REPORT OF THE
AFRICA-INDIAN OCEAN
TRAFFIC FORECASTING GROUP (AFI TFG)
SEVENTH MEETING

(Nairobi, 27-30 August 2013)

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1. INTRODUCTION

1.1. The ICAO Africa-Indian Ocean Traffic Forecasting Group (AFI TFG) was established in 1998 with the objective of developing traffic forecasts and other planning parameters to support the planning of air navigation services in the AFI Region. It has so far held seven meetings in 1998, 2001, 2003, 2006, 2009, 2011 and 2013.

1.2. This report provides forecasts and analysis prepared by the seventh meeting of the AFI TFG held from 27 to 30 August 2013, in the ICAO Eastern and Southern African (ESAF) Regional Office in Nairobi, Kenya. Representatives of Cape Verde Islands, Seychelles, Uganda, United Republic of Tanzania, African Airlines Association (AFRAA) and the Agency for Aerial Navigation Safety in Africa and Madagascar (ASECNA) participated at the meeting; a list of participants appears in **Appendix A.** The group's activities are serviced and coordinated by the ICAO Secretariat Headquarters, in close consultation with the Eastern and Southern Africa and Western and Central African Offices.

1.3. The Director of the ESAF Regional Office, Mr. M. Belayneh, officially opened the meeting and addressed the participants. He indicated that the work conducted by the group is in line with the ICAO Council Strategy on the development of regional traffic forecasts and other planning parameters in support of the regional air navigation systems planning. He warmly welcomed the participants to the ESAF Regional Office and wished them a fruitful and productive meeting.

1.4. The passenger traffic forecasts for the 2012-2032 period (with the subdivision into 2017-2017 and 2017-2032) were developed for five major route groups (region-pairs) using econometric modelling. They were then converted into aircraft movements and expanded to the city-pair level. The group also conducted peak period analysis for five selected ASECNA Centres (Antananarivo, Brazzaville, Dakar, Douala and Niamey) on the basis of the 2012 data provided by ASECNA. Peak period analysis was also carried out for the Seychelles flight information region (FIR), based on the 2012 data provided by the Seychelles Civil Aviation Authority. Historical data for the Dar es Salaam FIR for the 2000-2012 period, provided by the Civil Aviation Authority of the Republic of Tanzania, was also analysed.

1.5. Bearing in mind fast growing services between Africa and South America, the group felt that it should consider developing traffic and aircraft movement forecasts for this route group in the future as well.

1.6. The Communications, Navigation, and Surveillance (CNS) Regional Officer of the ESAF Office informed the group of Recommendation 6/11 of the ICAO Twelfth Air Navigation Conference (AN-Conf/12), on the alignment of air navigation plans and regional supplementary procedures adopted on the basis of AN-Conf/12-WP/24. The implementation of this Recommendation will result in the re-definition of the AFI Region as seven of its present FIRs (i.e. Alger, Cairo, Canarias, Casablanca, Khartoum, Tripoli and Tunis) will be transferred to the EUR and MID Regions. The group noted the information and recognized that it must explore the effect of this re-definition on its future work and to what extent the forecasts for the revised route groups could be developed, bearing in mind the availability of the necessary historical traffic data.

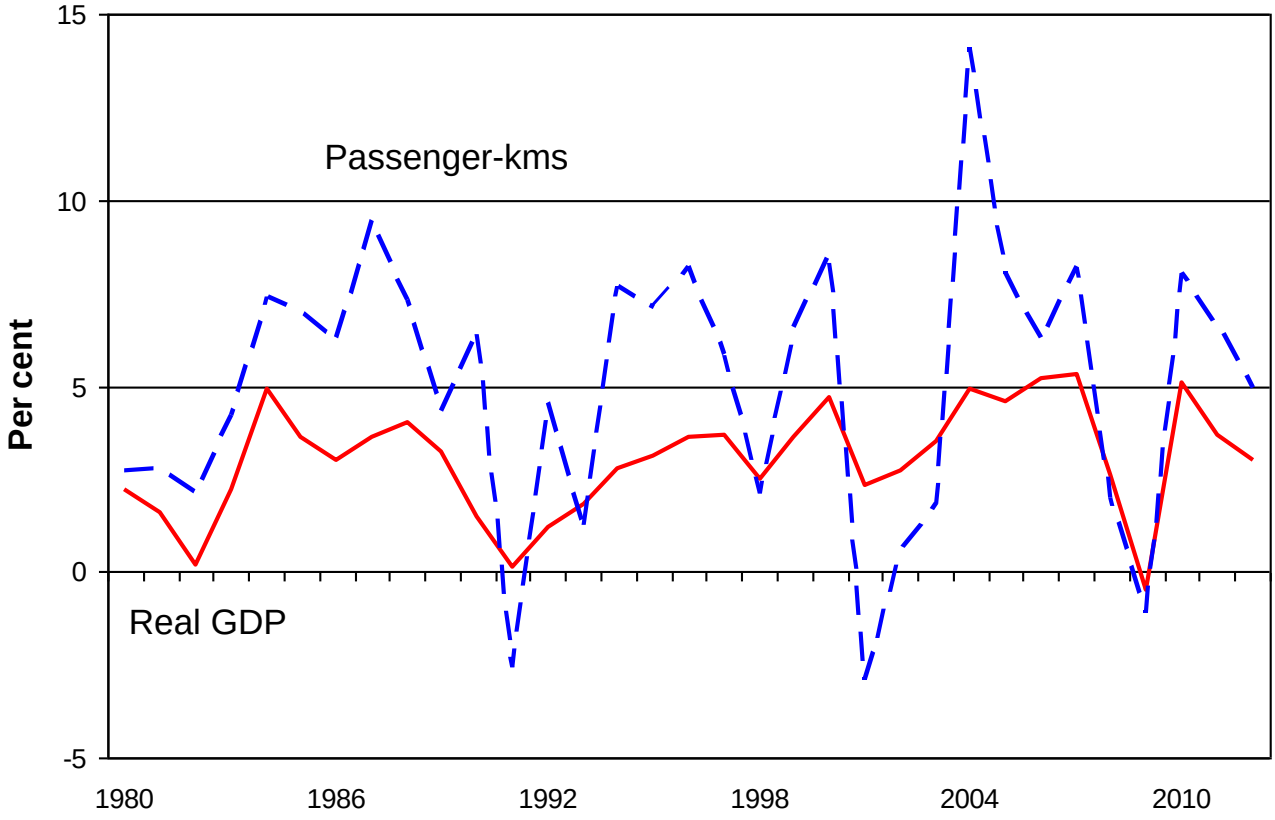
1.7. The group also noted the expectation of the AFI Planning and Regional Implementation Group (APIRG) to be provided with the forecasts of the homogenous ATM areas and major traffic flows/routing areas defined in the AFI Region, in accordance with the group's objectives of developing traffic forecasts and other planning parameters in support of the planning of air navigation services.[1]

[1] The AFI TFG had made an attempt to meet this expectation in 2006 (ICAO Doc 9879 refers); however, the forecasts were developed based on the OAG data, while more reliable forecasts can only be developed using the relevant FIR data and the latter is not easily available, especially for the African Region.

2. FACTORS AFFECTING DEMAND FOR AIR TRAVEL

2.1. Economic theory and analytical studies indicate a high correlation between air traffic growth patterns and economic trends, showing that demand for air travel is primarily determined by economic factors. Changes in gross domestic product (GDP) volume and personal income affect the consumer purchasing power and the propensity to undertake leisure travel. Commercial activity and trade have a direct impact on the demand for business travel and for air freight. **Figure 1** illustrates the fluctuation in global GDP and passenger growth rates for the 1980-2012 period, which implies a correlation of 0.73. It should be noted, however, that the impact of event-related developments on air travel (such as events of 11 September 2011, the war in Iraq and the Severe Acute Respiratory Syndrome (SARS) outbreak) indicates the sensitivity of the air transport industry relating to safety and security concerns, which influences consumer confidence.

FIGURE 1
GDP AND SCHEDULED PASSENGER TRAFFIC
WORLD GROWTH, 1980-2012



2.2. Other economic factors affecting demand for air travel include airline costs, and hence fares and rates. Rapid growth of air traffic in the 1960s coincided with the replacement of piston-engine aircraft with jet aircraft, which led to reduced fares. In addition to an adverse effect on the world economy, sharp changes in the price of oil and aviation fuel have had an important effect on airline costs over the past decades. In recent years, airline costs have also been negatively affected by increasing insurance and security costs, in addition to the sharp hikes in oil prices. Demand for air traffic is also

affected by other various factors such as liberalization of air services, new entrant and low-cost carriers, the changing structure of the airline industry and urbanization.

2.3. In the development of the passenger traffic forecasts for the five traffic flows to/from and within Africa, the GDP or GDP per capita, as the main driver of the demand for air travel, was explored and used. Other factors, which have less influence on the demand and on which the data were limited or unavailable, were not included in the econometric modelling.

3. GLOBAL ECONOMIC AND TRAFFIC TRENDS

3.1. Economic trends

3.1.1. Between the years 2000 and 2012, the aggregate world economy measured in terms of GDP grew at an average annual rate of 3.5 per cent in real terms (PPP- power purchasing parity). Growth rates varied across regions, from a high of 6 per cent for Asia/Pacific to a low of 1.6 per cent for North America. During this period, the world population increased at an average annual rate of 1.2 per cent, therefore, the world's GDP per capita increased at an average annual rate of 2.3 per cent.

3.1.2. It is anticipated that the aggregate world economy will grow at an average annual rate of 4 per cent over the 2012-2017 period and slow down to 3.8 per cent from 2017 to 2032. In terms of GDP/capita, the anticipated average annual growth rates are 2.9 per cent and 3 per cent, respectively. Over the period 2012-2032, the world economy is anticipated to grow at 3.9 per cent per annum and in terms of GDP/capita at 3.0 per cent per year.

3.2. Historical traffic trends

3.2.1. Total scheduled airline traffic, measured in terms of total tonne-kilometres performed, grew at an average annual rate of 4.1 per cent between the years 2000 and 2012. Passenger-kilometres grew at an average rate of 4.6 per cent per annum and freight tonne-kilometres at 3.1 per cent per annum.

3.2.2. In broad terms, the pattern of passenger traffic growth over the 2000-2012 period was a reflection of economic conditions. In the year 2000, traffic increased by 8.6 per cent, supported by the strong performance of the world economy with a 4.6 per cent GDP growth. The economic downturn and related decline in business and consumer confidence had a negative impact on traffic in late 2000 and in 2001, when the events of 11 September exacerbated an already difficult situation. As a result, traffic declined in 2001 by 2.9 per cent; the first decline since 1991 and the second one since 1945. In 2002, the demand for air travel remained depressed and traffic grew at only 0.5 per cent. Following declines in the first part of the year due to the outbreak of SARS and the war in Iraq, traffic rebounded in the second part of 2003 and increased by 1.8 per cent for the whole year. In 2004, traffic recovered strongly, mainly for the airlines in the Asia/Pacific Region, the worst affected by the SARS outbreak. It was supported by improved performance of most regional economies (Africa, Asia/Pacific, Europe, North America, Latin America/Caribbean) and sustained performance of the Middle East economy, and to some extent by the marginal decline of the cost of travel expressed in real terms. Global traffic growth for the year 2004 was about 14.1 per cent. This strong performance continued through the years 2005, 2006 and 2007 with growth rates of 8.0, 6.2 and 8.2 per cent, respectively. The trend reversed again in 2008 as a result of the global financial meltdown and traffic grew by about 2 per cent only. The spill-over effects of a global economic crisis, felt all over the world during 2009, had a negative impact on world traffic, which declined by 1.1 per cent in that year. The year 2010 saw a rebound of the economy with the implementation of economic policies and measures to build-up consumer confidence and domestic demand globally. These measures, in part, had a positive impact which resulted in the recovery process and economic bounce back, posting a growth of 5.1 per cent in real terms. The world scheduled traffic in

2010 increased by 8 per cent and continued to grow in 2011 and 2012, albeit at lower rates of 6.6 per cent and 4.9 per cent, respectively, impacted by slower GDP growth of 3.7 per cent in 2011 and 3 per cent in 2012.

4. REGIONAL ECONOMIC TRENDS

4.1. Africa

4.1.1. From 2000 to 2012, the aggregate economy of the African Region grew at an average annual rate of 4.8 per cent, while the GDP per capita increased at a rate of 2.4 per cent per annum in real terms. Factors, such as greater macroeconomic stability, modest progress in liberalizing markets and privatizing State enterprises, helped the region to attain improved economic performance. Favourable external conditions, such as the rapid growth in world trade and influx of private capital, also helped. During the period 2000-2002, the region's economy grew only about 4 per cent on average, due mainly to factors such as increases in oil prices (for oil-importing countries), the resurgence of civil conflict, and losses of terms of trade resulting from weak commodity prices. During the period 2003-2008, the aggregate African economy showed remarkable improvement with growth rates in the 5 to 6 per cent range with oil-exporting countries benefiting from higher than average oil prices, while other countries benefited from the rise in non-fuel commodity prices, stronger domestic policy frameworks, a more supportive global economic environment and advantageous terms of trade. After recovering from the significant slowdown in 2009, the aggregate African GDP grew at 5.1 per cent in 2010, followed by a further increase of 2 per cent and 4.4 per cent in 2011 and 2012, respectively.

4.1.2. From 2012 to 2032, the GDP of the African Region is forecasted to grow at an average annual rate of 4.6 per cent (GDP per capita of 2.5 per cent), reflecting, to a certain extent, economic reforms and liberalization to strengthen the private sector, increase domestic savings, expand non-oil exports and consolidate domestic and international economic policies. During the 2012-2017 period, it is expected to increase at 5 per cent per annum and at 4.4 per cent during the remainder of the period.

4.2 Asia/Pacific

4.2.1 Over the 2000-2012 period, the aggregate economy of the Asia/Pacific Region grew at an average annual rate of 6 per cent in real terms. Asia/Pacific has achieved the largest share in the world economy and has also been the fastest growing region despite a slowdown in 2001 and a recession in 2009. Following a financial crisis, the region regained its economic strength, and GDP continued to grow well above the world average even in 2001 (3.8 per cent) despite a global slowdown that year. In 2002, the region's economy grew by about 4.7 per cent. Despite the adverse effects of the SARS outbreak in the first half of 2003, the economy bounced back in the second half of the year with a surge in domestic demand, coupled with export growth resulting from increased global activity, the upturn in demand for high technology goods, favourable exchange rates, higher consumer confidence and a boost in tourism, registered a growth rate of 5.9 per cent for 2003. Between 2004 and 2007, the region's economy enjoyed a period of high growth with annual growth rates ranging between 6.7 and 8.4 per cent. Due to the effects of the global financial and economic crisis, the region's economic growth slowed down to 4.7 per cent in 2008 and 3.9 per cent in 2009. The Asian markets began to flourish again with the economic recovery in 2010, which saw a growth of 8.3 per cent in the real GDP. The growth of 5.8 per cent and 5.2 per cent continued in 2011 and 2012, respectively.

4.2.2 The aggregate GDP of Asia/Pacific is projected to grow at an average annual growth rate of 5.3 per cent over the 2012-2032 period, while GDP per capita is forecast to grow at the average rate of 4.6 per cent, over the same period. From 2012 to 2017, the GDP average annual growth rate is anticipated to be 6 per cent, significantly higher than during the 2017-2032 period, which is forecast to be 4 per cent.

Likewise, the GDP/capita average annual growth rate for the period 2012-2017 is expected to be 5 per cent and higher by some 0.6 per cent than that for the 2017-2032 period.

4.3 Europe

4.3.1 Over the 2000-2012 period, the aggregate economy of the European Region increased at 1.9 per cent per annum. After an impressive growth in the year 2000, it slowed down in the years 2001 to 2003 (about 2 – 2.5 per cent). The economy recovered in the following years supported by stronger domestic demand, investment and exports. This performance, however, came to a halt in 2008 with the spread of the global financial meltdown and the resulting economic crisis. Faced with a global recession and the decline in oil and commodity prices, the economy of the European Region experienced a decline in the magnitude of 4.8 per cent in 2009. During 2010, with the recovery on the horizon and crude prices slowly rising above the average, the economy witnessed a growth of 2.6 per cent, but slowed down again to 2.4 per cent and 0.4 per cent in 2011 and 2012, respectively. This resulted to some extent from the implementation of fiscal austerity measures in major European economies.

4.3.2 The aggregate GDP of Europe is projected to grow at an average annual growth rate of 1.9 per cent both over the period 2012-2017 and 2.3 per cent during the period 2017-2032, while GDP per capita is forecast to grow at the average rate of 1.7 per cent, over the 2012-2017 period and 2.3 per cent over the period 2017-2032 (2.1 per cent for the whole period 2012-2032).

4.4 North America

4.4.1 Over the 2000-2012 period, the economy of the North American Region grew at an average annual rate of 1.6 per cent in real terms. After a long period of expansion, it experienced a slowdown starting from the second half of the year 2000, with a worsening impact after the events of 11 September 2001. As a result, the year 2001 saw a sluggish GDP growth. In the years 2002 to 2004, the region's economy showed a steady recovery owing to improvements in industrial production and trade, with growths of 1.9, 2.5 and 3.4 per cent, respectively. Since 2005, higher prices for crude oil and refined products started to take their toll on manufacturing production and trade counterbalanced to some degree by a robust service sector. In 2006, private consumption and residential investment started to slow down in the United States, while the Canadian economy continued to benefit from a strong macroeconomic policy framework and a significant increase in global commodity prices. This trend was aggravated in 2007 by the emergence of the financial crisis in the United States and the unavoidable impact on the Canadian economy. In 2008 and 2009, the financial crisis spread across the globe leading to an unprecedented economic crisis. The North American GDP slowed down considerably in 2008 and witnessed a contraction of 0.2 per cent. In 2009 it went into recession, while the crisis deepened with a decline of 3 per cent. Governments across the globe, including those of the United States and Canada, intervened quickly with various monetary and fiscal measures designed to limit the impact of the crisis. This intervention seems to have achieved its goal as the economic recovery started in the later months of 2009 and resulted in a positive 2.5 per cent growth in 2010. However, the growth of the North American economy slowed down to 1.9 per cent in 2011 and 2.2 per cent in 2012.

4.4.2 The aggregate North American GDP is projected to grow at an average annual growth rate of 2.5 per cent over the period 2012-2032, while GDP/capita is forecast to grow at the average rate of 1.7 per cent, over the same period. For the period 2012-2017 the average annual growth rates are expected to be 2.7 per cent and 1.9 per cent for the GDP and GDP/capita, respectively. These rates are anticipated to decrease to 2.4 per cent and 1.6 per cent, respectively, during the 2017-2032 period.

4.5 Middle East

4.5.1 The Middle Eastern economy is largely driven by oil production and exports and, as a result, the region's economic growth is highly dependent on changes in oil prices. Over the period 2000-2012, the aggregate GDP for the Middle East grew at an average annual rate of 4.8 per cent in real terms. The increases in oil prices since 2002 helped the economy of the region grow at faster rates through robust domestic demand, improved business environment, increased investment, particularly in construction projects, higher trade volumes and tourism activity. This particularly fast-paced growth has led to shortages in labour and construction material up until the first half of the year 2008. The combination of the increase in consumption, dominated by imported goods, and higher world commodity prices, however, led to higher inflation, which eased since then. In 2009, the aggregate economy of the Middle East registered a slowdown in growth (2.7 per cent) owing mainly to the decline in demand for oil. The global financial crisis had a significant impact on certain countries in the region but the overall impact on the economy was manageable. The oil prices, on the rise again in 2010, helped the economy bounce back with an impressive growth of 6.2 per cent. However, the growth slowed down to 4.3 per cent and 2.2 per cent in 2011 and 2012, respectively, with the slower growth of oil prices in 2011 and their stagnation in 2012.

4.5.2 The GDP for the region is expected to increase at an average annual rate of 3.6 per cent for the 2012-2032 period, while GDP per capita is forecast to grow at the average rate of 1.9 per cent, over the same period. For the intermediate periods 2012-2017 and 2017-2032, the GDP average annual growth rates are anticipated at 3.5 per cent and 3.7 per cent, respectively, while the GDP/capita rates are expected to be 1.5 per cent and 2.1 per cent, respectively.

