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

Draft Final Report

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Executive Summary

The Airbus ProSky ACAC Study Team wishes to thank Arab Civil Aviation Commission (ACAC) for the opportunity to participate in the ACAC Communications, Navigation, and Surveillance (CNS) /Air Traffic Management (ATM) Study Update & Strategic Planning (2015-2030) Project efforts, and trusts that ACAC will find the Team's efforts a meaningful contribution to ACAC's efforts to foster aviation in the Middle-East.

We particularly want to acknowledge the support the Airbus Middle-East provided in funding the study.

The ACAC Team acknowledges that the success of its effort was in large part the result of the willing and open cooperation and support of the ACAC state participants. We particularly want to acknowledge the leadership and counsel provided by Mr. Hasan Alghorabi as Chairman of the Air Navigation Committee (ANC) and Mr. Mohamed Rejeb as the ACAC focal point for the project.

The final report addresses the study activities and analysis conducted in support of the Air Navigation Committee since imitation of the study in May 2015.

Since the time of the previous study in 2004–2005, there have been significant changes in the global approach to 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 (GANP), development of the Aviation System Block Upgrade (ASBU) approach to ATM evolution, implementation of formalised Safety Management System (SMS), and shifts in how Air Navigation Services are provided. There has been and continues to be unprecedented rapid growth of aviation in parts of the region that is straining ATM capabilities and spurring various localised nation re-planning efforts.

Airbus ProSky and Airbus Mid-East agreed that a study would be extremely beneficial to the region by addressing near-term and strategic ATM needs and requirements in the Middle East and North Africa, and further agreed to conduct an updated study. Key drivers in that decision were:

- This region of 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 greater aircraft activity levels than ATM capabilities and airspace route structures can and will be able to support.
- Legacy operational agreements and procedures between nations lack the ability to prevent oversaturating ATM capabilities of adjacent nation ATM facilities.
- Operators like Emirates Airlines, Etihad Airlines, and Egypt Air have already expressed concerns about limitation to airspace access and excessive delays.
- Air Traffic Flow Management (ATFM) to assist in managing 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 immediate effect on aviation growth, economic growth, safety, and the environment.
- These shortfalls have direct impact on Air traffic growth.

While all ACAC states are expected to grow substantially through the period of time that the GANP is to be implemented through the ABSU 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 both there are not gaps in capabilities as traffic crosses state borders and that “ no country is left behind” as aviation advances in the Middle East / Norther Africa regions.

Further complicating achieving 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).

The ATM Study intent 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 aiming to optimise 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. There are, however, substantial challenges in being able to effectively accommodate the anticipated aviation growth and expectations of its stakeholders. Some aspects of the current regional 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. Specific objectives to be highlighted in the Regional Concepts for the year 2030 and transition from today’s system include:

1. Improve airspace safety and efficiency
2. Improve interoperability between ANSPs to foster seamless services across borders
3. Increase airspace capacity to meet future demand requirements
4. Increase access to airports
5. Reduce environmental impact of increasing traffic by providing improved ATM operations

The initial scope of the study is defined as follows:

- <u>Time Scale</u>: 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, ensuring security and environmental impact and best value solutions.
- Geographically: The study will cover ACAC area (19 Arab States as illustrated in Table 1 (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.

During the performance of the study, challenges were encountered in obtaining data from some of the ACAC member states. The difficulties in obtaining data continued into the spring of 2016 and were significantly affecting completion of the study. As a result, there was agreement to proceed based on what data was available as of 18 March 2016, with accommodation of information after that date to be done as practical.

During the Gap Analysis meeting, a decision was made to allow additional time to complete the findings and recommendations with their targeted presentation by the ACAC CNS committee moved from the June ACAC general meeting until the October meeting. It was agreed that the schedule adjustment will provide the study team adequate time to complete the final report, for the ACAC CNS Committee to provide feedback and for the Final report to be updated accordingly. Section 3 contains a complete explanation of the project's timetable and adjustments.

The methodology and approaches used throughout the study were consistent with the SOW, and include (1) work teams, (2) data identification and collection, (3) comparative analysis, and (4) baseline ASBU Block descriptions.

The Airbus ProSky Team used an approach to the ATM Study necessitating a highly qualified and diverse team of multi-discipline industry experts in not only studying aviation systems, but with real world experience managing them and implementing major new capabilities and system enhancements. The Airbus ProSky Team drew upon the expertise of its companies and Airbus for world leading aviation expertise to form the core of the ATM Study Team.

While the Request for Proposal (RFP) outlined a study approach predicated on providing updates to the previous study, the breadth of changes in the aviation environment and regional environment would render such an approach to have only minimal benefit. As a result, Airbus ProSky Team's approach was to focus on both 2030 needs and the nearer term requirements that could be realised by 2020 and 2025. The overall approach to the ATM Study is shown in Figure 10.

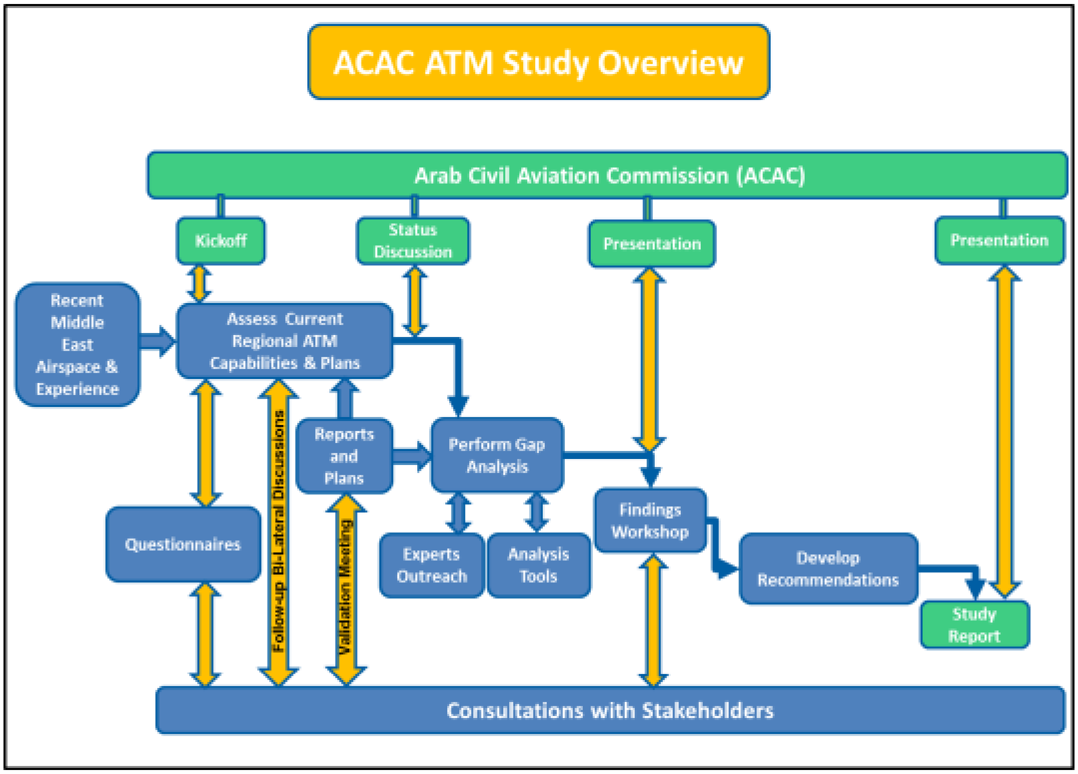

Figure 10: ATM Study Approach

Key elements of the 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 International Civil Aviation Organization (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 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 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

The Airbus ProSky Team methodology for the ACAC ATM Study was consistent with the approach described earlier. Table 6 provides a depiction of the major study elements and key aspects that were examined.

Table 6: 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

The following provides an overview of the activities and outputs from the various phases of the study effort:

- ***Kick Off***

  Airbus ProSky Team approached the study kick off in a manner that reflects the importance of starting the study prepared. This attention to detail and timeliness assured the ACAC that we were ready to begin the study and focused on ensuring a successful outcome for the ACAC, the Middle East and North Africa.

  At the kick off, we presented the ACAC with a current project plan reflective of the actual start date and a draft presentation and questions for the first round of stakeholder sessions. We prepared to work with the ACAC onsite to finalise the draft presentation and questions and prepared for scheduling discussions and coordinating stakeholder sessions.

  Terms of reference, roles and responsibilities of the Project Team and ACAC were discussed and fundamentally agreed to.

  In addition, according to a “NO COUNTRY LEFT BEHIND” approach, the associated mitigation to the risk of insufficient data collected from some concerned States, due to the political situation in the region was recognised as a risk that could lead to delay or to a limitation of the scope of the study or result in difficulties in the development or acceptance of the study conclusions.

- ***Stakeholder Data Gathering and Questionnaires***

  The Airbus ProSky Team worked with ACAC to obtain stakeholder input primarily through use of questionnaires. We coordinated the content of the questionnaires through ACAC as well as relied on ACAC to provide the interface with the ACAC members for responding to the questionnaires and facilitating follow-up discussions. Additionally, a survey was developed and distributed to the Arab Air Carriers Organization (AACO) in an attempt to gather more input from the customer perspective. Near the end of the data gathering effort, the Airbus ProSky Team conducted a workshop with the ACAC members to review and confirm the overall input received.

From the onset of this study 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. Realizing the project constraints (time and resources), the project team supplemented ACAC Member State provided data with recently collected data from regional ATC and ATM in support of a major UAE regional ATM airspace and procedure redesign effort. This leveraging of information assisted the project team by providing a highly detailed perspective of a segment of the overall ACAC jurisdictional environment.

Table 8 depicts the outreach timelines used for both the ACAC CNS-ATM Study Update and the UAE Airspace and Procedure Redesign.

Table 10: ACAC and other Regional Stakeholder Outreach Timelines

ACAC and other Regional Stakeholder Outreach Efforts			
Meeting Type	**Primary Stakeholders**	**Type Activity**	**Dates**
On-Site	ACAC Organization	CNS-ATM Study Objectives and Status Update	14 December 2015
Teleconference	ACAC Mgmt.	Data Collection Status Update Meetings	Periodic
Teleconference	ACAC Mgmt.	ATM Assessment Briefing	18 March 2016
On-site	ACAC Organization	CNS-ATM Study Workshop - Data Gathering & Confirmation Activities	7 April 2016
On-site	ACAC Organization	Presentation	7 April 2016
UAE Regional Stakeholder Outreach Efforts			
On-site	SZC, Project Technical Team (PTT), National Aviation Stakeholder Advisory Committee (NASAC)	Work Groups & Work Shops	Multiple 2015

ACAC and other Regional Stakeholder Outreach Efforts			
Meeting Type	Primary Stakeholders	Type Activity	Dates
On-site	SZC, DANS, ADAC, GCAA,	Data Gathering & Requirements Identification	Multiple 2015
On-site	SZC, PTT	Data Gathering & Requirements Identification	Multiple 2015
On-site	SZC, Airbus ProSky	Development Activities	Multiple 2015
On-site	Bahrain	Regional Data Gathering	24 March 2015
On-site	Oman	Regional Data Gathering	24 March 2015
On-site	Qatar	Regional Data Gathering	29 March 2015
Teleconference	Saudi Arabia	Regional Data Gathering	19 May 2015
On-site	SZC, PTT	Work Shop - Review, Affirmation and Advancement	Multiple 2015

A careful review was conducted of the data supplied, when it was received and searches for all available public source data were conducted. As a result, judgments were required by the contract team to determine which FIRs provided sufficient and effective data in order to be able to conduct a timely and meaningful analysis. **Erreur ! Source du renvoi introuvable.** depicts which States were included in the study and which were not as determined using the criteria noted below:

- Category 1 States - those States included in the study
- Category 2a States - those States not included in the study due to data being submitted beyond the March 18, 2016 cut-off date
- Category 2b States - those States not included as they did not submit data

Table 8: State Study Inclusion Status

State Study Inclusion Status		
Category 1	Category 2a	Category 2b

State Study Inclusion Status			
Category 1		Category 2a	Category 2b
Algeria	Oman	Tunisia	Iraq
Bahrain	Palestine	Mauritania	Jordan
Egypt	Qatar		Kuwait
Lebanon	Saudi Arabia		Libya
Morocco	Sudan		Syria
UAE			Yemen

Section 5 Stakeholder Consultation contains an account of the responses obtained for both the initial and supplemental questionnaires and the effectiveness of the data provided.

- ***CNS/ATM Assessment***

The Airbus ProSky 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 and ATM capabilities in the Middle East and North Africa. The Study team reviewed the available Aeronautical Information Publications (AIPs) applicable to the ACAC States nations. The Airbus ProSky Team l also leveraged the familiarity and recent presence and stakeholder interaction in the UAE and surrounding countries to formulate stakeholder briefing and questions

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. The Airbus ProSky Team made assessments of current ATM capabilities that will deliver accurate ATM procedures for safe, orderly, and efficient ATM within the Middle East and North Africa while considering the needs/limitations of the stakeholder community. 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 specific assessments are contained in Section **Erreur ! Source du renvoi introuvable.**6 Assessment Process and Criteria.

In addition, the Airbus ProSky Team undertook an effort to categorize the FIRs to support the concept of 'one size does not fit all' and is similar to the philosophy of the ICAO Aviation System Block Upgrade methodology. The team categorized the FIRs into groups of High, Medium and Low activity based on the current ACC and Aerodrome activity. This methodology is fully explained in Section 7.

- ***Gap Analysis and Findings***

Key to a gap analysis was deciding on the points in time the gap will be assessed against. The Airbus ProSky 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 gap analysis provided assessments in terms of the major element identified in the approach section of the proposal as applicable to all phases of the study. In performing the gap analysis, two factors were considered primary and not to be compromised; safety and security.

The Airbus ProSky Team evaluated gaps in capabilities to meet forecasted activity demand and expected ABSU functionality using a need – capability model, as illustrated in Figure 30.

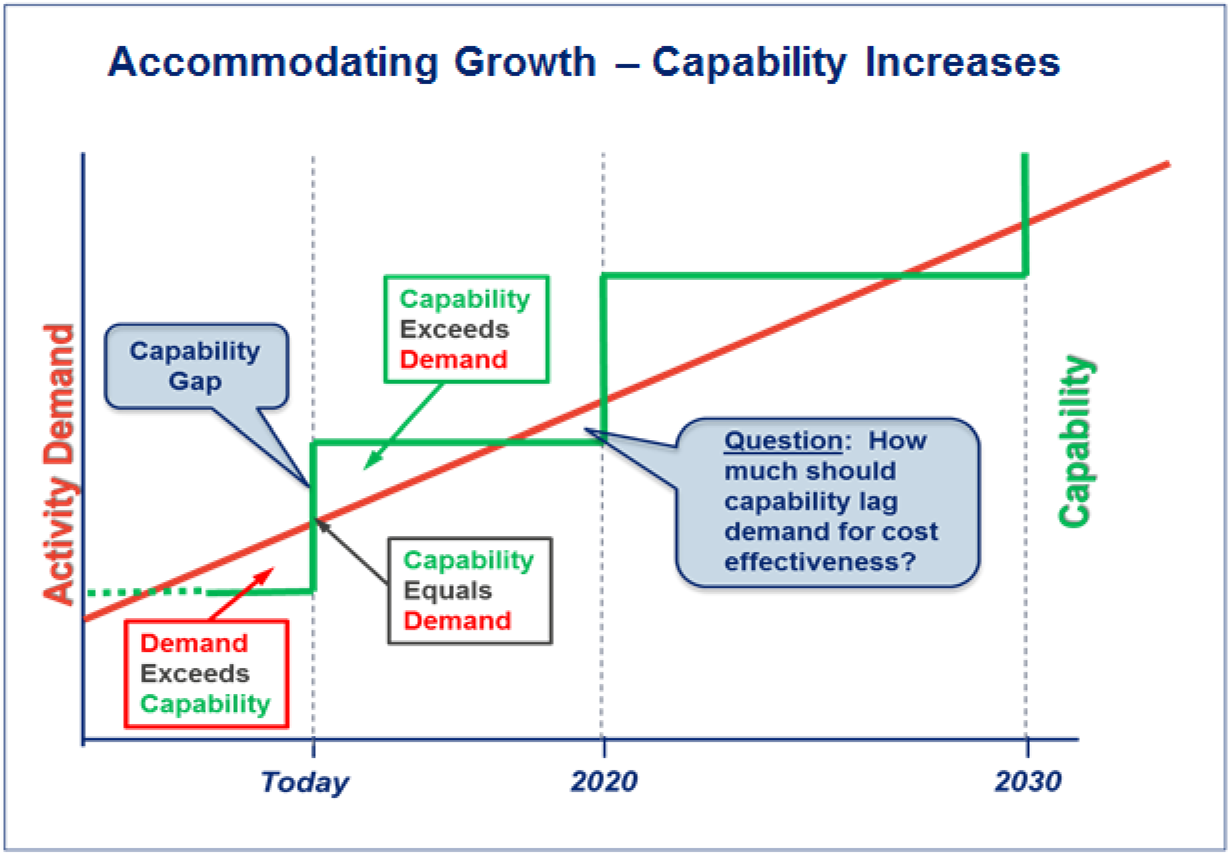

Figure 30: Growth Accommodation

Utilizing data provided by States in the surveys, we analysed the progress made towards reaching the objectives in the GANP ASBU plan in the four (4) Performance Improvement Areas: Airport Operations; Globally Interoperable Systems and Data; Optimum Capacity and Flexible Flights and Efficient Flight Paths.

Gaps are presented by noting the current status of the ACAC States towards meeting the targets in each of the four performance areas and in an itemized list of the Study Team's findings in the areas of:

- 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

The Study Team's findings in current capabilities and services were primarily derived from the surveys provided by the individual States plus a review of any internal documents that were submitted by the States. Unable to conduct direct observation of the air traffic operations resident in the participating States, the research team relied primarily on the responses to the questions in the surveys, ICAO documents, and the very limited amount of internal documentation that was provided. 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. All of the findings listed in Section 9 apply to all assessed States based on their existing and forecast traffic density. We also indicate if the finding is either directly or indirectly linked to the Block Upgrade modules. Specific findings care located in sections 9.1.1 through **Erreur ! Source du renvoi introuvable.**.

- ***Recommendations***

The recommendations proposed to mitigate the gaps identified in the previous section are framed into two time periods: near term recommendations and far term 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 ABSU 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 38. While the project team attempted to frame the recommendations into 5 year increments through 2030, the fidelity of the available data prevented such a detailed delineation.

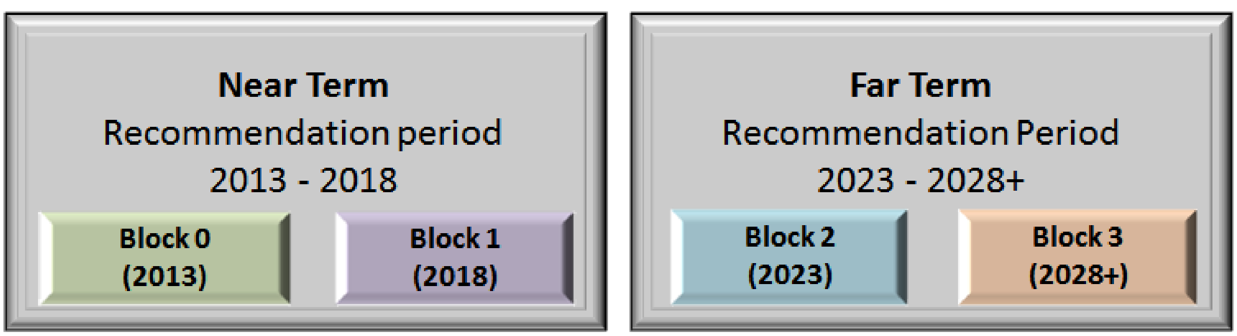

Figure 38: Recommendation Period Definitions

The specific recommendations are addressed in section **Erreur ! Source du renvoi introuvable.** through 9.1.9.

The recommendations in section 9.110.1 are provided to ACAC for their review, consideration, confirmation, censuses and/or comments. ACAC member input is requested to identify those Regional and State recommendations that are particularly important to the Member State and/or ACAC organisation that warrant focused attention. Additionally, ACAC Organisational and State members are invited to provide supplementary recommendations for analysis and inclusion.

Once the ACAC review period is complete, and input received, the project team will aggregate and analyse the input to draw a series of key recommendations. The key recommendations will inform ACAC of those areas where focused attention is required.

- ***Final Report***

The objective of this report was to provide ACAC with an assessment of the current state of air traffic services in the Region defined by the ACAC membership. The current state of air traffic services is a combination of the equipment capabilities currently available and how they are being used. Therefore it is equally important to study the procedures and policies in place in each ANSP in order to conduct a fair assessment. For this study we were limited to the information provided by the ACAC member States and the information that the study team could obtain from publically available sites. For the most part, detailed information contained in the internal standard operating procedures for conducting day-to-day operations; letters or memorandums of agreement with adjacent facilities; training plans; operations and quality assurance metrics were not provided. Therefore the study team had to draw its own conclusions regarding day to day air traffic operations from the very limited amount of information contained in the two surveys provided to the ACAC States. Some of the surveys were completed in their entirety including descriptions of impacts caused by inadequate equipment capability or due to inherent air traffic procedures or flow management practices. However many of the surveys did not reach this level of completeness. In those cases the study team relied heavily on its own AT experience including that gained from having conducted previous studies of operations in the Region to fill as many gaps in information as possible.

We have itemized many near term and far term recommendations in Section 10. Those we have designated as near term are recommendations we believe should be considered and implemented as soon as possible. In High and Medium activity FIR's these will enhance the quality of air traffic services being provided today as well as help to mitigate impacts being experienced today. For Low activity FIR's incorporating these recommendations into their operation today will help prepare them for the traffic increases forecasted for the area.

Paramount for the Region we believe are two equally important issues: first - is to achieve as close to one hundred percent as possible interoperability among adjacent facilities in information, data, and communications exchanges by creating interfaces where none exist and maximizing those that do exist. Any hope for consistency in air traffic services or to meet the forecasted air traffic demand in the Region is dependent upon this. Second - is to ensure the equipment and capabilities present today are being utilized to the maximum extent possible. For example, having the benefit of surveillance capabilities are diminished if standard separation practices far exceed the minimum required in a radar environment.

