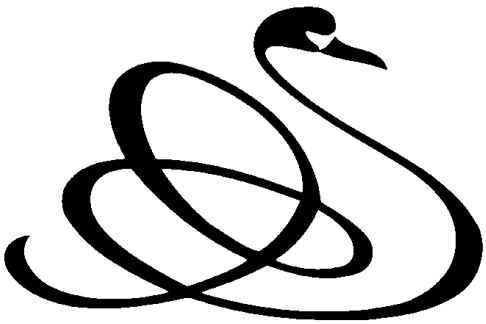


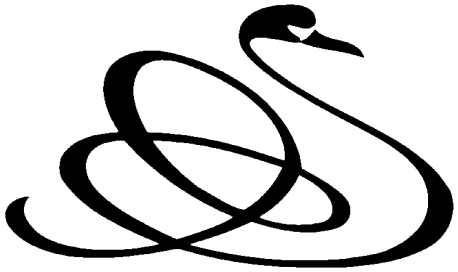
York Aviation

TRANSPORT FOR LONDON

LONDON AIRPORTS ROUTE NETWORKS IN 2050

Methodology Note

June 2013



York Aviation

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TRANSPORT FOR LONDON

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Contents

1 EXECUTIVE SUMMARY

1.1 This paper sets out the results of York Aviation's analysis of the potential passenger route networks at the London airports in 2050. We have developed a systematic approach that is grounded in the evidence available, while at the same time accounting for the changing landscape of the world economy and the behaviour of airlines. While it should be recognised that this paper considers long term outcomes and that consequently there are uncertainties inherent in the analysis, we believe that it provides a useful basis for further discussion and analysis.

1.2 **Table 1.1** sets out the impact of three different scenarios examined on the range of destinations and total frequencies offered across the London airports and at Heathrow or an alternative expanded hub airport.

Table 1.1: Destinations & Total Weekly Frequencies by Scenario

		2013	Maximum Use		2 x 2 x 2		4 Runway Hub	
			No.	+/- %	No.	+/- %	No.	+/- %
LHR /	Dests.	171	140	-18%	140	-18%	299	75%
New Hub	Frqs.	4,714	4,850	3%	4,850	3%	9,226	96%
Total	Dests.	385	322	-16%	358	-7%	435	13%
London	Frqs.	10,133	12,201	20%	15,598	54%	16,576	64%

1.3 The development of a Four Runway Hub is the best option in terms of London's connectivity. It offers more destinations and more efficient use of capacity than the next best option, a 2 x 2 x 2 arrangement with additional runways at Gatwick and Stansted.

1.4 In terms of specific markets, the Four Runway Hub is important in allowing the development of more marginal routes and in delivering additional frequency on key services. For instance, it enables eight more Chinese destinations to be served than the next best option, three more Brazilian destinations, four more Indian destinations and ten more destinations in the USA.

1.5 The primary purpose of this exercise was not to forecast the number of passengers that might use a new hub airport or an expanded Heathrow or to identify the utilisation of capacity at a new hub. However, we estimate that in broad terms weekly frequency capacity at a new four runway hub would be between 9,000 and 10,000 movements. By 2050, our route network is at the lower end of that threshold.

1.6 In terms of passenger demand, we have worked primarily within the confines of the DfT unconstrained forecasts for demand growth. The model developed does not provide a precise answer as to anticipated demand given the various uplifts and manual adjustments to destinations and frequencies. However, we assess that the route network and levels of frequency are reflective of an airport handling around 170 million passengers a year. This is in line with DfT forecasts for an unconstrained Heathrow.

1.7 The detailed outputs from this work can be found in the accompanying spreadsheets.

2 INTRODUCTION

Background

2.1 Transport for London (TfL) has asked York Aviation to consider the shape of potential route networks for the London airports in 2050 based on available evidence. This is intended to support on-going work around consideration of the economic benefits associated with the development of significant new airport capacity for London. This paper deals exclusively with passenger flights. This analysis has been undertaken in a relatively short time-frame and there is clearly scope for further research and refinement. However, we believe that the results are a useful guide as to how connectivity might develop in London under different scenarios.

2.2 Our analysis has considered five airports:

- Heathrow, which also acts as proxy for a non-location specific major hub airport;
- Gatwick;
- Stansted;
- Luton;
- London City.

Scenarios

2.3 We have then considered three potential development scenarios:

- **Maximum Use of Existing Capacity (Maximum Use)** – no additional runways are built at any of the five London airports;
- **Development of a Four Runway Hub** – a new airport is built to replace Heathrow with four runways or Heathrow is expanded to four runways. Further runway capacity is not developed at any of the other airports;
- **2 x 2 x 2 Runways** – additional runways are added at Gatwick and at Stansted but no additional runway is built at Heathrow. This results in a 2 x 2 x 2 runway distribution at London's largest airports.

2.4 We have based our analysis on the routes currently offered at each of the airports then cascaded traffic when an airport reaches constraint. Given the limitations on this analysis in terms of time and data availability, we have not built a full traffic allocation model which takes into account the surface access to each of the airports and the nature of local demand, which could influence how route networks develop in practice at each airport, including the hub. Hence, our analysis is not location specific and, except for the specifically designated hub airport, there may be a certain amount of interchangeability in terms of how route networks might develop across the non-hub airports.

2.5 The analysis has sought to develop a weekly schedule for each of the airports for each scenario and as a consequence the capacity of each airport has been considered in terms of weekly movements. The estimated capacity of each airport currently and in expanded form is shown in **Table 1.1**.

Table 1.1: Assumed Airport Weekly Movement Capacity

	Maximum Use	Expanded
Heathrow /4 Runway Hub	4,850	9,500
Gatwick	2,700	4,500
Stansted	2,150	4,500
Luton	1,350	n/a
London City	1,150	n/a

Source: York Aviation.

2.6 It should be noted that in relation to Gatwick and, to a lesser extent, Stansted, some small allowance has been made for charter traffic that does not appear in current OAG schedules over and above the limits described above. We do not believe this do be material to our analysis.

Key Data and Intelligence Sources

2.7 The evidence base from which we have drawn our analysis is extensive. However, ultimately, it should be recognised that an exercise of this nature is speculative. It is simply not possible to forecast route development out to 2050 with a significant degree of confidence. What we have sought to do is use the existing evidence in relation to current travel patterns combined with views on future growth and the shape of the world economy in a systematic way to produce a reasoned route network. This is clearly not perfect but provides a defensible position. We also believe this to be relatively conservative in terms of new destinations.

2.8 The key data and intelligence sources used for this analysis include:

- the CAA Passenger Survey 2012 provides information on existing passenger flows from the London airports, particularly in terms of final destinations, patterns of hubbing currently and the extent to which transfer passengers support frequency levels on different routes;

- the OAG Schedules Analyser has been for a number of purposes in the analysis. It provides the baseline for each London airport for a typical week in Summer 2013 in terms of destinations and frequencies for scheduled services and for a significant proportion of charter services. It has also been used to examine current network gaps from London compared to the other major hub airports in Europe (including Madrid) and in the Middle East. This provides some insight in to destinations that might be particularly likely to be served in the future. It should be noted that OAG data is not perfect and hence there may be small anomalies in current schedules. We do not believe these to be material in the overall context of the analysis;

- the DfT Aviation Forecasts 2013 provide demand growth rates through to 2050 by broad world area. These forecasts have been used as an underlying base for considering growth in passenger flows. As previously discussed with TfL, our general view is that the world zones used by DfT are too coarse for detailed route level analysis. However, as these are the basis for much of the other work being undertaken, growth within this overall framework has been used to provide consistency. We have, however, adjusted individual country level or city level growth rates to reflect the potential for faster growth in some markets. However, this is a zero sum game. If one country grows faster than the average for a world area, another must grow more slowly than the average to compensate;

- the McKinsey Global Institute (MGI) Urban World database provides projections in terms of country and city GDP growth through to 2025. This information provides a basis for adjusting underlying traffic growth rates. It also provides information on the world's most dynamic and fast growing cities and a ranking of the largest cities in 2050. This information has been used to provide additional evidence for the potential for services to currently unserved cities. While the time horizon for this assessment is only 2025, we believe it provides a reasonable basis for considering changing patterns of world economic geography;

- *Which are the largest city economies in the world and how might this change by 2025?* was produced by PwC in November 2009. It is similar in nature to the MGI research and has been used in a similar way in our analysis, providing a second view on potential high growth cities;

- the *European Cities Monitor 2011* again provides information on cities that are likely to see significant expansion through company location decisions. The survey of senior decision makers includes questions around the global cities that companies are most likely to expand in to in coming years. This has been used in a similar way to the MGI and PwC research;

- the impact of constraint on route networks has been considered in terms of the value of individual slots to airlines in terms of overall contribution to network revenue. In order to derive this contribution, we have used a flight distance to yield curve developed using data published by the Association of European Airlines.

