REPUBLIC OF KENYA

KENYA CIVIL AVIATION AUTHORITY

AIRSPACE MASTER PLAN
2015-2030

DELIVERABLE4 (D4)

DEVELOPMENTALIMPACT ASSESSMENT AND PROJECT IMPLEMENTATION PLAN

DOCUMENT REVIEW

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DOCUMENT LOG

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2.0	25/03/2016	Update to incorporate the comments made by KCAA in February and March 2016. Incorporate the comments made by the stakeholders during the forum held in February 2016.	All sections
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5.0	17/08/2020	Updated: JKIA decongestion of SIDS/STARS PBN concept Updated: ANS will participate in the Nairobi A-CDM development.	Version 4 Sections 3.3
5.0	17/08/2020	JKIA A-CDM development deleted	Version 4 Sections 3.3.3
5.0	17/08/2020	Replacement of JKIA Point Merge Systems implementation with systemization of SIDS/STARS through Strategic deconfliction of ATS Routes using the PBN concept.	Version 4 Sections 3.3.4
5.0	17/08/2020	JKIA 2nd RWY ANS adaptations deleted	Version 4 Sections 3.3.6
5.0	17/08/2020	Apron management at both JKIA and Mombasa has been deleted as this evolution belongs to KAA	Version 4 Sections 3.3.11
5.0	17/08/2020	Vehicles management on the manoeuvring area deleted	Version 4 Sections 3.3.12
5.0	17/08/2020	ANS provision at smaller Kenya airports replaced with ATS provision at smaller Kenya airports	Version 4 Sections 3.3.12

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1 INTRODUCTION

1.1 Purpose of the document

This document is the fourth deliverable towards the development of the "KCAA Airspace Master Plan for 2015 – 2030".

This deliverable analyzes the developmental impacts which are expected in Kenya from the implementation of the KCAA Airspace Master Plan.

This deliverable also describes an Implementation Plan that proposes an approach and a timeline for the implementation of recommended evolutions in terms of ANS organization, operations, technical means, human resources and legal /institutional aspects.

1.2 Reference documents

The following documents are reference documents for this deliverable.

[1] Agreement between KCAA and EGIS for the Preparation of the KCAA Airspace Master Plan 2015-2030, CFT n° KCAA/026/2013-2014

[2] EGIS Technical and Financial Proposal n° A140100_O140052, Version 1.0, in response to the CFT n° KCAA/026/2013-2014

[3] KCAA Airspace Master Plan; Deliverable D1 "Organizational Review of KCAA and Analysis of Current Airspace Infrastructure in Kenya"

[4] KCAA Airspace Master Plan; Deliverable D3 (Legal part) "Review of Institutional, Legal and Regulatory Issues"

[5] KCAA Airspace Master Plan; Deliverable D3 (Environmental part) "Preliminary Environmental Impact and Benefit Assessment"

[6] ICAO Annex 1 – Personnel Licensing

[7] ICAO Annex 2 – Rules of the Air

[8] ICAO Annex 4 – Aeronautical Charts

[9] ICAO Annex 11 – Air Traffic Services

[10] ICAO Annex 12 – Search and Rescue

[11] ICAO Annex 13 – Aircraft accident and Incident Investigation

[12] ICAO Annex 15 – Aeronautical Information Services

[13] ICAO Doc. 4444 PANS-ATM – Procedures for Air Navigation Services – Air Traffic Management

[14] ICAO Doc.8126 – AeronauticalInformation Services Manual

[15] ICAO AFIAir Navigation System Implementation Action Plan For The African-Indian Ocean (AFI) Region, Version 1.0, October 2013

[16] Kenya eAIP, July 2015

[17] Regulator Audit findings on ATS, AIS and CNS, 2015

[18] Air Navigational Services – Engineering, CNS Facilities Inventory, Year 2015

[19] KCAA Strategic Plan 2012/13-2016/17

[20] ICAO Doc.9859 – SafetyManagement Manual (SMM)

[21] ICAO Doc.9841 –Manualon the Approval of Flight Crew Training Organisations Ed 2 (2012)

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[29] Comprehensive Regional Implementation Plan For Aviation Safety In Africa (AFI Plan) Fifteenth AFI Plan Steering Committee Meeting(Maputo, Mozambique, 19 May 2015)

[30] African Civil Aviation Commission (AFCAC) AFI Aviation Safety Symposium, AFI Cooperative Inspectorate Scheme (AFIS-CIS), 27-28 May 2014

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[32] ICAO, Seminar/Workshop in Addis Ababa, Ethiopia Aviation System Block upgrades (ASBU) (17-19 November 2014), Current Status Of Implementation Planning Process - Planning And Implementation Experiences,presentation by Kenya

[33] KCAA, Staff deployment, July 2015

[34] EUROCONTROL, EUROCONTROL Specification for the ATCO Common Core Content Initial Training, ref: EUROCONTROL-SPEC-113, Ed 1.0, 21/10/2008

[35] ICAO AIM Training Development Manual using a Competency-Based Model Draft 1.0

[36] ICAO, Assembly Resolution A36-23

[37] ICAO, Assembly Resolution A37-11

[38] ICAO, APIRG/18, Global Navigation Satellite System (GNSS) Implementation Strategy for the ICAO African-Indian Ocean (AFI) Region, March 2012.

[39] KCAA, PBN Implementation Plan/ Roadmap KENYA Version 2, December 2009

[40] ICAO, Global Air Navigation Plan (GANP) (Doc 9750) 4th Edition, 2013

[41] ICAO, Annex 19 Safety Management – First Edition – July 2013

[42] ICAO, AFI Air Navigation Plan Volume I, Basic ANP, November 2012

[43] ICAO, Cir 330, AN/189 – Civil/Military Cooperation in Air Traffic Management

[44] ICAO, Doc. 7192, Part E2 “Training Manual” for ATSEP, First Edition, 2011

[45] ANS MANOPS Part 1 – ATM

[46] The Civil Aviation (Aerodromes, Air Navigation Services, Personnel Licensing, Approved Training Organisations, Airworthiness) Regulations

[47] Kenya SAR plan

[48] Agreements between Kenya and neighbouring States on SAR

1.3 Acronyms

The following acronyms are used in this document.

Acronym	Definition
A-CDM	Airport Collaborative Decision Making
A-SMGCS	Advanced Surface Movement Guidance & Control System
ACARS	Aircraft Communication Addressing and Reporting System
ACC	Area Control Centre
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AFI	African Indian Ocean region
AFIS	Aerodrome Flight Information Services
AFISO	Aerodrome Flight Information Service Officer
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATS Interfacility Data Communication
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
AIXM	Aeronautical Information Exchange Model
AMAN	Arrival Management
AMHS	ATS Message Handling System
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
AODB	Airport Operations Database
APIRG	AFI Planning and Implementation Regional Group
APP	Approach
ASBU	Aviation System Block Upgrade
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer

ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATN	Aeronautical Telecommunication Network
ATS	Air traffic Services
ATSEP	Air Traffic Safety Electronics Personnel
ATM	Air Traffic Management
ARO	Aerodrome Reporting Office
AWOS	Automated Weather Observing System
CCO	Continuous Climb Operations
CDO	Continuous Descent Operations
CDR	Conditional Route
CNS	Communication, Navigation and Surveillance
COM	Communication
CPDLC	Controller Pilot Data Link Communication
D-ATIS	Digital Automatic Terminal Information Service
DMAN	Departure Management
DME	Distance Measuring Equipment
DRC	Disaster Recovery Centre
EASA	East African School of Aviation
EFS	Electronic Flight Strips
ENR	En-route
FIR	Flight Information Region
FIS	Flight Information Service
FL	Flight Level
FUA	Flexible Use of Airspace
GANP	Global Air Navigation Plan
GBAS	Ground Based Augmentation System
GLS	GBAS Landing System
GNSS	Global Navigation Satellite System
HF	High Frequency
HMI	Human Machine Interface
HQ	Headquarters
HR	Human Resources
ICAO	International Civil Aviation Organization

IFP	Instrument Flight Procedure
ILS	Instrument Landing System
JKIA	Jomo-Kenyatta International Airport
KAA	Kenya Airport Authority
KCAA	Kenya Civil Aviation Authority
KQ	Kenya Airways
KRA	Kenya Revenue Authority
LOC	Local (runway) controller
LVP	Low Visibility Procedure
MET	Meteorology
MLAT	Multilateration
MOU	Memorandum of Understanding
MSSR	Monopulse Secondary Surveillance Radar
NAVAID	Navigation Aid
NCASP	National Civil Aviation Security Programme
NM	Nautical Mile
NOTAM	Notice To Air Men
OJT	On-the-job Training
OJTI	On-the-job Training Instructor
OLDI	On-Line Data Interchange
PBN	Performance Based Navigation
PSR	Primary Surveillance Radar
R&D	Research & Development
RCC	Rescue Coordination Centre
RNAV	Area Navigation
RNP	Required Navigation Performance
RPL	Repetitive Flight Plan
RWY	Runway
SAR	Search And Rescue
SBAS	Satellite-Based Augmentation System
SID	Standard Instrument Departure
SM	Safety Manager
SMM	Safety Management Manual
SMR	Surface Movement Radar

SMS	Safety Management System
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Route
SWIM	System Wide Information Management
TMA	Terminal Manoeuvring Area
TRA	Temporary Reserved Area
TSA	Temporary Segregated Area
TWR	Tower
TWY	Taxiway
VCCS	Voice Communication & Control System
VHF	Very High Frequency
VOR	VHF Omnidirectional Range
VSAT	Very Small Aperture Terminal
WAM	Wide Area Multilateration

2 DEVELOPMENTAL IMPACT ASSESSMENT

The proposed *"KCAA Airspace Master Plan for 2015 – 2030"*delivers a number of recommendations for the implementation of new CNS technologies and ATM procedures that will supplement the airspace infrastructure in Kenya. Most of these recommendations are stemming from the priorities allocated to ICAO ASBU modules in order to meet the KCAA operational objectives.

This section assesses how the implementation of the main recommended changes will positively impact on the civil aviation system of Kenya.

2.1 Infrastructure

2.1.1 Communication

The communication infrastructure in Kenya will be impacted by the introduction of data link capabilities for air-ground communications (ADS-C and CPDLC).

These capabilities will allow communications with FANS-1/A equipped aircraft.

These capabilities are already available in the ATM System and an access to an ACARS network service provider is also available.

The use of ADS-C and CPDLC particularly in the oceanic area under responsibility of KCAA which is already mostly covered by VHF will enable the decommissioning of HF communications as a main means of communications (but HF equipment will be replaced for back-up purposes).

These changes in the communication infrastructure are expected in the very short term.

Nevertheless, the transition to ATN-based communications in Kenya is not seen as a priority.

2.1.2 Navigation

The navigation infrastructure in Kenya largely relies on the use of DVOR, DME and ILS. PBN procedures have already started to be introduced and will continue to be implemented in the short term period. Moving towards satellite based navigation is consistent with the regional orientations and it is expected to progressively lead to the decommissioning of conventional NAVAIDS.

In Kenya, the conventional NAVAIDS will need replacement in 2024/2025 and then in 2028/2029 based on their theoretical end of life (15 years).

Part of the VOR/DME will need to be replaced in 2024/2025 and the remaining part of the VOR/DME will need to be replaced in 2028/2029 together with the ILS.

At that date, decision will have to be made to replace or not these VOR/DME after consultation of the airspace users to define a navigation roadmap beforehand.

For the ILS at Nairobi JKIA, decision will have to be made to replace or not these ILS, taking account of GBAS, knowing that the GBAS CAT II requirements are still under validation.

The eventual availability of SBAS in the long term should also be considered in the navigation roadmap that will need to be drawn in the medium term.

2.1.3 Surveillance

The surveillance infrastructure in Kenya will be impacted by the introduction of new surveillance technologies, particularly ADS-B.

The current surveillance infrastructure in Kenya is based on the use of MSSRs for en-route and approach surveillance.

The implementation of ADS-B, initially as a back-up to the MSSRs, will enable in the long term a full transition to ADS-B surveillance in En-route, depending on the publication of a mandate for the mandatory carriage of ADS-B equipment. Such a mandate shall be coordinated at regional level and with the airspace users, well in advance of the application date.

The surveillance infrastructure will also be impacted by the introduction of MLAT systems, which will be used for airport surveillance at JKIA and also for approach surveillance (WAM systems).

2.1.4 SWIM

ATM is extensively depending on relevant and accurate information, often in real-time, that directly supports operational decision making process. The concept of SWIM – System Wide Information Management – is at the very heart of the paradigm shift of how information will be managed in the near future along its full lifecycle and across the worldwide ATM system.

As part of **ASBU Block1**, the deployment of SWIM services (applications and infrastructure) should be effective from 2021 onwards. It will create the aviation intranet based on standard data models and internet based protocols to maximize interoperability. This change is of course **not optional**, each state will go its own pace; however benefits will increase as more states will participate.

SWIM will support exchanges of all data types:

- Aeronautical data,
- Flight trajectory,
- Aerodrome operations information,
- Meteorological information,
- Air traffic flow management information,
- Surveillance data, and
- Capacity and demand information.

SWIM is expected to improve flight efficiency thanks to the better information exchanges. SWIM is also expected to have a beneficial impact on environment as well as on safety.

In respect of implementation 3 distinct layers will need to be addressed for SWIM:

- The communication network infrastructure required to support the Ground-Ground and Air-Ground data exchanges;
- The legal, institutional, commercial aspects related to the management and operation of SWIM;

- The implementation of *SWIM-enabled* systems e.g. an FDPS capable to process the future standard for flight plans (which is part of FF-ICE – "Flight and Flow Information for a Collaborative Environment") and connected to the SWIM network.

2.1.5 Airspace design and organisation

The continual upgrade of the airspace design and supporting ATC sectorization is necessary in most part of the world to face the growth of air traffic and to adapt to the changing patterns of traffic flows.

In Kenya there is much to expect from the changes proposed in this area in the frame of the Master Plan:

- Better airspace organisation including:
  - The extension of the Flexible Use of Airspace (FUA);
  - The development of the PBN Routes network including the creation of additional Conditional Routes (CDRs);
  - Introduction of the Free Route concept; and
- Nairobi APP re-sectorization.
- ACC re-sectorization.

Extension of the Flexible Use of Airspace (FUA)

As detailed in the deliverable D1 [3] section 4, the implementation of the FUA in Kenya is only at its early stages and is evolving slowly. In the timeframe of the Master Plan the full implementation of FUA in Kenya airspace is recommended, following a stepped approach.