We also believe it is important to the Region for all facilities to adapt the principals of traffic flow management and they be incorporated into all ATC personnel training plans. Each ANSP should assess for each facility within its area of jurisdiction the role of Traffic Flow Management and determine who will provide the functions in the day to day operation. In some areas, we can see that the Traffic Flow Management functions should be conducted by dedicated personnel while in other areas these functions can easily be assigned as an additional duty with no loss of benefit. However, prior to expending resources on traffic flow management equipment or personnel it is first important to conduct a complete assessment of all agreements, airspace and procedures that may be contributing to the current impacts to air traffic services. Traffic flow management is not a substitute for inefficient procedures or airspace design.

This report can only be viewed as a beginning for the Region. We encourage a more complete analysis of the operating procedures in each ANSP. Additionally we encourage the development of Regional airspace redesign goals tied directly to safety and delay metrics. We recommend these goals include standardized high altitude sector designs; creation of bi-directional routings based on satellite navigation (while maintaining a limited amount of ground based navigation routings for those aircraft lacking modern equipage); routes that accommodate continuous descent and climb profiles and a fast track/slow track methodology to alleviate bottle necks caused by differing aircraft operating characteristics.

- ***Stakeholder and Executive Presentation***

At the request of ACAC the Airbus ProSky Team will conduct the final report presentation to ACAC and its leadership during the latter part of 2016.

ACKNOWLEDGEMENTS

The Airbus ProSky Study Team acknowledges the participation, support and collaboration of the Arab Civil Aviation Commission and particularly the Air Navigation Committee representatives. We particularly want to acknowledge the support the Airbus Middle-East provided in funding the study. We would like to provide special thanks and recognition to Mr. Hasan Alghorabi and Mr. Mohamed Rejeb for their project support, understanding and operational insights.

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List of Acronyms and Glossary

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

ANS..Air Navigation Services

ANSP ....Air Navigation Service Provider

AOP..Airport Operations Planning

APC.......................................Approach Control

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

ArcGIS ....ESRI Graphical Information System Software

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

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

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

ATC.......................................Air Traffic Control

ATFM ....Air Traffic Flow Management

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

ATN ....Aeronautical Telecommunication Network

ATS ....Air Traffic Service

ATSA ....Air Traffic Situational Awareness

C2..Control and Command

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

CAP.......................................Corrective Action Plan

CAT.......................................Category

CCO ....Continuous Climb Operations

CDM ....Collaborative Decision Making

CDO ....Continuous Descent Operations

CIDIN ....Common ICAO Data Exchange Network

CMP ....Code Management Plan

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

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

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

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

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

Ft. ....Feet

FTP..File Transfer Protocol

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

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

GBAS ....Ground-Based Augmentation System

GCAA ....General Civil Aviation Authority

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

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

IGA ....International General Aviation

ILS...Instrument Landing System

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

ISO ....International Organization for Standardization

KPI ....Key Performance Indicator

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

LOA ....Letters of Agreement

MAEP ....Middle East Airspace Enhancement Programme

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

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

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

MIT ....Miles-in-Trail

MLAT ....Multilateration

MVA ....Minimum Vectoring Altitude

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

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

NDB ....Non-Directional Beacon

Nm...Nautical Mile(s)

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 Aerodrome Traffic Service

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

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

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

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

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. nm ....Square Nautical Mile(s)

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 Aerodrome Forecast

TBD.......................................To Be Determined

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

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

TEM ....Technical Exchange Meeting

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 ....United States

USOAP ....Universal Safety Oversight Audit Program

VHF..Very High Frequency

VNAV ....Vertical Navigation

VOIP ....Voice Over Internet Protocol

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

VOR ....VHF Omni Directional Radio Range

WAFS ....World Area Forecast System

WAM ....Wide Area Multilateration

WIFS ....Internet File Service

WXXM ....Weather Information Exchange Model

XML.......................................Extensible Mark-Up Language

1 Introduction

Airbus ProSky (the ATM subsidiary of Airbus) is pleased to provide this final report of the ACAC CNS/ATM study, including recommend strategic plans to optimise ATM capabilities within the area under the ACAC coverage. The study provides an updated view of CNS/ATM capabilities and plans from those presented in an earlier study, some 10 years ago.

The final report addresses the study activities and analysis conducted in support of the Air Navigation Committee since imitation of the study in May 2015.

2 Background

Since the time of 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 (GANP), development of the Aviation System Block Upgrade (ASBU) approach to ATM evolution, implementation of formalised Safety Management System (SMS), and shifts in how Air Navigation Services (ANS) are provided. There has been and continues to be unprecedented rapid growth of aviation in parts of the region that 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 Communications, Navigation, and Surveillance (CNS)/ATM status and quickly develop a new strategy to implement a more efficient modernization of the ATM system in the region.

During the ACAC Air Navigation Committee (ANC) meeting (ANC32) in Morocco, December, 2014, Airbus ProSky was approached by its chairman, vis chairman and secretary to inquire how Airbus ProSky could cooperate with ACAC to conduct the study.

Airbus ProSky and Airbus Mid-East agreed that such a study would be extremely beneficial to the region by addressing near-term and strategic ATM needs and requirements in the Middle East and North Africa, and further agreed to conduct such a study. With the geopolitical environment in the region affecting aircraft routings and flows involving more than the nations represented by ACAC, Airbus recommended that the study take a larger geographic perspective that also includes ATM aspects for the State of Kuwait and Islamic Republic of Iran. The principal study rationale and mutual benefits are as follows:

- This region of 20 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 greater aircraft activity levels than ATM capabilities and airspace route structures can and will be able to support.
- Legacy operational agreements and procedures between nations lack the ability to prevent oversaturating ATM capabilities of adjacent nation ATM facilities.
- Operators, such as Emirates Airlines, Etihad Airlines, and Egypt Air, have already expressed concerns about limitation to airspace access and excessive delays.
- Air Traffic Flow Management (ATFM) to assist in managing 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 immediate effect on aviation growth, economic growth, safety, and the environment.
- These shortfalls have direct impact on air traffic growth.

Since the Airbus initial recommendation on the study scope, the State of Kuwait has joined the ACAC organization making it an eligible participant in the study, while a decision was made to address the Islamic Republic of Iran separately.

2.1 ACAC Membership

The ACAC Member States are listed in Table 1.

Table 1: ACAC Member States

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

2.2 ACAC Regional Description

The ACAC Member States geographic jurisdiction is illustrated Figure 1.

Figure 1: ACAC Geographical Area

2.3 Traffic Growth

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

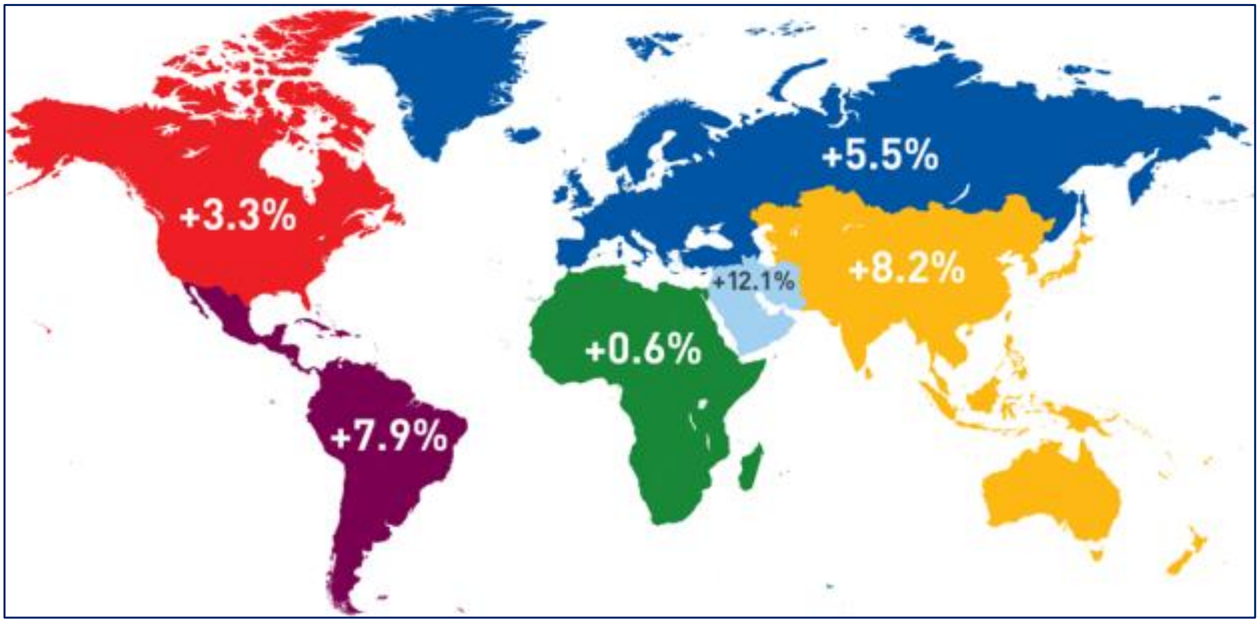


Figure 2: Middle East 2015 Traffic Increases

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 percent of that demand, see Appendix A for the regional fleet mix. [Boeing]

Traffic growth in the Middle East continues to grow at a rate and is expected to grow 6.2 percent annually during the next 20 years. Approximately 80 percent 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. [Boeing]

The Middle East growth can be in part attributed to the continued development of airport hub operations as focal points between East and West, and supplemented by the rise of trade links between Africa, the Middle East and Asia. In 2014 economic growth in the United States (US) also boosted Middle East – North America traffic.

According to ICAO, African air traffic grew at a rate of 0.6 percent in 2015, but a recent IATA report finds that African carriers may have seen a loss of an estimated $300 million this year.

Breakeven load factors are relatively low, as yields are a little higher than average and costs are lower. However, few airlines in the region are able to achieve adequate load factors, which average the lowest globally at 56 percent in 2015 and 2016. [IATA Year End Report]

Next two decades annual growth estimated trend: regional +5.9% vs. global +4%, increase in passengers from 125M to 377M. [AFI/MID WS ASBU], see Figure 3.

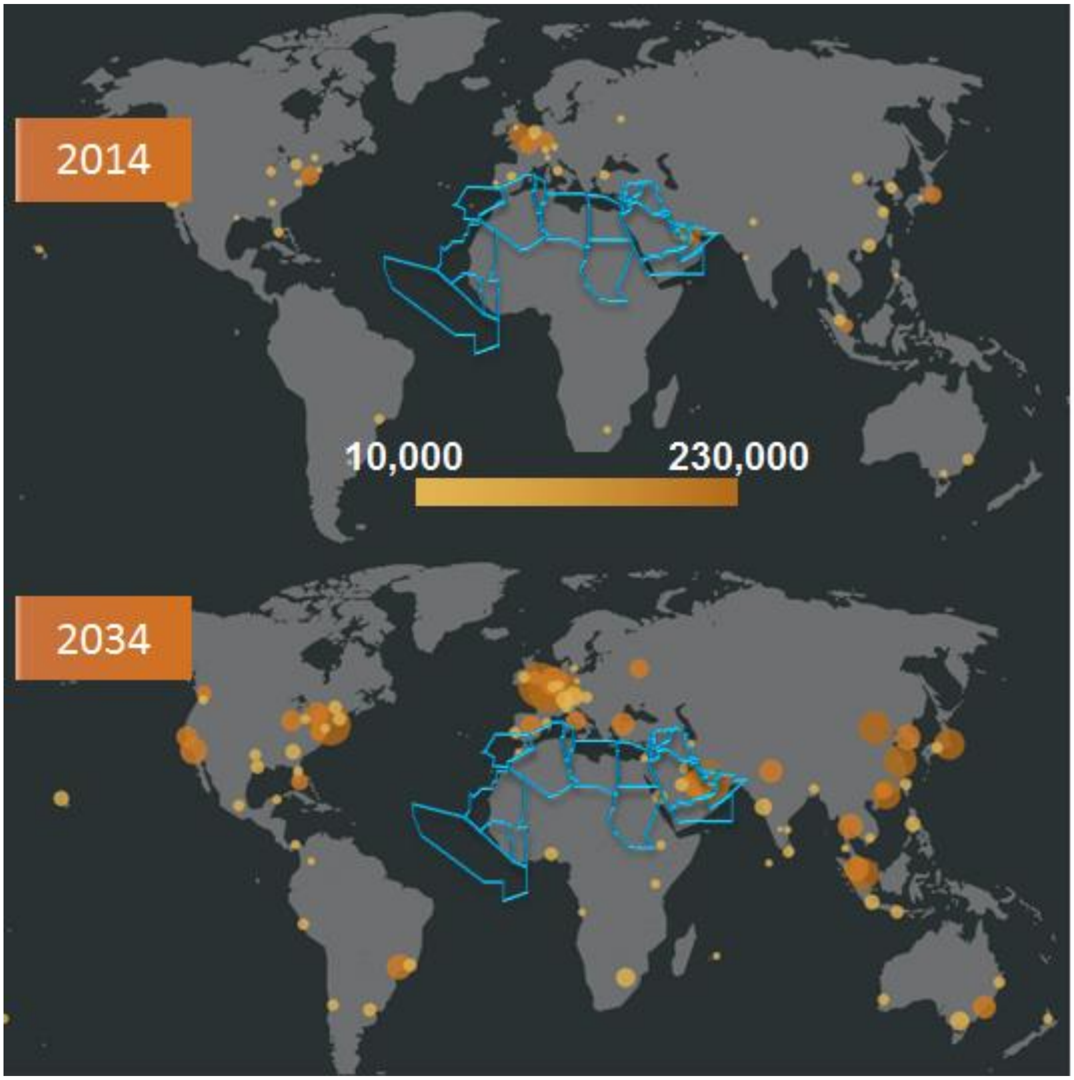


Figure 3: World Aviation Mega-City Expansions
(Source: Airbus Global Market Forecast 2015–2034)

2.4 Problem Statement

While all ACAC states are expected to grow substantially through the period of time that the GANP is to be implemented through the ABSU 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 both there are not gaps in capabilities as traffic crosses state borders and that " no country is left behind" as aviation advances in the Middle East / Northern Africa regions.

Further complicating achieving 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 Previous Related Work

Both the previous CNS-ATM Study by Sofreavia and the work done by Airbus ProSky, in support of the United Arab Emirates (UAE), provided a good foundation for this ACAC CNS/ATM Study Update & Strategic Planning (2015–2030) effort.

2.5.1 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. Some of the most notable aspects from that study of particular relevance to the current study were:

- Identification of current and potential traffic bottlenecks, mostly in the Middle East.
- Creation of three (3) homogenous areas reflecting different fundamental traffic flows and operational air traffic density
- Development of a high-level CNS/ATM roadmap to serve as guidance for state planning and deployment priorities, with a recommendation that it be regularly updated
- Recommendation to develop a regional Air Traffic Flow Management entity

2.5.2 UAE Airspace and ATM Study

The UAE General Civil Aviation Authority (GCAA) awarded Airbus ProSky a contract to conduct the UAE Airspace and Air Traffic Management (ATM) Study. The UAE Airspace Study formed an important step in GCAA's efforts to foster the UAE's aviation sector future to 2030. Those efforts reflect the vital role that aviation plays in the UAE's economy and society. The successful growth of the aviation sector is founded in the GCAA's stated vision to promote "A leading, safe, secure and sustainable civil aviation system."

Optimizing the use of available airspace and planning for the projected expansive growth in aviation pose substantial challenges. Recent growth is very much tied to the success of the UAE's national airlines and establishing UAE airports as worldwide hubs. The national airlines have large aircraft order books and their aircraft are equipped with advanced technologies to take advantage of emerging capabilities. Added to the challenges are the increasing traffic levels that transit UAE airspace due to its location at a geographic crossroads in region.

There were three distinct internal phases of the Study:

- Phase 1 – Assessing Current and Future System Needs and Capabilities
- Phase 2 – Gap Analysis

Phase 3 – Developing Findings and Recommendations Figure 4 provides an overview of how the guiding principles were applied to the Study effort, including the major coordination points with the GCAA and stakeholders.

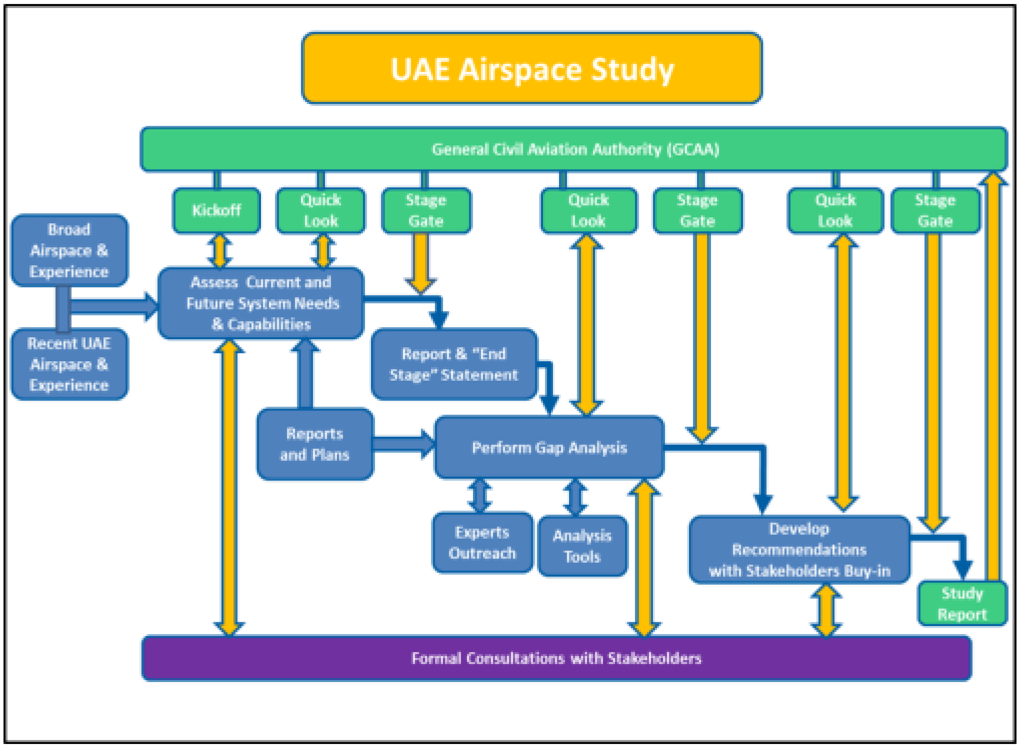


Figure 4: Overview of Airspace Study Coordination and Interfaces

Of particular relevance to the current study effort was the extensive coordination with aviation stakeholders both within the UAE and external FIRs and States, including from a number of the ACAC states part of this stud concerning current capabilities and the needed and expected aviation environment through 2030. The comprehensive stakeholder outreach as part of the study included:

- Air Navigation Service Providers
- Airline and Aircraft Operators
- Airports
- Government
- External

One of the key outputs of the study was a succinct characterization of the strategic vision of the 2030 UAE ATM system and aviation environment that will resonate with airspace stakeholders as achievable targets they can focus their planning on. The resulting End Stage Statement, see Figure 5, has relevance to the current study in that many of the ACAC objectives are similar for their member states.

UAE Airspace and ATM End Stage Statement

The UAE Airspace and ATM System of 2030 is one that supports the UAE GCAA vision for "A leading, safe, secure, and sustainable civil aviation system." It realises the capabilities set forth in the UAE Air Traffic Management Strategic Plan 2012–2030, for an ATM system "that is performance-based, addresses ATM community expectations, is cost-efficient, environmentally sustainable and is globally harmonised. This ensures that the UAE continues to maintain an ATM system that can safely accommodate demand, is globally interoperable, environmentally sustainable, and satisfies national interests, including defence and security.

Key attributes of the 2030 UAE Airspace and ATM System include:

- Fair and equitable access to all airspace, airports, and ATM services based on Best Capable – Best Served during congested periods.
- UAE airspace considered as a "National (Federal) Asset" with the implementation of Flexible Use of Airspace (FUA) for civil and military operations, based on needs.
- Seamless Air Navigation Service Provision throughout the UAE.
- Performance-Based Navigation (PBN) route structure throughout UAE.
- Flight Procedures tailored for optimal climb and descent to runways in use.
- Airport infrastructures that maximise throughput and minimise congestion.
- Balancing traffic demands and capacities in a collaborative manner.
- Interoperability of ATM systems within the UAE and with neighbouring Flight Information Regions (FIRs).

Figure 5: End Stage Statement

Similar to the current ACAC study effort, the assessments of capabilities and gap analysis led to development of a comprehensive set of recommendations. A partial sampling of the key recommendations from the UAE Airspace and ATM Study are presented in Table 2 as a preview of the type of recommendation information to be presented in the final version of this report.

Table 2: Key Recommendation Summary (Partial List)

#	Recommendation	Background	Justification	Benefits	Consequences of not Implementing
1	Integrate the various individual Air Navigation Service Provider (ANSP) strategic planning efforts into a seamless UAE Airspace and ATM strategic plan.	Strategic planning: Efforts vary among stakeholders: Individual interests Differences in planning horizons Differences in objectives, capabilities and when realised	Need to ensure strategic planning reflect the best interest for the UAE minimizing differences in capabilities and when available.	Ensure that all stakeholder plans are aligned with the UAE ATM Strategy and are in line with ICAO Standards and recommended practices (SARPs)	Implementation of different capabilities Inefficiencies and delays in system-wide implementations Limiting aviation and corresponding economic growth
2	Conduct a detailed analysis of ANSP operational position needs for the UAE through 2030, and develop a plan to meet those needs with optimum effectiveness and efficiency.	New ways of doing business coupled with the projected traffic growth can have significant effect on what types of operational positions and numbers needed.	The number and types of operation positions are envisioned to change as in technology and traffic growth occurs.	Smooth transition to new capabilities and facilitate being able to meet aviation growth	Strong potential that new capabilities will not we effectively used and overall aviation needs not efficiently met
3	Base airspace access, procedural development, and flight prioritization planning on a shift in policy towards Best Capable – Best Served during congested periods, realizing that accommodating exceptions to that policy will reduce over time.	The UAE Airspace is a The UAE Airspace is a finite resource and based on the projected traffic growth; the airspace and some airports will reach saturation for extended periods in the not too distant future. Dubai International Airport (OMDB) is already routinely experiencing periods of saturation.	Higher levels of traffic can be safely accommodated based on advanced capabilities and precision instrument flight procedures, and the airspace route structure and sectorisations are optimised for maximum efficiency.	More traffic can be managed safely and efficiently when advanced capabilities are leveraged. Such an environment also fosters aviation growth and commensurate increase in revenue.	Accommodating lower capable aircraft operations, especially during periods of airspace saturation or near saturation, will adversely affect other airspace users in Emirates FIR and limit the capacity of the FIR and its major airports. In turn, it will limit operator expansion and economic development in the UAE.