3 PASSENGER NETWORKS: OUR APPROACH

Introduction

3.1 Below, we have set out a step by step guide to how we have derived the passenger networks for each scenario. Initially, however, we have outlined a number of underlying principles that have informed our analysis.

Underlying Principles

3.2 At the outset it is important to understand the underlying principles and assumptions that are behind the analytical approach we have taken:

- **Grounded in Existing Flows** – as described above, articulating a route network at an airport in 2050 is a matter of speculation. However, in our view it is not sensible or possible to come to a reasoned view without reference to existing flows of traffic as a starting point, not least because these provide intelligence on the formation of the network now and current airline responses to the demand base. It would also seem reasonable to assume that, even where routes do not exist currently, some passenger flows will exist to many future new destinations now. We do not have perfect information on origins and destinations but the CAA Passenger Survey does provide a good source of intelligence on this, albeit that sample sizes at this level of disaggregation can be small;

- **Quantum of Demand is Defined** – this exercise is not intended to comment on the potential size of a new hub in terms of passenger demand but works within the parameters that have already been established using the DfT 2013 Aviation Forecasts. The growth of markets is therefore to some extent defined and while it is possible to make some grow faster, this has to result in others growing more slowly. It also does not take in to account any potential total boost derived from increased economic growth stemming from expanded connectivity. In other words, there is no assumption around a virtuous circle of growth;

- **Constraining Heathrow Means a Loss of Hub Function** – we have assumed that if Heathrow is not able to expand, its ability to function as a hub will decline and hence new services will be more reliant on point to point demand;

- **High 'Value' Services will Displace Low 'Value' Services** – in circumstances where constraints are applied to an airport, we have sought to develop a mechanism which replicates the way in which airlines behave in relation to the use of slots. Essentially, that they will prefer to retain services that are of high revenue value to them over those which are of lower value. This is consistent with what has been seen at Heathrow. 'Value' is defined by:
  - the fare that can be charged based on distance;
  - the number of passengers per movement;
  - the contribution of the individual to wider network in terms of transferring passengers, again related the distance of the onward sector;
  - the proportion of business passengers on the route.
- **A Cascade Dynamic will Operate in the London System** – in considering the impact of constraints on individual airports, we have assumed a simplified cascade hierarchy in London. Destinations pushed out of Heathrow initially move to Gatwick, while destinations pushed out of Gatwick then move to Stansted. This is clearly a simplified version of reality but without developing a detailed allocation model by reference to the location of underlying demand, it is the only practical option. It should be noted that this does result in some interplay between the networks at Gatwick and Stansted, whereby some high value destinations get 'stuck' in Gatwick when in reality the frequency is likely to be split between the two airports. Examples of this include services to Middle East hubs or New York services. We believe that, however, in aggregate the picture is reasonable;

- **Sheer Economic Size in itself is not a Guarantee of a New Service** – most commentators expect there to be a significant number of new very large and large cities in the world by 2050. China in particular is expected to experience significant growth in both the number and size of major urban centres. However, we do not believe it is sensible to assume that all these cities will be served simply because they reach a particular economic threshold. With long haul air travel likely to remain dominated by hub and spoke models of airline behaviour, it seems reasonable to assume that airlines will either focus on serving cities that act as hubs or they will seek to serve cities that are at the heart of a geographic cluster. Simply put, operating a smaller number of routes with larger aircraft is more profitable for the airline. In undertaking our analysis, we have therefore made some allowance for the geographic characteristics of the end destinations, so that new destinations that are in close proximity will not all be served. Again, it should be remembered that this is speculative and in some cases while we have picked one city in a cluster, it is quite possible that a new service may in fact focus on a different city in that cluster.

Step by Step Methodology

3.3 The simplest way to understand the approach that we have taken to defining the route networks for the London airports is via a step by step description.

- **Step 1: Identify the Size of Origin & Final Destination Flows** – using CAA Passenger Survey 2012, we have identified the number of passengers travelling between the London airports and each ultimate destination;

- **Step 2: Identify if Each Market is Currently Served** – using OAG schedules data for a Summer 2013 week, we have identified which of these markets are currently served and which are not;

- **Step 3: Allocate Country Markets to DfT World Zones and Identify Underlying Growth Rates** – the DfT forecasts consider the world in terms of five zones, domestic, Europe, OECD, Less Developed Countries and Newly Industrialised Countries. Each zone has a growth rate defined by an econometric analysis;

- **Step 4: Adjust Country Growth Rates Using MGI GDP Forecasts** – where a country's GDP is forecast to grow faster or slower than the average of for its world zone, the traffic growth rate is adjusted up or down proportionally to reflect this. This is intended to counteract the coarseness within the DfT forecast zones and allow for more growth to faster growing countries;

- **Step 5: Grow each Origin and Destination Market Forward on the Basis of the Adjusted Country Growth Rate**;

- **Step 6: Adjust City Growth Rates within Countries using MGI or PwC** – in some countries individual cities are expected to grow significantly faster than others in GDP terms. These might be expected to generate more air traffic. We have again adjusted individual traffic market growth rates within countries to allow for this process using the MGI or PwC forecasts. Again, those growing faster than average are adjusted up, those below average are adjusted down;

- **Step 7: Grow each Origin and Destination Market Forward on the Basis of the Adjusted City Growth Rate**;

- **Step 8: Apply Qualitative Demand Uplifts** – our analysis recognises that the world will have changed substantially by 2050 and that even our adjustments to growth rates may not reflect fully these changes. Therefore, for currently unserved markets, two qualitative uplifts have been applied. An uplift to underlying demand of between 100% and 10% has been applied to the top 100 cities (note many are already served and are hence not eligible) in terms of total GDP growth between now and 2025 based on MGI and PwC. This is designed to reflect the potentially stimulatory effect of the existence of a service. A second uplift is applied based on whether or not the currently unserved destination is served via another European hub airport. This is designed to reflect the fact that overseas airlines will often enter Europe at a single point and then add more once the market is proven. Hence, the existence of a destination now elsewhere suggests that it is a likely contender for the future;

- **Step 9: Grow Existing Market Frequencies** – frequencies on existing markets are simply grown forward on the basis of the change in origin and destination demand. They are, however, adjusted downwards to allow for 0.5% per annum increase in aircraft size/load factor. A further adjustment is also made to domestic frequencies. A number of domestic services operate or have operated at high numbers of departures per day to facilitate hubbing at Heathrow and to support the needs of business travellers to London in particular. We have, however, assumed that ultimately the level of frequency on domestic services is finite and at some point airlines will start to substitute frequency for much larger aircraft, as further frequency will add little to transfer options and it is more economical to operate one flight rather than two. We have assumed that the maximum threshold for domestic services is 15 flights per day;

- **Step 10: Identify New Destination Frequencies Based on Market Size** – demand thresholds for new services have been identified based on:

  - a minimum level of service dependent on the type of destination. For Domestic services this is assumed to be 3 per day, European destinations 2 per day, OECD destinations (non European) 1 per day, Middle East 1 per day and other destinations 4 per week;

  - the existing level of demand required to support a service to the same country or the same world area;

  - an allowance for whether the London airport is a hub airport and hence able to attract transfer traffic. The level of the allowance is based on current performance in attracting transfer traffic to that country or world region.

