

# **SAAM**

## **System Wide Modelling**

**Madrid**  
**16 November 2006**  
**Thierry Champougny**

**EUROCONTROL**  
**Airspace, Network Planning and Navigation**  
**APN**



# SAAM – System Wide Modelling

## Introduction to SAAM:

SAAM at a glance

Main Features

## SAAM & ATM structure in Europe

Today situation

From Past to Future: increasing Complexity

## SAAM handle Complexity to create Capacity:

Network / Airspace / 4D trajectories

Civil / Military

Airport / En-route

Environment

Global Cost Solution

## SAAM & some European Projects:

V5 - AAS – CCAMS - DMEAN



# Introduction to SAAM

**S**ystem for Traffic  
**A**ssignment and  
**A**nalysis on a  
**M**acroscopic scale



# Introduction to SAAM

**SAAM is an integrated and modular system**

**for Local / Europe wide**

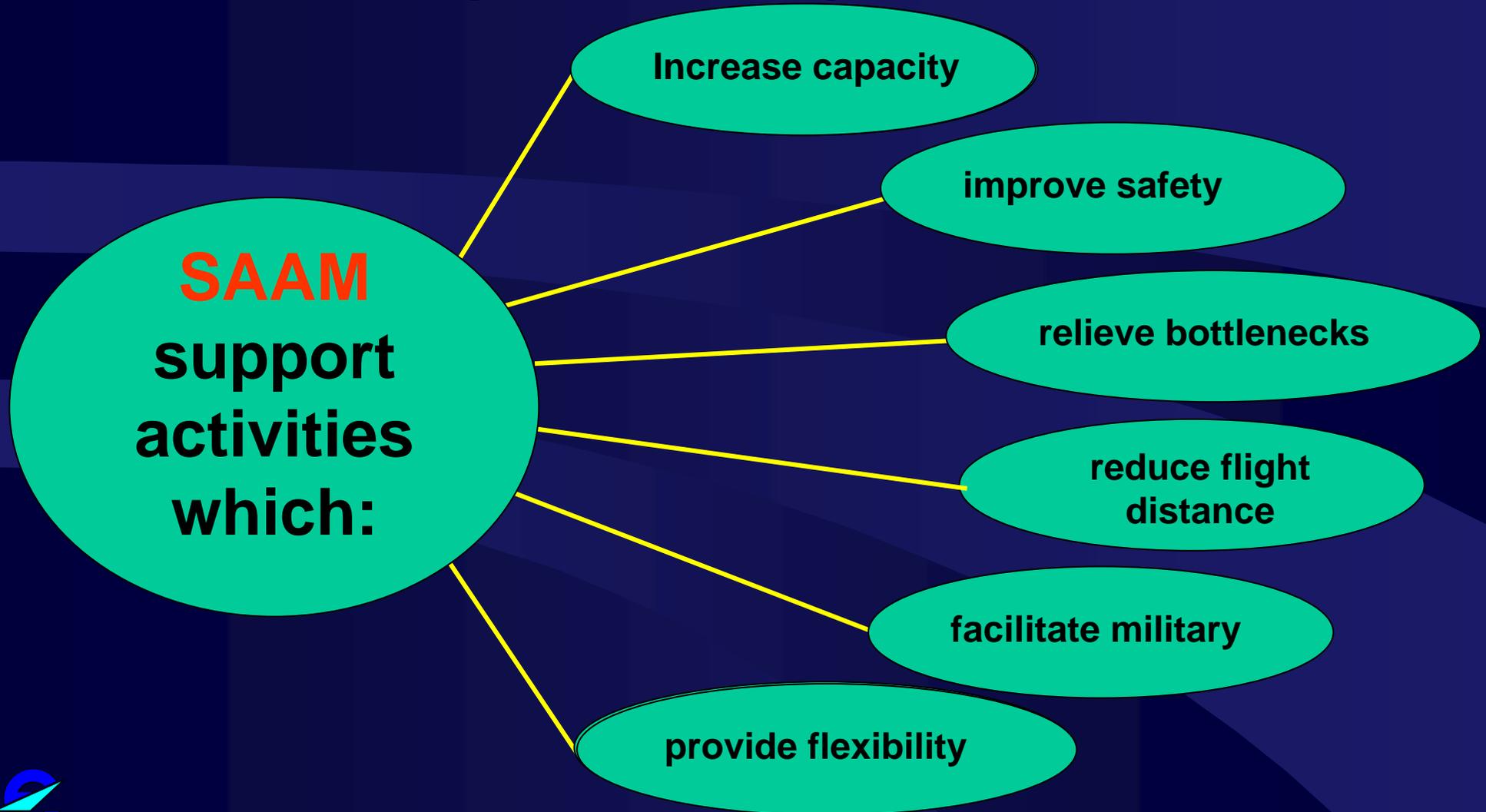
**Airspace / TMA scenarios**

**Design, Analysis, Simulation and Presentation**



# Introduction to SAAM

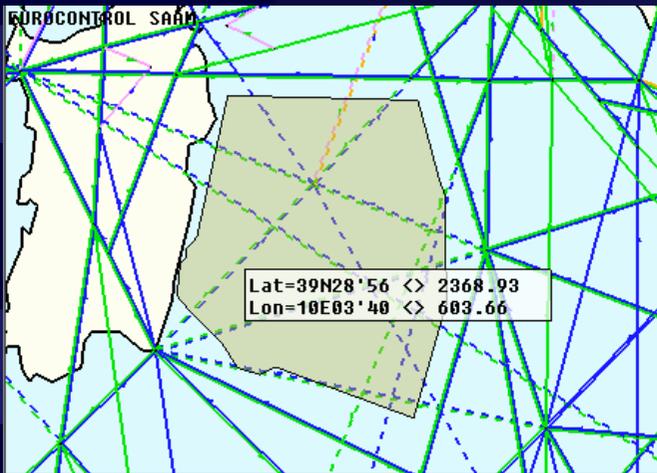
## Operational Improvements



# Introduction to SAAM

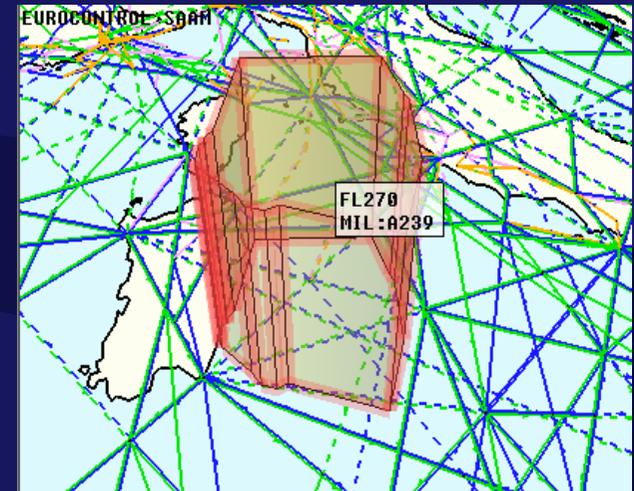
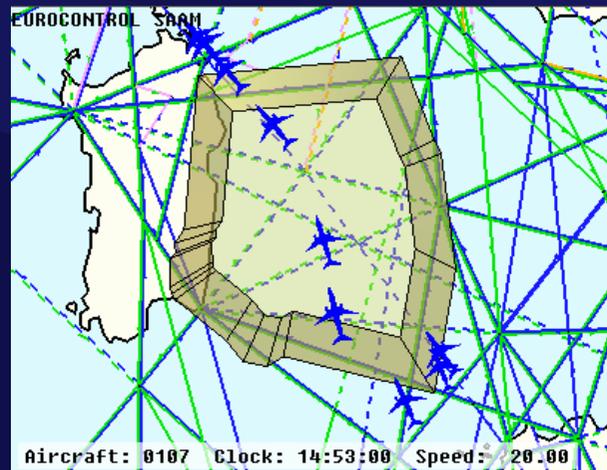
## Main Features

Permanent 2D, 3D and 4D GIS platform,



2D network edition

### 4D animations



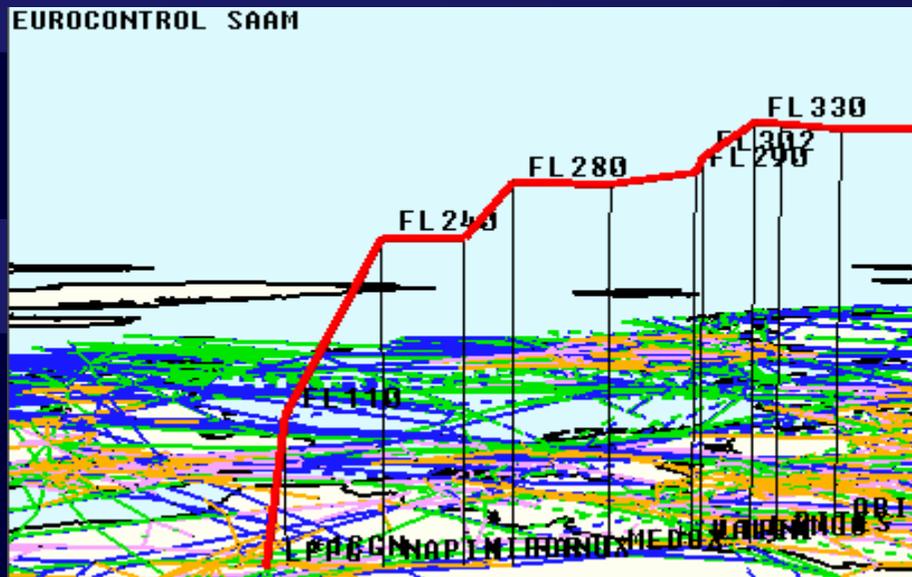
3D sectors edition



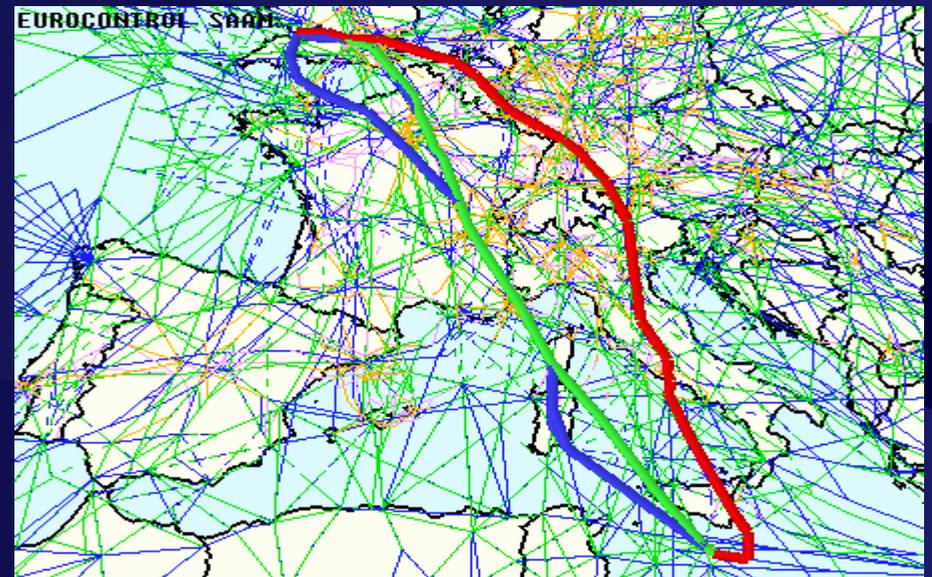
# Introduction to SAAM

## Main Features

Constraints are fully editable and always used



Profile Constraints



Routing Constraints

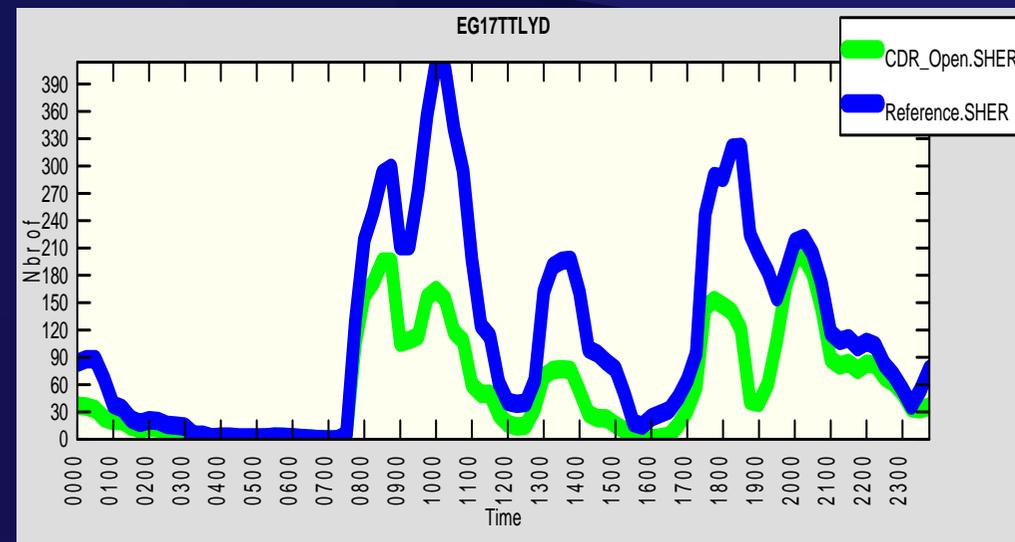


# Introduction to SAAM

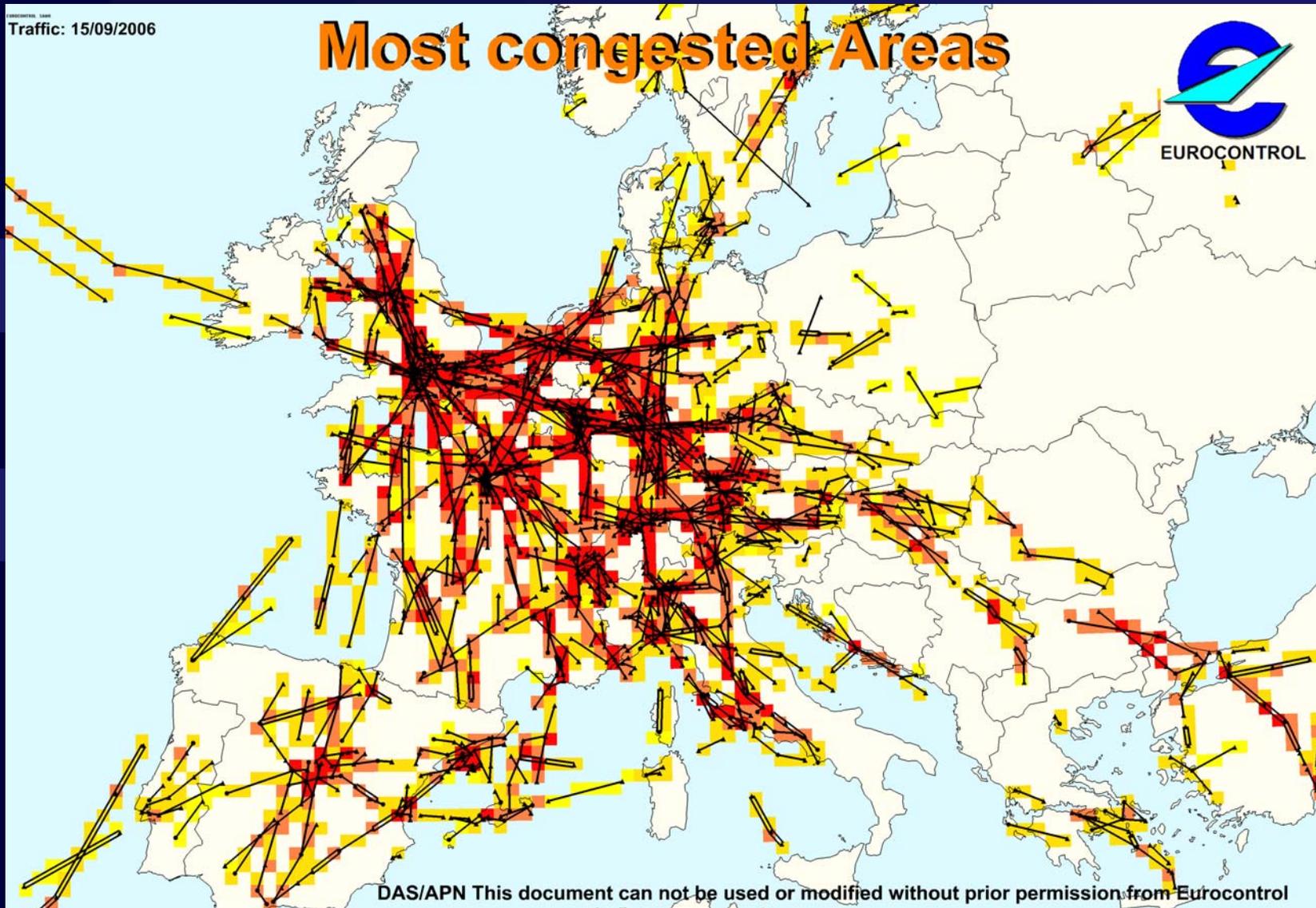
## Main Features

Powerful pre / post scenario **analysis** and **comparison** tools

Sector Capacity problem  
Complexity measure  
Route Charge  
Delay  
FL & Route Extension analysis  
Traffic Queries  
Environmental impact  
...  
Global Cost Function



# Introduction to SAAM



# Introduction to SAAM

## Main Features

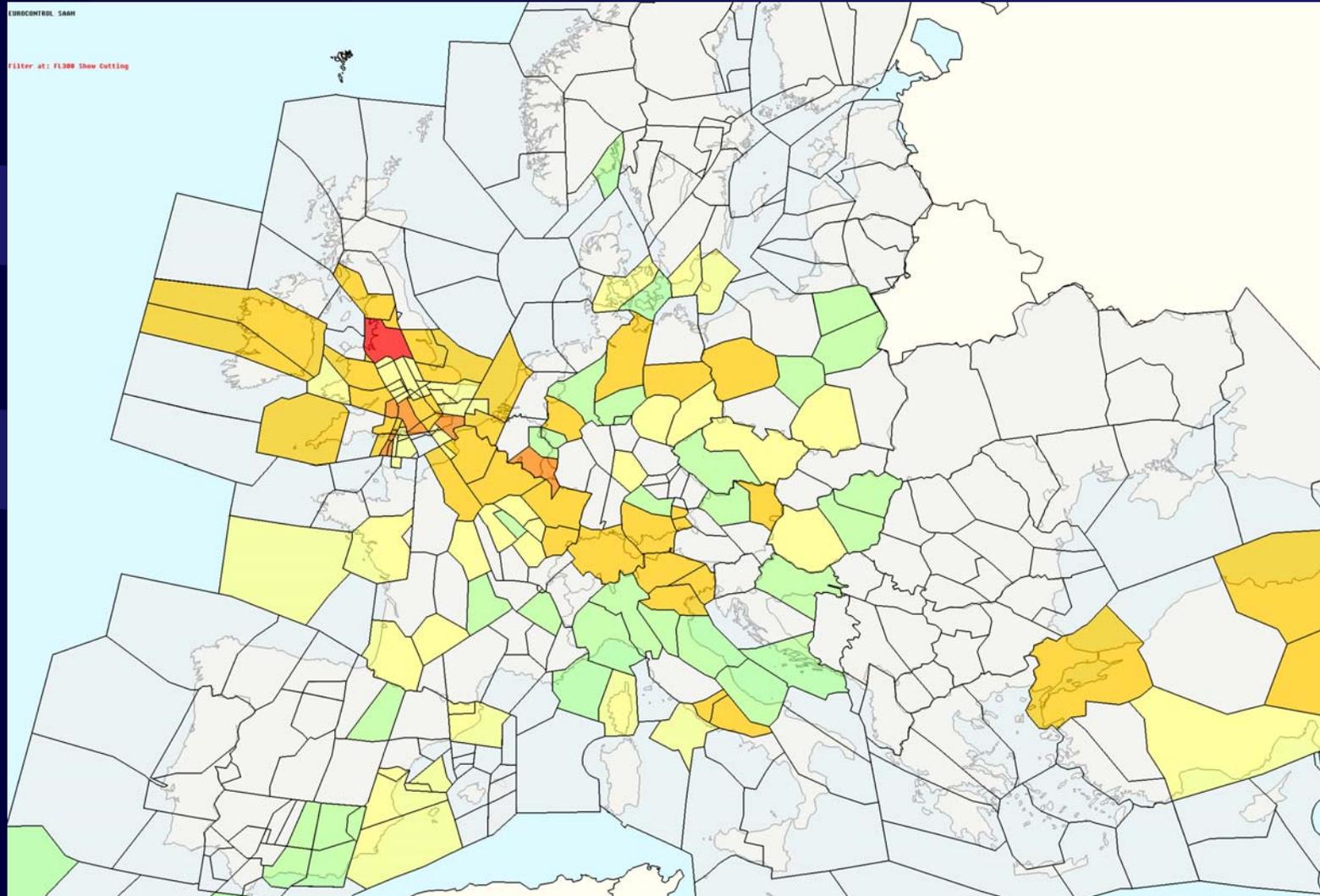
### Global Optimisation tool set

- **Strategic traffic flow organisation**  
**(Best paper - ATM2001 - Santa Fe - USA)**
- **Sectors configuration**
- ...



