurate and updated airport capacity and maximum allowable gate delay based on the airport's operational demand and capability to manage it. The maximum gate delay component could be considered in the appropriate issuance of CTOTs during ATFM implementation.

This concept has been developed for and is under operational trial in the several Asia-Pacific States encountering much the same operational constraints that are present within the ACAC jurisdictional operating region. This concept forms the most viable ATFM solution that can better manage the cross-border flow of traffic in Asia-Pacific region and should be considered for the ACAC region.

Figure 60 depicts a notional application of a virtual ATFM application in two Phases, where Phase 1 (depicted surrounding the **green circle**) would incorporate those key States that have a clear and immediate need for constraint mitigation, and a Phase 2 (depicted surrounding the **red circle**) where, at a later time, States with lesser than immediate needs would then participate.

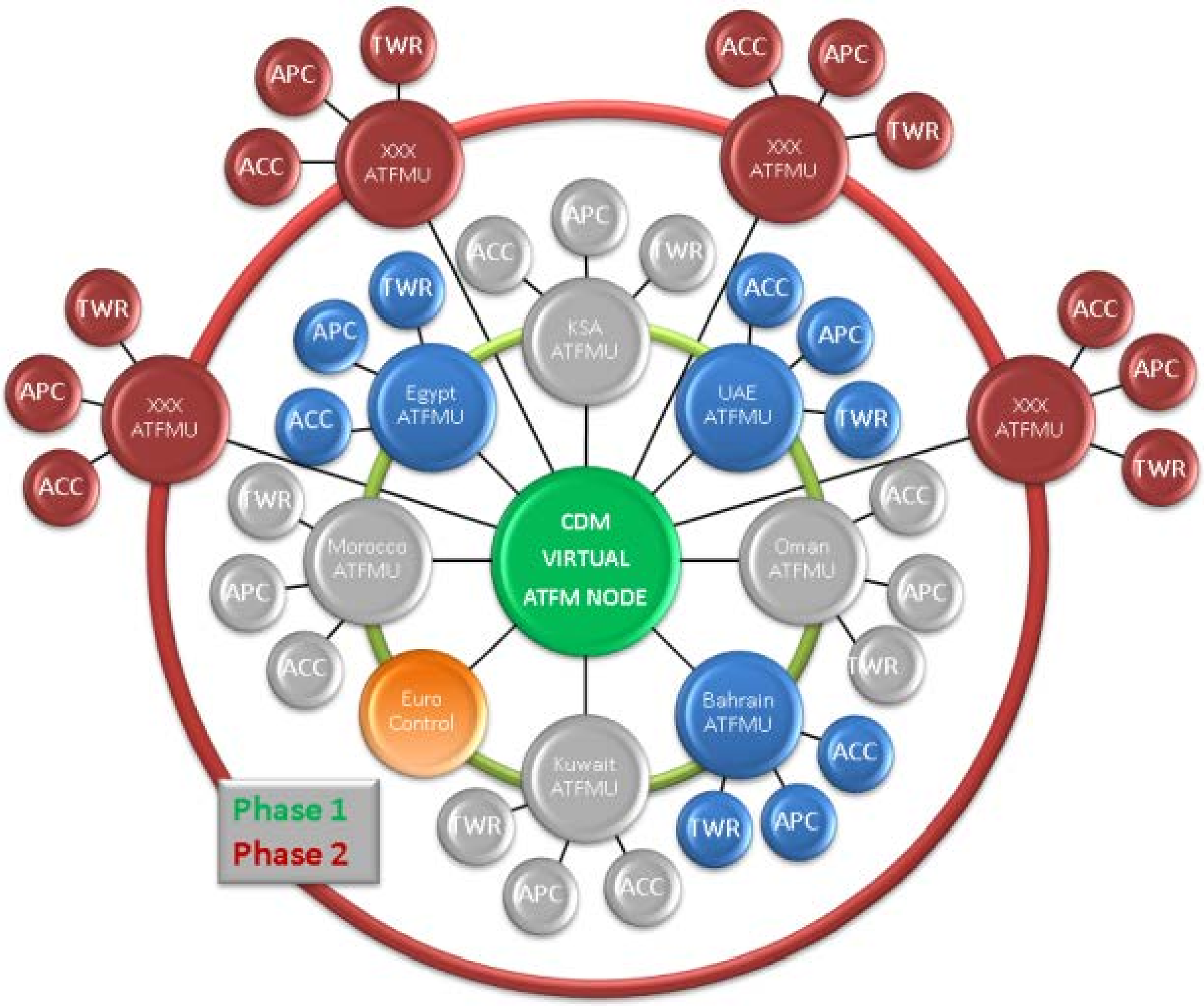


Figure 60: Phased Distributed Multi-Nodal ATFM Virtual Network

Appendix I Regional Fleet Mix

Table 44 (depicted over the next three pages) represents the regional fleet mix serving the ACAC jurisdictional airspace, depicting the types, numbers, and capabilities of the fleet.