As a matter of example, a first extension could be the inclusion in the scope of the FUA of the big chunk of restricted airspace represented by the HKR 10 area. This would allow planning conditional routes across this area. It would allow the airlines to plan these routes depending on the expected military activity and to use them on the day of operations. The benefits would be an **increased ATC capacity** and a **reduction in delays and fuel burn** to general air traffic in this area of the Kenya airspace.

More globally, the full implementation of the FUA in Kenya will permit to solve issues with the **military areas** for which **current design** is **not compatible** with the **traffic growth** forecast.

Development of the PBN Routes network

In the future, we recommend pursuing the deployment of the PBN Routes network which will allow the Kenya to face the challenge of their aviation growth e.g:

- The definition of double ATS routes between Nairobi and Wajir to allow more traffic on this crowded axe.

The benefits of a better access to airspace with equity stemming from the full implementation of FUA in the Kenyan airspace will be amplified by the development of an efficient PBN routes network, e.g.:

- The creation of CDR across the HKR10 area following in order to have more direct routes when conditions permit.

Introduction of the Free Route concept

Free route airspace refers to a specific portion of airspace within which airlines may plan a route freely between a defined entry point and a defined exit point, with the possibility of deviating via intermediate navigation points without reference to the fixed route network.

The implementation of the Free Route concept in the Kenyan airspace will allow offering flexible routing to airlines, enabling them thus substantial benefits thanks to the shorter flight times, and thereby lowering carbon dioxide (CO2) emissions and fuel burn.

The evolution will rely on the upgrade of ATC systems to provide improved support tools for the detection of conflicts.

Nairobi APP re-sectorization

The re-sectorization of the Nairobi APP, as recommended in the deliverable D1 [3] section 4, will contribute to solve a safety issue in this TMA as well as to improve its capacity.

Indeed, the definition of a second sector in this APP as suggested will create the conditions to manage safely the traffic in TMA in all conditions, especially during peak hours or busy days, which is not the case today. Moreover this change is necessary to face the traffic growth expected at Nairobi airports.

ACC re-sectorization

As reported in the deliverable D1 [3], the ACC North sector presents a large area of surveillance for one controller with two distant choke points at LOV and WAV.

To address this safety issue in this ACC North sector, the En-route sectorization should be changed, implementing a third ACC sector.

2.1.6 Continuous climb and descent operations (CCO & CDO)

The implementation of both Continuous Climb Operations (CCO) and Continuous Descent Operations (CDO) will be enabled through the implementation of PBN SID and STAR procedures.

The implementation of CCO and CDO is part of the ICAO Block modules B0-CDO and B0-CCO, which are a priority at global (ICAO), regional and national levels.

KCAA already developed PBN procedures that allow CCO and CDO, and reported that they are practiced between Nairobi and Mombasa as well as to the North. The charts need to be updated to indicate that CDO and CCO are available.

The second runway at JKIA will lead to the revision of the existing IFPs and to the creation of new IFPs. CCO and CDO should continue to be available.

The implementation of the Point Merge is recommended in Nairobi and Mombasa. Point Merge is referenced as a technique to support continuous descent operation

(CDO) (ICAO Doc. 9931): The Point Merge system and the associated operational procedure for approaching aircraft enable an aircraft to use their on-board FMS to facilitate a CDO towards the runway, reducing pilot and controller workload.

2.2 Technology Transfer and Productivity Enhancement

2.2.1 Introduction of sequencing tools

The implementation of sequencing tools is recommended to improve the traffic flows to and from major airports in Kenya.

These tools will allow an **optimized usage of terminal airspace** and of the **runway capacity**, improving thus the airport operations.

AMAN

An AMAN is to be deployed in the APP(s) feeding the concerned airport(s) with remote display in the relevant ACC(s) and TWR(s).

The AMAN (Arrival MANager) will mainly support the work of the **APP controllers**, providing them with the optimized arrival sequence taking account of the Estimated Landing Times, the aircraft types, surveillance data and weather information, allowing thus to achieve the maximal landing capacity at a given airport.

Additionally, the AMAN will also provide information to ACC controllers who are requested to adapt the speed of aircraft in the Enroute airspace so as to meet the AMAN constraints.

Finally the AMAN will improve the awareness of the Tower controllers regarding the incoming traffic.

The major benefit for the ATC will be a **decreased workload** for **APP controllers** due to reduced traffic holding in terminal area, whilst the **efficiency of the TWR controllers** will be improved thanks to the **accuracy of information on the inbound traffic**.

DMAN

A DMAN is to be deployed in the TWRs at the concerned airports in an **A-CDM** context since the DMAN needs the target ready times provided by the airlines to calculate the departures sequences.

The DMAN (Departure MANager) will support the work of the **TWR controllers** providing them with the optimized departure sequence taking account of the Estimated Departure Times, the aircraft types, the target ready times provided by the airlines; the SID information and the weather information.

The DMAN will help to optimize the runway capacity and better distribute the traffic on SIDs by sequencing departing flights in a way that successive flights do not use the same departure route

In mixed mode operations, coupled to an AMAN, the DMAN will provide the optimised interleaved sequence of aircraft ensuring the maximum runway throughput.

The major benefit for the ATC will be a **decreased workload** for **TWR controllers** and a **reduced fuel burn** for the **airspace users** as the authorisation to start the engines will be given according to the departing sequence of tower controllers and to the expected taxi time.

2.2.2 Point Merge

The implementation of Point Merge system(s) is recommended to improve the efficiency of terminal airspace operations **in the Nairobi TMA**.

A Point merge system is new STAR design for merging arrival flows based on a specific **P-RNAV route structure** that consist of a point where traffic is converging (the Merge Point) with pre-defined legs (the sequencing legs) equidistant from the Merge Point, that should be used for path shortening or stretching.

The sequence is achieved with conventional ***direct-to*** instructions to the Merge Point. In this context open-loop vectoring should only be used to recover from unexpected situations.

Point Merge System's main observed benefits are the improvement of capacity whilst minimising the environmental impact and **reducing** the pilot and **controller workload** thanks to the greater degree of predictability of the trajectory flown.

2.2.3 Moving towards an electronic strips environment

The controllers in TWR, APP and ACC still handle the traffic using paper strips. A transition will need to be made, preferably in the medium term, to an electronic strips environment. The advantages of the electronic strips are:

- Possibility to share data with other stakeholders;
- Update of flight plan data; and
- Management of strips according to their status.

The update of flight plan data in the ATC system will also enable the effective use of other automated support functions such as some alerting functions that require up-to-date flight data (e.g. Cleared Level Adherence Monitoring alerts), and ADS-C & CPDLC functions.

The transition to an electronic strips environment will require the use, after possible adaptations to KCAA's operational needs, of the electronic strips facilities available in the ATM system, at least in APP and ACC. For TWR, it is recommended to implement a dedicated Tower Electronic Flight Strip system at the main airports, which implements a specific workflow adapted to TWR operations, taking account of the clearances to be issued to departing and arrival flights.

2.2.4 Inter-centres coordination

The effective implementation of AIDC/OLDI, with neighbouring centres in Kenya or with neighbouring countries, is recommended to KCAA since it will improve the coordination between Air traffic service units (ATSUs).

AIDC and OLDI are tools to coordinate flight data between Air Traffic Service Units (ATSU) and both satisfies the basic coordination of flight notification, coordination and transfer of control.

Additional options like pre-departure coordination, Civil-Military coordination and air-ground data link for forwarding log-on parameters are available in the OLDI.

In line with the approach recommended in ASBU B0 FICE module, improvements in this area are key to increase the ground-ground integration, the enabler for an increased interoperability, a better efficiency and capacity.

2.2.5 AIS/AIM system modernization

The modernization of the AIS/AIM system is key for the improvement of the ATM system in Kenya

This change, that will address the full scope of the current AIS system, will:

- Support the AIS/AIM transition of Kenya;
- Cover the deficiencies identified in current system (FPL/RPL processing, AIP publishing capabilities, PANS-OPS procedures 3D simulations);
- Provide a State-of-the-art system offering high-level of service to its users inter alia thanks to web-based HMIs offered to the AIS staff but also to the airspace users, which will allow them to fill flight plans on-line;
- Provide a system ready for the future concepts of operations and data exchanges in a SWIM environment planned from 2021 onwards.

The major benefit for KCAA will be an increased efficiency of the AIS officers in all their activities which should result in the enhancement of their productivity.

2.2.6 Aeronautical Search & Rescue (SAR) support tool

The Search & Rescue (SAR) activities in Kenya are currently manual and require a lot of time to provide an answer: all the information and data from various sources must be manually analysed and cross-checked. KCAA reported that 12 to 18 hours were needed last time to provide an answer to an accident. Time is an important consideration and some improvements are required to automatically integrate and process data from various sources in order to speed-up the SAR activities.

There is therefore a need to procure, install and operate an integrated aeronautical SAR software for use at the RCC in Nairobi. This SAR software will integrate and process data from various external sources to facilitate the search of the probable area of the accident and then to coordinate the rescue effectively. This support tool should be the same or an upgrade of the one available at EASA.

2.2.7 ATFM

The implementation of an Air Traffic Flow Management function is recommended to KCAA **firstly as a local solution** to solve capacity issues in the Nairobi TMA.

Indeed, ATFM consists in balancing demand from airspace users and the capacity offered by airspace and airports (runway) whilst smoothing the traffic flows and minimizing the number of regulations to be fairly distributed across airspace users.

In the medium term, an ATFM function put in place locally will allow to have a better view of capacity offer and demand in the Nairobi TMA, hence permitting a better management of the capacity issues in this airspace.

In the long term, the ATFM will be implemented at regional level in coordination with neighbouring countries, providing solutions that support the development of traffic in the upper airspace managed at a regional scale.

2.3 Safety and Security

2.3.1 Safety

To comply with international regulations, it is necessary that KCAA develops its Safety Management System (SMS) in accordance with requirements and recommendations laid down in ICAO safety regulations (Annex 19) with regard to the Use of Safety Management Systems by Air Navigation Service Providers.

The ICAO Safety Management Manual (SMM), Doc 9859, AN/474, Third Edition, 2013provides guidance to States &ANSPs for the development, implementation and maintenance of an SMS.

The implementation of the SMS, recommended in the short term, will permit KCAA to establish the proper organization and procedures, allowing in particular:

- To establish a safety management program, in accordance with the State Safety Program, in order to achieve and maintain acceptable levels of safety;
- To monitor continuously the safety performance within KCAA and to validate the effectiveness of safety risk controls;
- To systematically manage the safety risks that may arise from changes having potentially an impact on safety;
- To ensure the training of the staff throughout the KCAA ANS Directorate; and
- To maintain a formal means for safety communication within KCAA.

2.3.2 Security

The development of ATM Security Management is recommended to KCAA in order to meet the requirements of the international regulations. Indeed, until recently ATM security was not a major concern, but after the September 2001 events this issue has been addressed by the aviation community and ATM security is now integrated in the ICAO regulations.

According to Annex 17 - amendment 12, States are required to include ANSPs in their National Civil Aviation Security Programme (NCASP) and to ensure that they establish and implement appropriate security provisions to meet the requirements of the NCASP.

The ICAO Aviation Security Manual (Doc 8973 – Restricted) and the ICAO ATM Security Manual (Doc 9985 – Restricted) are providing guidance to States and ANSPs for the implementation of appropriate security provisions.

The ATM Security is a major component of Aviation Security and comprises two key areas:

- **Safeguarding of the ATM System** from security threats and vulnerabilities, by ensuring the security and resilience of the physical infrastructure, personnel, information and communication systems, ATM/CNS infrastructure and networks;

- **Collaborative support** providing services or information from ATM to another agent such as law enforcement, military agencies, emergency services or incident investigation agencies relating to an act of unlawful interference.

It is therefore proposed to KCAA to initiate the establishment of its ATM Security Management in the short term by tasking the "ANS Planning & Projects" unit with this responsibility. In the medium and longer terms, the organization of the ATM Security Management should then be developed with appropriate procedures and relevant human resources.

In the medium term there is need to set up a national centralized CCTV systems for ANS stations and installations

2.4 Market-Oriented Reforms

The deliverable D3 (Legal part) [4] describes the recommended institutional, legal and regulatory changes to be made together with the rationale for such changes.

In summary, the following main changes are recommended:

- Functional separation between the regulator and the ANSP. This change is identified as an enabler for A-CDM deployment at JKIA because it will allow KCAA /ANSP to establish MoUs with other airport stakeholders.
- Amendments to the Civil Aviation Act on crimes and offences. This change will complement the measures which will be implemented by KCAA /ANSP for ATM Security.
- Amendments to the Civil Aviation Act on the basic principles for a voluntary and a mandatory reporting system in order to ensure a legal protection for the reporter and more generally of the information source. This change will support implementation of the SMS by KCAA /ANSP.
- Legal options for the provision of air navigation services at regional level. This change will enable surveillance data sharing with adjacent centres and support KCAA /ANSP's initiatives to have a lead role for SWIM and AFTM at regional level.
- Amendments to the Civil Aviation regulations on the Apron Management Service and on the circulation of airport vehicles on the airport movement area. This change will reduce the legal exposure of KCAA.
- Regulatory framework for ANS charges (and airport charges). This change will ensure a transparent system with fair and equal treatment of all users.
- Financing of the meteorological services for ANS through the user charges. This change will allow the provision of meteorological services by the MET department to be aligned with the needs of ANS and to support the ASBU B0-AMET module implementation in Kenya.

- Arrangements at the regional level to make mandatory carriage of the ADS-B avionics. This change will allow in the long term a transition from a radar environment to an ADS-B environment, at least in En-route.
- Change of name from Airspace master plan 2015-2030 to Kenya air navigation plan 2015-2030

Additionally, in the context of a regional ATM integration, which encourages the development of a harmonized implementation and modernization of ANS facilities (cf. East African Upper Airspace and Northern Corridor Initiative described in[3]), the opportunity to have joint procurements should be investigated by KCAA and its neighbouring countries.

There could be different degrees of involvement, from the development of common operational and technical requirements in support to the procurement process by each ANSP to the actual joint procurement of CNS/ATM systems, similarly to what exist in Europe with COOPANS.

The potential benefits are both operational (because it will ensure and facilitate the actual interoperability of systems) and financial (because it will decrease the costs associated to the development of requirements by each individual ANSP and then to the procurement of these systems by each individual ANSP).

One factor which could limit the scope of such cooperation between ANSPs is the procurement rules. For example, all ANSPs involved in COOPANS already have the same ATC system, which is key to enable a joint procurement of upgrades.