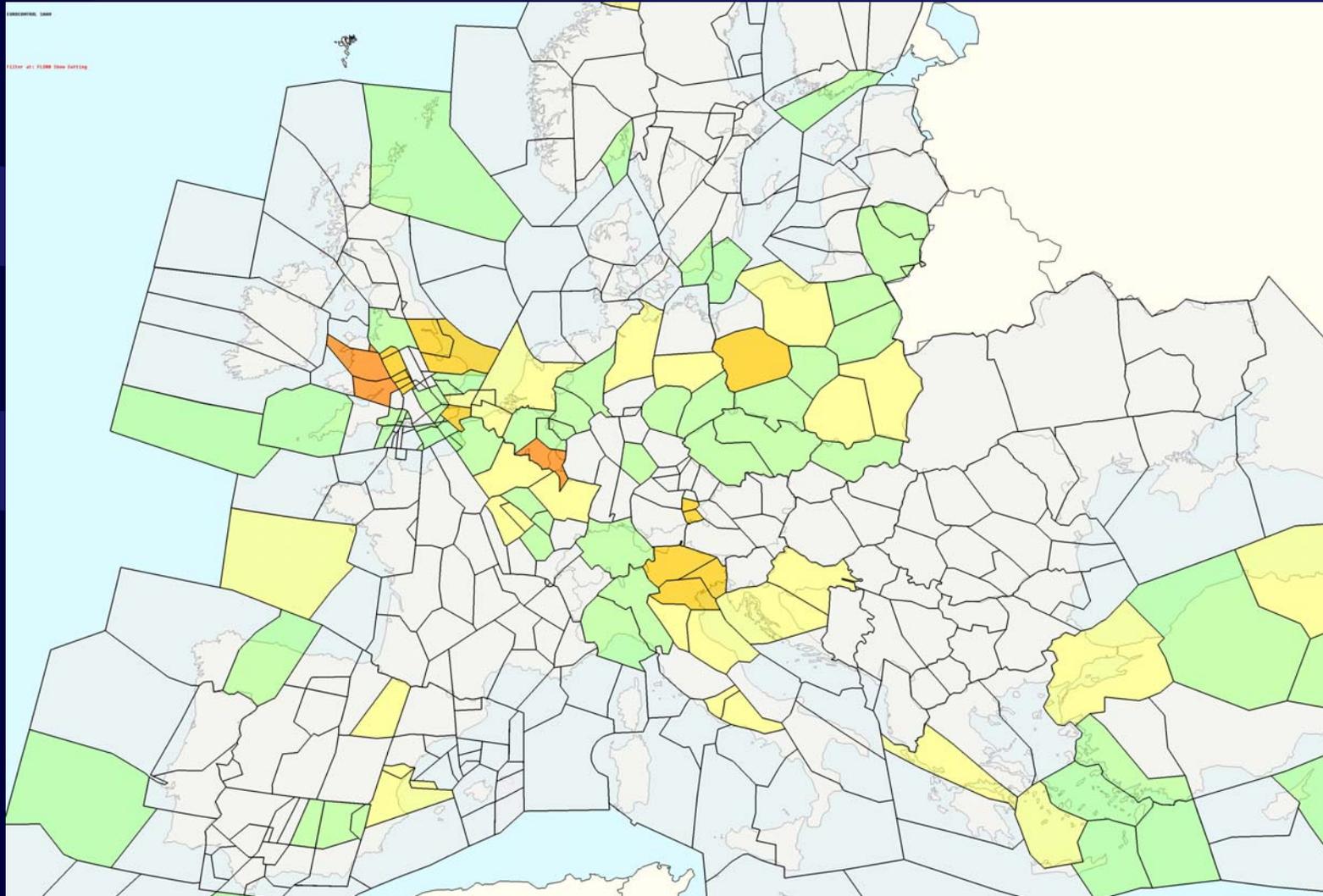
# Introduction to SAAM

## Sectors overload before Optimisation



# Introduction to SAAM

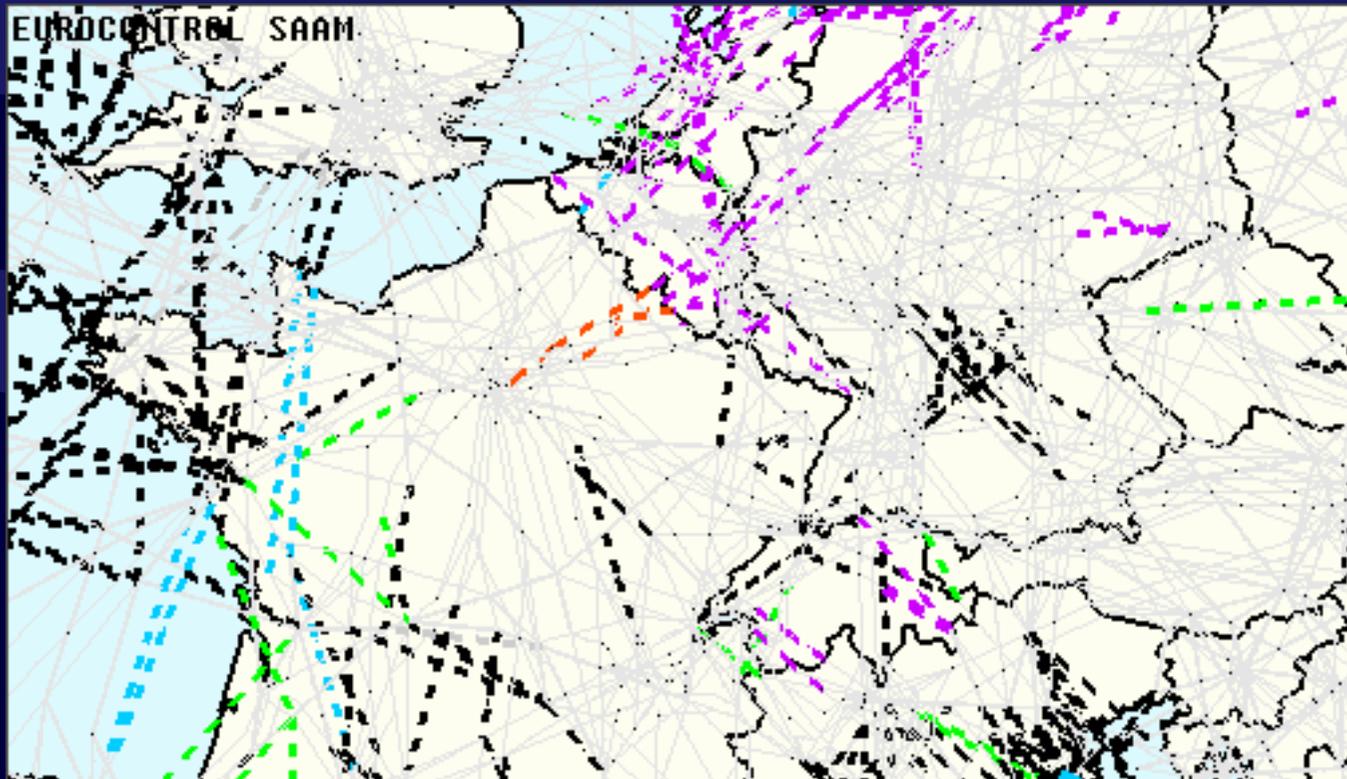
## Sectors overload after Optimisation



# Airspace Design Tool: SAAM

## Main Features

### Conditional Route (CDR) Management

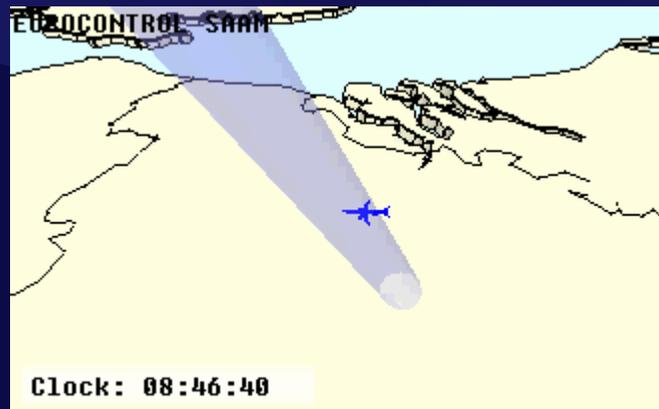


# Airspace Design Tool: SAAM

## Main Features

Animation & presentation of scenarios

More than **350** movies created for  
high level European audience  
as well as  
small local project presentation



# Airspace Design Tool: SAAM

## Main Features

### Export / Import of scenario

SAAM can import and export scenario to other simulators (fast-time and real-time)



# Airspace Design Tool: SAAM

## Main Features

- **Easy to install**  
no admin right, no registry
- **No license is required**  
self contained and free GNU tools except for optimisation
- **Very flexible**  
huge combinations of tools & modules
- **Quick**  
Classical analysis & solution of local problem is done in a day