#	Recommendation	Background	Justification	Benefits	Consequences of not Implementing
4	Develop and implement a plan to manage airspace in a coordinated manner that is seamless from a stakeholder perspective, including requirements, system capabilities, and coordination.	Airspace is divided among the Emirates with responsibilities divided among the military and the various civil ANSPs. Almost universal stakeholder recommendation for a single UAE ANSP.	The division of operational responsibilities results from a stakeholder perspective in less than optimal airspace utilisation and efficiency.	Stakeholder confidence that the UAE airspace is service is being optimally provided if it was more integrated and "seamless" from their perspective with common strategy, plans, systems, procedures and interface points and without operational walls.	Stakeholder concerns will likely grow, as will the resulting limits on efficiency and capacity with increasing costs to both users and ANSPs.
5	Develop and implement a UAE-wide Enterprise Architecture for the provision of air navigation services and information, including military	Limitations exist in interoperability and data transfer. There is no apparent national enterprise architecture for the ATM systems.	While the various ATM automation systems are capable or expandable to meet expected operational capacity needs, the variety of different systems and capabilities are limiters	Steer the provision of services and procurement of associated system resulting in more uniformity and facilitate upgrading of capabilities to meet growth	Further inconsistencies in service provision, duplication of capabilities, increased risk of systems interoperable shortfalls to share data and information resulting in increased overall costs and limiting growth.
6	Leverage best practices for Technical Error classification procedures, and deploy similar error classifications with phased implementation beginning with final approaches at major airports	Spacing between aircraft is commonly increased above required so controllers do not risk being taken off position or lose their job for even the slightest reduction below standards.	Not all instances of separation loss are treated the same with the recognition that in striving to maximise operations, slight variations from the standard are to be expected and acceptable.	Increased operational performance and greater effective capacity.	Continued losses of capacity and perpetuation of delays, resulting in overall reduced operational efficiency and losses of potential revenue.

3 Project Objectives, and Scope of Work

This section contains the contractual information derived from the signed agreement between the affected parties.

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

The nominal structure includes the following sub-sections:

3.1 Project Objectives

The ATM Study intent 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 aiming to optimise ATM for the Arab Middle East and Northern Africa area.

The region's economic growth and prominence in the global environment is strongly linked to its aviation sector. A significant portion of the Gross Domestic Product (GDP) of various nations is either directly resultant from the aviation sector employment and services or indirectly contributed to by enabling tourism, finance, and other service industries through its robust and progressive aviation sector. Many of the national airlines are preparing for expansive growth over the next decade and beyond, projected in the range of 5% or more annually. The national airlines are upgrading their fleets in numbers of aircraft, size, and capabilities. Many airlines already have some of the newest and most modern fleets in the industry and their order books clearly indicate that they will become world leaders. Many airlines are uniquely positioned to take advantage of the advancing ATM capabilities emerging in many parts of the world to transform aviation to meet capacity, efficiency, and environmental needs of the future.

The Air Navigation Service Providers (ANSPs) and civil aviation authorities have developed strategic plans to address the growing needs. There are, however, substantial challenges in being able to effectively accommodate the anticipated aviation growth and expectations of its stakeholders. Some aspects of the current regional 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. Specific objectives to be highlighted in the Regional Concepts for the year 2030 and 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 environmental impact of increasing traffic by providing improved ATM operations

The 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, ensuring security and environmental impact and best value solutions.
- Geographically: The study will cover ACAC area (19 Arab States as illustrated in Table 1 (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 ATM Study is to be based on the GANP, ABSUs and relevant documents, and will ensure the coverage of all ACAC Member States and consider the interaction with neighbouring areas, including Iran.

3.3 Deliverables

As required, the Airbus ProSky Team is providing the following as deliverables for the ACAC ATM Study. Identified are both formal document deliveries and anticipated project meetings involving the ACAC and Airbus ProSky Study team, the planned format and due dates, in terms of weeks after award of the study.

Table 3 provides a summary concerning the proposed deliverables.

Table 3: Deliverables Schedule

Deliverables	Deliverable Type	Due Date: Months after study award	Notes/Explanations
Kick-off	Meeting	1	Project planning discussion and draft initial stakeholder questionnaire
Data Collection / Stakeholder Consultations	Questionnaires/Responses	6	Questionnaire responses, Bi-lateral follow-up discussion summaries and workshop updates

Deliverables	Deliverable Type	Due Date: Months after study award	Notes/Explanations
ATM Assessment	Briefing / WebEx	8	Presentation for beginning Study Gap Analysis
Gap Analysis / Findings	Briefing / Presentation	10	Workshop with all Nations invited
Final ATM Study Report	Report / Presentation	12	

3.4 Timelines

Figure 6 is a representation of the project activities and timeline described previously as modified from this proposal and captured in the initial SOW.

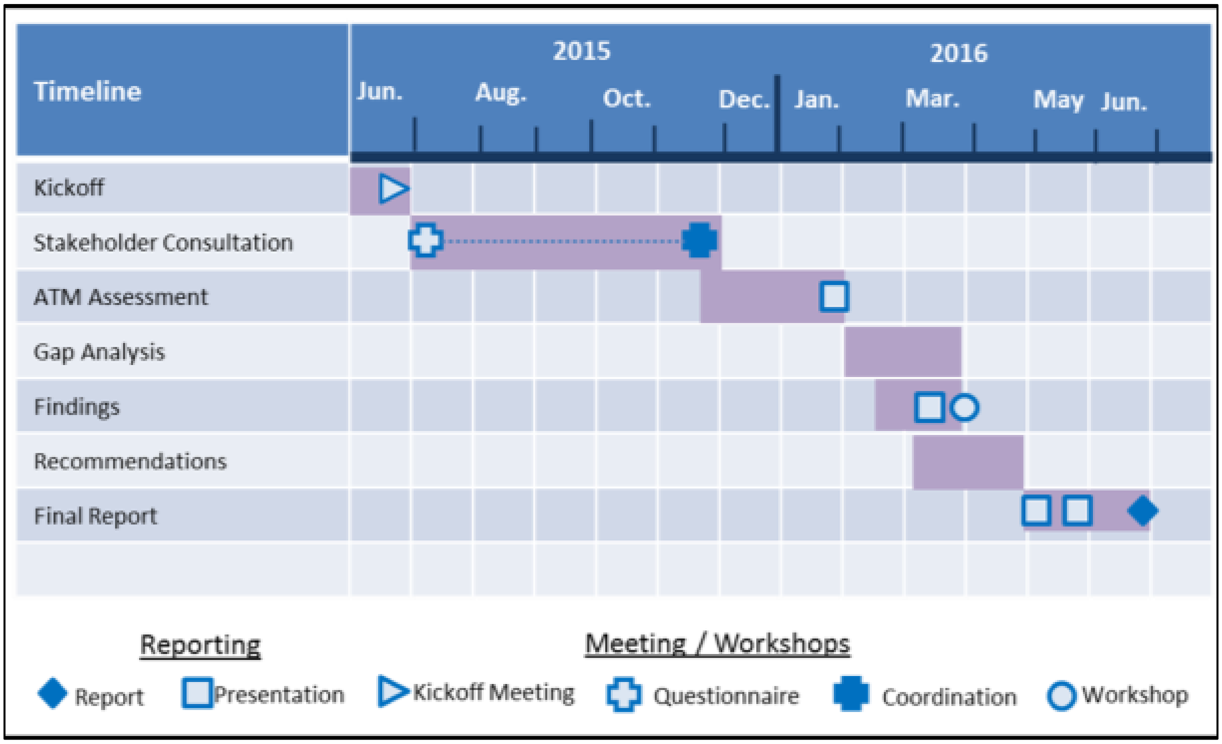


Figure 6: Proposed Project Timeline

3.5 Modifications to Timelines

During the performance of the study, some challenges were encountered in obtaining data from some of the ACAC member states and for some other states within planned timeframes. Figure 7 reflects the schedule variance that had resulted by December 2015 from the initial data availability shortfalls.

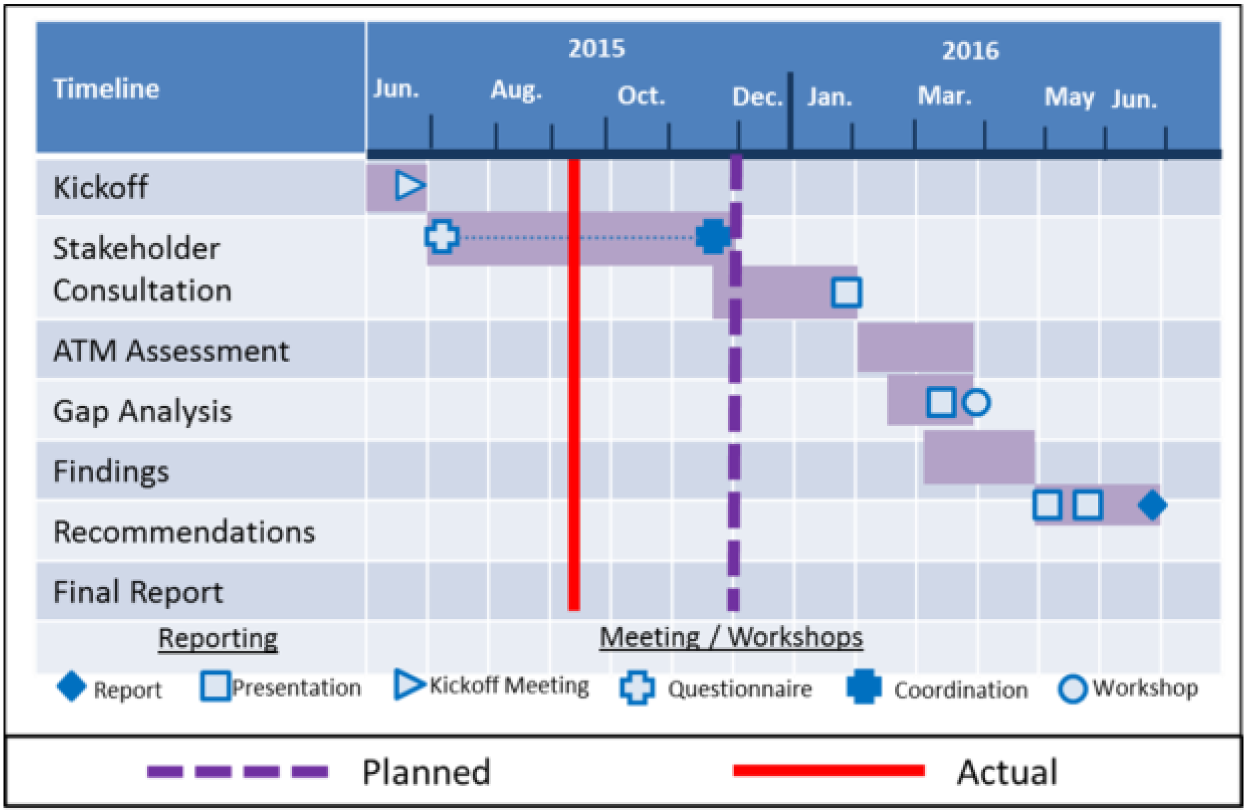


Figure 7: Project Timeline Variance as of December 2015

The difficulties in obtaining data continued into the spring of 2016 and were significantly affecting completion of the study. As a result, there was agreement to proceed ahead based on what data was available as of 18 March 2016, with accommodation of information after that date to be done as practical.

By the April 2016 Gap Analysis presentation, while quite a bit of the requested data from member States had begun to be provided, there were some significant shortfalls impacting the ability of the study team to develop comprehensive finds and recommendations to meet the original milestone schedule. Figure 8 reflects the milestone schedule as presented during the Gap Analysis presentation.

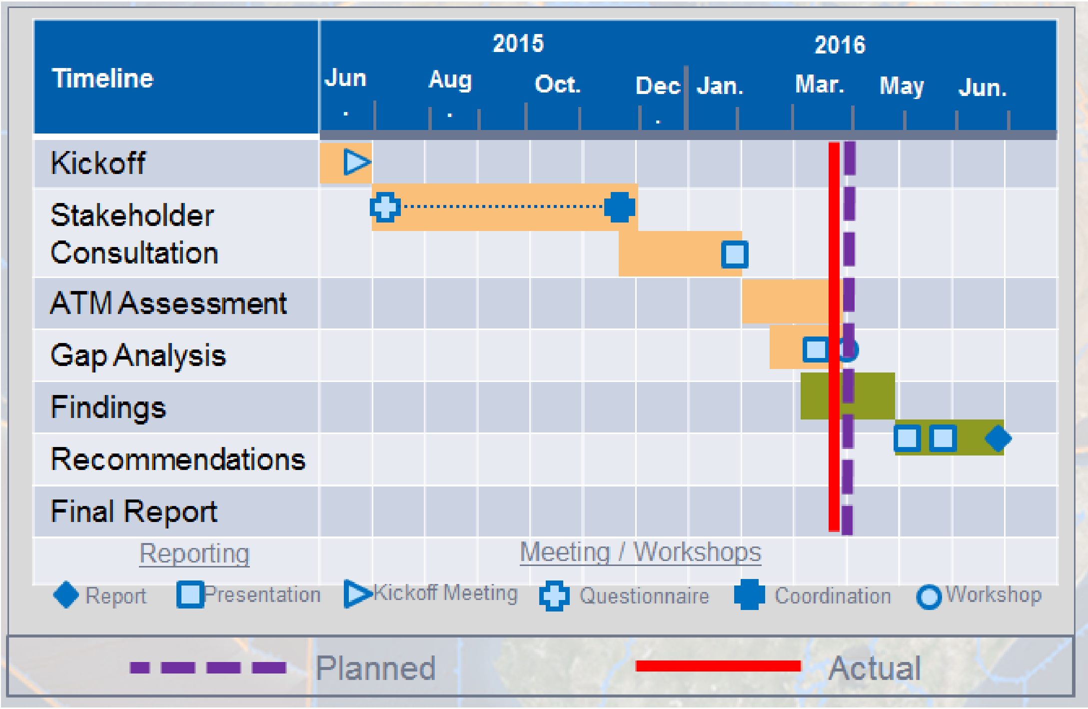


Figure 8: Milestone Schedule

During the Gap Analysis meeting, a decision was made to allow additional time to complete the findings and recommendations with their targeted presentation by the ACAC CNS committee moved from the June ACAC general meeting until the October meeting. It was agreed that the schedule adjustment will provide the study team adequate time to complete the final report, for the ACAC CNS Committee to provide feedback and for the Final report to be updated accordingly. The updated milestone schedule is depicted in Figure 9.

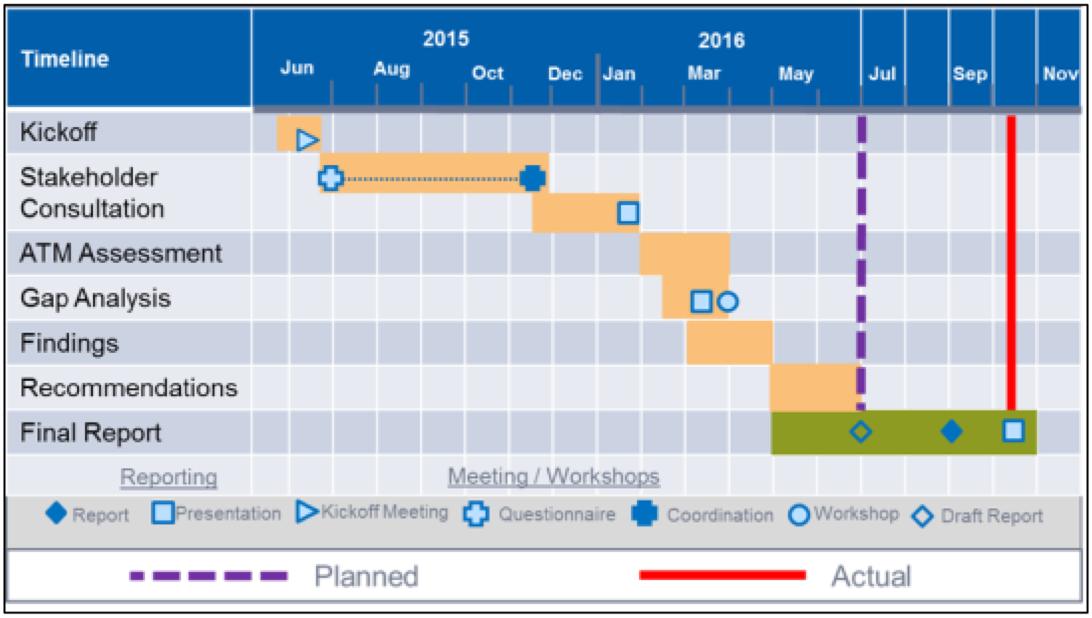


Figure 9: Updated Milestone Schedule (May 2016)

3.6 Risk Management

Airbus ProSky has identified the risks inherent in this study and developed the associated mitigation procedures.

According to "NO COUNTRY LEFT BEHIND" approach, the associated mitigation to the risk of insufficient data collected from some concerned States, due to the political situation in the region, should be addressed as appropriate.

Airbus ProSky recognised that risks could lead to delay or to a limitation of the scope of the study or to difficulties in the development or acceptance of its conclusions.

3.7 Identified Risks

The key risk at the start of the study was ensuring timely and comprehensive response by ACAC member to questionnaires and follow-on discussions.

3.8 Term of Reference, Roles & Responsibilities

In accordance with the Terms of Reference, the following ACAC responsibilities were provided to the Study Team:

3.8.1 ACAC Roles & Responsibilities are:

- ACAC nominate a Project Manager for the CNS ATM study from the secretary.
- ACAC will designate study focal points from each Member State.
- ACAC will contribute, as much as possible according to the political situation in the region, with the necessary inputs for the data collection phase.
- ACAC will provide feedback for the refinement of the study assumptions and State replies.
- ACAC will provide feedback for the refinement of the Airbus ProSky analysis and recommendations and actions plan.
- ACAC will provide all necessary inputs to promote the study results at the regional and international level, through the ACAC magazine, website, presentations during its technical committee, council and assembly, and as appropriate during the regional and international meetings and conferences.

3.8.2 ACAC Project Manager of the CNS/ATM Roles & Responsibilities

The ACAC project manager of the CNS/ATM study is responsible for the following:

- Ensure the coordination of the programme schedules, management of the major milestones relating to the CNS/ATM study.
- Ensure the coordination with the Focal Points designated nationally for the CNS/ATM study, to ensure the timely data collection according to the SOW and related timeline.

- Ensure the close coordination with Airbus ProSky Project Manager appointed for the CNS/ATM study and also with the rest of Project Team.
- Provide the ACAC feedbacks for the refinement of the study assumptions and State replies, further coordination with focal points.
- Provide the ACAC feedbacks for the refinement of the Airbus ProSky analysis and recommendations and actions plan, further coordination with ANC (Air Navigation Committee) chairman.
- Facilitate the development of the study and ensure the fulfilment of SOW.
- Facilitate the necessary inputs to promote the study result at the regional and international level, through the ACAC magazine, website, presentations during ANC, council and assembly meeting, and as appropriate during the regional and international meeting and conference.
- Present CNS/ATM study progress reports during the ACAC air navigation committee meetings.

4 Methodology/Approach

This section describes the methodology and approaches used throughout the study consistent with the SOW, and include (1) work teams, (2) data identification and collection, (3) comparative analysis, and (4) baseline ASBU Block descriptions.

The Airbus ProSky Team used an effective approach to the ATM Study. The effort necessitated using a highly qualified and diverse team of multi-discipline industry experts in not only studying aviation systems, but with real-world experience managing them and implementing major new capabilities and system enhancements. The Airbus ProSky Team will draw upon the expertise of its companies and Airbus for world leading aviation expertise to form the core of the ATM Study Team.

Further, with the wealth of knowledge resident within these organisations, Airbus ProSky has access to a wealth of other resources within Airbus, as well as a number of whom have experiences and relationships within the Middle East as they have with airspace regulators, ANSPs, stakeholders, governing bodies and international organisations throughout the region, and globally. These credible relationships will be valuable in ensuring the study is collaborative and inclusive regional aviation stakeholders and ANSPs, in addition to gaining the necessary buy-in to make the study successful.

While the RFP outlined a study approach predicated on providing updates to the previous study, the breadth of changes in the aviation environment and regional environment would render such an approach to have only minimal benefit. As a result, Airbus ProSky will approach will be focused on both 2030 needs and the nearer term requirements that could be realised by 2020 and 2025. The overall approach to the ATM Study is shown in Figure 10.

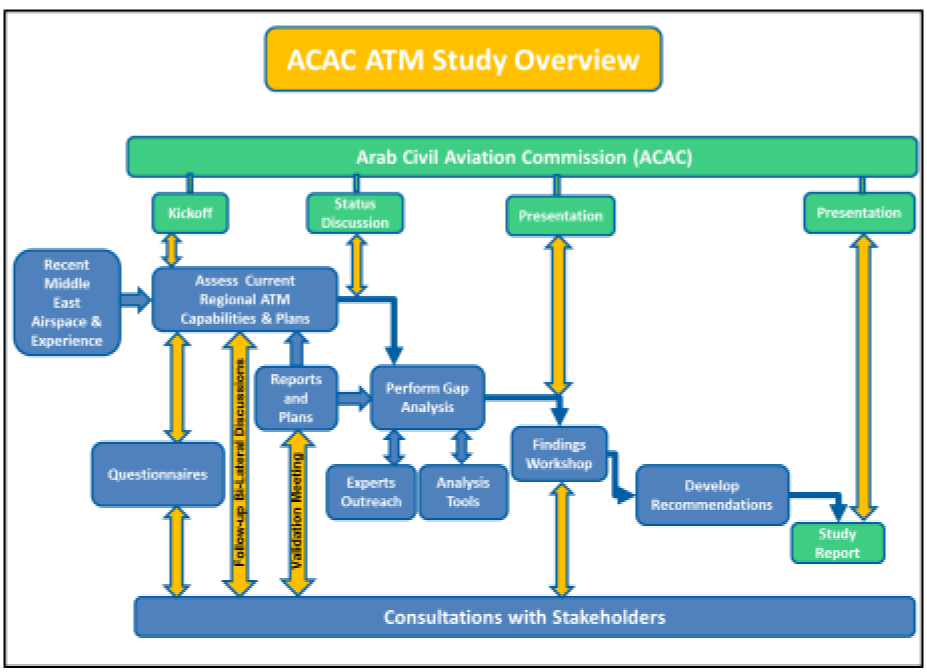


Figure 10: ATM Study Approach

4.1 Project Work Team

The work project team is depicted in Figure 11, and consists of recognised experts in their fields of operations spanning many years of operational, administrative, and managerial air traffic and analytical experience.