  If an origin or destination service has demand in excess of this threshold, it is assumed to operate at a frequency pro-rata to the level of demand compared to the threshold;

- **Step 11: Add Additional New Destinations Based on High Growth Cities Data** – the underlying demand data is survey data and does not identify all current passenger flows, particularly at highly disaggregated levels. Equally, by 2050, the level of economic growth in some countries, notably China, is such that some new very large cities are likely to appear that are not currently identifiable destinations. Hence, we have used a regression analysis based on a distance related fare proxy, along with current city GDP taken from the MGI research, to develop a model that examines which of the top 200 cities by GDP in 2025 from MGI's research that are not currently served might be by 2050 and at what level of frequency. The strength of this relationship is reasonable (r2 of around 0.66) but it should be recognised that this approach is more speculative. Following the initial analysis, some manual adjustments have been made to allow for cities that are in reality in close geographic proximity and hence that are unlikely to be served separately. Where a city is identified as a new destination in both Step 10 and Step 11, the higher of the two frequencies identified is used;

- **Step 12: Adjust Existing Service Frequencies to Hubs for New Direct Services** – in the long run, we would expect the demand attracted to new services to be abstracted from existing hub services. Therefore, we then reduce frequency to existing hub services in line with frequencies on new services. This is done in line with current hubbing patterns in CAA Passenger Survey 2012 data. It should be noted that this does not change the quantum of frequencies offered in the market as a whole. The negative adjustments to services to hubs exactly equal the additional frequencies accounted for by services to new destinations, which may be a slight simplification;

- **Step 13: Calculate Unconstrained Route Network for Each London Airport** – this is based on the existing and new destinations described above;

- **Step 14: Calculate the 'Value' of Each Service to the Airline** – as described above, we have assumed that destinations and frequencies will be forced away from a constrained airport in line with the value of the service to airlines. For existing services this is calculated using AEA and CAA Passenger Survey data taking in to account the factors described above. For new services, this is based on characteristics for similar services, usually to the same country;

- **Step 15: Apply a First Round 'Shadow Cost'** – this cost is applied to the service value to identify a percentage reduction in frequency for each service until the total number of movements is equal to the constrained threshold described in Section 1 (clearly if the threshold is not breached at an airport no cost is applied). High value services will be affected much less than low value services because the shadow cost will be a much smaller percentage of the value. At Heathrow, the application of a 'shadow cost' also results in an assumed change in airline behaviour. It is assumed that in the long run airlines will no longer be prepared to operate relatively low frequency services as these are not likely to be as profitable as higher frequency services. Hence, ultimately, the airlines will focus more on denser routes. Evidence of this dynamic can already be seen at Heathrow, where the average number of frequencies per destination has been increasing for some time. We have assumed that by 2050 long haul routes will need to support a minimum of one departure per day, short haul services two departures a day and domestic services three departures per day;

- **Step 16: Cascade Lost Heathrow Services to Gatwick** – in circumstances where frequencies or destinations are lost at Heathrow due to constraint, these are cascaded initially to Gatwick under the following rules:

  - the 'value' of the service must be higher than the minimum value of a service at Gatwick;

  - where the destination lost from Heathrow or from which frequency is lost is served from Gatwick, the additional frequencies are simply added to the Gatwick network;

  - where the destination is not served from Gatwick a new service is started only if the level of frequency transferred is above the minimum threshold for a new service of that type (see Step 10 for minimum thresholds);

  - the number of frequencies cascaded from Gatwick is adjusted downward by the proportion of hub passengers on the relevant route. This is designed to reflect the fact that some of the frequency of service observed at Heathrow is supported by the functioning of the Heathrow hub. If the service moves to another airport that does not operate as a hub, these hub passengers and, hence, the corresponding level of frequency will be lost.

- **Step 17: Apply Second Shadow Cost at Gatwick** – if the cascaded frequencies from Heathrow result in Gatwick breaching its capacity threshold a further shadow cost is applied at Gatwick in the same way as before to balance demand and capacity;

- **Step 18: Cascade Lost Gatwick Services to Stansted** – in circumstances where frequencies or destinations are lost at Gatwick due to constraint, these are cascaded to Stansted under the following rules:

  - the 'value' of the service must be higher than the minimum value of a service at Stansted;

  - where the destination lost from Heathrow or from which frequency is lost is served from Stansted, the additional frequencies are simply added to the Stansted network;

  - where the destination is not served from Stansted a new service is started only if the level of frequency transferred is above the minimum threshold for a new service of that type.

- **Step 19: Apply Second Shadow Cost at Stansted** – if the cascaded frequencies from Heathrow result in Stansted breaching its capacity threshold a further shadow cost is applied at Stansted in the same way as before to balance demand and capacity. No onward cascade from Stansted is assumed as both London City and Luton are full in all scenarios and services lost are likely to be of low value;

- **Step 20: Manually Adjust for Domestic Services in Unconstrained 4 Runway Hub** – the complete loss of some domestic services to Heathrow over recent years means that the model is not able to effectively add these back in an unconstrained world. We have, therefore, added in a small number of domestic hub feeder services in this specific scenario. We have considered a number of routes and the likely way in which the market might develop over the coming decades. We have assumed that HS2 will be delivered and that this will assist in providing fast, direct access to Heathrow or an alternative hub airport. This will reduce the likelihood of services being offered from most currently unserved points in England. We have, however, assumed additional services from Newquay and Durham Tees Valley. We considered a number of other points within England, including Humberside, Doncaster Sheffield and Liverpool. We believe that all are either too close to existing services and that airlines will serve these markets via other airports or that HS2 will undermine any potential for a service. In Scotland, we have included services to Dundee and Inverness as both appear to be sufficiently remote from other options, have reasonable demand bases and will be unaffected by HS2. In Northern Ireland, we have added City of Derry Airport. We believe this to be a marginal case given the proximity to the Belfast airports, but we have erred on the side of optimism, albeit that we have assigned a lower frequency to this route. Finally, we have assumed that services to Jersey, Guernsey and the Isle of Man also come forward in an unconstrained environment;

- **Step 21: Manually Adjust for Additional European Services in Unconstrained 4 Runway Hub** – in recent years Heathrow's European network has been eroded. Demand has switched to other airports and particularly to low fares airlines offering services at other airports. In an unconstrained hub scenario it would seem reasonable to suggest that there will be a cascade of some of these services back to the hub, particularly as the other airports in the London system become constrained over time. This process is likely to include a number of smaller capital cities, secondary cities and major leisure destinations. In addition, there are a number of cities in Eastern Europe that have high percentage business flows now but where the overall flows are currently very small that are expected to be economically important in the future. Working from a long list of such potential destinations, we have added a number of additional European destinations to the Hub that it would seem reasonable to expect to develop based on three key criteria:

- if the business traffic percentage on the route is expected to be higher than 15% and the combination of implied but unrealised frequency at the hub plus half[1] the frequency forced out of other London airports is greater than seven per week;

- the business component of the current flow is more than 25% of traffic;

- the total frequencies offered across the other London airports is in excess of 50 per week and more than seven frequencies per week have been forced out of the other London airports. This is designed to identify major leisure markets, for instance Malaga, that we would expect to be served from most airports to service a local demand base.