2.5 Human Capacity Building

The deliverable D1 [3]provides an assessment of the number and type of local jobs that are required to support the implementation of the recommended evolutions and to address the current staff shortage. The following Table 1 summarises for each station the current staff deployment and the required staffing for each staff category.

Station	CNS (Eng.)		COM		ATM (ATCOs)		AIS		SMS		ANS Planning		ATM Security	
	July 2015	Required	July 2015	Required	July 2015	Required	July 2015	Required	July 2015	Required	July 2015	Required	July 2015	Required
Headquarters	9	9	1	0	5	5	6	12	0	1	0	5	0	1
JKIA	25	29	13	0	90	131	17	20	1	6	0	0	0	0
Mombasa	14	20	0	0	33	38	9	13	0	3	0	0	0	0
Eldoret	9	12	0	0	4	15	6	5	0	0	0	0	0	0
Wilson	5	7	0	0	15	19	7	8	0	3	0	0	0	0
Kisumu	4	7	0	0	5	6	3	4	0	0	0	0	0	0
Malindi	4	7	0	0	4	6	3	4	0	0	0	0	0	0
Wajir	4	5	0	0	3	5	2	3	0	0	0	0	0	0
Lokichoggio	2	3	0	0	3	5	2	3	0	0	0	0	0	0
Central Workshops	8	13	0	0	0	0	0	0	0	0	0	0	0	0
Mua Hills	3	5	0	0	0	0	0	0	0	0	0	0	0	0
Poror	3	5	0	0	0	0	0	0	0	0	0	0	0	0
SUB-TOTAL	**90**	**122**	**14**	**0**	**162**	**230**	**55**	**72**	**1**	**13**	**0**	**5**	**0**	**1**
Lamu	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Isiolo	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Nanyuki	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Embu	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Ukunda	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Lodwar	0	3	0	0	0	3	0	0	0	0	0	0	0	0
TOTAL	**90**	**140**	**14**	**0**	**162**	**248**	**55**	**72**	**1**	**13**	**0**	**5**	**0**	**1**

Table 1: Summary of the human capacity building requirements

Note: AIS staffing should increase for the next 5 years. This number will then cover the staffing requirements at the new stations once flight planning will be available as a web-service, requiring less staff at existing stations.

Increase in staffing levels in the offices of SMS, SAR and capacity building at the new stations such as Diani and yet to be opened Isiolo and Lodwar.

3 PROJECT IMPLEMENTATION PLAN

This chapter describes the proposed Implementation Plan for the implementation of the recommended evolutions in terms of ANS organisation, operations, technical means, human resources and legal/institutional aspects.

This Implementation Plan proposes an approach to deployment of these evolutions which is to conform to the ASBU planning methodology. This approach is based on the analysis of the current situation in Kenya, as documented in the deliverable D1, and on the relevance of the ASBU modules in the regional and national context to set priorities for the implementation of these evolutions.

This Implementation Plan describes the activities to be performed to implement the recommended evolutions, using a timeline on a yearly basis.

This Implementation Plan is structured to cover the following domains:

- **ANS general aspects**, which are transversal subjects in ANS with potential implications in terms of ANS organisation.
- **Air Traffic Management (ATM)**, which is further split into the following sub domains to address the ATM concepts and procedures to be implemented:
  - **En-route (ENR) operations**
  - **Approach and Tower (APP/TWR) operations**
- **Aeronautical Information Services (AIS)**, which address the provision of services in the scope of the AIS Unit together with the supporting technical systems.
- **Communications, Navigation and Surveillance (CNS)**, which is split into the following technical sub-domains:
  - **Communications**
  - **Navigation**
  - **Surveillance**
  - **ATC Systems**
- **Search and Rescue (SAR)**, which is provided by ANS in Kenya.
- **Training**, this covers the training facilities and programmes.
- **Human Resources** in terms of ANS staffing.

It is important to note that these domains are not independent from each other and that there will be dependencies between some evolutions to be made in different domains. Typically, most evolutions in CNS, Training and Human Resources will be made to support the evolutions to be made for the improvement of ATM and AIS operations. These dependencies will be highlighted in the description of the Implementation Plan to show the complementarities between the activities.

Finally, it has to be noted that the legal/institutional aspects will be covered on an ad-hoc basis in the description of the Implementation Plan activities.

3.1 Air Navigation Services (ANS) – General evolutions

The overall planning of for the general evolutions in the Air Navigation Services (ANS) domain is depicted in the Figure 1below.

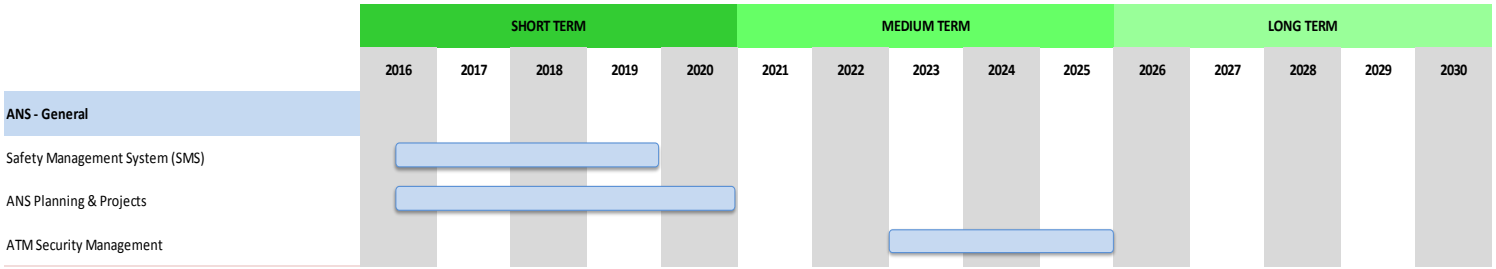

Figure 1: Implementation Plan – ANS general evolutions

In the short term, there are two priority;/../es with the implementation of the “Safety Management System” unit and the development of the “ANS Planning and Projects” unit.

In the medium term, there will be the implementation of an “ATM Security Management” unit.

3.1.1 Safety Management System (SMS)

The implementation of the SMS will require the following activities:

- To appoint an SMS Manager and to create the SMS Headquarter unit and the local SMS units;
- To staff the SMS unit with permanent and ad-hoc staff at ANS-HQ and at other stations;
- To provide external technical assistance to the SMS unit for the practical implementation of the SMS (e.g. methodology for the analysis of incidents, definition of indicators...);
- To develop the functions and procedures of the SMS unit as detailed in the deliverable D1 section 4.1.4 [3].

It will be necessary to identify the organisation that will provide external technical assistance for the practical deployment of the SMS.

The setting of the SMS unit will rely on the availability of human resources. In this context, the staff from the COM Centre could be re-assigned to the SMS unit as support staff to collect all the required data for analysis.

The SMS unit should be staffed as follows:

- Full time **SMS Manager** at ANS HQ / Nairobi ACC.
- **SMS coordinator** in each Kenyan airport, requesting a full time position at JKIA, Wilson airport and Mombasa airport. The SMS coordinator at Eldoret, Malindi, Kisumu, Wajir and Lokichoggio airports needs to be identified but it does not require any staff increase.
- **SMS ATCO**, requesting a full time position at Nairobi ACC, JKIA, Wilson and Mombasa. The SMS ATCO at Eldoret, Malindi, Kisumu, Wajir and Lokichoggio airports will be on an ad-hoc basis and it does not require any staff increase.
- **SMS Engineer**, requesting a part time position in Nairobi. The SMS Engineer at the other airports will be on an ad-hoc basis and it does not require any staff increase.
- **SMS AIM Officer**, requesting a part time position in Nairobi. The AIM Officer at the other airports will be on an ad-hoc basis and it does not require any staff increase.

The SMS application will rely on the “ANS Planning and Projects” unit, which will be responsible to perform safety cases and safety assessments in the ANS Projects.

3.1.2 ANS Planning & Projects

The implementation of the “ANS Planning & Projects” unit will require the following activities:

- To appoint an "ANS Planning & Projects" Manager and to create the "ANS Planning & Projects" unit;
- To staff the "ANS Planning & Projects" unit at ANS-HQ as recommended in D1 [3] section 8.3;
- To provide external training to the staff in the "ANS Planning & Projects" unit;
- To develop the functions and procedures of the "ANS Planning & Projects" unit as recommended in D1 [3]section 8.2.

The “ANS Planning and Projects” unit, which is responsible for Safety Case developments, will rely on the SMS implementation which will be responsible to provide the safety policies and processes (e.g. for safety investigation).

3.1.3 ATM Security Management

The “ATM Security Management” unit will be created in a second phase.

The following activities will be required:

- To appoint an ATM Security Manager and to create the ATM Security unit;
- To develop the functions and procedures of the ATM Security unit.

The “ATM Security Management” unit will rely on the “ATM Planning & Projects” unit, which will be responsible at a first step to initiate the development of the ATM Security Management and to start developing security cases as part of the new ANS projects. In a second step, the “ATM Planning & Projects” unit will continue to be in charge of the security cases and security assessments in ANS Projects.

3.2 Air Traffic Management (ATM) – En-route Operations (ENR)

The overall planning of evolutions in the ATM En-route operations domain is depicted in the Figure 2below.

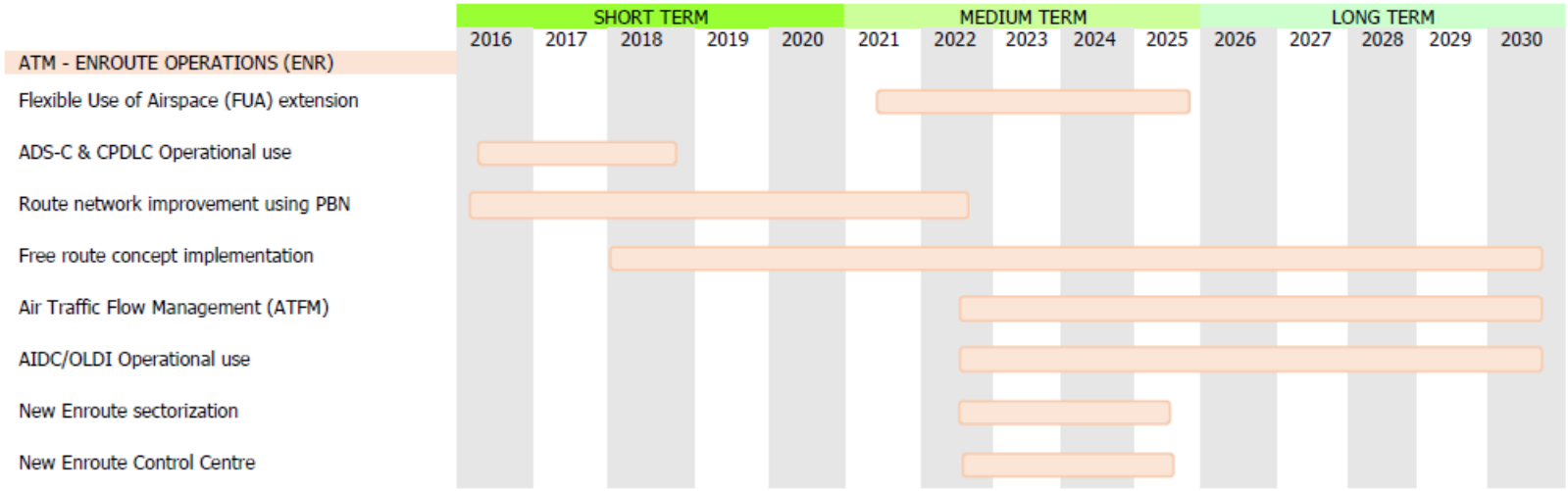

Figure 2: Implementation Plan – ATM En-route operations

In the short term, priorities will be on the ADS-C and CPDLC operational use, particularly over the oceanic area as well as on the implementation of local ATFM to have a better view of capacity offer and demand in the short term. These improvements will support the deployment of others concepts.

The Free Route concept will then be implemented in the oceanic area, depending on ADS-C and CPDLC operational transition.

In the medium term, priority will be given to the extension of the FUA to include the HKR10 area to meet the airspace user's requests to have more direct routes. To benefit from this improvement, priority will be on the routes network adaptation by creating CDRs (using PBN) through the HKR10 area. The FUA extension activities will continue over the period, as well as the route network improvement to profit from a better use of the airspace and to create new routes.

The routes network improvement using PBN will come to an end benefiting from the last aircraft navigation system performance. The FUA will also go on up to the middle of the period. The operational use of AIDC/OLDI will be set between Nairobi and Mombasa and eventually extended to the neighbouring countries. The Free Route concept will be extended to the continental area above a certain level. The new ACC and a new En-route sectorization will be implemented, leading to the creation of a 3rd En-route sector.

In the long term, the use of AIDC/OLDI will be extended to additional neighbouring countries. ATFM will be implemented at regional level. The Free Route concept will continue to be deployed, by progressively decreasing the FL above which it is used.

3.2.1 Flexible Use of Airspace (FUA) extension

As explained in the deliverable D1 [3], the basis for the FUA concept is that airspace should no longer be designated as either military or civil airspace but as one continuum and used flexibly on a day-to-day basis. Therefore any necessary airspace segregation should be of a temporary nature.

The extension of the FUA will concern the inclusion of the HKR10 area as this area is particularly detrimental to international flights to Addis Ababa.

The priority will be to offer the possibility to the airlines to plan a route through this area at D-1, depending on military activity (setting up of the ASM Level 2 (pre-tactical level)). For that purpose, a message will be sent to the airlines at D-1 to indicate which parts are active and non-active (in 3 dimensions).

The extension of FUA concept is expected to be a continuous action to progressively include the entire HKR10 area in the FUA at the 3 ASM Levels (strategic, pre-tactical and tactical).

The activities to be envisaged are:

- Re-enforcement of the civil/military collaboration and communication to progressively apply the 3 ASM Levels to the HKR10 area;
- Regular review of the TSAs to ensure that the limits are the minimum required to safely contain the activity therein;
- Establishment of new routes and associated sectorization resulting from the FUA extension.

3.2.2 ADS-C & CPDLC operational use

The priority is to allow the operational use of ADS-C and CPDLC over the oceanic area to palliate the deficiencies of VHF and HF, knowing that from a technical point of view, the majority of the enablers are available; i.e. theATMsystem is capable of ADS-C and CPDLC, the ACARS network access is available and most aircraft flying in this oceanic area are also suitably equipped.

The activities to be performed are:

- Operational procedure development;
- Operational training;
- Safety case to ensure that the use of ADS-C and CPDLC is acceptably safe from the specification till the transition phase and during the operations;
- The issue of an AIC to inform the users of the future operational use of CPDLC an ADS-C;
- The update of the AIP when it is effective.