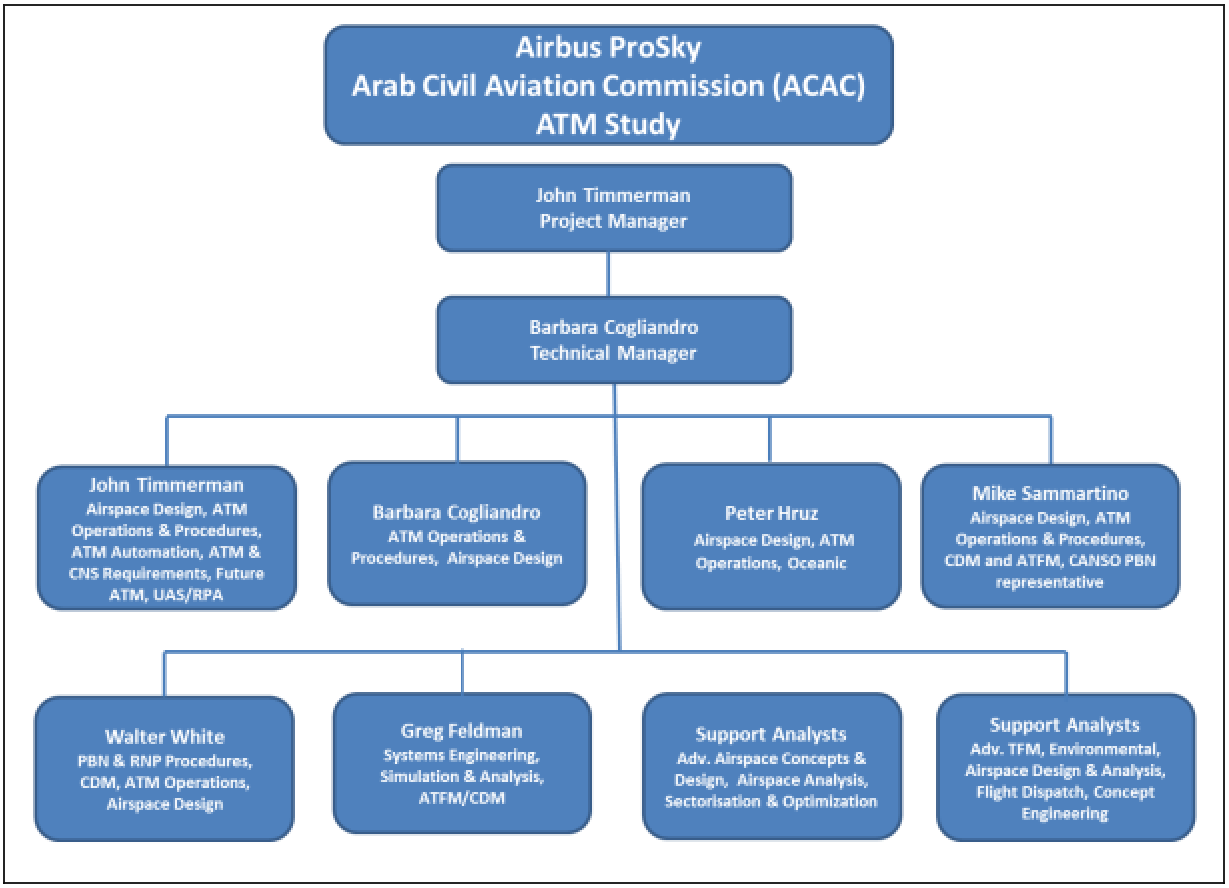


Figure 11: Work Project Team

4.2 Airbus ProSky Program and Technical Managers

Airbus ProSky provided both a Program Manager and Technical Manager. The Program Manager is the main point of contact (POC) for the ACAC and is responsible for high-level programme schedules, management to the major milestones, and contract management. Contract management for clarifications, modifications, and amendments is performed in close coordination with the Airbus ProSky contracts team and the ACAC contracts team. The Program Manager provides periodic reporting on status, next steps, milestone tracking, and outstanding risks.

The Program Manager was supported by a Technical Manager regarding detailed task-level implementation plans and resolution of technical issues affecting major milestones associated with the implementation and trial period. The Technical Manager worked closely to coordinate technical efforts across the project. The Technical Manager was the technical POC for the ACAC and is responsible for the detailed implementation plan, professional services, resource assignments, technical project management, and resolution of technical issues. The Technical Manager closely coordinates with the Program Manager, provides frequent status updates, and supports relevant activities and the resolution of issues.

4.3 ACAC Project Team and Program Managers

ACAC provided a Project Manager and State focal points. The Project Manager was the main point of contact for the ACAC and is responsible for coordination of the programme schedules, management to the major milestones, and contract management. The Program Manager provided periodic reporting on status, next steps, milestone tracking, and outstanding risks to the ACAC air navigation Committee, which has been tasked by the ACAC executive council to follow up the CNS/ATM study.

The State focal points were responsible to provide technical input and data as requested and in the required timeframe.

4.4 Key Study Elements

Key elements of the 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 International Civil Aviation Organization (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 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 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

4.5 Study Phases

The Airbus ProSky 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 provides 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 Airbus ProSky 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

4.5.1 Analysis Framework

The Airbus ProSky approach used an established framework to examine and analyse in each of the above dimensions what should resonate with the key stakeholders and with whom "buy-in" of the recommendations will be sought. We used a Political, Operational, Economic, and Technical (POET) framework to provide a broader context and perspective of the issues that need to be considered in the planning process.

4.5.2 Stakeholder Coordination

Stakeholder involvement and consultation is essential to the effectiveness of the study and its acceptance. The Airbus ProSky Team approach is to first leverage our existing stakeholder relationships and knowledge of their objectives and concerns to form the basis to start stakeholder consultation. Although we sought input from international and major stakeholder organisations such as the regional representatives for ICAO, International Air Transport Association (IATA) and Civil Air Navigation Services Organization (CANSO), as examples; very little input was received. We relied on both ACAC aviation sector relationships and the standing of Airbus ProSky in the aviation industry to foster stakeholder involvement in the study.

The Airbus ProSky Team plan for stakeholder engagement for the ACAC ATM Study development is detailed in Table 4. In planning, we have assumed that these events will be nominally conducted through coordination with the ACAC.

Table 4: Stakeholder Engagement (as proposed)

Stakeholder Engagement Event	Event Type	Months after award	Notes/Explanations
Plans and Capabilities	Questionnaires	2 – 3	Obtain Plans & Airspace needs
Bi-Lateral questionnaire follow-up	TELCON and Correspondence	3 – 4	Obtain Plans & Airspace needs
Confirmation of data and responses	Workshop	5	Proposed location: to be determined (TBD)
Findings Workshop	Workshop	9	Proposed location: TBD
Final Report Presentations	Presentation	11	Presentation at ACAC Headquarters

Through ACAC facilitation, we collated the information from the earlier study effort. The initial outreach was conducted through questionnaires to the various national civil aviation authorities, ANSPs and stakeholder organisation(s).

We worked closely with ACAC in the preparation of stakeholder presentations and questionnaires. We viewed it as vital that there is agreement with and approval of all materials presented to stakeholders.

4.5.3 ACAC Coordination

Airbus ProSky believes that a close-working relationship with the ACAC and routine interactions are essential to a successful study effort. Fundamentally, the Airbus ProSky Team approach was to discuss upcoming activities with the ACAC and get their concurrence before moving to the next phase of the study. Our approach was to provide a "quick look" briefing at the completion of all intermediate phases. For the final report, we are coordinating findings and recommendations with the ACAC prior to the associated stakeholder sessions.

At the kick off, Airbus ProSky discussed the proposed study approach with ACAC and work collaboratively to ensure there is common understanding and agreement before proceeding. Because of the number of nations within the study scope, Airbus ProSky needs ACAC designate a Point of Contact (POC) in their organisation to provide guidance and facilitate coordination.

4.6 Communications Plan

Table 5 represents the communications plan for the ACAC Study.

Table 5: Communications Plan

Comm Type	Objective of Communication	Medium	Frequency	Audience	Owner
Kick-off Meeting	Review project objectives and management approach	- Face to Face	Once	- Project Sponsor - Project Team - Stakeholders	Project Manager
Project Team Meetings	Review status of the project with the team	- Face to Face - Conference Call	Weekly	- Project Team	Project Manager
Technical Team Meetings	Discuss and develop technical solutions	- Face to Face	As Needed	- Project Technical Staff	Technical Lead
Monthly Project Status	Report on the status of the project	One Interim face-to-face meeting	Monthly TELCON	- Project Management Office (PMO)	Project Manager

Comm Type	Objective of Communication	Medium	Frequency	Audience	Owner
Meetings		- Conference Call			
Project Status Reports	Report on the status of the project including activities, progress, and issues	- Email	Monthly	- Project Sponsor	Project Manager
				- Project Team	
				- Stakeholders	
				- PMO	

The Airbus ProSky Team requested ACAC representatives accompany the technical teams to the consultations to meet with aviation stakeholders and representatives of Flight Information Regions (FIRs). The consultations had an opportunity for the technical team to ask questions and discuss issues of importance from the stakeholders' point of view, to the extent that such stakeholders were available.

4.6.1 Approach Rationale

Airbus ProSky understands how to approach an intricate ATM Study such as required by the ACAC. Our approach relied on highly skilled respected industry experts with experience in not just studying, but also in managing complex aviation system elements and working with stakeholders. We presented solutions primarily relying on the expert assessments that will most importantly ensure safety and enable the progression towards higher capacity and a more efficient aviation system in the Middle East and North Africa. The team has broad and expert experience supporting analysis and changes to airspace, ATM procedures, and CNS infrastructure brings credibility to the ACAC ATM Study.

4.7 Methodology

The Airbus ProSky Team methodology for the ACAC ATM Study was consistent with the approach described earlier. Table 6 provides a depiction of the major study elements and key aspects that were examined.

Table 6: 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

4.7.1 Study Phases

In the following sections, we provide further detail on our approach and how we conducted study activities.

4.7.1.1 Kick Off

Airbus ProSky Team approached the study kick off in a manner that reflects the importance of starting the study prepared. This attention to detail and timeliness assures the ACAC that we are ready to begin the study and focused on ensuring a successful outcome for the ACAC, the Middle East and North Africa

We prepared for the kick off, by leveraging the Airbus ProSky's extensive knowledge of the Middle East region understanding of stakeholders concerns, plans and interests and by reviewing the various applicable reports and plans. A number of the Airbus ProSky representatives who are participating in the ACAC ATM Study have recent experiences working with UAE General Civil Aviation Authority (GCAA) Airspace stakeholders in implementing capabilities in the UAE and participating with on-going current efforts for improving aspects of the UAE aviation system. The familiarity of the Airbus ProSky Team with the Middle East airspace and ATM system effectively negated the traditional start up needs. The experts on the Airbus ProSky Team have much familiarity with such study efforts and the needed to get started quickly and effectively.

At the kick off, we presented the ACAC with a current project plan reflective of the actual start date and a draft presentation and questions for the first round of stakeholder sessions. We prepared to work with the ACAC onsite to finalise the draft presentation and questions and prepare for scheduling discussions and coordinating stakeholder sessions.

As addressed earlier in this proposal, the Airbus ProSky Team entered into a close-working relationship with the ACAC as essential to the study success. We discussed the specifics of that working relationship and key interface elements. We recommend bi-weekly communications between the Study Team Project Manager and the ACAC, with in-person meets on a nominal quarterly basis.

Terms of reference, roles and responsibilities of the Project Team and ACAC were discussed and fundamentally agreed to.

In addition, according to "NO COUNTRY LEFT BEHIND" approach,, the associated mitigation to the risk of insufficient data collected from some concerned States, due to the political situation in the region was recognised as a risk that could lead to delay or to a limitation of the scope of the study or result in difficulties in the development or acceptance of the study conclusions.

4.7.1.2 Stakeholder Data Gathering and Questionnaires

The Airbus ProSky Team worked with ACAC to obtain stakeholder input primarily through use of questionnaires. As addressed earlier, we coordinated the content of the questionnaires through ACAC as well as relied on ACAC to provide the interface with the ACAC members for responding to the questionnaires and facilitating follow-up discussions. Near the end of the data gathering effort, the Airbus ProSky Team conducted a workshop with the ACAC members to review and confirm the overall input received. The stakeholder responses and updates resulting from the follow-on discussions were provided to ACAC to support further updates in the future of the CNS/ATM study.

To affect a reliable, secure and efficient means of transferring potentially large volumes of data, a secure File Transfer Protocol site had been established for: (1) ACAC, (2) each ACAC Member State, (3) other identified stakeholders, and (4) availability for future FTP sites. Figure 12 illustrates the collaboratively designed data delivery flow process used to securely transfer data between project team members.

From the onset of this study 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. Realizing the project constraints (time and resources), the project team supplemented ACAC Member State provided data with recently collected data 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 project team by providing a highly detailed perspective of a segment of the overall ACAC jurisdictional environment.

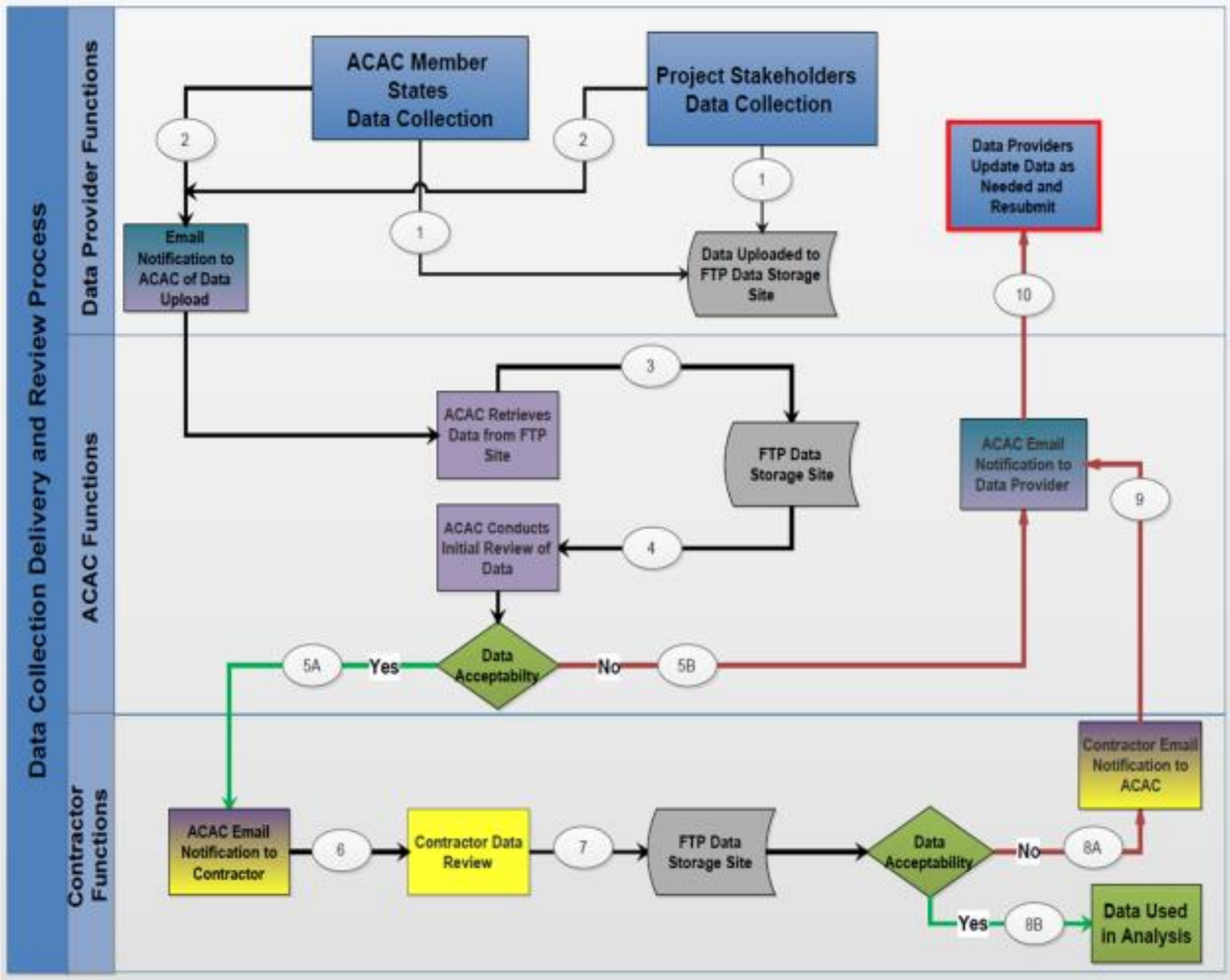


Figure 12: Data Delivery Flow Chart

4.7.1.3 ATM Assessment

The Airbus ProSky 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 ATM capabilities in the Middle East and North Africa. The Study team reviewed the Aeronautical Information Publications (AIPs) applicable to each of the ACAC nations. The Airbus ProSky Team will also leverage the familiarity and recent presence and stakeholder interaction in the UAE and surrounding countries to formulate a stakeholder briefing and questions. Of particular interest were the diverse stakeholder assessments of current and projected capabilities, concerns and needs.

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.

The Airbus ProSky Team made assessments of current ATM capabilities that will deliver accurate ATM procedures for safe, orderly, and efficient ATM within the Middle East and North

Africa while considering the needs/limitations of the stakeholder community. Focus areas will include but not be limited to:

- ATM – current operating procedures and agreements with surrounding ANSPs and FIR flight operators, flow rates internal and adjacent within the Middle East and North Africa, regional constraints and their mitigation planning, intra-/inter-facility ATM communication and data exchange capabilities, and ATM decision support tools (DSTs).
- CNS Infrastructure – operating and technological constraints within communications, navigation, and surveillance capabilities within the Middle East and North Africa FIRs that are affecting adjacent FIR operations.

Following the stakeholder sessions, we analysed the information from the stakeholder sessions combined with information from reference reports and plans. A briefing was generated and presented to the ACAC prior to starting the subsequent Gap Analysis Phase. The briefing to the ACAC Team present, with the general team participating by TELCON.

4.7.1.4 Gap Analysis / Findings

Key to a gap analysis is deciding on the points in time the gap will be assessed against. The Airbus ProSky 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 gap analysis provided assessments in terms of the major element identified in the approach section of the proposal as applicable to all phases of the study. In performing the gap analysis, two factors were be considered primary and cannot be compromised; specifically safety and security.

The Airbus ProSky Team evaluated gaps in capabilities to meet forecasted activity demand and expected ABSU functionality using a need – capability model similar to that shown in Figure 13.

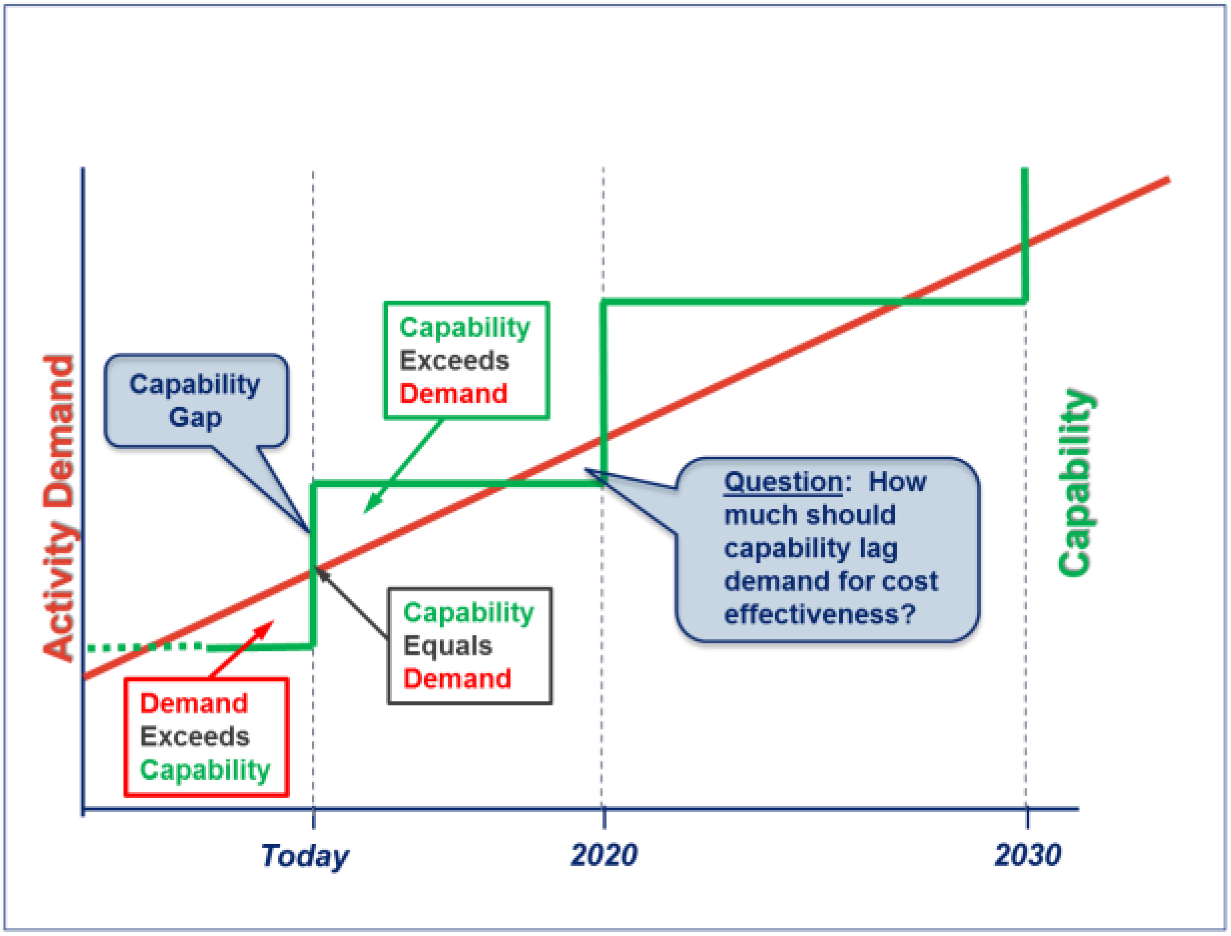


Figure 13: Growth – Capability Model

The assessment included a Comparative Analysis relative to:

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

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

The following references were used to identify dependencies between the capability needs and related technologies and processes, see Table 7:

1. ICAO ASBU
2. ACAC ATM Study Final Report recommendations
3. Middle East and North Africa ATM planning documentation
4. Checklist of items projected to be of specific interest to the ACAC are identified below:

Table 7: Enabling Technologies

Technology Area	Candidate Enabling Technology
Global Navigation Satellite System (GNSS)/CNS support technologies including Controller Pilot Data Link Communications (CPDLC)	Automated assignment and communication of cleared procedures and Required Time of Arrival information directly to aircraft reduces controller workload, improves efficiency, and enhances safety.
Simulator systems & Training requirements	Closed-loop test beds that provide an offline environment for testing and training accelerate the introduction of new procedures and technologies into the operational environment.
Flow Management	Strategic, Pre-Tactical, and Tactical flow management provide demand-capacity balancing for aviation resources (e.g., airports, airspaces). With the introduction of Area Navigation (RNAV) procedures in an airspace design, smoothing demand upstream of the RNAV procedures allows efficient use of the procedures and the realisation of the reduced operating costs and controller workload.
On board system capabilities to enhance Air Traffic Control (ATC) network	Aircraft equipage and crew certification to utilise defined RNAV procedures are critical to realise the full benefits available from an airspace redesign and supports the design and implementation of Best Equipped – Best Served airspaces.
Dynamic Airspace Management Tools	Due to the dynamic nature of the Middle East and North Africa aviation environment, including the growth of multiple international airports in close proximity, tactical dynamic airspace management, including sectorisation and procedure design, will allow automated airspace changes to reflect the current demand profiles. This will improve efficiency across the Middle East and North Africa and reduce controller workload.
Weather resilience systems	Weather has a direct impact on aviation capacity, in the air and on the ground. Airspace designs that incorporate PBN procedures to separate traffic flows that account for airport and runway specific approach, departure, and missed approach procedures can be resilient to weather changes.
Any other technologies as deemed appropriate	Stakeholder ground system enhancements can also be an enabling technology that supports the implementation of an airspace design. For example, Collaborative Decision Making (CDM) involvement by aircraft operators can improve the efficiency of tactical airspace utilisation when insights into the operational picture, expected demand and capacity, and alternative routings or flight substitutions are part of meeting the business objectives of the aircraft operator.