5 MAJOR ROUTE GROUPS TO, FROM AND WITHIN THE AFRICAN REGION

5.1 Definition

5.1.1 Traffic forecasts in this report are provided on the basis of route groups to, from and within the African Region. The major route groups correspond to the following region-pairs:

a) Africa – Europe
b) Africa – Middle East
c) Africa – Asia/Pacific
d) Africa – North America
e) Intra Africa

5.1.2 The above regions are the ICAO statistical regions (see **Appendix F**).

5.2 Historical traffic

5.2.1 According to the historical data, air traffic on the above five route groups to, from and within the African Region increased from some 41.2 million passengers in 2002 to 87.1 million passengers in 2012 at an average annual growth rate of 7.8 per cent. The volume of annual passengers carried on each of the route groups concerned is illustrated in **Table 1**, which shows that passenger air traffic on Africa-Middle East, Intra-Africa, and Africa-Asia/Pacific routes had the highest growth rates; traffic on the Africa-Middle East route group almost quadrupled during the period concerned.

5.2.2 This historical data include all airlines operating on these routes regardless of their region of registration.

5.2.3 It should be noted that the historical data appearing in **Table 1** have been revised and updated compared to those contained in the report of the previous meeting, taking into account the results of a detailed analysis conducted by the ICAO Secretariat of the Official Airline Guide (OAG) datasets and ICAO traffic by stage data collection, as well the International Air transport Association (IATA) data prior to the present meeting.

TABLE 1

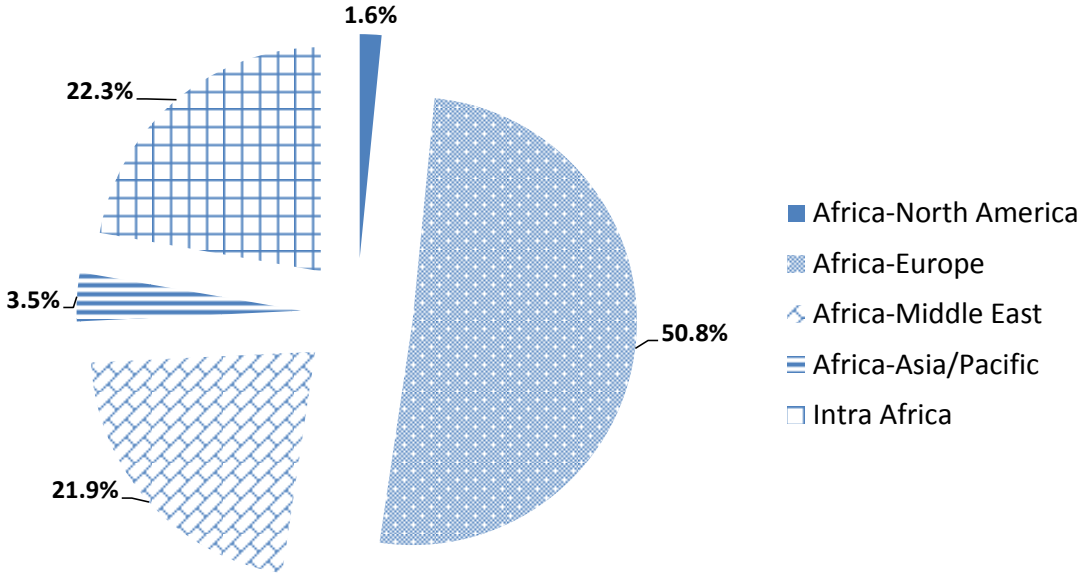
PASSENGER TRAFFIC TO/FROM AND WITHIN AFRICA BY ROUTE GROUP, 2002-2012
(Thousands of passengers carried)

Year	Africa-North America	Africa - Europe	Africa - Middle East	Africa - Asia/Pacific	Intra Africa	Total
2002	857	25 675	5 321	1 416	7 903	41 172
2003	868	25 135	5 923	1 393	8 156	41 476
2004	949	27 800	7 421	1 447	9 118	46 736
2005	996	29 605	8 403	1 718	10 496	51 219
2006	1 021	33 630	9 714	1 807	11 597	57 770
2007	1 100	37 498	11 200	2 229	13 407	65 434
2008	1 148	38 623	12 801	2 384	14 948	69 905
2009	1 110	39 975	13 915	2 337	15 263	72 600
2010	1 257	43 013	15 459	3 029	16 134	78 891
2011	1 321	41 507	15 800	2 898	17 199	78 725
2012	1 360	44 247	19 054	3 066	19 383	87 111
Average annual percentage growth rates						
2002-2012	4.7	5.6	13.6	8.0	9.4	7.8

5.2.4 In 2012, the Africa-Europe route group had by far the highest passenger share in the total international traffic to, from and within Africa, followed by Intra-Africa, Africa-Middle East, Africa-Asia/Pacific and Africa-North America route groups as illustrated in **Figure 2**.

FIGURE 2

Passenger Traffic Shares 2012



6 FORECASTING METHODOLOGY

6.1 As described in section 2 above, demand for air travel is primarily determined by income levels, demographics and the price of air travel. In this report, GDP was used as an explanatory variable as it is deemed to have maximum impact on demand for passenger travel. It is also assumed that the general political and economic climate affects air traffic growth; however, no specific assumptions are made about possible political and economic scenarios beyond those implicit in the basic GDP growth rates' forecast.

6.2 The following forecast horizons have been considered:

a) medium-term forecasts (2012-2017); and
b) long-term forecasts (2017-2032)

6.3 Econometric models were developed to determine the cause and effect relationship between traffic and GDP. It was recognized, however, that even where models were developed, the forecasts should incorporate a significant element of judgement.

6.4 Forecasts of aircraft movements for a particular route-group are determined using the base year movements and the estimated yearly growth rates over the forecast horizon. Yearly aircraft movement growth rates can be derived from the passengers annual growth rates and the changes in load factors and average aircraft size.

6.5 The relationship between the aircraft movements, passenger traffic, load factors and average aircraft size is as follows:

$$\text{Aircraft movements} = \frac{\text{passenger numbers}}{\text{(passenger/seats) . (seats per aircraft)}}$$

$$= \frac{\text{passenger numbers}}{\text{(load factor) . (average aircraft seats)}}$$

6.6 The relationship between changes in the same variables can therefore be deduced:

$$Y = X_1 - X_2 - X_3$$

Where:
Y = change in aircraft movements (%)
X_1 = change in passenger numbers (%)
X_2 = change in load factor (%)
X_3 = change in average aircraft seats (%)

6.7 Assumptions were made about future trends in load factors and average aircraft seats based on expectations about airlines marketing strategies and the types of aircraft that might be introduced to the route over the forecast period.

6.8 The approach adopted for every route-group can be described as follows:

a) develop econometric models explaining the growth of passenger air traffic using historical data;

b) develop aggregate passenger air traffic forecasts for each of the major route groups using appropriate models and judgement;

c) analyze the historical trends of other parameters for each route-group: total seats offered, average aircraft capacity (seats per aircraft), average load factor, total passengers carried, as well as aircraft movements compiled by ICAO supplemented by data from IATA, OAG and other sources; and

d) derive aircraft movement forecasts based on assumptions about future trends in average aircraft capacity and load factors.

7 PASSENGER TRAFFIC FORECASTS

7.1 Applying the approach described above, several econometric models were developed for each major route group listed in paragraph 5.1.1 using GDP as the explanatory variable. An analysis of the statistical significance of each model led to the following selection. Each model is provided with its coefficient of determination adjusted R^2 and the t-statistics below each regression coefficient.

7.2 The following econometric model was selected for the **Africa-Europe** route group:

$$\text{Log(Traffic)} = -1.20 + 1.88\ \text{Log(GDP Europe + Africa)} \qquad \text{Adj. } R^2 = 0.95$$
$$(19.0)$$

The model demonstrates that traffic between Africa and Europe is explained by the aggregated GDP of Africa and Europe with an elasticity of 1.88. Assuming a GDP growth rate of 2.4 per cent in real terms for the 2012-2017 period, a passenger traffic is expected to grow by 4.5 per cent per annum. Whereas, by assuming a GDP growth of 2.7 per cent for the period 2017-2032, a growth of passenger traffic is anticipated to be 5.2 per cent. The overall average for the period of 2022-2032 is forecast to be 5 per cent.

7.3 The following econometric model was selected for the **Africa-Middle East** route group:

$$\text{Log(Traffic)} = -1.04 + 2.02\ \text{Log(GDP Middle East + Africa)} \qquad \text{Adj. } R^2 = 0.97$$
$$(25.2)$$

Traffic on this route group is influenced by the GDP of the Middle East Region, as well as that of the African Region. Assuming a GDP growth rate of 4.3 per cent over the period 2012-2017, the passenger traffic growth rate on this route group would be in the range of 8.9 per cent. Similarly by applying a GDP growth rate of 4.1 per cent for the long- term forecast for the period 2017-2032, the passenger growth would be 8.5 per cent. The overall growth for the period 2012-2032 would then be 8.6 per cent.

7.4 The following econometric model was selected for the **Intra-Africa** route group:

$$\text{Log(Traffic)} = 0.44 + 2.01\ \text{Log(GDP Africa)} \qquad \text{Adj. } R^2 = 0.99$$
$$(39.5)$$

Intra-Africa traffic is extremely dependent on Africa GDP as proven by the high t-value showing significance of the coefficient. Assuming a real GDP growth rate of 5 per cent over the period 2012-2017, the passenger traffic growth rate on this route group will be in the range of 10.3 per cent. Whereas a GDP growth of 4.4 per cent would result in a passenger traffic growth of 9.1 per cent during the period 2017-2032. The overall growth for the period 2010-2030 is anticipated to be 9.4 per cent.

7.5 The following econometric model was selected for the **Africa-North America** route group:

$$\text{Log(Traffic)} = -4.04 + 1.84\ \text{Log(GDP North America+ Africa)} \qquad \text{Adj. } R^2 = 0.88$$
$$(12.1)$$

Traffic between Africa and North America is explained by the GDP in both regions combined as shown in the model by a moderately high R^2 value. Assuming that the GDP would grow at a rate of 3.2 per cent over the period 2012-2017, the passenger traffic growth rate on this route group is expected to be around 5.9 per cent. During the period 2017-2032, a GDP growth of 2.8 per cent will result in a projected passenger traffic growth of 5.3 per cent. The average growth for the period 2012-2032 would be 5.5 per cent.

7.6 The following econometric model was developed for the **Africa-Asia/Pacific** route group:

$$\text{Log (Traffic)} = 2.98 + 1.15 \underset{(15.4)}{\text{Log (GDP Africa + Asia/Pacific)}} \qquad \text{Adj. } R^2 = 0.93$$

Assuming a combined GDP for both regions will grow at 5.9 per cent over the period 2012-2017, the passenger traffic growth rate on this route group is expected to be 6.8 per cent, whereas, a GDP growth of 5 per cent will result in a passenger traffic growth of 5.8 per cent during the period of 2017 to 2032. The growth for the period 2012-2032 is projected to be 6 per cent.

7.7 Based on the results described above, passenger air traffic to, from and within the African Region on the five major route groups for the period 2012-2032 is expected to increase at an average annual rate of 7.2 per cent. The Intra-Africa route group is expected to experience the highest average annual growth rate of 9.4 per cent per annum, followed by Africa-Middle East, Africa-Asia/Pacific, Africa-North America and Africa-Europe route groups with growth rates of 8.6 per cent, 6 per cent, 5.5 per cent and 5 per cent, respectively, for the period concerned as illustrated in **Table 2**.

TABLE 2

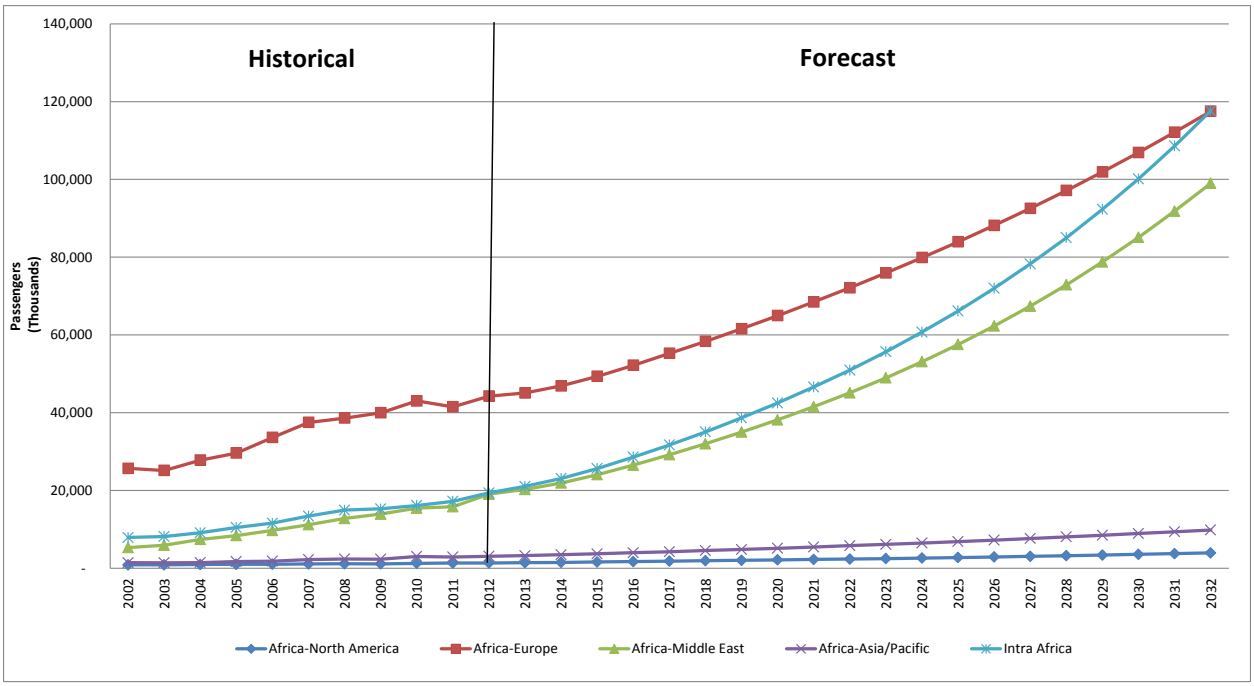
PASSENGER FORECAST TO THE YEAR 2032
(thousands of passengers carried)

Route group	2012	2017	2032	Average annual growth rate (%)		
				2012-2017	2017-2032	2012-2032
Africa - North America	1 360	1 815	3 939	5.9	5.3	5.5
Africa - Europe	44 247	55 257	117 527	4.5	5.2	5.0
Africa - Middle East	19 054	29 186	99 007	8.9	8.5	8.6
Africa - Asia/Pacific	3 066	4 252	9 843	6.8	5.8	6.0
Intra Africa	19 383	31 706	117 643	10.3	9.1	9.4
TOTAL	87 111	122 216	347 960	7.0	7.2	7.2

7.8 The evolution of historical and forecast traffic for each of the route groups to/from and within Africa is depicted in **Figure 3**

FIGURE 3

PASSENGER TRAFFIC FORECAST BY ROUTE GROUP



8 AIRCRAFT MOVEMENT FORECASTS

8.1 Having established the passenger traffic growth rates for each route group in the manner described in section 7 above, forecasts of aircraft movement growth rates for the period 2012-2032 were developed using the methodology outlined in section 6 and the assumptions related to the future evolution of load factors and average aircraft seats over the same period. Historical trends from the past decade for these two elements were examined carefully and their growth patterns were kept fairly consistent with their past behaviour.

8.2 The future trends in load factors and average seats for the route groups concerned are presented in **Tables 3 and 4**, respectively.

TABLE 3

LOAD FACTOR FORECAST TO THE YEAR 2032

Route group	2012	2017	2032
Africa - North America	66.4	68.1	72.6
Africa - Europe	77.6	78.8	82.6
Africa - Middle East	72.5	74.8	82.3
Africa - Asia/Pacific	77.4	78.9	83.4
Intra Africa	65.4	75.0	80.0

TABLE 4

AVERAGE AIRCRAFT SIZE FORECAST TO THE YEAR 2032
(number of seats per aircraft)

Route group	2012	2017	2032
Africa - North America	265	262	252
Africa - Europe	193	187	198
Africa - Middle East	196	198	213
Africa - Asia/Pacific	278	274	267
Intra Africa	117	117	127

8.3 The estimated aircraft movement forecasts for the period 2012-2032 and the respective growth rates are given in **Table 5**. It is important to note that after establishing the passenger forecast growth rates for each of the route-groups, in the manner described in Section 7, percentage growth rates in aircraft movements for the periods 2012-2017, 2017-2032 and 2012-2032 were obtained by plugging the corresponding growth rates of load factors and average aircraft seats in the equation shown in paragraph 6.6. The final aircraft movement forecasts, however, were then prepared for each of the route groups concerned by applying these growth rates to the actual 2012 OAG data as the base year.

TABLE 5

AIRCRAFT MOVEMENT FORECAST TO THE YEAR 2032

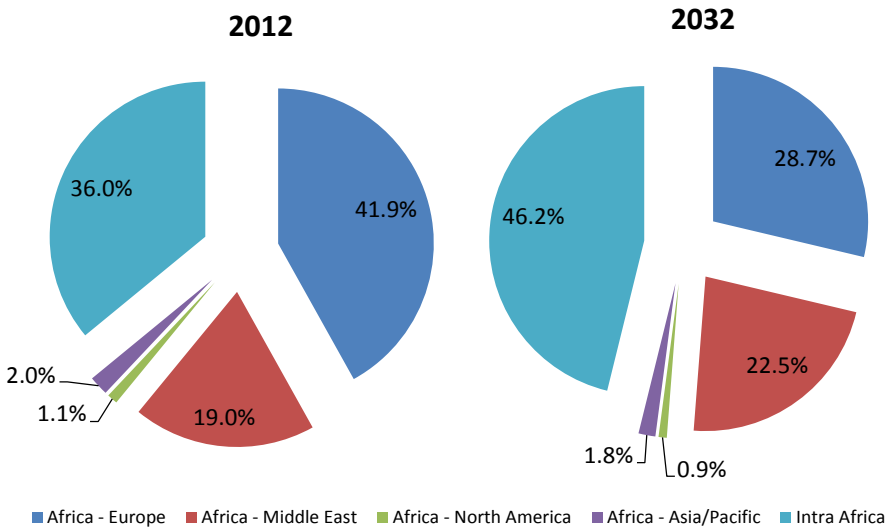
Route group	2012 (1)	Forecast		Average Annual Growth (%)		
		2017	2032	2012-2017	2017-2032	2012-2032
Africa - Europe	304 458	385 796	742 779	4.8	4.5	4.6
Africa - Middle East	137 921	203 072	582 358	8.0	7.3	7.5
Africa - North America	7 924	10 434	22 123	5.7	5.1	5.3
Africa - Asia/Pacific	14 711	20 277	45 643	6.6	5.6	5.8
Intra Africa	261 224	371 063	1 194 087	7.3	8.1	7.9
Total	726 238	990 642	2 586 990	6.4	6.6	6.6

(1) OAG data

8.4 The total aircraft movements to, from and within the African Region are forecast to increase from some 726.2 thousand in 2012 to about 2 587 thousand in 2032 at an average annual growth rate of 6.6 per cent. Aircraft movements will grow the fastest within Intra-Africa, followed by Africa-Middle East and Africa-Asia/Pacific. The share of each route group in the total number of aircraft movements is depicted in **Figure 4** below.

FIGURE 4

AIRCRAFT MOVEMENT SHARES BY ROUTE GROUP 2012 AND 2032



9 CITY-PAIR AIRCRAFT MOVEMENT FORECASTS

9.1 Using the 2012 OAG data as the baseline, aircraft movement forecasts for the top 25 city-pairs within each of the route groups, identified in paragraph 5.1 above, were estimated. Where appropriate, the forecasts for the rest of the city-pairs in each route group were aggregated into one figure, and included as "All Other" in the tables. The city-pairs are ranked in descending order based on 2012 departures. The aircraft movements forecasts for the city-pairs of the route groups concerned are given in **Appendix B.**

9.2 While developing the forecasts for city-pairs appearing in the 2012 OAG dataset, the Group recognised that during the course of the forecast period scheduled services on new city pairs will be introduced, bearing in mind plans of various airlines to launch new services. However, at this stage, it would be extremely difficult to try to include such city-pairs, without knowing the detailed plans of the airlines concerned.