Table 44: ACAC Fleet Mix

OPERATOR	A380-ALL SERIES	A350-ALL SERIES	A340-ALL SERIES	A330-ALL SERIES	A321-ALL SERIES	A320-ALL SERIES	A319-ALL SERIES	A310-ALL SERIES	B787-ALL SERIES	B777-ALL SERIES	B767-ALL SERIES	B747-ALL SERIES	B737-ALL SERIES	ATR-72-ALL SERIES	CRJ-900-ALL SERIES	DHC-8-ALL SERIES	E170-ALL SERIES	E190-ALL SERIES	E195-ALL SERIES	ERJ-145-ALL SERIES	ERJ175-ALL SERIES	FK50-ALL SERIES	Airline Total	FLEET AGE
AFRIQIYAH AIRWAYS						3	1																4	3-9
AIR ALGERIE				8							3		23	15									49	1-35
AIR ARABIA						35																	35	1-10
AIR CAIRO						7																	7	7-13
BADR AIRLINES													4										4	17-25
EGYPT AIR				11	3	7				7			22				12						65	4-34
EMIRATES	69		5	17						154													245	1-19
ETIHAD	4		11	32	9	25	2		5	33													121	1-24
FLY DUBAI													50										50	1-7
FLYNAS						25																	25	3-13
GULF AIR				6	6	16																	28	3-17

Regional Fleet Capability:	Modern	Series Dependent	Classic

Modern Capability Includes: FMS, FAN-1/A [2/B]: ADS, CPDLC, Satellite Communications (ACARS[VHF data link]) and Navigation (RNP))

ATC service enablers

OPERATOR	A380-ALL SERIES	A350-ALL SERIES	A340-ALL SERIES	A330-ALL SERIES	A321-ALL SERIES	A320-ALL SERIES	A319-ALL SERIES	A310-ALL SERIES	B787-ALL SERIES	B777-ALL SERIES	B767-ALL SERIES	B747-ALL SERIES	B737-ALL SERIES	ATR-72-ALL SERIES	CRJ-900-ALL SERIES	DHC-8-ALL SERIES	E170-ALL SERIES	E190-ALL SERIES	E195-ALL SERIES	ERJ-145-ALL SERIES	ERJ175-ALL SERIES	FK50-ALL SERIES	Airline Total	FLEET AGE
IRAQI AIRWAYS				1	2	3				1	1	2	12		6								28	1-23
JORDAN AVIATION						2					2		6										10	13-30
KUWAIT AIRWAYS			4	4		10				2		1											21	1-24
LIBYAN AIRLINES				3		3									2								8	1-7
MAURITANIA AIRLINES													3							1			4	11-19
MIDDLE EAST AIRLINES				4	2	11																	17	3-13
NILE AIR						4																	4	7-9
NOUVELAIR					1	7																	8	5-17
OMAN AIR				10					1				23								4		38	1-14
PALESTINE AIRLINES																						2	2	27-28

Regional Fleet Capability:	Modern	Series Dependent	Classic

OPERATOR	A380-ALL SERIES	A350-ALL SERIES	A340-ALL SERIES	A330-ALL SERIES	A321-ALL SERIES	A320-ALL SERIES	A319-ALL SERIES	A310-ALL SERIES	B787-ALL SERIES	B777-ALL SERIES	B767-ALL SERIES	B747-ALL SERIES	B737-ALL SERIES	ATR-72-ALL SERIES	CRJ-900-ALL SERIES	DHC-8-ALL SERIES	E170-ALL SERIES	E190-ALL SERIES	E195-ALL SERIES	ERJ-145-ALL SERIES	ERJ175-ALL SERIES	FK50-ALL SERIES	Airline Totals	FLEET AGE
QATAR AIRWAYS	5	5	4	35	8	39			23	48													167	1-15
ROTANA JEY							2													3			5	4-15
ROYAL AIR MAROC									2		4	1	37	5					4				53	2-23
ROYAL JORDANIAN				2	2	7	3	2	5										2		3		26	2-28
SAUDI			1	12	16	35				44		6									15		129	1-24
SUDAN AIRWAYS													1										1	22
SYRIAN ARAB AIRLINES						6								2									8	6-18
TASSILI AIRLINES													4			8							12	5-9
TUNISAIR				2		17	4						7	3	1								34	1-26
YEMEN AIRWAYS						2		2															4	5-25
Regional Totals	78	5	25	147	49	264	12	3	36	289	10	10	192	25	9	8	12	0	6	4	22	2	1210	

Regional Totals	1210
Regional Fleet Age	1-35

Regional Fleet Capability:	Modern	Series Dependent	Classic

Appendix J Findings & Recommendations Matrix

The same observation areas were used for both findings and recommendations. To foster traceability, both the findings and recommendations were mapped to the recommendation area and are listed in Table 45.