The collection of enabling policy, procedures, technologies, and processes and corresponding availability supported the final report development. Based on the criticality of various ATM capabilities or dependence on an enabling policy, procedure, technology, or process, alternative policy, procedures, technologies, and capabilities may be evaluated to reduce the implementation risk.

The Airbus ProSky Team followed a similar process as for the requirements and design segments of the project by first collecting relevant data and obtaining input and buy-in from stakeholders.

The Airbus ProSky Team integrated transition approach, policy implications, and enabling capabilities into the final report.

4.7.2 Final Report

The Airbus ProSky Team developed an integrated Final Report containing pertinent information from the previous deliverables. The draft of the report was provided to ACAC review prior to the completion of the contract period of performance.

Different from other report deliverables, the Airbus ProSky Team expected that the Final Report may require coordination with higher organisational levels; as a result, it may take a few weeks longer to provide the team with comments. Once those comments are received, the Airbus ProSky Team updated this Final Report.

4.7.3 Stakeholder and Executive Presentation

The Airbus ProSky Team proposed that the project not stop with the production of the Final Report. We recommended that appropriate presentations be developed for stakeholders and executives. We would be pleased to support those presentations if so requested by the ACAC.

4.7.3.1 Stakeholder Presentation

Understanding the importance of stakeholder involvement to the ACAC, the Airbus ProSky 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 be given to making the presentation’s key aspects available throughout the Middle East and North Africa civil aviation authorities, ANSPs, and stakeholder representative organisations.

5 Stakeholder Consultation

From the onset of this study 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. Realizing the project constraints (time and resources), the project team supplemented ACAC Member State provided data with recently collected data 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 project team by providing a highly detailed perspective of a segment of the overall ACAC jurisdictional environment.

In both cases, the ACAC overall region and the UAE localised, questionnaires were a major source of information and when possible supplemented with on-site work group and work shop activities, with the latter being more prevalent within the localised UAE project (which included the countries of – UAE [and its major flight operators – Emirates Airlines and Etihad Airways], Bahrain, Oman, Qatar, and Saudi Arabia). In neither case, was information provided from 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 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, the unique jurisdictional overlap is illustrated in Figure 14. The questions developed were intended to provide the project contract team with the necessary data needed to obtain an overall customer perspective of ATC operations and flow management within the ACAC region. Unfortunately, no responses were provided. The questionnaire was and is available online through the AACO website: www.acac.org.ma

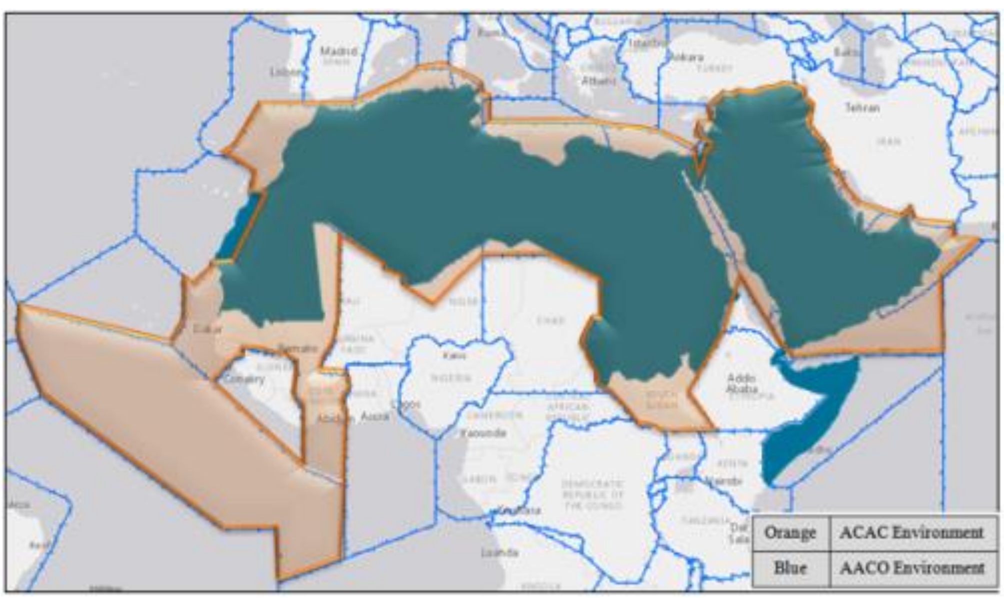


Figure 14: Jurisdictional Overlap

Table 8 depicts the outreach timelines used for both the ACAC CNS-ATM Study Update and the UAE Airspace and Procedure Redesign.

Table 8: ACAC and other Regional Stakeholder Outreach Timelines

ACAC and other Regional Stakeholder Outreach Efforts			
Meeting Type	**Primary Stakeholders**	**Type Activity**	**Dates**
On-Site	ACAC Organization	CNS-ATM Study Objectives and Status Update	14 December 2015
Teleconference	ACAC Mgmt.	Data Collection Status Update Meetings	Periodic
Teleconference	ACAC Mgmt.	ATM Assessment Briefing	18 March 2016
On-site	ACAC Organization	CNS-ATM Study Workshop - Data Gathering & Confirmation Activities	7 April 2016
On-site	ACAC Organization	Presentation	7 April 2016
UAE Regional Stakeholder Outreach Efforts			
On-site	SZC, Project Technical Team (PTT), National Aviation Stakeholder Advisory Committee (NASAC)	Work Groups & Work Shops	Multiple 2015
On-site	SZC, DANS, ADAC, GCAA,	Data Gathering & Requirements Identification	Multiple 2015
On-site	SZC, PTT	Data Gathering & Requirements Identification	Multiple 2015
On-site	SZC, Airbus ProSky	Development Activities	Multiple 2015
On-site	Bahrain	Regional Data Gathering	24 March 2015
On-site	Oman	Regional Data Gathering	24 March 2015

ACAC and other Regional Stakeholder Outreach Efforts			
Meeting Type	**Primary Stakeholders**	**Type Activity**	**Dates**
On-site	Qatar	Regional Data Gathering	29 March 2015
Teleconference	Saudi Arabia	Regional Data Gathering	19 May 2015
On-site	SZC, PTT	Work Shop - Review, Affirmation and Advancement	Multiple 2015

5.1 Stakeholder Data Availability Impacts

Assessment outcome is directly linked to (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. A careful review was conducted of the data supplied, when it was received and available public source data. As a result, judgments were required by the contract team to determine which FIRs provided sufficient and effective data in order to be able to conduct a timely and meaningful analysis.

Table 9 depicts which States were included in the study and which were not as determined using the criteria noted below:

- Category 1 States - those States included in the study
- Category 2a States - those States not included in the study due to data being submitted beyond the March 18, 2016 cut-off date
- Category 2b States - those States not included as they did not submit data

NOTE: The Category 2a supplied data is being retained by the study team, and if there were a timely resource modification during the 2-3 month ACAC review period, those category 2a States could have their data analysed and added to the overall project study.

Table 9: State Study Inclusion Status

State Study Inclusion Status			
Category 1		Category 2a	Category 2b
Algeria	Oman	Tunisia	Iraq
Bahrain	Palestine	Mauritania	Jordan
Egypt	Qatar		Kuwait
Lebanon	Saudi Arabia		Libya
Morocco	Sudan		Syria
UAE			Yemen

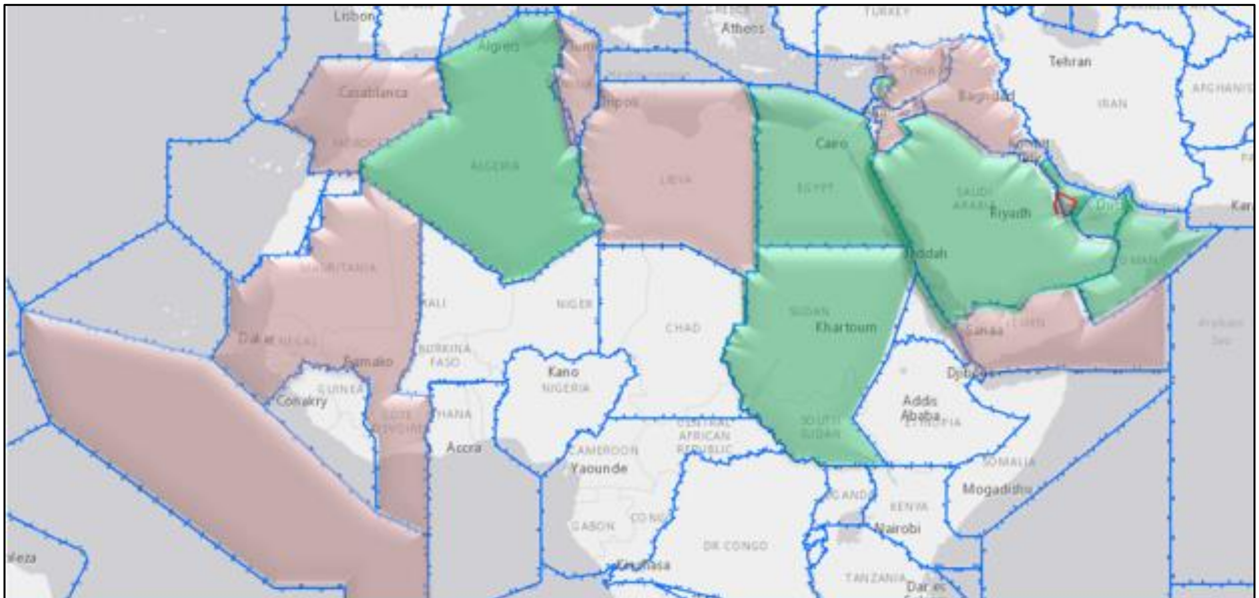
Table 10 indicates the responses obtained for both the initial and supplemental questionnaires and the effectiveness of the data provided.

Table 10: 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	ND	ND	ND	ND	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	DP	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 UAE airspace redesign project.

Category 1 and 2 States are illustrated in Figure 15 graphically depicting the study area.



ACAC FIR ASSESSMENT STATUS										
Category 1 FIRs	Algeria	Bahrain	Egypt	Lebanon	Oman	Palestine	Qatar	Sudan	Saudi Arabia	UAE
Category 2 FIRs		Iraq	Jordan	Kuwait	Libya	Mauritania	Morocco	Syria	Tunisia	Yemen

Figure 15: Category 1 and 2 State Illustration

6 Assessment Process and Criteria

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

6.1 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 16 in section 6.1.3.

6.1.1 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 project team derived additional data from publically available sources and used it to help augment missing or insufficient data provided by questionnaire respondents.

6.1.2 Data Processing:

The processing activity commenced using the data collected from the; (1) Initial Questionnaire, (2) Supplemental Questionnaire, and (3) data derived through 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 project 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 Middle East) ANSPs. These requirements are listed in great detail in the following sections (6.1.3 and 6.2).

6.1.3 Data Assessment:

As the process in Figure 16 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.

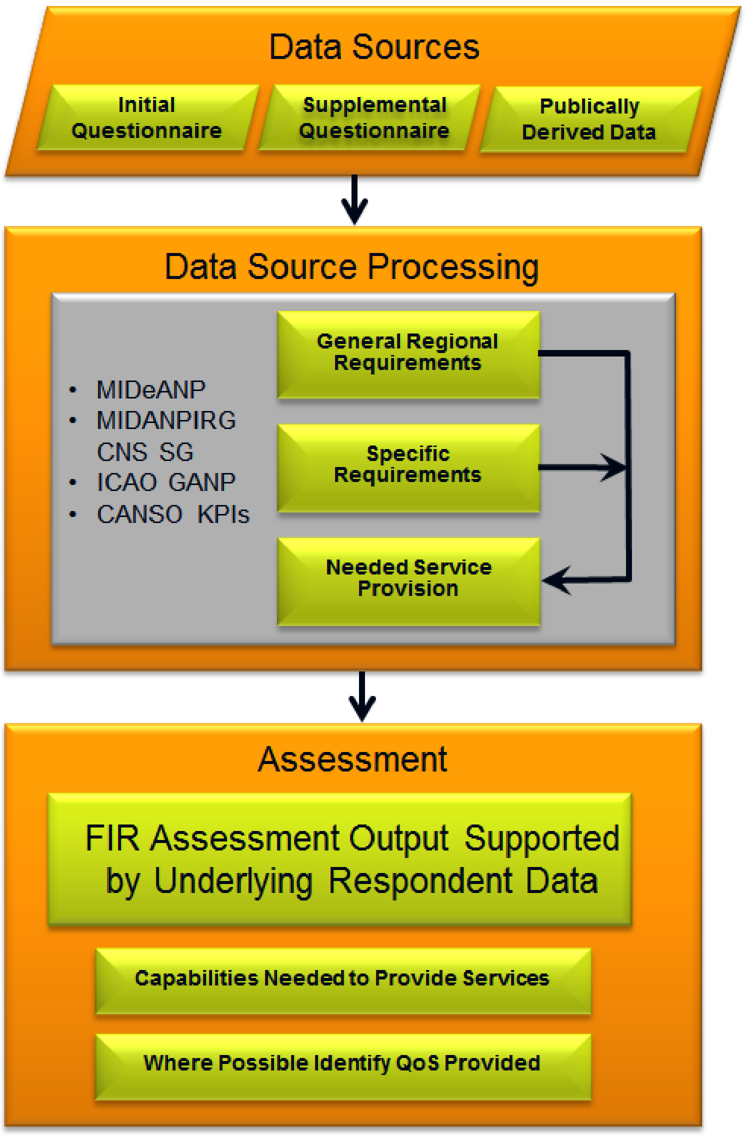


Figure 16: Assessment Process

6.2 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 Study 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.

6.2.1 Communications

6.2.1.1 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 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 inter-operation 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 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.

6.2.1.2 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 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 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), aerodromes 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, recognizing 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.

Aerodromes 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.

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 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 automated exchange of flight data between ATS units to enhance the overall safety of the ATM operation and increase airspace capacity.

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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.

6.2.1.3 Current Aeronautical Telecommunication/Datalink Provided Services

Classification of the aeronautical telecommunication 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 telecommunication 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 telecommunications 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 telecommunication service which processes or displays air traffic control data (including aviation meteorological data) for use by an ATS provider.

6.2.1.4 Current Aeronautical Telecommunication/Datalink Facilities

Classification of Facilities (Capabilities)

The following list classifies the kinds of aeronautical telecommunication 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;

6.2.1.5 Current Aeronautical Telecommunication/Datalink Quality of Services

Quality of Services

The following list classifies the kinds of aeronautical telecommunication 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 land line 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;

6.2.2 Navigation

6.2.2.1 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 take-off 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 air navigation service providers, 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 aerodrome operations

At aerodromes 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 aerodrome, 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, air navigation service providers 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.

6.2.2.2 Specific Regional ATM Requirements

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

6.2.2.3 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

6.2.2.4 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;

6.2.2.5 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 is 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;

6.2.3 Surveillance

6.2.3.1 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 aerodrome, specific minima 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 aerodrome 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 are 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 aerodromes 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 aerodromes surrounded by significant terrain and obstacles, the availability of terrain and obstacle databases of an assured quality, made up by digital data sets that depict the ground surface in terms of continuous elevation values, and digital data sets on obstacles that constitute terrain features that have vertical significance in relation to adjacent and surrounding features and which are considered a hazard for 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.

6.2.3.2 Specific Regional Surveillance Requirements

The surveillance systems to be used in the (MID) Region(s) 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.

6.2.3.3 Current Surveillance Provided Services

Surveillance and alerting service is 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.

6.2.3.4 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. Back-up 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;

6.2.3.5 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;

6.2.4 ATM

6.2.4.1 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 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 air navigation service providers (ANSP) should apply the SSR Code Management Plan (CMP) approved by MIDANPIRG in order to ensure continuous and unambiguous aircraft identification.

States should inform the ICAO MID Regional Office 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.

Performance-based Navigation (PBN)

States' PBN implementation Plans should be consistent with the MID Regional PBN Plan.

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 organizing 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 on 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 a 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 MIDeANPvII

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 aerodromes1, at intervals of one half-hour at aerodromes as indicated in Table MET II-2. For aerodromes 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 aerodromes that are not operational throughout 24 hours, METAR should be issued at least 3 hours prior to the aerodrome resuming operations in the MID Region.

Meteorological Forecasts

Note: Tables referenced are contained in MIDeANPvII

In the MID Region, an aerodrome forecast, issued as a Terminal Aerodrome Forecast (TAF), should be for the aerodromes indicated in Table MET II-2.

In the MID 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 MID 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 aerodromes indicated in Table MET II-2.

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

Meteorological Requirements for and use of Communications

Note: Tables referenced are contained in MIDeANPvII

Operational meteorological information prepared as METAR, special (SPECI), and TAF for aerodromes 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 MID Region.

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

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

In the MID Region, the aerodromes 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.

Aerodrome 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 aerodromes to satisfy the provisions of aerodrome capacity assessment and requirement

Runway selection procedures and standard taxi routes at aerodromes 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 taxiing 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 aerodromes 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 aerodrome authorities and affected users.

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

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

Where restrictions in aerodrome capacity are identified, a full range of options for their reduction or removal should be evaluated by the aerodrome 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 aerodromes, airspace capacity has influence on the aerodrome capacity. If the declared capacity of a specified airspace has influence on aerodrome operations, this should be indicated and action undertaken to reach a capacity in this airspace corresponding to the aerodrome capacity.

Aviation System Block Upgrades (ASBUs), Modules and Roadmaps

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

Collaborative Decision Making

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

6.2.4.2 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 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 MIDeANPvII

In the MID 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 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 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.

6.2.4.3 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 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 minimizing 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 with 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 reorganizing airspace to maintain maximum efficiency.

Aerodrome Operations

Constraints on flights moving from 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. 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 to 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

Service provider offers services to airspace users to mitigate real time aircraft performance limitations.

Conflict management

Tactical management

Negotiated 4-D trajectories will receive 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 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 allow for collaborative decision making to occur among airspace users directly, without any involvement of an ATM service provider.

6.2.4.4 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 fits the complexity, volume and efficiency of the operation;
5. Effective and inclusive CDM procedures are in place;
6. Homogenous areas are in place as defined by MIDeANP;
   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 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, freq 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 aerodrome 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;
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;

6.2.4.5 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 polices 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 prober/alert, weather displays) are effectively and efficiently utilised;

6.3 Current Capabilities and Assessment

This section describes the (1) current capabilities of the region as determined from ACAC member provided information and other publically available data sources, and (2) provides where discernible an operational assessment of those capabilities. The assessment utilises the categorisation methodology, described in section 7 that is used to organise the ACAC region into a series of unique derivative groupings based on current capabilities, and airspace and aerodrome 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.

As described in section 6.2, a comparison was conducted of the ICAO and Regional Sub-Group requirements and guidelines 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 include: MIDeANP, CNS Sub Group Reports, GANP, CANSO KPIs, etc. Table 11**Erreur ! Source du renvoi introuvable.**, provides the reader with a cross reference of the location of the requirements and guidelines relative to each of the operational topics.

Table 11: Cross-Reference Guide

Operational Topic	Location
Communications	6.2.1 (6.2.1.1 – 6.2.1.5)
Navigation	6.2.2 (6.2.2.1 – 6.2.2.5)
Surveillance	6.2.3 (6.2.3.1 – 6.2.3.5)
ATM	6.2.4 (6.2.4.1 – 6.2.4.5)

The Study Team approached the assessment process by first determining if the capability was available then assessing the current usage of the capability or the quality of service. Capabilities include equipment; systems or procedures while quality of service is an assessment of how the equipment, system, or procedures is 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 Study Team. For example, if a State reported Controller Pilot Data Link Communications (CPDLC) was available the Study 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 contained in Table

12**Erreur ! Source du renvoi introuvable.** and Table 13**Erreur ! Source du renvoi introuvable.**.

Table 12: 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.
No Capability	The subject system/method is unavailable
No data	An assessment was not possible due to either no data was provided or data was insufficient perform an assessment

Table 13: 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 due to either no data was provided or data was insufficient perform an assessment

6.4 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 research team conducted web searches for publicly accessible 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. Firstly we received responses from approximately 50% of the States surveyed. Some of these States submitted both surveys, 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 research 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 maximizing current capabilities by ensuing 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 follow in the next sections.

6.4.1 Communication

Upon review of the data provided in the area of Communication we found the following:

- All the FIRs that provided data have VHF and 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 believed to be due to equipment limitations or radio coverage limitations.
- HF communications is present in 3 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.
- CPDLC (controller pilot data link communications) capabilities being pursed and most reported to currently have the 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) was assessed as highly capable, except in two High-activity FIRs where it was assessed as moderate capability.
- Search and Rescue procedures are in place but no data received indicating SAR agreements with surrounding facilities have been established and are in place.