10 PEAK-PERIOD PARAMETERS FOR FIR TRAFFIC

10.1 The analysis of the FIR traffic data provided by Centre by ASECNA and the Seychelles FIR for the year 2012 covering annual, monthly, daily and hourly traffic parameters as well as traffic densities is provided in **Appendix C and Appendix D**. The evolution of the traffic serviced by the Dar es Salaam FIR over the period 2001-2012 and the monthly traffic volumes for the year 2012 are depicted in **Appendix E.**

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APPENDIX A

SEVENTH MEETING OF THE AFRICA-INDIAN OCEAN TRAFFIC FORECASTING GROUP

(NAIROBI, 27 – 30 AUGUST 2013)

LIST OF PARTICIPANTS

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APPENDIX B

AIRCRAFT MOVEMENT FORECASTS BY CITY-PAIRS

TABLE B - 1
CITY-PAIRS RANKED BY 2012 MOVEMENTS
BETWEEN AFRICA AND NORTH AMERICA

Rank	**City-Pair** (1)	**Aircraft movements 2012** (2)	**Aircraft movements 2032**	**Average annual growth (%) 2012-2032**
1	Johannesburg- Atlanta	732	2 579	6.5
2	Washington-Dakar	732	2 348	6.0
3	Johannesburg-New York (J.F Kennedy)	720	1 910	5.0
4	Lagos-Atlanta	706	1 049	2.0
5	New York (J.F Kennedy)-Casablanca	683	1 647	4.5
6	New York (J.F. Kennedy)-Cairo	662	984	2.0
7	Montreal-Casablanca	634	2 319	6.7
8	Lagos-Houston	604	2 337	7.0
9	New York (J.F. Kennedy) - Accra	438	791	3.0
10	Montreal-Algiers	364	2 040	9.0
11	Washington-Addis Ababa	313	465	2.0
12	New York (J.F. Kennedy)-Lagos	313	1 189	6.9
13	New York (J.F. Kennedy)-Dakar	257	563	4.0
14	Washington-Accra	237	388	2.5
15	Boston-Praia	229	792	6.4
16	Atlanta-Accra	192	315	2.5
17	Bata-Annette Island	60	275	7.9
18	Toronto-Addis Ababa	48	132	5.2
	TOTAL	7 924	22 123	5.3

1/ Both directions.
2/ OAG data.

TABLE B-2
25 TOP CITY-PAIRS RANKED BY 2012 MOVEMENTS
BETWEEN AFRICA AND EUROPE

Rank	**City-Pair** (1)	**Aircraft movements 2012** (2)	**Aircraft movements 2032**	**Average annual growth (%) 2012-2032**
1	Algiers - Paris (Orly)	4 954	11 948	4.5
2	Casablanca - Paris (Orly)	4 365	8 685	3.5
3	Algiers - Paris (Charles De Gaulle)	4 241	7 660	3.0
4	Marrakech - Paris (Orly)	3 828	12 277	6.0
5	Tunis - Paris (Orly)	3 798	10 077	5.0
6	Johannesburg - London (Heathrow)	3 764	5 070	1.5
7	Casablanca - Paris (Charles De Gaulle)	3 549	6 410	3.0
8	Tunis - Paris (Charles De Gaulle)	3 485	5 179	2.0
9	Cairo - Istanbul	3 239	13 759	7.5
10	Algiers - Marseille	2 999	9 618	6.0
11	Cairo - London (Heathrow)	2 374	6 299	5.0
12	Tunis - Rome (Fumicino)	2 282	6 055	5.0
13	Lagos - London (Heathrow)	2 196	10 235	8.0
14	Tripoli - Istanbul	2 130	9 928	8.0
15	Cairo - Rome (Fumicino))	2 074	4 127	3.5
16	Tunis - Marseille	2 023	2 468	1.0
17	Casablanca - Lisbon	1 978	2 414	1.0
18	Nairobi - London (Heathrow)	1 975	4 763	4.5
19	Agadir - Paris (Orly)	1 942	9 928	8.5
20	Cairo - Frankfurt	1 898	2 556	1.5
21	Luanda - Lisbon	1 882	8 772	8.0
22	Algiers - Rome (Fumicino)	1 832	8 539	8.0
23	St-Denis - Paris (Orly)	1 816	2 216	1.0
24	Cape Town - London (Heathrow)	1 780	2 645	2.0
25	Cairo - Milan (Malpensa)	1 778	3 211	3.0
	All Other	236 276	567 942	4.5
	TOTAL	304 458	742 779	4.6

1/ Both directions.
2/ OAG data.

TABLE B-3
25 TOP CITY-PAIRS RANKED BY 2012 MOVEMENTS
BETWEEN AFRICA AND THE MIDDLE EAST

Rank	**City-Pair** (1)	**Aircraft movements 2012** (2)	**Aircraft movements 2032**	**Average annual growth (%) 2012-2032**
1	Jeddah - Cairo	8 313	22 057	5.0
2	Amman - Cairo	5 304	29 726	9.0
3	Kuwait - Cairo	4 452	17 228	7.0
4	Riyadh - Cairo	4 166	16 121	7.0
5	Jeddah - Alexandria	3 563	48 968	14.0
6	Beirut - Cairo	3 378	13 072	7.0
7	Dubai - Cairo	3 282	10 526	6.0
8	Dubai - Addis Ababa	3 067	20 633	10.0
9	Abu Dhabi - Cairo	2 822	10 920	7.0
10	Jeddah - Khartoum	2 407	10 225	7.5
11	Dubai - Nairobi	2 379	4 734	3.5
12	Medinah - Cairo	2 290	37 479	15.0
13	Dubai - Johannesburg	2 196	11 226	8.5
14	Doha - Cairo	2 138	3 861	3.0
15	Damman - Cairo	2 138	7 534	6.5
16	Dubai - Khartoum	2 050	28 174	14.0
17	Kuwait - Alexandria	1 791	10 037	9.0
18	Bahrain - Cairo	1 654	4 826	5.5
19	Riyadh - Alexandria	1 534	7 150	8.0
20	Doha - Khartoum	1 474	9 053	9.5
21	Doha - Nairobi	1 464	11 803	11.0
22	Dubai - Alexandria	1 418	13 678	12.0
23	Damascus - Cairo	1 417	3 760	5.0
24	Dubai - Lagos	1 346	15 510	13.0
25	Dubai - Cape Town	1 282	10 336	11.0
	All Other	70 596	203 721	5.4
	TOTAL	137 921	582 358	7.5

1/ Both directions.
2/ OAG data.

TABLE B-4
25 TOP CITY-PAIRS RANKED BY 2012 MOVEMENTS
BETWEEN AFRICA AND ASIA/PACIFIC

Rank	**City-Pair** (1)	**Aircraft movements 2012** (2)	**Aircraft movements 2032**	**Average annual growth (%) 2012-2032**
1	Johannesburg - Hong Kong	1 447	4 222	5.5
2	Nairobi - Mumbai	923	1 172	1.2
3	Johannesburg - Mumbai	776	3 296	7.5
4	Addis Ababa - Mumbai	732	3 412	8.0
5	Johannesburg - Singapore	732	1 457	3.5
6	Cairo - Bangkok	732	3 412	8.0
7	Johannesburg - Sydney	730	1 453	3.5
8	Nairobi - Bangkok	729	2 821	7.0
9	Addis Ababa - Bangkok	725	3 080	7.5
10	Addis Ababa - Delhi	724	3 075	7.5
11	Johannesburg - Perth	668	1 206	3.0
12	Addis Ababa - Beijing	659	3 072	8.0
13	Addis Ababa - Guangzhou	512	2 386	8.0
14	Cairo - Guangzhou	507	1 345	5.0
15	Cairo - Mumbai	375	822	4.0
16	Mauritius - Mumbai	366	600	2.5
17	Cairo - Beijing	314	833	5.0
18	Johannesburg - Bangkok	314	688	4.0
19	Johannesburg - Beijing	278	892	6.0
20	Mauritius - Kuala Lumpur	225	722	6.0
21	Mauritius - Delhi	224	491	4.0
22	Antananarivo - Bangkok	223	715	6.0
23	Mauritius - Hong Kong	220	482	4.0
24	Nairobi - Delhi	198	434	4.0
25	Cairo - Tokyo (Narita)	184	273	2.0
	All Other	1 194	3 283	5.2
	TOTAL	14 711	45 643	5.8

1/ Both directions.
2/ OAG data.

TABLE B-5
25 TOP CITY-PAIRS RANKED BY 2012 MOVEMENTS
INTRA AFRICA

Rank	City-Pair (1)	Aircraft movements 2012 (2)	Aircraft movements 2032	Average annual growth (%) 2012-2032
1	Gaborone - Johannesburg	6 871	18 231	5.0
2	Nairobi - Entebbe	5 812	18 640	6.0
3	St-Denis - Mauritius	5382	15 703	5.5
4	Windhoek - Johannesburg	5 316	12 821	4.5
5	Cairo - Khartoum	5 312	51 241	12.0
6	Johannesburg - Harare	4 975	23 188	8.0
7	Nairobi - dar Es Salaam	4 531	36 530	11.0
8	Maputo - Johannesburg	4 283	15 092	6.5
9	Tripoli - Tunis	3 906	21 891	9.0
10	Entebbe - Kigali	3 841	23 590	9.5
11	Accra - Lagos	3 578	20 053	9.0
12	Bujumbura - Kigali	3 356	12 987	7.0
13	Nairobi - Kilimanjaro	3 171	51 898	15.0
14	Kigali - Nairobi	3 091	20 795	10.0
15	Johannesburg - Lusaka	3 066	11 864	7.0
16	Nairobi - Johannesburg	2 915	11 280	7.0
17	Windhoek - Cape Town	2 719	6 557	4.5
18	Johannesburg - Manzini	2 527	3 755	2.0
19	Cairo - Tripoli	2 290	8 862	7.0
20	Lusaka - Harare	2 239	7 181	6.0
21	Nairobi - Addis Ababa	2 139	4 687	4.0
22	Zanzibar - Nairobi	1 967	11 024	9.0
23	Johannesburg - Maseru	1 958	3 536	3.0
24	Tunis - Casablanca	1 887	2 804	2.0
25	Johannesburg - Victoria Falls	1 837	4 874	5.0
	All Other	172 255	775 003	7.8
	TOTAL	261 224	1 194 087	7.9

1/ Both directions.
2/ OAG data

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APPENDIX C

PEAK-PERIOD ANALYSIS FOR ASECNA CENTRES

Five sets of traffic data for the following Centres:

- Antananarivo,
- Brazzaville,
- Dakar,
- Douala, and
- Niamey

provided by ASECNA for the year 2012 were analyzed thoroughly in order to determine the main peak-period parameters, using a computer application developed by the Secretariat. The analysis covered the following items:

1. **Monthly traffic**

2. **Traffic analysis by day:**
   - 2.1 Daily traffic profile
   - 2.2 Maximum, minimum, average and standard deviation of daily traffic
   - 2.3 Daily traffic ranking

3. **Hourly traffic analysis:**
   - 3.1 Hourly traffic (whole year)
   - 3.2 Traffic profile by specified hour
   - 3.3 Maximum, minimum and average hourly traffic
   - 3.4 Traffic peaking by specified hour

4. **Annual traffic analysis:**
   - 4.1 Aircraft movements by type of flight
   - 4.2 Aircraft movements by aircraft type
   - 4.3 Aircraft movements by flight level
   - 4.4 Aircraft movements by point of entry
   - 4.5 Aircraft movements by point of exit
   - 4.6 Aircraft movements by pair of entry point-exit point.

The following sections provide the detailed results of the analysis.

1. MONTHLY TRAFFIC

1.1 The tables and graphs below illustrate the traffic by month for the five Centres for the year 2012.

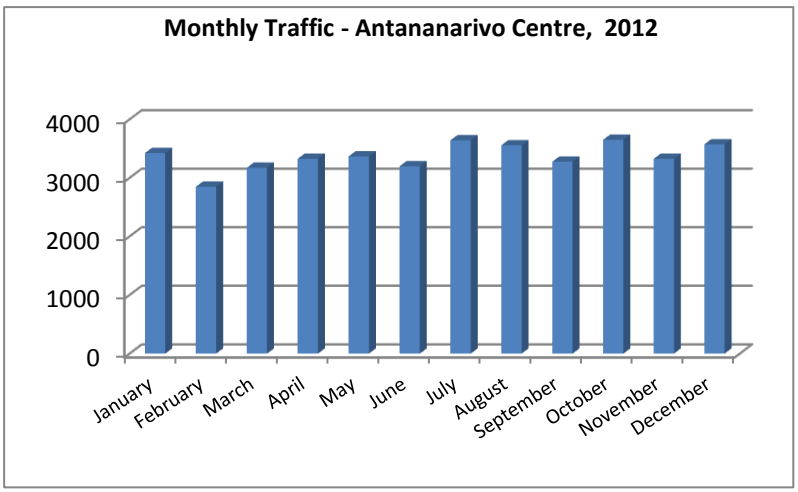
Antananarivo Centre, 2012	
Month	**Number of movements**
January	3 423
February	2 846
March	3 171
April	3 324
May	3 365
June	3 197
July	3 641
August	3 556
September	3 275
October	3 650
November	3 325
December	3 573

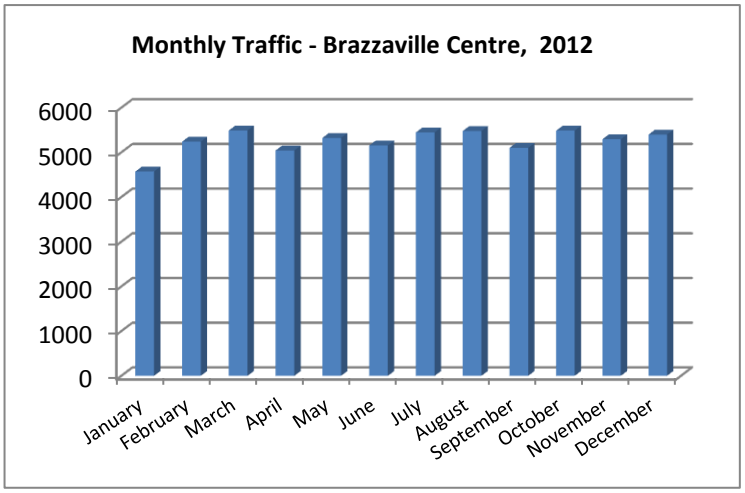
Brazzaville Centre, 2012	
Month	**Number of movements**
January	4 570
February	5 239
March	5 490
April	5 043
May	5 323
June	5 154
July	5 447
August	5 477
September	5 100
October	5 487
November	5 293
December	5398

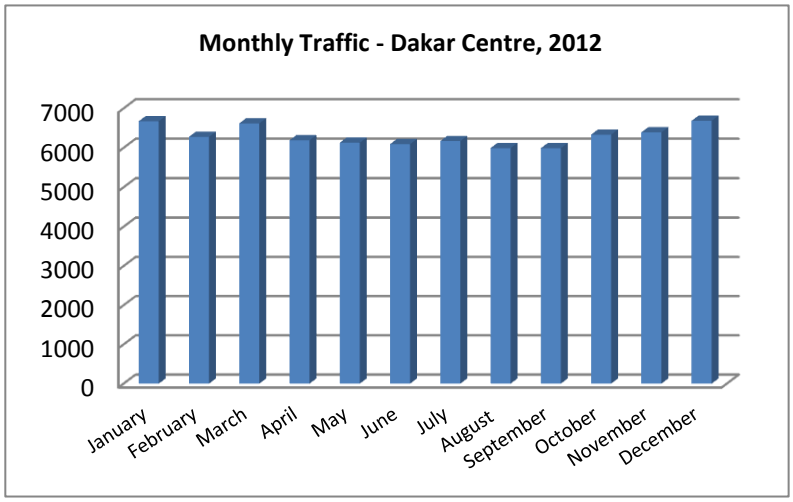
Dakar Centre, 2012	
Month	**Number of movements**
January	6 673
February	6 278
March	6 618
April	6 191
May	6 130
June	6 093
July	6 171
August	5 993
September	5 990
October	6 333
November	6 391
December	6 684

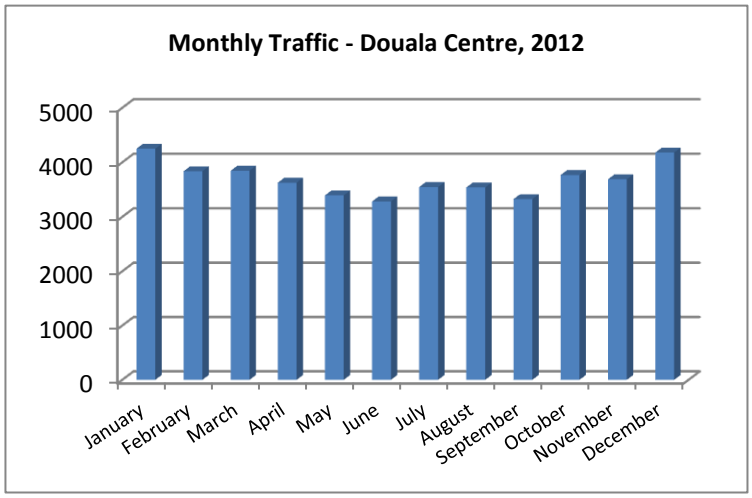
Douala Centre, 2012	
Month	**Number of movements**
January	4 249
February	3 836
March	3 846
April	3 626
May	3 394
June	3 283
July	3 547
August	3 539
September	3 325
October	3 767
November	3 689
December	4 179

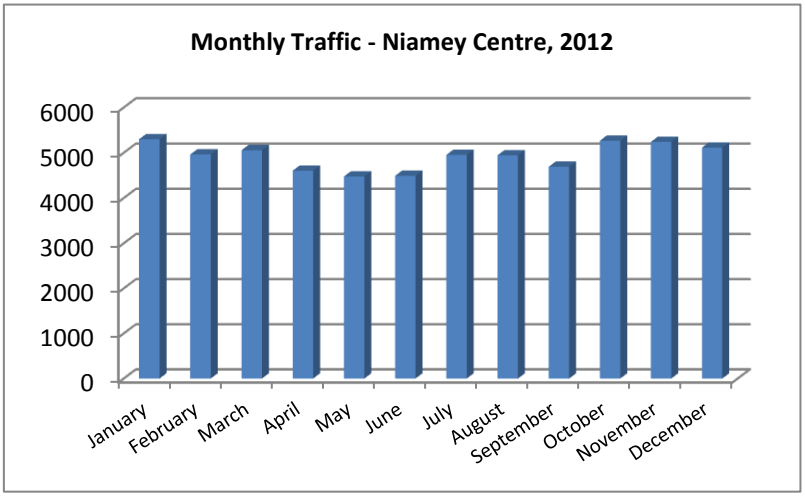
Niamey Centre, 2012	
Month	**Number of movements**
January	5 300
February	4 963
March	5 057
April	4 603
May	4 476
June	4 491
July	4 953
August	4 945
September	4 691
October	5 268
November	5 241
December	5 114









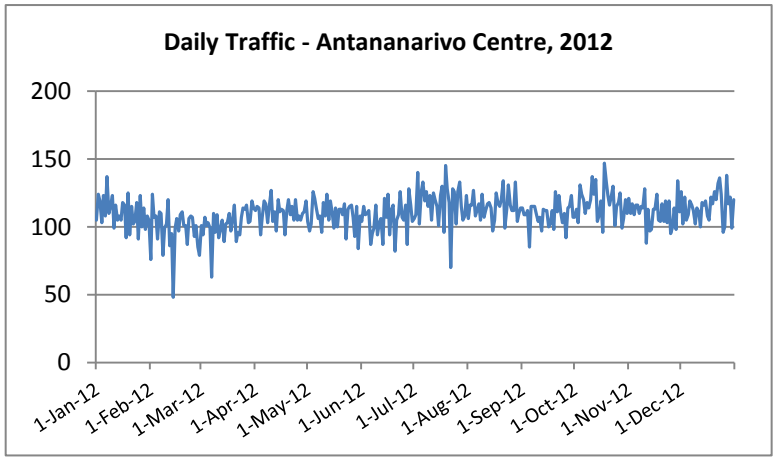


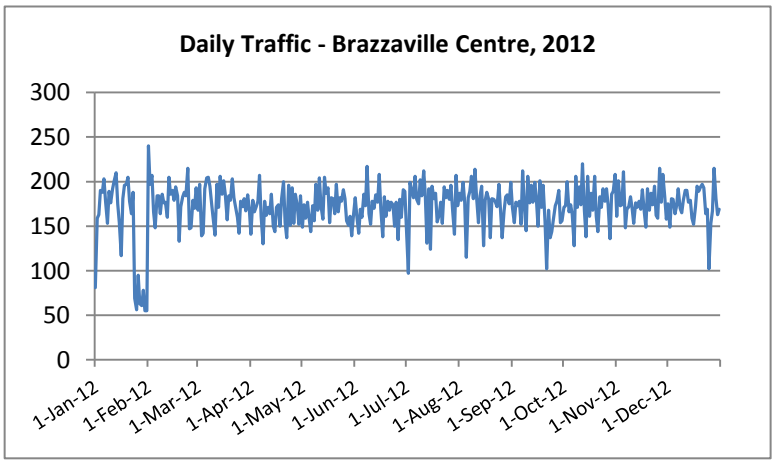
1.2 With the average of 6 295 movements per month, the Dakar Centre serves the biggest volume of monthly traffic among the selected ASECNA Centres. The busiest months are: December, January, March and November. The Dakar Centre is followed by the Brazzaville Centre with the average monthly traffic of 5 252 movements and the busiest months of March, October, August and July. The third busiest is the Niamey Centre with the average monthly traffic of 4 925 movements and busiest months of January, October, November and December.