Table 45: Findings and Recommendations Matrix

Recommendation Area	Findings	Recommendations
ANSP Interoperability	1. Various individual air navigation service providers' (ANSPs) strategic planning efforts are advancing with insufficient adjacent ANSP acceptance and integration. 2. A common framework for increasing the level of cooperation in conducting accident investigations appears to be in development. There is no mention of a framework for increasing communications and cooperation for conducting other safety analysis. (PIA-3) 3. AIP data is not uniformly available across all ACAC Member States. (PIA-2) 4. There is no clear indication that standardisation, consistency, and uniformity practices exist in the development and application of Air Traffic procedures. (All PIAs) 5. CDM organisation and processes vary among the ACAC members, ranging from full and effective inter- and intra-agency participation to minimal participation. (PIA-3) 6. Insufficient effective procedures exist for the inter-facility coordination of traffic and constraint information to prevent oversaturation of operational sectors. As an example, in Gulf region FIRs where routine holding occurs, there are instances where inter-facility procedures	**Near-Term** 1. Establish a common framework for conducting internal safety analysis (PIA-3) similar to the work that has been done for external accident and incident analysis. For example, establish a common policy/template to be used as the mainstay of an internal and regional Quality Assurance process. The process should include goals such as a non-punitive self-reporting system (for the operator and ANSP), investigation guidelines, trend monitoring procedures, and a follow-up process that includes training and briefings for all personnel. 2. Implement a Region-wide joint aviation information responsibility that monitors, gathers and distributes AIP information to the member States and external interests. (PIA-2) 3. Encourage standardisation consistency and uniformity in the development and application of air traffic procedures wherever possible. (All PIAs) 4. Increase frequency and span of communications between adjacent FIRs. Focus on improving the capabilities and efficiency of operations within the region and between adjacent facilities. Work groups should be developed to

Recommendation Area	Findings	Recommendations
ANSP Interoperability Cont'd.	and responsibilities are not as thoroughly defined as they should be. (PIA-3) 7. Operational sectors become oversaturated, very often at predictable times and flows. (PIA-3) 8. Individual operating and support systems are not fully interoperable nor share common functionalities and flight data with adjacent FIRs. (PIA-2) 9. Current staffing levels at select facilities are inadequate for the required service provision, as illustrated in Table 28. 10. Geopolitical and security uncertainty (Lebanon, Libya, Iraq, Syria, and Yemen) are affecting ANSP interoperability, airspace and route usage, as indicated in Figure 25.	include operational and staff support level participants. (PIA-3) 5. Continue to move toward creating, strengthening, and revising existing agreements between adjacent FIRs. These agreements should incorporate: Holding responsibilities and procedures, and TFM techniques (e.g., off-loading traffic to lower density routes when tracks threaten to become saturated, dynamic airspace procedures). (PIA-3) **Far-Term** 6. If not currently under development, integrate various individual air navigation service providers' (ANSPs) strategic planning efforts into a Regional Airspace and ATM strategic plan. 7. Implement automation and decision-support systems, including meteorological, flight data and alert functions that are fully interoperable and integrated with functionalities that share data with adjacent FIRs. (PIA-2)

Recommendation Area	Findings	Recommendations
Airspace Policy & Procedures	11. Airspace design among ANSPs while generally effective for local operations do not always provide seamlessness with adjacent FIR airspace designs. (PIA-3,4) 12. Coordination procedures are limited to manual capabilities among many regional ANSPs. 13. Based on available information, existing and authorised ATC procedures are not being utilised to their fullest capabilities (e.g., radar separation, automated flight data transfer, visual separation). (PIA 1-4) 14. Sector designs are often based on legacy aircraft capabilities, and thus have become inefficient relative to modern aircraft capabilities and operator desires. (PIA-4) 15. PBN advancement in the en-route environment is continuing; however, there was no clear indication provided that these advancements are being extended beyond the local FIR boundary in an integrated effort. (PIA-1) 16. Significant changes to homogenous area traffic flows are expected that will have substantial effects on current airspace design and procedures as sequentially depicted in Figure 26. An example of a significant change to a homogeneous area in the ACAC Region is illustrated in	**Near-Term** 8. Ensure operational procedures and agreements contain handoff and transfer of control/communication points that are acceptable to affected facilities to avoid unplanned holding. (Best Practice) 9. Ensure operational procedures and practices within the FIR utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services within the FIR. (PIA 1-4) [This is both a near-term and far-term recommendation] 10. Establish sector structures that utilise common features that are agreed upon with adjacent FIRs (e.g., uniform altitude strata; matching boundaries, routing connections), beginning with high-altitude sectors. (PIA-3,4) 11. Develop and implement flight procedures and sector designs that foster continuous/optimised climb and descent to the maximum extent possible. (PIA-4) 12. Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed, continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation]