# SAAM – System Wide Modelling

## SAAM & ATM structure in Europe

### Today Situation



# Current ATM Structure in Europe

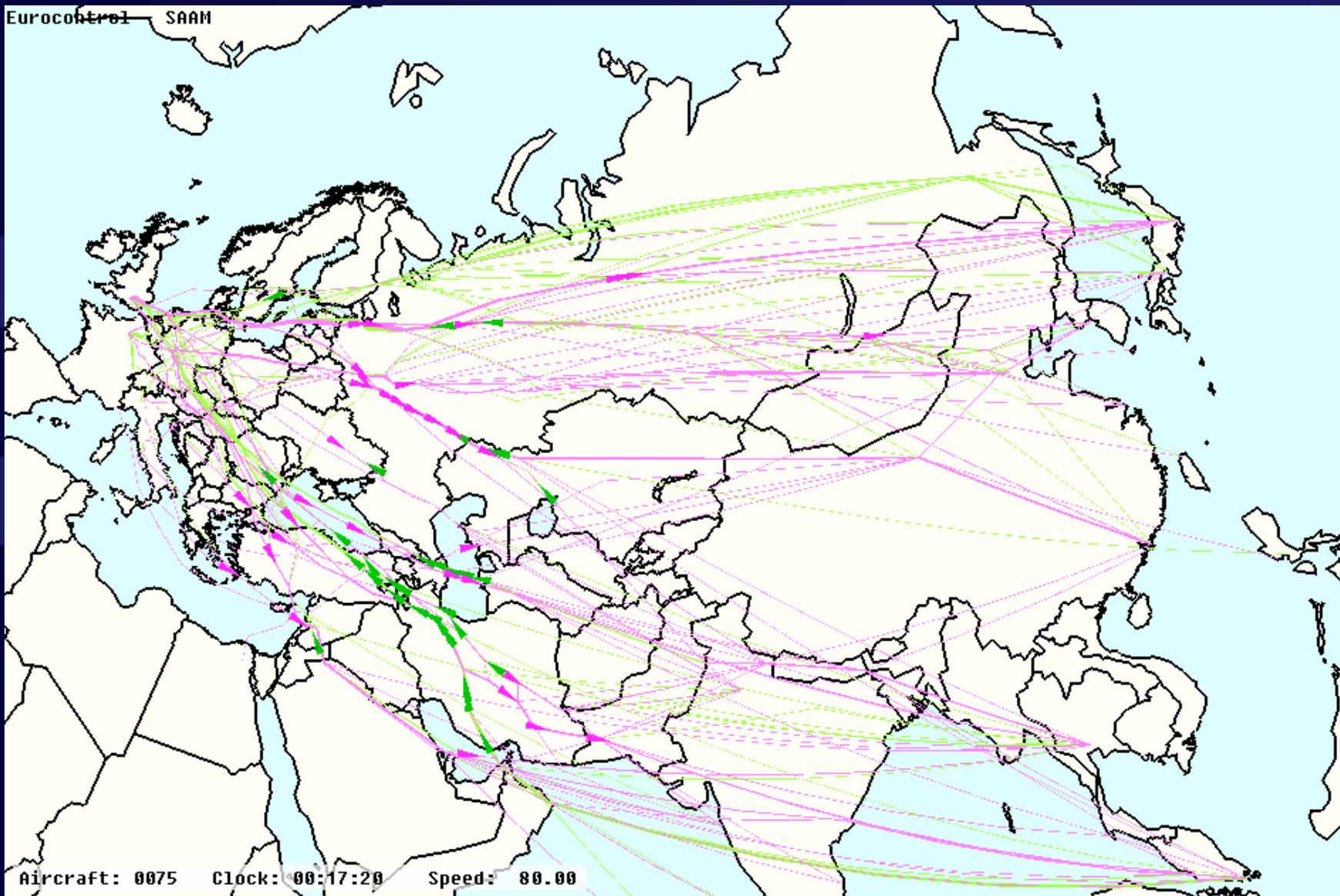
Eurocontrol SAAM



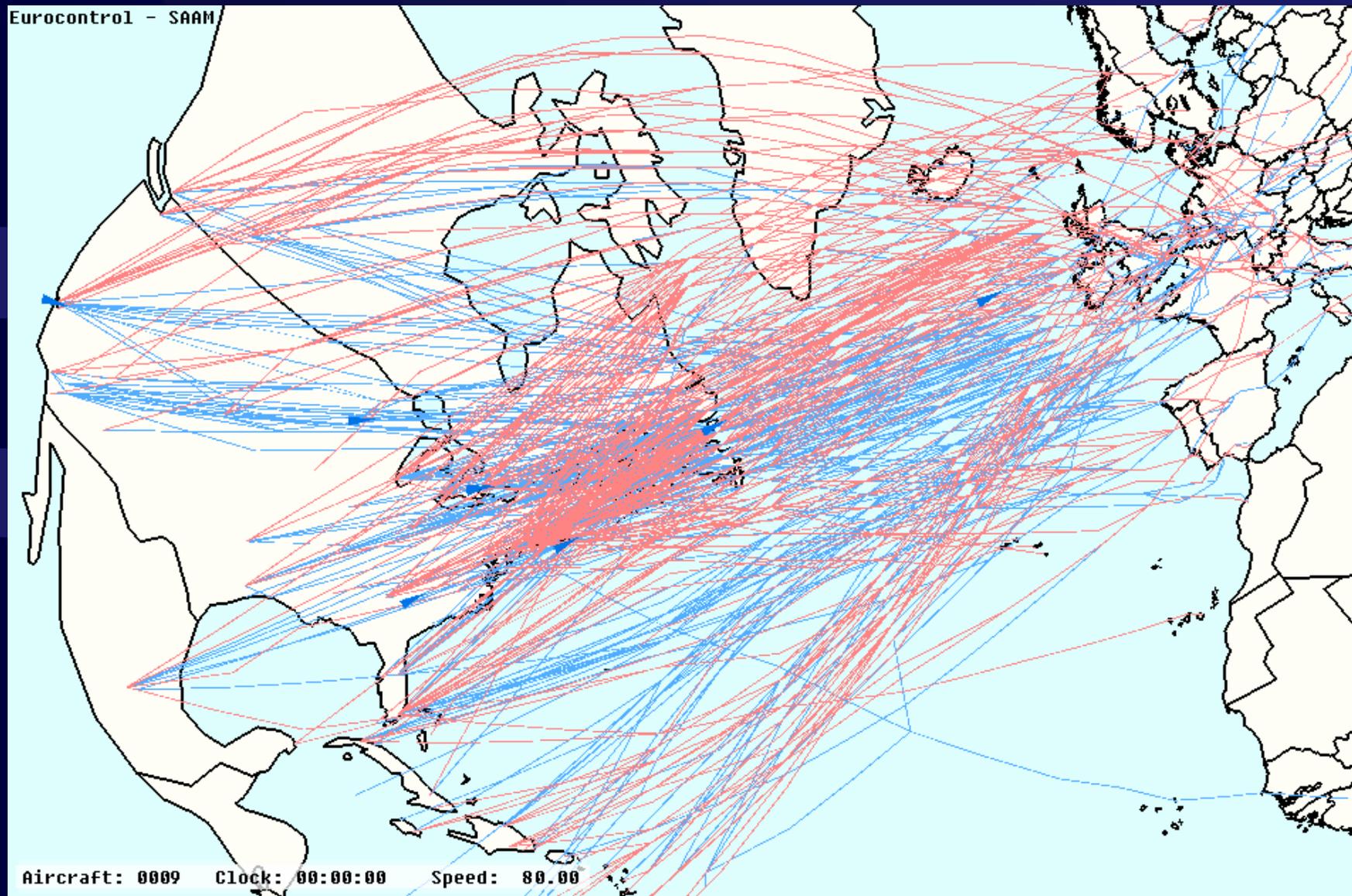
# Current ATM Structure in Europe



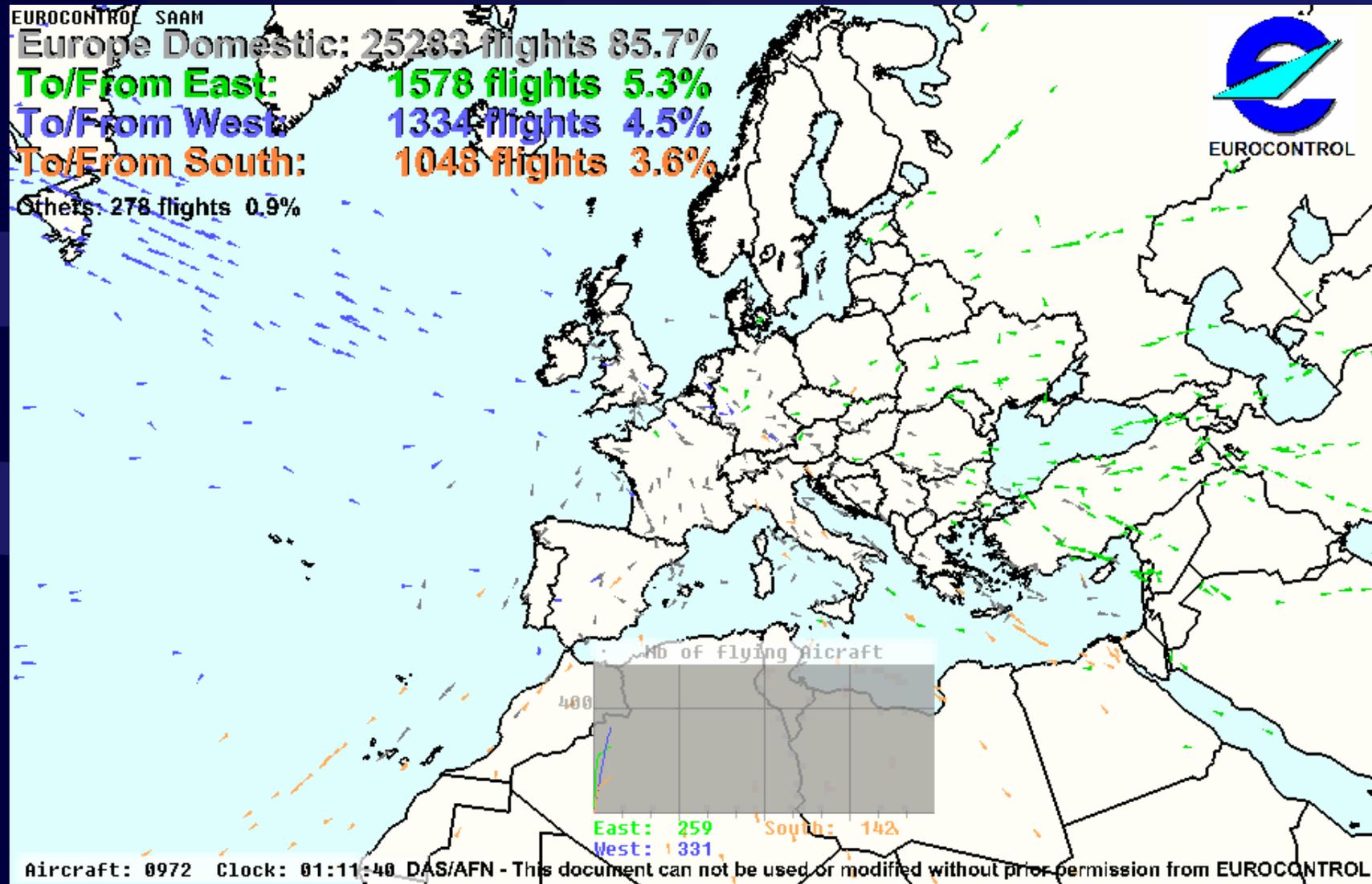
# Current ATM Structure in Europe



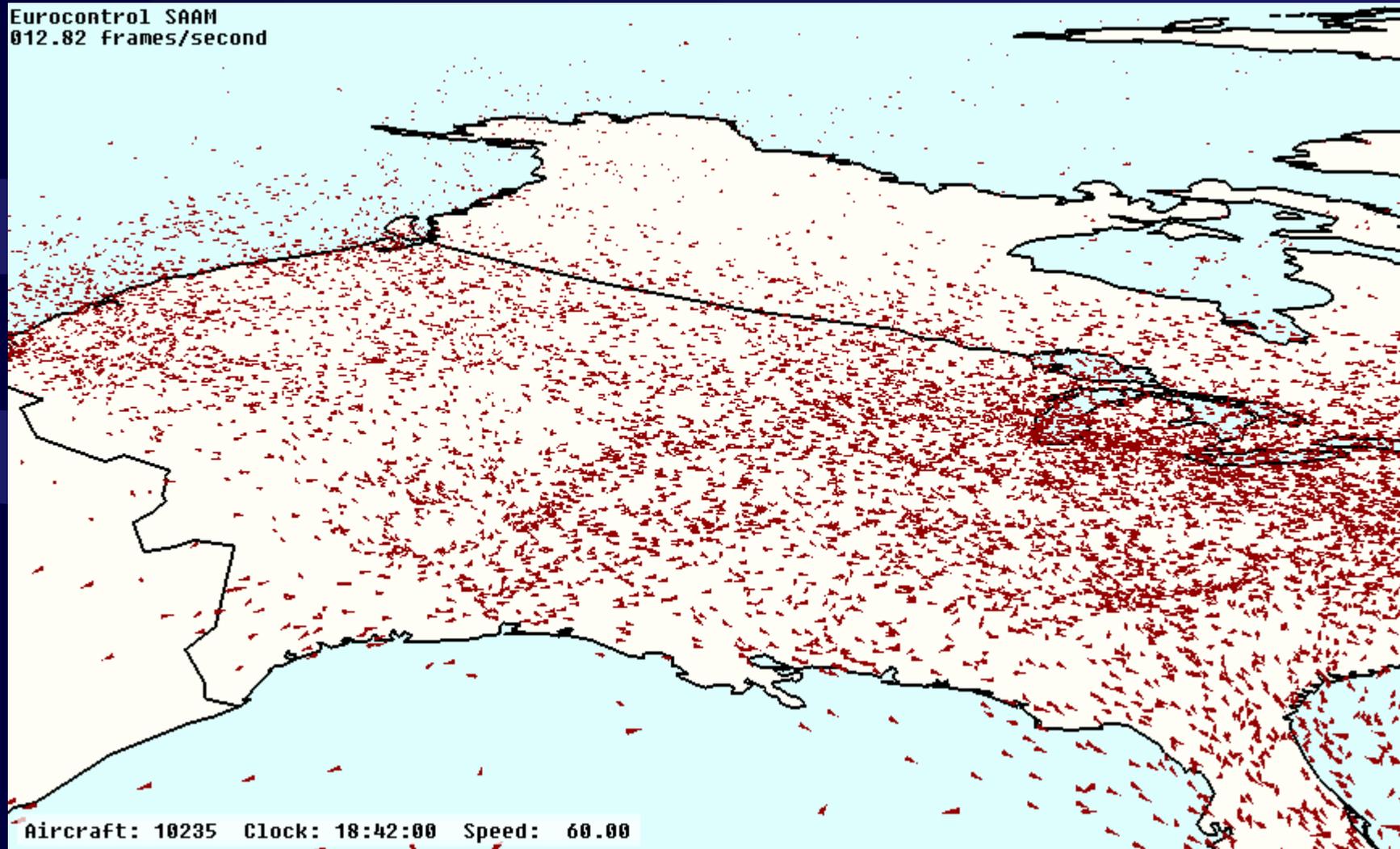
# Current ATM Structure in Europe



# Current ATM Structure in Europe



# Current ATM Structure in Europe



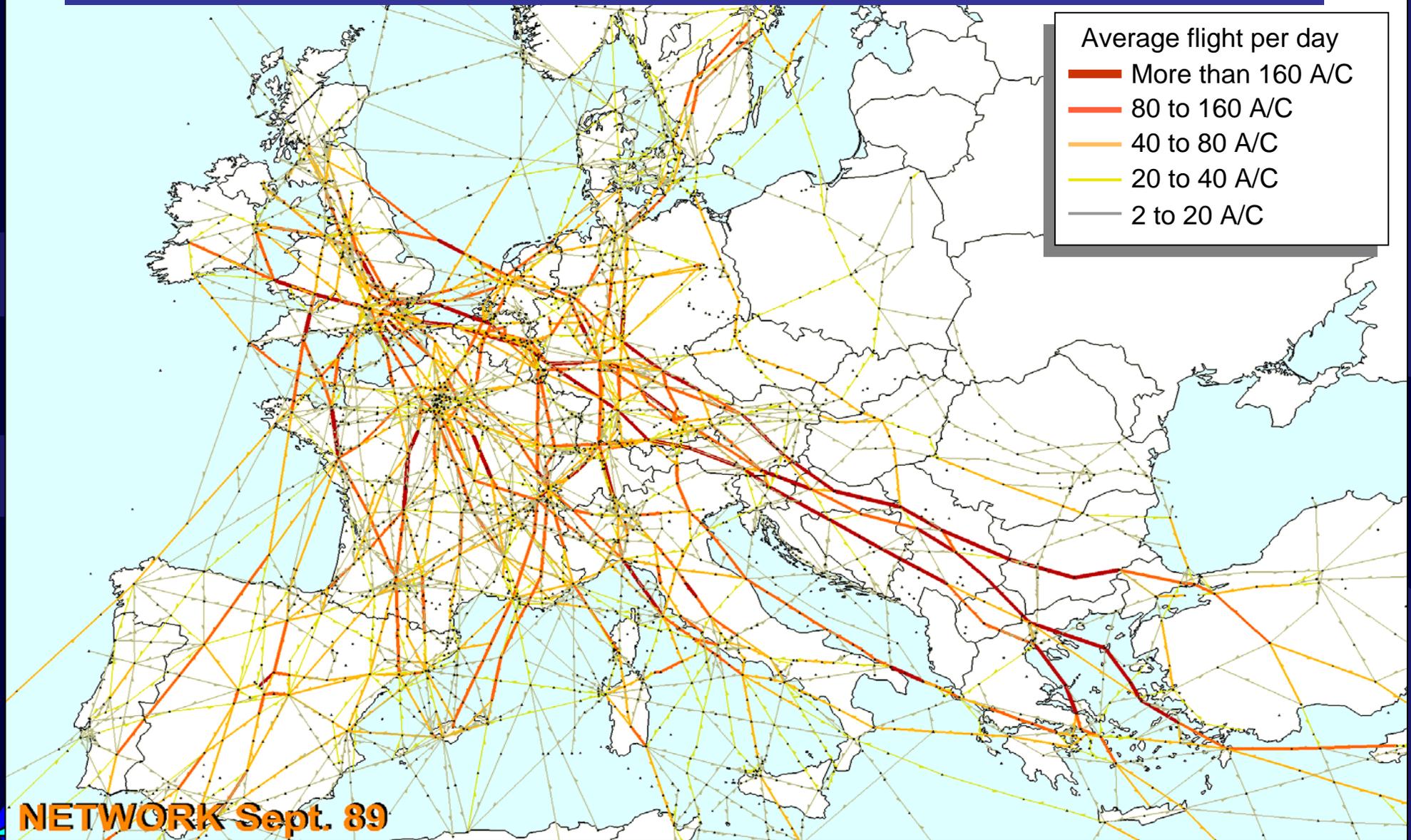
# SAAM – System Wide Modelling

## SAAM & ATM structure in Europe

**From Past to Future:  
Increasing complexity**

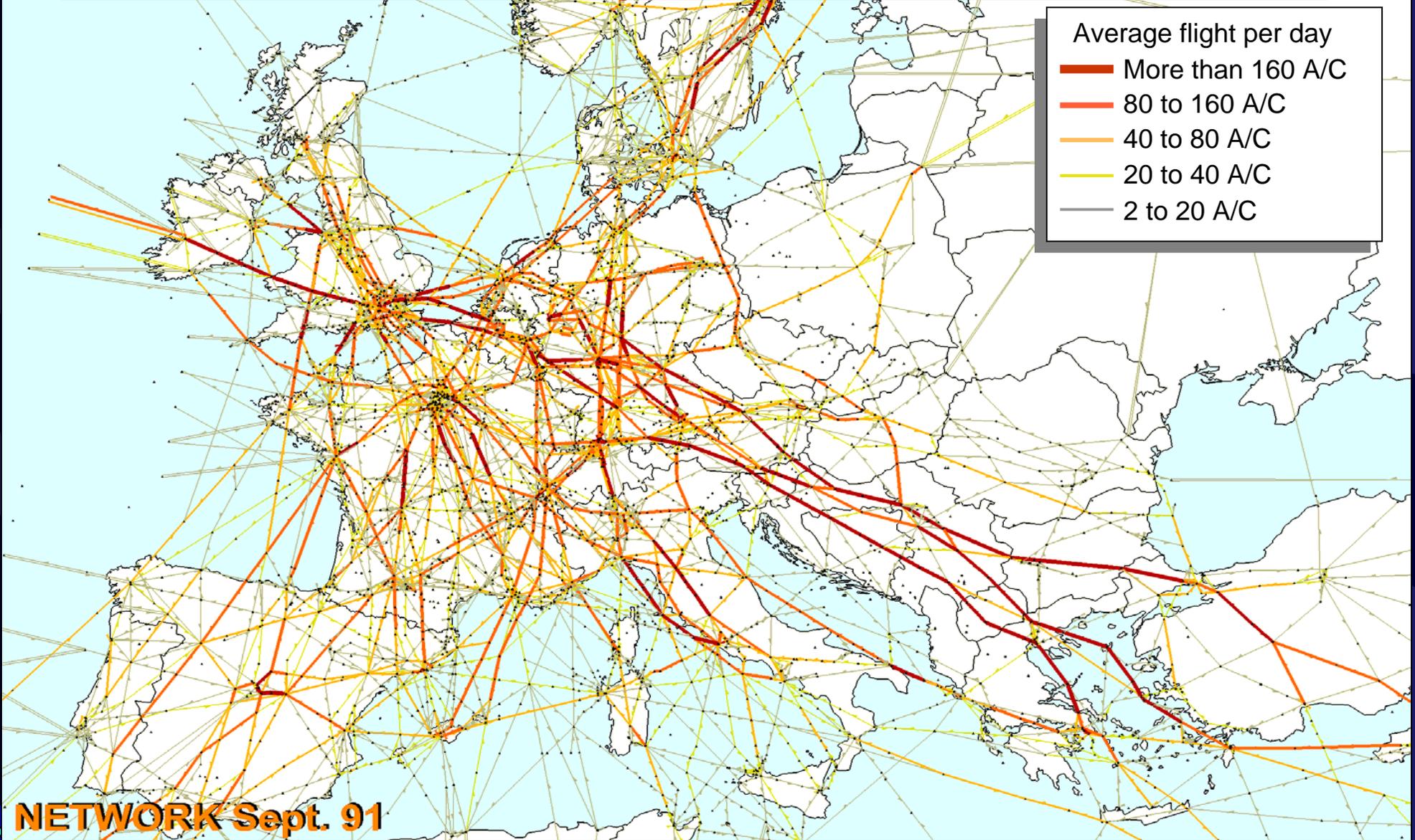


# From Past to Future



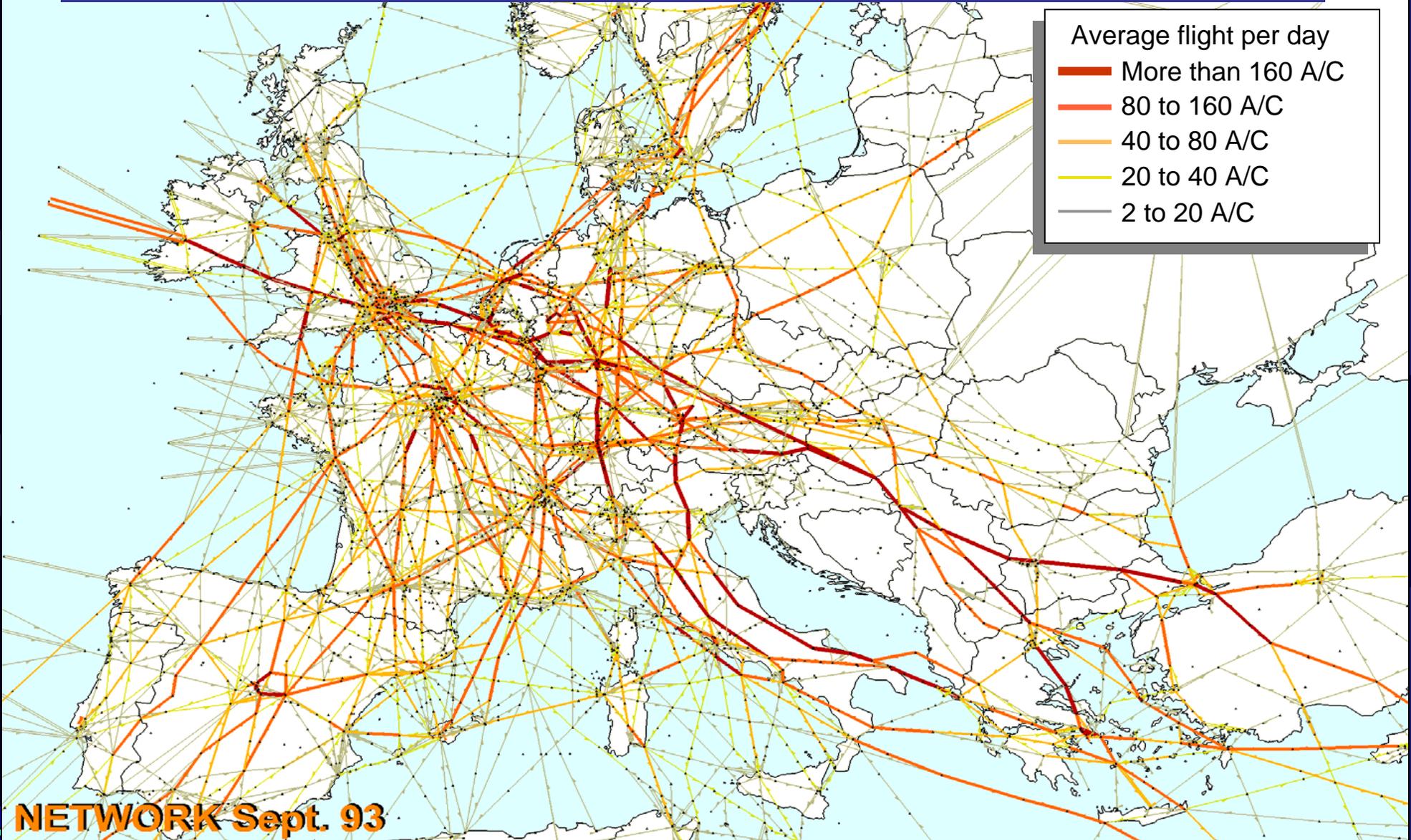