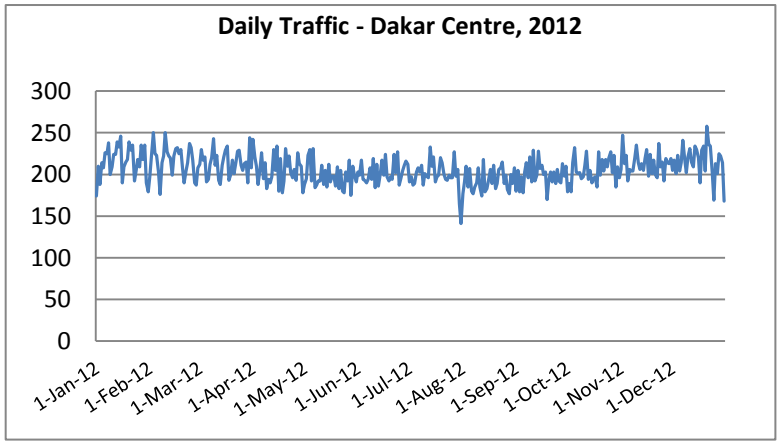
2. TRAFFIC ANALYSIS BY DAY

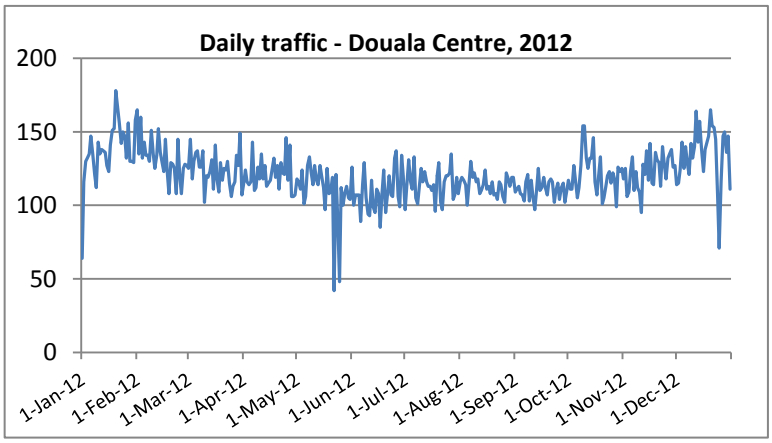
2.1 Daily traffic profile

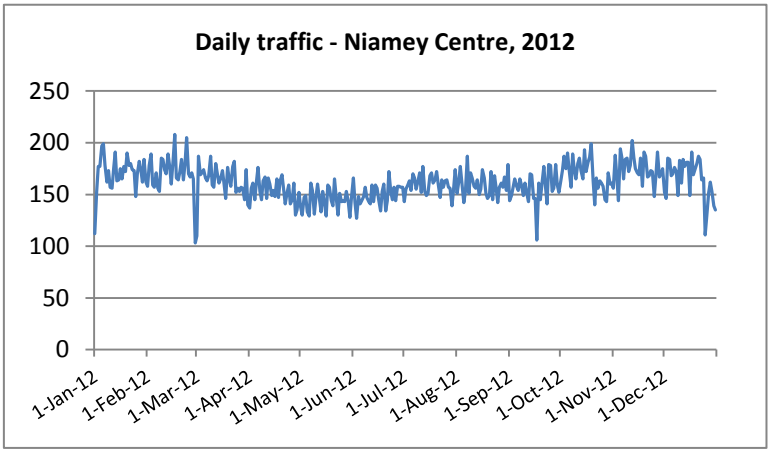
2.1.1 The following figures depict the daily traffic profile for each of the Centres and help in the identification of any seasonality pattern in the annual traffic.











2.2 Maximum, minimum, average and standard deviation of daily traffic

2.2.1 Beyond the graphical display and from the series listed above, the maximum, minimum, average and standard deviation of daily traffic were produced for the Centres concerned.

	Antananarivo	Brazzaville	Dakar	Douala	Niamey
Average	110	172	206	121	161
Maximum	147	240	258	178	208
Minimum	48	55	141	42	103
Standard Deviation	12	27	17	17	17

2.2.2 With the average of 206 movements per day, the Dakar Centre is the most busy centre in terms of average daily traffic, followed by the Brazzaville Centre (172 movements) and the Niamey Centre (161 movements).

2.3 Daily traffic ranking

2.3.1 The daily traffic sorted by number of flights helps identify the days in the year when traffic was the busiest in 2012 and also the ones with less traffic. To illustrate this, the 20 days recording the biggest traffic in the Centres concerned are listed in the following tables.

Antananarivo Centre, 2012

Rank	Date	Number of movements
1	18-Oct-12	147
2	19-Jul-12	145
3	3-Jul-12	140
4	27-Dec-12	138
5	11-Oct-12	137
6	7-Jan-12	137
7	23-Dec-12	136
8	13-Oct-12	135
9	29-Nov-12	134
10	21-Aug-12	134
11	19-Oct-12	133
12	6-Jul-12	133
13	27-Jul-12	133
14	28-Aug-12	133
15	22-Dec-12	132
16	4-Oct-12	131
17	24-Aug-12	131
18	17-Jul-12	130
19	23-Oct-12	130
20	20-Jul-12	128

Brazzaville Centre, 2012

Rank	Date	Number of movements
1	1-Feb-12	240
2	12-Oct-12	220
3	8-Jun-12	217
4	26-Nov-12	215
5	24-Feb-12	215
6	28-Dec-12	215
7	10-Aug-12	214
8	7-Sep-12	212
9	11-Jul-12	212
10	5-Nov-12	211
11	13-Jan-12	210
12	28-Nov-12	208
13	31-Oct-12	208
14	15-Jun-12	208
15	6-Apr-12	207
16	3-Feb-12	207
17	30-Jul-12	207
18	19-Oct-12	206
19	8-Oct-12	206
20	10-Sep-12	206

Dakar Centre, 2012

Rank	Date	Number of movements
1	21-Dec-12	258
2	3-Feb-12	250
3	10-Feb-12	250
4	2-Nov-12	247
5	15-Jan-12	246
6	30-Mar-12	244
7	9-Mar-12	243
8	1-Apr-12	242
9	7-Dec-12	241
10	13-Jan-12	239
11	20-Jan-12	239
12	8-Jan-12	238
13	24-Feb-12	237
14	23-Nov-12	237
15	22-Dec-12	236
16	22-Jan-12	235
17	27-Jan-12	235
18	29-Jan-12	235
19	10-Nov-12	235
20	17-Mar-12	234

Douala Centre, 2012

Rank	Date	Number of movements
1	20-Jan-12	178
2	21-Jan-12	166
3	20-Dec-12	165
4	1-Feb-12	165
5	12-Dec-12	164
6	3-Feb-12	160
7	31-Jan-12	158
8	14-Dec-12	157
9	22-Jan-12	156
10	27-Jan-12	156
11	10-Oct-12	154
12	9-Oct-12	154
13	21-Dec-12	154
14	22-Dec-12	153
15	13-Feb-12	152
16	19-Jan-12	152
17	18-Jan-12	151
18	9-Feb-12	151
19	28-Dec-12	150
20	24-Jan-12	150

Niamey Centre, 2012

Rank	Date	Number of movements
1	17-Feb-12	208
2	24-Feb-12	205
3	12-Nov-12	202
4	19-Oct-12	199
5	6-Jan-12	199
6	5-Jan-12	197
7	5-Nov-12	194
8	15-Oct-12	193
9	13-Jan-12	191
10	19-Nov-12	191
11	27-Nov-12	191
12	17-Dec-12	191
13	5-Oct-12	190
14	20-Jan-12	190
15	13-Feb-12	189
16	8-Oct-12	189
17	3-Feb-12	189
18	2-Nov-12	188
19	2-Mar-12	187
20	20-Nov-12	187

2.3.2 Among the Centres, Dakar recorded 258 movements on 21 December 2012, followed by the Brazzaville Centre (240 movements on 1 February 2012), the Niamey Centre (208 movements on 17 February 2012), the Douala Centre (178 movements on 20 January 2012) and the Antananarivo Centre (147 movements on 18 October 2012).

3. HOURLY TRAFFIC ANALYSIS

3.1 Hourly traffic (all year: 24 hours, 366 days)

3.1.1 Traffic per hour over the whole year for each of the Centres has been determined and sorted by amount of traffic per hour. The following tables show the top 20 hours in terms of traffic per hour during the year for each of the Centres.

Antananarivo Centre, 2012

Rank	Date	Hour	Number of movements
1	13-Oct-12	0600	21
2	23-Jun-12	0600	19
3	5-Jun-12	0900	17
4	3-Jul-12	0600	17
5	21-Oct-12	0500	17
6	31-Dec-12	0700	17
7	16-Jan-12	0600	16
8	19-Feb-12	0600	16
9	21-Jun-12	0900	16
10	19-Jul-12	1200	16
11	24-Aug-12	0500	16
12	25-Sep-12	0900	16
13	11-Oct-12	0900	16
14	18-Oct-12	0600	16
15	2-Nov-12	0900	16
16	4-Jan-12	0600	15
17	19-Mar-12	0500	15
18	24-May-12	0600	15
19	26-May-12	0800	15
20	14-Jun-12	0900	15

Brazzaville Centre, 2012

Rank	Date	Hour	Number of movements
1	13-Jan-12	0800	22
2	14-Mar-12	0800	22
3	6-Apr-12	0900	22
4	24-Aug-12	0800	22
5	7-Mar-12	0800	21
6	12-Nov-12	0900	21
7	15-Feb-12	0800	20
8	7-Aug-12	1100	20
9	17-Sep-12	0700	20
10	1-Feb-12	0800	19
11	24-Feb-12	0800	19
12	25-Apr-12	1000	19
13	25-Apr-12	1400	19
14	11-May-12	0900	19
15	15-May-12	0900	19
16	8-Jun-12	1400	19
17	4-Aug-12	0800	19
18	30-Oct-12	1100	19
19	26-Nov-12	1300	19
20	7-Dec-12	1000	19

Dakar Centre, 2012

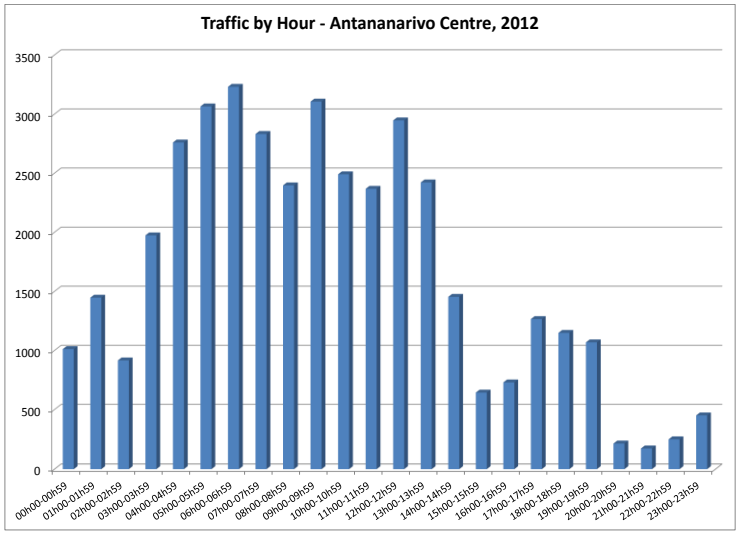
Rank	Date	Hour	Number of movements
1	12-Nov-12	0300	31
2	9-Sep-12	0200	30
3	2-Dec-12	0300	30
4	18-Jan-12	0300	28
5	23-Feb-12	0300	28
6	20-Sep-12	0200	28
7	30-Sep-12	0200	28
8	11-Nov-12	0300	28
9	19-Jan-12	0300	27
10	23-Apr-12	0200	27
11	17-Aug-12	0200	27
12	29-Dec-12	0000	27
13	22-Jan-12	0300	26
14	23-Feb-12	0000	26
15	6-Apr-12	0200	26
16	8-Apr-12	0200	26
17	13-Apr-12	0200	26
18	9-May-12	0200	26
19	11-May-12	0200	26
20	21-Jul-12	0200	26

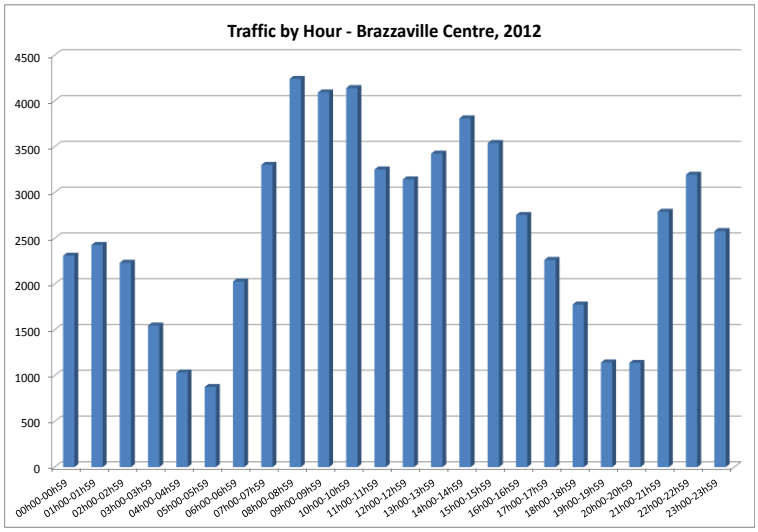
Douala Centre, 2012			
Rank	Date	Hour	Number of movements
1	15-Oct-12	1400	17
2	29-Feb-12	0900	16
3	19-Nov-12	1000	16
4	6-Nov-12	1500	16
5	19-Dec-12	1500	16
6	20-Jan-12	2200	16
7	15-Feb-12	2200	16
8	4-Jan-12	0900	15
9	1-Feb-12	0900	15
10	3-Jun-12	0900	15
11	22-Dec-12	1000	15
12	20-Apr-12	1400	15
13	23-Nov-12	1400	15
14	9-May-12	1500	15
15	14-May-12	1500	15
16	20-Jan-12	1600	15
17	2-Mar-12	1600	15
18	16-Nov-12	1600	15
19	26-Jun-12	1800	15
20	3-Feb-12	2200	15

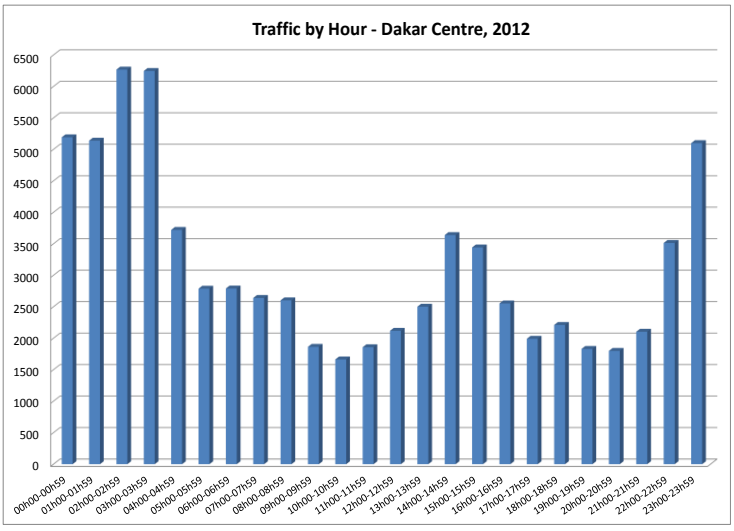
Niamey Centre, 2012			
Rank	Date	Hour	Number of movements
1	17-Apr-12	2300	30
2	10-Aug-12	2300	29
3	16-Jan-12	0000	28
4	30-Mar-12	2300	28
5	24-Aug-12	2300	28
6	7-Jan-12	0000	27
7	17-Jul-12	2300	27
8	13-Jan-12	0000	26
9	21-Jan-12	0000	26
10	30-Jan-12	2300	26
11	17-Feb-12	2300	26
12	13-Apr-12	2300	26
13	3-Aug-12	2300	26
14	31-Aug-12	2300	26
15	15-Jan-12	0000	25
16	22-Jan-12	0000	25
17	4-Feb-12	0000	25
18	14-Feb-12	0100	25
19	17-Feb-12	0000	25
20	19-Feb-12	2300	25

3.1.2 Based on the most busiest 20 hours, it can be concluded that both the Dakar and Niamey Centres had the highest traffic during the night hours, while the Brazzaville and Antananarivo Centres mainly during the morning hours. Only the Douala Centre had the most dense traffic during the morning and afternoon hours.

3.1.3 In case of the Dakar Centre, the average number of flights between midnight and 0400 hours was over 5 700 and the busiest hour was between 0200 and 0300 hours with 6 267 flights. The Niamey Centre was busiest between 2200 and 0200 hours with the average number of flights of 5 269 and the busiest hour between 2300 and midnight when 6 575 movements were recorded. Hours between 0700 and 1500 were the busiest with the average of 3 705 flights for the Brazzaville Centre; the busiest hour for that Centre was between 0800 and 0900 with 4 240 flights. Morning hours, between 0400 and 1000 were the busiest for the Antananarivo Centre; the average for these hours was 2 898 and the busiest hour was between 0600 and 0700 with 3 230 flights. The Douala Centre experienced the busiest traffic between 0900 and 1900 with the average number of movements of 2 510 and the busiest hour between 1500 and 1600 with 3 023 flights.


