

# HIGHWAYS IN THE SKY

## Overview

At 5pm Pacific Time, 15<sup>th</sup> December, 2015, there are 10,197 commercial, military and private planes in the air across the world<sup>1</sup>. This number does not include low altitude flying light planes and some military aircrafts, both of which are not registered with Air Traffic Control (ATC). As seen in the picture below, the high altitude flying planes are distributed extremely unevenly across the world, with the highest density over North America, East Asia and Europe. But, unless you have flown a military jet, you have probably never looked out of a plane's window and seen another plane flying by. This is because in order to avoid collisions in the air, planes all over the world fly on precise routes, speeds and altitudes given to them by the ATC, which they cannot deviate from without serious consequences.

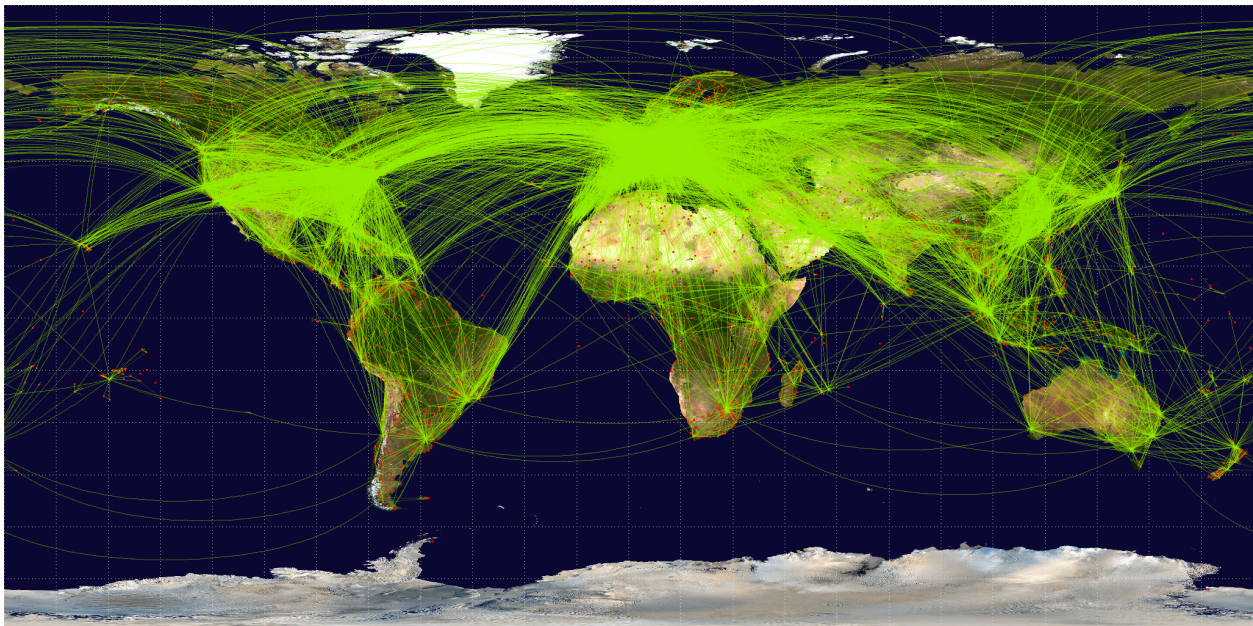


<sup>1</sup> "Your Flightradar24.com Session Has Timed-Out." *Flightradar24.com*. Web. 17 Dec. 2015. <<http://www.flightradar24.com/11.32,-33.05/2>>.

<sup>2</sup> "Rush Hour in the Skies: Real Time Map That Shows You Every Plane in the Air Right Now." 17 Sept. 2012. Web. 13 Dec. 2015.

## What is being organized?

The primary resources that are organized within the scope of this system are the airways or flight routes across the world that connect destinations, and are overseen by Air Traffic Control bodies. The positioning of the planes is of significance, but as a secondary resource within the predetermined highways in the sky, or the airways, that the planes fly through i.e. the green lines in the picture below. Air Traffic Controllers monitor the planes as they embark on these routes to ensure they do not come too close to one another, or stray too far from the designated route. These routes are established by civil/federal aviation authorities and implementing new ones takes a couple of weeks at the very minimum. The busier the airway e.g. around Dubai airport, the longer new airways take to be formed. It is a long complicated, bureaucratic process that requires gaining permissions from every country whose airspace the plane intends on flying through.



3

## Why is it being organized?

Busy airports such as Rio de Janeiro, Seoul, Melbourne, Chicago and Dubai handle hundreds of incoming and outgoing flights every day. The most basic and crucial reason for organizing flight routes is so that planes flying different routes do not crash into each other as they approach or leave the airports. Within the air corridors, the planes are further organized so that those scheduled to fly the same route don't collide. This organization needs to be done perfectly because unlike cars on the road, it is almost impossible for an airplane to swerve to safety in the opposite direction if it comes too close to another airplane because of high speeds and air pressure.