**NETWORK Sept. 89**

# From Past to Future



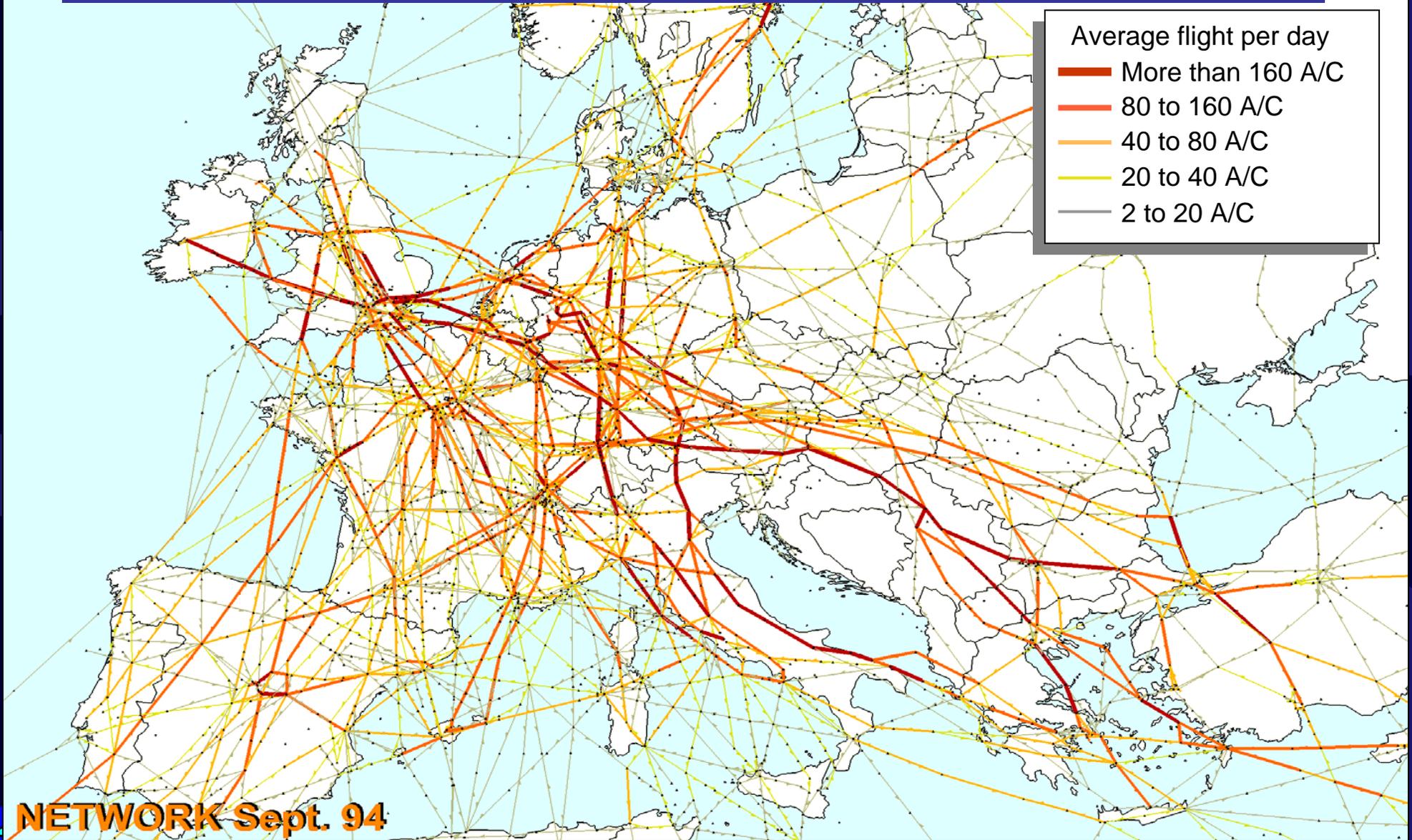
**NETWORK Sept. 91**

# From Past to Future



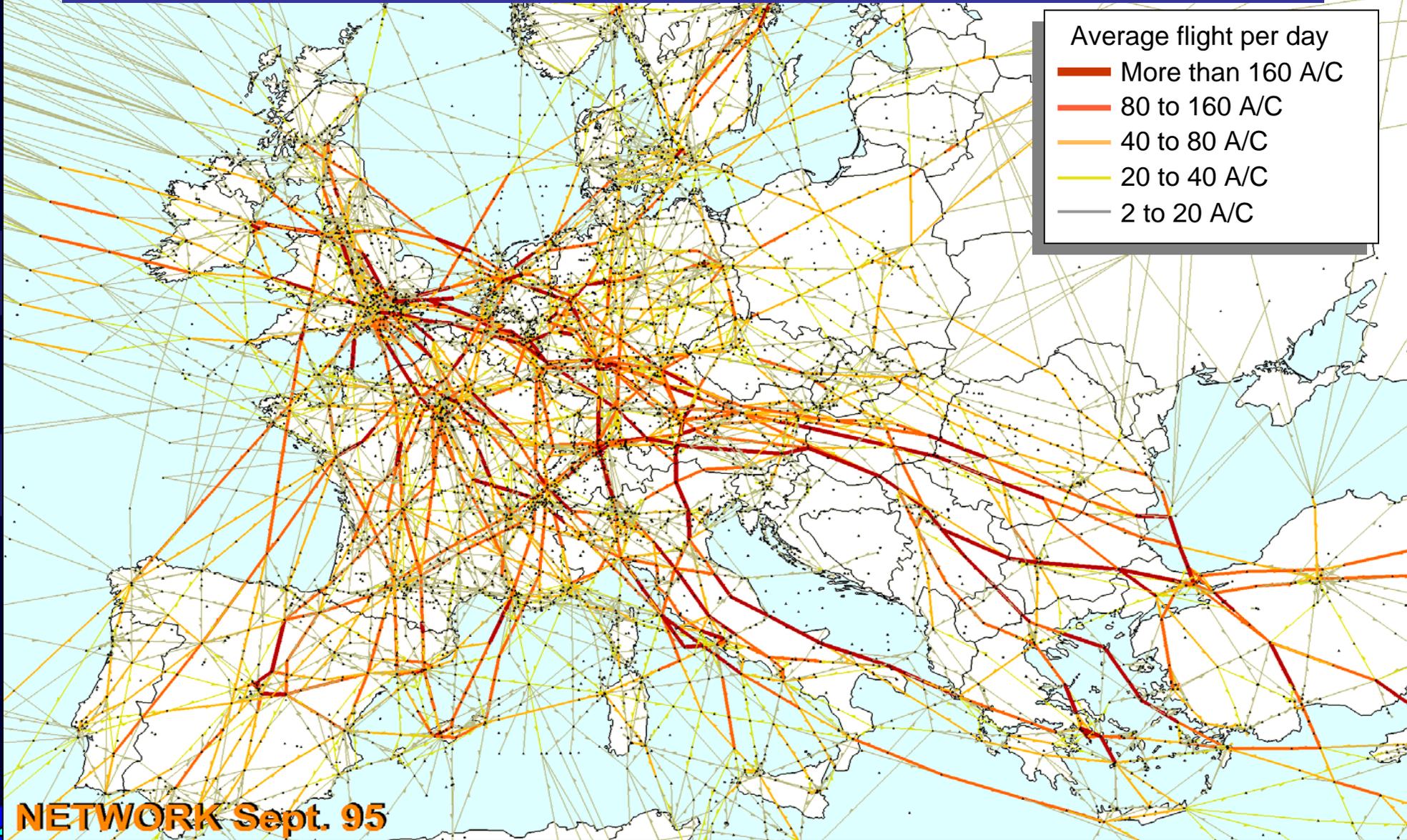
**NETWORK Sept. 93**

# From Past to Future



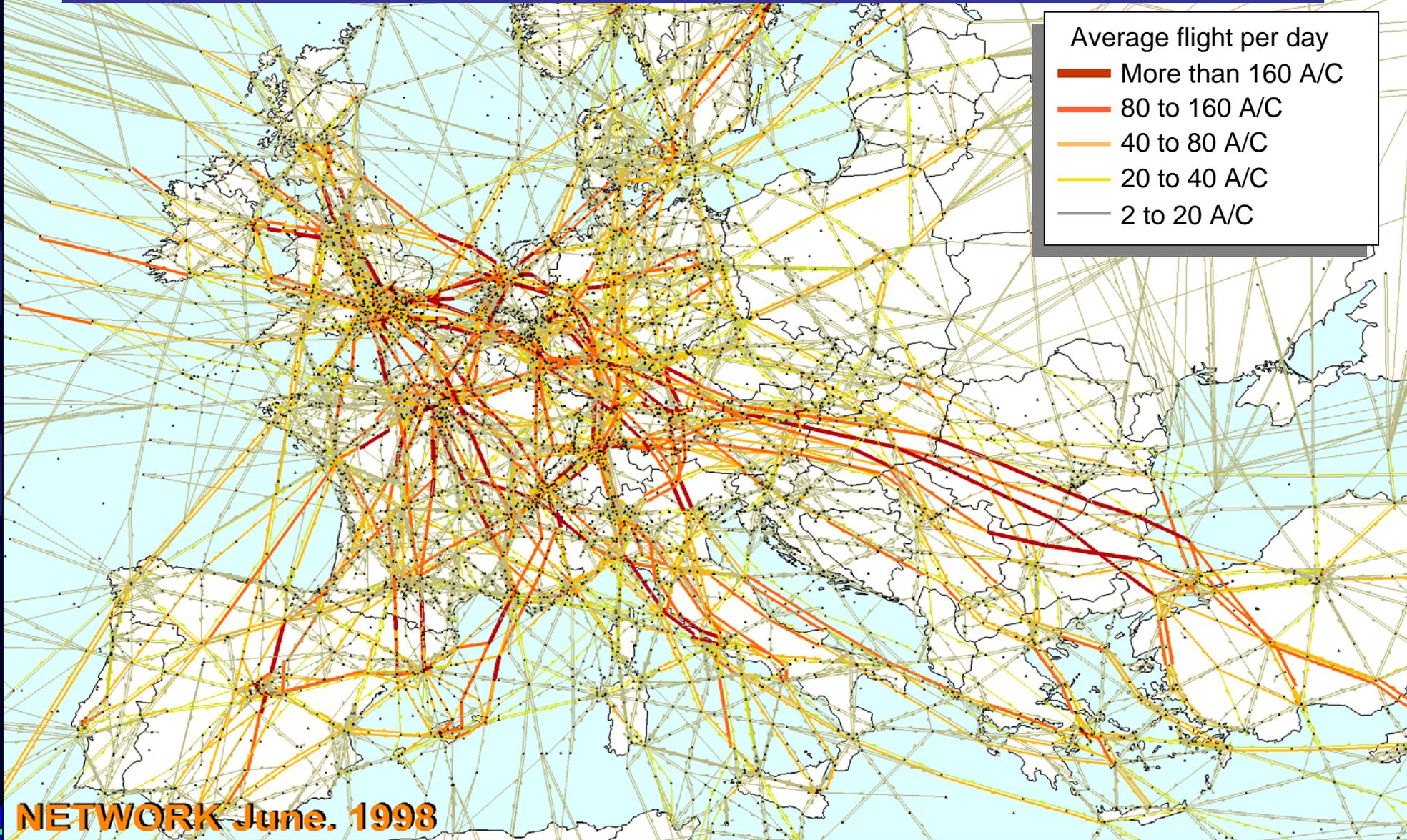
**NETWORK Sept. 94**

# From Past to Future

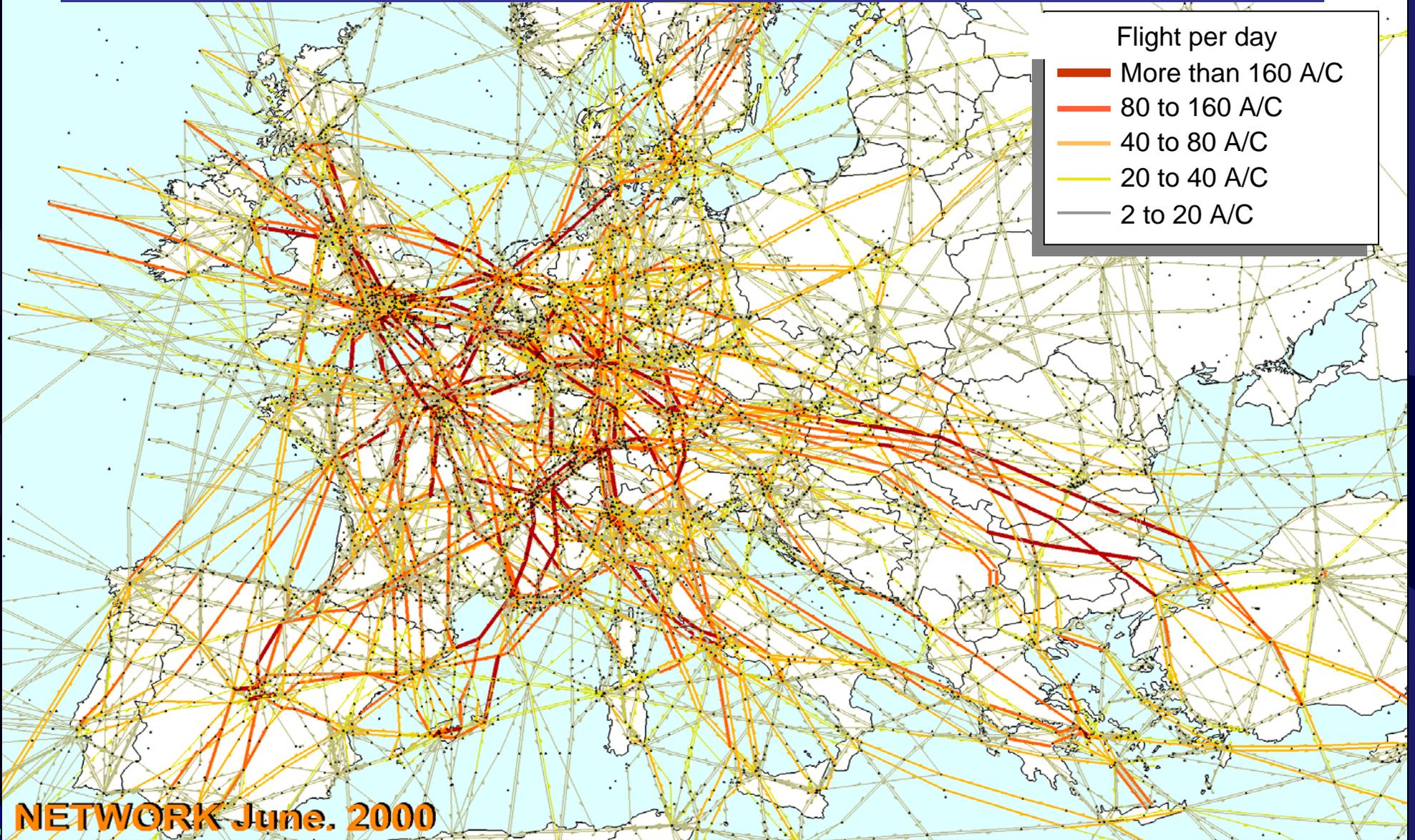


**NETWORK Sept. 95**

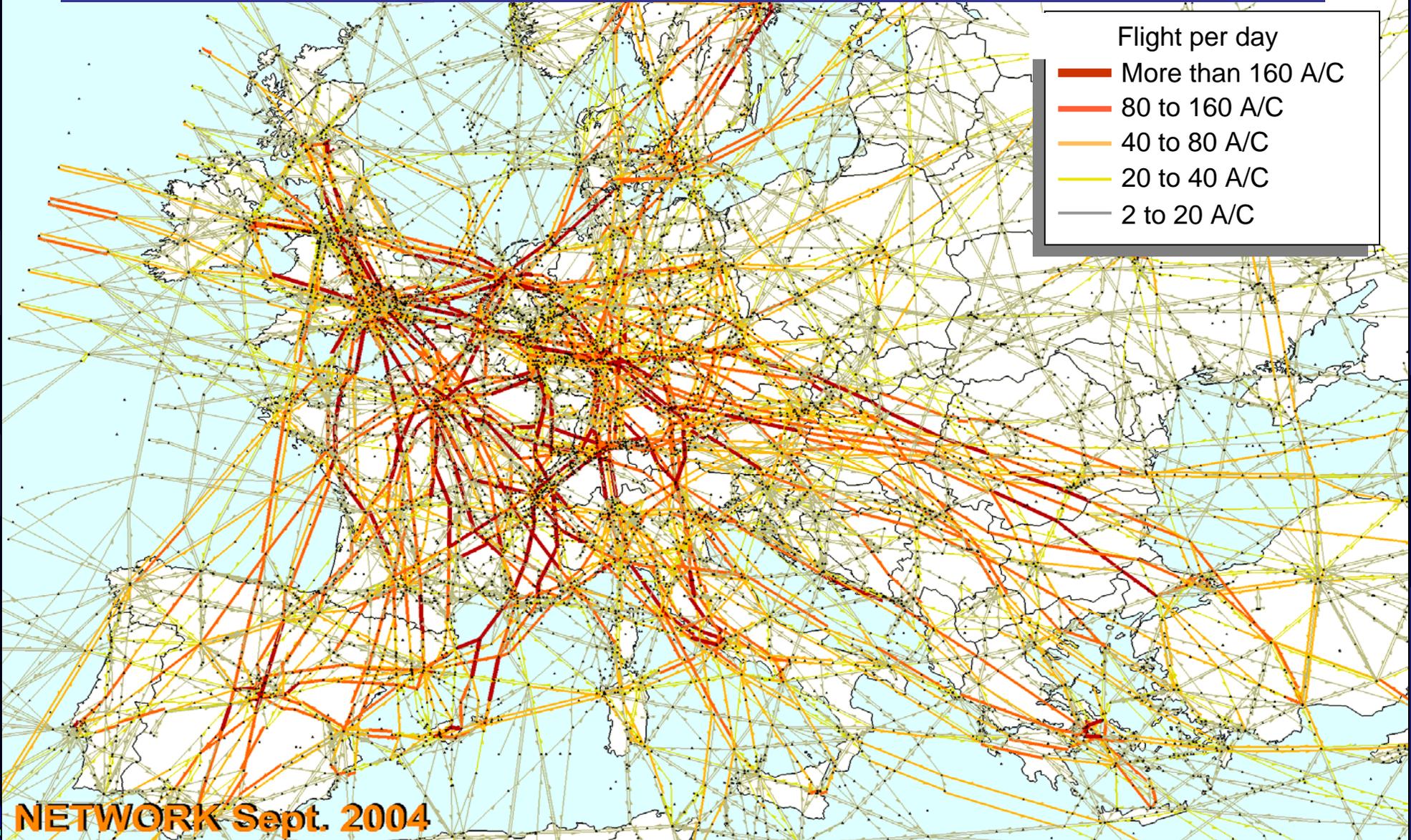
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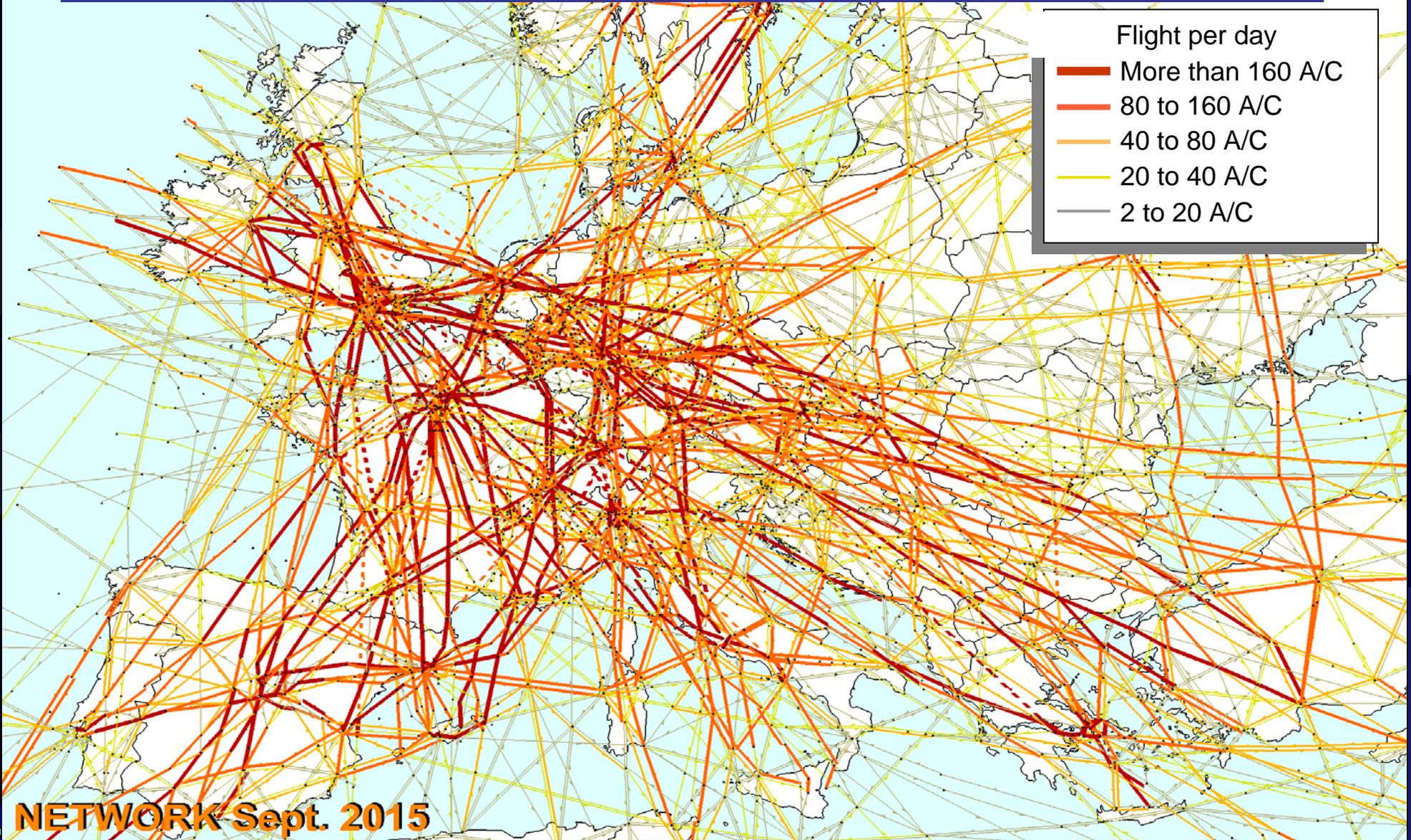
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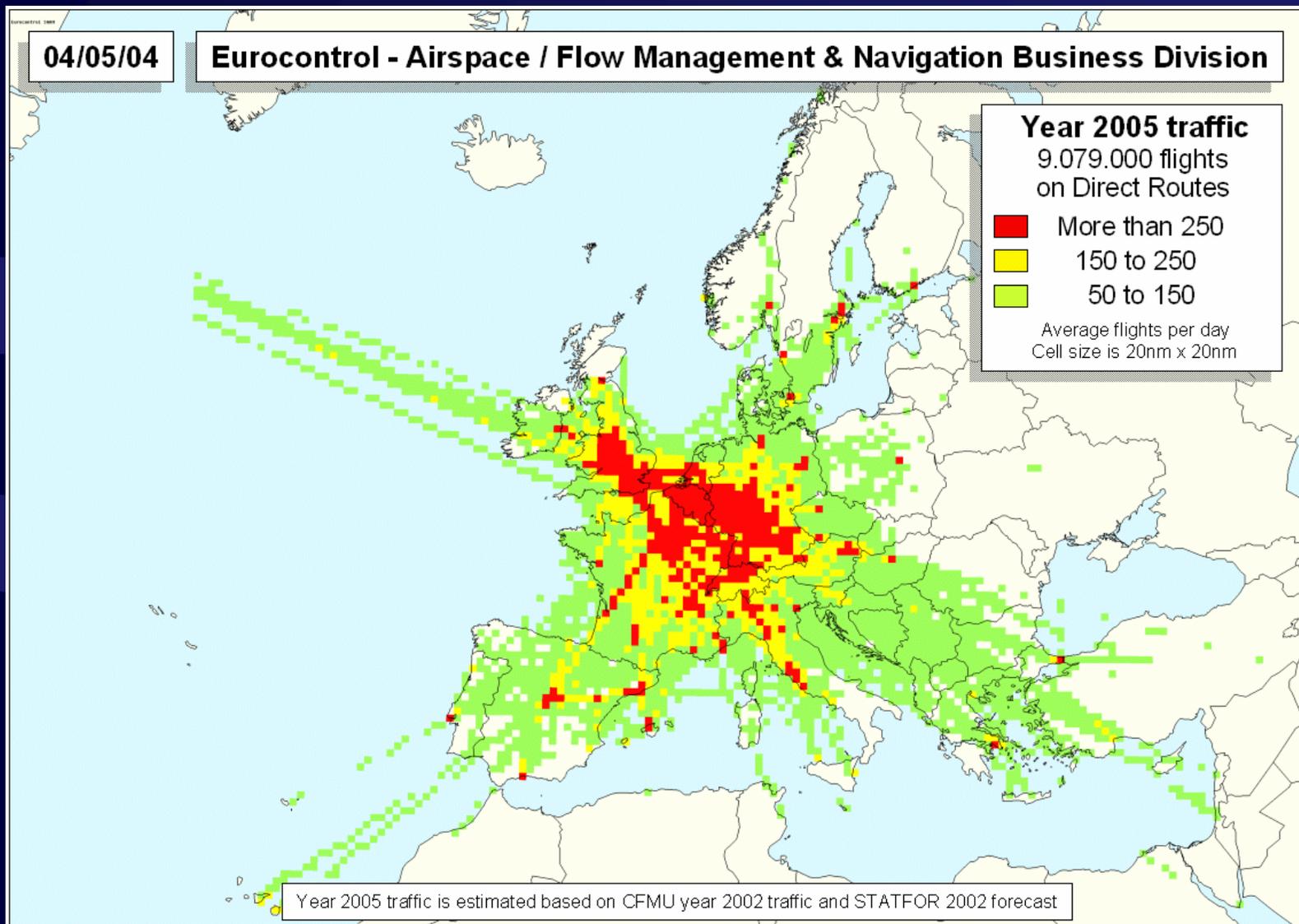
# From Past to Future



# From Past to Future



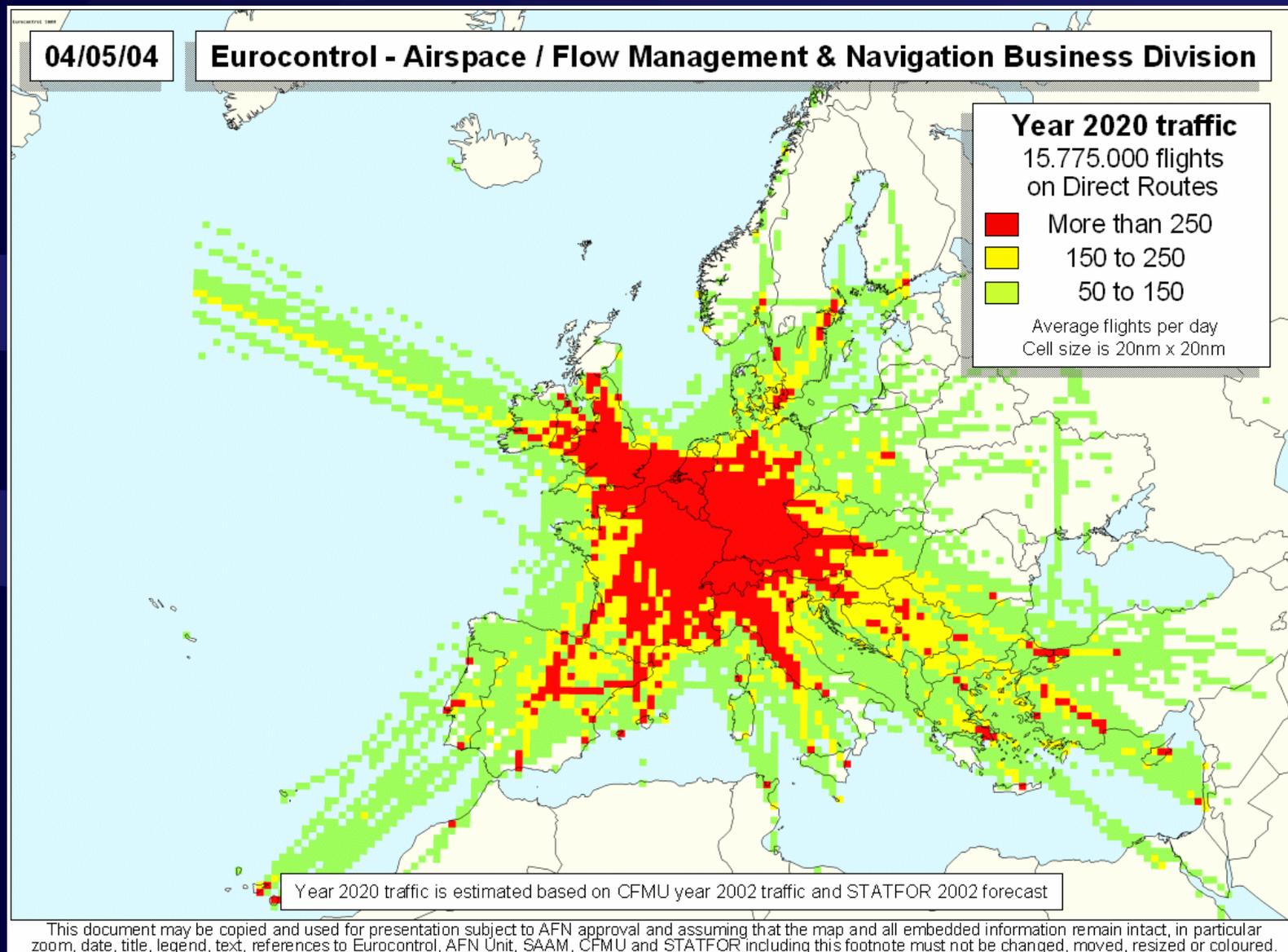
# From Past to Future



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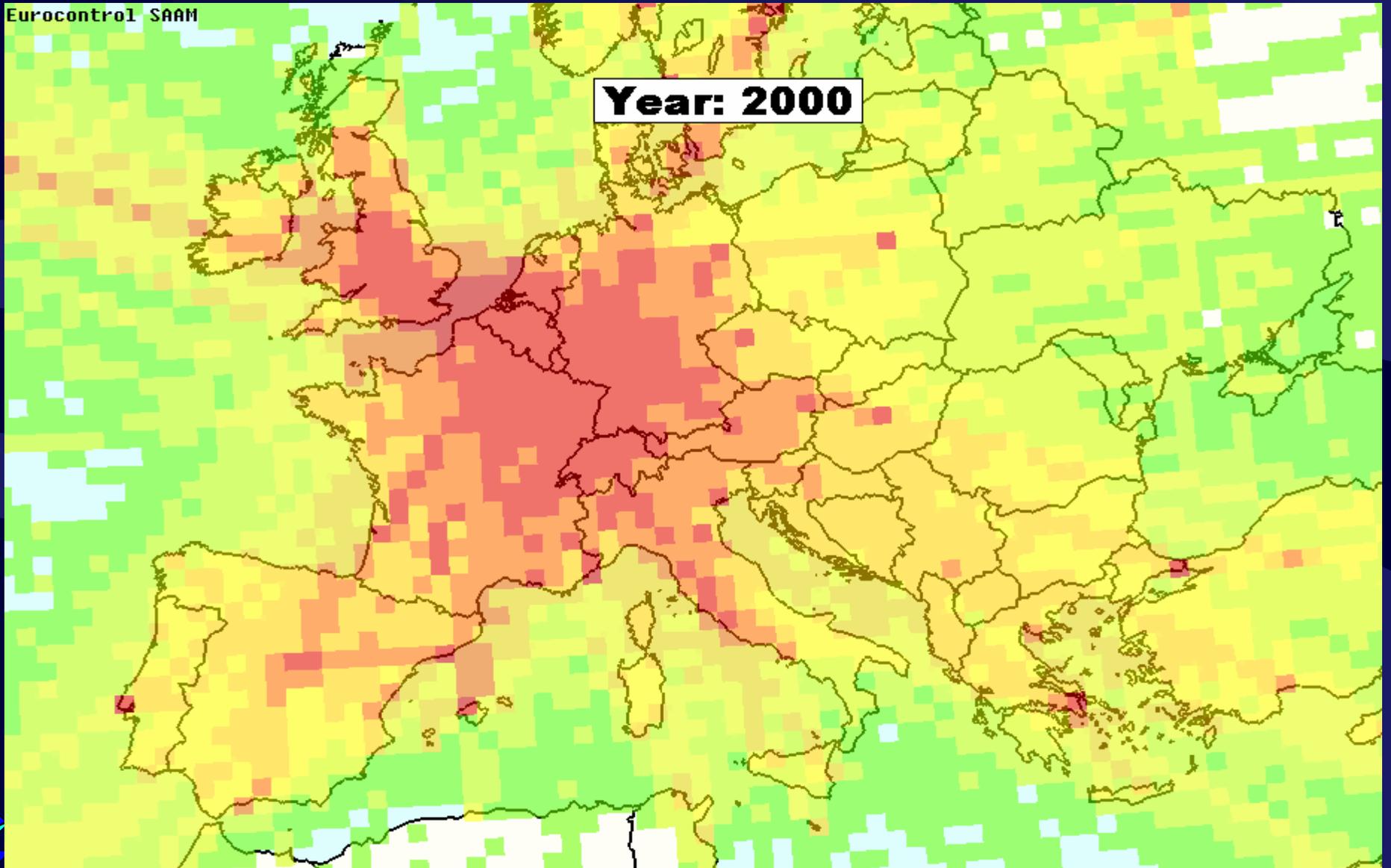
# From Past to Future