Traffic by Hour - Antananarivo Centre, 2012
3500
3000
2500
2000
1500
1000
500
0
00h00-00h59
01h00-01h59
02h00-02h59
03h00-03h59
04h00-04h59
05h00-05h59
06h00-06h59
07h00-07h59
08h00-08h59
09h00-09h59
10h00-10h59
11h00-11h59
12h00-12h59
13h00-13h59
14h00-14h59
15h00-15h59
16h00-16h59
17h00-17h59
18h00-18h59
19h00-19h59
20h00-20h59
21h00-21h59
22h00-22h59
23h00-23h59


Traffic by Hour - Brazzaville Centre, 2012
4500
4000
3500
3000
2500
2000
1500
1000
500
0
00h00-00h59
01h00-01h59
02h00-02h59
03h00-03h59
04h00-04h59
05h00-05h59
06h00-06h59
07h00-07h59
08h00-08h59
09h00-09h59
10h00-10h59
11h00-11h59
12h00-12h59
13h00-13h59
14h00-14h59
15h00-15h59
16h00-16h59
17h00-17h59
18h00-18h59
19h00-19h59
20h00-20h59
21h00-21h59
22h00-22h59
23h00-23h59


Traffic by Hour - Dakar Centre, 2012
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
00h00-00h59
01h00-01h59
02h00-02h59
03h00-03h59
04h00-04h59
05h00-05h59
06h00-06h59
07h00-07h59
08h00-08h59
09h00-09h59
10h00-10h59
11h00-11h59
12h00-12h59
13h00-13h59
14h00-14h59
15h00-15h59
16h00-16h59
17h00-17h59
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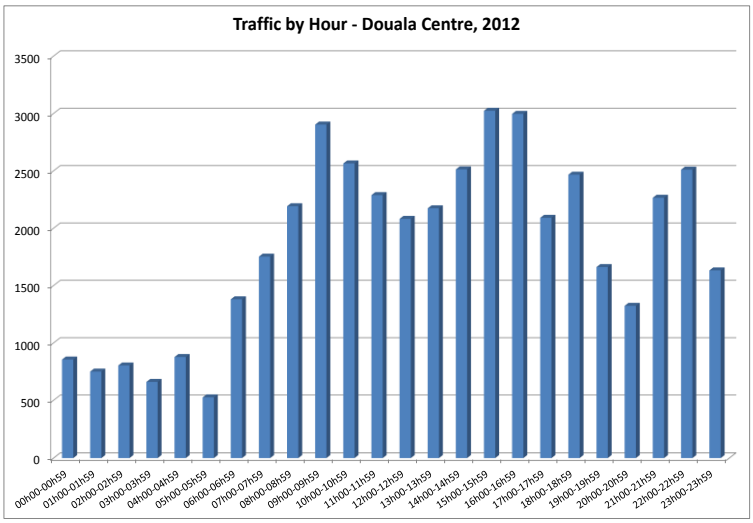
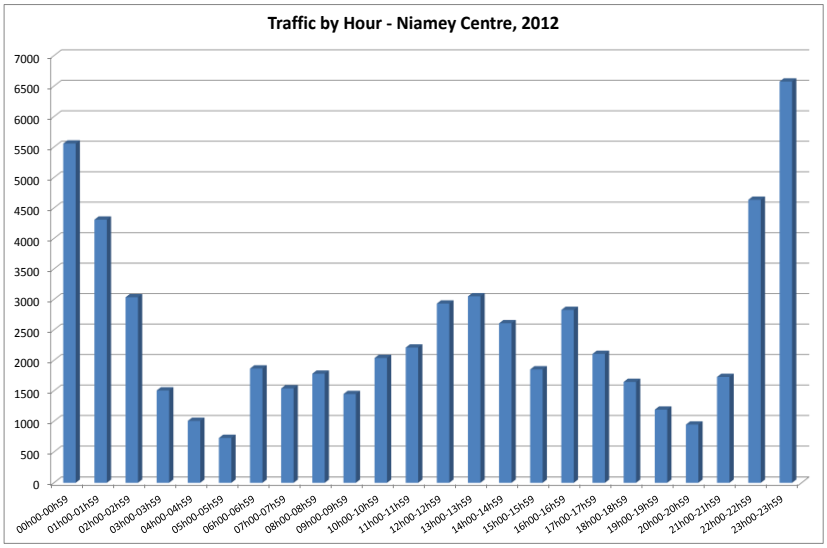
19h00-19h59
20h00-20h59
21h00-21h59
22h00-22h59
23h00-23h59


Traffic by Hour - Douala Centre, 2012
3500
3000
2500
2000
1500
1000
500
0
00h00-00h59
01h00-01h59
02h00-02h59
03h00-03h59
04h00-04h59
05h00-05h59
06h00-06h59
07h00-07h59
08h00-08h59
09h00-09h59
10h00-10h59
11h00-11h59
12h00-12h59
13h00-13h59
14h00-14h59
15h00-15h59
16h00-16h59
17h00-17h59
18h00-18h59
19h00-19h59
20h00-20h59
21h00-21h59
22h00-22h59
23h00-23h59


Traffic by Hour - Niamey Centre, 2012
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
00h00-00h59
01h00-01h59
02h00-02h59
03h00-03h59
04h00-04h59
05h00-05h59
06h00-06h59
07h00-07h59
08h00-08h59
09h00-09h59
10h00-10h59
11h00-11h59
12h00-12h59
13h00-13h59
14h00-14h59
15h00-15h59
16h00-16h59
17h00-17h59
18h00-18h59
19h00-19h59
20h00-20h59
21h00-21h59
22h00-22h59
23h00-23h59

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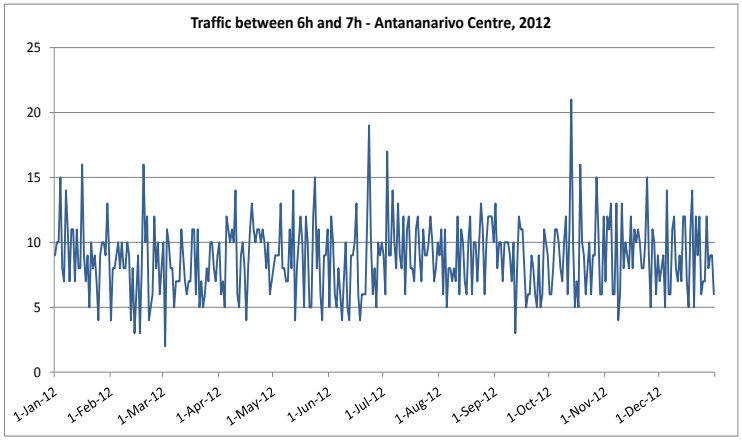
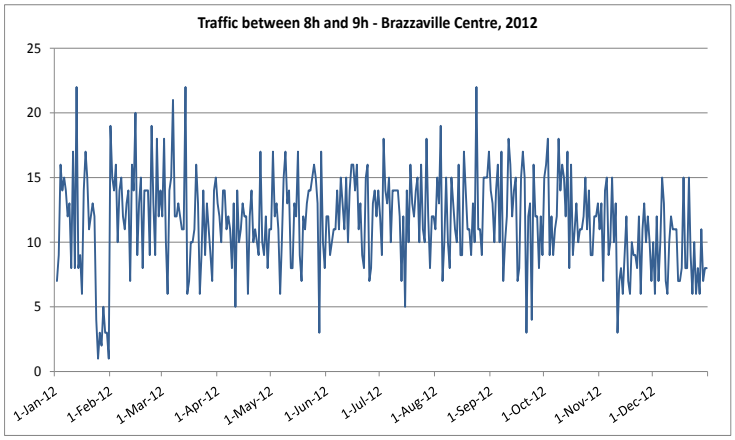
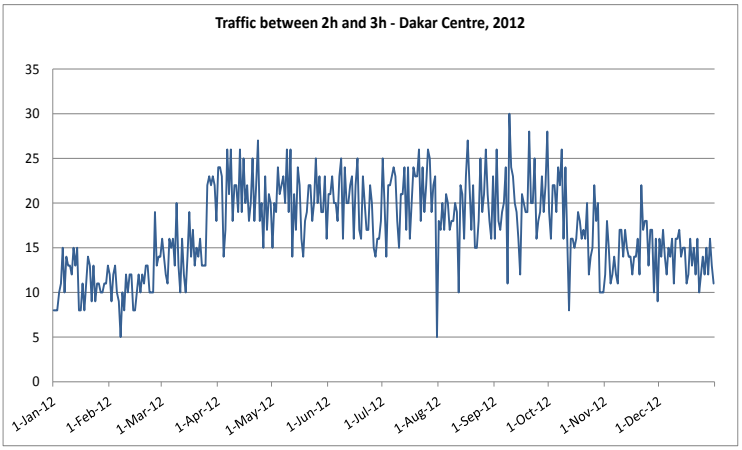
3.2 Traffic profile by specified hour

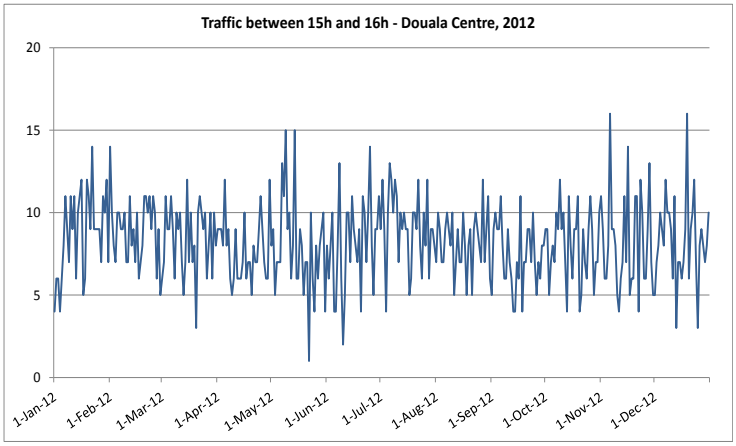
3.2.1 The graphs below illustrate the profile of the most dense traffic for a specific hour for each of the centres. The most busiest hour was:

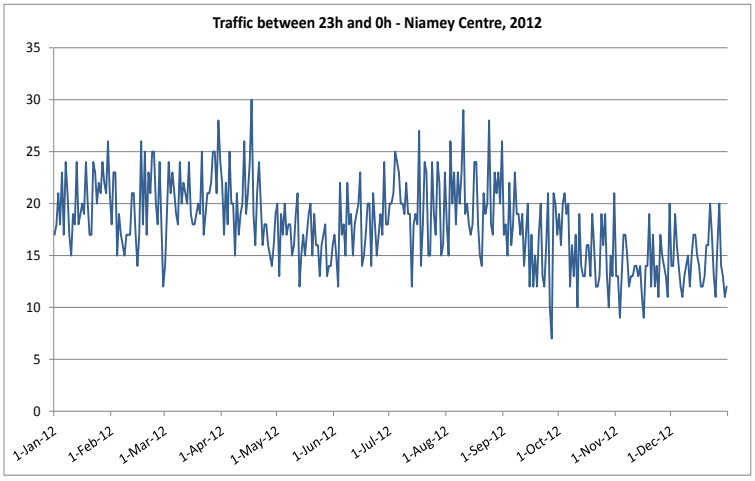
- Antananarivo Centre – between 0600 and 0700 hours
- Brazzaville Centre – between 0800 and 0900 hours
- Dakar Centre – between 0200 and 0300 hours
- Douala Centre – between 1500 and 1600 hours and
- Niamey Centre – between 2300 and midnight.











3.3 Maximum, minimum, average and standard deviation of hourly traffic

3.3.1 For each of the Centres, the maximum, minimum, average and standard deviation of hourly traffic for the most dense hours depicted above are determined in the tables below. The average ranged between 8 and 18 movements with the maximum of 30 flights recorded in the Dakar and Niamey Centres.

	Antananarivo	Brazzaville	Dakar	Douala	Niamey
Average	9	12	17	8	18
Maximum	21	22	30	16	30
Minimum	2	1	5	1	7
Standard Deviation	3	4	5	2	4

3.4 Traffic peaks by specified hour

3.4.1 Traffic peaks by specified hours for each of the Centres are shown below.

Antananarivo Centre, 2012

Rank	Date	Hour	Number of movements
1	13-Oct-12	0600	21
2	23-Jun-12	0600	19
3	3-Jul-12	0600	17
4	16-Jan-12	0600	16
5	19-Feb-12	0600	16
6	18-Oct-12	0600	16
7	4-Jan-12	0600	15
8	24-May-12	0600	15
9	27-Oct-12	0600	15
10	24-Nov-12	0600	15
11	7-Jan-12	0600	14
12	10-Apr-12	0600	14
13	12-May-12	0600	14
14	6-Jul-12	0600	14
15	5-Dec-12	0600	14
16	19-Dec-12	0600	14
17	30-Jan-12	0600	13
18	19-Apr-12	0600	13
19	5-May-12	0600	13
20	16-Jun-12	0600	13

Brazzaville Centre, 2012

Rank	Date	Hour	Number of movements
1	13-Jan-12	0800	22
2	14-Mar-12	0800	22
3	24-Aug-12	0800	22
4	7-Mar-12	0800	21
5	15-Feb-12	0800	20
6	1-Feb-12	0800	19
7	24-Feb-12	0800	19
8	4-Aug-12	0800	19
9	27-Feb-12	0800	18
10	2-Mar-12	0800	18
11	3-Jul-12	0800	18
12	27-Jul-12	0800	18
13	11-Sep-12	0800	18
14	3-Oct-12	0800	18
15	9-Oct-12	0800	18
16	11-Jan-12	0800	17
17	18-Jan-12	0800	17
18	25-Apr-12	0800	17
19	2-May-12	0800	17
20	9-May-12	0800	17

Dakar Centre, 2012

Rank	Date	Hour	Number of movements
1	9-Sep-12	0200	30
2	20-Sep-12	0200	28
3	30-Sep-12	0200	28
4	23-Apr-12	0200	27
5	17-Aug-12	0200	27
6	6-Apr-12	0200	26
7	8-Apr-12	0200	26
8	13-Apr-12	0200	26
9	9-May-12	0200	26
10	11-May-12	0200	26
11	21-Jul-12	0200	26
12	26-Jul-12	0200	26
13	27-Aug-12	0200	26
14	2-Sep-12	0200	26
15	8-Oct-12	0200	26
16	15-Apr-12	0200	25
17	20-Apr-12	0200	25
18	25-May-12	0200	25
19	8-Jun-12	0200	25
20	17-Jun-12	0200	25

Douala Centre, 2012			
Rank	**Date**	**Hour**	**Number of movements**
1	6-Nov-12	1500	16
2	19-Dec-12	1500	16
3	9-May-12	1500	15
4	14-May-12	1500	15
5	22-Jan-12	1500	14
6	1-Feb-12	1500	14
7	25-Jun-12	1500	14
8	16-Nov-12	1500	14
9	7-May-12	1500	13
10	8-Jun-12	1500	13
11	6-Jul-12	1500	13
12	28-Nov-12	1500	13
13	16-Jan-12	1500	12
14	19-Jan-12	1500	12
15	30-Jan-12	1500	12
16	15-Mar-12	1500	12
17	5-Apr-12	1500	12
18	30-Apr-12	1500	12
19	2-Jul-12	1500	12
20	7-Jul-12	1500	12

Niamey Centre, 2012			
Rank	**Date**	**Hour**	**Number of movements**
1	17-Apr-12	2300	30
2	10-Aug-12	2300	29
3	30-Mar-12	2300	28
4	24-Aug-12	2300	28
5	17-Jul-12	2300	27
6	30-Jan-12	2300	26
7	17-Feb-12	2300	26
8	13-Apr-12	2300	26
9	3-Aug-12	2300	26
10	31-Aug-12	2300	26
11	19-Feb-12	2300	25
12	23-Feb-12	2300	25
13	24-Feb-12	2300	25
14	21-Mar-12	2300	25
15	27-Mar-12	2300	25
16	28-Mar-12	2300	25
17	5-Apr-12	2300	25
18	4-Jul-12	2300	25
19	7-Jan-12	2300	24
20	13-Jan-12	2300	24

4. ANNUAL TRAFFIC ANALYSES

4.1 Traffic by type of flight (international arrivals and departures, domestic and overflights)

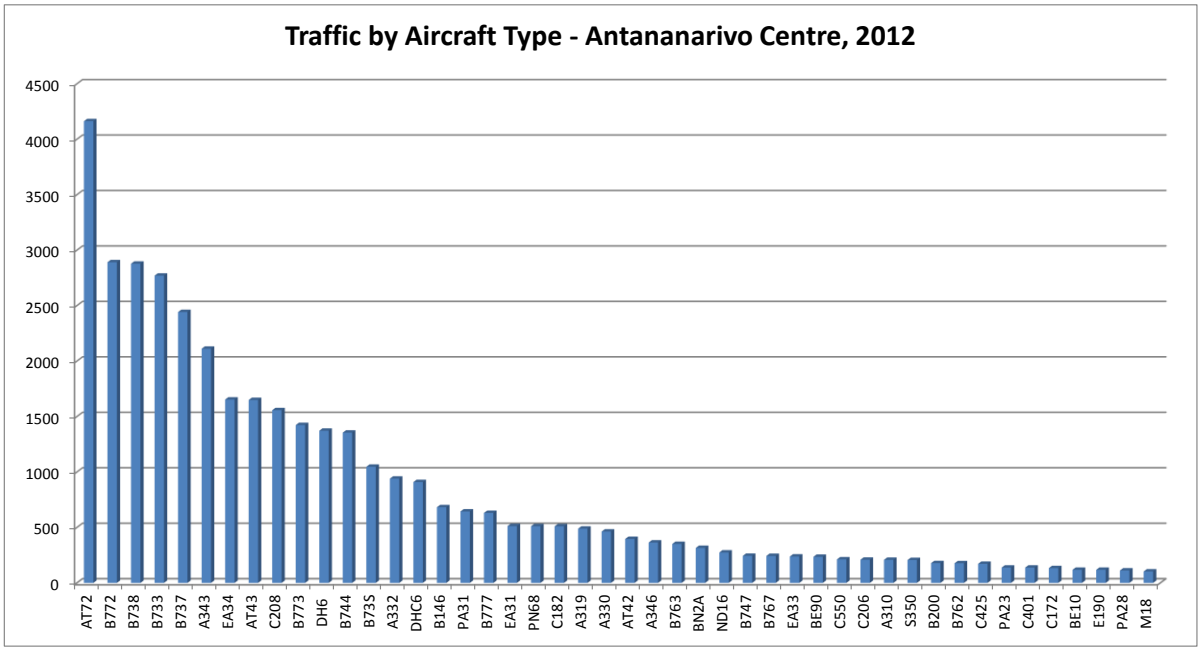
4.1.1 The tables and graphs below illustrate the annual traffic by flight type for each of the Centres concerned.

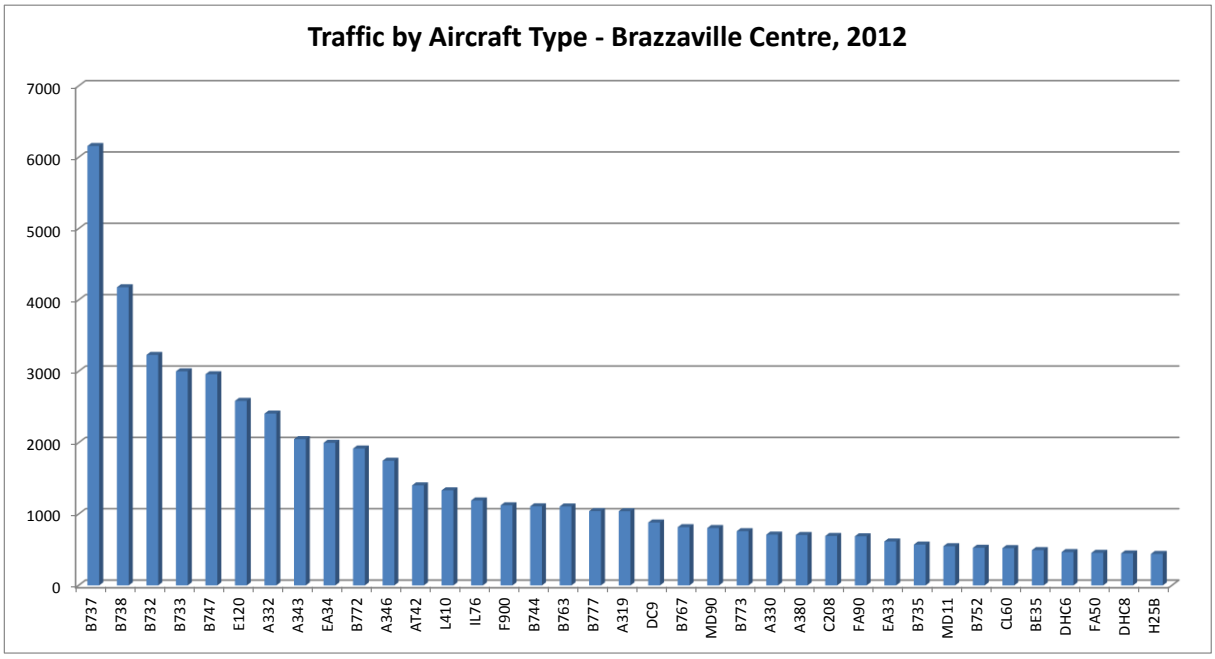
Type of Movement	Antananarivo	Brazzaville	Dakar	Douala	Niamey
	Number of Movements				
Arrivals	4 465	4 126	11 745	7 184	2 959
Departures	4 424	3 885	11 801	7 168	2 971
Overflights	9 640	42 337	48 268	25 504	49305
Domestic	21 817	12 673	3 731	4 424	3 867

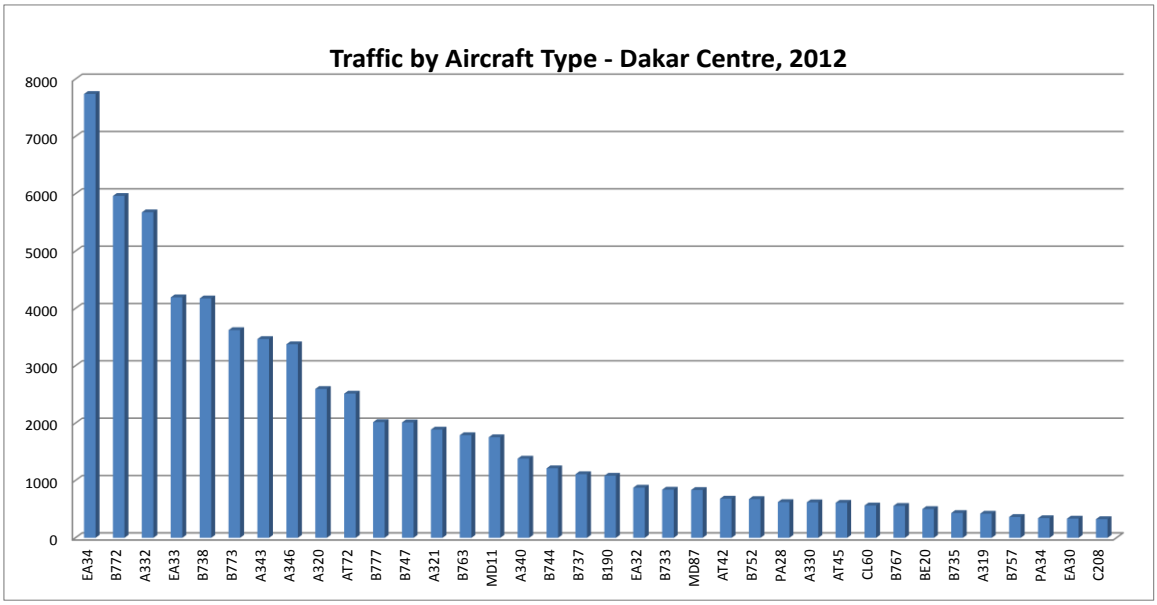
4.1.2 Most of the movements recorded by the Centres were overflights, except for the Antananarivo Centre, where domestic movements dominated. The volume of international arrivals and departures was bigger than domestic movements in case of the four remaining Centres.