Recommendation Area	Findings	Recommendations
Airspace Policy & Procedures **Cont'd.**	Figure 27. 17. Insufficient data to determine the use of effective aircraft ground staging. (Training)	**Far-Term** 13. Base airspace access, procedural development, and flight prioritisation planning are on a shift in policy towards Best Capable–Best Served during congested periods, accommodating exceptions to that policy will reduce over time. (PIA-1,3) 14. Develop airspace plans to transition to a Performance-Based Navigation (PBN) airspace environment. Where plans have been or are being developed, continue towards implementation. (PIA-1) [This is both a near-term and far-term recommendation] 15. Ensure operational procedures and practices across FIR boundaries utilise existing technological and procedural capabilities to their full advantage. This will enable and assist in the movement towards a more seamless application of services with internal facilities and adjacent ANSPs. (PIA 1-4) [This is both a near-term and far-term recommendation] 16. To increase airspace capacity and efficiency, we recommend all States develop concepts and implementation strategies for: • Dynamic Airspace Management procedures to strategically mitigate airspace design, traffic volume, or other operational constraints affecting efficiency and safety. • Flexible Use of Airspace plans that will result in the transition to integrated civil-military airspace management.

Recommendation Area	Findings	Recommendations
Airspace Policy & Procedures Cont'd.		17. Expand SID/STAR usage and design to extend SIDs from the airport to top of the climb, and STARs from the top of descent to airport. 18. Identify locations where space-based ADS-B can be used to supplement current ground-based surveillance to enable full airspace surveillance.

Recommendation Area	Findings	Recommendations
Separation Standards	18. The application of separation standards exceeds the minimum standard required for the operational environment (i.e., using significantly increased values within and across ANSP boundaries). (PIA-3) 19. ATC conflict alert or conflict resolution advisory features are not available in all ANSP operating systems. (PIA-3) 20. There was no clear indication available to determine if there is an effective use of terminal aircraft ground staging. (training) 21. There was no clear indication available to determine if there is an effective use of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. (Training) 22. Based on available information, existing and authorised ATC procedures are not being utilised to their fullest capabilities (e.g., visual separation, parallel runway operations, and diverging departure headings.). (Policy and Training). (PIA 1-4)	**Near-Term** 19. At High- and Medium-activity airports, increase airport throughput via application of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. (Training) 20. At High- and Medium-activity airports and ACCs increase airspace capacity through the application of visual separation in the approach control and en-route environs. (Policy and Training) 21. At High- and Medium-activity airports increase airport throughput via application of diverging departure heading separation procedures for both same runway and parallel runways. (Policy and Training) **Far-Term** 22. Plan for and implement the transition of separation methods from human-centric tactical ATC-developed instructions to the use of ground and airborne automation decision support. (PIA-3) 23. Provide enhanced system monitoring and alerting of separation and spacing that supports multiple separation modes and standards between aircraft with trend analysis. (PIA-3) 24. At currently Low-activity airports that are forecasted to increase airport activity, improve airport throughput via the application of visual separation between arrivals on the same runway, arrivals to parallel runways, and arrivals from departures. Developing and training on these techniques in simulation training will help prepare

Recommendation Area	Findings	Recommendations
Separation Standards Cont'd.		for a future increase in traffic. (Policy and Training). 25. At currently Low-activity airports and ACC, increase airspace capacity via application of visual separation in the approach control and en-route environs. Developing and training on these techniques in simulation training will help prepare for a future increase in traffic. (Policy and Training).

Recommendation Area	Findings	Recommendations
Routing	23. Regional North Africa States have route structures that largely consist of single routes between city pairs and general en-route airspace overflights. 24. Regional North Africa route structures are largely based on conventional ground-based NAVAIDs, with limited RNAV routes, leading to route bottlenecks at NAVAIDs. 25. It is not uncommon for the North Africa ANSPs to have multiple routes converge into a single route at an adjacent FIR boundary fix—presuming a procedural requirement by that ANSP. NOTE: Finding is often consistent with the State's national boundary. 26. The use of full-time single direction routes could have a negative effect on the overall efficiency of the airspace and controller resources; this is most noticed in the Gulf Region States. 27. Regional Middle East States have route structures that largely consist of closely spaced parallel RNAV routes within the majority of their airspace. 28. Regional Middle East (KSA and Gulf States) route structures are largely based on RNAV capabilities. The major national airlines in the gulf region are bringing increased levels of technology and sophistication to their operations. Capabilities are being added to not only improve monitoring their flights but also to help manage the impacts of capacity limitations in the system. While	**Near-Term** 26. In High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., fast track/slow track capability. 27. Utilise single direction routes bi-directionally when operationally feasible. The development of additional routes offset from primary routes that would allow a fast track/slow of offload track capability is not evident. 28. Consider flexible point-to-point routing for high-altitude operations, to eliminate dog-legs common within the fixed route structure, except where structured routing is required. (PIA-3) 29. Develop or enhance existing Flexible Use of Airspace (FUA) procedures to provide allocation (joint use, shared use, separate use) of airspace based on tactical needs within the FIR. (PIA-3)