- The number of inter/intra facility ATC coordination communication lines 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 indicate adequate lines available.
- Of the FIRs that responded, data link and land line performance was assessed as substandard in one High-activity FIR and marginal in the remaining FIRs with one exception. One medium FIR assessed performance as good.
- Most FIRs responding to the surveys indicated a 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 exist:
    - Amount of coordination – causes moderate impact
    - Airborne holding – coordination constrains 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. ADS-C may be being used in some North Africa FIRs to fill in coverage gaps
- 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 due to adjacent FIR capabilities.

6.4.2 Navigation

Upon review of the data provided in the area of Navigation we found the following:

- All FIRS have 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 NAVAIDs thereby limiting options to classic capability aircraft.
- Limited migration to GLS (Ground-Based Augmentation System Landing System) was reported.
- High-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., VORs, DME, TACAN, and 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 received regarding system status monitoring capabilities.
- System outage and/or service limitation notification process (i.e., NOTAMs) are in place and published in a timely manner for stakeholder notification and planning.
- Collaboration with stakeholders when developing navigation procedures is not generally present.
- Documentation of system outage and restoration metrics and analysis of same were not available.
- Of those that responded adequate system failure or degradation contingency planning is in place.
- The majorities of the ACAC FIRs either have or are developing PBN implementation planning as depicted in Figure 17**Erreur ! Source du renvoi introuvable.**.

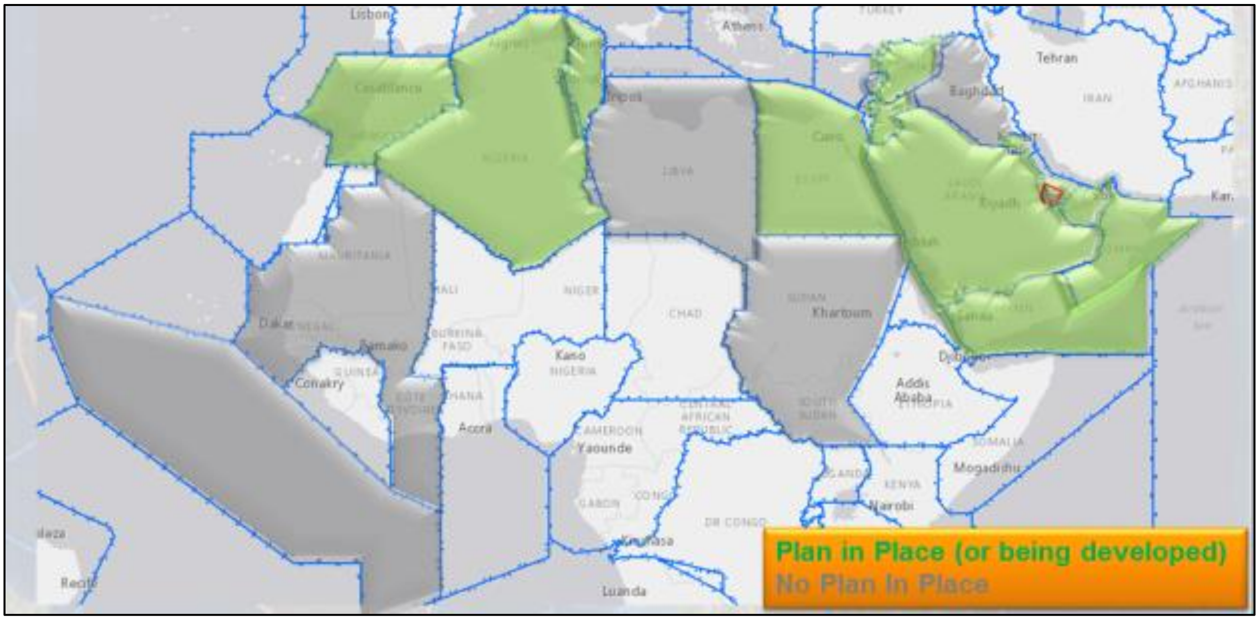


Figure 17: ACAC Regional FIR PBN Planning (Source: ICAO Air Nav Report 2015 and Surveys)

6.4.3 Surveillance and Automation

Upon review of the data provided in the area of Surveillance and Automation we found the following

- Most FIRs possess primary and secondary radar. One Low-activity FIR reported no primary surveillance radar but has Secondary only. However, gaps in coverage were reported as well as unreliable or intermittent coverage in at least one High-activity FIR.
- Backup radar capabilities limited
- No outages record or data was provided to determine the impact from a loss of radar.
- All FIRs responding to the surveys appear 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 indicates that ability is minimal.
- Interfaces with bordering facilities allowing coordination and automated transfer of data is minimal or non-existent throughout the Region
- No data was provided regarding Space-based ADS-B capability awareness and planning development. Minimal discussion or planning for space-based ADS-B capabilities
- ADS-B capability being pursued at most FIRs for ACCs and some Approach Facilities. It is expected to be operational by 2020 for most of those where planned, as depicted in Figure 18**Erreur ! Source du renvoi introuvable.**.
- ADS-C capability is operational in two larger FIRs, as depicted in Figure 19 .
- Indications are 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. That FIR indicated its compliance.
- Most FIRs reported the lack of automated inter-facility handoffs.
- All FIRs that responded indicate controllers have access to automation depicting pertinent radar and flight data and the ability to filter surveillance data to fit controller needs.
- Automated partial or complete flight data processing available in most FIRs that provided information.
- Automated flight coordination with adjacent airspace is very limited throughout the Region.
- Automated point-out capabilities are generally 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 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 a 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 volume of targets.
- Generally, automation does not support merging and spacing decisions except one High-activity FIR and one Medium-activity FIR reported that asset.
- Flow management automated information and future traffic levels automation is available in some High- and Medium-activity FIRs.
- Of the FIRs that provided information, surface surveillance currently available within two High-Activity FIRs and one Medium-activity FIR.
- Some, but limited, sharing of surveillance data between FIRs
- Inter/intra facility contingency plans for a loss of radar or automation are in place within the FIRs that provided information.
- Broad use of non-radar procedures in a radar environment across the Region limiting the benefits provided by surveillance capabilities and adding to controller and flight crew workload.
- Substantial increases in 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.

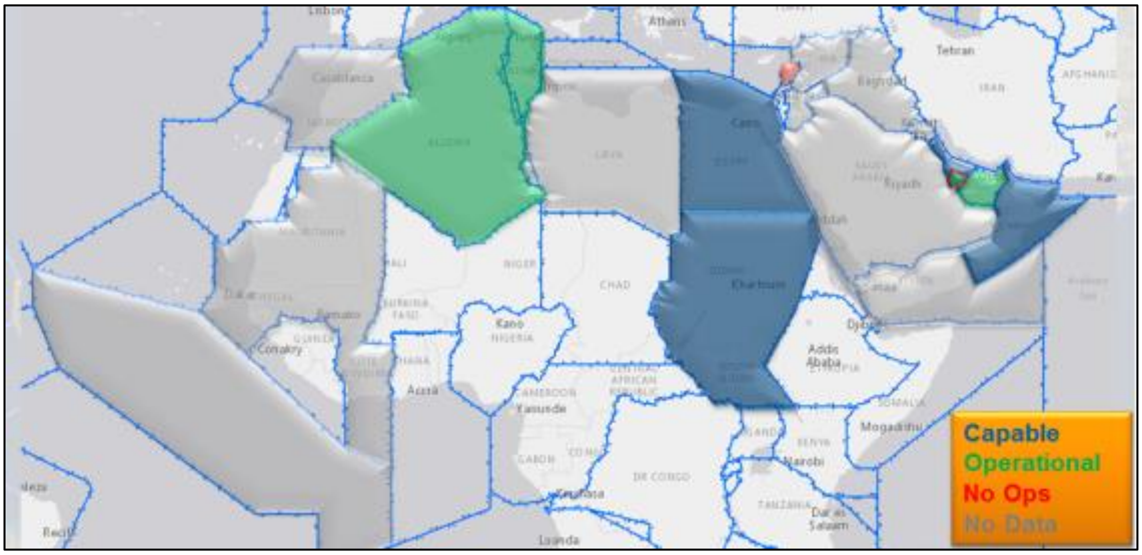


Figure 18: ACAC FIRs ADS-B-Out Capability (Source: Surveys, ICAO 2014)

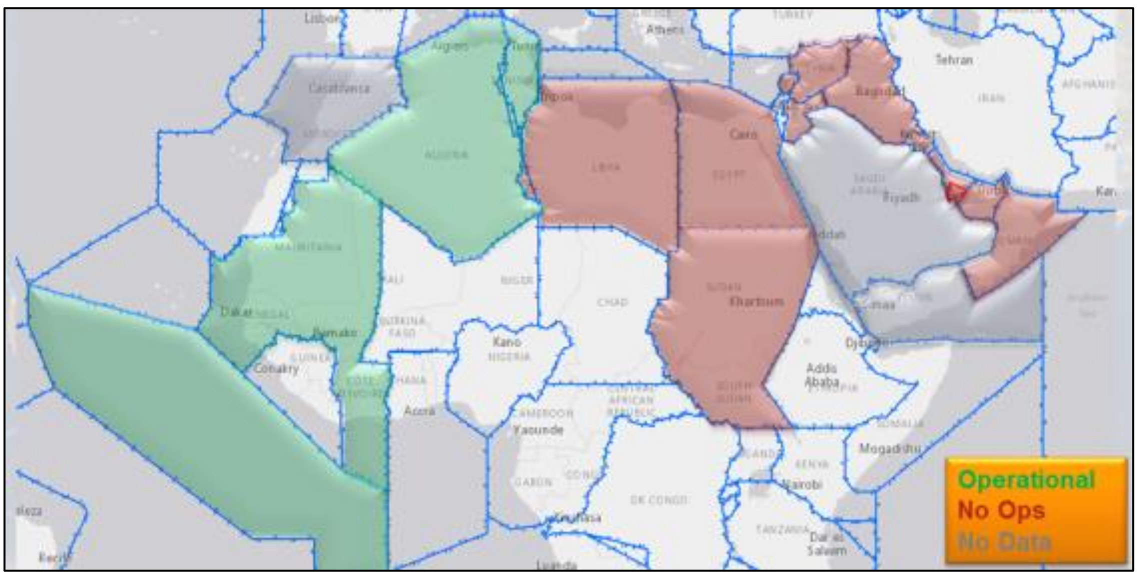


Figure 19: ACAC FIRs ADS-C Capability (Source: Surveys, ICAO 2014)

6.4.4 Air Traffic Management

Upon review of the data provided in the area of Air Traffic Management we found the following:

- Middle East traffic projections are the world's highest, resulting in sudden increases to traffic volume now impacting the ability of many FIRs to efficiently accommodate demand Advancements and efforts are being made in recognizing future demand capacity imbalances in several local FIRs and developing airspace modifications to accommodate traffic projections.

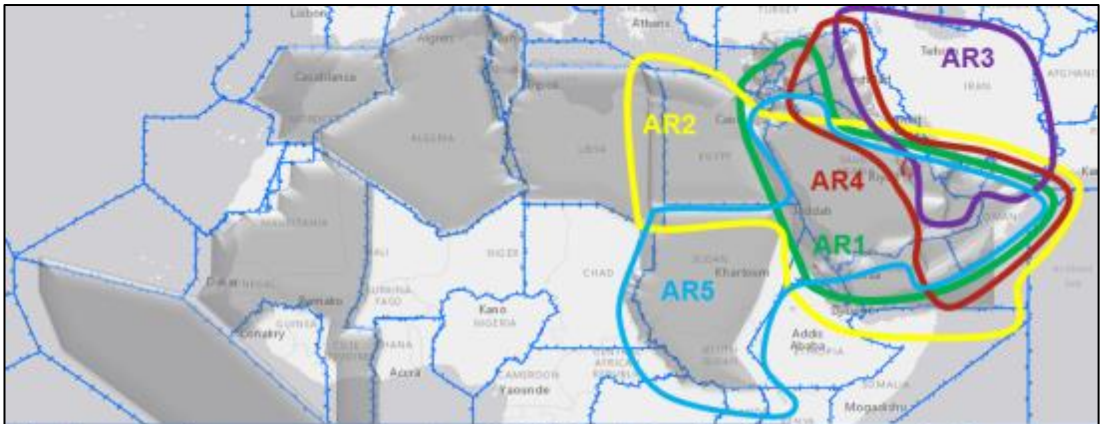
- Regionally the ATM systems are modern and highly capable but lack necessary integration to fully realise seamlessness and obtain maximum efficiencies in operations.
- Air traffic management at the local levels are moderately effective, yet when viewed as an integrated element within the region their effectiveness becomes minimally effective Collective Decision Making (CDM) activities at the operational level are expanding in select FIRs.
- Air traffic service provision and procedures in many cases is 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 limiting 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 attributed to Special Activity Airspace; however on micro regional level, Special Activity Airspace (SAA) operations such as UAE (OMR54) provide significant operational impact beyond the UAE FIR and require greater use of FUA.
- This is no indication that Visual separation is used other than at Aerodromes. 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.

6.4.5 Air Traffic Flow Management

Upon review of the data provided in the area of Air Traffic Flow Management we found the following

- 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.

- 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.
- Develop and analyse metrics to identify the areas of strength and weakness, i.e., Sector capacities and Route demand.
- 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. Encourage Stakeholder engagement in identifying focus areas and when considering procedure changes and/or establishing traffic management initiatives.
- 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 20 and Figure 21 requiring common detailed plans that foster the implementation of interoperable ATM systems and procedures that extend well beyond tier 1 facilities. Local impacts to 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
    - Substantially modified regional planning documentation and implementation strategies are probable
    - Regional support to local FIRs that require additional resources to streamline and reduce regional constraints through select airspace may be needed
    - 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 20: 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 21: 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 22.

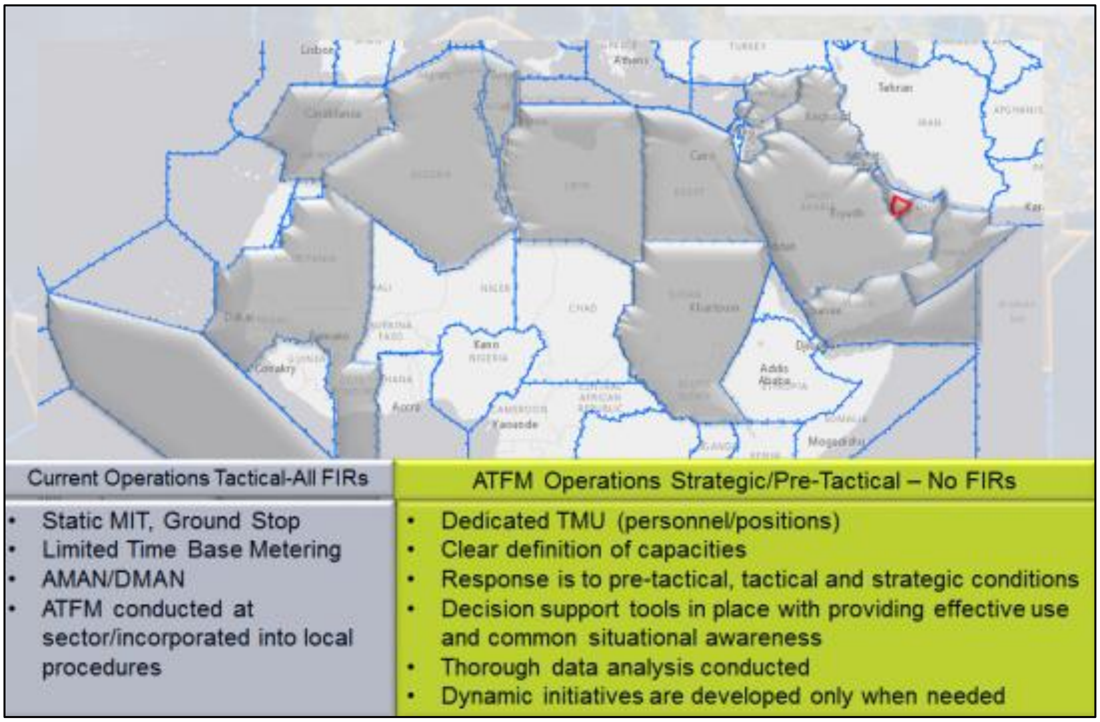


Figure 22: AFTM Capability usage (Source: Surveys, ICAO 2014)

6.5 Safety

For the purposes of studies such as this one, safety in nominally referred 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 indicating the current status of safety from these two perspectives.

6.5.1 Aviation Safety [2], [4]

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, referred to as: Regional Aviation Safety Group Regions (RASG-EUR, RASG-MID, and RASG-AFI) and are depicted in Figure 23

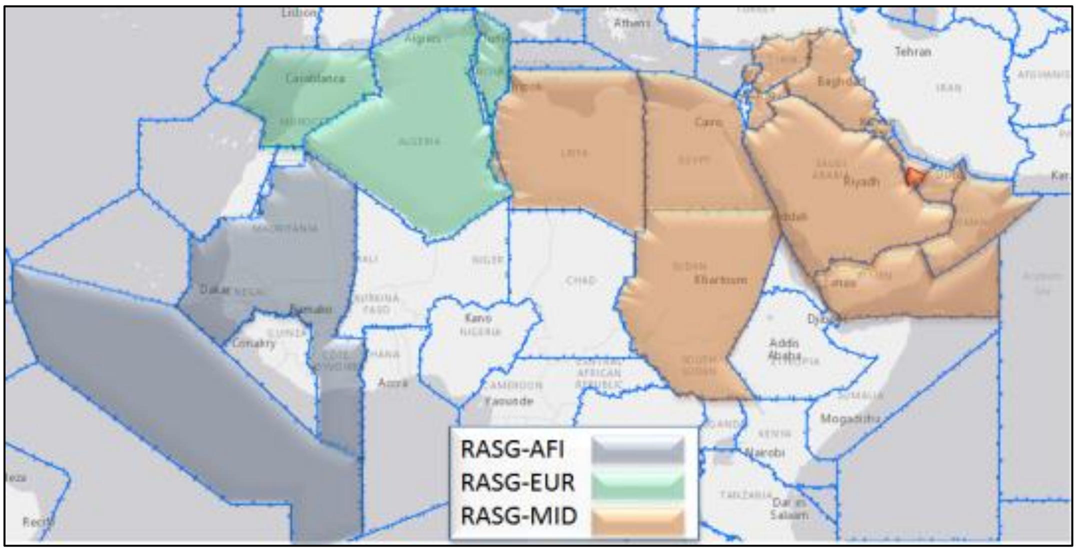


Figure 23: ACAC State Distribution among ICAO RASG Regions

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 indicating an effective safety implementation capability. Figure 24 illustrates those ACAC States above and below the global average [2].

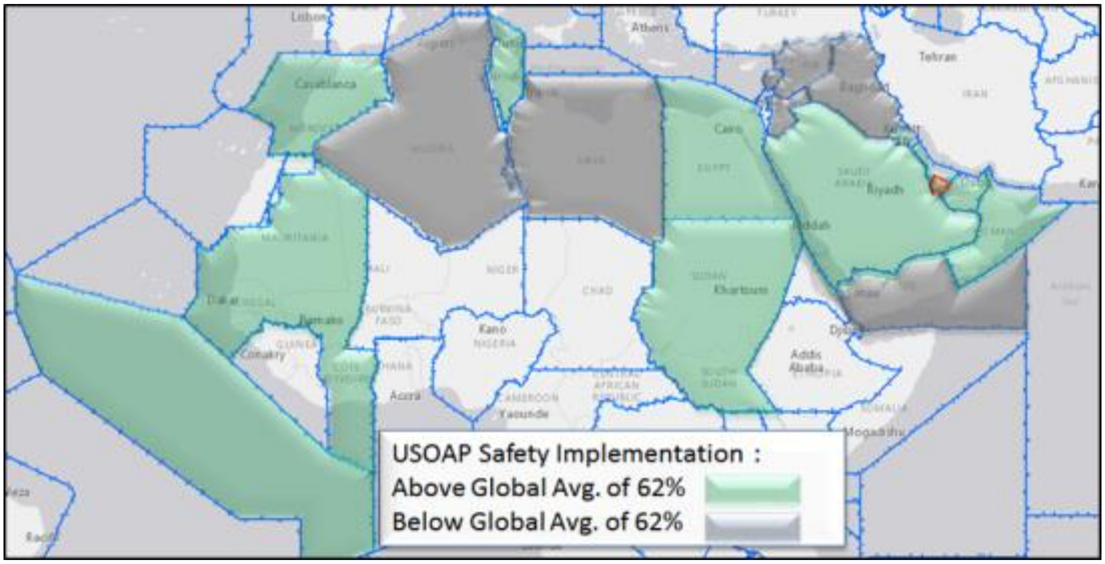


Figure 24: ACAC State Distribution Relative to Global Safety Implementation Averages

A further analysis depicts a safety parameter, as portrayed in regional accident statistics of commercial air transport within each RASG region. Table 14 and Table 15 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 14: 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 15: 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 AFI and PA RASG region's 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 25 depicts the percentage of accidents and related fatalities by RASG region.

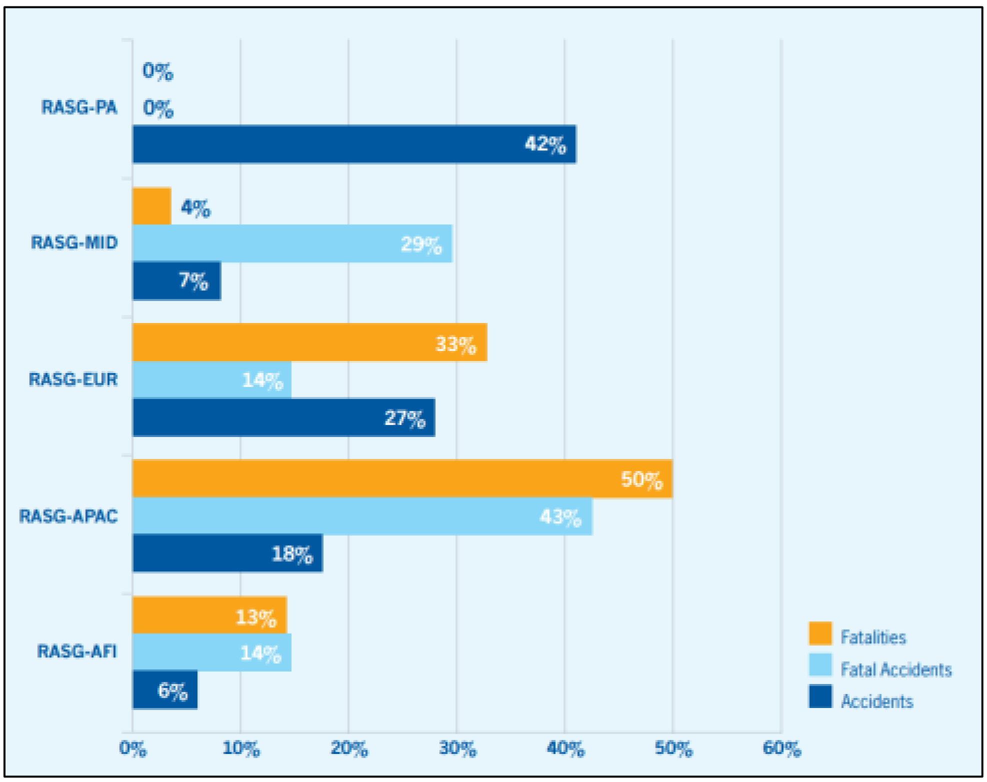


Figure 25: Percentage of Accidents and Fatalities per RASG Region

6.5.2 Airspace Safety Risk Classification [3]

Significant numbers of ACAC Member State FIRs have been classified based upon assessment of 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 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 16 and depicted in Figure 26

Table 16: 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, South Sudan, Egypt
Level 3	Caution	No 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.