These services are assumed to operate at either seven or 14 frequencies per week depending on the level of implied but unrealised frequency and the number of frequencies forced out of other London airports by capacity constraints. This process results in a total of 28 additional European destinations being added to the hub in the Four Runway Hub Scenario.

✈ **Step 22: Calculate Final Constrained Route Networks**.

[1] This is designed to reflect that a significant proportion of the frequency elsewhere may be being supported by low fares that will not necessarily be achievable at the hub.

4 RESULTS AND BRIEF COMMENTARY

4.1 **Table 4.1** shows the numbers of destinations served across the London airports and the total level of weekly frequency. In addition, the same information is shown for Heathrow or a Replacement Four Runway Hub Airport in each scenario.

Table 4.1: Destinations & Total Weekly Frequencies by Scenario

		2013	Maximum Use		2 x 2 x 2		4 Runway Hub	
			No.	+/- %	No.	+/- %	No.	+/- %
LHR /	Dests.	171	140	-18%	140	-18%	299	75%
New Hub	Frqs.	4,714	4,850	3%	4,850	3%	9,226	96%
Total	Dests.	385	322	-16%	358	-7%	435	13%
London	Frqs.	10,133	12,201	20%	15,598	54%	299	75%

4.2 This shows the substantial benefits associated with the development of a 4 runway hub compared to the other options. The expansion allows a significant increase in the numbers of new destinations served both at the Airport itself and across the London system. The 2 x 2 x 2 scenario limits the damage to London's overall route network compared to now and allows a substantial increase in the total number of frequencies. A failure to build any new runways results in significant erosion of London's connectivity compared to now in terms of destinations served.

4.3 A more detailed analysis of the impact of different scenarios on London's connectivity is shown in **Table 4.2**. This shows the number of destinations served and the level of frequency offered by destination world zone.

4.4 This shows the importance of a four runway hub in connecting London to increasingly influential long haul destinations, enabling both more destinations to come on stream and greater frequency. It is particularly beneficial in terms of destinations in Asia and Latin America. It also allows continued expansion of London's already strong links with North America. From an economic impact perspective, it is important to remember that while the BRICs and other emerging markets are becoming more important, the United States is also expected to continue to grow rapidly and will be a key international partner.

4.5 Short haul destinations decline in all scenarios. This is because all scenarios assume some capacity constraints and consequently some leisure focussed, low frequency, low value destinations are lost from Gatwick, Stansted and Luton particularly. There is potential for some of these to move in to an expanded hub airport, and we have adjusted for this in our analysis, but equally they many may simply be serving specific local demand bases that are not likely to move but rather simply switch to a destination that is being served from the local airport. Therefore, we believe that are analysis gives a good view of the potential coverage of economically important destinations but that there may be some trade-offs in terms of short haul leisure destinations that could increase the breadth of the network slightly.

Table 4.2: Destinations & Frequencies by World Zone (All London Airports)

	Summer 2013		Maximum Use 2050		2 x 2 x 2 2050		4 Runway Hub	
	Dests	Frqs.	Dests	Frqs.	Dests	Frqs.	Dests	Frqs.
Africa : Central/Western Africa	6	48	6	97	6	102	9	150
Africa : Eastern Africa	5	33	3	46	3	46	7	73
Africa : North Africa	17	150	12	224	14	262	14	274
Africa : Southern Africa	5	51	2	70	2	70	6	96
Asia : Central Asia	3	9	1	5	2	11	5	29
Asia : North East Asia	12	239	16	383	16	412	31	547
Asia : South Asia	11	131	15	299	15	301	23	406
Asia : South East Asia	6	94	4	135	4	135	11	195
Latin America : Caribbean	14	62	7	53	12	81	16	126
Latin America : Central America	2	21	2	29	2	30	7	65
Latin America : Lower South America	3	31	5	57	5	57	8	98
Latin America : Upper South America	0	0	0	0	0	0	5	45
Middle East	12	323	12	447	12	449	15	477
North America	33	882	33	1,336	33	1,345	45	1,560
Southwest Pacific	3	35	5	79	5	79	5	92
Europe : Eastern/Central Europe	51	720	43	1,298	46	1,689	52	1,710
Europe : Western Europe	187	6,095	143	6,750	167	9,029	159	9,067
Domestic	15	1,209	13	893	14	1,500	17	1,566
Total	**385**	**10,133**	**322**	**12,201**	**358**	**15,598**	**435**	**16,576**

4.6 The primary purpose of this exercise was not to forecast the number of passengers that might use a new hub airport or an expanded Heathrow or to identify the utilisation of capacity at a new hub. However, we estimate that in broad terms weekly frequency capacity at a new four runway hub would be between 9,000 and 10,000 movements. By 2050, our route network is at the bottom end of that threshold. In terms of passenger demand, we have worked primarily within the confines of the DfT unconstrained forecasts for demand growth. The model developed does not provide a precise answer as to anticipated demand given the various uplifts and manual adjustments to destinations and frequencies. However, we assess that the route network and levels of frequency are reflective of an airport handling around 170 million passengers a year. This is in line with DfT forecasts for an unconstrained Heathrow.

4.7 The detailed results of our analysis are primarily set out in the accompanying spreadsheets as the sheer quantity of data is not conducive to effective display in a Word document. However, we have set out overleaf in **Table 4.3** the destinations and frequencies by country and in **Table 4.4** the destinations served and the level of frequency by route from all London airports under each scenario, now and in 2050.

4.8 We would highlight a number of points in relation to the analysis:

- focussing on emerging markets as an area of particular interest, there are a number of points to be made:
  - routes to China increase in all scenarios as they are, ultimately, of high value to the airlines. However, the expansion of Heathrow or the delivery of an alternate four runway hub enables airlines to consolidate demand on one point, innovate and operate more flexibly, resulting in a significantly larger number of destinations being served in this scenario (14). Maximum Use and 2 x 2 x 2 are only able to deliver a total of six destinations;
  - the number of destinations served within Russia remains constant across all scenarios but the level of frequency of service is higher in the Four Runway Hub scenario;

- India sees growth in the number of destinations served in all scenarios, going from five across London currently to eight in the Maximum Use and 2 x 2 x 2 scenarios and 12 in the Four Runway Hub scenario. Again, overall frequencies are substantially higher in the Four Runway Hub Scenario. This expansion of destinations reflects greater existing passenger flows combined with high economic growth potential;

- Brazil sees the addition of four new destinations in the Four Runway Hub scenario. Maximum Use and 2 x 2 x 2 Runways both result in one additional destination, with airlines mainly focussing on the major gateway airports in Sao Paulo and Rio de Janeiro;

- in general across other emerging markets, the new hub airport is important in supporting higher levels of frequency and bringing on stream more marginal destinations.

✈ perhaps the most significant other gains in terms of new long haul connections are actually expected to come in terms of the United States. The Four Runway Hub scenario has 11 additional destinations served by 2050, compared to only one additional destination in the Maximum Use and 2 x 2 x 2 scenarios. This highlights the effectiveness of London as a hub for North America given its geographic position. Clearly, capacity concentrated on a new Hub airport or an expanded Heathrow is able to exploit this position.