The use of ADS-C and CPDLC will complement the VHF communications in the oceanic areas while HF communications will be put on 'hot-standby' at the ACC and impact the Human Resources with a re-assignment of the COM Centre staff to other ANS functions.

3.2.3 Routes network improvement using PBN

The route network will be improved continuously.

Resulting from the FUA extension with the HKR10 inclusion, the first priority will be to create CDRs through the HKR10 area in order to have more direct routes between Nairobi and Addis Ababa and to define double routes between Nairobi and Wajir.

Resulting from the use of ADS-C and CPDLC, the route network over the oceanic area will be reviewed to enable to use of RNP4 specifications and to reduce separation between the routes.

The associated activities to be done are:

- Design of the new route structure;
- Update of the AIP;

- Communication towards the airspace users.

3.2.4 Free Route concept implementation

The implementation of the Free Route concept will follow a stepped approach.

The first step will be the implementation of Free Route in the oceanic area. This will be possible in the medium term period once the operational use of ADS-C and CPLC is in effect.

In the medium term, the Free Route will be deployed in the continental airspace above FL330. This deployment over the continental airspace will depend on the FUA extension in order to be able to fly across the HKR10 area and also across other Segregated Areas.

In the long term, the Free Route airspace will be progressively extended by decreasing the lower FL. Additionally, in the context of an increased regional integration, the Free Route airspace should then be considered at regional level.

The implementation of Free Route may require an upgrade of the ATC systems. Particularly, the implementation of Free Route at a regional level is expected to require an upgrade of the Flight Data Processing Systems to support the cross border coordination.

3.2.5 Air Traffic Flow Management (ATFM)

Two phases are identified for the implementation of ATFM.

In the medium term, the ATFM will be put in place locally to have a better view of capacity offer and demand.

It requires centralising the flight plans database with means for the verification of flight plans and routes (which is part of the on-going AIS system upgrade). The ATC system should then allow the visualisation of capacity offer and demand based on the centralised database (which is part of the medium term ATM system upgrade). The capacity of sectors will need to be defined.

This evolution will be essential for a better management of the JKIA APP capacity management issues.

In the long term, the ATFM will be implemented at regional level.

In that perspective, the following activities will be required:

- Regional coordination;
- Definition of the procedures for flow management and for effective issuance of ATFM measures;
- Provision of staff and training for the centralised function;

- Organisation of trials to validate the ATFM procedures.

For both phases, ATFM will rely on:

- The AIS system upgrade which is on-going (to offer the possibility to file FPL online);
- SWIM implementation to exchange the information at regional level (in the long term);
- The upgrade of ATM systems for the visualisation of capacity offer and demand (in the medium term) and for the definition of new functions to support a regional ATFM (e.g. accurate traffic demand prediction and capacity assessment and airspace view);
- The collaboration with the meteorological services to have accurate MET information that could affect flights.

3.2.6 AIDC/OLDI operational use

The operational use of AIDC/OLDI will be done in two phases:

- In the medium term, the operational use of AIDC will be set between Mombasa and Nairobi ACCs, using existing capabilities in the ATM system.
- In the long terms, the operational use of AIDC or OLDI will be set between Nairobi ACC and adjacent centres in neighbouring countries, depending on the capabilities of these adjacent centres.

The AIDC/OLDI operational use will rely on the improvement of communication links (cf. section 3.5).

The following activities will be required:

- Regional coordination (for the longer term);
- Definition of procedures associated to the use of AIDC/OLDI;
- ATC system configuration;
- Safety Case.

3.2.7 New En-route sectorization

As reported in the deliverable D1 [3], the ACC North sector presents a large area of surveillance with two distant choke points at LOV and WAV. To address this problem in the ACC North sector the En-route sectorization should be changed, implementing a third ACC sector. A detailed analysis should be performed, involving simulations, including fast-time simulations and real time simulations with ATCOs in the loop, to define and validate this new En-route sectorization.

The activities to be performed will be:

- Design of the new sectorization;
- Definition of the associated operational procedures;
- Training of the controllers;
- Upgrade of the ATC systems and voice communication systems to set up the new sectors and the new radio frequency;
- Update of the AIP to inform about the new sectors and radio frequencies.

The realisation of this evolution is strongly dependant on the human resources (ATCO availability) since more controllers are required to staff the new positions. Considering the priority to first split the Nairobi APP sector into two sectors (cf. section 3.3.1), this new En-route sectorization is expected to be implemented after the new Nairobi APP sectorization.

This evolution should be synchronised with the implementation of the new En-route Control Centre (cf. section 3.2.8 below).

This evolution will require the creation of additional controller working positions, which imply an upgrade of the ATC system and of the voice communication systems (cf. sections 3.5.1 and 3.8.4).

3.2.8 New En-route Control Centre

KCAA has a plan for the creation of a new En-route Control Centre to a site along Mombasa Road, at the Central Transmitting Station site. The ACC facilities will move to this new En-route Control Centre while the APP and TWR facilities will stay at JKIA. The RCC will move as well to this new site. The plan is also to implement a Disaster Recovery concept between the two sites. The main advantage of this plan will be the possibility for the ATCOs to move easily and quickly to the other site if needed (which was not the case when the Disaster Recovery was considered in Mombasa).

The creation of this new ACC will thus have to take care of the following operational requirements:

- Implementation of a Disaster Recovery concept with JKIA, which needs to be further analyzed; and
- Implementation of a new En-route sectorization (cf. section 3.2.7).

This evolution requires the procurement and installation of a new ATC system and of new voice communication systems (cf. sections 3.5.1 and 3.8.6).

This requires procurement of systems for the Disaster Recovery Center to ensure resilience in service disruptions (cf. sections 3.8.6)

3.3 Air Traffic Management (ATM) – Approach & Tower Operations (APP/TWR)

The overall planning of evolutions in the ATM Approach & Tower operations domain is depicted in the Figure 3 below.

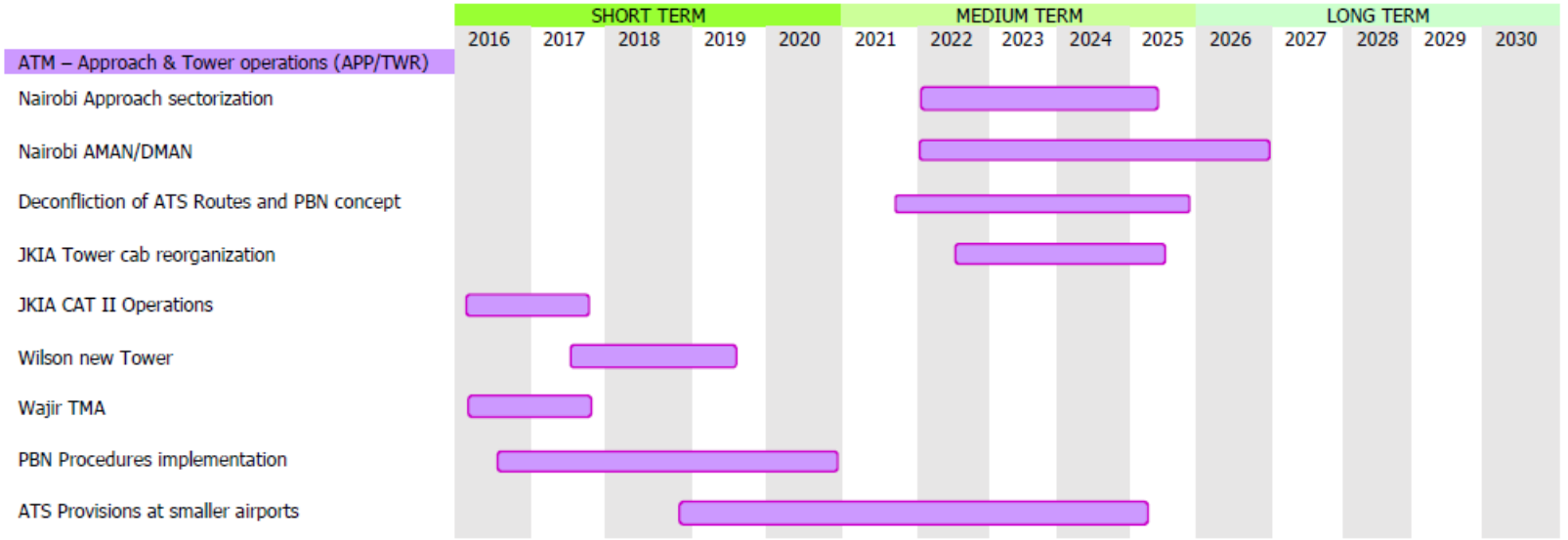

Figure 3: Implementation Plan – ATM Approach & Tower operations

In the short term, the priority will be to enable Cat II operations at JKIA by continuing the actions currently on-going.

The priorities will also be:

- The realisation of the Wajir TMA to cope with the traffic coming from Mogadishu and the continuation of the PBN implementation procedures across the country
- Implementation of a new tower at Wilson airport

In the medium term, there will be the continuation of the PBN implementation plan and the provision of ANS at smaller airports.

For APP operations improvement, the implementation of AMAN and DMAN in Nairobi. In a second step, the JKIA decongestion of SIDS/STARS PBN concept and the new Nairobi APP sectorization will be implemented.

For TWR operations improvement, the JKIA tower cab reorganisation, the ANS provision at smaller airports and the Wilson new tower.

ANS will participate in the Nairobi A-CDM development.

3.3.1 Nairobi APP sectorization

A new APP sectorization is one of the three measures recommended (with AMAN/DMAN and SID/STARs decongestion PBN concept) to solve the Nairobi APP safety, efficiency and capacity issues.

The evolution will consist in the split of the APP sector into two sectors.

The activities to be performed will be:

- Design of the new sectorization;
- Definition of the associated operational procedures;
- Training of the controllers;
- Adaptation of the dataset, ATM system and voice communication systems to set up the new sectors and the new radio frequency;
- Upgrade of the AIP to inform about the second radio frequency.

The realisation of this evolution is strongly dependant on the human resources (ATCO availability) since more controllers are required to staff the two new positions.

The new sectorization shall take into account the planned 2nd runway at JKIA as well as the design of the SIDS/STARS using PBN concept, which is planned to improve JKIA's arrivals & departures. The design of the new sectorization shall be done according to the planned operational use of these two evolutions, taking also into account the fact that Nairobi APP is taking care of JKIA, Eastleigh and Wilson, which implies that the new APP sectorization should improve the operations in all three airports.

3.3.2 Nairobi AMAN & DMAN

The implementation of arrival and departure management is one of the three measures recommended (with the APP sector split and Point Merge) to meet the capacity objectives in Nairobi.

- AMAN is to be deployed in Nairobi APP together with remote displays in Nairobi ACC and in the JKIA, Eastleigh and Wilson TWR.
- DMAN is to be deployed in JKIA TWR/APP in an A-CDM context as agreed by stakeholders. Note: Coordination will be required between the TWR supervisors at JKIA, Eastleigh and Wilson to implement a common timeline for departures sequencing with an allocation of departure slots to Wilson, JKIA and Eastleigh airports. The DMAN installed at JKIA-APP will be configured accordingly, by considering a ratio of “free slots” and/or some periods of “no departures” to allow departures from Wilson & Eastleigh.

The activities required to set the operational use of the AMAN and DMAN will be:

- To select the appropriate AMAN and DMAN tools;
- To install the AMAN and DMAN tools and to feed them with operational data (e.g. FPL and surveillance data);
- To adapt and calibrate the tools (and the dataset) to the Nairobi environment, covering both JKIA, Eastleigh and Wilson operations;
- To define the operational procedures for the use of AMAN and DMAN; dedicated positions with one ATCO for each position should be set (or manned by the supervisor);
- To provide training to the controllers for the use of AMAN (APP/ACC/TWRs) and DMAN (APP/TWRs).

It is important to note that the DMAN deployment is fully dependent on full A-CDM implementation at JKIA since the DMAN needs the target ready-times provided by the airlines to calculate the departure sequences.

The efficient use of AMAN and DMAN will rely on the local implementation of the ATFM in the medium term. ATFM will provide a more up-to-date flight plan data base (to be used to compute the pre-departure and arrival sequences) and will allow to smooth the arrival traffic flow (with the reduction of the use of holding stack) and favour the delay absorption with AMAN indications only.

3.3.3 Systemization of SIDS/STARS through Strategic deconfliction of ATS Routes using the PBN concept

The implementation SIDs/STARs in the Nairobi TMA is one of the three measures recommended (with Nairobi APP sector split and AMAN/DMAN) to solve the JKIA capacity &efficiency issues.

The realisation of the SIDs/STARs is ongoing and will culminate with Nairobi APP sectorization /re-sectorization.

The activities related to the implementation of this concept will be:

- To design the specific SIDS/STARS and enroute route structures defining the route structures, in accordance with the PBN concept;
- To define operational procedures for the use of the SIDS/STARS;
- To provide the training to the controllers;
- To update the AIP and inform the stakeholders;
- To perform a safety case.

3.3.4 JKIA TWR cab reorganisation

The JKIA Tower cab reorganisation is required to integrate the future operational use of the 2nd runway (the management of the new runway and the taxiways) and facilitate ground control. Moreover, new positions are identified resulting from the recommendations to review the organisation of the positions in term of responsibilities (e.g. to separate the areas of responsibility regarding the Ground and Air positions).

The activities related to this re-organisation will be:

- To create additional positions for the control of the existing runway and taxiways (e.g. ground control, clearance delivery) with provisions for the installation of additional positions for the 2nd runway and associated taxiways;
- To review the arrangement of each Tower position, improving the integration of existing equipment (e.g. A-SMGCS display) and any new equipment (e.g. AMAN & DMAN displays);
- To define the operational procedures and responsibilities for each position;
- To provide training to the controllers.

The reorganisation will rely on:

- The availability of the controllers who will be required to man each position; and
- The update of the ATC systems to reflect the new positions and responsibilities.

3.3.5 JKIA 2nd RWY ANS adaptations

The JKIA 2nd runway ANS adaptations are required to integrate the future operational use of the 2nd runway. This 2nd runway at JKIA will not only increase the airport capacity, it will also contribute to improve the operations at Wilson by reducing the conflicts between departures from JKIA and Wilson (assuming that this 2nd runway is far enough and is used for departures).