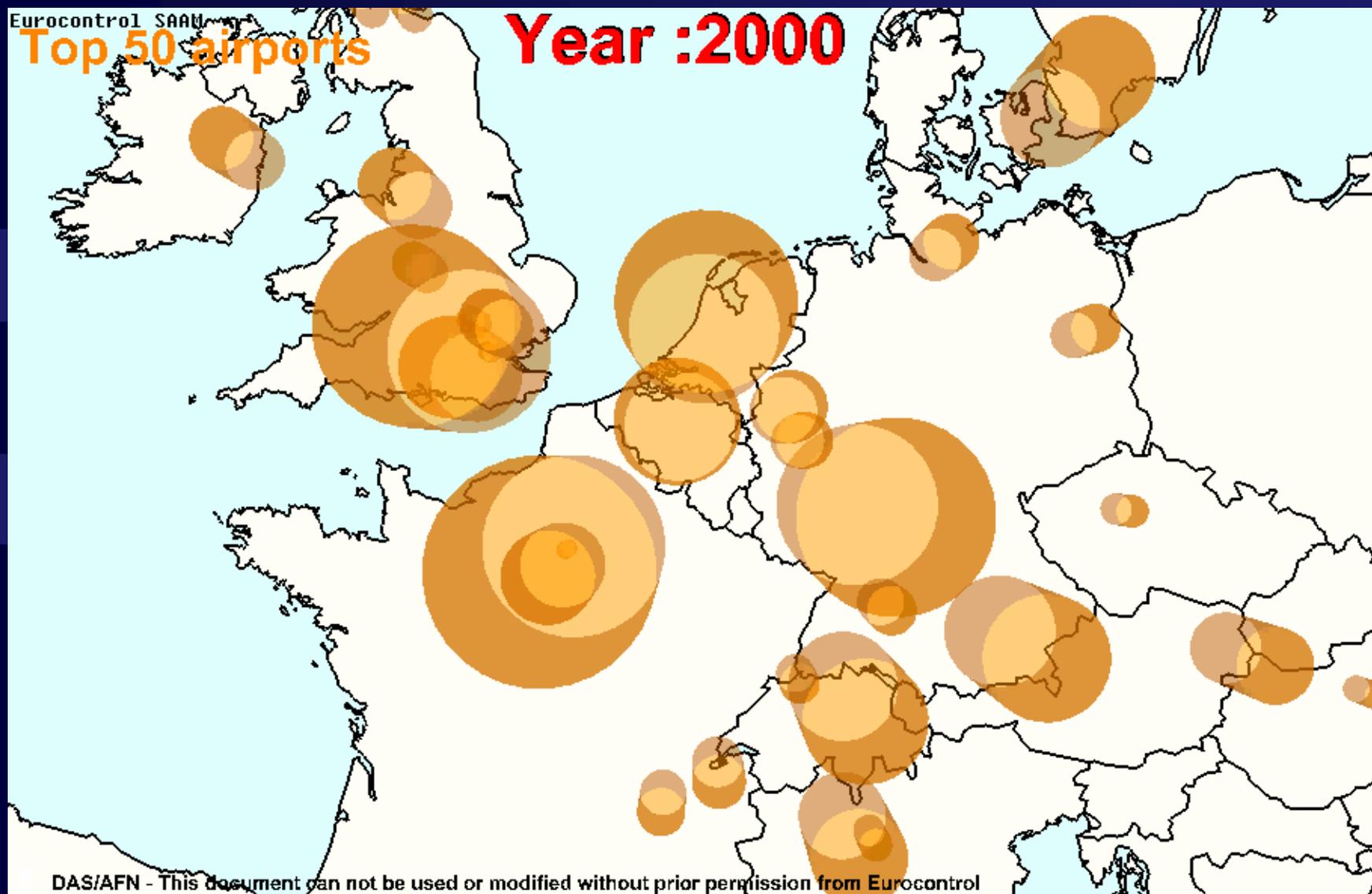
# From Past to Future

Eurocontrol SAAM

**Year: 2000**



# From Past to Future



# SAAM – System Wide Modelling

**SAAM**  
**handle Complexity to create**  
**Capacity**

**Network / Airspace / 4D trajectories**

**Civil / Military**

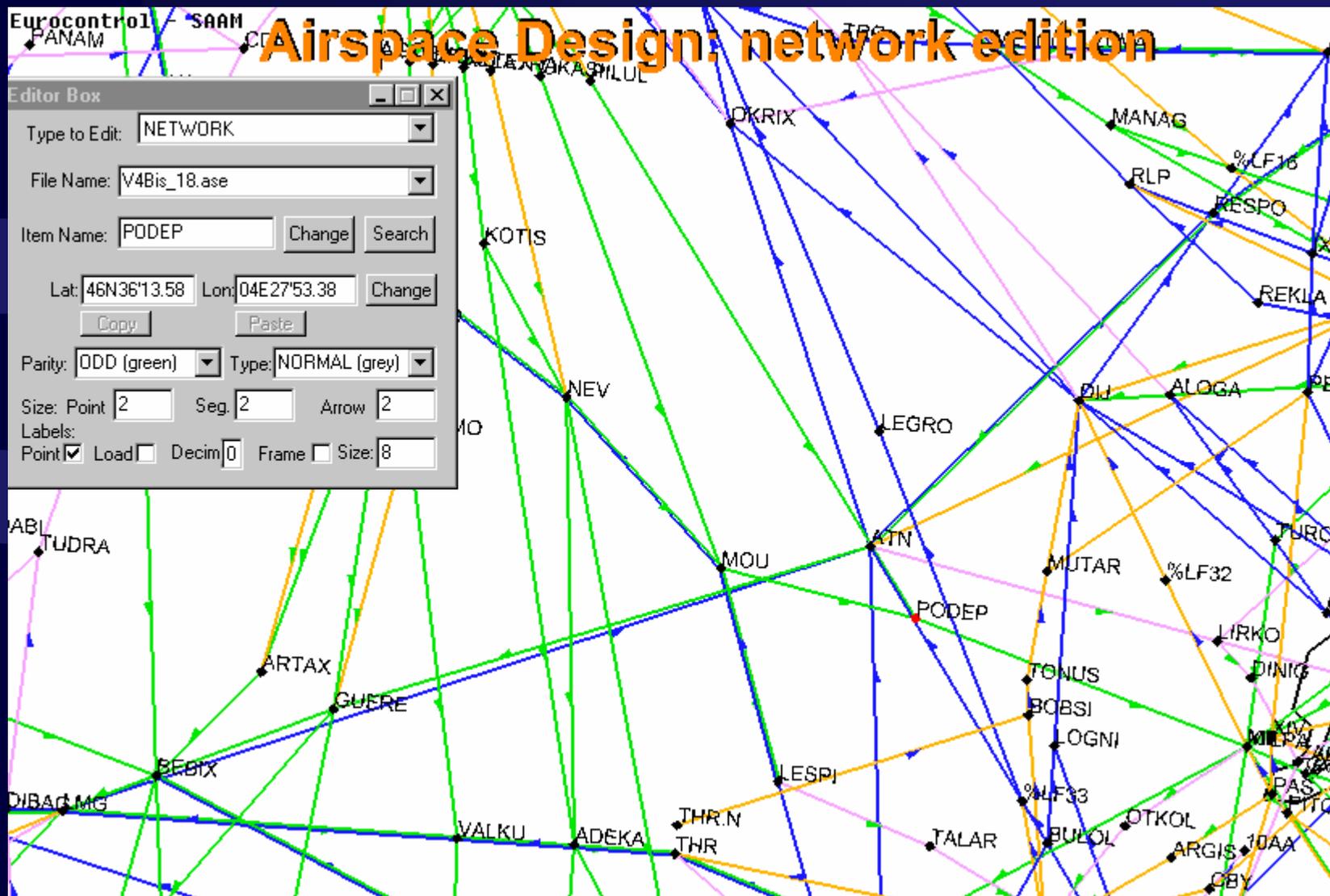
**Airport / En-route**

**Environment**

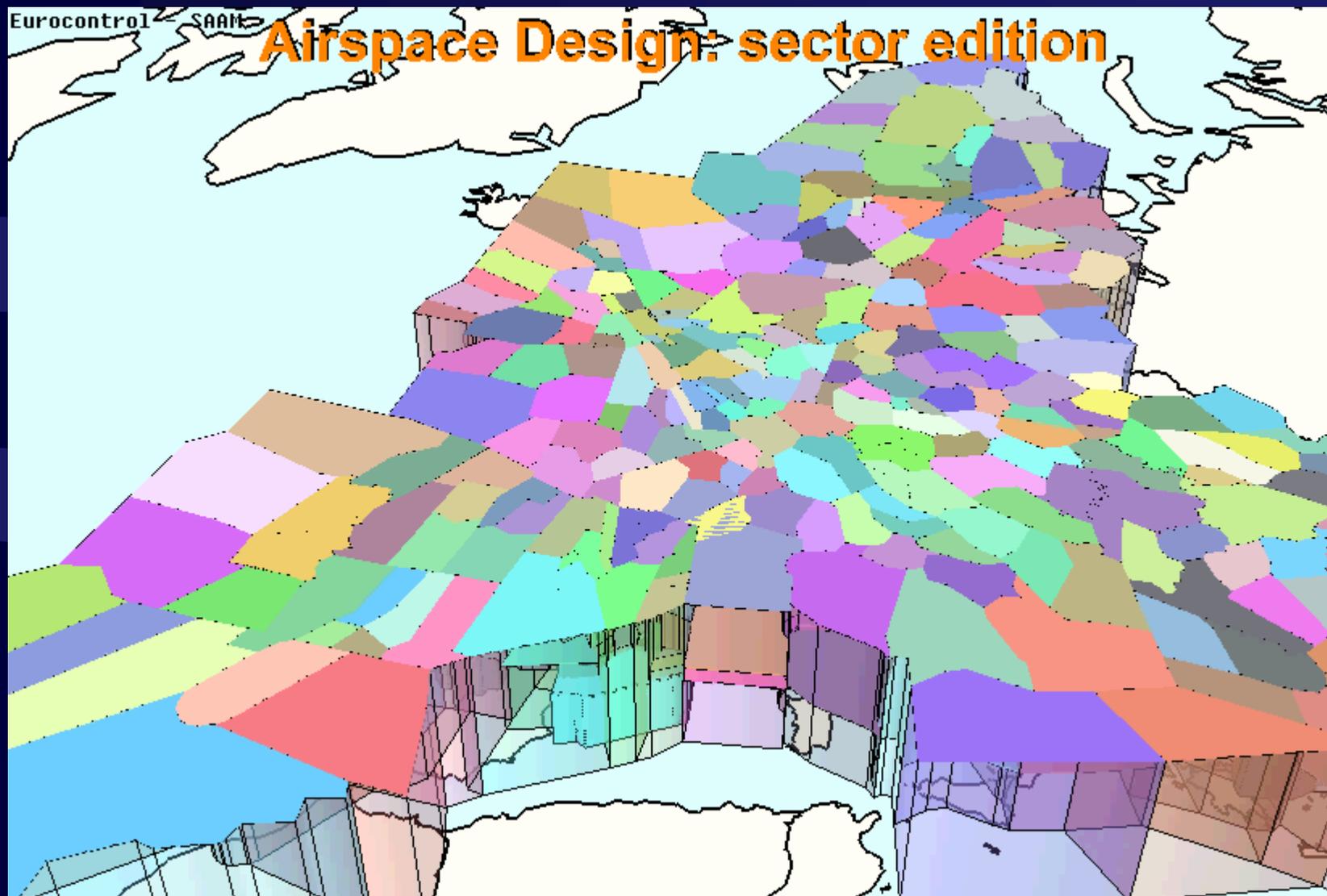
**Global Cost Solution**



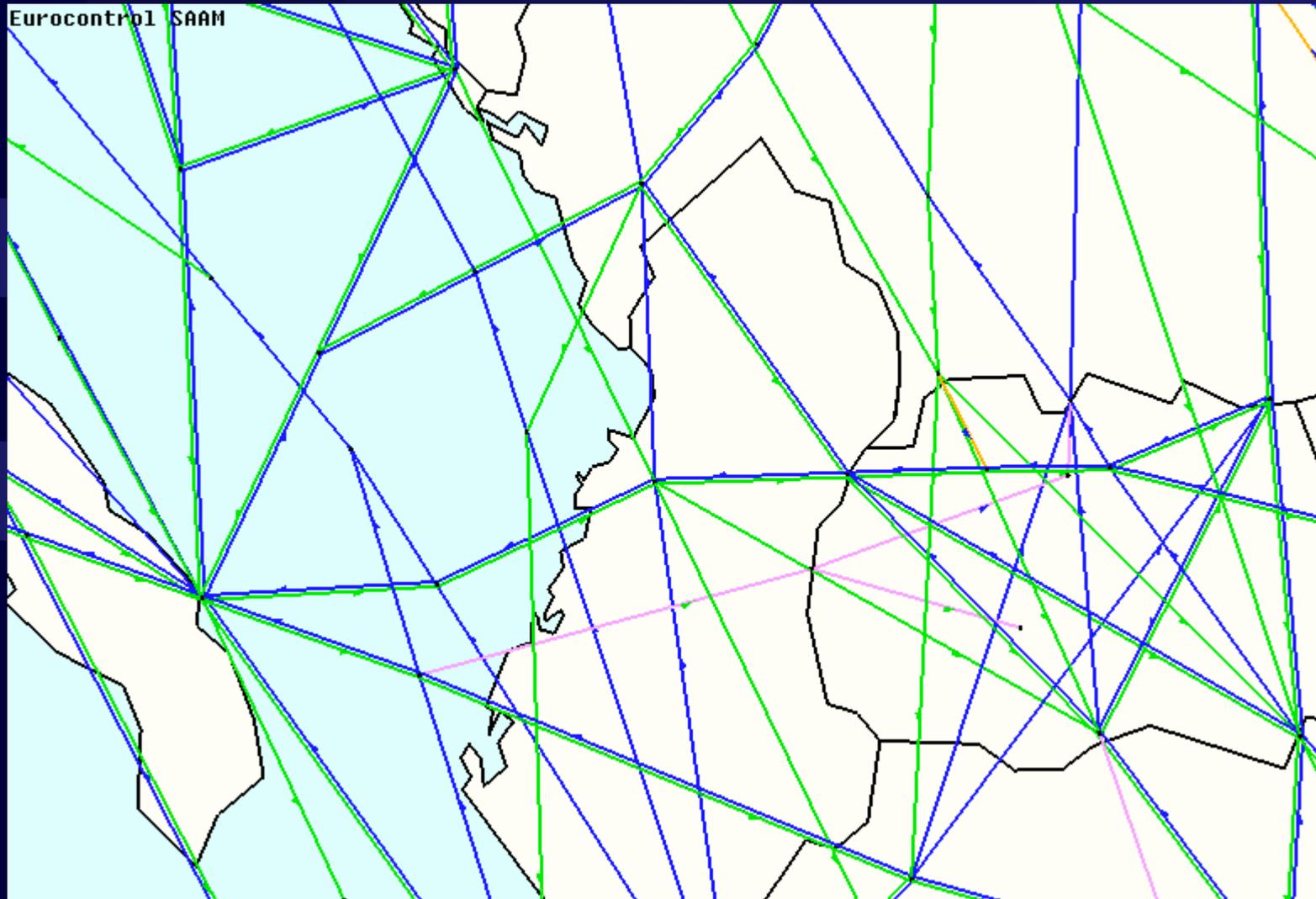
# Design Interaction Challenge



# Design Interaction Challenge

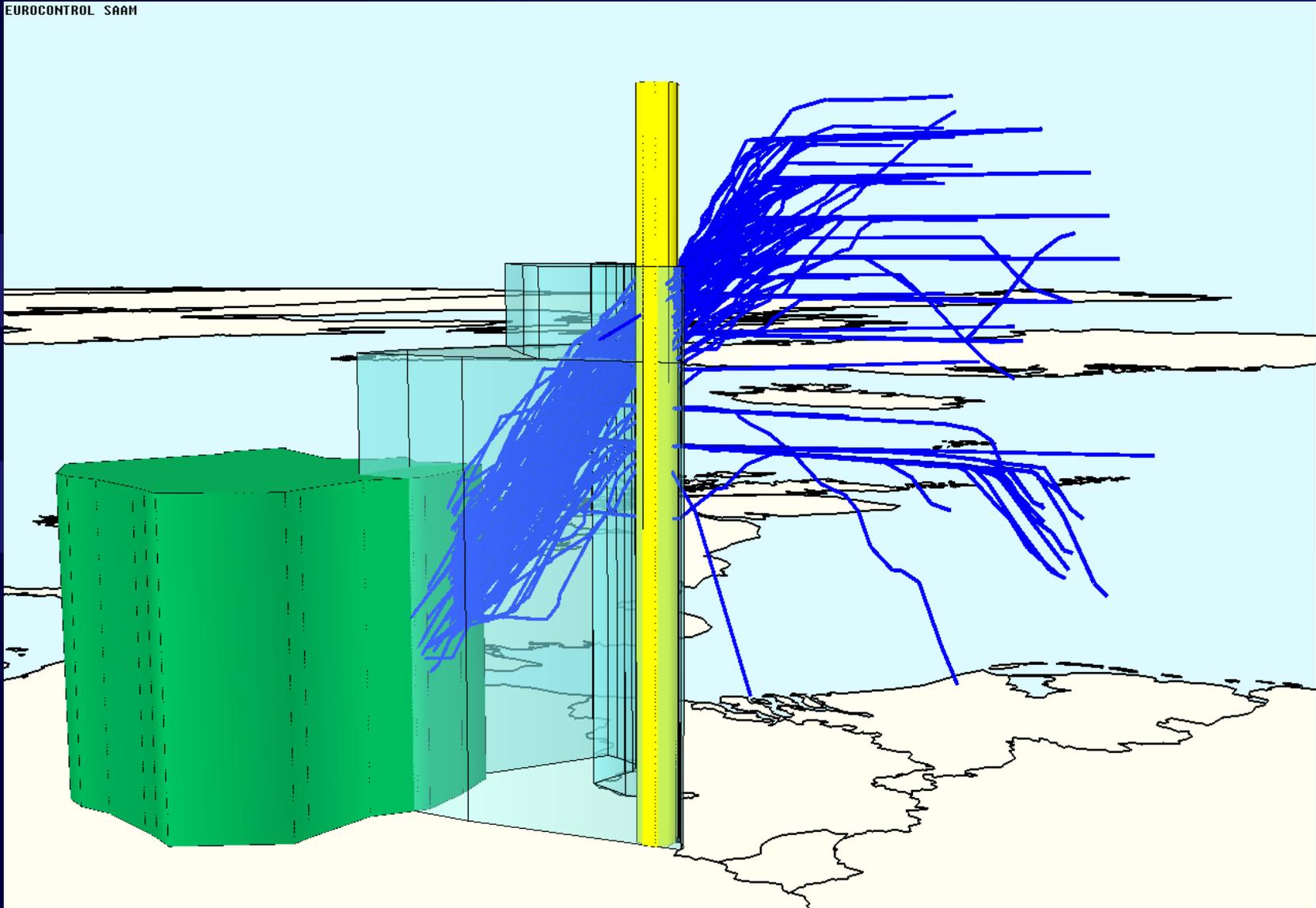


# Design Interaction Challenge



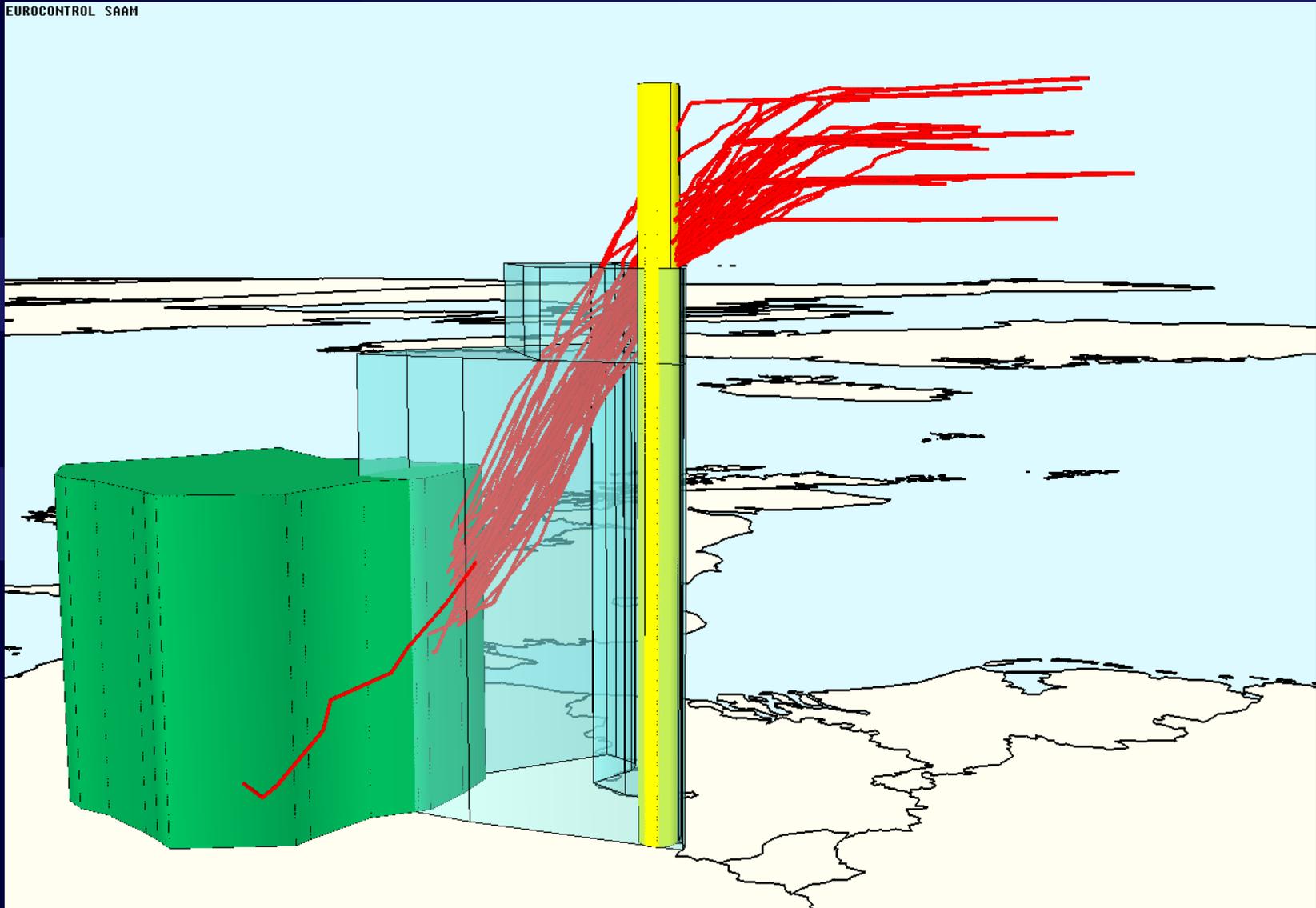
# Design Interaction Challenge

EUROCONTROL SAAM