Table 4.3: Destinations & Frequencies by Country

	Summer 2013		Maximum Use 2050		2 x 2 x 2 2050		4 Runway Hub 2050	
COUNTRY	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.
Afghanistan	0	0	1	6	1	7	2	15
Albania	1	7	1	7	1	14	1	10
Algeria	2	14	1	15	1	19	1	14
Angola	1	2	0	0	0	0	1	6
Antigua & Barbuda	1	7	0	0	1	5	1	4
Argentina	1	7	1	11	1	11	1	13
Armenia	0	0	0	0	0	0	1	8
Aruba	1	1	0	0	0	0	0	0
Australia	2	28	4	64	4	64	4	77
Austria	5	78	2	89	5	111	3	117
Azerbaijan	1	12	0	0	0	0	1	24
Bahamas	1	5	0	0	0	0	1	7
Bahrain	1	21	1	21	1	21	1	22
Bangladesh	1	3	0	0	0	0	2	9
Barbados	1	14	1	7	1	7	1	8
Belarus	1	4	0	0	1	7	0	0
Belgium	2	92	2	75	2	95	2	149
Bermuda	1	7	1	9	1	10	1	10
Bosnia Herzegovina	0	0	0	0	0	0	1	7
Brazil	2	24	3	38	3	38	6	69
Brunei Darussalam	1	6	0	0	0	0	1	5
Bulgaria	4	50	3	78	4	91	4	90
Canada	8	153	7	207	7	209	9	252
Cape Verde	2	3	1	4	1	4	1	5
Cayman Islands	0	0	0	0	0	0	1	14
Chile	0	0	1	8	1	8	1	16
China	3	43	6	112	6	112	14	192
Colombia	0	0	0	0	0	0	2	19
Congo	0	0	0	0	0	0	1	8
Costa Rica	0	0	0	0	0	0	1	7
Cote D'Ivoire	0	0	0	0	0	0	1	10
Croatia	6	70	5	129	5	173	6	163
Cuba	3	4	0	0	0	0	0	0
Cyprus	2	81	3	147	3	165	3	158
Czech Republic	3	71	3	123	3	173	3	175

Table 4.3: Destinations & Frequencies by Country

COUNTRY	Summer 2013		Maximum Use 2050		2 x 2 x 2 2050		4 Runway Hub 2050	
	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.
Denmark	4	169	3	200	4	278	3	273
Dominican Republic	2	5	1	6	2	11	2	16
Ecuador	0	0	0	0	0	0	1	4
Egypt	6	58	5	92	5	98	5	107
Estonia	1	8	1	31	1	40	1	48
Ethiopia	1	6	1	11	1	11	1	11
Faroe Islands	1	2	0	0	0	0	0	0
Finland	2	58	2	129	2	126	2	136
France	35	594	18	484	27	737	22	744
Gambia	0	0	1	7	1	7	1	8
Georgia	0	0	0	0	0	0	1	10
Germany	21	801	14	613	20	1,061	21	1,140
Ghana	1	12	1	30	1	30	1	35
Gibraltar	1	25	1	24	1	30	1	39
Greece	17	227	11	256	11	322	12	286
Grenada	0	0	1	7	1	8	1	8
Hong Kong	1	56	1	69	1	72	1	54
Hungary	2	76	2	162	2	191	2	188
Iceland	1	34	1	79	1	95	1	87
India	5	102	9	247	9	248	12	310
Indonesia	0	0	0	0	0	0	2	14
Iran	1	3	0	0	0	0	1	5
Iraq	0	0	1	7	1	7	2	22
Ireland	5	447	5	419	5	694	5	667
Israel	1	51	1	74	1	74	1	84
Italy	28	681	26	625	28	902	26	866
Jamaica	2	8	1	6	2	11	2	16
Japan	2	33	3	61	3	61	5	103
Jordan	1	21	1	28	1	28	1	27
Kazakhstan	1	5	1	5	1	6	1	9
Kenya	2	17	1	23	1	23	2	30
Korea, Republic Of (South)	1	23	1	27	1	27	2	27
Kuwait	1	14	1	22	1	22	1	24
Kyrgyzstan	0	0	0	0	0	0	1	4
Latvia	1	27	1	38	1	49	1	48

Table 4.3: Destinations & Frequencies by Country

	Summer 2013		Maximum Use 2050		2 x 2 x 2 2050		4 Runway Hub 2050	
COUNTRY	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.
Lebanon	1	17	1	22	1	22	1	30
Libyan Arab Jamahiriya	1	5	0	0	0	0	1	8
Lithuania	2	37	2	73	2	86	2	82
Luxembourg	1	57	1	91	1	107	1	128
Macedonia	1	5	1	13	1	13	1	13
Malaysia	1	14	1	17	1	17	1	16
Maldives	1	4	1	11	1	11	1	16
Malta	1	45	1	109	1	120	1	118
Mauritius	1	7	1	12	1	12	1	13
Mexico	2	21	2	29	2	30	5	53
Moldova Republic of	1	2	1	6	1	11	1	7
Montenegro	2	3	0	0	0	0	0	0
Morocco	5	49	4	90	5	108	4	103
Nepal	0	0	1	8	1	8	1	15
Netherlands	4	387	2	443	4	592	4	565
New Zealand	1	7	1	15	1	15	1	15
Nigeria	2	28	2	46	2	50	3	67
Norway	10	197	7	173	8	282	7	327
Oman	1	7	1	9	1	9	1	11
Pakistan	3	10	2	9	2	9	4	22
Panama	0	0	0	0	0	0	1	5
Peru	0	0	0	0	0	0	1	13
Philippines	0	0	1	18	1	18	2	37
Poland	12	213	12	445	12	602	12	568
Portugal & Madeira	6	229	4	271	4	308	4	328
Qatar	1	35	1	82	1	83	1	71
Romania	7	63	6	80	6	80	7	106
Russian Federation	4	77	4	104	4	130	7	155
Saudi Arabia	2	28	2	51	2	51	3	73
Serbia	2	17	1	24	1	32	2	42
Sierra Leone	1	5	1	10	1	11	1	17
Singapore	1	42	1	55	1	55	1	55
Slovakia	1	16	1	29	1	44	1	32
Slovenia	1	10	1	15	1	26	1	17

Table 4.3: Destinations & Frequencies by Country

COUNTRY	Summer 2013		Maximum Use 2050		2 x 2 x 2 2050		4 Runway Hub 2050	
	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.	Dests.	Frqs.
South Africa	2	44	2	70	2	70	3	80
Spain	25	1,129	23	1,395	23	1,657	24	1,544
Sri Lanka	1	12	1	18	1	18	1	19
St. Kitts And Nevis	0	0	1	8	1	8	1	9
St. Lucia	1	8	1	10	1	12	1	12
Sudan	0	0	0	0	1	4	1	14
Sweden	6	161	6	249	6	303	6	299
Switzerland	4	387	4	357	4	468	4	549
Taiwan	1	7	1	10	1	10	2	16
Tajikistan	0	0	0	0	0	0	1	7
Tanzania	0	0	0	0	0	0	2	17
Thailand	1	28	1	45	1	45	2	54
Trinidad & Tobago	1	3	0	0	2	9	2	8
Tunisia	3	24	2	27	2	33	2	28
Turkey	6	214	7	522	7	576	7	547
Turkmenistan	1	2	0	0	1	5	1	5
Turks & Caicos Islands	0	0	0	0	0	0	1	7
Uganda	1	3	0	0	0	0	1	2
Ukraine	2	29	2	45	3	57	3	72
United Arab Emirates	2	126	2	131	2	132	2	108
United Kingdom	15	1,209	13	893	14	1,500	17	1,566
United States	25	729	26	1,129	26	1,136	36	1,308
Uzbekistan	1	2	0	0	0	0	1	4
Venezuela	0	0	0	0	0	0	1	9
Vietnam	2	4	0	0	0	0	2	14
Virgin Islands (U.S.)	0	0	0	0	0	0	1	7
Zambia	1	3	0	0	0	0	1	5
Zimbabwe	1	2	0	0	0	0	1	5
Grand Total	**385**	**10,133**	**322**	**12,201**	**358**	**15,598**	**435**	**16,576**

