[EN-004] Analyzing the Impact of the European Gates Concept on En-route Congestion

(EIWAC 2010)

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Abstract: In order to reduce en-route congestion, increase hub functionality, and optimize the European ATM; we are working on a new concept known as the European Gates Concept. The basic idea of this approach is to create super hubs which will be receiving transcontinental and transatlantic traffic; this will help in redistributing traffic over Europe. The location of the Gates will depend on the network of the High Speed Train - HST which is planned for 2020. The European Gates and the new tracks of the HST will have some consequences like some intercontinental traffic will be removed and some new will be created and this might increase the intra-European hub and spoke and point-to-point traffic. However, the analysis we made by using the Central Flow Management Unit - CFMU data shows, that between 1.7% and 2.33% of the intra-European flights will be abandoned depending on the scenario that would occur when the HST will be fully operating in 2020.

Keywords: Congestion, European Gates, En-route, hub, High Speed Train

1. INTRODUCTION

The continued growth of traffic in Europe has numerous reasons, but the liberalisation of the European air transport play's the main role. However, most of the new studies indicate that in 2020 traffic is going to be doubled; the reasons for such growth are because of the low prices of tickets, the steady growth of the hub and spoke operations, and the increase of the low cost carriers' activities. Current congestion in airports, and en-route airspace limit to certain extent the departing aircraft, which causes an increase in delays and at the same time increases the airspace congestion as arriving aircraft are flying in a holding pattern.

The fact is that by reducing en-route congestion we will simultaneously reduce delays, but airspace demand cannot be limited. Thus, efficient airspace operations require new routes, which can be achieved by optimising the usage of existing ATM and airspace; new technologies, such as Controller-Pilot Data Link Communications – CPDLC; or to make some effective changes in the airspace structure and sector optimization which balance and organise traffic according to the capacity constraints and possibilities [1] and that's using methodologies such as Dynamic Management of The European Airspace Network – DMEAN [2].

2. ENROUTE CONGESTION

In order to reduce en-route congestion we can use two main concepts. The first one is by changing the shape or size or number of the en-route sectors. The second is by creating or adjusting new routes through available sectors [3]. In the current system the most effective ways to increase capacity has been to increase the number of sectors that can be operated simultaneously, but we cannot keep in dividing the sectors forever [4]. Thus, a new way to increase capacity has to be found, and this is likely to need a shift in the Air Traffic Control (ATC) paradigm, by which the ground Air Traffic controllers would redistribute their tasks, including delegating some tasks to the aircraft. The extent and scope of tasks to be distributed or delegated, the new operational concept which would sustain such changes will depend upon the maturity and desirability of new automated systems, including more autonomous aircraft-based capabilities and/or more advanced, dependable ground-based systems in support to human operators [1].

En-route congestion occurs in some sectors in Europe and in order to find out where exactly the constrained points are, we made some analysis using the available data from the CFMU. The data was analyzed from the 29th week of the year 2004. Figure 1 shows the 50 top constraining points in Europe. The results of our analysis were very similar to Table 1 published by Eurocontrol [5], which

conforms that the core area of Europe (shaded area in Figure 1) has in more than one point over 1100 constrained flights and more than 20,000 extra miles as shown in Figure 2.

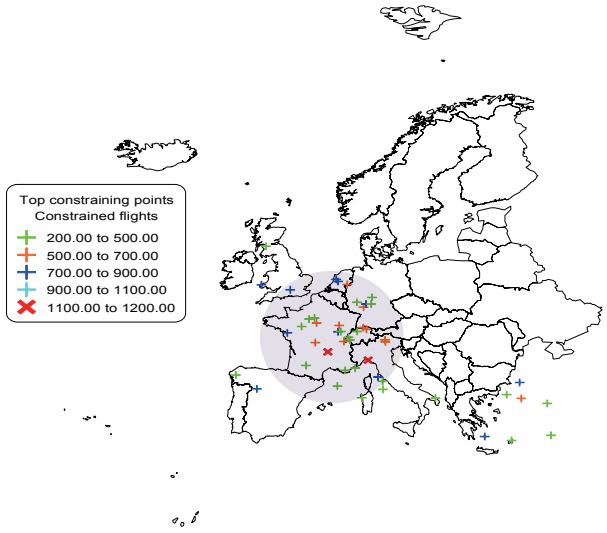

Figure 1 Top 50 most-constraining points in Europe – Constrained flights (1week)

In order to reduce congestion and delays we are studying a new concept known as (European Gates) which might be a good solution to reduce en-route congestion, to reduce delays and to increase sector capacity.