The activities related to this re-organisation will be:

- To create additional positions for the management of the second runway (e.g. Ground and Runway control, planner position);
- To extend the infrastructure to consider the 2nd runway, e.g. surveillance coverage, ILS (see sections3.5, 3.6, 3.7and 3.8);
- To define the operational procedures for the use of the two runways;
- To provide training to the controllers.

This evolution will rely on:

- The availability of the human resources (i.e. sufficient controllers to man the positions);
- The CNS and ATC systems upgrade; and
- The tower cab reorganisation that will rearrange the positions to integrate the new runway.

3.3.6 JKIA Ground Control adaptations

The JKIA tower ground position adaptations is required to integrate operational use of the SMGCS. This SMGCS will optimize use of the airport by increasing capacity during periods of poor visibility, it will also contribute to improve on the safety of operations at the airport reducing the conflicts between departures and arrivals and between aircraft and vehicles operating on the manoeuvring away from aprons.

The activities related to this re-organisation will be:

- To create additional positions for the management of Ground control & planner position);
- To extend the infrastructure to consider MLAT surveillance coverage;
- To define the operational procedures for the use of surveillance equipment in tower;
- To provide training to the controllers.

This evolution will rely on:

- The availability of the human resources (i.e. sufficient controllers to man the positions);
- The CNS and ATC systems upgrade; and
- The tower cab reorganisation that will rearrange the positions to integrate the Ground position.
-

3.3.7 JKIA CAT II operations

The implementation of Cat II operations is recommended as there are some diversions due to weather, which impact JKIA operations.

The JKIA ILS is potentially useable for Cat II and work needs to be undertaken by KAA to enable CAT II.

This evolution concerns the full implementation of ILS Cat II procedure on RWY 06 with the continuation of the on-going work.

The associated activities will be:

- Technical verification/validation of the performances;
- Definition of associated procedures for the use of CAT II;
- AIP update.

3.3.8 Wilson new TWR

This evolution concerns the implementation of a new tower at Wilson airport. This new tower will include a new ground coordinator position (which was not possible before due to a lack of space in the existing tower).

The associated activities will include:

- To build a new tower (on-going procurement);
- To equip the new TWR (using existing equipment but also new equipment, e.g. for the new position);
- To define the operational procedures with regard to the new organisation;
- To define a transition plan to move from the old to the new TWR;
- To perform a safety case.

This evolution will rely on:

- The availability of human resources (i.e. sufficient controllers to man the additional position)
- The CNS and ATC systems upgrade (e.g. new position).

3.3.9 Wajir TMA

This evolution concerns the implementation of the TMA at Wajir airport to cope with the traffic coming from Mogadishu. The TMA realisation will come with the implementation of SIDs and STARs.

The following activities will be required:

- Definition of operational procedures;
- Training of the controllers;
- Update of the AIP.

Note: The design of the Wajir TMA has already been completed.

3.3.10 PBN procedures implementation

PBN procedures (Approach Procedures and SID and STARs) already exit at JKIA, Mombasa, Kisumu and Lokichoggio.

This evolution will be the continuation of the implementation of PBN procedures at some additional airports. Particularly, there exists a strong requirement from the Airspace Users to implement PBN procedures at Wilson airport in the short term.

The supporting activities will be:

- The design the procedures (Approach procedures and SIDs and STARs);
- The training of controllers;
- The update of the AIP and communication towards the users;
- The realisation of Safety Cases.

3.3.11 ATS provision at smaller Kenya airports

At some smaller airports, it is recommended to provide flight information and alerting services or air traffic control services, depending on the traffic evolution.

The targeted airport for the provision of air traffic control services is Lamu airport.

The targeted airports for the provision of flight information and alerting services are Isiolo, Nanyuki, Embu, Ukunda and Lodwar. Air traffic control services could be provided later on at these airports subject to traffic.

In that perspective, the activities to be undertaken are:

- The recruitment and training of ATC controllers (ATCO);
- The provision of the required equipment for the ATCO working position, e.g. strips and VHF communications;
- The update of the AIP.

This evolution will rely on:

- The recruitment and availability of the Human Resources (ATCO availability);

- The implementation of ATCO working positions at these small airports.

3.3.12 Kisumu new ATC Control TWR

This evolution concerns the implementation of a new tower at Kisumu airport.

The associated activities will include:

- To build a new ATC Control tower;
- To equip the new TWR;
- To define the operational procedures with regard to the new organisation;
- To define a transition plan to move from the old to the new TWR;
- To perform a safety case assessment.

This evolution will rely on:

- The availability of human resources;
- The CNS and ATC systems upgrade;

3.3.13 Malindi new ATC Control TWR

This evolution concerns the implementation of a new tower at Malindi airport.

The associated activities will include:

- To build a new ATC Control tower;

- To equip the new TWR;
- To define the operational procedures with regard to the new organisation;
- To define a transition plan to move from the old to the new TWR;
- To perform a safety case assessment.

This evolution will rely on:

- The availability of human resources;
- The CNS and ATC systems upgrade;

3.3.14 Isiolo new ATC Control TWR

This evolution concerns the implementation of a new ATC Control Tower at Isiolo airport.

The associated activities will include:

- To build a new ATC Control tower;
- To equip the new TWR;
- To define the operational procedures with regard to the new organisation;
- To define a transition plan to move from the old to the new TWR;
- To perform a safety case assessment.

This evolution will rely on:

- The availability of human resources;
- The CNS and ATC systems upgrade;

3.4 Aeronautical Information Services (AIS)

The overall planning of evolutions in the Aeronautical Information Services (AIS) domain is depicted in the Figure 4 below.

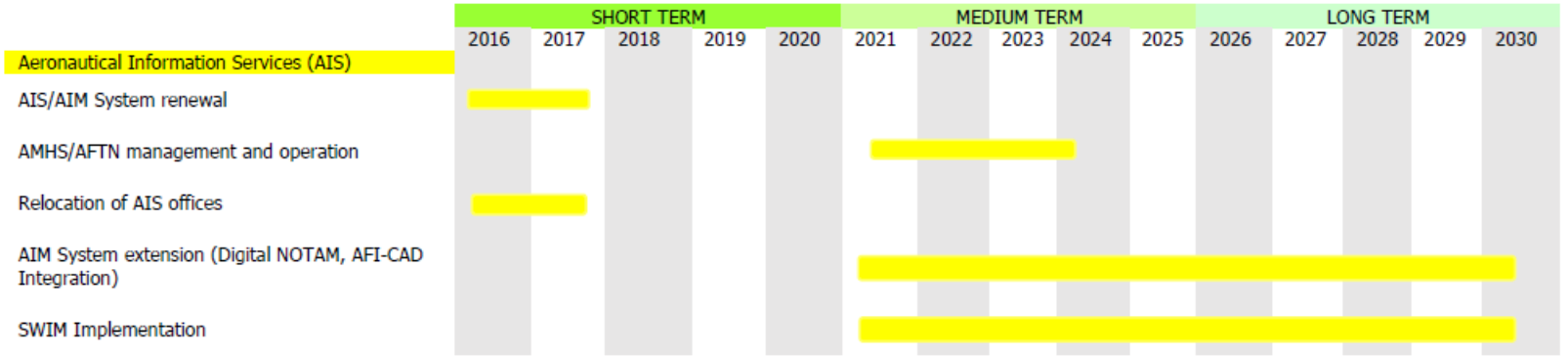

Figure 4: Implementation Plan – Aeronautical Information Services

As detailed in the deliverable D1 [3] section 6, in Kenya the AIS includes the following main functions:

- Aeronautical data and aeronautical information management;
- Aeronautical Information Publication (AIP);
- NOTAM management;
- Provision of pre-flight and post-flight information;
- Aeronautical Charts Management (as per ICAO Annex 4).
- Flight plan Management for ATS Reporting Offices (ARO);
- Instrument Flight Procedure Design.

These functions are currently implemented by two main software components: one is supporting the Procedure Design activities and the other one is supporting the core AIS functions.

In the short term, priority will be given to the replacement of the AIS system which is currently under procurement by KCAA.

This procurement process supporting the transition from AIS to AIM will cover the **full scope** of the AIS system.

Later on, once the procurement of the new AIS system is well on the track, the priorities will then be the relocation of AIS offices.

The **In the medium term and long terms**, the challenge for KCAA will be the implementation of SWIM at national level, taking account of the regional context. The AIM System will be extended to integrate new functionalities enabled by the SWIM environment.

This will also include the integration of AMHS/AFTN management and operations within the scope of responsibilities of AIS staff

3.4.1 AIS System renewal

The procurement for a new AIS/AIM system is currently undergoing. This procurement addresses the full scope of the current AIS system as follows:

- NOTAM Management (NOF),
- Flight plan Management (ARO),
- Pre and post flight Briefing (BOF),
- AIM Operations (AIXM database, eAIP),
- Aeronautical Maps & charts (Cartography),
- Instrument Flight Procedure Design(IFPD),
- Web based system to enable aeronautical data exchange, and
- Contingency System.

All the services will be available via Web-based Human Machine Interfaces (HMIs). Particularly, it will provide the airspace users with on-line services to fill flight plans.

This new system will solve in particular the following issues identified in D1 [3] section 6:

- Necessary improvements of the FPL/RPL processing;
- Connection to FDPS used in ACC and APP;
- Interconnection of the central AIXM database with all functionalities in every location;
- Number of licences of PANS-OPS tool;
- 3D simulation tool for PANS-OPS unit;
- AIP publishing capacities.

It is expected that this new system will be fully operational by **end 2017**.

3.4.2 AMHS/AFTN management and operation

The tasks related to AMHS/AFTN management and operation will be taken in charge by the AIS staff in the NOTAM Office.

This change will allow KCAA to address the current COM Centre staff shortage by reducing its activities. In the overall planning presented in the Figure 4, this change is planned in the medium term.

3.4.3 Relocation of AIS offices

The AIS offices at Wilson airport are located to the new tower building while in Kisumu airport, KAA allocated space was not sufficient and hence the AIS Offices relocated back to the current tower building. This evolution was to offer better services to the airspace users

3.4.4 AIM System extension

The new AIM system will be upgraded to integrate functions like Digital NOTAM processing or the connection to AFI-CAD the ICAO Centralised AFI Region AIS Data Base.

The planning of these changes will need to be reviewed according to the actual situation in AFI region as currently digital NOTAM is not yet an ICAO standard and this requires continuous monitoring with ICAO and once implemented AIM System functionality on digital NOTAM will be activated as the system currently has the capability. This evolution is planned for medium and long term implementation.

3.4.5 SWIM Implementation

SWIM is not the issue of a single State like Kenya; SWIM implementation will be coordinated at the regional scale.

The overall planning of SWIM implementation, according to ICAO GANP is depicted in Figure 5 below.

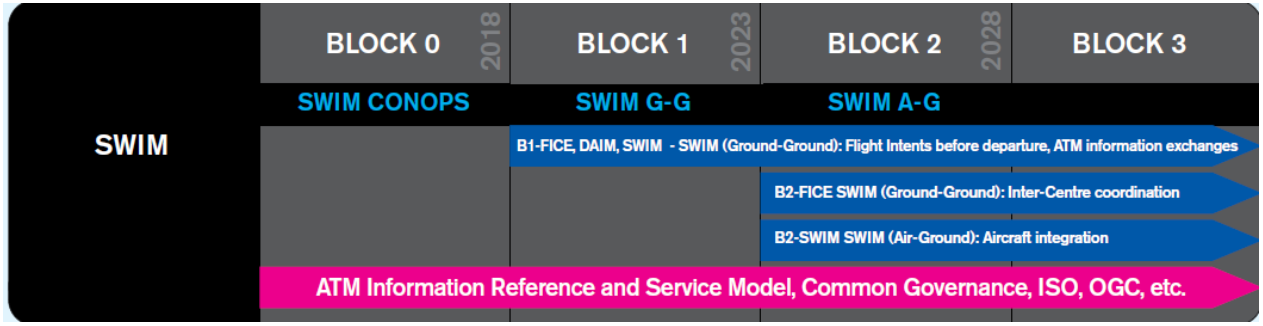

Figure 5: ICAO GANP – SWIM Implementation Roadmap

In this context, SWIM implementation in Kenya will depend on the progress achieved in this area in the AFI region. In the overall planning presented in the Figure 4, this change is planned at the beginning of 2021 which corresponds to the beginning of Block-1 functionalities rollout. This is probably a bit optimistic.

3.5 Communications

The overall planning of evolutions in the Communications domain is depicted in the Figure 6 below.

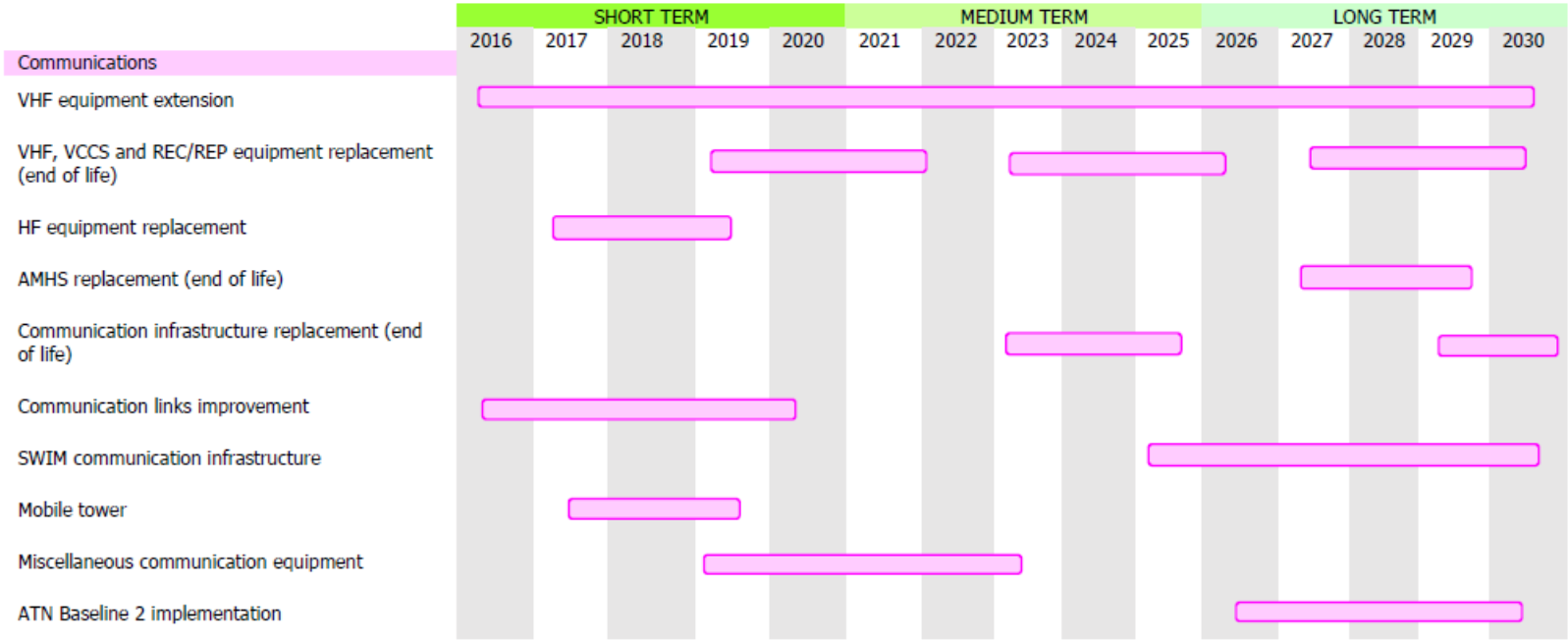

Figure 6: Implementation Plan – Communications

In the short term, there will be four main evolutions in the Communications domain:

1. Procurement and installation of additional communication equipment for voice communications to support the ATM evolutions described in section 3.3(e.g. second runway in Nairobi, provision of ANS at small airports, etc...).