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
Afghanistan	Kabul	0	6	7	10
	Kandahar	0	0	0	5
Albania	Tirana	7	7	14	10
Algeria	Algiers(Dar El Beida)	12	15	19	14
	Hassi Messaoud(Oued Irara	2	0	0	0
Angola	Luanda	2	0	0	6
Antigua & Barbuda	Antigua (V.C. Bird Intl)	7	0	5	4
Argentina	Buenos Aires(Ezeiza)	7	11	11	13
Armenia	Yerevan	0	0	0	8
Aruba	Aruba Reina Beatrix	1	0	0	0
Australia	Brisbane	0	9	9	12
	Melbourne(Tullamarine Int	7	11	11	13
	Perth	0	10	10	14
	Sydney(Kingsford Smith)	21	34	34	38
Austria	Graz	0	0	0	7
	Innsbruck	3	0	4	0
	Klagenfurt	3	0	6	0
	Linz	3	0	6	0
	Salzburg	9	9	17	12
	Vienna (Schwechat)	60	80	78	98
Azerbaijan	Baku, Heydar Aliyev International Airport	12	0	0	24
Bahamas	Nassau	5	0	0	7
Bahrain	Bahrain	21	21	21	22
Bangladesh	Chittagong(Patenga)	0	0	0	5
	Dacca (Zia International)	3	0	0	4
Barbados	Bridgetown	14	7	7	8
Belarus	Minsk By	4	0	7	0
Belgium	Antwerp (Deurne)	26	38	38	38
	Brussels (National)	66	37	57	111
Bermuda	Bermuda-Hamilton(Kindley	7	9	10	10
Bosnia Herzegovina	Sarajevo	0	0	0	7
Brazil	Brasilia	0	7	7	13
	Belo Horizonte	0	0	0	10
	Rio De Janeiro(Galeao)	10	14	14	18
	Sao Paulo International Br	14	17	17	14

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Porto Alegre Br	0	0	0	5
	Salvador	0	0	0	9
Brunei Darussalam	Bandar Seri Begawan	6	0	0	5
Bulgaria	Bourgas	12	19	20	20
	Plovdiv	3	0	6	4
	Sofia	30	52	58	59
	Varna	5	7	7	7
Canada	Edmonton International	8	10	10	12
	Halifax(Shearwater)	8	9	9	12
	Ottawa International	8	9	9	12
	Montreal (Dorval)	15	20	20	23
	Vancouver	28	43	43	46
	Winnipeg	0	0	0	11
	Calgary	17	24	24	27
	St Johns	7	0	0	12
	Toronto	62	92	94	97
Cape Verde	Boa Vista Rabil	2	4	4	5
	Ilha Do Sal(Sal Island)C.	1	0	0	0
Cayman Islands	Grand Cayman	0	0	0	14
Chile	Santiago De Chile	0	8	8	16
China	Guangzhou	7	14	14	14
	Chongqing Cn	0	9	9	17
	Chengdu Cn	0	0	0	10
	Dalian	0	0	0	5
	Hangzhou	0	0	0	10
	Nanking/Nanjing	0	0	0	10
	Beijing/Peking	18	35	35	32
	Shanghai	18	37	37	39
	Shenyang	0	0	0	8
	Shenzhen Cn	0	10	10	18
	Jinan	0	0	0	4
	Urumqi	0	0	0	4
	Wuhan	0	7	7	14
	Xi An Xianyang	0	0	0	7
Colombia	Bogota	0	0	0	12
	Medellin	0	0	0	7

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
Congo	Kinshasa N'Djili Cd	0	0	0	8
Costa Rica	San Jose Cr	0	0	0	7
Cote D'Ivoire	Abidjan(Port Bouet)	0	0	0	10
Croatia	Dubrovnik	22	46	62	51
	Pula	4	7	12	8
	Rijeka	1	0	0	5
	Split	21	42	56	48
	Zadar Yu	3	4	8	5
	Zagreb	19	30	35	46
Cuba	Havana	2	0	0	0
	Holguin Cu	1	0	0	0
	Varadero Cu	1	0	0	0
Cyprus	Ercan Cyprus	0	11	16	12
	Larnaca	41	66	71	74
	Paphos	40	70	78	72
Czech Republic	Brno Turany	10	18	27	19
	Ostrava	3	8	16	9
	Prague	58	97	130	147
Denmark	Aalborg	3	0	4	0
	Aarhus (Tirstrup) (Rdanaf	7	8	14	9
	Billund	25	28	45	45
	Copenhagen (Kastrup)	134	164	215	219
Dominican Republic	Puerto Plata	2	0	5	4
	Punta Cana	3	6	6	12
Ecuador	Quito	0	0	0	4
Egypt	Cairo Eg	21	23	23	22
	Borg El Arab	0	9	9	19
	Hurghada	6	9	10	10
	Luxor	4	5	6	6
	Marsa Allam	1	0	0	0
	Sharm El Sheikh Eg	25	46	50	50
	Taba	1	0	0	0
Estonia	Tallinn	8	31	40	48
Ethiopia	Addis Ababa(Bole Int.)	6	11	11	11
Faroe Islands	Faroe Islands	2	0	0	0
Finland	Helsinki	55	125	118	131

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Tampere	3	4	8	5
France	Ajaccio (Campodell'Oro)	1	0	0	0
	Angers	2	0	0	0
	Avignon (Caumont)	1	0	0	0
	Brest Fr	2	0	0	0
	Bastia (Poretta)	2	0	0	0
	Biarritz	10	15	27	19
	Bordeaux (Merignac)	29	18	31	37
	Brive La Gaillarde	2	0	0	0
	Beziers (Vias)	4	5	5	5
	Carcassonne	7	5	11	6
	Paris - Charles De Gaulle	111	116	119	141
	Chambery (Aix Les Bains)	3	0	0	4
	Dole	2	4	11	5
	Dinard (Pleurtuit/St Malo	6	0	9	0
	Deauville (St Gatien)	2	0	0	0
	Bergerac	8	7	16	9
	Nimes (Garnons)	7	9	9	9
	Grenoble (St Geoirs)	0	22	28	25
	Tarbes - Ossun(Lourdes)	2	0	3	0
	Limoges (Bellegarde)	7	0	11	5
	La Rochelle (Laleu)	7	0	11	5
	Lyon	47	34	56	60
	Montpellier (Frejorgues)	14	10	15	13
	Marseille	39	17	44	53
	Nice	135	117	168	172
	Nantes(Chateau Bougon)	10	10	10	10
	Paris-Orly	61	61	61	90
	Perpignan (Rivesaltes)	5	0	8	4
	Poitiers (Biard)	4	0	6	0
	Pau (Pont-Long-Uzein)	3	4	4	4
	Rodez (Marcillac)	4	0	6	0
	Strasbourg	3	6	16	8
	Strasbourg (Entzheim)	0	0	0	14
	Toulon (St Mandrier)	5	0	5	0
	Toulouse (Blagnac)	43	24	41	46

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Tours (St Symphorien)	4	0	6	0
	Quimper	2	0	0	0
Gambia	Banjul(Yundum Internation	0	7	7	8
Georgia	Tbilisi	0	0	0	10
Germany	Bremen	12	6	20	15
	Cologne (Bonn)	46	0	71	36
	Dresden	6	9	9	23
	Dortmund (Wickede)	12	17	17	17
	Dusseldorf	98	22	103	119
	Friedrichshafen (Loewenta	3	0	0	4
	Karlsruhe	7	0	12	5
	Memmingen - Allgäu	7	4	12	5
	Munster (Osnabruck)	7	10	10	10
	Frankfurt Main	174	201	247	260
	Hannover (Lagenhagen)	33	0	20	41
	Hamburg (Fuhlsbuttel)	72	44	67	108
	Hahn Airbase	16	6	27	9
	Leipzig	5	0	8	7
	Munich	122	130	157	178
	Niederrhein	14	0	24	5
	Nuremburg	18	31	56	53
	Paderborn/Lippstadt	6	32	32	32
	Stuttgart De	38	0	35	54
	Berlin (Schonefeld)	46	54	75	60
	Berlin - Tegel	59	47	59	99
Ghana	Accra(Kotoka)	12	30	30	35
Gibraltar	Gibraltar	25	24	30	39
Greece	Athens Gr	55	73	75	82
	Corfu	32	42	48	44
	Chania	8	6	12	7
	Kefallinia(Argostolion)	15	18	22	19
	Heraklion	29	29	44	33
	Mikonos	8	15	17	16
	Skiathos Gr	3	0	0	4
	Thira	7	5	8	7
	Kos	14	13	22	15

