

## MORE EFFECTIVE USAGE OF AIRSPACE

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Received: October 1, 2001

### Abstract

In air transportation the rate of delayed flights because of the limited airspace is high, about 25% of all delays. Controllers cannot handle more than 20–25 planes in an hour, and the demand is more than this. Therefore new methods are necessary, most of them are developed by Eurocontrol, European Organisation for the Safety of Air Navigation, which organizes the air traffic over Europe. This paper introduces the three most important methods, and another opportunity to grow the airspace capacity.

*Keywords:* airspace capacity, air transportation, Eurocontrol projects, superjumbo airplane.

### 1. Introduction

The airspace is limited, and the air traffic grows on average by 5% a year. There are many projects, which try to make airspace more effective. These projects are developed by Eurocontrol (European Organization for the Safety of Air Navigation), which organizes the air traffic above Europe. In the following article I introduce the most important methods and a special project developed in the USA.

### 2. Projects of Eurocontrol

The main cause for delays is the limited airspace, that is why Eurocontrol tries to make it more effective. The three most important projects are reorganization of ATM (Air Traffic Management), implementation of TCAS (Traffic Alert and Collision Avoidance System) and ACAS (Airborne Collision Avoidance System) and introduction of RVSM (Reduced Vertical Separate Minimum).

#### 2.1. ATM 2000+

In Eurocontrol there is a unit called PRC, Performance Review Commission, which works on optimization of ATM. The name of the project is ATM 2000+, because it wants to reorganize the air navigation after the year of 2000.

The most important problem is to harmonize the European airspace. The states can introduce new methods, but the final solution involves harmonization between all states in Europe. The results and costs have to be compared, and after this a new air traffic flow must be realized.

The main motto is: 'to give users the wanted secure service and capacity in long term for which he is ready to pay'. The optimum solution is, of course, when capacity exactly satisfies demands.

The objects are following:

- make security level higher,
- make ATM cost lower,
- provide the demanded capacity in the critical time without causing any negative changes,
- more effective usage of airports,
- harmonization between civil and military flights.

Methods of increasing capacity are following: reorganization and simplification of European airspace, better distribution of navigation sectors, better coordination between civil and military flights, making flight plans better and faster, faster information exchange of the flight, better usage of airports, better automation of the work of air traffic controllers.

What does the main projects mean? Optimization of Flight Plans means to get it faster to the central, better information exchange. Make Flight Plans more exact, the air traffic can be forecasted better.

Make information exchange faster about the state of the flight allowing a better ground service for the airplane. The airline could forecast more exact when a plane will arrive.

## 2.2. TCAS

### 2.2.1. About TCAS System

TCAS was developed and introduced in the USA, the European version is called ACAS.

The substance of the system is following: it watches the traffic around the airplane and gives the pilot a warning when another plane comes too close. So the distance between two planes can reduce, because any plane watches the traffic around him, independently of ground controlling. So can fly more planes in the same airspace.

### 2.2.2. How the System Works

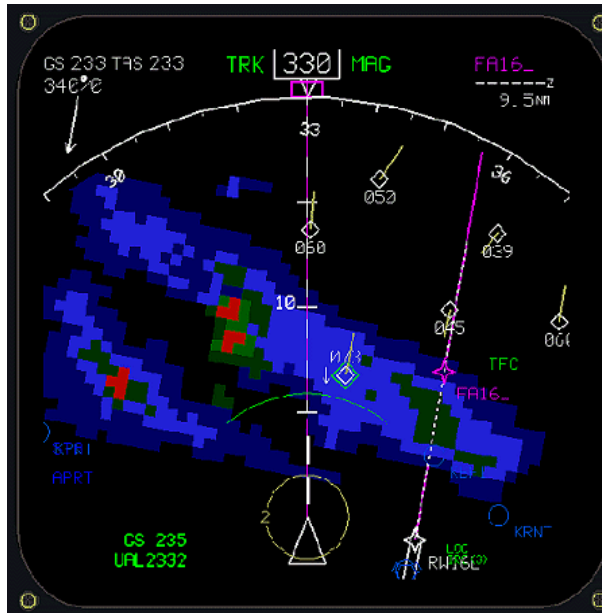
I talk only about TCAS II, which allows vertical separation. TCAS III will make horizontal separation also available, and TCAS IV will work with GPS.

The system contains the following elements:

- S mode transponder, which can identify airplanes and can give its flying level,
- TCAS antennas,
- central computer,
- monitor and sound system in cockpit.

The transponder, with the help of radio waves, watches the traffic around the plane and the central computer calculates the distance between the two planes and the monitor displays the traffic in the cockpit. The height of the intruder airplane is the most important data, and the system can calculate whether the other plane is climbing or descending.

*Fig. 1* shows the display of the system.



*Fig. 1.* Display of TCAS system

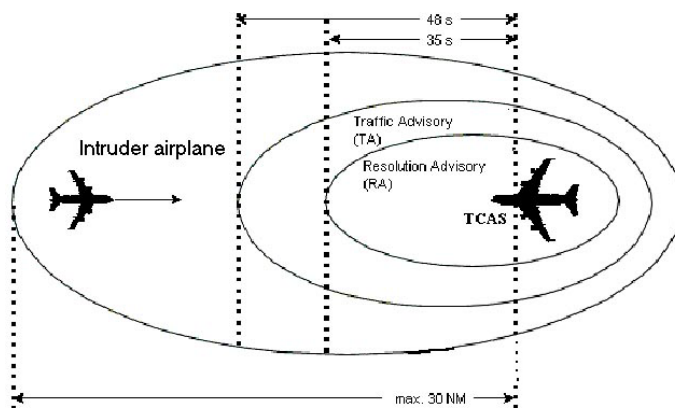
The system does not work like a radar, it can only identify planes equipped with transponder. In the USA every plane flying above 10,000 feet has to have a transponder. The system can handle 45 planes at the same time, but can display only 30.