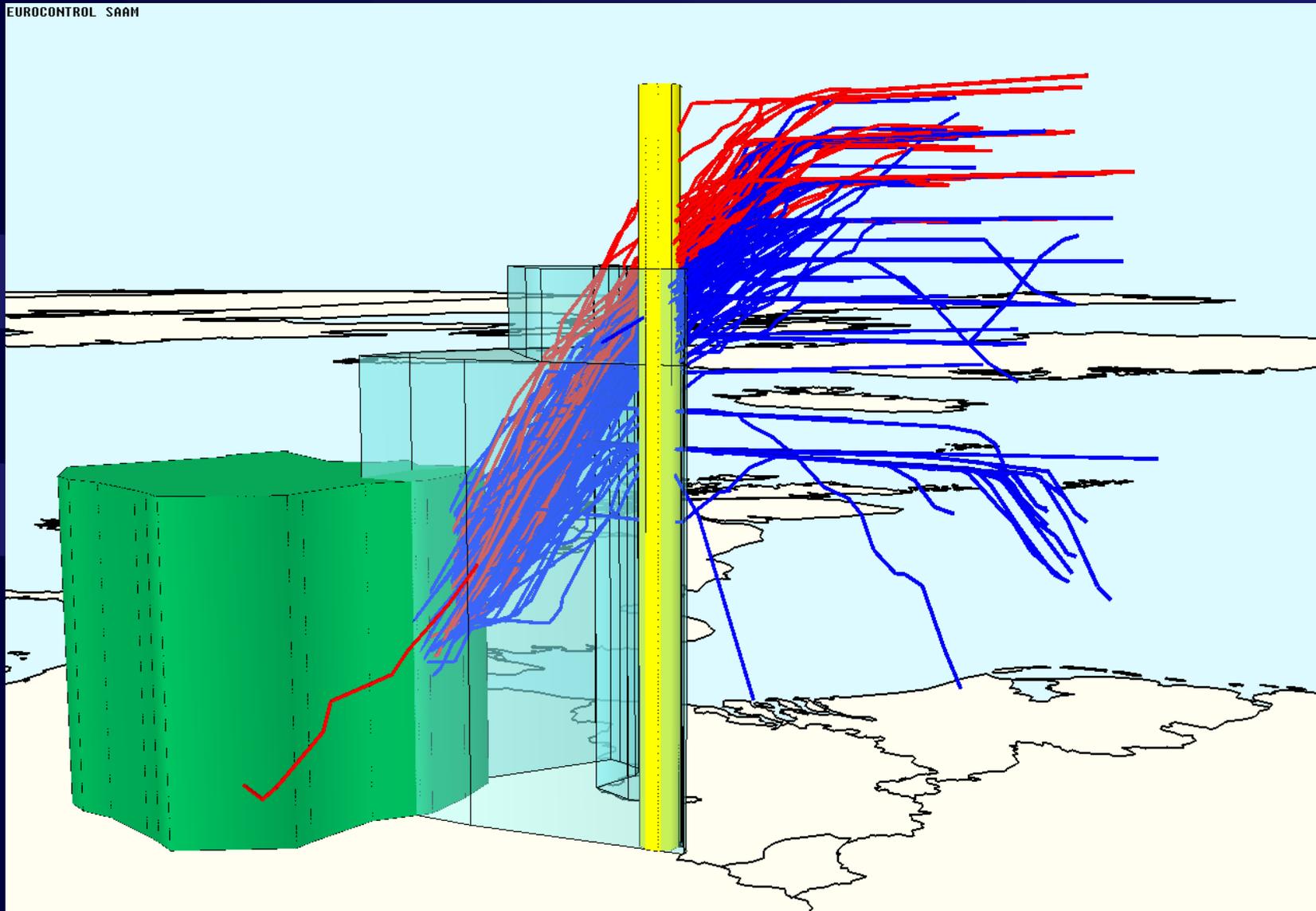
# Design Interaction Challenge

EUROCONTROL SAAM



# Design Interaction Challenge

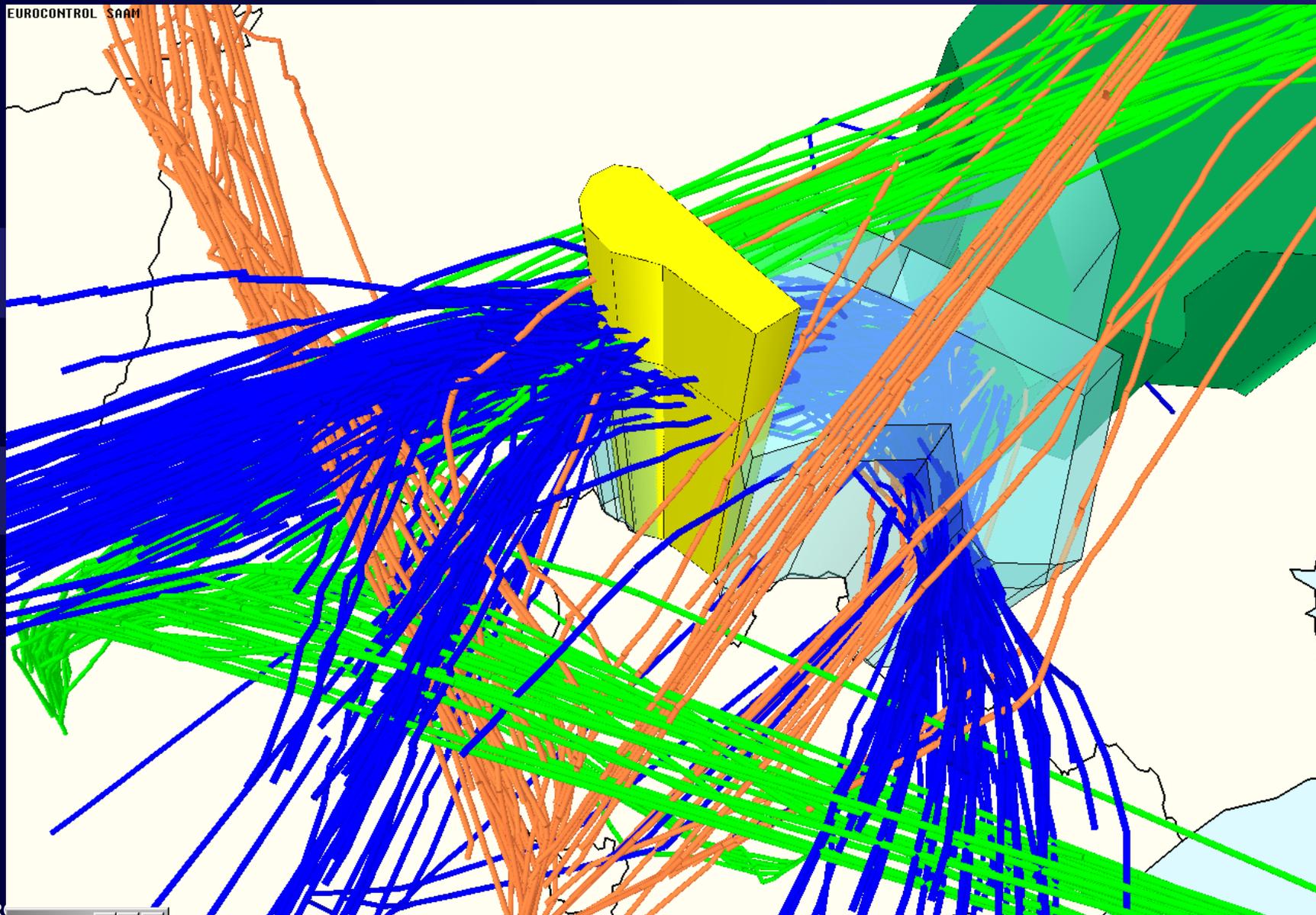
EUROCONTROL SAAM



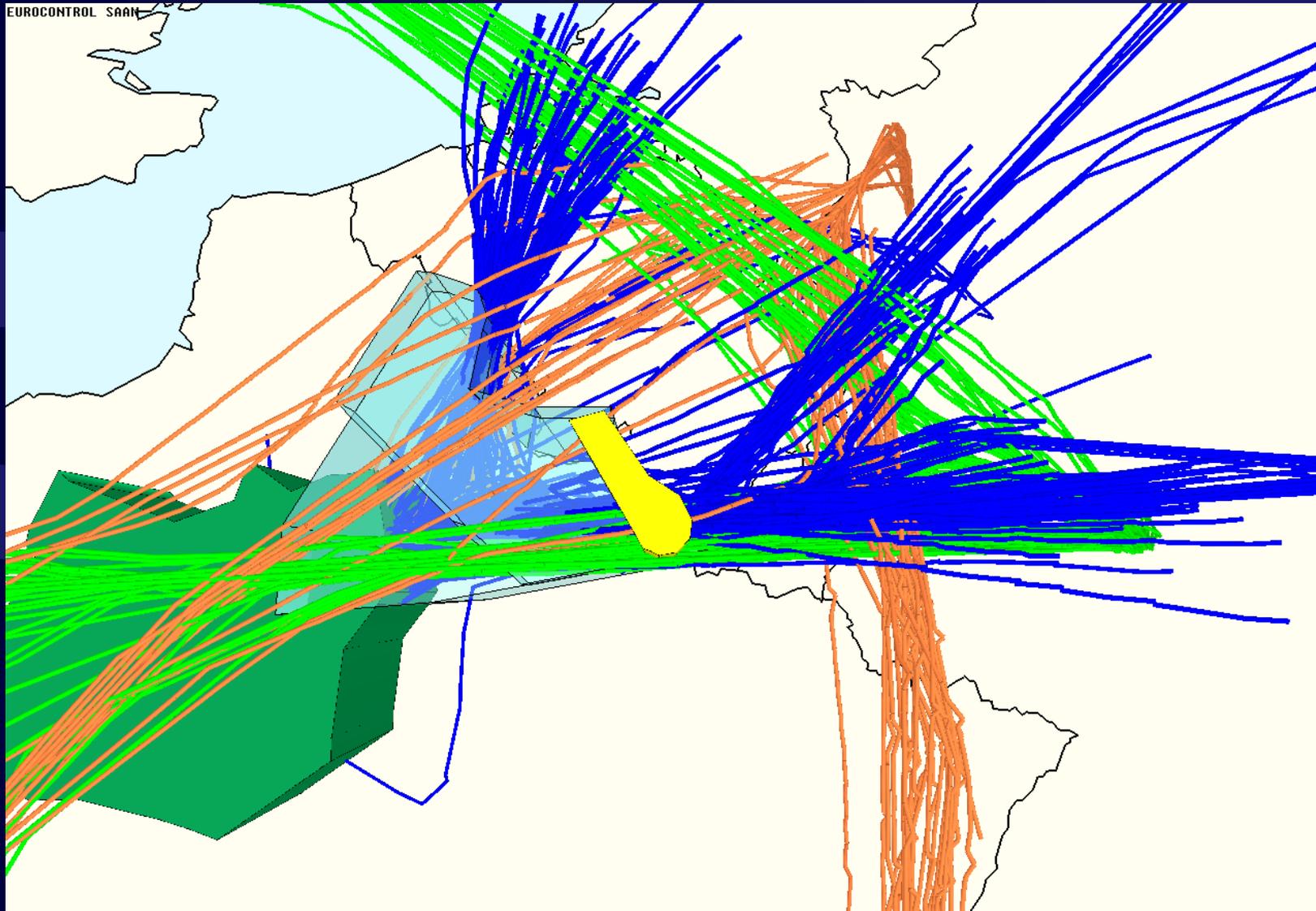
# Design Interaction Challenge



# Design Interaction Challenge



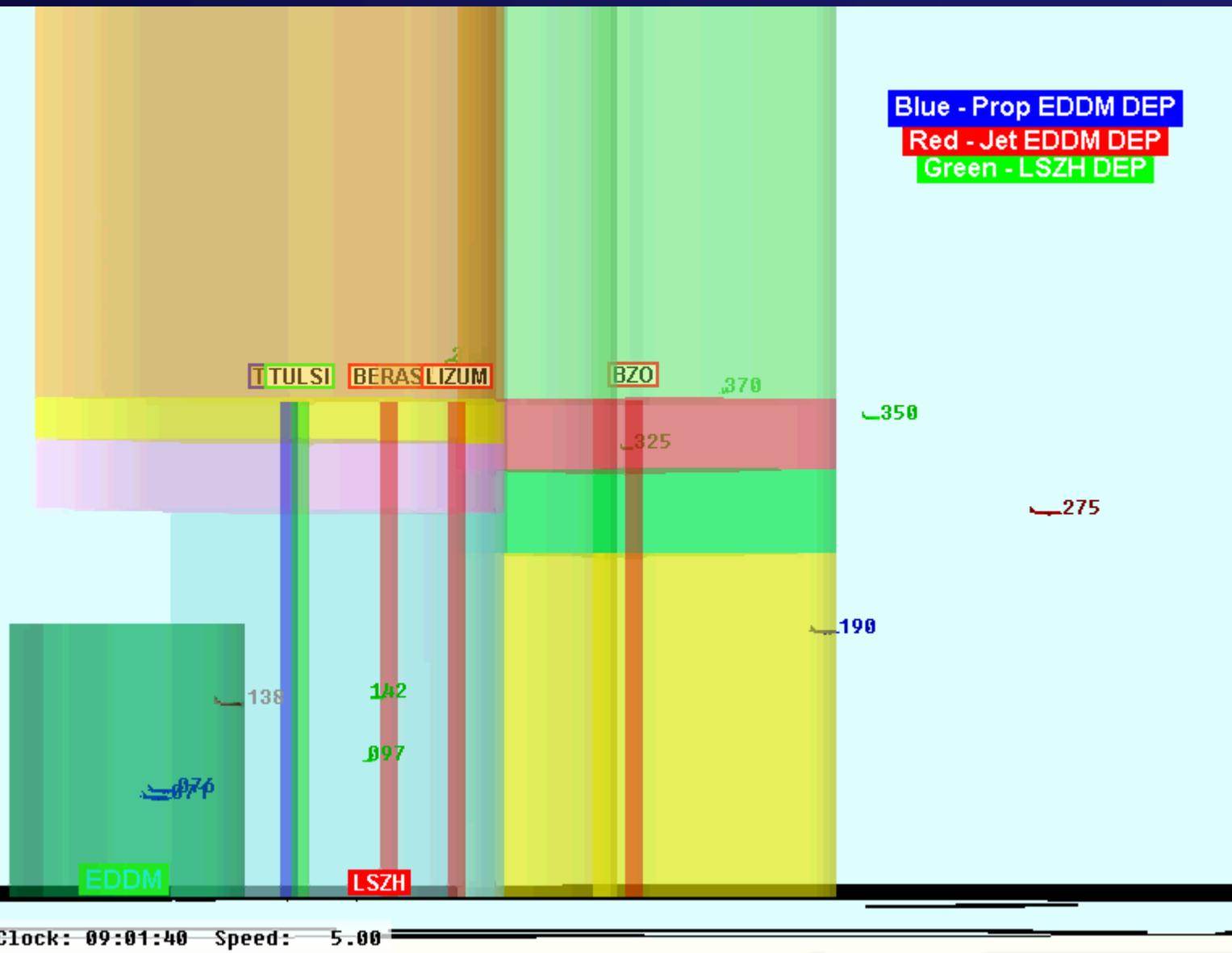
# Design Interaction Challenge



# Design Interaction Challenge

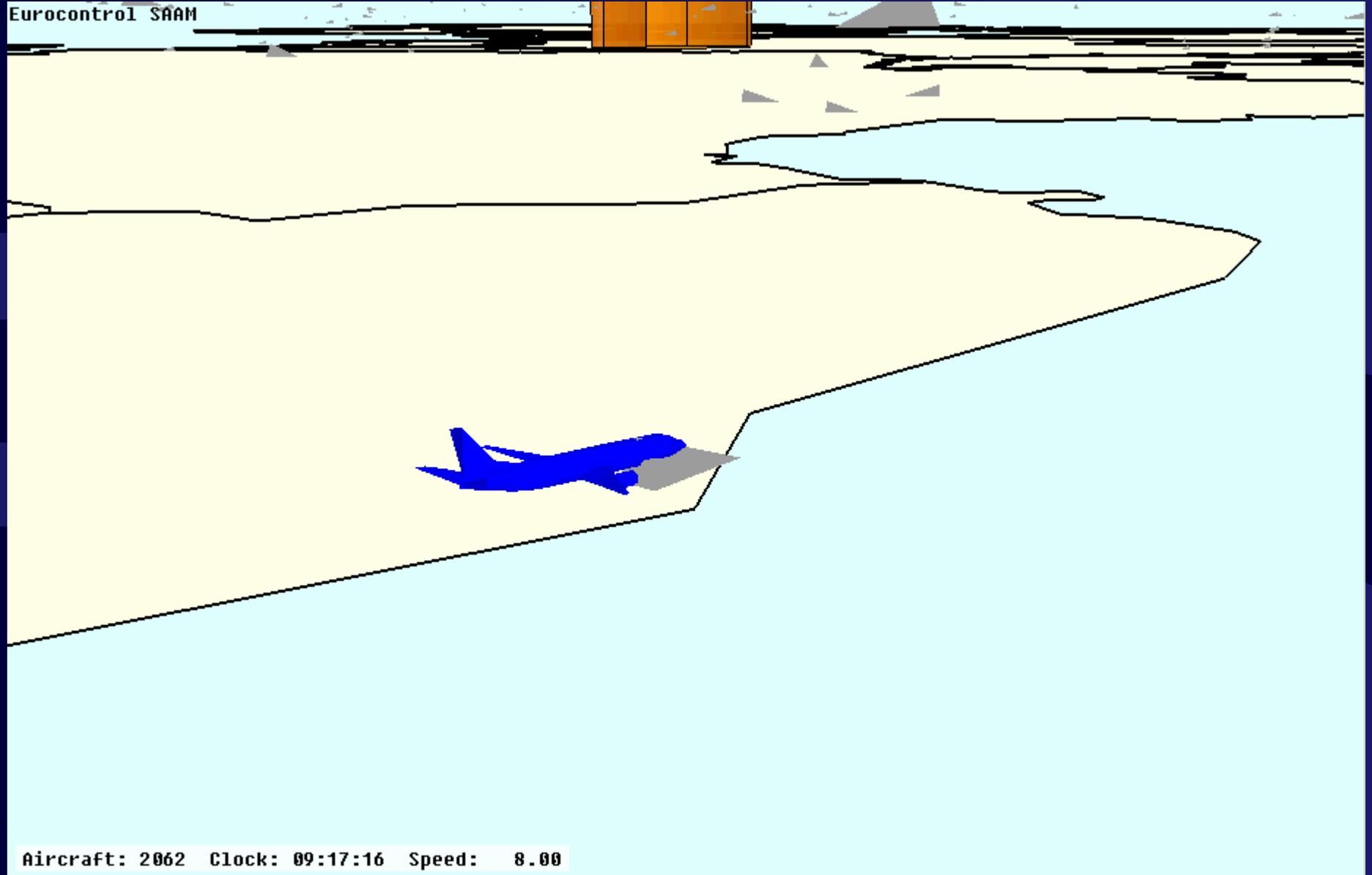
EUROCONTROL SAAM  
Italy Current  
09/09/2005

Blue - Prop EDDM DEP  
Red - Jet EDDM DEP  
Green - LSZH DEP



# Design Interaction Challenge

Eurocontrol SAAM



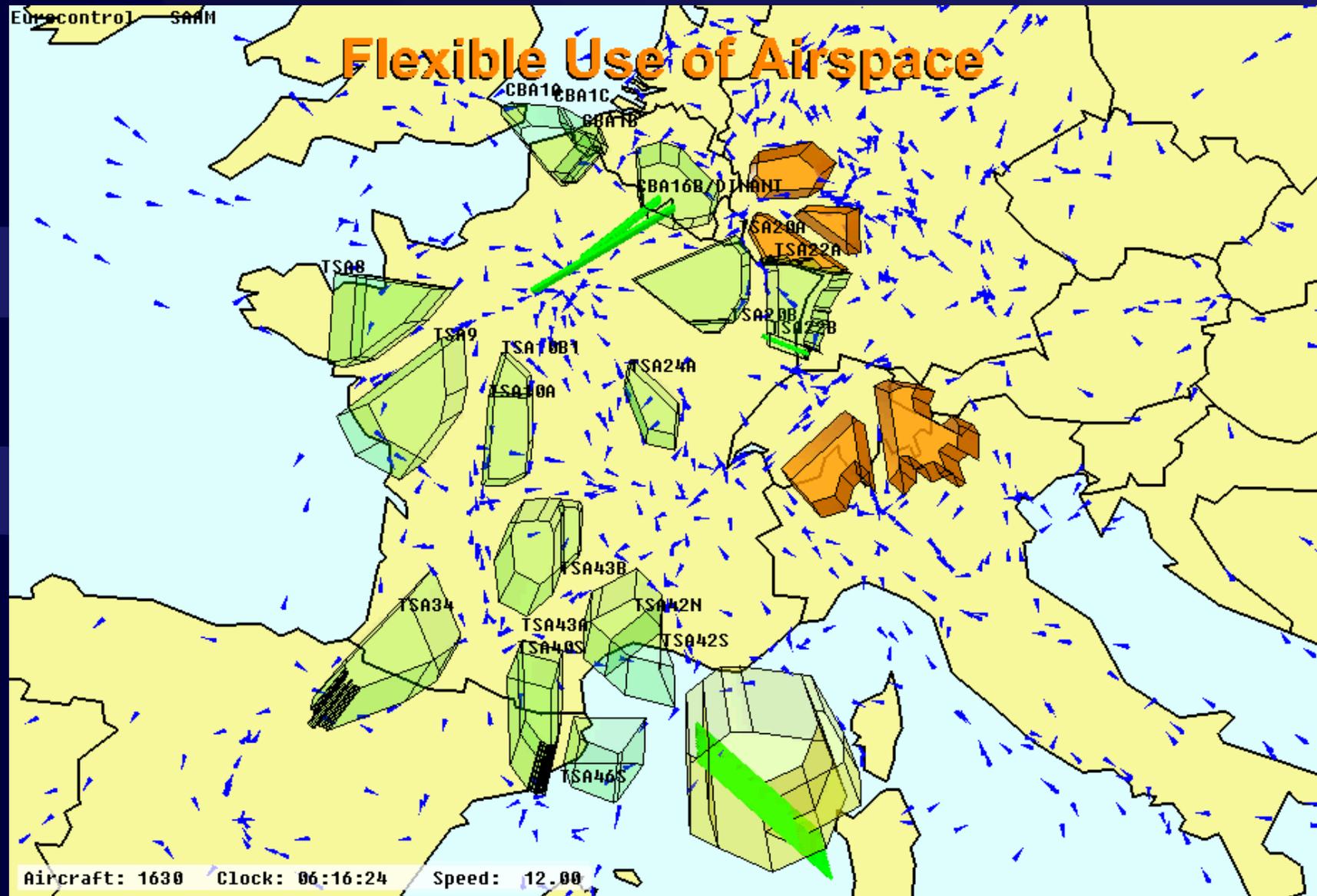
Aircraft: 2062 Clock: 09:17:16 Speed: 8.00