The airways look like arcs on the map but these arcs are usually the shortest distance from Point A to Point B and appear as a curved line because the three-dimensional earth is

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<sup>3</sup> <http://openflights.org/demo/openflights-routedb-2048.png>

represented in a two-dimensional drawing. A major consideration in designing flight routes is fuel efficiency and conservation i.e. planes should try and fly the shortest distance to burn less fuel, save money and green house emissions.

That, however, is not the only way of organizing flight routes because the technical specifications and limitations of aircrafts are also a contributing factor. First, let's dispense with the misconception that planes *always* follows the shortest route to get from Point A on the map to Point B. This shortest distance is called the Great Circle Route and is most commonly taken by four engine planes, but two engine planes might take a longer route for transoceanic flights. Why? Well, two engine aircrafts are required by standards issued by the International Civil Aviation Organization, namely the Extended Range Twin Engine Operational Performance Standards, to not fly too far from terra firma when flying across the ocean. In case of an engine failure, the other engine must be able to carry the aircraft to the closest alternate airport without falling into the ocean by running out of time.

### **How much is it being organized?**

The airways, air corridors, or flight routes (as I've been using interchangeably), while conceptually similar to terrestrial highways, are actually much bigger in size. They are three-dimensional, wide corridors in the air, measuring several kilometers in width and height. There is considerable distance maintained between two airways. Within each air corridor, the planes fly at fixed speeds, altitudes and compass points. The distance between two planes used to be 10km but with increasingly more accurate and reliable technology was reduced to 5km, and is now a mere 1km.

In case a plane enters or wants to circumnavigate a bad weather system, the pilot contacts the Air Traffic Controller who checks for close flying planes, and accordingly diverts the plane to a different position within the airway. It is significant to note that the plane is not diverted to an alternate airway, but moved within the existing one. This points towards good design principles of air corridors as they are made to not just accommodate the existing, regular air traffic but also provide affordances for reorganization of the planes in case of contingencies.

### **When is it being organized?**

Air corridors are quite consistent in nature and the same ones established many years ago are still in use, and will likely remain so (though the artifact points to a different future). It is likely that the flight route between John F. Kennedy and Heathrow airport has not changed in the past three decades. In case an airline or private flyer wants to request passage through a channel that is not recognized as an airway, they have to request special permission from every single federal aviation authority whose airspace they intend to fly over. But, this is not an everyday occurrence as planes will usually just fly on the same routes they always have and most places on earth are well connected with airways by now.

Meanwhile, the secondary resources i.e. the planes, are each individually organized by the ATC every single time they take off from the runway.

### **How or by whom is it being organized?**

Every country has a central aviation body called something like the Federal Aviation Authority (FAA) or Civil Aviation Authority (CAA). These are the top level agents responsible for the organization of airways within the country's airspace. The FAA or CAA reign over multiple Air Traffic Controllers that can be considered their foot soldiers as they abide by all the laws, regulations and standards set up or adhered to by the higher authority, and are responsible for their daily execution.

The sky is divided up into territories much like the states in the US and when a plane flies from Los Angeles to Baltimore, it will talk to 11 ATCs on the way<sup>4</sup>. This means that the plane will travel through the jurisdictions of 11 different ATCs, who will each tell the plane exactly what speed, altitude and geographic coordinates to maintain.

Although the prime authority with a country is the FAA or CAA, even when flying domestically, planes are actually adhering to international aviation standards and norms set up by the United Nations body called International Civil Aviation Organization (ICAO). The ICAO "works with 191 Member States and industry groups to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector."<sup>5</sup>

## Other considerations

When planes are flying within their designated airways, or deviate from them, their resource descriptions are of critical interest to the air control authorities of that airspace. Some of the most important descriptors are the the country of origin of the flight, the country which the airline belongs to, aircraft type and destination. Why do these matter? The reason is quite political i.e. an Indian plane straying from its designated course over Pakistani airspace would probably elicit a military reaction much faster than a Chinese one owing to the diplomatic relations between the countries. In 1983, a commercial passenger Korean Air Lines Flight 007 that deviated from the assigned route was shot down over Russian airspace because the Soviets suspected it of being on a reconnaissance mission.

Airways are also designed to circumvent sensitive locations such as the White House. In rare but known cases, the political climate over a region might lead to new airways being created or alternate ones being used instead. A good example of this is from 2014 when a Ukrainian missile hit and crashed the Malaysia Airlines Flight MH17, most airlines decided to avoid flying over the region.

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<sup>4</sup> "Air Traffic." *Air Traffic*. Web. 17 Dec. 2015. <[http://www.faa.gov/air\\_traffic/](http://www.faa.gov/air_traffic/)>.

<sup>5</sup> "International Civil Aviation Organization." *About ICAO*. Web. 17 Dec. 2015. <<http://www.icao.int/about-icao/Pages/default.aspx>>.

## ARTIFACT

The Federal Aviation Authority has begun the implementation of a more accurate satellite (GPS) based navigation system called NextGen (Next Generation Air Transportation System) that aims to replace the older, ubiquitous radio frequency based navigation system by 2025. Benefits include fuel efficiency through more accurate flight paths, time savings, as well as a reduction in green house gases emissions. Planes can be funneled into airports faster, 'eliminating wide circling approaches or takeoffs that required steep turns to get on course'<sup>6</sup>.