Recommendation Area	Findings	Recommendations
Routing Cont'd.	such investments lead to internal efficiency improvements, what is not evident are significant CDM procedures and technology to improve common situational awareness and share these data points between the operators, airports, and the ANSP. 29. If SAA is adversely affecting commercial operations, then there is an immediate need to develop and/or enhance existing Flexible Use of Airspace (FUA) procedures to provide an allocation of airspace based on tactical needs within the FIR. (PIA-3)	**Far-Term** 30. In Medium- and Low-activity areas where activity is forecasted to increase either within the FIR or on routes servicing High-activity areas, develop additional routes offset from primary routes to allow greater flexibility, i.e., a fast track/slow track capability. 31. Revise current route structures and develop new route structures to ensure that the routes are contiguous across FIR boundaries especially in North Africa connecting to Central & South Africa. 32. Consider development of a regional grid system that is formed through the definition of points created by the intersection of lines (latitude and longitude) from the Geographic Coordinate System onto a repeating matrix of regionally defined parameters, (i.e., an intersection every 30 seconds of latitude and every 2 degrees of longitude).

Recommendation Area	Findings	Recommendations
Contingency & Growth Planning	30. Several States have conducted a detailed analysis of operational position needs within each State through 2030, and are developing a plan to meet those needs with optimum effectiveness and efficiency. Growth planning is critical for continued safe and efficient operations; however, many States did not respond to this data request, and thus there is a great amount of uncertainty as to whether the regional as a whole is prepared to accommodate projected traffic growth. Figure 28 and Figure 29 respectively denote regional ANSP ACC Sector and APC Sector forecasts through the near- and far-term periods. 31. A determination could not be made if all regional facilities could ensure continuity of operations in the event of a system failure. NOTE: The UAE in particular, is fully capable to indefinitely sustain such an event. 32. From the reporting ANSPs, there are several significant facility expansion needs and planning through 2020 as indicated in Table 30.	**Near-Term** 33. Ensure contingency plans exist and include agreements with adjacent FIRs in the event of technical failures such as communication and/or surveillance. Conduct a vulnerability and risk assessment study to ensure a continuity of operations is provided should system failure(s) occur. 34. Ensure contingency plans for potential expansion of temporary and/or sudden geopolitical uncertainty or security constraints are in place. An example, as illustrated in Figure 33, shows the potential loss of overflight approval over Iran. This example would then result in immense volumes of traffic routing through Egypt, Jordan, Saudi Arabia, and the Gulf States (as outlined in green), requiring intense preparation and coordination to support air traffic operations **Far-Term** 35. Conduct detailed analysis of operational position (workstation) needs within each State through 2030 and develop a plan to meet those needs with optimum effectiveness and efficiency. 36. Establish collaborative constraint analysis processes to understand how projected annual traffic growth will translate to hourly time frames and airspace sector traffic levels.

Recommendation Area	Findings	Recommendations
Civil-Military	33. Limited data was submitted regarding the development of high-level agreements and plans that would result in a transition to integrated civil-military airspace management. (PIA 1-4) 34. Limited data was submitted regarding enhancing Flexible Use of Airspace procedures to provide an allocation of airspace based on tactical needs. (PIA-3) 35. While limited data was provided, through assumptions and involvement with the UAE Airspace Study, there does not appear to be Region-wide involvement in negotiations, for the provision of air navigation services and information sharing for the civilian use of SAA between representative parties of ANSPs, Military stakeholders, and commercial operators. (PIA 1-4)	**Near-Term** 37. Enhance Flexible Use of Airspace procedures to provide an allocation of airspace based on tactical needs, by developing high-level agreements and plans that will result in the transition to an integrated civil-military airspace management. (PIA 1-4) **Far-Term** 38. Develop and implement region-wide Enterprise Architecture for the provision of air navigation services and information sharing, including with the military. Establish processes to ensure common standards and requirements for air navigation service provision within each FIR. (PIA 1-4)