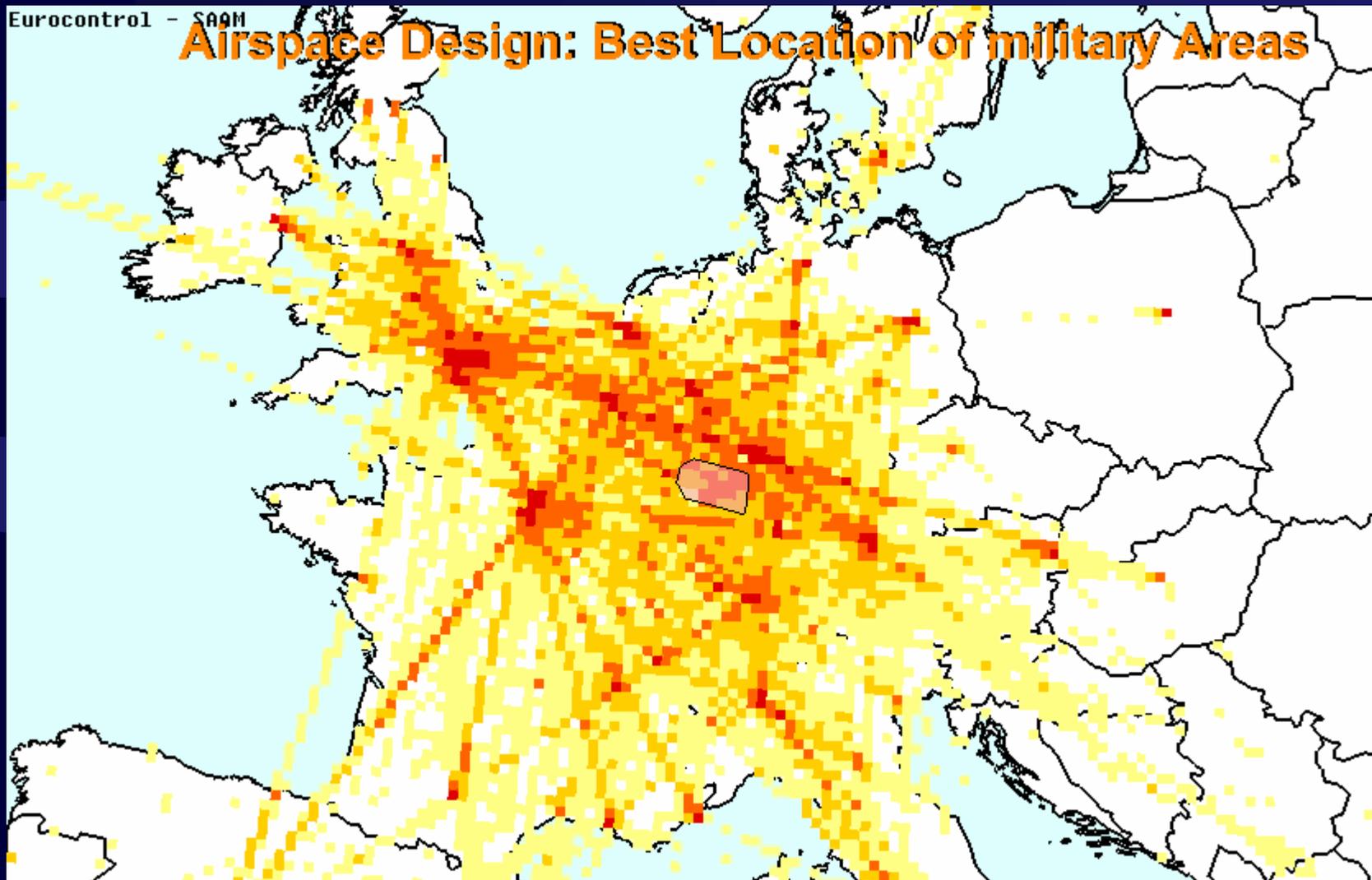
# Design Interaction Challenge



# Design Interaction Challenge

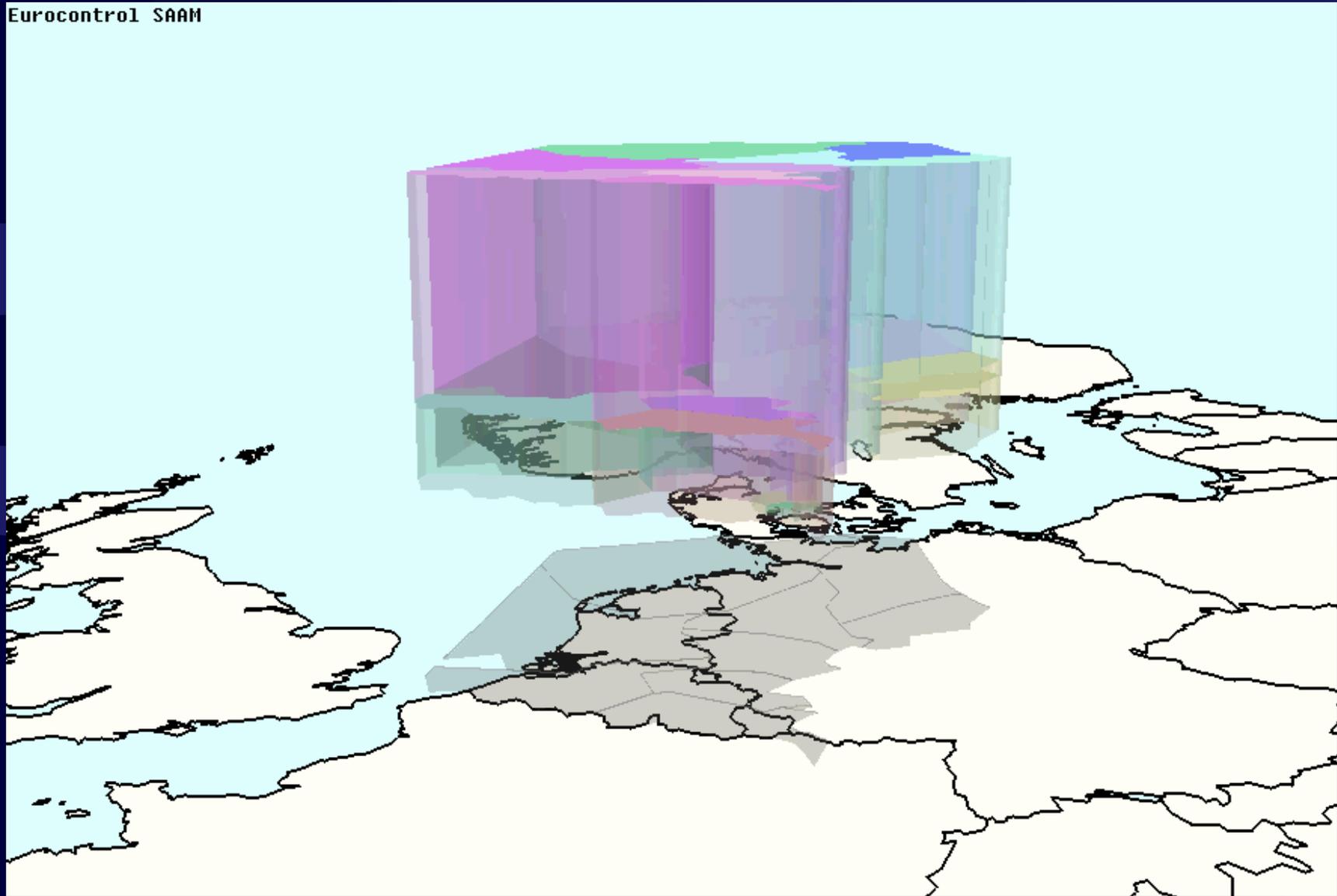


# Design Interaction Challenge



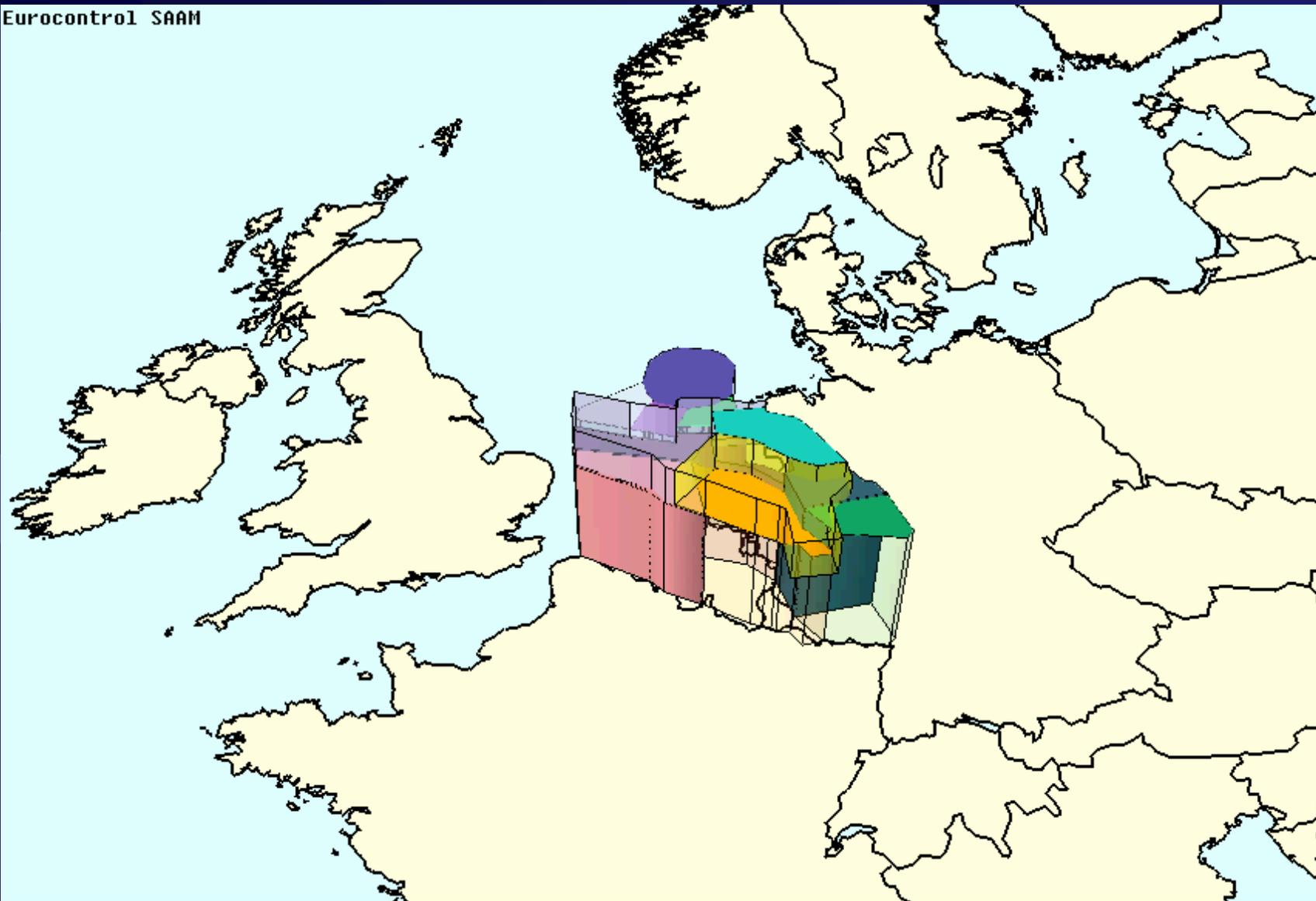
# Design Interaction Challenge

Eurocontrol SAAM

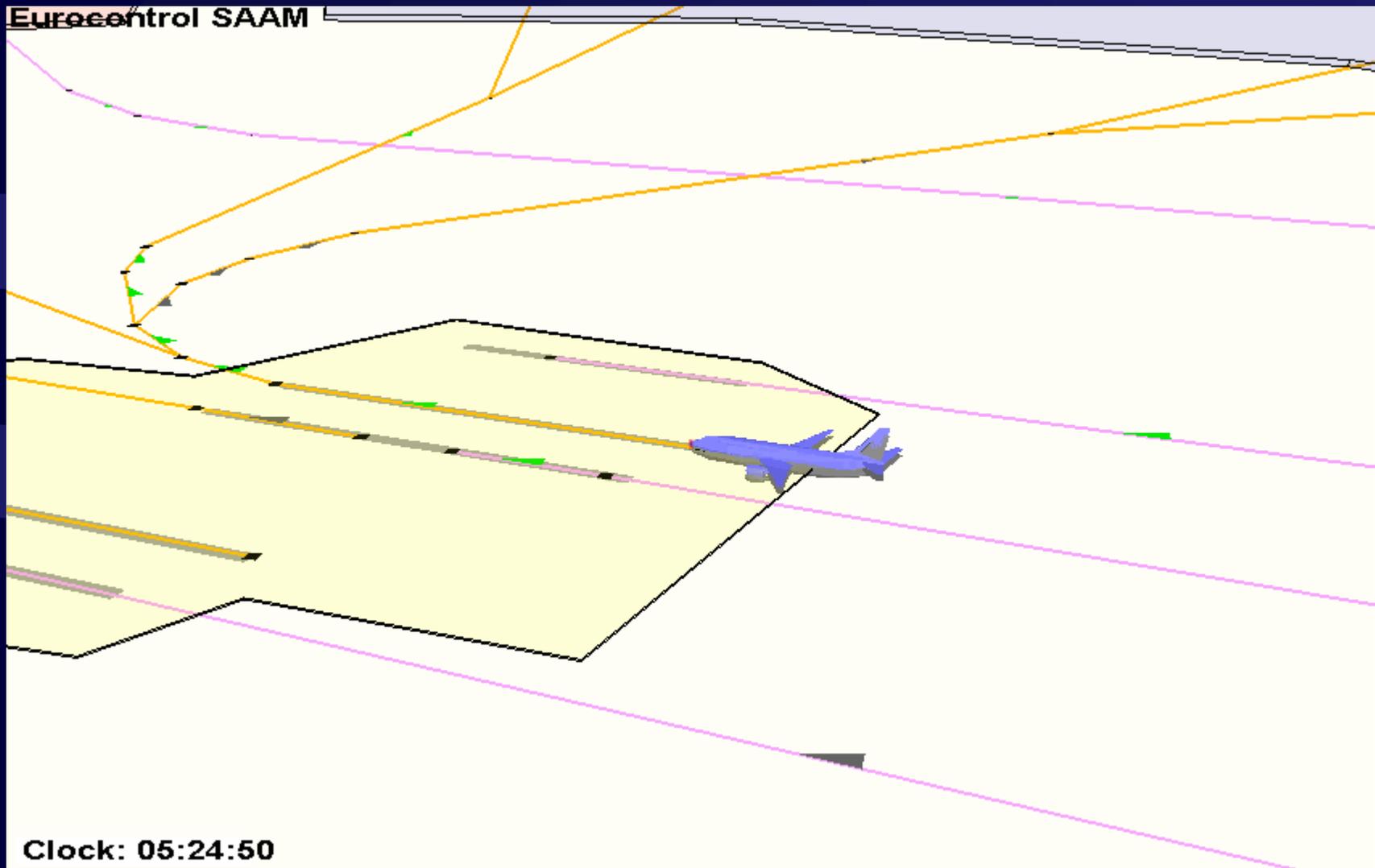


# Design Interaction Challenge

Eurocontrol SAAM

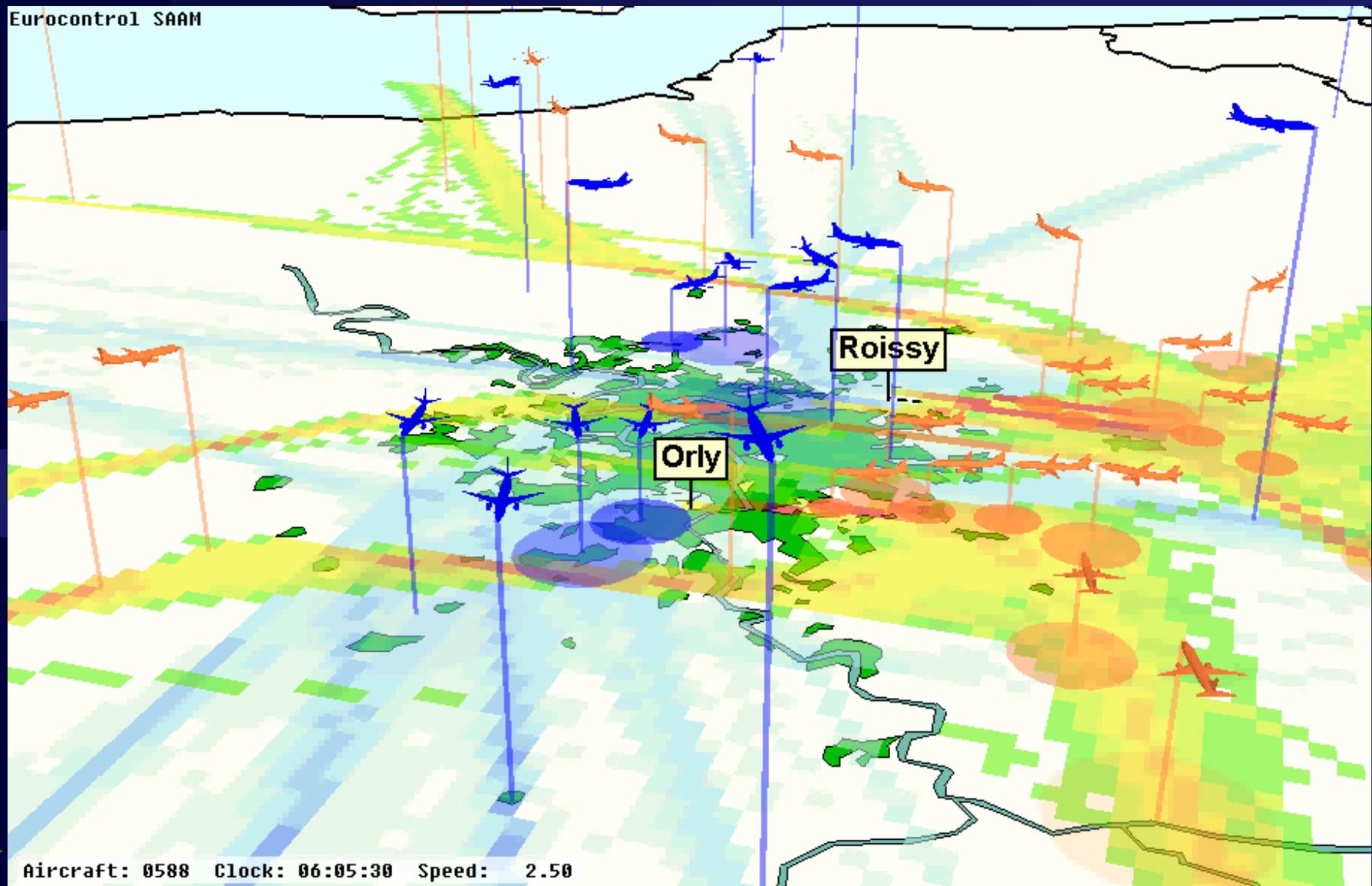


# Design Interaction Challenge

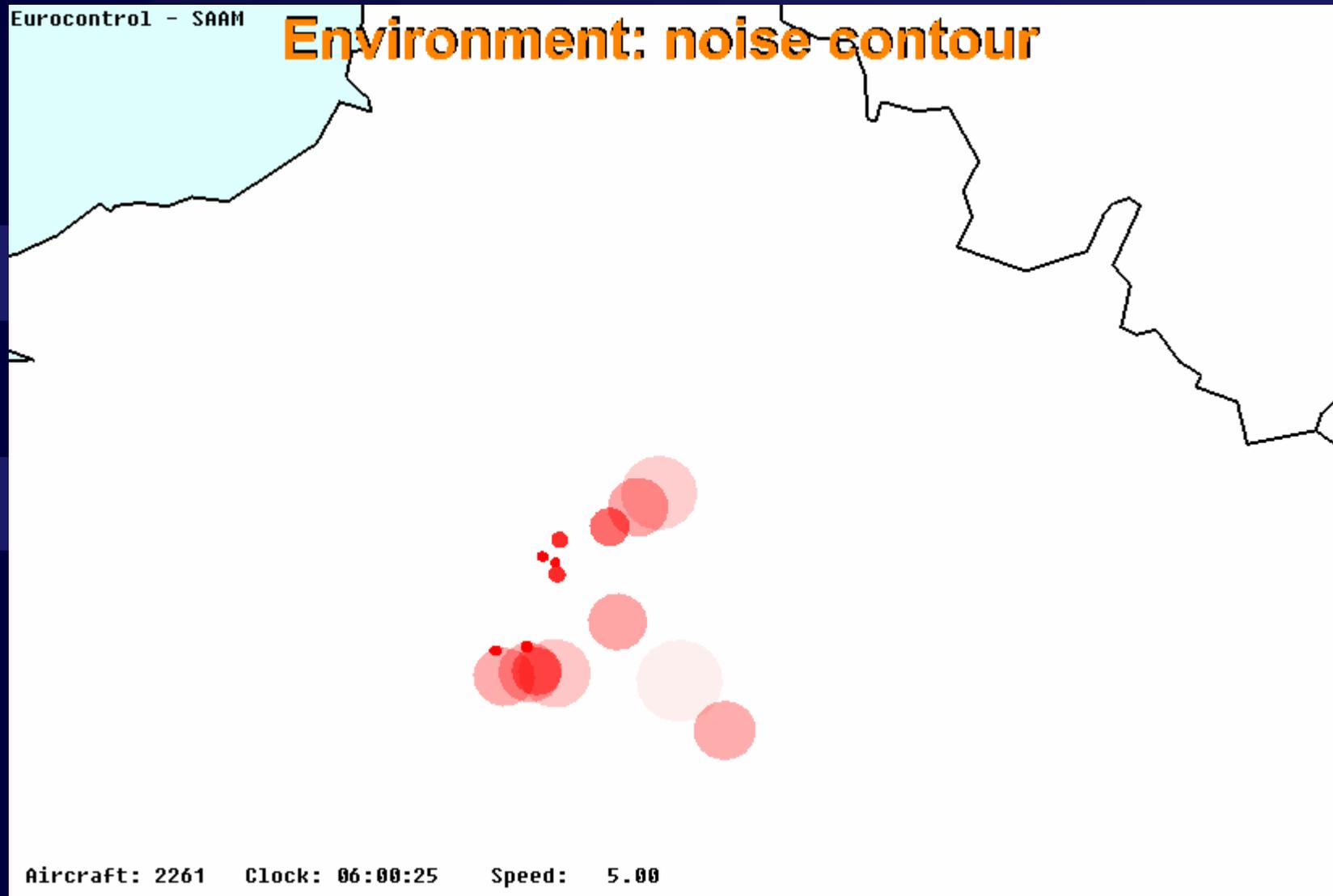


# Design Interaction Challenge

Eurocontrol SAAM



# Design Interaction Challenge



# Design Interaction Challenge

**SAAM traffic flow Optimisation generates 'best possible solution'**

	Reference	Solution	Difference	
Number of flights	34000	34000		
Re-Routed Flights	~	7500 (22%)		
Delay (min/flight)	58354 (1.71)	38486 (1.13)	<b>-34%</b>	<b>Benefit</b>
Route Extension	30.188.000nm	30.249.000nm	<b>+ 0.2%</b>	<b>Cost</b>

Global cost reduction: +1.0M€ (delay) – 384000€ (routing)