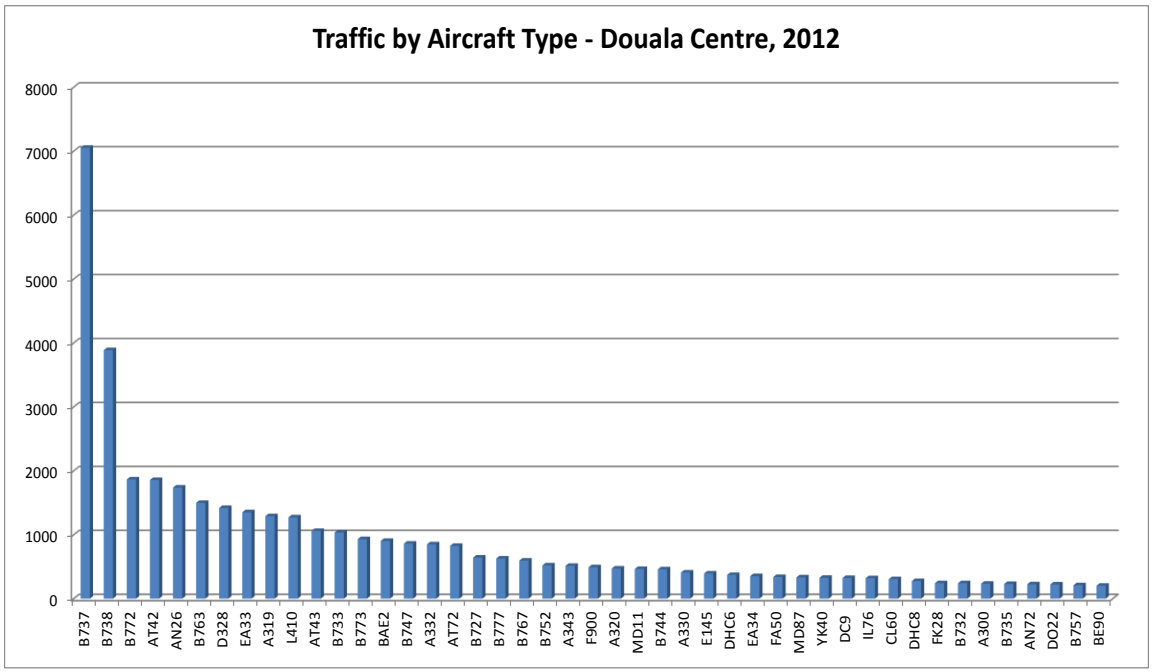
4.2 Traffic by aircraft type

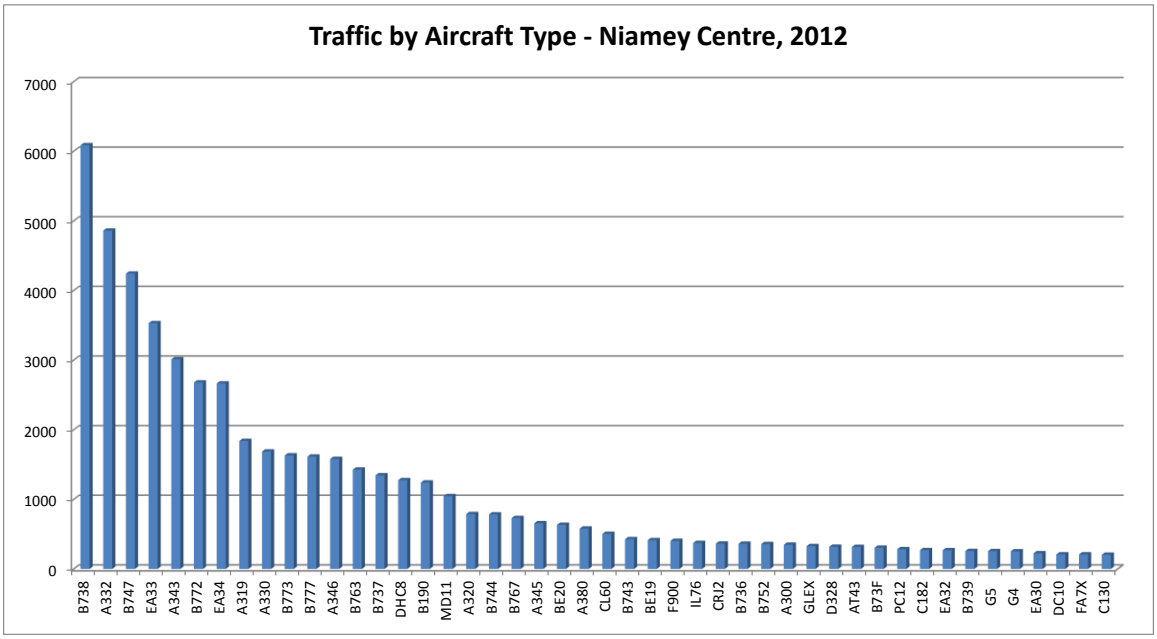
4.2.1 The charts below show aircraft movements by the most popular aircraft types for each of the five Centres.






Traffic by Aircraft Type - Dakar Centre, 2012
8000
7000
6000
5000
4000
3000
2000
1000
0
EA34 B772 A332 EA33 B738 B773 A343 A346 A320 AT72 B777 B747 A321 B763 MD11 A340 B744 B737 B190 EA32 B733 MD87 AT42 B752 PA28 A330 AT45 CL60 B767 BE20 B735 A319 B757 PA34 EA30 C208

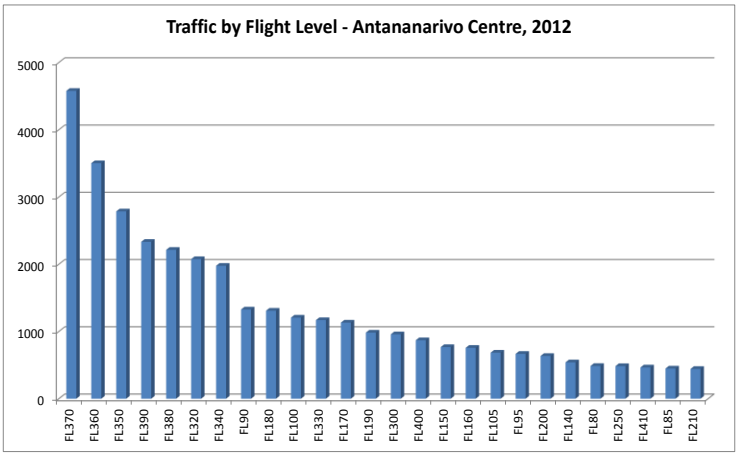

Traffic by Aircraft Type - Douala Centre, 2012
8000
7000
6000
5000
4000
3000
2000
1000
0
B737 B738 B772 AT42 AN26 B763 D328 EA33 A319 L410 AT43 B733 B773 BAE2 B747 A332 AT72 B727 B777 B767 B752 A343 F900 A320 MD11 B744 A330 E145 DHC6 EA34 FA50 MD87 YK40 DC9 IL76 CL60 DHC8 FK28 B732 A300 B735 AN72 DO22 B757 BE90

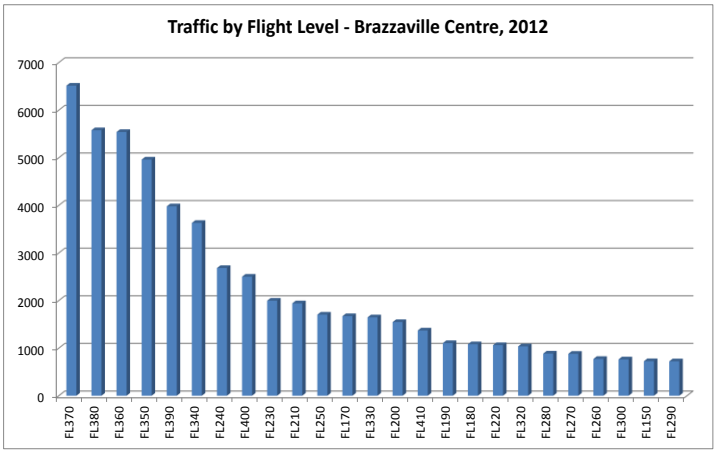

Traffic by Aircraft Type - Niamey Centre, 2012
7000
6000
5000
4000
3000
2000
1000
0
B738 A332 B747 EA33 A343 B772 EA34 A319 A330 B773 B777 A346 B763 B737 DHC8 B190 MD11 A320 B744 B767 A345 BE20 A380 CL60 B743 BE19 F900 IL76 CRJ2 B736 B752 A300 GLEX D328 AT43 B73F PC12 C182 EA32 B739 G5 G4 EA30 DC10 FA7X C130

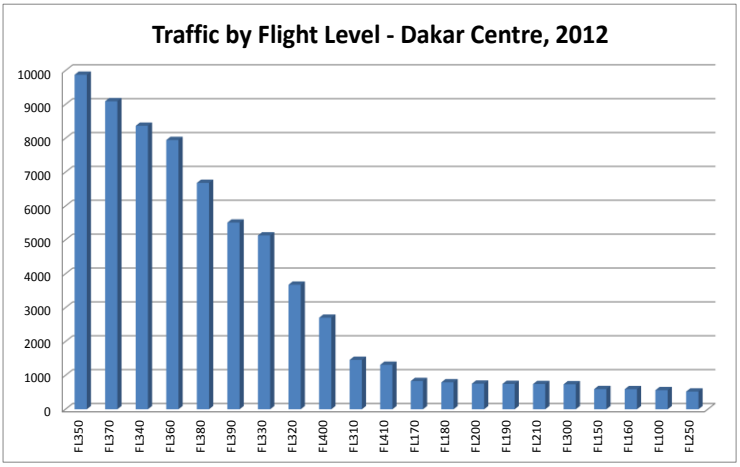
4.2.2 The Boeing 737 and Boeing 738 aircraft types prevailed in the Brazzaville, Douala and Niamey Centres (10 336, 10 940 and 7 431, respectively). The Dakar Centre recorded the biggest number of movements (7 741) performed with Airbus 340, while The Antananarivo Centre recorded the biggest number of flights operated with AT72 (4 163 flights).

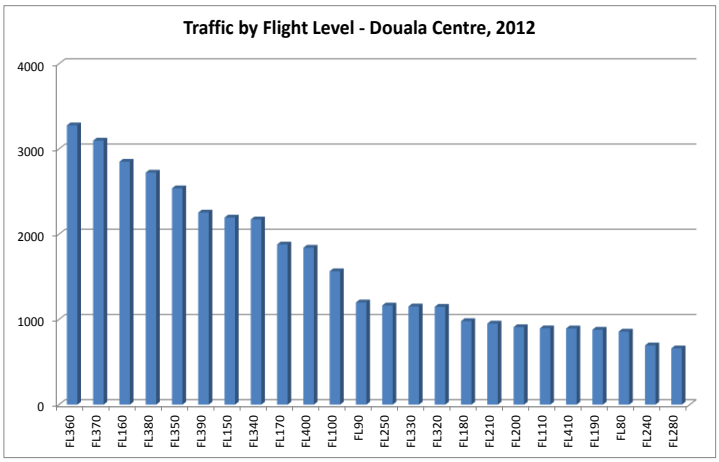
4.3. Traffic by flight level

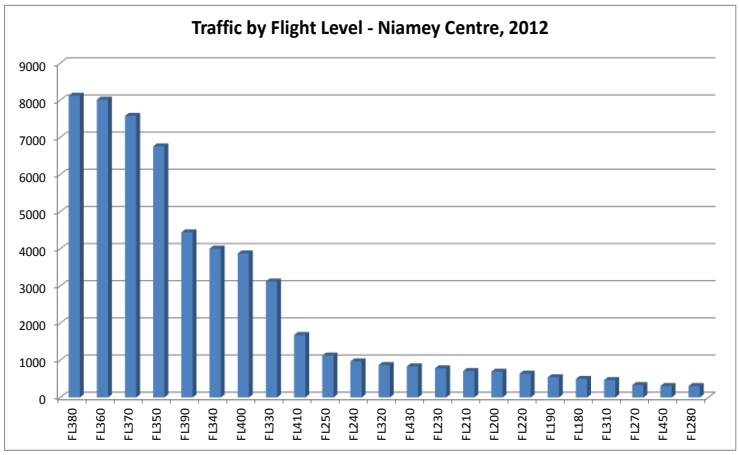
4.3.1 The charts below depict the preferred flight levels for each of the five Centres.











4.3.2 FL370 was the most popular in the Antananarivo and Brazzaville Centres, while FL350, FL360 and FL380 were the most often used in the Dakar, Douala and Niamey Centres, respectively.

4.4. Traffic by point of entry

4.4.1 The tables below present traffic for top 20 points of entry for each of the Centres.

Antananarivo Centre, 2012

Rank	Entry Point	Number of movements
1	FMMI	9 139
2	FMMT	2 308
3	FMNM	1 774
4	DENLI	1 675
5	UVENA	1 537
6	SUNIR	1 509
7	FMCZ	1 491
8	KINAN	1 421
9	ANKOR	1 318
10	AMBOD	1 305
11	UNKIK	1 110
12	FMNN	1 095
13	GERAG	1 082
14	EROPA	1 033
15	FMCH	921
16	RUPIG	841
17	NESAM	840
18	FMNA	755
19	FMMV	682
20	FMST	677

Brazzaville Centre, 2012

Rank	Entry Point	Number of movements
1	FCBB	8 544
2	FCPP	6 852
3	KOPOV	2 790
4	ONUDA	2 659
5	FOOL	2 625
6	LIKAD	2 617
7	MPK	2 492
8	BZ	2 419
9	FEFF	2 164
10	ARAKI	1 945
11	KEMOX	1 934
12	EDGUM	1 908
13	ONPOX	1 764
14	PIPLO	1 349
15	EMSAT	1 310
16	TJN	1 150
17	MERON	1 104
18	BUNDO	1 098
19	FOON	994
20	DEREP	966

Dakar Centre, 2012

Rank	Entry Point	Number of movements
1	GOOY	13 634
2	DEKON	8 222
3	KENOX	6 765
4	NEVDI	6 294
5	TASIL	4 919
6	POMAT	4 854
7	GATIL	2 898
8	KODOS	2 628
9	GBYD	2 201
10	BOTNO	2 183
11	LUMPO	2 036
12	BADIA	1 875
13	SESEL	1 341
14	ERETU	1 174
15	MOGSA	967
16	KOMOR	877
17	SCEL	769
18	BIKIS	700
19	LEMD	700
20	GOGG	680

Douala Centre, 2012

Rank	Entry Point	Number of movements
1	FGSL	8 313
2	FKKD	7 796
3	OBUDU	4 523
4	FGBT	4 112
5	FKYS	3 023
6	BIMOD	2 515
7	BT	2 306
8	ARASI	2 233
9	KEMOX	1 742
10	IKROP	1 432
11	DESAM	1 418
12	DEREP	1 017
13	RALIN	655
14	TAPEK	557
15	TAKUM	553
16	GUPAM	398
17	DELOR	271
18	IPOVO	181
19	ETNOM	177
20	OMDB	160

Niamey Centre, 2012

Rank	Entry Point	Number of movements
1	GANLA	6 535
2	DRRN	4 337
3	ERKEL	3 986
4	IKTAV	3 031
5	TERAS	2 883
6	SENOR	2 599
7	EREBO	2 538
8	ENORA	2 505
9	ZAWAT	2 267
10	MOKAT	2 000
11	LITAK	1 811
12	TOBUK	1 722
13	PINGO	1 614
14	POTOL	1 610
15	OPULU	1 590
16	NUREX	1 498
17	INISA	1 494
18	DEKAS	1 288
19	RIPOL	1 242
20	INAMA	1 150

4.5 Traffic by point of exit

4.5.1 The tables below illustrate traffic for top 20 points of exit for each of the Centres.

Antananarivo Centre, 2012

Rank	Exit Point	Number of movements
1	FMMI	9 010
2	FMMT	2 318
3	UVENA	1 786
4	FMNM	1 652
5	GERAG	1 594
6	KINAN	1 569
7	FMCZ	1 546
8	DENLI	1 370
9	AMBOD	1 317
10	ANKOR	1 309
11	EROPA	1 246
12	FMNN	1 089
13	SUNIR	1 018
14	FMCH	861
15	ENDEL	846
16	UNKIK	781
17	FMNA	751
18	FMST	680
19	FMMV	677
20	FMMS	664

Brazzaville Centre, 2012

Rank	Exit Point	Number of movements
1	FCBB	8 392
2	FCPP	6 859
3	KOPOV	3 143
4	BZ	2 956
5	MPK	2 595
6	ONUDA	2 247
7	LIKAD	2 085
8	ONPOX	2 020
9	EMSAT	1 909
10	KEMOX	1 718
11	ARAKI	1 685
12	MERON	1 633
13	FOOL	1 633
14	FEFF	1 610
15	DESAM	1 351
16	EDGUM	1 312
17	BUNDO	1 254
18	FOON	1 040
19	DEREP	936
20	PIPLO	897

Dakar Centre, 2012

Rank	Exit Point	Number of movements
1	GOOY	13 539
2	AMDOL	8 229
3	NANIK	6 753
4	NEVDI	5 844
5	POMAT	4 917
6	TASIL	4 858
7	KODOS	3 491
8	GATIL	2 934
9	GBYD	2 183
10	ERETU	2 181
11	LUMPO	2 180
12	BADIA	1 680
13	BOTNO	1 175
14	SESEL	979
15	KOMOR	845
16	SCEL	769
17	BIKIS	753
18	DEMIL	749
19	GOGG	666
20	LEMD	653

Douala Centre, 2012

Rank	Exit Point	Number of movements
1	FGSL	8 296
2	FKKD	7 776
3	OBUDU	4 876
4	FGBT	4 117
5	FKYS	3 039
6	BIMOD	2 992
7	BT	2 379
8	KEMOX	1 981
9	ARASI	1 761
10	IKROP	1 077
11	DEREP	1 052
12	DESAM	947
13	TAKUM	844
14	RALIN	541
15	DELOR	427
16	GUPAM	422
17	TAPEK	318
18	GEBRO	247
19	ETNOM	143
20	DNMM	116

Niamey Centre, 2012

Rank	Exit Point	Number of movements
1	ERKEL	6 190
2	GANLA	5 869
3	DRRN	4 350
4	ENORA	3 016
5	SENOR	2 702
6	MOKAT	2 645
7	IKTAV	2 498
8	TERAS	2 272
9	LITAK	2 114
10	OPULU	1 799
11	INISA	1 723
12	POTOL	1 674
13	INAMA	1 617
14	TOBUK	1 505
15	ZAWAT	1 476
16	NUREX	1 339
17	BATIA	1 332
18	GULEN	1 243
19	DEKAS	1 204
20	PINGO	1 106

4.6. Traffic by entry and exit points

4.6.1 The tables below illustrate the top 20 routes by entry-exit points handles by each of the Centres.

Antananarivo Centre, 2012

Rank	Route	Entry - Exit Point	Number of movements	Average flight time
1	UR780	DENLI-UVENA	1 655	01:11:29
2	UG853	SUNIR-GERAG	1 508	01:28:47
3	UR348	FMMT -FMMI	1 407	00:45:44
4	UR348	FMMI -FMMT	1 370	01:06:35
5	UR780	UVENA-DENLI	1 361	01:09:13
6	UA665	ANKOR-AMBOD	1 317	01:08:11
7	UA665	AMBOD-ANKOR	1 305	01:08:30
8	UA401	UNKIK-FMMI	1 101	00:59:53
9	UG853	GERAG-SUNIR	1 012	01:42:14
10	UA401	FMMI -KINAN	855	01:17:09
11	UG465	NESAM-ENDEL	836	00:56:00
12	UA401	FMMI -UNKIK	772	00:57:08
13	UR438-UB536	RUPIG-EROPA	728	02:07:07
14	UA401	KINAN-FMMI	643	01:20:49
15	UB790	FMCH -KINAN	566	00:13:11
16	-	FMMI -FMNM	553	01:08:23
17	-	FMNM -FMMI	513	01:12:00
18	UB536-UR438	EROPA-RUPIG	506	01:58:17
19	-	FMMI -FMNN	500	01:13:37
20	-	FMNN -FMMI	493	01:13:28