Recommendation Area	Findings	Recommendations
Airport Policy & Procedures	36. A determination could not be made regarding the routine use of mixed-use runway procedures when there are peak periods with higher numbers of arrivals or departures. (PIA 1,3)	**Near-Term** 39. At High-activity airports, routinely use mixed-use runway procedures when there are peak traffic periods with higher numbers of arrivals or departures. (PIA 1,3) 40. Review airport procedures and master plans to ensure they support minimising operations on runways for other than actual take-offs and landings. 41. Increase airport throughput and capacity through the application of global best practice procedures. For those airports where demand nears or exceeds capacity, leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1)
		Far-Term 42. Where airports are forecasted to increase operations, develop procedures and training plans to routinely use mixed-use runway procedures in the event there are peak periods with higher numbers of arrivals or departures. (PIA 1,3) 43. For those airports where demand is forecasted to exceed capacity, begin to develop procedures and training plans to leverage emerging best practices for wake turbulence by developing or revising separation standards. (PIA-1) 44. Develop daily planning actions to ensure that any project activities are coordinated with all stakeholders. This will ensure capacity and efficiency impacts are understood and mitigated to the maximum extent possible. (PIA-1)

Recommendation Area	Findings	Recommendations
Airport Physical Infrastructure	37. Airport planning project information was insufficient to reach a meaningful finding or identify a gap. 38. Based on current and forecasted airport demand, it is unsure from the data received that any accelerated planning and construction for rapid exit taxiways to be optimally located to minimise runway occupancy time for typical aircraft is underway. (PIA-1) At least one ANSP reported current inadequacy in runway, taxiway, gate, terminal and other airport infrastructure.	**Far-Term** 45. Ensure future airport planning projects are coordinated with all stakeholders to ensure capacity and efficiency impacts are understood and mitigated to the maximum extent possible. (PIA-1) 46. Based on current and forecasted airport demand, accelerate planning and construction of rapid exit taxiways to be optimally located so that they will minimise runway occupancy time for typical aircraft. (PIA-1)

Recommendation Area	Findings	Recommendations
TFM/CDM	39. Limited information was provided indicating the establishment of Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Generally, centralised ATFM functions do not exist within facilities. (PIA-3) 40. There appears to be insufficient identification and collection of metrics that can assist in capturing current performance data such as sector and runway capacity, which can aid in determining the need, cost, or benefit of procedure modification or development and equipment acquisition. (PIA 1,3) 41. Many reporting ANSPs did not indicate whether an implemented traffic situational display capability exists or is planned for ANSPs and stakeholders, including Airport Operators, which will provide a common situational awareness of aircraft within or destined for the FIR. (PIA-3) 42. In FIRs where routine holding occurs, data did not indicate planning for and implementation of time-based trajectory management. (PIA-3) 43. Many ANSPs have A/D/E-MAN capabilities; however, implementation of fully integrated capabilities of the systems has not been realised. (PIA-1) 44. No indication that enhanced departure constraint management capabilities exist which include tactical adjustments to flight levels, routes, and broad stakeholder substitution automation capabilities. (PIA-1)	**Near-Term** 47. Future traffic projections indicate there is a need for enhanced Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. 48. Where high traffic exists, establish Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Establish as an additional duty, ATFM procedures within FIRs of lower traffic density. Incorporate ATFM procedures into all ATC training programmes. (PIA-3) 49. Establish metrics that can assist in capturing current performance data such as sector and runway capacity, and delay statistics (i.e., minutes off-ground delay, taxi time, airborne holding, diversions reroutes, MIT / MINIT), which can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3) 50. Enhance departure constraint management capabilities, including tactical adjustments to flight levels, route assignments, etc. (PIA-1) 51. Reduce static ATC restrictions, such as those embedded in agreements and standard operating procedures, with more strategic and tactical traffic flow management initiatives, i.e., MIT and restrictions ‘regardless of altitude’, or multiple routes ‘as one’. (PIA 1,3) 52. Establish Collaborative Decision Making (CDM) capabilities and processes for exchanging strategic and