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Kalamata	3	0	0	0
	Kavala	1	0	0	0
	Lemnos Gr	1	0	0	0
	Preveza/Levkas	2	0	0	0
	Rhodes	18	22	26	23
	Thessaloniki/Salonika	14	20	25	21
	Samos	1	0	0	0
	Zakinthos Is. Zante	16	13	23	15
Grenada	Grenada (Point Saline Int	0	7	8	8
Hong Kong	Hong Kong(Kai Tak)	56	69	72	54
Hungary	Budapest	71	149	178	175
	Debrecen	5	13	13	13
Iceland	Keflavik	34	79	95	87
India	Ahmedabad	0	7	7	14
	Amritsar(Rajah Sansi)	0	0	0	21
	Bhuj	0	0	0	5
	Bangalore	7	15	15	17
	Bombay	42	87	88	82
	Calcutta	0	9	9	17
	Cochin	0	11	11	21
	Delhi	42	88	88	83
	Goa	0	7	7	17
	Hyderabad(Begumpet)	6	13	13	15
	Chennai In (Madras)	5	10	10	12
	Trivandrum	0	0	0	6
Indonesia	Jakarta-Soekarno-Hatta In	0	0	0	7
	Bali International	0	0	0	7
Iran	Khomeini International	3	0	0	5
Iraq	Baghdad Al Muthana	0	7	7	14
	Erbil International Airport Erbil, Erbil Internati	0	0	0	8
Ireland	Dublin	317	309	486	490
	Kerry County (Killarney)	14	11	24	16
	Connaught (Knock)	23	22	41	26
	Cork	51	45	78	75
	Shannon	42	32	65	60
Israel	Tel Aviv	51	74	74	84

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
Italy	Alghero/Sasari (Fertilia)	7	5	8	5
	Ancona (Falconara) It	8	8	12	8
	Brindisi	4	4	6	4
	Bergamo	21	21	33	23
	Bologna	35	37	48	48
	Bari	11	12	17	13
	Cagliari (Elmas)Sardinia	7	6	11	6
	Rome (Ciampino)	21	20	33	22
	Catania (Fontanarosso)	14	10	16	13
	Rome (Fiumicino)	117	138	153	162
	Florence It	13	16	24	24
	Genoa	13	11	20	14
	Milan (Linate)	95	69	96	135
	Milan (Malpensa)	60	22	61	59
	Naples	39	42	61	62
	Olbia (Costa Smeralda)Sar	11	17	20	19
	Perugia	5	4	8	4
	Parma	3	0	5	0
	Palermo	12	13	19	14
	Pisa	62	57	87	76
	Pescara (Ital)	5	4	8	5
	Lamezia-Terme	4	0	6	0
	Trapani (Birgi)	3	4	4	4
	Turin (Caselle)	13	10	20	19
	Trieste (Ronci De Legiona	7	5	11	6
	Treviso (St Angelo)	7	5	11	6
	Venice (Marco Polo)	59	54	77	78
	Verona (Villafranca)	25	31	27	37
Jamaica	Kingston	3	0	5	4
	Montego Bay	5	6	6	12
Japan	Fukuoka	0	0	0	12
	Tokyo(Haneda)	5	0	0	4
	Osaka (Kansai Int)	0	26	26	45
	Nagoya(Komaki)	0	15	15	26
	Tokyo(Narita)	28	20	20	16
Jordan	Amman(Queen Alia Int'L)	21	28	28	27

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
Kazakhstan	Almaty Kz	5	5	6	9
Kenya	Mombasa(Port Reitz)	2	0	0	6
	Nairobi(Embakasi)	15	23	23	24
Korea, Republic Of (South)	Seoul (Incheon)	23	27	27	23
	Pusan	0	0	0	4
Kuwait	Kuwait	14	22	22	24
Kyrgyzstan	Bishkek	0	0	0	4
Latvia	Riga	27	38	49	48
Lebanon	Beirut	17	22	22	30
Libyan Arab Jamahiriya	Tripoli	5	0	0	8
Lithuania	Kaunas Lt	12	31	38	32
	Vilnius	25	42	48	50
Luxembourg	Luxembourg (Findel)	57	91	107	128
Macedonia	Skopje	5	13	13	13
Malaysia	Kuala Lumpur Internationa	14	17	17	16
Maldives	Male International	4	11	11	16
Malta	Malta Mt	45	109	120	118
Mauritius	Mauritius(Plaisance)	7	12	12	13
Mexico	Cancun	13	18	19	19
	Guadalajara	0	0	0	8
	Mexico City	8	11	11	12
	Monterrey Mx	0	0	0	9
	Puebla	0	0	0	5
Moldova Republic of	Chisinau	2	6	11	7
Montenegro	Titograd (Podgorica)	1	0	0	0
	Tivat	2	0	0	0
Morocco	Agadir(Inezgane)	7	10	13	12
	Casablanca Mohammed V Apt	13	34	38	34
	Fez(Saiss)	2	0	3	0
	Marrakesh(Menara)	23	38	44	46
	Tangier(Boukhalf)	4	8	10	11
Nepal	Kathmandu	0	8	8	15
Netherlands	Amsterdam-Schiphol	302	371	462	446
	Eindhoven (Rnethaf)	14	0	25	5
	Maastricht/Aachen	6	0	33	8

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Rotterdam	65	72	72	106
New Zealand	Auckland International	7	15	15	15
Nigeria	Abuja	7	11	11	14
	Lagos(Murtala Muhammed)	21	35	39	41
	Kano	0	0	0	12
Norway	Aalesund	2	0	0	0
	Bergen (Flesland)	32	27	40	50
	Haugesund (Karmoy)	3	0	6	0
	Kristiansand (Kjevik)	3	5	5	5
	Oslo (Fornebu)	85	79	107	142
	Rygge, NO	20	30	60	37
	Stavanger (Sola)	32	16	31	58
	Tromsoe (Langres)	2	0	0	0
	Trondheim (Vaernes)	5	4	7	20
	Torp (Oslo 75km)	13	12	26	15
Oman	Muscat	7	9	9	11
Pakistan	Islamabad (Rawalpindi)	4	5	5	6
	Karachi International	3	4	4	4
	Lahore	3	0	0	4
	Faisalabad	0	0	0	8
Panama	Panama City	0	0	0	5
Peru	Lima	0	0	0	13
Philippines	Cebu	0	0	0	5
	Manila	0	18	18	32
Poland	Bydgoszcz	7	11	20	12
	Gdansk	27	56	72	73
	Krakow	21	41	59	59
	Katowice (Pyrzowice)	28	57	74	60
	Lodz, Lodz Lublinek	10	19	27	20
	Lublin	6	22	32	24
	Poznan Pl	13	26	35	34
	Rzeszow	10	19	27	20
	Szczecin Goleniow	4	5	11	6
	Warsaw	51	88	104	138
	Warsaw Modlin Mazovia	21	73	101	78
	Wroclaw	15	28	40	44