Brazzaville Centre, 2012

Rank	Route	Entry - Exit Point	Number of movements	Average flight time
1	B732	FCBB -FCPP	4 822	00:41:24
2	B732	FCPP -FCBB	4 793	00:44:09
3	UA400	ARAKI-ONPOX	1 945	00:35:42
4	UM731	EDGUM-EMSAT	1 908	00:51:54
5	UA400	ONPOX-ARAKI	1 684	00:37:24
6	-	ONUDA-MERON	1 633	00:29:52
7	-	LIKAD-KOPOV	1 478	00:36:19
8	UA609	KEMOX-MPK	1 441	00:52:30
9	UA610	PIPLO-DESAM	1 347	00:44:48
10	UM731	EMSAT-EDGUM	1 309	00:50:24
11	UR526	LIKAD-BUNDO	1 116	00:29:24
12	-	MERON-ONUDA	1 104	00:31:56
13	-	KOPOV-LIKAD	1 100	00:36:33
14	UR526	BUNDO-LIKAD	959	00:30:17
15	-	FOOL -FOON	912	00:57:17
16	-	FOON -FOOL	906	00:56:33
17	UA609	MPK -KEMOX	905	00:51:03
18	UR987	TAPIL-FCPP	897	00:36:29
19	UA610	DESAM-PIPLO	888	00:47:09
20	-	KOPOV-FCBB	882	00:51:38

Dakar Centre, 2012

Rank	Route	Entry - Exit Point	Number of movements	Average flight time
1	UN866	DEKON-AMDOL	8 221	01:17:59
2	UN741	KENOX-NANIK	6 748	01:13:00
3	UN873	TASIL-POMAT	4 913	01:24:18
4	UN873	POMAT-TASIL	4 849	01:25:51
5	UR975	NEVDI-GOOY	3 286	00:22:48
6	UR975	GOOY -NEVDI	3 178	00:21:30
7	UR975-UA302	NEVDI-KODOS	2 491	02:18:44
8	UN857	BOTNO-ERETU	2 181	01:29:27
9	UA302-UR975	KODOS-NEVDI	1 875	02:15:55
10	UA601	GOOY -GATIL	1 800	00:51:37
11	UA601	GATIL-GOOY	1 739	00:50:53
12	UR979	GOOY -BADIA	1 249	00:36:46
13	UR979	BADIA-GOOY	1 241	00:41:06
14	UN857	ERETU-BOTNO	1 173	01:28:52
15	-	GATIL-LUMPO	1 102	01:02:31
16	-	LUMPO-GATIL	1 008	00:57:45
17	UB600	SESEL-GOOY	856	00:50:16
18	UB600-UB601	GBYD -NEVDI	789	00:29:49
19	UB601	GOOY -BIKIS	717	00:22:01
20	-	KOMOR-GOOY	673	00:37:45

Douala Centre, 2012

Rank	Route	Entry - Exit Point	Number of movements	Average flight time
1	-	FGBT -FGSL	3 841	00:39:08
2	-	FGSL -FGBT	3 834	00:38:40
3	UG861-UA604	ARASI-OBUDU	1 845	00:34:40
4	UA610	FKYS -FKKD	1 481	00:28:22
5	UA609	IKROP-KEMOX	1 415	00:26:58
6	UA604-UG861	OBUDU-ARASI	1 409	00:35:52
7	UA610	FKKD -FKYS	1 400	00:31:22
8	-	BIMOD-FGSL	1 277	00:18:33
9	-	FKKD -BIMOD	1 157	00:20:49
10	-	FGSL -BIMOD	1 097	00:16:42
11	UA604-UG861	OBUDU-FKKD	1 070	00:29:18
12	UA609	KEMOX-IKROP	1 047	00:25:15
13	-	FGSL -FKKD	1 007	00:25:06
14	UG861-UA604	FKKD -OBUDU	1 001	00:22:32
15	-	FKKD -FGSL	975	00:19:14
16	-	BIMOD-FKKD	966	00:28:30
17	UA604-UG857	OBUDU-BT	862	00:36:09
18	UG857-UA604	BT -OBUDU	855	00:34:34
19	-	OBUDU-FGSL	840	00:32:46
20	-	FGSL -OBUDU	839	00:32:07

Niamey Centre, 2012				
Rank	Route	Entry - Exit Point	Number of movements	Average flight time
1	UA604-UR978	GANLA-ERKEL	5 628	00:55:40
2	UR978-UA604	ERKEL-GANLA	3 488	00:57:19
3	UB730	IKTAV-ENORA	2 983	00:18:14
4	UB730	ENORA-IKTAV	2 452	00:20:31
5	UA604	EREBO-GANLA	2 360	00:52:33
6	UM998	TOBUK-INISA	1 720	00:36:34
7	UM114	ZAWAT-LITAK	1 705	01:01:48
8	UA603-UG859	PINGO-MOKAT	1 614	01:17:40
9	UM608-UR981	TERAS-SENOR	1 602	01:18:09
10	UM998	INISA-TOBUK	1 491	00:39:31
11	UR866	NUREX-OPULU	1 441	00:31:39
12	UM114	LITAK-ZAWAT	1 228	01:01:56
13	UR981-UM608	SENOR-TERAS	1 211	01:17:03
14	UR866	OPULU-NUREX	1 175	00:29:50
15	UG859-UA603	MOKAT-PINGO	1 106	01:22:15
16	UA604	GANLA-EREBO	900	00:57:12
17	-	SENOR-POTOL	779	01:44:26
18	UG854	DRRN -DEKAS	773	00:30:04
19	UG854	DEKAS-DRRN	765	00:30:55
20	-	TERAS-TATAT	754	01:15:58

APPENDIX D

PEAK-PERIOD ANALYSIS FOR SEYCHELLES FIR

FIR traffic data provided by Seychelles for the year 2012 was analyzed thoroughly, in order to determine the main peak-period parameters, using a computer application developed by the Secretariat. The analysis covered the following items:

1. Monthly traffic

2. Daily traffic analysis:

- 2.1 Daily profile of traffic by control centre
- 2.2 Maximum, minimum and average daily traffic
- 2.3 Daily traffic ranking

3. Hourly traffic analysis:

- 3.1 Hourly traffic (whole period)
- 3.2 Traffic profile by specified hour
- 3.3 Maximum, minimum and average hourly traffic
- 3.4 Traffic peaking by specified hour

4. Annual traffic analysis:

- 4.1 Aircraft movements by aircraft type
- 4.2 Aircraft movements by flight level
- 4.3 Aircraft movements by point of entry
- 4.4 Aircraft movements by point of exit
- 4.5 Aircraft movements by pair of entry point-exit point.
- 4.6 Aircraft movements by origin and destination

The following sections provide the detailed results for the Seychelles FIR Centre. It should be noted that the data does not cover two days of May and one day of August 2012.

1. MONTHLY TRAFFIC

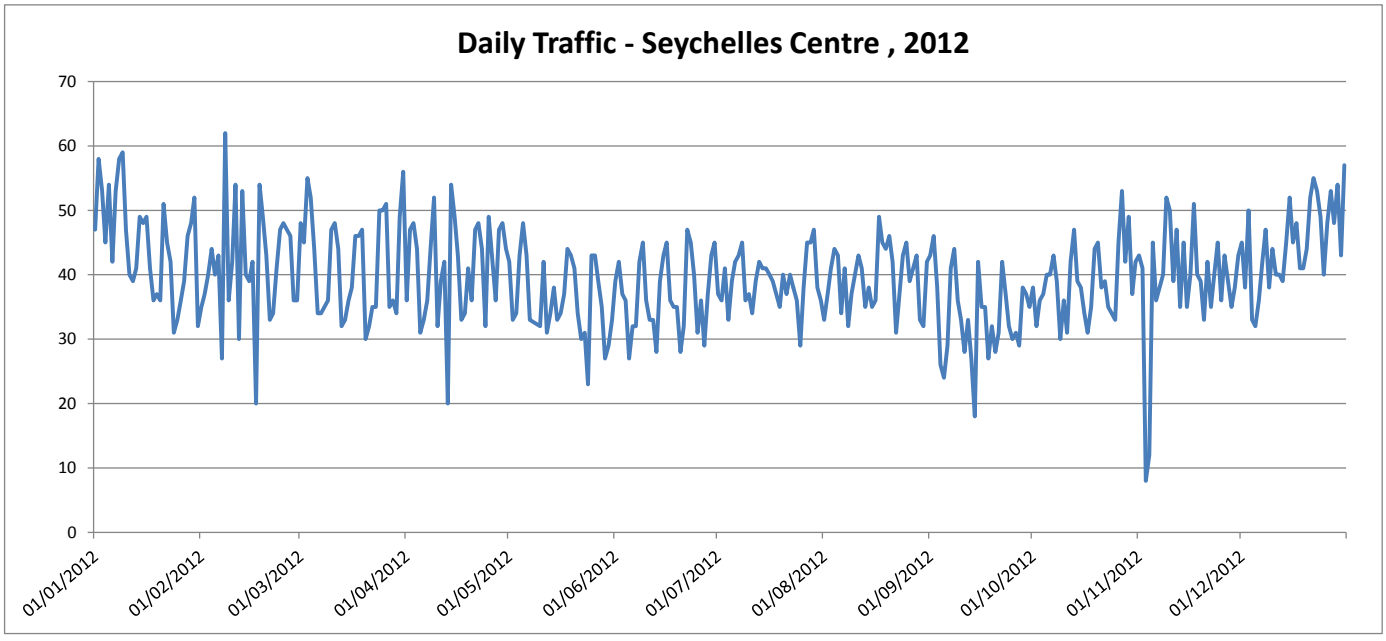
1.1 The table below illustrates the monthly traffic for the Seychelles FIR Centre for the year 2012. The average monthly traffic was 1 196. The movements were distributed quite evenly throughout the year. However, the months of January and December recorded much higher number of movements (1 387 and 1 392, respectively) than other months.

Seychelles FIR Centre, 2012	
Month	**Number of movements**
January	1 387
February	1 198
March	1 258
April	1 189
May	1 052
June	1 108
July	1 206
August	1 185
September	1 007
October	1 204
November	1 165
December	1 392

2. DAILY TRAFFIC ANALYSIS

2.1 Daily profile of traffic by control centre

2.1.1 The following figure shows the daily traffic profile for the Seychelles FIR Centre and helps in the identification of any seasonality pattern in the annual traffic.



2.2 Maximum, minimum, average and standard deviation of daily traffic

2.2.1 Beyond the graphical display, the maximum, minimum, average and standard deviation of daily traffic were produced for the Seychelles FIR.

Average	40
Maximum	62
Minimum	8
Standard Deviation	7

2.3 Daily traffic ranking

2.3.1 The daily traffic was ranked by number of flights. This helps identify the busiest and least busy days for the given period. For illustration purposes, the first 20 days' ranking of the Seychelles FIR Centre are displayed in the table below.

Seychelles FIR Centre, 2012		
Rank	**Date**	**Number of movements**
1	8-Feb-12	62
2	9-Jan-12	59
3	2-Jan-12	58
4	8-Jan-12	58
5	31-Dec-12	57
6	31-Mar-12	56
7	3-Mar-12	55
8	22-Dec-12	55
9	5-Jan-12	54
10	11-Feb-12	54
11	18-Feb-12	54
12	14-Apr-12	54
13	29-Dec-12	54
14	3-Jan-12	53
15	7-Jan-12	53
16	13-Feb-12	53
17	27-Oct-12	53
18	23-Dec-12	53
19	27-Dec-12	53
20	30-Jan-12	52

3. HOURLY TRAFFIC ANALYSIS

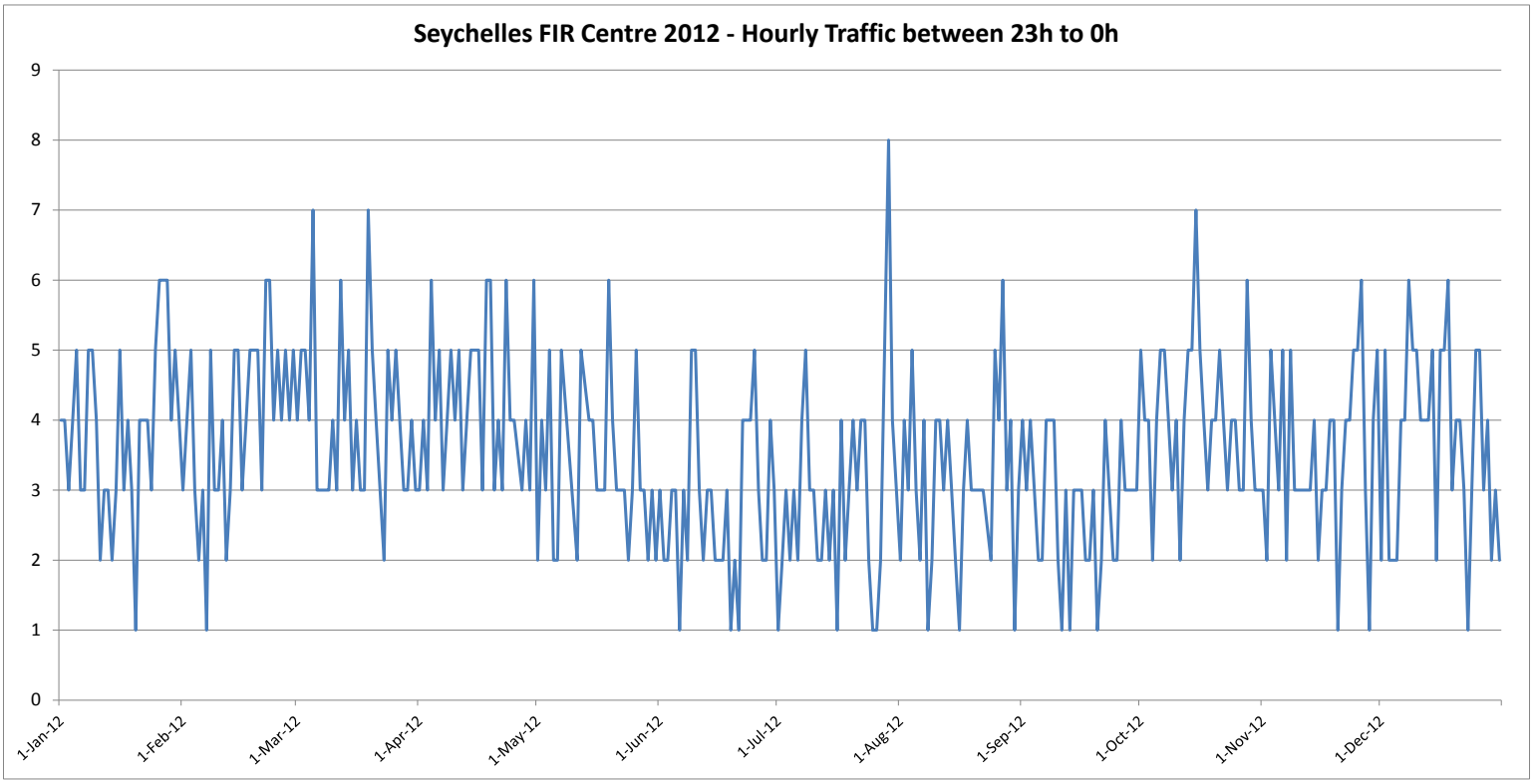
3.1 Hourly traffic

3.1.1 The program calculates the traffic by hour throughout the whole period and provides a sorted list of traffic by hour. The following table shows the top 20 hours in terms of traffic for the given period.

Seychelles FIR Centre, 2012			
Rank	**Date**	**Hour**	**Number of movements**
1	13-Feb-12	0000	9
2	8-Jan-12	0700	8
3	11-Feb-12	0000	8
4	18-Feb-12	0000	8
5	1-Mar-12	0400	8
6	24-Mar-12	0200	8
7	14-Apr-12	0000	8
8	25-Apr-12	0200	8
9	29-Jul-12	2300	8
10	5-Jan-12	0700	7
11	14-Jan-12	2000	7
12	15-Jan-12	0000	7
13	22-Jan-12	0700	7
14	8-Feb-12	2000	7
15	11-Feb-12	0700	7
16	4-Mar-12	0000	7
17	4-Mar-12	0700	7
18	5-Mar-12	2300	7
19	19-Mar-12	2300	7
20	12-May-12	0000	7

3.2 Traffic profile by specified hour

3.2.1 A traffic profile chart by a given hour from the control centre was also produced for the year 2012. The following figure illustrates the traffic profile for the Seychelles FIR Centre between 2300 and 2400 hours, the busiest hour for the Centre.



3.3 **Maximum, minimum, average and standard deviation of traffic for a specified hour**

3.3.1 Beyond the graphical display, the maximum, minimum, average and standard deviation of traffic for the busiest hour (between 2300 and midnight) for the Seychelles FIR Centre, were determined:

Average	4
Maximum	8
Minimum	1
Standard Deviation	1

3.4 Traffic peaking by specified hour

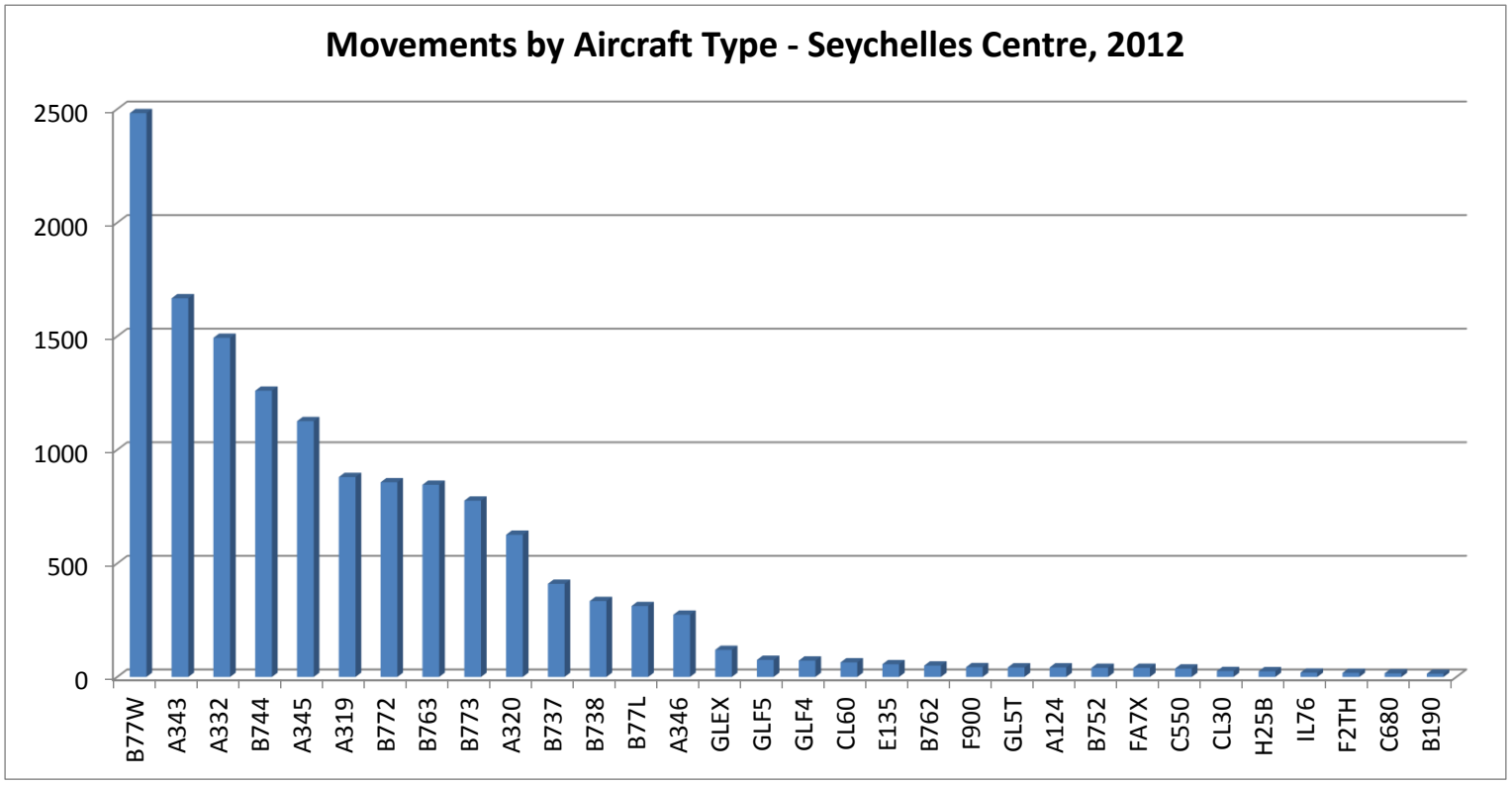
3.4.1 The following table provides more insight into traffic peaking between 2300 and midnight (by providing the list of the top 20 days for traffic at midnight).