Recommendation Area	Findings	Recommendations
TFM/CDM Cont'd.	45. Many static MITs exist within the region that appear to be embedded in agreements and standard operating procedures additionally; some MIT restrictions appear to be "regardless of altitude" restrictions. (PIA 1,3) Table 31 depicts those State flow restrictions that were provided. 29. There is limited indication that CDM processes are utilised for flight plan and trajectory information exchanges. Examples of the types of situations where CDM would provide opportunities for improved efficiency and situational awareness: (PIA-3) a. It could not be determined if information or data to indicate capabilities and processes for exchanging strategic and tactical information and decision-making are available between the ANSPs and stakeholders. (PIA-3) b. It could not be determined if regional CDM processes existed to disseminate the information collected in (a) above to affected stakeholders. 30. No data supplied or other information indicates airports of major demand airports have established process for the automated substitution of slot times between stakeholders. (PIA-2)	tactical information and to enable decision-making between the ANSPs and stakeholders. (PIA-3) 53. Establish CDM processes for making tactical decisions to adjust pre-departure flight trajectories to aid in minimising demand-capacity imbalances. (PIA-1) 54. Where demand requires it, establish a process for the automated substitution of slot times between stakeholders. (PIA-2) **Far-Term** 55. Where needed, enhance Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. (PIA-1) 56. Plan for and implement flight plan and trajectory information capabilities for ANSPs and stakeholders that support both strategic and tactical CDM. (PIA-3) 57. Implement traffic situational display capability for ANSPs and stakeholders, including Airport Operators, which will provide a common situational awareness of aircraft within or destined for the FIR. (PIA-3) 58. In FIRs where routine holding occurs, plan for and implement time-based trajectory management. (PIA-3) 59. In anticipation of changes to the homogenous areas based on forecasted traffic levels develop and empower multi-national ANSP work groups from the affected areas to identify and design changes in procedures and airspace that are necessary to accommodate the flows of traffic. Design characteristics would include:

Recommendation Area	Findings	Recommendations
TFM/CDM Cont'd.		• Equipment and automation requirements • An effect on local operations • Coordination and communication with tier 2 and 3 facilities • Strategic and tactical planning documentation changes • Identification of regional support to affected ANSPs • Greater involvement and coordination with regional stakeholder support organisations (i.e., ACAC, flight operators)

Recommendation Area	Findings	Recommendations
Technical & Administrative Expertise, Proficiency, and Training	48. From a regional perspective, there are insufficient numbers of trained and experienced procedure designers. [27] 49. For those States that have procedure designers, there is often insufficient design work or refresher training to attain or maintain adequate proficiency. [27] 50. Regionally there is a lack of airspace and procedure training covering the following required training concentrations: initial, OJT, and recurrent. [27] 51. There is a lack of skilled expertise to effectively integrate procedure design with airspace development and to then perform an appropriate quality assurance assessment/report. [27] 52. There is a lack of skilled expertise to oversee the process leading to procedure documentation. [27]	**Near-Term** Based on review of regional charters for various current projects affecting operation and administration (ARNOP, MID FPP, NCLB, VTC, RSOOP), our findings support the following initiatives: 60 - 64 60. Provide full support to the MID Flight Procedure Program (MIDD FPP). Projects assists States in developing sustainable capabilities in instrument flight procedure (IFP) design, PBN airspace design and PBN OPS approval, including regulatory oversight. The objective is to meet State commitments under Assembly Resolutions A37-11 for Performance Based Navigation (PBN) implementation and the regional requirements, and comply with ICAO provisions related to flight procedure design and PBN. [27] 61. Provide full support to the Virtual Training Centre project that will support staff training activities. [31] 62. Develop or improve training programmes for procedure and airspace designers. A formal training programme will ensure consistency in procedural development. (Training)

Recommendation Area	Findings	Recommendations
Safety	53. The region is advancing under the guidelines established in the Global Aviation Safety Plan, utilising the USOAP protocols and audit procedures to monitor and judge compliance with global indicators and targets. 54. The ICAO world member States safety audit result is at 63%, the ACAC geographic Africa State average is 49%, and the Middle East geographic State average is 68% (based on August 9, 2016, data). 55. The ACAC Africa geographic States have largely met (Tunisia, Sudan, Morocco, and Mauritania) the 2012 Africa Ministerial target of a 60% Effective Implementation target by 2017, three States have not and may not by 2017 (Libya, Egypt, and Algeria). 56. Six of the ACAC Middle East geographic States (the UAE, KSA, Kuwait, Oman, Bahrain, and Qatar) exceeded the ICAO world safety audit average of 63% Effective Implementation. Three States (Syria, Jordan, and Lebanon) are within a range of ~53-60% Effective Implementation, while no data is available for Iraq, Syria, and Yemen. There was insufficient data to determine if a Ministerial target is in place for the Middle East geographic area. 57. As the majority of ACAC Member States have attained Effective Implementation of more than 60%, and other States approach that benchmark, they will be required to begin the development and implementation phase of the State Safety Programmes, an area in which virtually all the MENA States require assistance. 58. Critical Element 4 (technical staff and qualified	**Near-Term** 63. Provide full support to the No Country Left Behind (NCLB) Initiative, whose objectives are assisting States in enhancing their oversight capabilities through conducting ICAO assistance missions to States, providing required training—particularly the Government Safety Inspector courses, and supporting the certification of international airports. [27] 64. Provide full support to the Regional Safety Oversight Organisation Project (RSOO) whose core objective is to assist member States in meeting their safety oversight obligation. [30] 65. Consider an engagement process with Agência Nacional de Aviação Civil (ANAC), European Aviation Safety Agency (EASA), the Federal Aviation Administration (FAA), and Transport Canada Civil Aviation (TCCA) for expansion of and inclusion in the Certification Management Team (CMT) established May 2016. The CMT oversees and manages collaboration efforts to permit the development and implementation of regulatory and policy solutions common to certification issues and support greater harmonisation of systems. CMT strategic focus areas are (1) Partnership Leveraging, (2) Continued Confidence Building, (3) Global Leadership, and (4) Certification Policy Alignment. [38]