The diagram below shows that better organization is not necessarily good because it exposes the system to new interactions with the public that in the case of Santa Cruz<sup>7</sup>, are considered a serious enough public nuisance that the residents are pushing for a lawsuit against the FAA.

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<sup>6</sup> "SFO and FAA Need to Rethink Noisy Flight Paths." *San Francisco Chronicle* 17 Nov. 2015, Opinion sec. Web. 12 Dec. 2015.

<sup>7</sup> "FACTS save Our Skies Santa Cruz NEXTGEN." *SAVE OUT SKIES Santa Cruz*. Web. 17 Dec. 2015.  
<http://www.sossantacruz.org/facts.html>



NEXTGEN ROUTE

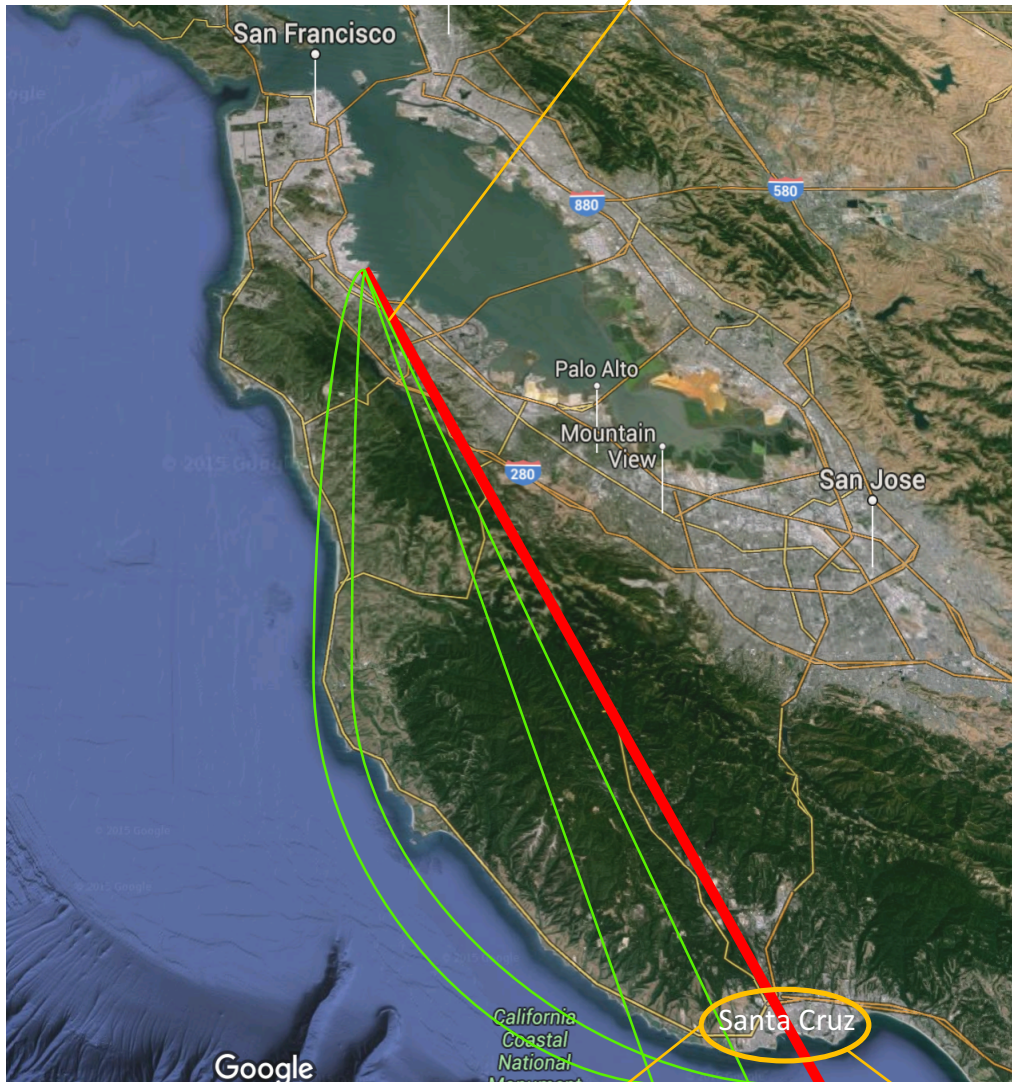


OLD ROUTES



[Both are approximate routes to facilitate a conceptual understanding of the issue]

The new route on account of being much more precise makes traffic that was previously dispersed over many miles of randomized routes focus on a narrow corridor → Much more noise experienced on ground



Savings in fuel and flight time are benefits for the airlines but residents under the red line experience no rewards from the new organization. Legacy organizing systems, when modified without the buy in of the people they impact, often result in a strong backlash, as in this case.

Low flying jets on this new NextGen enabled airway bring heavy air traffic over areas where there was none or little previously. Residents are enraged over the effect this has on property values as well as their quality of life.