Seychelles FIR Centre, 2012 Traffic between 23h and 0h		
Rank	**Date**	**Number of movements**
1	29-Jul-12	8
2	5-Mar-12	7
3	19-Mar-12	7
4	15-Oct-12	7
5	26-Jan-12	6
6	27-Jan-12	6
7	28-Jan-12	6
8	22-Feb-12	6
9	23-Feb-12	6
10	12-Mar-12	6
11	4-Apr-12	6
12	18-Apr-12	6
13	19-Apr-12	6
14	23-Apr-12	6
15	30-Apr-12	6
16	19-May-12	6
17	27-Aug-12	6
18	28-Oct-12	6
19	26-Nov-12	6
20	8-Dec-12	6

4. ANNUAL TRAFFIC ANALYSIS

4.1 Aircraft movements by aircraft type

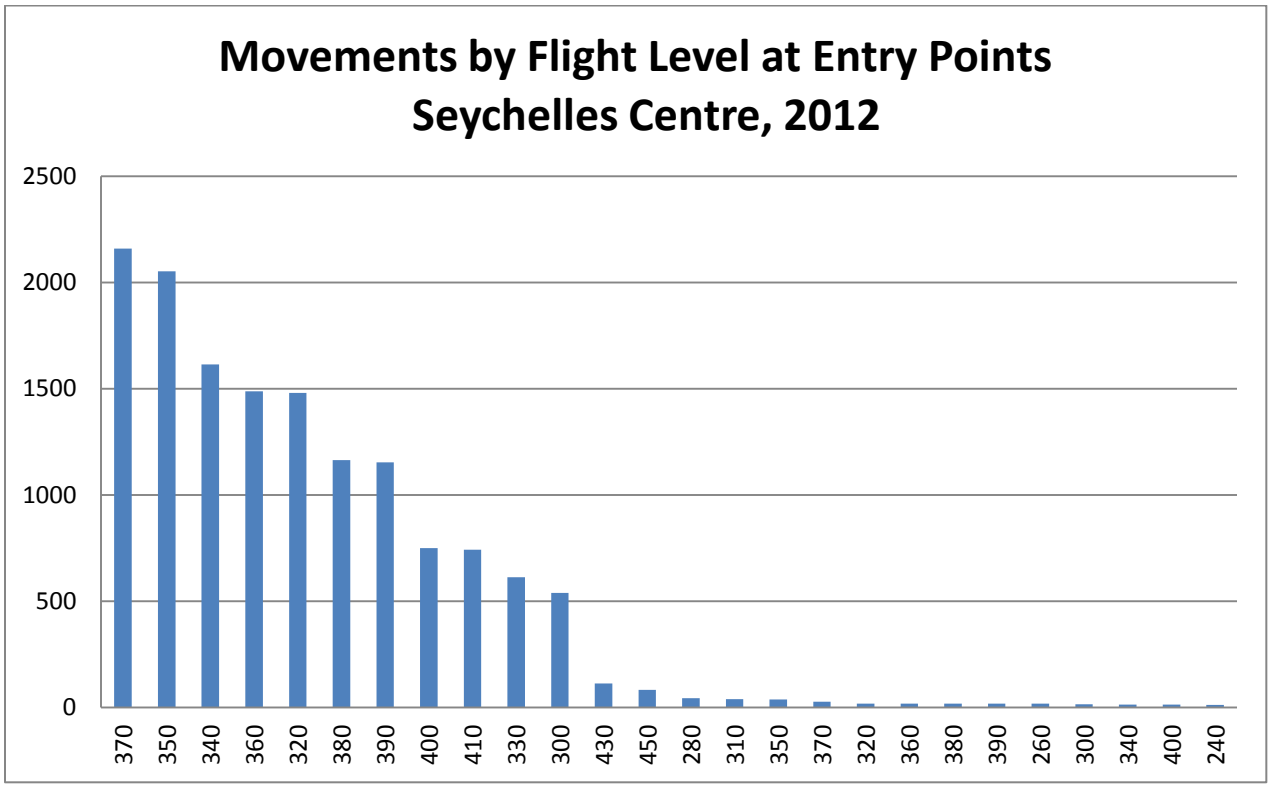
4.1.1 The following chart illustrates the aircraft movement traffic by aircraft type.



4.1.2 The aircraft type most often used in operations within the Seychelles FIR was Boeing 77W with 2 483 movements, followed by Airbus 343 and Airbus 332 (1 667 and 1 493 movements, respectively).

4.2 **Aircraft movements by flight level**

4.2.1 The graph below depicts the flight levels used most frequently at entry points. FL370 and FL350 were by far the most popular ones with aircraft movements of 2 160 and 2 052, respectively.



4.3 Aircraft movements by point of entry

4.3.1 FIR traffic was aggregated by point of entry (to the FIR) and sorted by traffic volume (aircraft movements). The table below shows the top 10 points of entry for Seychelles FIR Centre in 2012.

Seychelles FIR Centre, 2012		
Rank	Entry Point	Number of movements
1	ITLOX	2 271
2	AXINA	2 064
3	ATD	2 048
4	ANKOR	1 290
5	DENLI	1 274
6	OTKIR	872
7	ALRAN	798
8	APKAK	742
9	NESAM	456
10	ATOLA	411

4.4 Aircraft movements by point of exit

4.4.1 FIR traffic was aggregated by point of exit (from the FIR) and sorted by traffic volume (aircraft movements). The table below shows the top 10 exit points for the Seychelles FIR Centre in 2012.

Seychelles FIR Centre, 2012		
Rank	Exit Point	Number of movements
1	ITLOX	2 440
2	AXINA	2 060
3	DENLI	1 605
4	ANKOR	1 274
5	ALRAN	802
6	NESAM	795
7	UDLET	759
8	CLAVA	517
9	FSIA	515
10	KISAK	431

4.5 Aircraft movements by pair of entry point – exit point

4.5.1 In addition, FIR traffic was aggregated by a pair of entry and exit points and sorted by traffic volume (aircraft movements). The table below shows the top 10 pairs of entry and exit points, for the Seychelles FIR Centre in 2012.

Seychelles FIR Centre, 2012		
Rank	Entry - Exit Point	Number of movements
1	ATD-AXINA	1 247
2	ANKOR-ITLOX	1 194
3	DENLI-ITLOX	1 110
4	ITLOX-ANKOR	1 078
5	ITLOX-DENLI	1 038
6	AXINA-UDLET	749
7	AXINA-ALRAN	660
8	ALRAN-AXINA	660
9	APKAK-DENLI	553
10	OTKIR-NESAM	545

4.6 Aircraft movements by origin and destination

4.6.1 Moreover, FIR traffic was aggregated by a pair of origin and destination and sorted by traffic volume (aircraft movements). The table below shows the top origin-destinations for the Seychelles FIR Centre in 2012.

Seychelles FIR Centre, 2012		
Rank	Origin - Destination	Number of movements
1	LFPO-FMEE	846
2	FMEE-LFPO	828
3	FIMP-LFPG	671
4	LFPG-FIMP	670
5	FIMP-OMDB	582
6	FSIA-OMDB	569
7	OMDB-FIMP	562
8	OMDB-FSIA	550
9	LFPG-FMEE	386
10	OMAA-FSIA	378

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APPENDIX E

ANNUAL AND MONTHLY ANALYSIS FOR DAR ES SALAAM FIR

1. The Tanzania Civil Aviation Authority provided annual data on aircraft movements in the Dar es Salaam FIR for the period 2001-2012 for the analysis of the group. For the year 2012, monthly aircraft movement data were also provided.

2. Table E-1 and Figure E-1 below illustrate the yearly aircraft movements recorded by the Dar es Salaam FIR during the period 2001-2012. The total movements increased from 40 720 in 2001 to 87 189 in 2012, at an average annual rate of 7.2 per cent. International revenue flights, which dominate in the Dar es Salaam FIR, increased by 8.7 per cent per annum, while domestic increased by 4.7 per cent.

3. The highest annual growth rates, over 20 per cent, were recorded in 2003, 2004, 2010 and 2012. Decreases ranging from 2.6 per cent to 8.6 per cent were witnessed in 2002, 2005, 2006, 2009 and 2011.

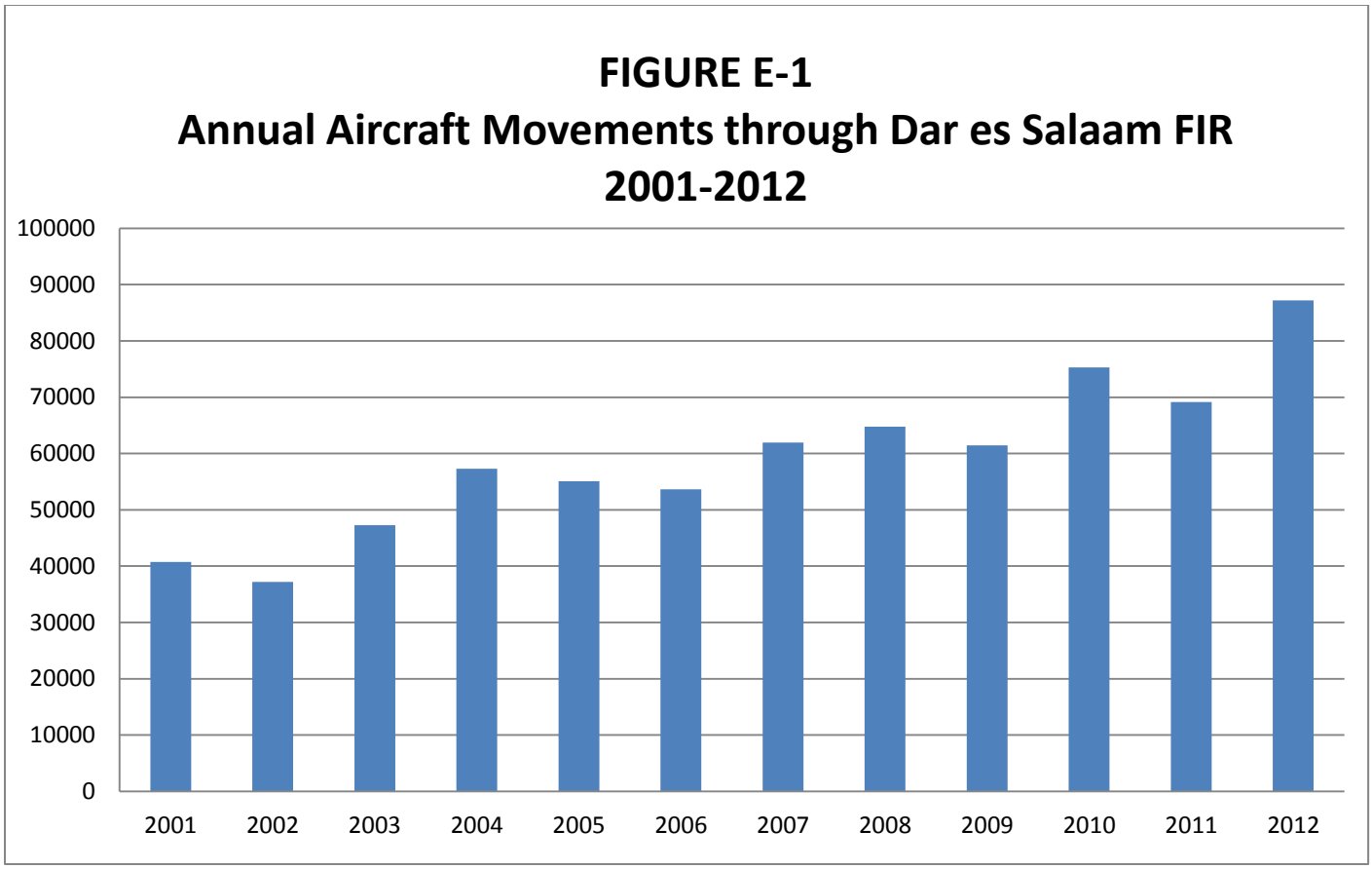
TABLE E-1
ANNUAL AIRCRAFT MOVEMENTS THROUGH DAR ES SALAAM FIR, 2001-2012

YEAR	NUMBER OF FLIGHTS							Annual % change
	International		Domestic		Total (International and Domestic)			Total (International and Domestic)
	Revenue flights	Other flights	Revenue flights	Other flights	Revenue flights	Other flights	total	
2001	24 136		15 942		40 078	642	40 720	
2002	23 909		12 686		36 595	628	37 223	- 8.6
2003	32 020		15 240		47 260		47 260	27.0
2004	32 662		18 210	1 469	50 872	6 428	57 300	21.2
2005	33 777	111	19 254	344	53 031	2 025	55 056	- 3.9
2006	34 440		18 734		53 174	455	53 629	- 2.6
2007	38 936		23 032		61 968		61 968	15.5
2008	43 046		21 727		64 773		64 773	4.5
2009	42 650		18 818		61 468		61 468	- 5.1
2010	53 878		21 419		75 297		75 297	22.5
2011	49 385		19 747		69 132		69 132	- 8.2
2012	60 653		26 536		87 189		87 189	26.1

Source: Tanzania Civil Aviation Statistics

Note:

Other flights: Government, Military, Medical, Survey flights etc.



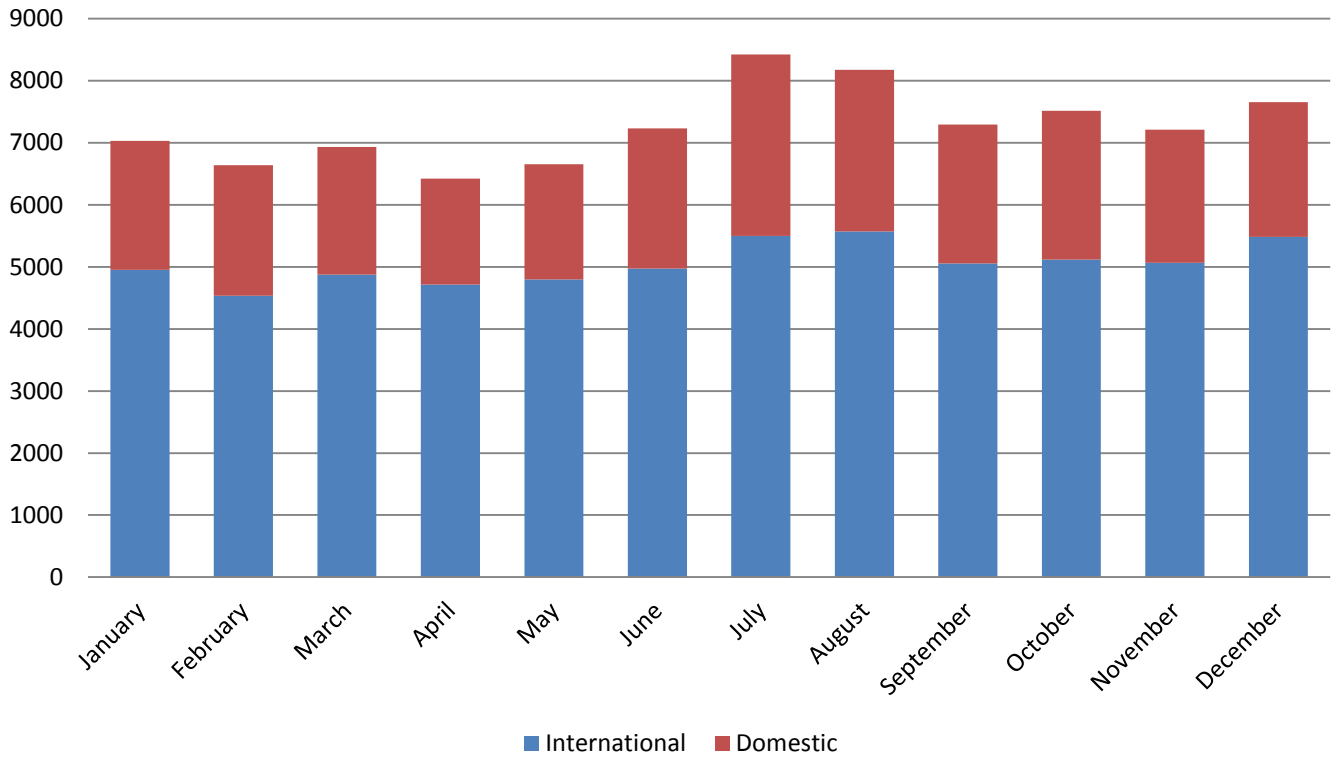
4. Table E-2 and Figure E-2 below illustrate the monthly movements recorded in 2012 by the Dar es Salaam FIR.

TABLE E-2
MONTHLY AIRCRAFT MOVEMENTS
THROUGH DAR ES SALAAM FIR, 2012

Month	NUMBER OF FLIGHTS		
	International	Domestic	Total
January	4952	2078	7030
February	4537	2100	6637
March	4874	2062	6936
April	4717	1704	6421
May	4800	1857	6657
June	4975	2256	7231
July	5501	2921	8422
August	5574	2604	8178
September	5058	2237	7295
October	5117	2397	7514
November	5065	2147	7212
December	5483	2173	7656

Source: Tanzania Civil Aviation Statistics

FIGURE E-2
Monthly Aircraft Movements through Dar es Salaam FIR, 2012



5. The average number of aircraft movements going through Dar es Salaam FIR in 2012 was 7 266 per month. July, with the total of 8 422 movements, was the busiest month, followed by August and December. International movements in those three months were also the highest (5 501, 5 574 and 5 483, respectively), compared to other months of the year.

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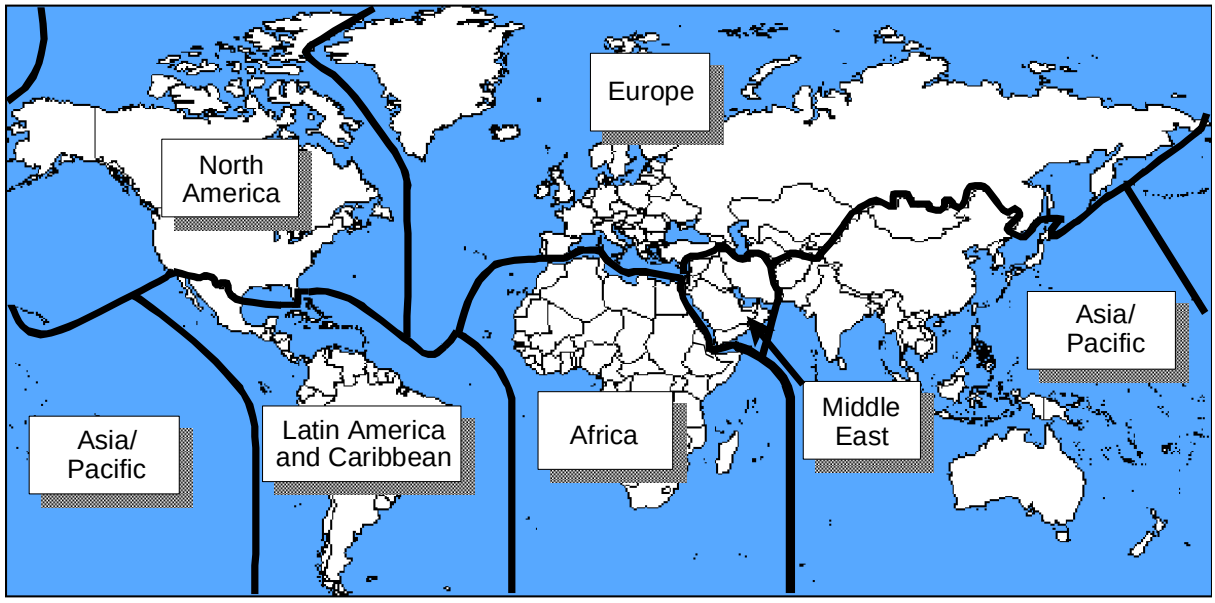
APPENDIX F

ICAO STATISTICAL REGIONS



International boundaries shown on this map do not imply official endorsement or acceptance by ICAO.

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