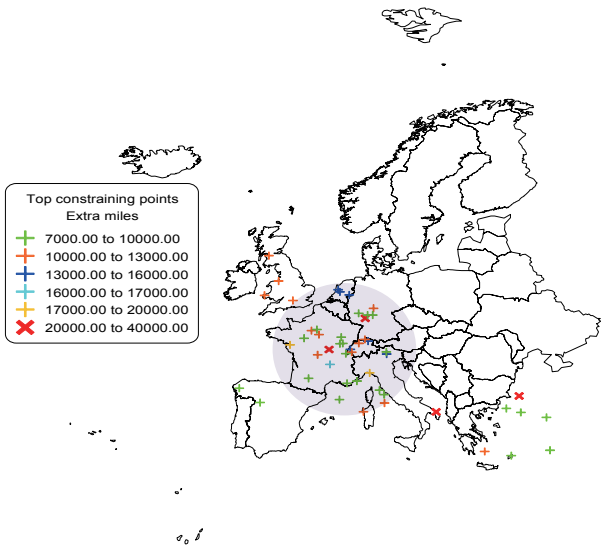

Figure 2 Top 50 most-constraining points in Europe – Extra Miles (1week)

3. THE EUROPEAN GATE CONCEPT

The basic idea of this approach is to compare two scenarios. The first baseline scenario will show system as today with its current traffic and a description of en-route congestion and sector capacity. The second scenario will include the new concept known as the European Gates with super hubs which will be receiving transcontinental and transatlantic traffic; this scenario will help to redistribute traffic over Europe. The redistribution of traffic will have some consequences like some intercontinental traffic will be removed and some new will be created and this might increase the intra-European hub and spoke and point-to-point traffic. The location of the super hubs will be depending on the HST network for 2020 as shown in Figure 3.

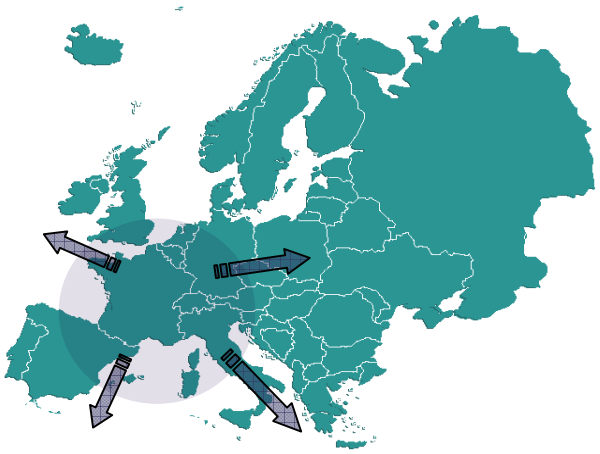

Figure 3 The suggested locations of the European Gates with respect to the HST network for 2020

To help redistributing traffic over Europe, a new transport (High Speed Trains - HST) will help to reduce traffic in some sectors. Thus the location of the European Gates will depend on the HST network. Figure 4 shows us the map of the high-speed network in Europe for the year 2020, were all the red lines will have a speed exceeding 250km/h. Because the location of the Gates depends on this network, we suggested the optimum locations of those hubs and we are now analysing the distance, speed, and the time taken to travel between city-pairs as shown in Table 1. The results from this analysis will be compared later on with other results from the travel time taken by aircraft between the same city pairs. The reason we think that those are the optimum location for the Gates is because the lay on the HST network and they connect the most city pairs. On the other hand, we are analysing the CFMU data to find out much intra-European flights can be removed when this

high-speed network will be active in 2020. By building those gates, airlines will start thinking of rerouting their flights in order to achieve a better business. We cannot force the airlines to change their routes, but we can change the way airlines look's at the new hubs, as they are going to have a high speed train connecting different cities and connecting more hubs. We thought that this approach can convince the airlines to achieve more profit and business, and then they would consider flying to these new gates.