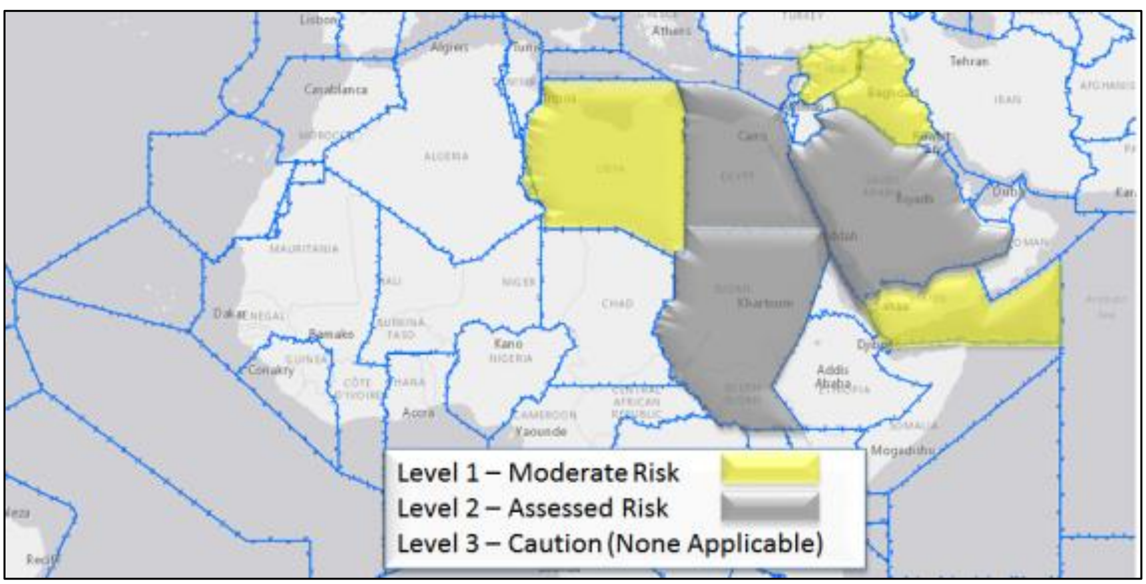


Figure 26: Risk Category Illustration

Data received on internal statistics regarding accidents, incidents and operational errors or pilot deviations was not provided to the Study 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 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 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 ACAC 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

7 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 Study 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 aerodromes in the FIR; and the total arrival and departure activity at the major aerodromes. 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 project team attempted to supplement and/or collect data from available public sources; however, only aerodrome 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:

- **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 Aerodromes** – for the purposes of this study a major aerodrome is one with more than thirty thousand total operations per year.
- **Aerodrome Activity** – activity within a one-year period for major airports as reported in the surveys and on public web sites if not reported by the State.

For the purposes of this study the Study Team defines a High-, Medium-, and Low-Activity FIR as follows, and depicted in Table 17:

- **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 aerodrome 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 aerodrome 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 aerodrome 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 17: Categorisation Criteria by Activity

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

7.1 Airspace Size

The study area includes the ACAC Member States illustrated in Table 1 (see section 2.1). Figure 27 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), 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 28. 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 27: ACAC Member State Illustration

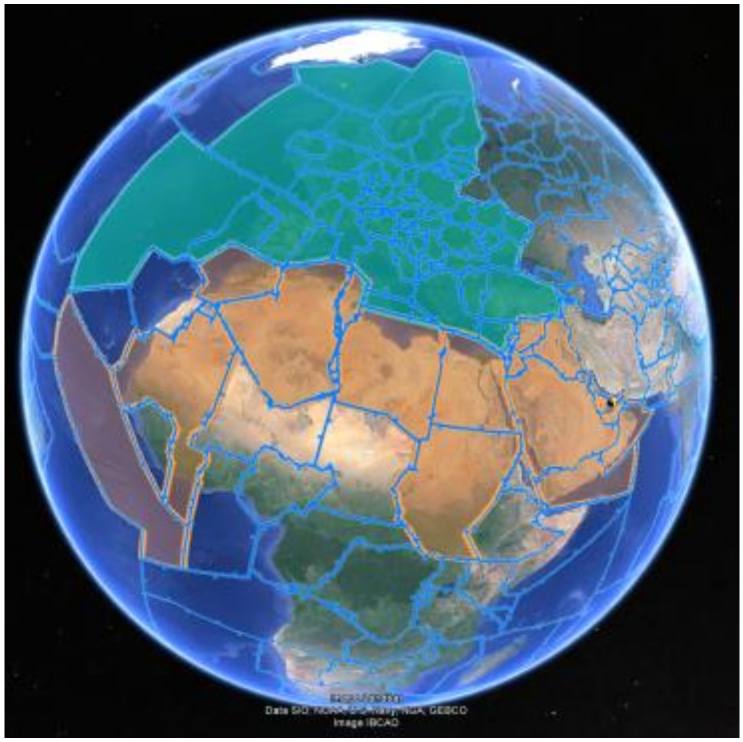


Figure 28: ACAC Jurisdictional Airspace Comparison with Europe

7.2 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 the 2014, 2020, 2025, and 2030 time frames are presented in two formats:

1. Figure 29 illustrates the range of raw density values in line graph format. The values indicate the number of aircraft operations per sq. nm.

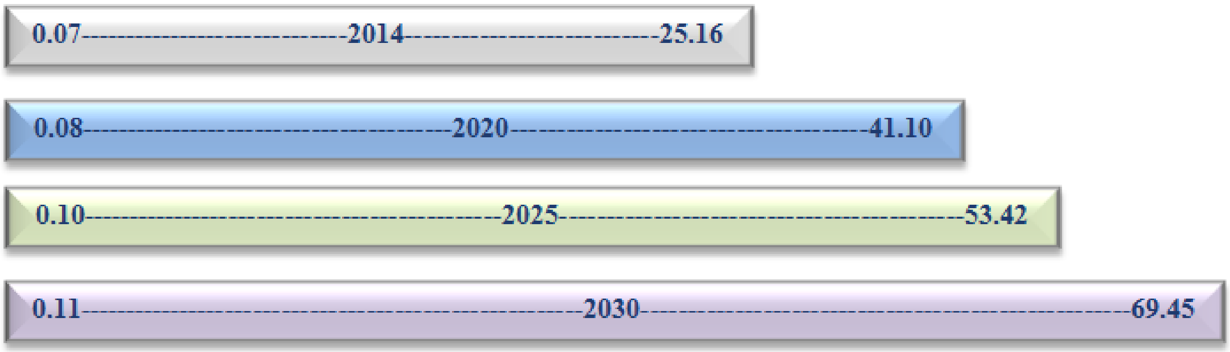


Figure 29: Illustration of Raw ACAC Jurisdictional Airspace Density Value Ranges 2015–2030

2. Table 18 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 18: 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						

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
^ Data activities for years 2020 and beyond were extrapolated at a rate of 7% per year *Denotes Approach Control Airspace (Qatar)									
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									

7.3 Major Aerodrome Activities

An accounting of aerodrome activity indicated that the number of ACAC member States aerodromes 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 aerodromes 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, where then sub-divided into the following four activity classifications: >180k, >80k, >30k and >10k. Table 19 depicts the (1) numbers of aerodromes within each FIR that meets the classification criteria, and (2) the two highest specific aerodromes with their respective traffic activity.

Table 19: Major Aerodrome 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		
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**								

7.4 FIR Categorisation Determinations

Utilizing the criteria listed above, Table 20 depicts the resulting ACAC FIR categorisations.

Table 20: 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 21 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 21: Aggregated Data Elements

ACAC FIR Categorisations (Current)							
FIR	FIR Sq. nm	2014 Activity (ACC)	2014 Density (ACC)	2015 Major Aerodrome 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

ACAC FIR Categorisations (Current)							
FIR	FIR Sq. nm	2014 Activity (ACC)	2014 Density (ACC)	2015 Major Aerodrome Activity (1,000s)			FIR Categorisation
				>180	>80	>30	
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

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8 Gap Analysis

This section will describe the methodology and baseline requirements, Regional/State planning and ATC subject matter expertise to which the current operational capabilities are assessed to determine the existence of any gaps.

8.1 Methodology

The Airbus ProSky Team evaluated gaps in capabilities to meet forecasted activity demand and expected ABSU functionality, as illustrated in Figure 30.

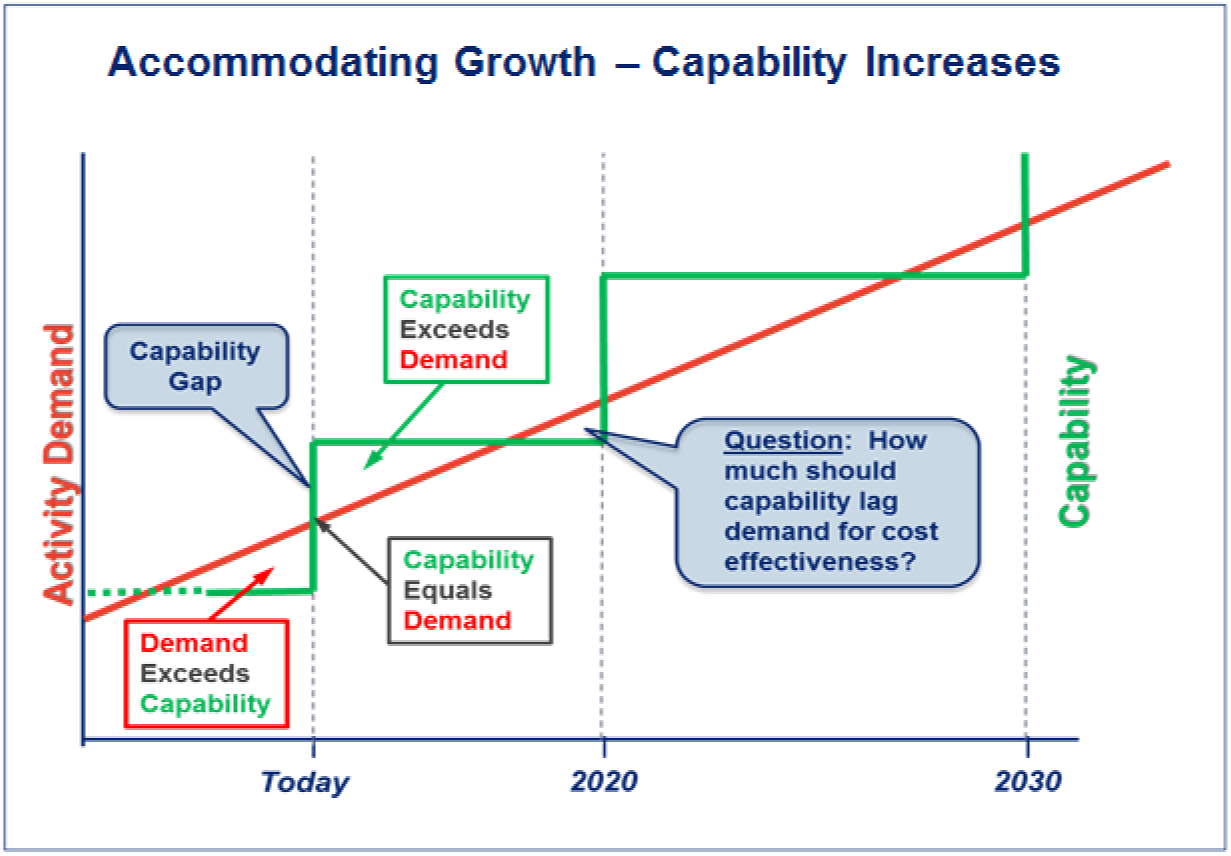

Figure 30: Growth Accommodation

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 the research team's understanding and assumptions of how those capabilities are currently being utilised.

Utilizing 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 (4) Performance Improvement Areas (PIAs) within each of the ASBU blocks, as illustrated below in Figure 31.

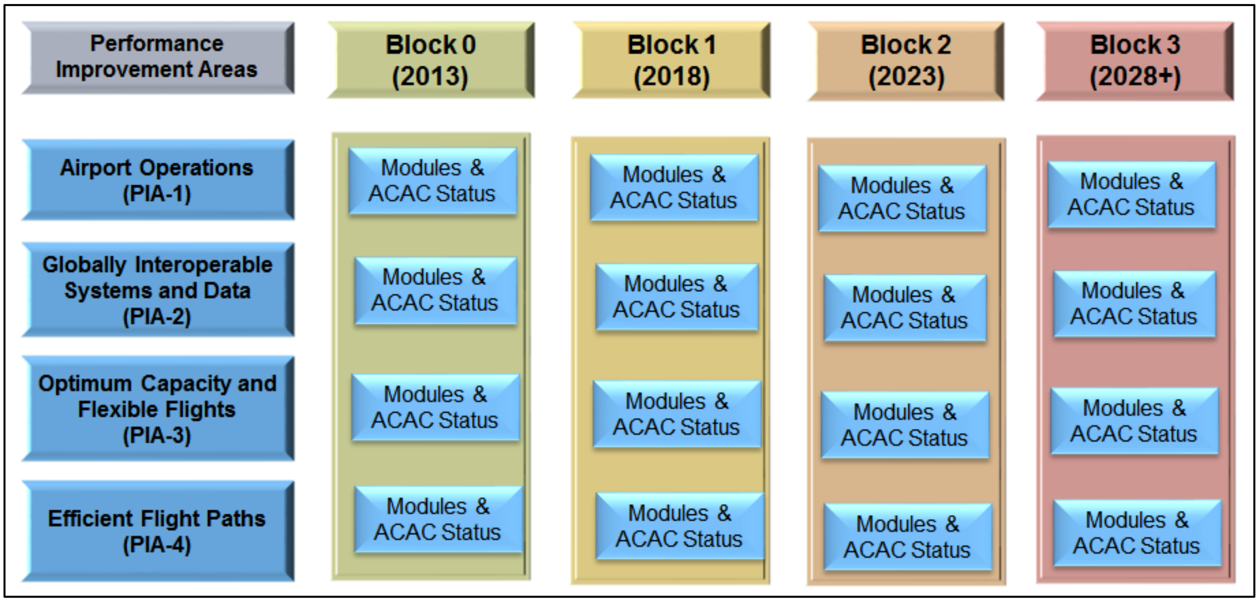

Figure 31: ACAC ASBU Comparison Format

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 Aerodrome 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 aerodromes. 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.

Although the findings are regional, as recommendations they have more application in some specific areas than others. This will be described in section 10 Recommendations.

8.2 Gaps

Gaps are presented in this report in two ways. First by comparing the ICAO ASBU methodology to the States current status in meeting the targets in the performance areas and second in an itemised list of the Study Team's observations in the areas of:

- 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

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

Table 22 to Table 29 describe the ASBU four performance improvement areas modules for Blocks 0 through 3 and the current status and/or targets 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 the 2023 through 2028 and onward timeframe.

Table 22, Table 23, Table 24, and Table 25 present the status of ASBU Block 0 and Block 1 for Performance Improvement Areas 1–4.

Table 22: 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
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 aerodrome or multiple dependent runways at closely proximate aerodromes	**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.

Performance Improvement Area 1: Airport Operations			
	ASBU Block 0	**ASBU Block 1**	**ACAC Status**
SURF	**Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)** • Provide surveillance and alerting of aircraft and vehicle movement at the aerodrome • 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
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	**NA**	**Remotely Operated Aerodrome Control** • Provides a safe and cost-effective air traffic services (ATS) from a remote facility • For aerodromes 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 23: 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
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	**NA**	**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.

Performance Improvement Area 2: Globally Interoperable Systems and Data – Through Globally Interoperable System Wide Information Management			
	ASBU Block 0	ASBU Block 1	ACAC Status
AMET	**Meteorological Information Supporting Enhanced Operational Efficiency and Safety** • Weather Information Exchange • Forecasts provided by world area forecast centres • Concise information of meteorological conditions that could adversely affect all aircraft at an aerodrome • 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) are 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 24: PIA 3 – ASBU 0, 1

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	ASBU Block 1	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

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	**ASBU Block 1**	**Status**
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 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.
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	**NA**	• 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

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	**ASBU Block 1**	**Status**
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	**NA**	• OPFL Block-0 applies to all areas • No implementation of OPFL module among the FIRs studied.
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	**NA**	• 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.

Performance Improvement Area 3: Optimum Capacity and Flexible Flights			
	ASBU Block 0	ASBU Block 1	Status
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 25: PIA 4 – ASBU 0, 1

Performance Improvement Area 4: Efficient Flight Paths			
	ASBU Block 0	ASBU Block 1	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 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.
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.

Performance Improvement Area 4: Efficient Flight Paths			
	ASBU Block 0	**ASBU Block 1**	**Status**
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	**NA**	• CCO Block-0 applies to all areas • One-Low activity FIR reports implementation of CCO Block-0. The remaining FIRs have established targets with implementation in the 2016-2019 time frames.
RPAS	**NA**	**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

8.2.2 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 the 2023 through 2028 and onward timeframe. These are **far term** elements.

Table 26, Table 27, Table 28, and Table 29 describe the modules within the performance area and to what level of activity FIR they apply. Throughout the FIRs that responded to the surveys indicate no implementation of the Block 0 and 1 modules.

Table 26: 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	**NA**	• 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	**NA**	• SURF Block-2 applies to High-activity areas. • No implementation

Table 27: 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 as an information node in SWIM • Enables full participation in collaborative ATM processes with exchange of data including meteorology	**NA**	• SWIM Block 2 applies to all areas. • No implementation
AMET	**NA**	**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 28: 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.	**NA**	• 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 minimizing deviations	**NA**	• ACAS Block-2 applies to Aircraft Only

Table 29: 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	**NA**	• CDO Block 2 applies to High-activity areas. • No implementation
TBO	**NA**	**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 • Standardizing 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 aerodrome procedures	• RPAS Block 2/3 applies to all areas. • No Implementation

9 Findings

9.1 Regional Findings

The following findings address the Study Teams findings in current capabilities and services. Much of these findings were derived from the surveys provided by the individual States plus a review of any internal documents that were submitted by the States. Unable to conduct direct observation of the air traffic operations resident in the participating States, the research team relied primarily on the responses to the questions in the surveys, ICAO documents, and the very limited amount of internal documentation that was provided. 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.

9.1.1 ANSP Interoperability

- Various individual Air Navigation Service Providers (ANSPs) strategic planning efforts are advancing with insufficient adjacent ANSP acceptance and integration.
- 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)
- AIP data is not uniformly available across all ACAC member States. (PIA-2)
- Encourage standardisation of Air Traffic procedures wherever possible. (All PIAs)
- CDM organisation and processes vary among the ACAC members, ranging from full and effective participation to minimal participation. (PIA-3)
- Insufficient procedures for the coordination of traffic conditions to prevent oversaturation of operational sectors. (PIA-3)
- Operational sectors become oversaturated, very often at predictable times and flows. (PIA-3)
- Individual operating and support systems are not fully interoperable nor share common functionalities and flight data with adjacent FIRs. (PIA-2)
- Current staffing levels at select facilities are inadequate for the required service provision, as illustrated in Figure 32.

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	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Bahrain	124	29	45	ID	73	29	26	ID	124	29	45	ID	ID	ID	ID	ID	ID	ID	ID	ID
Egypt	145	371		35	145	371		35	147	371		35	147	436		50	198	436		65
Iraq																				
Jordan																				
Kuwait																				
Lebanon	35		30	14	20		20	6	51		34	18								
Libya																				
Mauritania																				
Morocco																				
Oman	132	35	43		103	35	43		155	50	63		177	61	73		200	66	78	
Palestine	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Qatar		50	51			50	51		75	56	56	10	75	56	56	10	75	56	56	10
Sudan	50	15	25	ID	50	15	25	ID	55	40	32	ID	60	40	27	ID	65	45	32	ID
Saudi Arabia																				
Syria																				
Tunisia																				
UAE*	ID	ID	ID	ID	ID	61	72	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Yemen																				

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

Figure 32: Regional Staffing Needs

9.1.2 Airspace Policy/Procedures

- Airspace design among ANSPs while generally effective for local operations do not always provide seamlessness with adjacent FIR airspace designs. (PIA-3,4)
- Manual and verbal handoff procedures exist among many of the ACAC ANSP common boundaries.
- Existing and authorised ATC procedures are not being fully utilised to their fullest advantage (e.g., visual separation, radar separation, automated flight data transfer). (PIA 1-4)
- Sector designs are often based on legacy aircraft capabilities, and thus have become inefficient relative to modern aircraft capabilities and operator desires. (PIA-4)
- PBN advancement is continuing more on a local basis than a regional basis, and often is limited within a single FIR. (PIA-1)
- 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 33. An example of a significant change to a homogenous area in the Middle East is illustrated in Figure 34.