Recommendation Area	Findings	Recommendations
Safety Cont'd.	training) and Critical Element 8 (resolution of safety concerns) represent the lowest ACAC Regional Effective Implementation values at 44% and 55%, respectively. 59. It is uncertain, but likely, that the number of Regional Aviation Safety Groups (3 – EUR, AFI, and MID) responsible for geographic and administrative ACAC jurisdictional States may have a constraining regional impact on the development, coordination, data collection and implementation of ACAC regional safety enhancements. 60. Geopolitical and safety uncertainty within the region has resulted in several ACAC jurisdictional ANSPs (Iraq, Libya, Syria and portions of Yemen) being included in the highest level (Level 1) risk classification as identified in the Flight Service Bureau [3] Airspace Safety Risk Classification publication. Other ACAC State ANSPs are identified at a lesser risk classification. 61. Recognised in the *ICAO Safety Report 2015* is the United Arab Emirates (UAE) for significant contributions in improving the coordination of accident and incident investigation activities in the ACAC Member States. Holding workshops in 2012 and 2013 and attended by representatives from Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, and the UAE, led to the establishment of the Middle East and North Africa Society of Air Safety Investigators (MENASASI), affiliated as a regional chapter of the International Society of Air Safety Investigators (ISASI), whose goal	

Recommendation Area	Findings	Recommendations
Safety Cont'd.	is to promote cooperation and to act proactively in establishing cooperation in air accident investigation across the Middle East and ACAC Member States [4].	

Recommendation Area	Findings	Recommendations
Other Dynamics	62. The capabilities of the regional training organisations are constrained by the differences of regulatory requirements for recognition of credits, certificates, diplomas, or degrees among ACAC Member States.[5] 63. Of the ACAC study States, only Mauritania has made formal arrangements to develop a Memorandum of Agreement (MOA) for ConOps development with the space-based ADS-B service provider. No other ACAC member has either entered into a contract or MOA to develop a ConOps, as illustrated in Figure 30 , and enhanced in Figure 31 (Green signifies formal space-based ADS-B contract agreement, Blue signifies Memorandum of Agreement for space-based ConOps development, and Grey signifies no formal agreement with the space-based ADS-B service provider). As depicted in these figures, the 17 States that compromise the Agency for the Security of Aviation in Africa and Madagascar (ASECNA) have entered into an MOU with an ADS-B Space-Based service provider. [39] A clear opportunity exists to harmonise surveillance among the two organisations (ACAC and ASECNA).	66. Identify conditions and locations where technical simulation capabilities would be beneficial to simulate ATC procedures and flight deck capabilities in support of significant changes to operational systems, services and requirements, if not already in use. 67. Identify conditions where non-technical simulation (table-top exercises) would be beneficial to simulate ATC procedures, if not already engaged in the process. (Best Practice) 68. Develop or improve effective agency policy guidance that will govern decisional criteria affecting systems, personnel, procedures, actions, and reactions to defined metrics. The policy should be tailored to modern systems and training practices and be adaptable to future changing conditions. Policy categorisations would minimally fall into two groups: • Management and Administration Policy • Operational Policy 69. It is recommended that a dedicated regional study focused on surveillance availability, coverage, continuity, and reliability be conducted. 70. Develop a ConOps for the use of space-based ADS-B to supplement existing ground-based equipment that would lead to the provision of full regional/State surveillance coverage where needed (i.e., in remote and oceanic non-surveilled airspace). A resulting concept should include elements such as surveillance coverage that would be expanded to (1) entire airspace volumes (i.e., surface to unlimited), or (2) select volumes of airspace that could be

Recommendation Area	Findings	Recommendations
Other Dynamics Cont'd.		classified as exclusionary to those aircraft that are not yet equipped, (i.e., an airspace band FL340 and above to accommodate equipped overflight traffic, while non-equipped traffic would still have access to high-altitude airspace while they transition to ADS-B equipage). NOTE: A prominent ADS-B vendor provides a comparison chart of its services relative to the ICAO Aviation System Block Upgrades, it is available at: [41] http://aireon.com/resources/block-upgrades/ 71. Through potential Space-Based ADS-B interest/adoption, an opportunity can be created to harmonise surveillance capabilities, systems, procedures, and services among the two core organisations (ACAC and ASECNA) that have the greatest regional impact in working towards a single African sky reality.