To be able to determine the number of fights that will be abandoned, I foresee the following scenarios. First of all, a baseline for the scenarios based on the operations of the HST has to be drawn. In the baseline scenario, we expect rail transport share will grow from 22% to 69% in 2006 in certain routes. This scenario pursuits that transport policies and user costs follow a favourable development path for rail traffic and HST network will extend as expected for 2020 with HST operational speeds between 250km/h and 320km/h, the transport share of railways will be doubled on certain routes. A benchmark for the baseline scenario is the service between Paris and Marseilles. When the HST service started between Paris and Marseilles the journey was reduced to only three hours which helped the rail share to increase from 22% to 69% in 2006, and because of that EasyJet had to abandon all its flights between Paris and Marseille. However, the new TGV running between Paris and Strasbourg at a speed of 320km/m has slashed the journey from four hours to two and 20 minutes and this is going to reduced to a farther one hour and 50 minutes in the second phase; meaning that the rail share will be even higher.

Another benchmark is the Eurostar train that has taken 69% from the market between London and Paris; and between London and Brussels it has also taken 64% of the market share. Thus, if we look back at Table 10, we will see that the total number of flights estimated to be removed is 3823 and if the rail share will have a 70% share, then we are looking at a reduction of -1.7% in the intra-European flights. The figures in the baseline scenario are based on the following calculations. An important element of this calculations is to know that the total number of Intra-European flights of the 29th week (18th-24th July) of the 2005 is 155,742 as shown in Table 11 (bear in mind that the aerodromes that were used to get the total number of intra-European flights whether departure or arrival starts with the following codes L*** or E***) and thus if are assuming that 3823 flights from the four hubs will be removed, then 70% of this will be 2676 flights being removed, and therefore 2676/155,742 x 100 will be a reduction of -1.7% in the intra-European air traffic within a week.

The extension of the HST network leads to increasing demands in rail transport. Without the extension of the HST network railway share will not increase as is it the case with the baseline scenario for 2020. Travel times in rail passenger traffic are falling significantly as a result of the on-going extension of the High Speed Train Network and the modernisation technological development in the HST services.

Due to higher speeds on the new and upgraded lines the travel times are shorter and rail passenger demand is continuously increasing. In the optimistic scenario we pursuit that, the total rail transport share can be greater than in the baseline scenario if the extension of the HST network is fully realised by 2020, if the HST operational speed will be at least 360km/h and reaching up to 500km/h, if the railways prices will not dramatically increase, if the HSTs will be reliable and on time ever in severe weather conditions, and finally if the European integrated railway network will keep in developing. As a benchmark for this scenario the case of the Thalys service between Paris and Brussels where airlines had to abandon most of their flights. The journey time by the HST is only 1 hour and 22 minutes, thus very few flights left between the two cities. Another case where airlines had to remove all their flights is between Cologne and Frankfurt; the HST has also beaten air transport in this case, that no more flights are available on this route.

On the main city-pairs we estimate that 95% of the flights will be removed, and then we are expecting a decrease of approximately -2.33%. If we are assuming that 3823 flights from the four hubs will be removed, then 95% of this will be 3631 flights being removed, and therefore 3631/155,742 x 100 will be a reduction of -2.33% in the intra-European air traffic within a week.