2. Improvement of the communication links to provide redundancy and increased throughputat national and international levels. This was identified as the main weakness in the Communications domain (cf. deliverable D1 [3]).
3. Procurement of communication equipment to address some other weaknesses identified in the Communications domain (e.g. the need to have an ATIS system at Wilson airport or to replace the Intercom system at Eldoret airport).
4. Replacement of the HF equipment for back-up purposes, as recommended in section 3.2.

In the medium term, part of the communication equipment will need to be replaced at the end of its life. It concerns part of the VHF equipment, VCCS, voice recorders/reproducers, VSAT and radio links. The main evolution during this period will be the improvement of the communication infrastructure to support the implementation of SWIM in the medium term (cf. section 3.4).

In the long term, the remaining part of the communication equipment will need to be replaced at the end of its life. It concerns part of the VHF equipment, VCCS, voice recorders/reproducers, radio links and AMHS. ATN B2 will be implemented.

3.5.1 VHF equipment extension

This evolution at the technical level will provide the necessary VHF equipment whenever an ATM evolution requires such equipment.

The following ATM evolutions will need to be considered in the scope of this technical evolution:

- The installation of additional tower positions at JKIA (for ground control and clearance delivery) as part of the *"JKIA Tower cab reorganisation"* evolution (cf. section 3.3);
- The installation of additional tower positions at JKIA to take care of the second runway as part of the *"JKIA 2nd Runway ANS adaptations"* evolution (cf. section 3.3);
- The installation of one additional tower position at Wilson airport as part of the *"Wilson new Tower"* evolution (cf. section 3.3);
- The positions to be created at the smaller airports to provide ANS as part of the *"ANS provision at smaller airports"* evolution (cf. section 3.3).
- The provision of a dedicated frequency for communications with the search aircraft, away from the operational frequencies (cf. deliverable D1 [3] section 7.2 on SAR).
- The improvement of the VHF coverage in the Northern part of the country, as requested by the Airspace Users, by installing an additional ground VHF station (Garissa) to fill a gap in the VHF coverage.

- The creation of a new ACC (cf. section 3.2.8), which will require, inter alia, the procurement and installation of a new VCCS and of a new voice Recorder and Reproducer.

Note: No additional VHF equipment will be required for the second JKIA APP position as this position already exists.

This technical evolution will mostly be implemented in the 2017/2018 timeframe. It will then continue in the short term in accordance with the detailed planning of the *"ANS provision at smaller airports"* evolution.

3.5.2 VHF, VCCS and REC/REP equipment replacement

This evolution concerns the replacement of the following existing equipment at the end of its life (the procurement and installation of new equipment to support the ATM evolutions is covered in the previous section):

- VHF equipment;
- Voice Communication Systems (VCCS); and
- Recorders and Reproducers/Reproducers (REC/REP).

Based on the analysis of the current situation in the first deliverable D1 [3], there will be three main periods for the replacement of this equipment:

- In the 2019/2021 timeframe; to replace the VCCS in Malindi, Kisumu, JKIA and Mombasa
- In the 2023/2025 timeframe (medium term); and
- In the 2028/2029 timeframe (long term).

3.5.3 HF equipment replacement

The HF communications has been deployed as a 'hot-standby' in the ACC to act as a back-up communications means should VHF, ADS-C and CPDLC become un-operational.

3.5.4 AMHS replacement

The theoretical replacement date of the AMHS system is in 2028. This evolution is for the replacement of this system at the end of its life.

3.5.5 Communication infrastructure replacement

This evolution concerns the replacement of the VSAT (national and international) and of the radio links at the end of their life. Based on the analysis of the current situation in the deliverable D1 [3], there will be two main periods for the replacement of this equipment:

- In the 2023/2025 timeframe (medium term); and
- In the 2029/2030 timeframe (long term).

3.5.6 Communication links improvement

The main priority in communications is the improvement of the communication links at both national and international levels.

Based on the analysis of the current situation in the deliverable D1 [3], this evolution will take care of the following requirements:

- To provide redundancy and increased throughput;
- To enable the transition from AFTN to AMHS;
- To enable the use of AIDC/OLDI between Nairobi and Mombasa, and then between Nairobi ACC and other adjacent centres (cf. section 3.2);
- To enable the integration of JKIA MSSR into the A-SMGCS (cf. section 3.8).

This evolution should be implemented over the short term period to progressively improve the communication links.

3.5.7 SWIM communication infrastructure

This evolution is to further improve the communication infrastructure in order to support the implementation of SWIM in Kenya and in the Region.

There is a dependency between this evolution and the *"SWIM implementation"* (cf. section 3.4).

3.5.8 Mobile tower

KCAA does not have a mobile tower. Although it is not a priority, KCAA needs to have its own mobile tower fully equipped to cater for events at a location where there is no ANS or in the case of disaster.

Mobile Tower has been procured for operational use and stationed at Diani airport.

3.5.9 Miscellaneous communication equipment

The aim of this evolution is to fix the other weaknesses identified in communications. Based on the analysis of the current situation in the deliverable D1 [3], the following procurements are in the scope of this evolution:

- To provide an ATIS system at Wilson airport; and
- To replace the Intercom at Eldoret airport.

This evolution should be implemented in the short and medium term.

3.5.10 ATN Baseline 2 implementation

The standards for ATN Baseline 2 (B2) are about to be approved by RTCA and EUROCAE. The time frame for initial implementations of ATN B2 is around 2018-2025 (considering the time required to equip aircraft and ground systems once the standards are defined). It is therefore anticipated that some ATN B2 equipped aircraft (coming from Europe) may start to fly in the Kenyan airspace at the end of that time frame. Particularly, ATN B2 will enable the implementation of the ICAO module B1-TBO to perform trajectory negotiations. Although the implementation of this module is not a priority in Kenya,the implementation of ATN B2 in the long term is an opportunity to enable the progressive implementation of this module in Kenya and the progressive transition from FANS-1/A to ATN B2.

In this context, the implementation of ATN B2 should be consistent with the planned replacement or upgrade of the ATC system in the 2024/2025 time frame or later.

Arrangements with the Communication Service Provider(s) should be considered for the installation and operation of ATN routers and ground VDL radios, if not already done for FANS-1/A communications.

3.6 Navigation

The overall planning of evolutions in the Navigation domain is depicted in the Figure 7below.

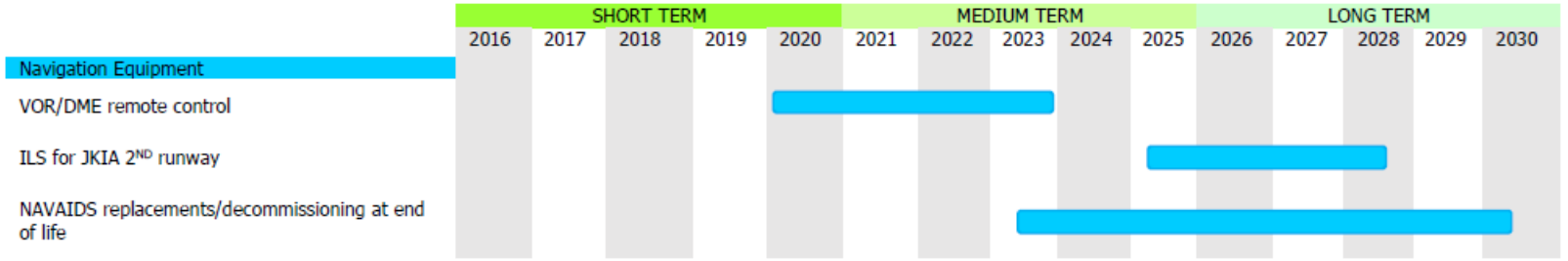

Figure 7: Implementation Plan – Navigation

In the medium and long terms, priority will be given to the installation of VOR/DME remote control at some airports and then to the deployment of the ILS for the 2nd runway at JKIA. The evolution will concern the NAVAIDS replacement or decommissioning at the end of their life.

3.6.1 VOR/DME remote control

This evolution is to fix the problems related to the lack of remote control of the existing VOR/DMEs.

The activities related to the installation of such remote control units will be to:

- Confirm the needs (e.g. it is needed in Mombasa, Wajir and Eldoret);
- Purchase and install the equipment for the remote control units;
- Identify and install the required communication links;
- Verify and validate the systems;
- Define the procedures for the use of these remote controls.

3.6.2 ILS for JKIA 2nd RWY

The installation of ILS is foreseen for the 2nd runway at JKIA.

This evolution is made in the context of the ATM "JKIA 2nd runway ANS adaptations"(see section 3.3) and shall be done once the structural works of the runway is done.

The activities will include:

- ILS installation;
- Operational and Instrument Flight Procedures definition;
- Verification of the performances of the system prior to the handover and during the operations;
- Update of the AIP.

3.6.3 NAVAIDS replacement/decommissioning

In the medium and long terms, there will be the theoretical replacement dates of the VOR and DME.

The VOR and DME have been installed between 2009 and 2014, which leads to a theoretical replacement from 2027.

In En-route and Terminal airspace, this will be the opportunity to not replace VOR/DME (in totality or not) and to allow the transition to use GNSS either as the sole means of navigation (assuming the multi-constellation GNSS) or to use conventional navigation aids to provide redundant and back-up services to GNSS. This choice should be done beforehand in the medium term through the consultation of the stakeholders.

In Approach airspace, there will be the opportunity not to replace VOR/DME and to allow the transition to use GNSS as sole means of navigation assuming multi-constellation GNSS and/or with ABAS, SBAS and GBAS.

Concerning ILS, CAT I should not be replaced (it is assumed that the same performances as CAT I can be obtained with GBAS). CAT II should be replaced until the CAT II requirements can be reached using GBAS (i.e. use of GLS). Knowing that the GBAS Cat II requirements are under validation, the use of GBAS Cat II can only be in the long term.

Similarly, the use of SBAS cannot be foreseen before 10 years when there is a constellation over the region.

However, this will be subjected to the equipment of the aircraft and their ability to perform GBAS procedures.

The use of GLS will offer the opportunity to apply CAT II at each runway (e.g. 4 runways at JKIA), whereas an ILS would be required at each runway.

The major activities related to the NAVAIDS replacement/decommissioning will be:

- To develop a roadmap in the medium term for the replacement or decommissioning of NAVAIDS at the end of their life in the long term (starting from 2025). Depending on the roadmap, mandates may be established to oblige the operators to be suitably equipped.
- To consult the stakeholders for the establishment of this roadmap.
- To implement the solution in the long term.

This activity will depend on the ATM PBN procedures implementation evolution and the operational needs.

3.7 Surveillance

The overall planning of evolutions in the Surveillance domain is depicted in the Figure 8 below.

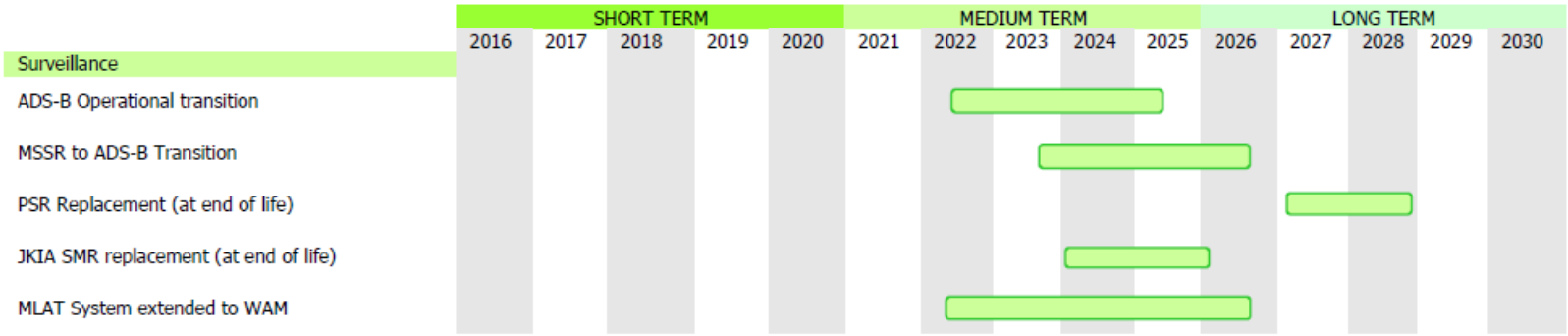

Figure 8: Implementation Plan – Surveillance

In the medium term, priority will be given to the ADS-B operational transition as this system is currently under procurement by KCAA. Priority will then be on the extension of some MLAT systems currently under procurement at some airports to WAM systems (Kisumu and possibly Malindi), and then on the installation of an airport MLAT system at JKIA for integration into the A-SMGCS system. the replacement of the SMR at JKIA at the end of its life will be needed. During this phase, there will be a need to prepare the surveillance strategy to be applied in the long term as the MSSRs will need to be replaced in the long term period. The theoretical replacement date of all the MSSRs is indeed in 2025 and a decision will be required to replace or not these MSSRs. In the proposed Implementation Plan, the option of not replacing the MSSRs is considered and thus a transition to a full ADS-B environment in En-route will need to be prepared. Such a transition to a full ADS-B environment will require a mandate for the on-board equipage. In that case, the regulatory material will need to be prepared and published in the 2020/2022 timeframe in order to be applicable in 2026. In this context, the MLAT system previously installed at JKIA could be extended to a WAM system to provide redundancy in approach.