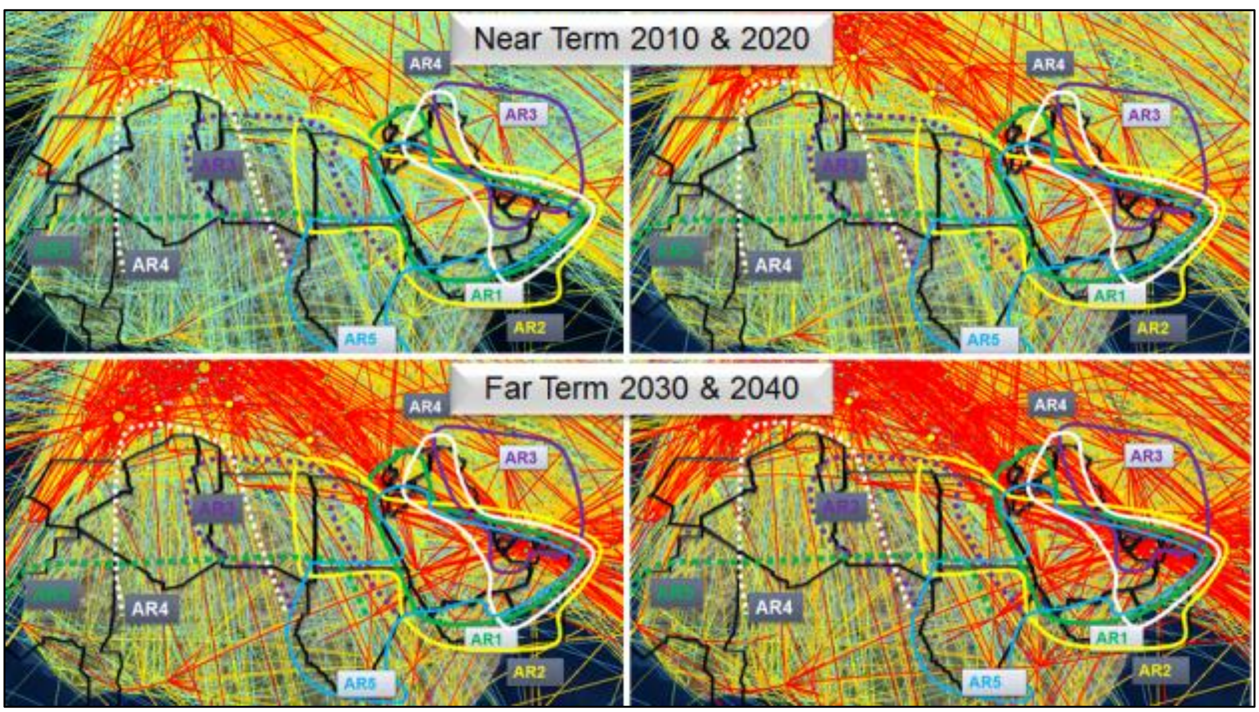

Figure 33: Near-Far Term Homogenous Area Traffic Impacts

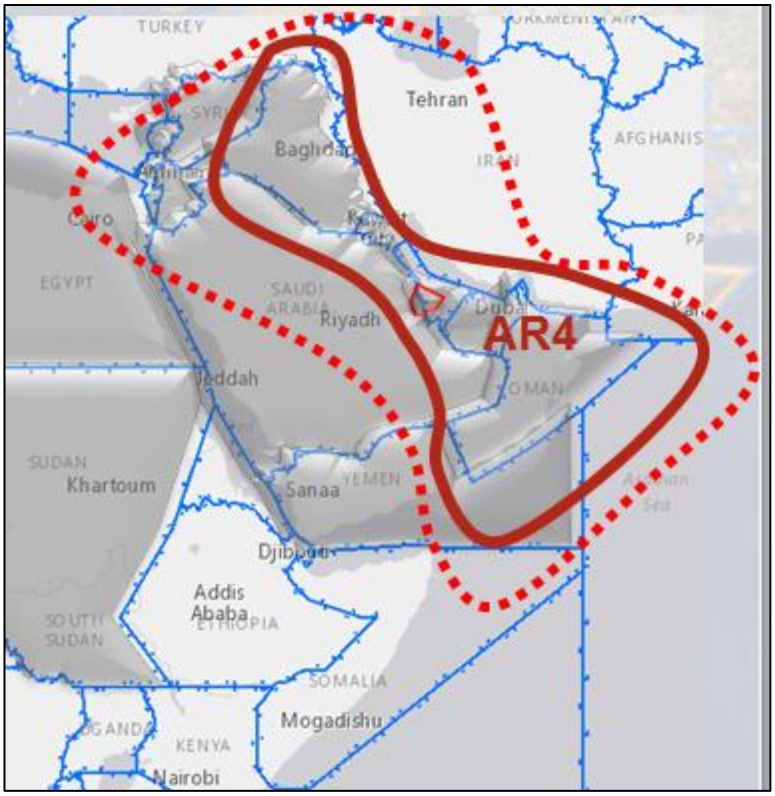

Figure 34: AR4 Middle East Homogenous Area Expansion

9.1.3 Separation Standards

- Inconsistent use of same separation standards among adjacent ANSPs, especially in the en route environment. (PIA-3)
- ATC conflict alert and monitoring features are not available in all ANSP operating systems. (PIA-3)
- There is little to no indication of application of visual separation between arrivals on same runway, arrivals to parallel runways, and arrivals from departures. (Training)
- Existing and authorised ATC procedures are not being fully utilised to their fullest advantage (e.g., visual separation, parallel runway operations, and diverging departure headings.). (Policy and Training)
- There is no indication of the application of diverging departure heading separation procedures for both same runway and parallel runways. (Policy and Training)

9.1.4 Routing

- The development is not evident of additional routes offset from primary routes that would allow a fast track/slow track capability.
- The use of 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

- Development and better use of flexible point-to-point routing for high-altitude operations, except where structured routing is required would be operationally feasible in many ANSPs. (PIA-3)
- There is an immediate need to develop and/or enhance existing Flexible Use of Airspace (FUA) procedures to provide allocation of airspace based on tactical needs within the FIR. (PIA-3)

9.1.5 Contingency and Growth Planning

- Several States have conducted 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 35 and Figure 36 respectively denote regional ANSP ACC Sector and APC Sector forecasts through the near and far term periods.

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

Figure 35: ACAC Regional ACC Forecast Near-Far Term

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

Figure 36: ACAC Regional APC Forecast Near-Far Term

- We were unable to determine if many facilities can ensure continuity of operations in the event of a system failure. UAE in particular is fully capable to indefinitely sustain such an event.
- From the reporting ANSPs there are several significant facility expansion needs and planning through 2020 as indicated in Figure 37.

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	ID	ID	ID	ID	ID	ID	ID	ID
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													
Jordan	1	2	3													
Kuwait	1	1	1													
Lebanon	1	1	2	1	1	1	2	1	ID	ID	ID	ID	ID	ID	ID	ID
Libya	1	3	8													
Mauritania	1*	1	2													
Morocco	1	7	22													
Oman	1	2	2	1	1	3	6	1	1	3	6	1	1	3	6	1
Palestine	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
Qatar	0	1	2		1	0	2		1	0	2		1	0	2	
Saudi Arabia	2	6	10													
Sudan	1	5	7	ID	1	6	8	ID	1	6	8	ID	2	6	8	ID
Syria	1	3	7													
Tunisia	1	8	10													
UAE	1	4	25	ID	1	4	25	ID	1	3	ID	ID	1	2	ID	ID
Yemen	1	1	9													
Green Highlighted Values Indicate an Increased Facility Need --- Red Highlighted values Indicate a Reduced Facility Need																

Figure 37: ACAC ANSP Facility Expansion Needs

9.1.6 Civil-Military

- Very little data was submitted regarding the development of high-level agreements and plans that would result in transition to integrated civil-military airspace management. (PIA 1-4)
- Very little data was submitted regarding enhancing Flexible Use of Airspace procedures to provide allocation of airspace based on tactical needs. (PIA-3)
- There does not appear to be Region wide Enterprise Architecture for the provision of air navigation services and information, including military. Establish processes to ensure common standards and requirements for air navigation service provision within each FIR. (PIA 1-4)

9.1.7 Airport Policy/Procedures

- There are several major airports that do not, appear to routinely use mixed-use runway procedures when there are peaks periods with higher numbers of arrivals or departures. (PIA 1,3)
- Planning for operational improvements can be enhanced by conducting a review of airport procedures and master plans to ensure they support minimizing operations on runways for other than actual take-offs and landings.
- Increase Airport throughput and capacity can be increased through application of global best practice procedures. (PIA-1)

9.1.8 Airport Physical Infrastructure

- Airport planning projects' information was insufficient to reach a meaningful finding or identify a gap; however, actions should be taken to ensure that any such actions are coordinated with all stakeholders to ensure capacity and efficiency impacts are understood and mitigated to the maximum extent possible. (PIA-1)
- 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)

9.1.9 TFM/CDM

- Little information was provided indicating the establishment of Air Traffic Flow Management (ATFM) as a core function with dedicated operational personnel within FIRs. Those ANSPs that did provide data indicated that formal ATFM functions do not exist within their facilities. (PIA-3)
- There appear to be insufficient identification and collection of metrics that can assist in capturing current performance data such as sector and runway capacity, and can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3)

- Many reporting ANSPs did not indicate an implemented 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)
- In FIRs where routine holding occurs, there is either no or minimal planning for and implementation of time-based trajectory management. (PIA-3)
- There is a need for enhanced Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. (PIA-1)
- No indication that enhanced departure constraint management capabilities exist which include tactical adjustments to flight levels and broad stakeholder substitution automation capabilities. (PIA-1)
- Many static MITs exist within the region that appears to be embedded in agreements and standard operating procedures additionally; some MIT restrictions appear to be regardless of altitude. (PIA 1,3)
- Not enough indication that CDM processes are utilised for flight plan and trajectory information exchange capability. (PIA-3) Other CDM findings include:
    - Little information or data that indicates capabilities and processes for exchanging strategic and tactical information and decision making exists between the ANSPs and stakeholders. (PIA-3)
    - Regionally CDM processes to determine capacity for hourly peaks versus the capacity accommodated through scheduling during non-peak times is not evident. (PIA- 1)
    - Regionally processes for making tactical decisions to adjust pre-departure flight trajectories to aid in minimizing demand-capacity imbalances is not evident. (PIA-1)
- 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)

10 Recommendations

This section describes the recommendations proposed to mitigate the gaps identified in the previous section. The recommendations are framed into two time periods: near term recommendations and far term 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 ABSU 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 38. While the project team attempted to frame the recommendations into 5 year increments through 2030, the fidelity of the available data prevented such a detailed delineation.

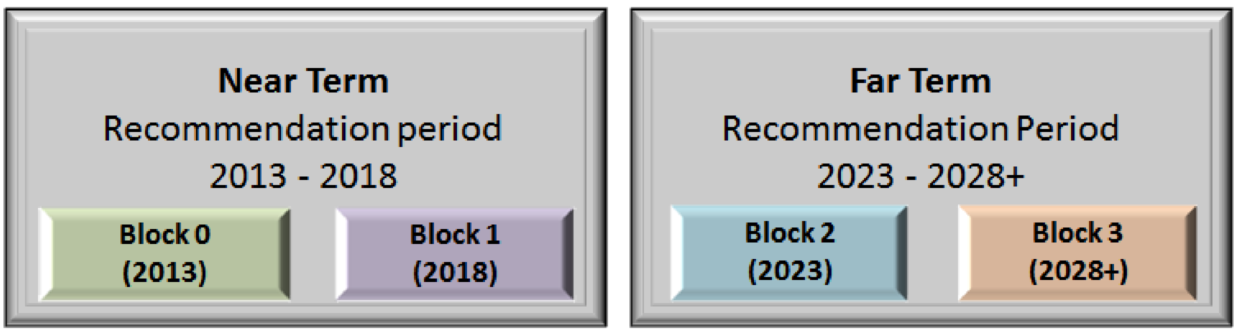

Figure 38: Recommendation Period Definitions

Although the recommendations are listed in the following functional areas and by both Near-Term and Far-Term, for tracking convenience the recommendations are numbered sequentially.

10.1 Near-Term & Far-Term Recommendations

10.1.1 ANSP Interoperability

10.1.1.1 Near-Term recommendations

1. Establish a common framework for conducting safety analysis (PIA -3) For example establish a common template to be used as the mainstay of an internal Quality Assurance process. The process should include goals that include; a non-punitive self-reporting system; investigation guidelines; and a follow-up process that includes training and briefings for all personnel.
2. Implement a Region wide joint aviation information entity to gather and distribute AIP information to the member States. (PIA-2)
3. Encourage standardisation of Air Traffic procedures wherever possible. (All PIAs)
4. Increase frequency and breadth of communications between adjacent FIRs focused on improving the capabilities and efficiency of operations within the region. (PIA-3)

5. Continue to move toward creating or strengthening existing agreements between adjacent FIRs. Incorporate into agreements TFM techniques such as off-loading traffic to lower density routes when tracks threaten to become saturated. (PIA-3)
6. Revise operational procedures and agreements to preclude the transfer of arrival, departure or over flight aircraft to operational sectors that have reached traffic saturation levels. (PIA-3)

10.1.1.2 Far-Term recommendations

7. Integrate various individual Air Navigation Service Providers (ANSPs) strategic planning efforts into a Regional Airspace and ATM strategic plan.
8. Implement automation and decision support systems, including meteorological, that are fully interoperable/integrated and have common functionalities and share data with adjacent FIRs. (PIA- 2)

10.1.2 Airspace Policy/Procedures

10.1.2.1 Near-Term recommendations

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

10.1.2.2 Far-Term recommendations

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

16. Ensure operational procedures and practices across FIR boundaries utilise existing capabilities to full advantage. This will enable seamless application of services with adjacent ANSPs. (PIA 1-4)
17. Develop concepts and implementation strategy for Dynamic Airspace Management use in strategically mitigating airspace design, traffic volume or other operational constraints affecting efficiency and safety. (Best Practices)
18. Expand SID/STAR usage and design to extend SIDs from airport to top of climb, and STARs from top of descent to airport. (Best Practices)
19. Identify locations where space-based ADS-B can be used to supplement current ground based surveillance to enable full airspace surveillance.

10.1.3 Separation Standards

10.1.3.1 Near-Term recommendations

20. At High- and Medium-activity aerodromes, increase airport throughput through application of visual separation between arrivals on same runway, arrivals to parallel runways, and arrivals from departures. (Training)
21. At High- and Medium-activity aerodromes and ACC increase airspace capacity through application of visual separation in the approach control and en-route environs. (Policy and Training)
22. At High- and Medium-activity aerodromes increase airport throughput by application of diverging departure heading separation procedures for both same runway and parallel runways. (Policy and Training)

10.1.3.2 Far-Term recommendations

23. Plan for and implement the transition of separation methods from tactical ATC-developed instructions to use of ground and airborne automation decision support. (PIA-3)
24. Provide enhanced system monitoring and alerting of separation and spacing that supports multiple separation modes and standards between aircraft with trend analysis. (PIA-3)
25. At currently Low-activity aerodromes that are forecasted to increase airport activity, improve airport throughput through application of visual separation between arrivals on 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).
26. At currently Low-activity aerodromes and ACC increase airspace capacity through 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)

10.1.4 Routing

10.1.4.1 Near-Term recommendations

27. In High-activity areas develop additional routes off set from primary routes to allow a fast track/slow track capability.
28. Utilise single direction routes bi-directionally.
29. Consider Flexible point-to-point routing for high altitude operations, except where structured routing is required. (PIA-3)
30. Develop or enhance existing Flexible Use of Airspace (FUA) procedures to provide allocation of airspace based on tactical needs within the FIR. (PIA-3)

10.1.4.2 Far -Term recommendations

31. 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 off set from primary routes to allow a fast track/slow track capability.

10.1.5 Contingency and Growth Planning

10.1.5.1 Near-Term recommendations

32. Ensure contingency plans include agreements with adjacent FIRs in the event of communication and/or surveillance failures.

10.1.5.2 Far-Term recommendations

33. Conduct detailed analysis of operational position needs within each State through 2030, and develop a plan to meet those needs with optimum effectiveness and efficiency.
34. Establish collaborative constraint analysis processes to understand how projected annual growth will translate to hourly time frames and airspace sector traffic levels.
35. Conduct a vulnerability and risk assessment study to ensure continuity of operations is provided for should system failures occur.

10.1.6 Civil-Military

10.1.6.1 Near-Term recommendations

36. Develop high-level agreements and plans resulting in transition to integrated civil-military airspace management. (PIA 1-4)
37. Enhance Flexible Use of Airspace procedures to provide allocation of airspace based on tactical needs. (PIA-3)

10.1.6.2 Far-Term recommendations

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

10.1.7 Airport Policy/Procedures

10.1.7.1 Near-Term recommendations

39. At High-activity aerodromes, routinely use mixed-use runway procedures when there are peaks periods with higher numbers of arrivals or departures. (PIA 1,3)
40. Review airport procedures and master plans to ensure they support minimizing operations on runways for other than actual take-offs and landings.
41. Increase airport throughput and capacity through 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)

10.1.7.2 Far-Term recommendations

42. Where aerodromes are forecasted to increase operations develop procedures and training plans to routinely use mixed-use runway procedures in the event there are peaks 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)

10.1.8 Airport Physical Infrastructure

10.1.8.1 Far-Term recommendations

44. Ensure 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)
45. Based on current and forecasted airport demand, accelerate planning and construction for rapid exit taxiways to be optimally located to minimise runway occupancy time for typical aircraft. (PIA-1)

10.1.9 TFM/CDM

10.1.9.1 Near-term recommendations

46. 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)
47. Establish metrics that can assist in capturing current performance data such as sector and runway capacity, and can aid in determining the cost/benefit of new procedure development and equipment acquisition. (PIA 1,3)
48. Enhance departure constraint management capabilities, including tactical adjustments to flight levels and broad stakeholder substitution automation capabilities. (PIA-1)
49. Work to replace MIT restrictions embedded in agreements and standard operating procedures with more strategic and tactical traffic flow management initiatives. Reduce or eliminate restrictions that are regardless of altitude. (PIA 1,3)
50. Establish Collaborative Decision Making (CDM) capabilities and processes for exchanging strategic and tactical information and decision making between the ANSPs and stakeholders. (PIA-3)
51. Establish CDM processes to determine capacity needed for hourly peaks versus the capacity accommodated through scheduling during non-peak times. (PIA-1)
52. Establish CDM processes for making tactical decisions to adjust pre-departure flight trajectories to aid in minimizing demand-capacity imbalances. (PIA-1)
53. Where demand requires it, establish process for the automated substitution of slot times between stakeholders. (PIA-2)

10.1.9.2 Far-Term recommendations

54. Where needed, enhance Arrival Manager (AMAN) capabilities, including tactical adjustments to rates, wake category inclusion, and multiple arrival runways. (PIA-1)
55. Plan for and implement flight plan and trajectory information capabilities for ANSPs and stakeholders that support both strategic and tactical CDM. (PIA-3)
56. 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)
57. In FIRs where routine holding occurs, plan for and implement time-based trajectory management. (PIA-3)
58. 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:
    - 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)

10.1.10 Other Dynamics

59. Identify conditions and locations where technical simulation capabilities would be required to simulate ATC procedures and flight deck capabilities in support of significant changes to operational systems, services and requirements, if not already in use. (Best Practices)
60. Identify conditions where non-technical simulation (table-top exercises) would be required to simulate ATC procedures, if not already engaged in the process. (Best Practice)
61. 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 (2) groups:
    - Management and Administration Policy
    - Operational Policy
62. Develop of improve training programmes that convey instructions, standards, and guidance to personnel charged with the implementation, operations, and maintenance of aviation procedures and/or equipment. A development of training objectives, plans, schedules, and materials, used to outline and develop the training objectives will be required. A formal training programme will ensure consistency in providing air traffic services. (Training)

10.2 Key Recommendations – Future Activity

The recommendations in section 10.110.1 are provided to ACAC for their review, consideration, confirmation, censuses and/or comments. ACAC member input is requested to identify those Regional and State recommendations that are particularly important to the Member State and/or ACAC organisation that warrant focused attention. Additionally, ACAC Organisational and State members are invited to provide supplementary recommendations for analysis and inclusion.

Once the ACAC review period is complete, and input received, the project team will aggregate and analyse the input to draw a series of key recommendations. The key recommendations will inform ACAC of those areas where focused attention is required. The final study report will present these key recommendations supported with the following data points and format (Text and Table 30):

- Background
- Justification
- Benefit
- Consequences if not implemented

10.2.1 Key recommendation Summary (Text Format)

10.2.1.1 Key Recommendation 1

10.2.1.1.1 Background

10.2.1.1.2 Justification

10.2.1.1.3 Benefit

10.2.1.1.4 Consequences of Non-Implementation

10.2.2 Key Recommendation Summary (Sample Table Format)

Table 30: Sample Key Recommendation Table

#	Recommendation	Background	Justification	Benefits	Consequences of Non-Implementation

11 References

[1] Report Commissioned by the Performance Review Commission, Complexity Metrics for ANSP Benchmarking Analysis, April 2006

[2] ICAO Safety Report 2015

[3] Flight Service Bureau, International Ops Notice 02/16, June 8, 2016

[4] ICAO Safety Report 2014

[5] ICAO Safety Report 2013

[5] Complexity Metrics for ANSP Benchmarking Analysis, EUROCONTROL, April 2006

[6] Annual MEAUSE Workshop Forum, Muscat, OMAN, February 2015

[7] AACO, AGM Resolution 5/2014

[8] Aviation System Block Upgrades, March 23, 2013

[9] Strategic Planning for ASBU Modules Implementation, CANSO, November 2013

[10] MIDeANP-VI/VII/VIII

[11] Communications, Navigation and Surveillance Sub-Group Meetings 2-6

[12] MIDANPRIG Comm, Nav, Surv/ATM/IC Sub-group 7, CNS/ATM/IC SG/7, October 2013

[13] MIDANPIRG ATM Sub-Group AMT SG/2, December 2015

[14] ICAO AFI/MID ASBU Implementation Workshop, November 2015

[15] Mid region ATM Enhancement Programme Steering Committee Meeting, MAEP SC/2, October 2015

[16] Manual on Air Navigation Services Economics, Fourth Edition, 2007

[17] MIDSANPRING/15 June 2015

[18] ICAO Doc 9854, Global Air Traffic Management Operational Concept, First Edition, 2005

[19] ICAO Doc 9965, Manual on Flight and Flow Information for a Collaborative Environment, 2011

[20] CANSO, Global Air Navigation Services Performance Report 2015

[21] IATA Annual review 2015

[22] ICAO Doc 9750, Global Air Navigation Plan, 2013-2028

[23] Air Navigation Plan, Middle East Region, First Edition 1999

[24] IATA, ASBU Workshop, Emirates Airlines, Dubai, October 2015

[25] European Airspace Concept Handbook for PBN Implementation, Euro-control, Edition 3.0

[26] CANSO, Recommended Key Performance Indicators for Measuring ANSP Operational Performance, 2015

Appendix A: Regional Fleet Mix

Table 31 represents the regional fleet mix serving the ACAC jurisdictional airspace, depicting the types, numbers, and capabilities of the fleet.

Table 31: 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
ETHIHAD	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