It handles planes three ways depending on how far they are. Not dangerous planes are only displayed, they are far. In Traffic Advisory, TA, mode are handled the planes which come closer, and planes which come so close that a crash is possible are handled in Resolution Advisory, RA mode.

In TA mode the system says in the cockpit: 'traffic, traffic'. This mode is active when the intruder plane is closer than 48 sec from the basic plane.

In RA mode the system makes an avoiding manoeuvre. It can suggest climbing or descending, and also speaks it in the cockpit. This mode is active when the intruder plane is closer than 35 sec from the basic plane.

*Fig. 2* shows the TA/RA territories.



*Fig. 2.* Territories of TCAS TA/RA modes

### 2.2.3. ACAS II

In Europe the project has a name ACAS II. From 01.01.2002. it is obligatory to equip with ACAS II all planes which transport more than 30 passengers or have a maximum take off weight more than 15.000 kg.

The system has a big advantage: when the plane is landing, it sends a movement message automatically to the central, so the services know exactly that the plane has arrived and they do not have to wait until they see it.

### 2.3. RVSM

The other solution for airspace problems is RVSM, Reduced Vertical Separate Minimum, which is developed also by Eurocontrol. It will be introduced in ECAC states in 01.24.2002.

The project means following: between 290 and 410 Flight Level (1 Flight Level is 100 feet) the vertical separate distance will be reduced from 2000 feet to 1000 feet. So 6 new flight levels will open ( $410 - 290 = 120$ ,  $120 \cdot 100 = 12000$  feet, that means  $12000/2000 = 6$  levels existed, and now  $12000/1000 = 12$  levels will exist).

It has another advantage: because there are more levels, the most economic height for the plane can be selected, so fuel can be saved.

Fig. 3 shows the flight levels from east to west, and from west to east in RVSM and non-RVSM airspace.

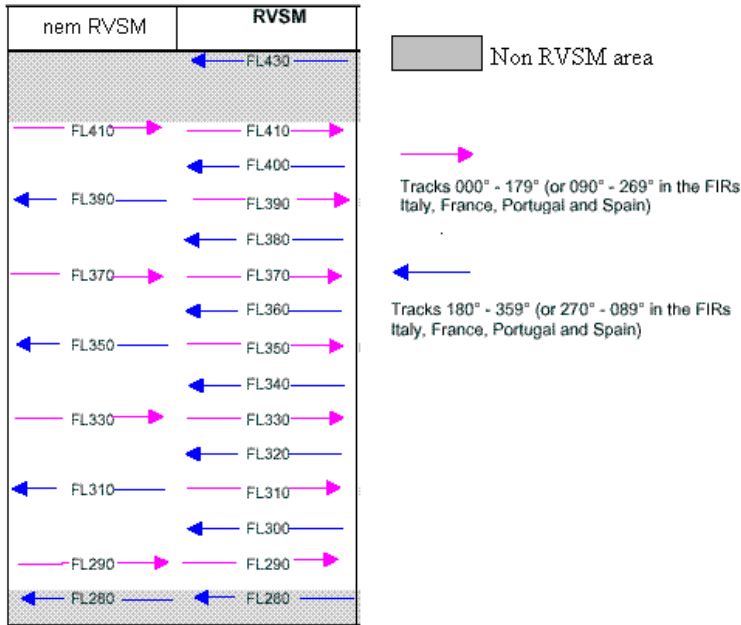


Fig. 3. Separation of RVSM airspace

In this reduced separate minimum system can only fly planes with the necessary equipment, with more exact height measuring systems.

A plane which is not equipped has to climb above or to descend below RVSM airspace.



Fig. 4. Airbus A 380

### 3. Extra Large Airplanes

The other method to increase airspace capacity is to transport more passengers in one plane. The biggest project is developed by Airbus Industry, and the plane is called A 380.

It will begin the test flying programs in 2004. *Fig. 4* shows the plane.

Until now many airlines have ordered from the plane, more than 50 pieces in all.

At present Boeing B 747-400, Jumbo is the biggest plane. In *Table 1* I compare the most important data of the two planes.

*Table 1.* The most important data of A 380 and B 747-400

	B 747-400	A 380
Span [m]	64.44	79.8
Length [m]	70.66	73
Height [m]	19.41	24.1
Max. take off weight [kg]	396 890	560 000
Capacity [person]	420-569	555
Range [km]	13 340	15 100
Max. fuel capacity [L]	216 840	325 000

The maximum capacity of Jumbo is 569, but this version is used only in Japan and only for regional flights. In the typical seat configuration it can transport 416 passengers. But its span is 15 meters less than the A 380 and its weight is 163 tons less. These measures cause a big problem, because the plane cannot land on every airport. And it is very hard to handle 555 passengers at the same time! So the plane will have a big turn around time.

And the other problem is: such a big plane generates a big turbulence, so the following plane must keep a big distance.

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