In the long term, the transition to a full ADS-B environment in En-route will be effective. The PSR in Nairobi and Mombasa will need to be replaced at the end of their life. This replacement will need to be made after the transition to ADS-B is made as the combined MSSR/PSR will be replaced by a PSR. Alternatively, a new PSR could be installed before the transition to ADS-B (i.e. in 2024/2025),

maintaining the existing MSSR/PSR in operation until its decommissioning after transition to ADS-B (i.e. in 2027).Nevertheless, this alternative is not considered in the proposed Implementation Plan.

3.7.1 ADS-B operational transition

An ADS-B system is currently under procurement. This evolution consists in the operational transition of the ADS-B system.

The following activities will need to be completed:

- Technical deployment of ADS-B stations and integration of ADS-B data into the ATM system for display to ATCOs;
- Development of operational procedures for the use of ADS-B data;
- Operational and technical training;
- Development of a safety case from the initial stages of the project until the actual operational transition.

It is anticipated that an external support will be required for the development of operational procedures and for the development of a safety case.

There is a dependency between this evolution and the necessary adaptations to be made in the ATM system for the processing of ADS-B data (cf. section 3.8).

3.7.2 MSSR to ADS-B transition

The theoretical replacement date of the MSSRs is in 2025. There will be an opportunity to not replace them and to have a transition to a full ADS-B environment in En-route. Such a transition will need to be prepared well in advance and it will require coordination at regional level and with the airspace users.

The transition to a full ADS-B environment could be made in 2026. The regulatory material is therefore expected to be prepared from 2020 in order to be published in 2021/2022 at the latest. This regulation shall concern the forward fit of new aircraft and the retrofit of existing aircraft with ADS-B equipment.

3.7.3 PSR replacement

The theoretical replacement date of the PSRs is in 2025. These PSRs should be maintained for approach control and they will need to be replaced at about that date. Considering the *"MSSR to ADS-B transition"* (cf. section 3.7.2), this transition will first need to be

completed before the existing combined MSSR/PSR is decommissioned and replaced by one new PSR. It should be anticipated that some adaptations will be required in the ATC System after its replacement in 2024/2025 for processing of data from this new PSR.

3.7.4 JKIA SMR replacement

The theoretical replacement date of the SMR at JKIA is 2025. This SMR will need to be replaced at about that date together with the A-SMGCS system (cf. section 3.8).

3.7.5 JKIA Airport MLAT

The implementation of an airport MLAT system at JKIA is recommended but it is not in the scope of the current procurement of airport MLAT systems. This procurement should be made in the medium term but there is no urgency. The A-SMGCS surveillance can indeed initially rely on the SMR and on the MSSR at JKIA. It is thus proposed to implement this system in a second step after the A-SMGCS operational transition is completed (cf. section 3.8).

This airport MLAT system will improve the airport surface surveillance, particularly the automatic identification of targets in A-SMGCS.

There is a dependency between this evolution and the necessary adaptations to be made in the A-SMGCS system for the processing of airport MLAT data (cf. section 3.8).

3.7.6 MLAT systems extended to WAM

Airport MLAT systems are currently under procurement by KCAA for installation at several airports. The MLAT systems that will be installed at some airports should be extended to a WAM system in order to improve the surveillance coverage of the approach area to these airports. These WAM systems will thus be “gap fillers”. The targeted airports in the medium term are Kisumu and Malindi.

The improved surveillance coverage of the approach area to Kisumu will be useful to the approach controller located in Eldoret. For that purpose, the surveillance data from the WAM system installed in Kisumu should be integrated into the ATM system in Nairobi for processing and display to the approach controller in Eldoret together with other surveillance data (MSSR), using a remote ATM display.

There is a dependency between this evolution and the necessary adaptations to be made in the ATM system for the processing of WAM data (cf. section 3.8). There is also a dependency between this evolution and the improvement of the communication links (cf. section 3.5) because the WAM data from Kisumu will need to be sent to Nairobi for integration into the ATM system.

In the medium term, additional airport MLAT systems may need to be extended to a WAM system to support the surveillance strategy that will be implemented in the long term, which involves the decommissioning of the MSSRs (cf. section 3.7.2). The targeted airports are Nairobi and Mombasa.

The surveillance data from the WAM systems installed in Nairobi and Mombasa should be integrated into the ATC systems in Nairobi and Mombasa for processing and display to the approach controllers in Nairobi and Mombasa, together with other surveillance data (PSR and ADS-B).

It should be noted that this evolution will occur when the ATC systems in Nairobi and Mombasa will need to be replaced (cf. section 3.8). These two evolutions should thus be considered together to ensure that the new ATC systems will process and display these WAM data.

3.8 ATC Systems

The overall planning of evolutions in the ATC Systems domain is depicted in the Figure 9 below.

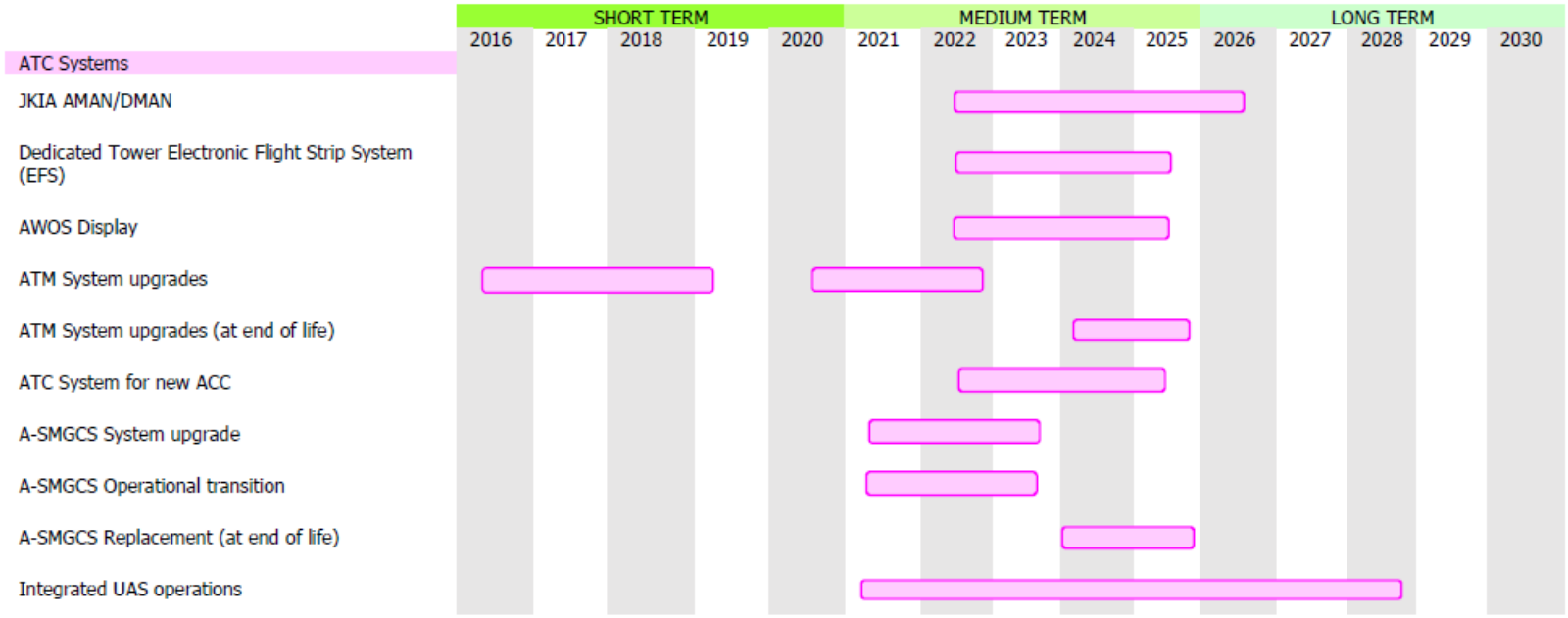

Figure 9: Implementation Plan – ATC Systems

In the medium term, priority will be on the necessary procurements and upgrades of ATC systems to support the recommended ATM evolutions and CNS improvements. It includes the following evolutions of ATC systems:

1. Procurement and installation of AMAN and DMAN tools at JKIA;

2. Procurement and installation of dedicated Tower EFS systems at the main Kenyan airports (Nairobi JKIA and Wilson airport, and Mombasa airport) to enable the transition from a paper strips environment to an electronic strips environment;
3. Procurement and installation of an AWOS display in Mombasa APP to directly provide weather information to APP controllers;
4. A series of ATM system upgrades to interface with the new ATC systems (AMAN/DMAN, Tower EFS), to integrate new surveillance data (ADS-B, WAM) and to provide an additional ATM display in JKIA Tower for the 2nd runway operations;
5. Operational transition of the A-SMGCS after integration of JKIA MSSR data and the JKIA Tower cab reorganisation to allow the effective use of the A-SMGCS surveillance; and
6. Integration of airport MLAT data into the A-SMGCS system to improve the airport surveillance function.
7. Integrated UAS operations

The ATM system will be upgraded in the 2020/2022 timeframe. A replacement will need to be considered at the end of its theoretical life in 2025. As part of these upgrade and replacement, the following operational requirements will have to be considered:

1. SWIM implementation; and
2. Free Route concept implementation in en-route continental airspace.

An operational transition of the A-SMGCS alerts function should be made in the 2021/2022 timeframe, after the operational transition and improvement of the A-SMGCS surveillance function in the medium term. A replacement will need to be considered at the end of its theoretical life in 2025.

No specific evolutions are identified in the long term.

3.8.1 JKIA AMAN & DMAN

This evolution is for the implementation of integrated AMAN and DMAN tools at JKIA. This evolution will support the evolution at ATM level to improve the arrival and departure management at JKIA (cf. section 3.3).

There is therefore a dependency between this evolution and the *"JKIA AMAN & DMAN"* evolution (cf. section 3.3).

3.8.2 Dedicated Tower Electronic Flight Strips (EFS) system

Paper strips are still used in Kenya. It is recommended to procure and install a dedicated Tower Electronic Flight Strips (EFS) system at the following main Kenyan airports to facilitate the transition from a paper strip environment to an electronic strip environment:

- Nairobi – JKIA
- Nairobi – Wilson
- Mombasa

These Tower EFS systems will need to be interfaced to the ATM system to share updated flight data.

3.8.3 AWOS display

The analysis of the current situation in Kenya (cf. deliverable D1 [3]) identified the need to provide an AWOS display in the Approach room in Mombasa. This evolution will directly provide weather information to the approach controller while he/she currently needs to call the tower controller to get this information.

3.8.4 ATM system upgrades

This series of evolutions will make the necessary upgrades or adaptations in the ATM system whenever an ATM evolution or a CNS improvement will require such an upgrade or adaption.

The following upgrades or adaptations have been identified for the ATM system:

- In the 2016/2026 timeframe:
  - Integration of ADS-B data (cf. *"ADS-B operational transition"* in section 3.7)
  - Integration with AMAN and DMAN systems (cf. *"JKIA AMAN & DMAN"* in section 3.8)
  - Display of sector capacity and demand (cf. *"AFTM"* in section 3.2)
  - Integration of WAM data (cf. *"MLAT system extended to WAM"* in section 3.7)
  - Integration with Tower EFS systems (cf. *"Dedicated Tower EFS system"* in section 3.8)
  - Installation of one additional ATM position at JKIA Tower for the second runway (cf. *"JKIA Second Runway ANS adaptations"*in section 3.3)

- SWIM implementation (unless this upgrade comes too early and is considered as part of the ATC system replacement, cf. section 3.8.5)
- Installation of additional ATM positions in the existing ACC to support the creation of a third ACC sector (cf. *"New En-route sectorization"* in section 3.2.7)
- Implementation of a Disaster Recovery concept with the new ACC (cf. *"New En-route Control Centre"* in section 3.2.8). This should be considered together with the procurement of a new ATC system for the new ACC (cf. section 3.8.6).

3.8.5 ATC system replacement

The theoretical replacement date of the ATM systems in Nairobi and in Mombasa is 2025. This replacement should thus be initiated in 2024.

As part of this replacement, the following operational evolutions should be considered as they are planned in the same timeframe:

- *"SWIM implementation"* (cf. section 3.4): The need to take account of flight objects, which will be exchanged through SWIM, and the impact on the FDPS will need to be considered.
- *"Free Route concept implementation"* (cf. section 3.2): The implications of implementing the free route concept in continental area will need to be considered in order to provide the appropriate safety support tools to controllers (detection of conflicts).
- *"ATN Baseline 2 implementation"* (cf. section 3.5.10).

3.8.6 ATC system for new ACC and DRC

This evolution is for the procurement and installation of a new ATC system in the new ACC (cf. section 3.2.8).

This procurement should consider the implementation of a Disaster Recovery concept with JKIA.

The procurement of systems for the Disaster Recovery Center should ensure resilience in ATC service disruptions (cf. sections 3.2.8)

3.8.7 ATC system for new ATC Control Tower at Kisumu Airport

This evolution is for procurement, installation and commissioning of ATM systems for the new control tower at Kisumu (cf. sections 3.3.14)

3.8.8 ATC system for new ATC Control Tower at Malindi Airport

This evolution is for procurement, installation and commissioning of ATM systems for the new control tower at Malindi (cf. sections 3.3.15)

3.8.9 ATC system for new ATC Control Tower at Isiolo Airport

This evolution is for procurement, installation and commissioning of ATM systems for the new control tower at Isiolo (cf. sections 3.3.16)

3.8.10 To Develop and implement Operational Performance Management system

Under this strategic objective, the following strategies are to be developed and implemented:

- To develop and implement a set of key performance indicators and measurement metrics
- To establish a data reporting chain with ATM community and promote a performance data reporting culture
- To verify the benefits accrued from implementation of ANS systems through operational performance assessment.

3.8.11 A-SMGCS system upgrade

This evolution is for the necessary adaptations to be made in the A-SMGCS system for the processing of surveillance data from the airport MLAT system following the installation of that system at JKIA (cf. section 3.7).

There is therefore a dependency between this evolution and the *"JKIA Airport MLAT"* evolution (cf. section3.7).

3.8.12 A-SMGCS operational transition

This evolution is to ensure the operational transition of the A-SMGCS, at Level 1 (surveillance) and then at Level 2 (alerts).

The tower controllers at JKIA will need to be trained to these new functions.

More importantly, the tower controller working positions at JKIA will need to be re-organized to allow the effective use of A-SMGCS by the controllers according to their roles and responsibilities.

There is therefore a dependency between this evolution and the *"JKIA Tower cab reorganisation"* evolution (cf. section 3.3).

