Assignment 6: Air Traffic, Operations and Runway Capacity

Date Due: March 13, 2018 Instructor: Trani

Problem 1

Read the article on Required Navigation Requirements (https://en.wikipedia.org/wiki/Required_navigation_performance) and answer the following:

a) Name the first airline and first approach commercial RNP approach

b) What is the meaning of RNP 4? Briefly explain.

c) What is the typical RNP value for terminal area operations?

d) Explain why are low values of RNP desirable in air traffic and navigation?

Problem 2

Read the article (https://en.wikipedia.org/wiki/Future_Air_Navigation_System) and answer the following:

a) Briefly explain what are the components of FANS.

b) How can FANS help airlines and air traffic controllers?

Problem 3

The Organized North Atlantic Track System (OTS) is a system of tracks derived daily that optimize the routes to be flown every day between North America and Europe (and also the opposite direction). The Eastbound tracks for a typical day are shown in Figure 1. Each track is defined between flight levels 310 and 390 (inclusive).

a) Estimate the hourly capacity (flights/hour) of one OTS track of the system of tracks shown in Figure 1 (6 Eastbound tracks). The distribution of times between arrivals to the track entry point (in the Canadian side) are shown in Figure 2. The average speed for flights Eastbound is estimated to be 510 knots ground speed.

b) Find the average longitudinal separation (in nautical miles) between aircraft flying the OTS Eastbound. Comment on the results obtained and compare the separation with domestic separations used in domestic US airspace.

c) An oceanic controller assigns a Boeing 767-200 (flying at Mach 0.80 and 38,000 feet) to track NAT-W. The controller assigns a Boeing 787-9 (flying at Mach 0.85 and 38,000 feet) to the same track NAT-W following the Boeing 767-200. If the minimum headway (i.e., time between two aircraft) equipped with FANS 1/A equipment using the same track and same flight level is 5 minutes, estimate the required headway at the oceanic track starting point. Controllers cannot assign operations to a track unless the two aircraft will be conflict free until the lead aircraft exits the tracks on the European side.

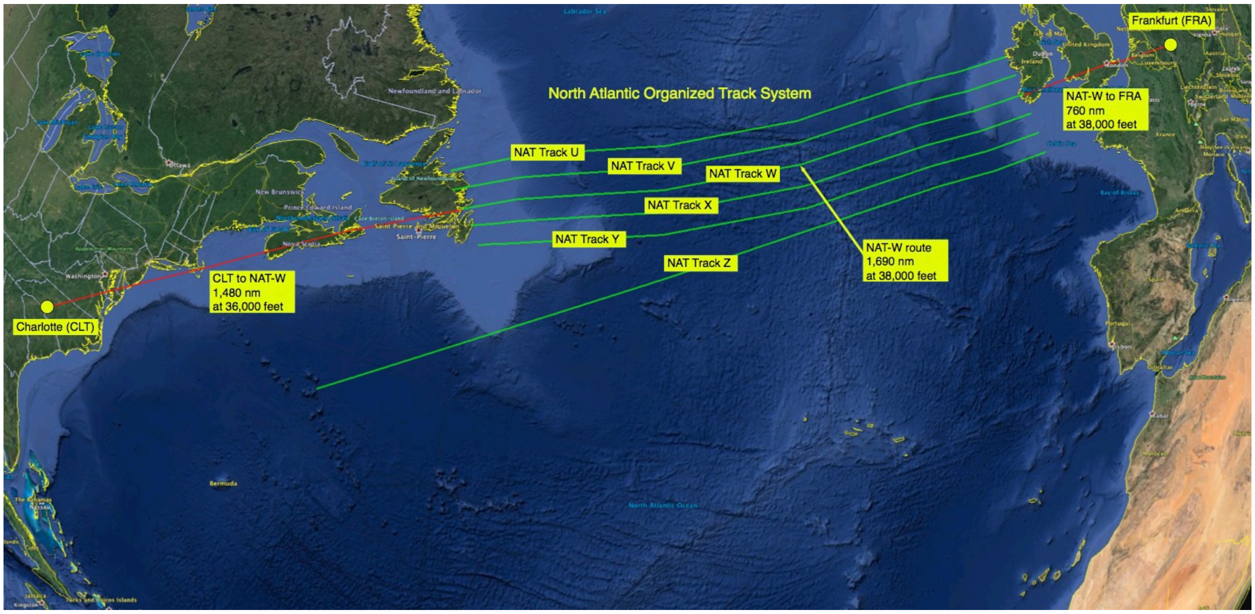

Figure 1. A Flight from CLT-FRA Using the Organized Track System.