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
Portugal & Madeira	Faro Pt	90	117	137	137
	Funchal	17	14	19	17
	Lisbon	87	103	100	119
	Porto (Pedras Rubras)	33	37	52	55
	Ponta Delgada	1	0	0	0
	Porto Santo	1	0	0	0
Qatar	Doha	35	82	83	71
Romania	Bucharest Baneasa	5	8	8	8
	Bacau	3	4	4	4
	Cluj Napoca	6	10	10	10
	Iasi	2	0	0	4
	Bucharest Otopeni	40	48	48	70
	Tirgu Mures	4	6	6	6
	Timisoara	3	4	4	4
Russian Federation	Moscow(Domodedovo)	35	50	57	59
	Nizhniy Novgorod Ru	0	0	0	7
	Kazan Ru	0	0	0	7
	St Petersburg	7	8	16	13
	Moscow (Sheremetyevo)	21	31	31	36
	Ekaterinburg	0	0	0	7
	Moscow(Vnukovo)	14	15	26	26
Saudi Arabia	Dammam	0	0	0	14
	Jeddah	14	29	29	31
	Riyadh	14	22	22	28
Serbia	Belgrade	15	24	32	35
	Pristina	2	0	0	7
Sierra Leone	Freetown Lungi International Apt	5	10	11	17
Singapore	Singapore(Changi Internat	42	55	55	55
Slovakia	Bratislava	16	29	44	32
Slovenia	Ljubljana	10	15	26	17
South Africa	Cape Town(Df Malan)	7	10	10	12
	Durban(Louis Botha)	0	0	0	7
	Johannesburg(Jan Smuts)	37	60	60	61
Spain	Lanzarote Arecife	27	38	41	38
	Malaga	138	191	211	211

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Alicante	103	143	158	148
	Barcelona	179	232	259	258
	Bilbao	21	8	22	21
	Fuerteventura	15	19	23	20
	Gerona (Costa Brava)	16	17	24	18
	Ibiza	83	100	127	108
	La Coruna	7	0	0	11
	Almeria	11	12	17	13
	Gran Canaria	20	27	31	28
	Madrid (Barajas)	166	183	208	207
	Mahon, Minorca	40	52	60	54
	Murcia San Javier	27	32	42	35
	Asturias (Aviles)	8	4	12	6
	Palma De Mallorca	146	183	221	197
	Reus	14	14	21	17
	Santiago de Compostela	7	16	22	18
	Santander	7	6	11	6
	Santa Cruz De La Palma	1	0	0	0
	Seville	13	15	20	16
	Tenerife Sur Reina Sofia	49	68	75	70
	Valencia	21	24	33	33
	Jerez	5	7	11	7
	Zaragoza (Saragossa)	5	4	8	4
Sri Lanka	Colombo(Katunayake)	12	18	18	19
St. Kitts And Nevis	St Kitts(Gold'Rock)	0	8	8	9
St. Lucia	St Lucia(Hewanorra)Windwa	8	10	12	12
Sudan	Khartoum	0	0	4	14
Sweden	Stockholm(Arlanda)	97	170	165	184
	Gothenburg (Landvetter)	26	22	35	49
	Gothenburg (Save)	14	15	31	18
	Malmo (Sturup)	5	5	11	6
	Nykoping	14	31	50	35
	Vasteras (Aasslo) (Rsweaf	5	6	11	7
Switzerland	Berne (Belp)	12	17	17	17
	Basle (Mulhouse)	47	23	41	58
	Geneva (Cointrin)	165	128	198	240

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Zurich Ch	163	189	212	234
Taiwan	Kaohsiung	0	0	0	4
	Taipei	7	10	10	12
Tajikistan	Dushanbe Tj	0	0	0	7
Tanzania	Dar-Es-Salaam Internation	0	0	0	11
	Kilimanjaro	0	0	0	6
Thailand	Bangkok	28	45	45	47
	Phuket Th.	0	0	0	7
Trinidad & Tobago	Port Of Spain	3	0	5	4
	Tobago	0	0	4	4
Tunisia	Djerba (Mellita)	2	0	0	0
	Enfidha Hammamet	12	19	22	16
	Tunis(Carthage)	10	8	11	12
Turkey	Izmir Tr	10	22	26	30
	Antalya	28	71	75	72
	Bodrum Tr	27	66	75	69
	Dalaman	57	148	160	152
	Ankara (Esenboga) Tr	0	11	11	23
	Istanbul	66	147	161	141
	Sabiha Gökçen International Airport	26	57	68	60
Turkmenistan	Ashkhabad	2	0	5	5
Turks & Caicos Islands	Providenciales (Tc)	0	0	0	7
Uganda	Entebbe	3	0	0	2
Ukraine	Kiev Zhulhany Ua	3	6	6	6
	Kiev Ua Borispol International	26	39	45	55
	Odessa	0	0	6	11
United Arab Emirates	Abu Dhabi	28	29	29	27
	Dubai	98	102	103	81
United Kingdom	Aberdeen Uk	111	86	107	150
	Belfast International	72	86	148	209
	Belfast City(Harbour)	108	78	169	154
	Dundee	13	20	20	41
	Edinburgh	277	248	324	322
	Guernsey	82	8	25	8

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Glasgow	173	178	252	227
	Inverness	35	17	36	43
	Isle Of Man	56	32	92	53
	Jersey	80	23	133	52
	Leeds/Bradford	20	0	0	36
	Londonderry(Eglington)	9	4	16	20
	Manchester	96	70	86	131
	Newcastle Uk	57	43	55	64
	Newquay	20	0	37	21
	Guernsey	0	0	0	21
	Durham Tees Valley	0	0	0	14
United States	Atlanta	28	42	42	45
	Austin Tx Usa	0	0	0	10
	Nashville Metropolitan	0	0	0	11
	Boston(Logan Internationa	42	62	62	76
	Baltimore(Friendship Int)	7	10	10	13
	Cleveland(Hopkins Int)	0	0	0	8
	Charlotte(Douglas)	7	11	11	13
	Cincinnati	0	0	0	6
	Denver(Stapleton Int)	7	9	9	13
	Dallas(Fort Worth)	28	39	39	39
	Detroit Wayne County Mi Us	7	9	9	10
	New York(Newark)	63	101	101	111
	Washington(Dulles Intern'	56	92	93	98
	Houston Intercontinental	35	52	52	58
	Indianapolis(Wier Cook)	0	0	0	8
	New York(Jf Kennedy)	143	237	237	246
	Las Vegas (Mccarron Int)	17	28	29	30
	Los Angeles International	56	87	87	99
	Kansas City Int. Mo	0	0	0	7
	Orlando (International)	25	38	42	41
	Miami International	35	40	40	27
	Minneapolis-St Paul Int	7	10	10	11
	New Orleans International	0	0	0	8
	Chicago(O'Hare)	70	109	109	113
	Portland(Oregon)	0	7	7	13

Table 4.4: Frequencies from London Airports by Scenario

COUNTRY	AIRPORT	2013	Maximum Use 2050	2 x 2 x 2 2050	4 Runway Hub 2050
	Philadelphia Internationa	21	31	31	36
	Phoenix(Sky Harbor Int'L)	7	11	11	13
	Pittsburgh Intl.	0	0	0	8
	Raleigh(Durham)	7	10	10	13
	San Diego(Lindbergh Fld)	7	11	11	13
	Seattle(Tacoma Internatio	7	9	9	12
	Sanford Fl Us	5	7	7	8
	San Francisco Internation	35	57	57	64
	Salt Lake City Internatio	0	0	0	8
	St Louis International	0	0	0	8
	Tampa International	7	10	11	11
Uzbekistan	Tashkent	2	0	0	4
Venezuela	Caracas	0	0	0	9
Vietnam	Hanoi	2	0	0	7
	Ho Chi Minh City/Saigon	2	0	0	7
Virgin Islands (U.S.)	St. Thomas Island V.I.	0	0	0	7
Zambia	Lusaka International	3	0	0	5
Zimbabwe	Harare	2	0	0	5
Grand Total		**10,133**	**12,201**	**15,598**	**16,576**