3.8.13 A-SMGCS system replacement

The theoretical replacement date of the A-SMGCS system at JKIA is 2025. This replacement should thus be initiated in 2024.

At that date, there will be an opportunity to request more advanced functions in terms of alerts, routing and planning, and guidance. It can be anticipated that some of these new alerts will be relevant in the Kenyan context. These new alerts will use the clearances and instructions input by the tower controllers in the electronic flight strips to trigger alerts in the case of contradictory clearances (e.g. one aircraft is cleared to line-up while another one is cleared to land) or in the case of non-conformance to a clearance (e.g. one aircraft enters the runway without an appropriate clearance). In that case, an upgrade to the Tower EFS system at JKIA may be required to implement this interface between the A-SMGCS system and the Tower EFS system.

3.8.14 Integrated UAS operations

This evolution is to ensure seamless operation of UAS within ATM airspaces while ensuring safety and security of both ATM systems and Aeroplanes

3.9 Search & Rescue (SAR)

The overall planning of evolutions in the Search & Rescue (SAR) domain is depicted in the Figure 10 below.

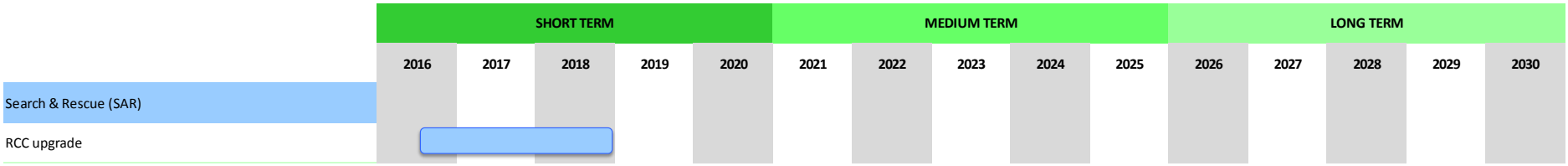

Figure 10: Implementation Plan – Search & Rescue

In the short term, an upgrade of the Rescue Coordination Centre (RCC) located at JKIA as part of the ACC should be made with the procurement and installation of an integrated aeronautical SAR software.

No evolutions are planned in the medium and long terms.

3.9.1 Rescue Coordination Centre (RCC) upgrade

The integrated aeronautical SAR software to be procured for the upgrade of the RCC should provide the same or an upgrade of the capabilities, which are simulated by the SAR software available at the EASA. If the operational SAR software installed at the RCC provides upgraded capabilities then the SAR software available at the EASA for training should be upgraded as well at the same time to ensure consistency between operational capabilities and training capabilities.

This SAR software will integrate and process data from various external sources to facilitate the search of the probable area of the accident and then to coordinate the rescue effectively. Particularly, it will integrate surveillance data (e.g. radar, ADS-B, WAM), AIS data, COSPAS-SARSAT data, terrain data, available resources data...It should also allow RCC and sub-RCCs to communicate with each other in real time.

In this context, to prepare the installation and operational use of this integrated aeronautical SAR software in the RCC, KCAA should maintain a register of available resources to perform the search and rescue.

3.10 Training

The overall planning of evolutions in the Training domain is depicted in the Figure 11below.

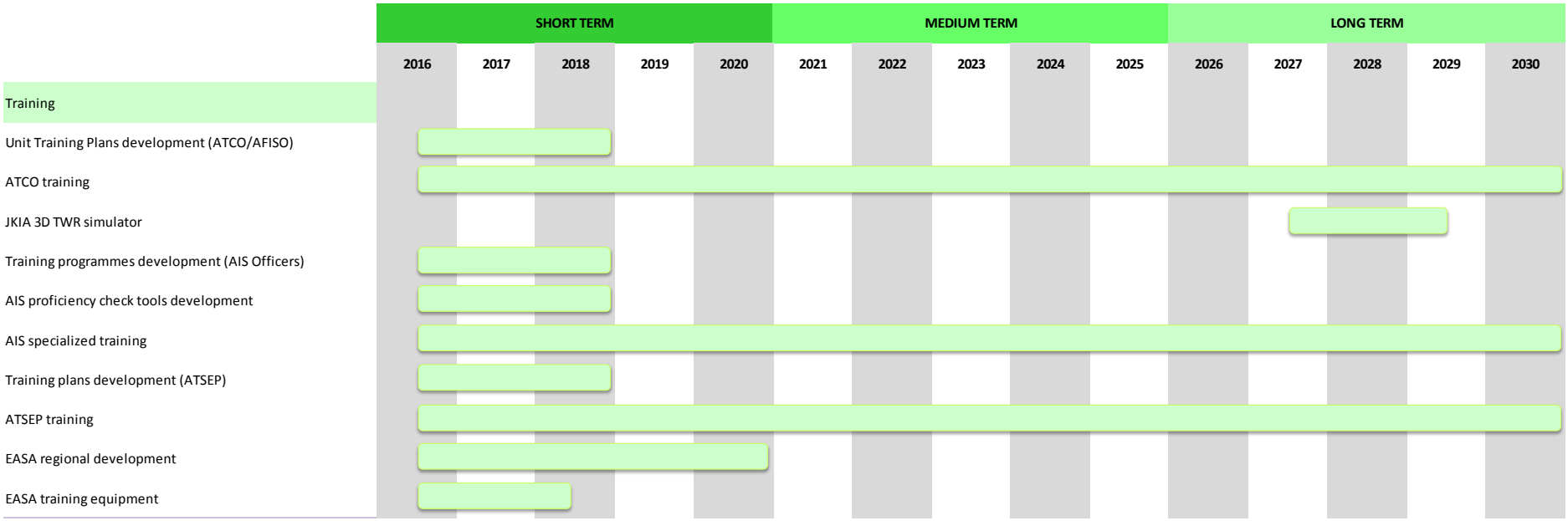

Figure 11: Implementation Plan – Training

In the short term, priority will be given to the development of the training plans for the different categories of personnel and the different stations, i.e. ATCO/AFISO units, AIS officers and ATSEP, so as to be in line with international recommendations and best practices. Another priority will be the development of AIS proficiency check tools as required by the ICAO.

In parallel of these first priorities, the training of all the personnel will start. This training will concern the continuation training to ensure the skills maintenance and the development training for the qualification of instructors and supervisors.

EASA will be equipped with the required facilities and resources, as identified in the deliverable D1 [3], and the process to enable the development of EASA at regional level will start.

In the medium term, the continuous training will still happen for the three main categories of personnel (ATCO/AFISO, ATSEP and AIS).

In the long term, in addition to the continuous training for the three categories of personnel, there will be procurement of a 3D Tower simulator at JKIA.

3.10.1 Unit Training Plans development (ATCO/AFISO)

KCAA will need to review its ATCO training program and develop an AFISO training program.

This will include:

- To implement a national training policy by making use of the best international recommendations and practices;
- To develop Unit Training Plans (training program) for ATCOs and for AFISOs (including refresher courses);
- To develop a program for conducting proficiency check.

The training will also have to include an awareness of the SMS and safety culture.

3.10.2 ATCO training

In a first step, KCAA shall provide OJTI and OPSUP training to ATCOs who are instructors and/or operational supervisors to meet the current weakness.

When the training programs are defined, KCAA will have to progressively put them in place.

The medium and long term ATCO training will rely on the availability of the Unit Training Plans.

3.10.3 JKIA 3D TWR simulator

KCAA shall install a 3D TWR simulator at JKIA for the training of ATCOs to cope with the growth of traffic (long term).

The associated activities will be:

- To purchase and install the 3D TWR simulator;

- To train dedicated ATCO instructors and ATSEP for the use of the simulator.

3.10.4 Training programmes development (AIS Officers)

It is recommended that KCAA develops training programs for AIS officers.

The activities are:

- To develop training programmes detailing the type of training to be provided to all categories of AIS officers assigned at the various AIS offices;
- To develop a periodic training plan detailing and prioritizing the type of training to be provided during a specific period and put strategies of implementing the same;
- To develop an OJT programme and designate an OJT officer to coordinate on the training activities at the station.

Coordination with the Regulator should be set for acceptance of the programme, which therefore assumes a (functional)separation between the Regulator and the ANSP.

3.10.5 AIS proficiency check tools development

KCAA will have to develop proficiency check tools to aid in the regular assessment of AIS officers.

This evolution will depend on the development of the training program and its application.

3.10.6 AIS specialized training

KCAA shall provide AIS specialised and refresher training, including:

- Specialized training to AIS officers in the Aeronautical Chart activity;
- Specialized and refresher training to PANS-OPS officers.

3.10.7 Training plans development (ATSEP)

It is recommended that KCAA develops ATSEP training plans by making use of international standards and practices.

The activities will be to:

- Design training plans in accordance with ICAO Doc 7192 Part E-2;
- Set all the procedures at the station level to adapt the existing training to the new training plan (e.g. to keep record of training and experience).

If KCAA decides to issue licences for CNS officers, KCAA will have to coordinate with the Regulator to put in place the process.

3.10.8 ATSEP training

For the ASEP training, it is recommended that KCAA implements the following activities:

- To provide training on instructional techniques to meet the current needs;
- To provide refresher and advanced technical training to meet the current needs.

3.10.9 EASA regional development

To support EASA in the perspective of a regional development, several activities are recommended in addition to the EASA strategic plan [25].

These activities are:

- To standardize training strategy and methodology by getting close to other training academies;
- To develop MoUs with neighbouring countries to ensure that the facilities and resources deployed at EASA will be fully utilized over time.

3.10.10 EASA training equipment

It is recommended to equip EASA to meet the current needs, which includes:

- A multimedia room;
- A NAVAIDS simulator.

Additionally, it is recommended that any procurement made by KCAA in CNS for deployment in the field includes a dedicated section to the procurement of corresponding training equipment at EASA.

3.11 Human Resources

The overall planning of evolutions in the Human Resources domain is depicted in the Figure 12 below.

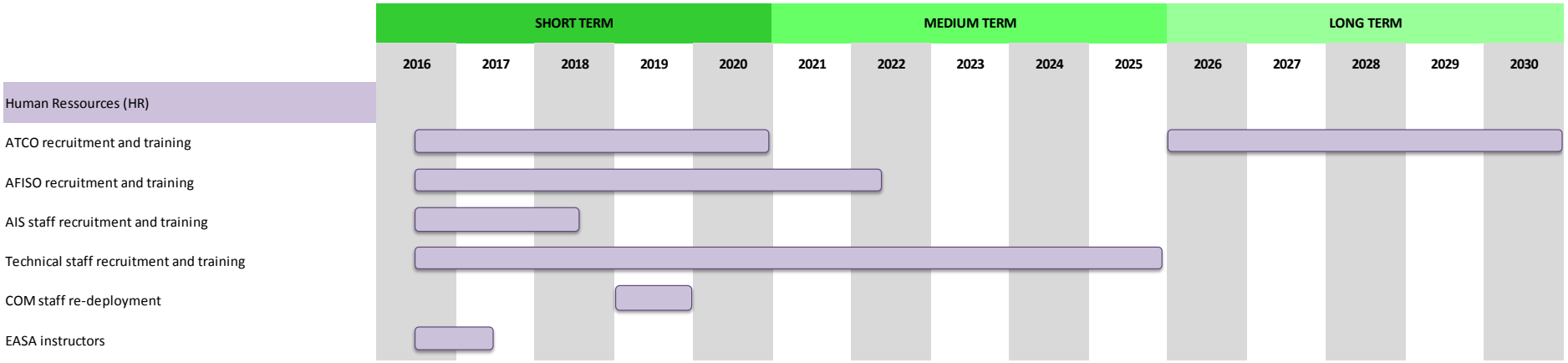

Figure 12: Implementation Plan – Human Resources

In the short term period, priority will be given to the recruitment and the training of the ATCOs, AIS staff and technical staff to palliate the deficits of human resources identified in the current organization. This recruitment and training will continue to enable the manning of the new positions related to the identified improvements, e.g. ATCOs positions for the new APP sector, for the 2nd runway at JKIA and for the deployment of the technical systems.

During this period, AFISOs recruitment and training will also start to enable progressively the deployment of AFIS positions at small airports.

The COM staff re-deployment will occur once the ADS-C and CPDLC are completely operational and the HF is no longer required as a main means of communication.

EASA instructors will also be recruited to meet the identified lack of staff (e.g. CNS instructors).

In the medium term, the recruitment and training of AFISOs and technical staff will continue to support the deployment of AFIS positions and the lack of technical staff.

In the long term, a new phase for ATCO recruitment and training will occur to handle the implementation of the centralised ATFM foreseen at regional level.

The following paragraph identifies the needs for the recruitment and training per category of personnel and the section 2.5provides a consolidation of the needs.

3.11.1 ATCO recruitment and training

The number of ATCOs will have to be increased to meet the current needs and to handle the future evolutions.

ATCOs will be recruited and trained for the followings:

- Flight data management positions at JKIA ACC and at MOI APP
- Additional TWR positions at JKIA (Ground control, Clearance delivery)
- Additional TWR positions at JKIA for the 2nd RWY (Ground, Loc an Planner positions)
- JKIA APP re-sectorization (Executive and Planner for the new sector)
- Additional TWR position at Wilson (new TWR)
- ATFM central function
- OJT instructors (at Nairobi and Mombasa).

3.11.2 AFISO recruitment and training

AFIS Officer will be recruited and trained for the provision of ANS at some smaller airports.

At Lokichoggio, if it is decided to provide AFIS instead of ATC, the existing ATCOs will be re-deployed to another location and they will be replaced by AFISOs.

Note: At least 2 AFISOs per site should be considered.

This needs for AFISO recruitments and training will depend on the implementation of ATM ANS provision at smaller airports.

3.11.3 AIS staff recruitment and training

AIS staff recruitment and training will be done to increase the number of AIS officers so as to meet the current needs:

- Additional active designer (short term)
- Additional officer for the "Aeronautical Maps & Charts" (short term)
- Additional officers at airports, including OJT instructors (short to medium term); e.g. at JKIA, Mombasa and Wilson.

3.11.4 Technical staff recruitment and training

Technical staff and training will be done to increase the number of technical staff at the various stations to meet the current needs.

3.11.5 COM staff re-deployment

When ADS-C and CPDLC are in place and the HF communications are no longer required, the COM centre will be dissolved and the COM staff will be re-deployed to other functions (e.g. SMS data collection and possibly AFISO).

3.11.6 EASA instructors

The number of permanent instructors at EASA will have to be increased in the CNS domain (communication and NAVAIDS).

*** End of document ***