Finally, the total rail transport share in the pessimistic scenario deviates at a quite small extent from the baseline scenario if the long awaiting changes and improvements in the rail sector will be slow to move in for example; the extension of the HST network will be delayed from five to ten years, and the operational speeds will not exceed 320km/h. If airline operators are willing to compete with railway operators and further reduce their ticket prices to satisfy customer demands. If airport security procedures are improved and delays are reduced, more passengers will tend to continue using air transport. Another important aspect is if the railway prices will be expensive and incomparable to airline tickets and the big uncertainties are the fuel and energy prices which can influence the market shares considerably.

The case of the HST between Madrid and Barcelona explains the pessimistic scenario. In February 2008 a new HST route started to serve between the two cities covering the 621km route in two hours and 35 minutes and will be

reduced to one hour and 50 minutes in the second phase in 2010.

The Spanish carrier Iberia is planning to reduce capacity on this route by 20% and that is by using smaller size planes, which will help maintaining the number of daily flights, but with the decrease in the seat capacity seat per aircraft the occupancy rate will increase.

Still though, it is hard to estimate the number of the passengers that would travel with the HST in case some flights are removed; because some of the passengers will look for another alternative way to get between city-pairs like driving or even paying more money to travel by air. However, this estimated value of flights being abandoned within the intra-European flights can vary dramatically. Because after all, the most important thing is how reliable would the HST be and how satisfied would the passengers be. Using the European Gate Concept and the High Speed Train (HST) Network will help reducing the intra-European flights; this new concept will not assure us that we will not have any future en-route congestion. On the other hand, the impact of the European Gates Concept and the influence on the sector capacity has to be studied in more depth. The hypothesis of this concept will bring reduction in en-route congestion and delays without negative impact on passengers demand and to maintain the ability of passengers to get to their final destination in a less complex network.

Figure 4 Map of the high-speed train network for Europe in 2020 [7] and the possible locations of the Super Hubs (European Gates)

4. ACKNOWLEDGMENTS

Processing the available data from the Central Flow Management Unit – CFMU for July 2004 showed me where the en-route congestion occurs in Europe and which waypoints are constrained; in order to plot the findings on a chart and compare it with the HST network. By knowing where the constrained points are, I was able to specify which routes are over loaded and I know where most of the traffic is concentrated. Thus, if I applied the European Gate Concept with HST station some flights may be removed and this would help in reducing en-route congestion. The location of the Gate depends on the network of the HST which is planned for 2020 and on the constrained points where the en-route congestion occurs.

After filtering the CFMU data for the 29th week of the year 2005, I was able to find the total number of intra-European flights, the number of the daily transatlantic flights between Europe and North and South America, and at the same time create different scenarios showing how much air traffic will be abandoned when the HST will be fully operational in 2020.

In order to build a super hub, it is important to know how much traffic would the hub serve, thus I filtered the data available from the CFMU data in more details and I found that the busiest day with traffic was the 22 July 2005 with 614 flights inbound to Europe from North and South America and 596 outbound from Europe. This actually concluded that the average transatlantic flights per day between Europe and North and South America were about 1200 flights. Nevertheless, it is very important to bear in mind that the super hub will have to deal with more than 1200 transatlantic flights daily plus the intra-European flights which will connect different European cities and will be most likely flying point-to-point routes.

On the other hand, I have foreseen different scenarios with the estimated number of flights that could be abandoned due to the operation of the HST. The first scenario was the baseline scenario; as it was shown in Table 10 the total number of flights estimated to be removed is 3823 and if the rail share will have a 70% share, then we are looking at a reduction of -1.7% in the intra-European flights.

Using the data available from the EAD (European AIS Database) and in conjunction with the PRR 8 report where the top most-constraining points are defined by name (code), it was possible to assign precise coordinates (Lat/Long) to each of the CPs. The result could therefore be interpreted in a plotting to see the geographical location and distribution of the CPs. This helped us in finding the proper location of the European Gates after having studied the HST network.

Finally, the European Gate Concept can be effective if the super hubs were really built, but that will require a huge capital to be spent in these hubs. However, the number of the abandoned intra-European flights which can be removed by 2020, does not really depend on the super hubs, because some passenger will prefer to travel by a high speed train rather than taking a flight for a distance of up to 800 km.

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