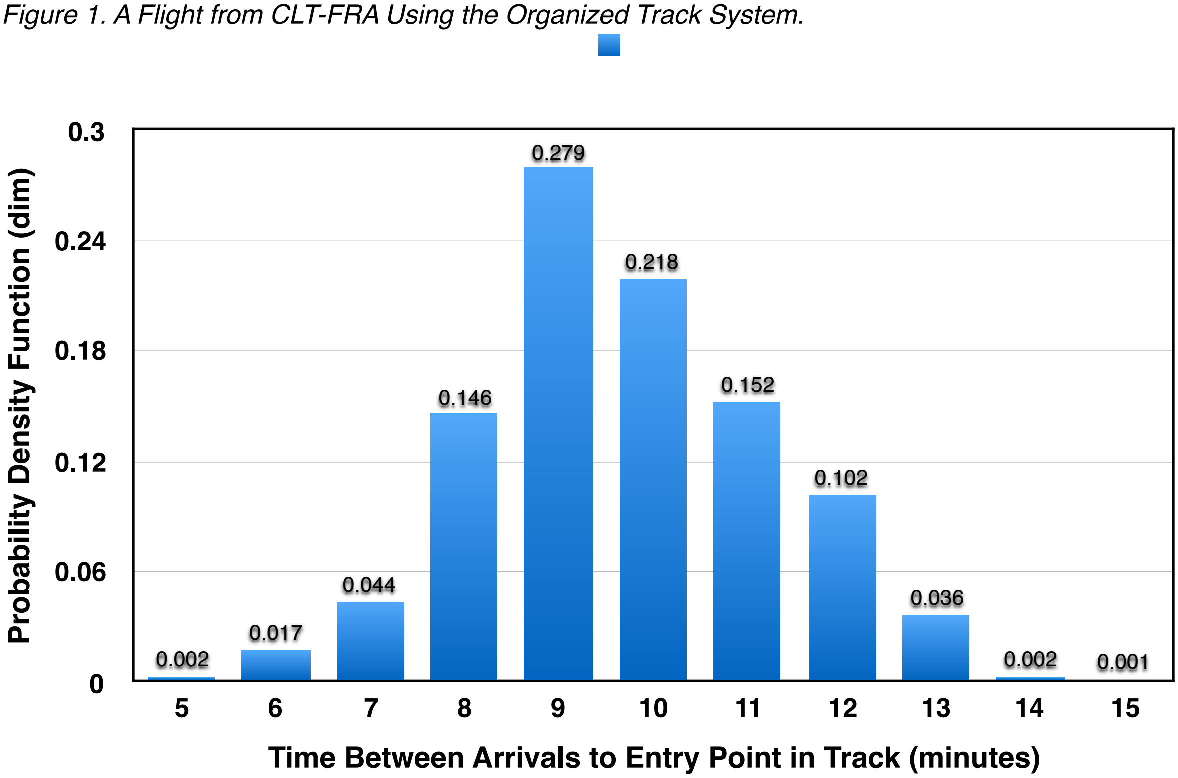

Figure 2. Typical Distribution of Time Between Arrivals to Tracks of the OTS.

Problem 4

Perform a simple capacity analysis for the San Diego International Airport (SAN) considering real operational information. Consult Google and Airnav to understand the problem. The airport has a single runway oriented East-West . San Diego terminal area arrivals and departures are controlled by Southern California TRACON using standard airport surveillance radar with a scan rate of 5 seconds. Table 1 shows the approximate fleet mix operating at the airport. For this analysis we use the following technical parameters: a) in-trail delivery error of 15 seconds under both VMC and IMC conditions, b) departure-arrival separation for IMC conditions is 2.3 nautical miles (when mixed operations are conducted on the same runway), c) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 9 miles from the runway threshold. The typical IMC separation values applied by ATC are shown in Figure 3 and Table 2.

Table 1. Runway Operational Parameters and Fleet Mix for Problem 1.

Aircraft	Percent Mix (%)	Runway Occupancy Time (s)	Typical Approach Speed (knots) from Final Approach Fix
Small	3	45	129
Large	80	56	145
Heavy or B757	17	64	152

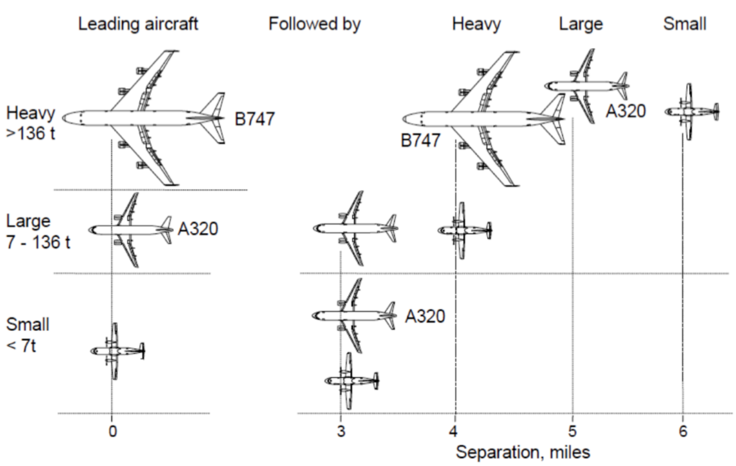

Figure 3. ICAO and FAA Recommended IMC Separations. Source: Lang et al., 2010. Arrival-Arrival Separations for all Groups Behind a Super-heavy add 2 nm over the Heavy Category.

Table 2. Minimum Departure-Departure Separations under IMC conditions. Values in are seconds.

Departure-Departure Separation Matrix (seconds)					
		Trailing Aircraft (Header Columns)			
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	60	60	60	60	60
Large	90	60	60	60	60
B757	120	120	60	60	60
Heavy	120	120	120	120	90
Superheavy	150	120	120	120	120

Estimation of Runway Capacity Operations

a) Find the IMC arrival saturation capacity of the runway configuration at SAN.

b) Find the IMC saturation departure capacity with 100% arrival priority of the airport if we assume departures operations are dependent of the arrivals calculated in part (a)

c) Find the departure only saturation capacity in IMC conditions.

d) Plot the Pareto diagram (arrivals/departures diagram) for solutions obtained above.