**617000 €**



# SAAM – System Wide Modelling

## SAAM & European Projects Preparing Future

V5 – AAS – CCAMS - DMEAN



# V5 European Network Project

European collaborative / co-operative process



# V5 European Network Project

## Europe Wide Projects involving SAAM support

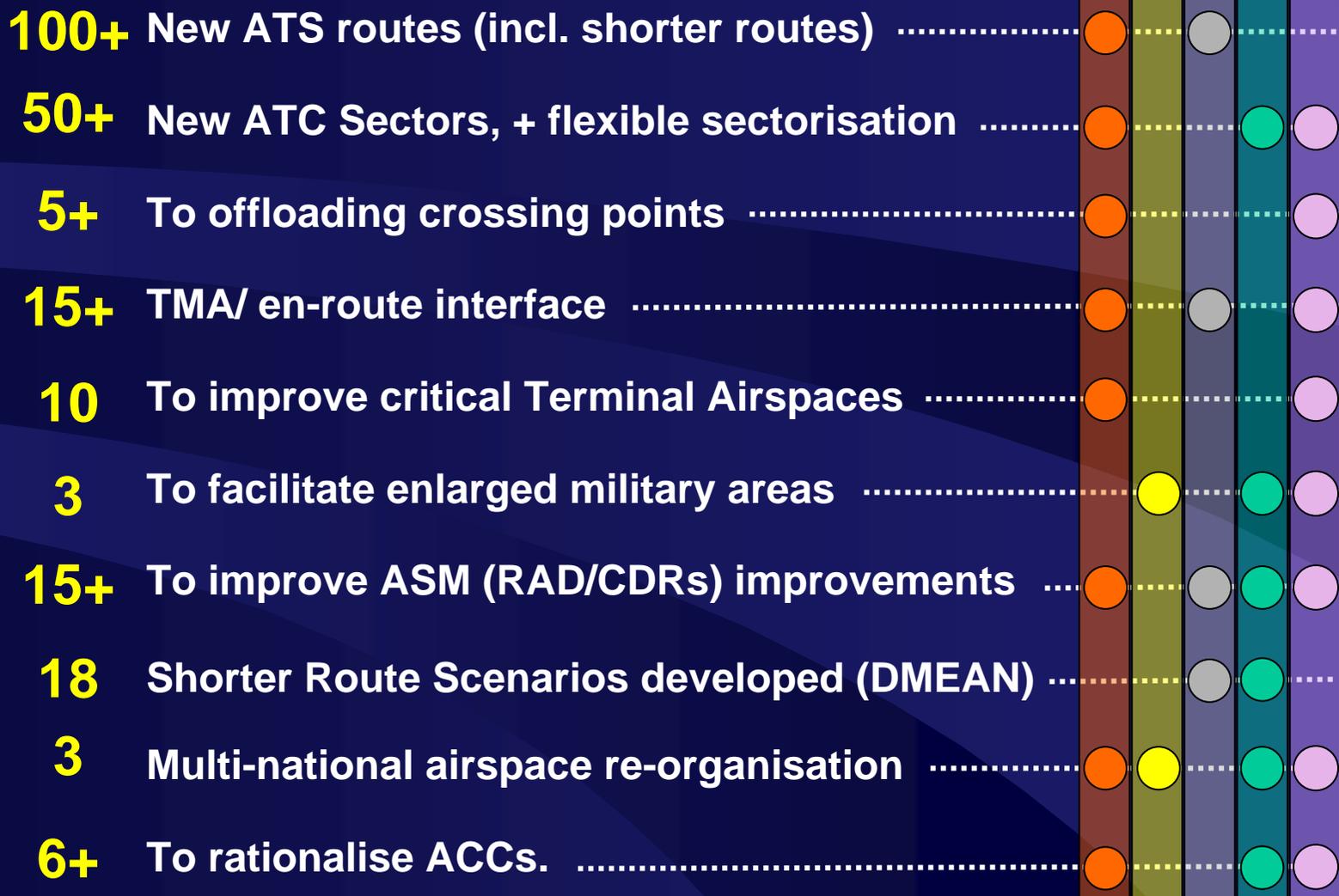
**Increase Capacity**

**Facilitate military requirements**

**Reduce flight distance**

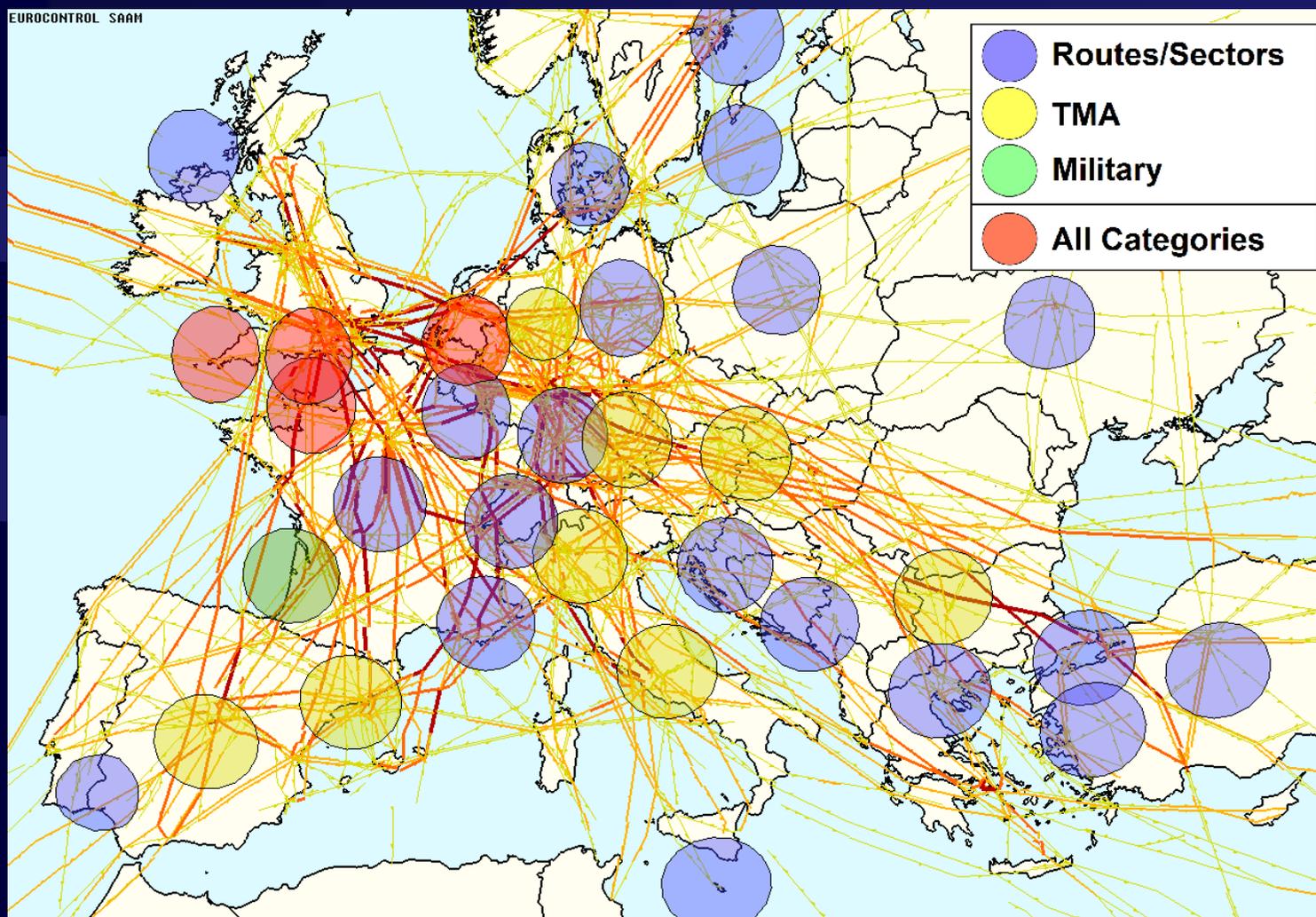
**DMEAN**

**Enhance safety**



# V5 European Network Project

## Geographical distribution of major Projects



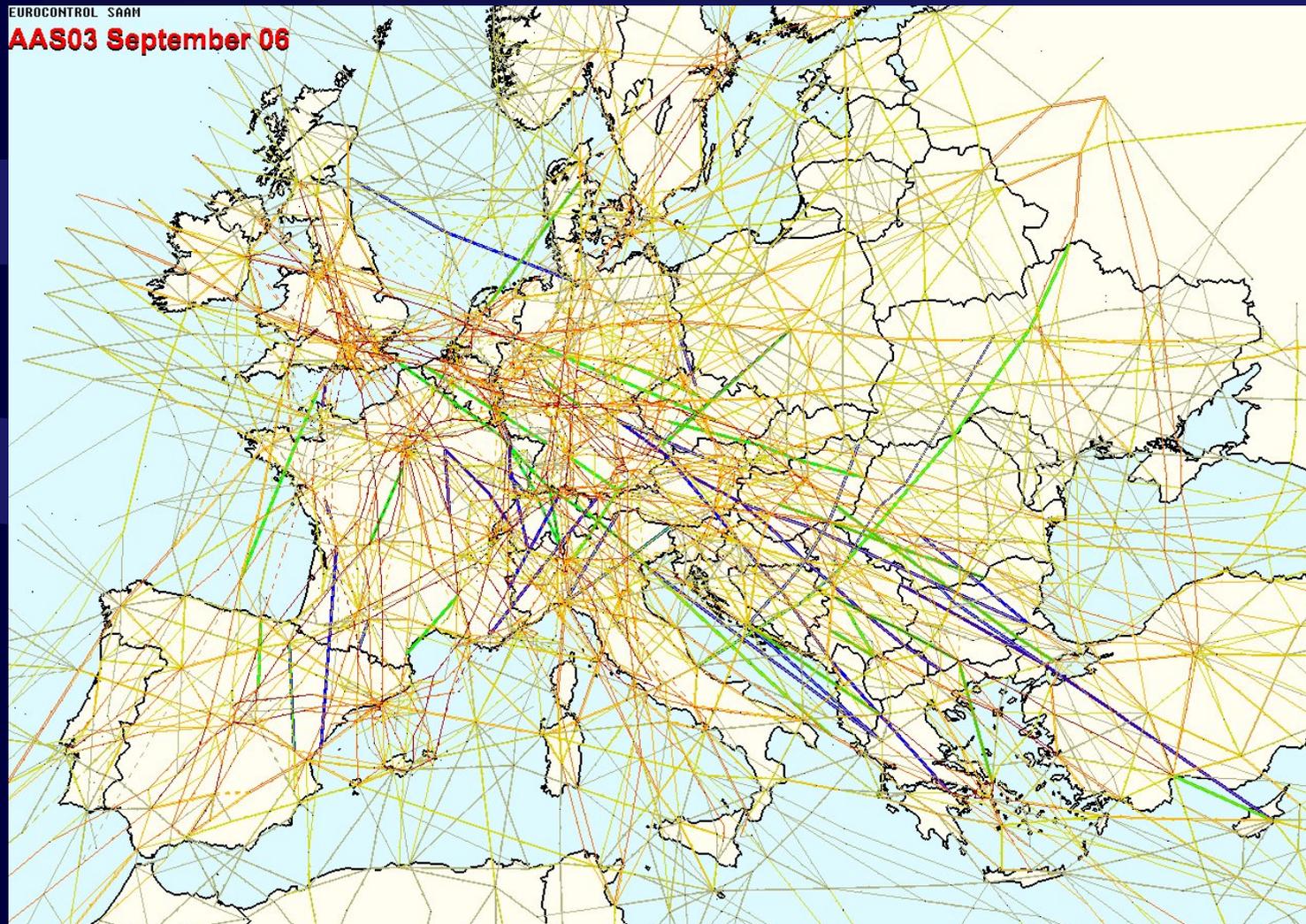
# Preparing for the Future

- **AAS** Advanced Airspace Scheme
- **CCAMS** Centralised SSR Code Assignment Management System
- **FABs** Functional Airspace Blocks
- **DMEAN** Dynamic Management of European Airspace Network



# AAS: Advanced Airspace Scheme

## A network long term view



# CCAMS

**Centralised SSR Code Assignment Management System**  
project will provide:

- discrete code to each flight subject to processing by IFPS,
- unique code for the entire flight route within CCAMS area,
- a code based on the analysis of 4D profile by CFMU

**for a safer ATC in Europe**



# CCAMS

**A quick assessment for the feasibility of CCAMS realized by SAAM in April 2006 with:**

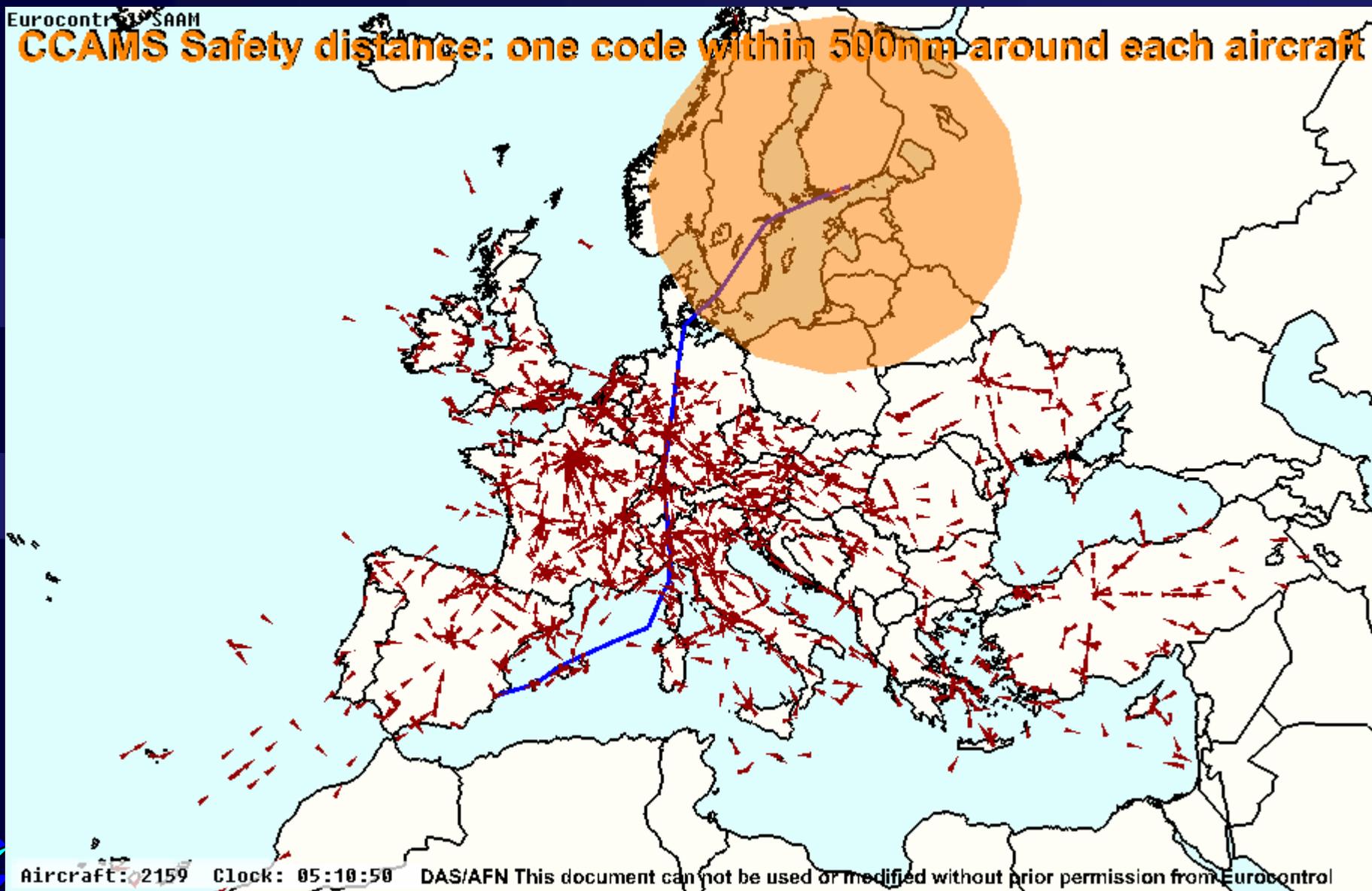
- a single code within **500nm** around each aircraft
- a single code in a given **ACC** for each aircraft
- **SSR code allocated 30 minutes before / 15 minutes after**
- one code for the entire flight in **ECAC area**
- using day of forecasted traffic sample 2012 High Trend:  
**46665 flights**



# CCAMS

Eurocontrol SAAM

**CCAMS Safety distance: one code within 500nm around each aircraft**



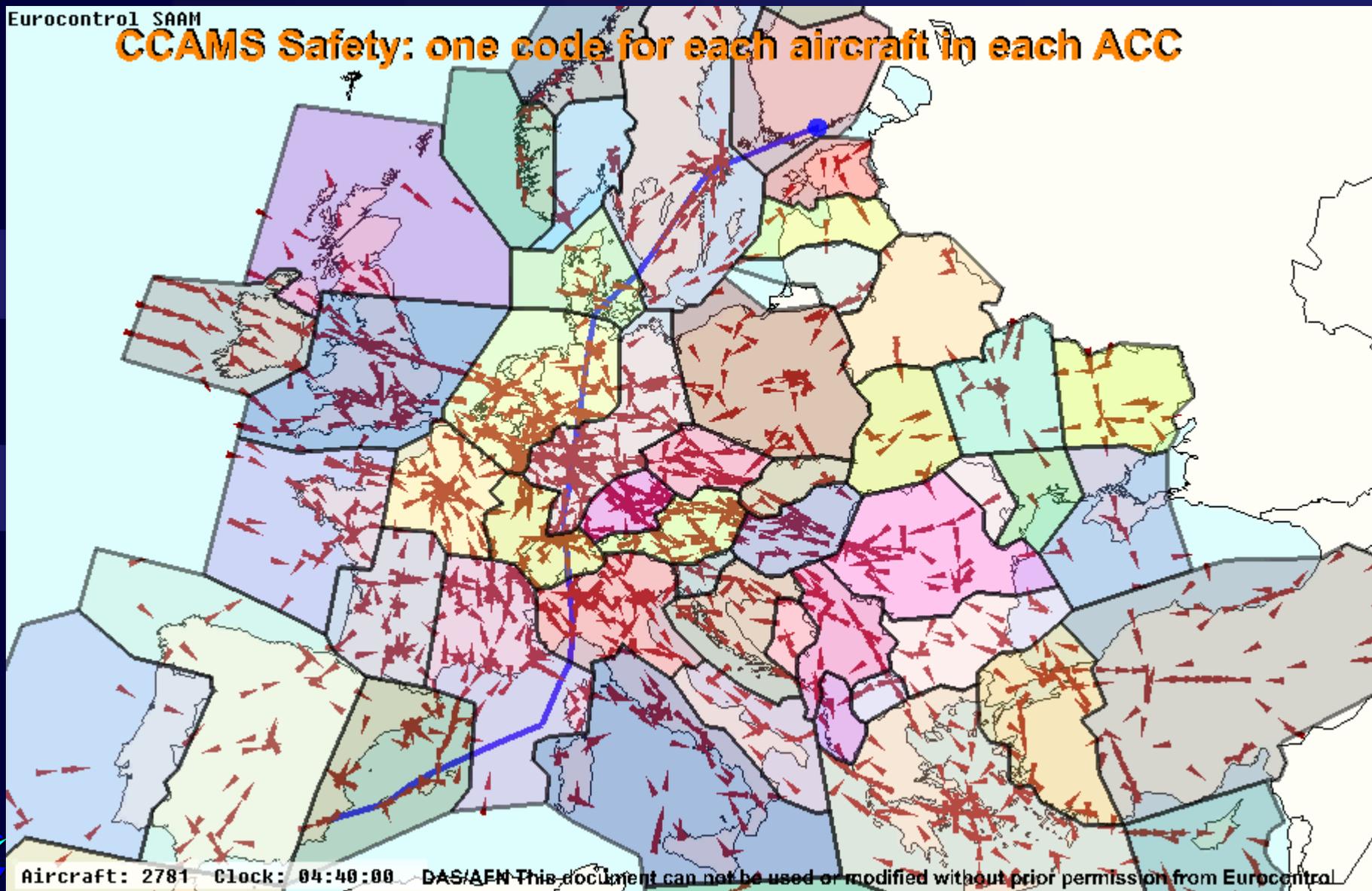
Aircraft: 2159 Clock: 05:10:50 DAS/AFN This document can not be used or modified without prior permission from Eurocontrol



# CCAMS

Eurocontrol SAAM

**CCAMS Safety: one code for each aircraft in each ACC**



Aircraft: 2781 Clock: 04:40:00 DAS/AFN This document can not be used or modified without prior permission from Eurocontrol



# CCAMS

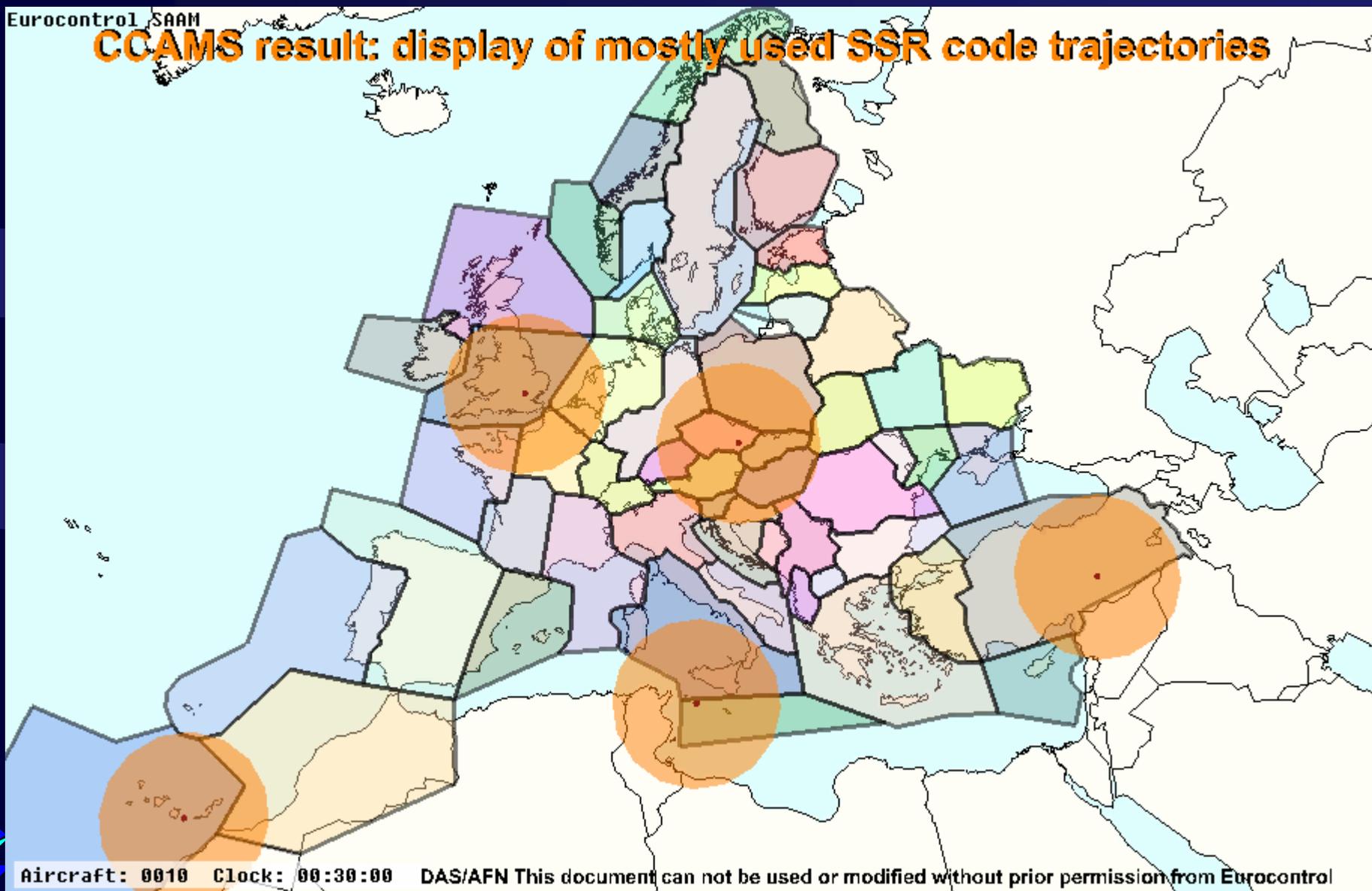
**This quick SAAM assessment shows that  
With CCAMS  
a maximum of 2300 SSR codes  
would be necessary in 2012**



# CCAMS

Eurocontrol SAAM

**CCAMS result: display of mostly used SSR code trajectories**



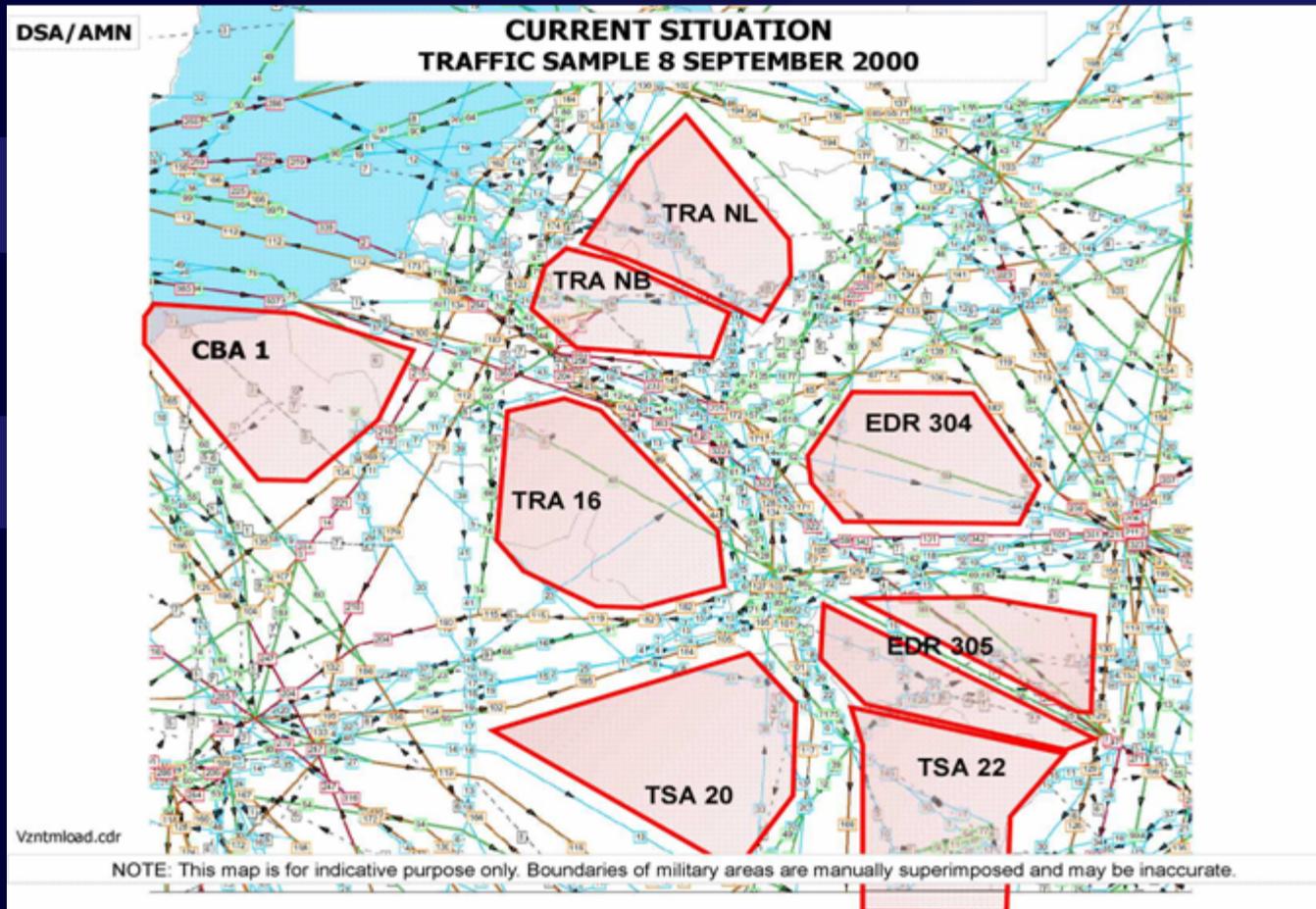
Aircraft: 0010 Clock: 00:30:00 DAS/AFN This document can not be used or modified without prior permission from Eurocontrol

# DMEAN

## Dynamic Management of European Airspace Network



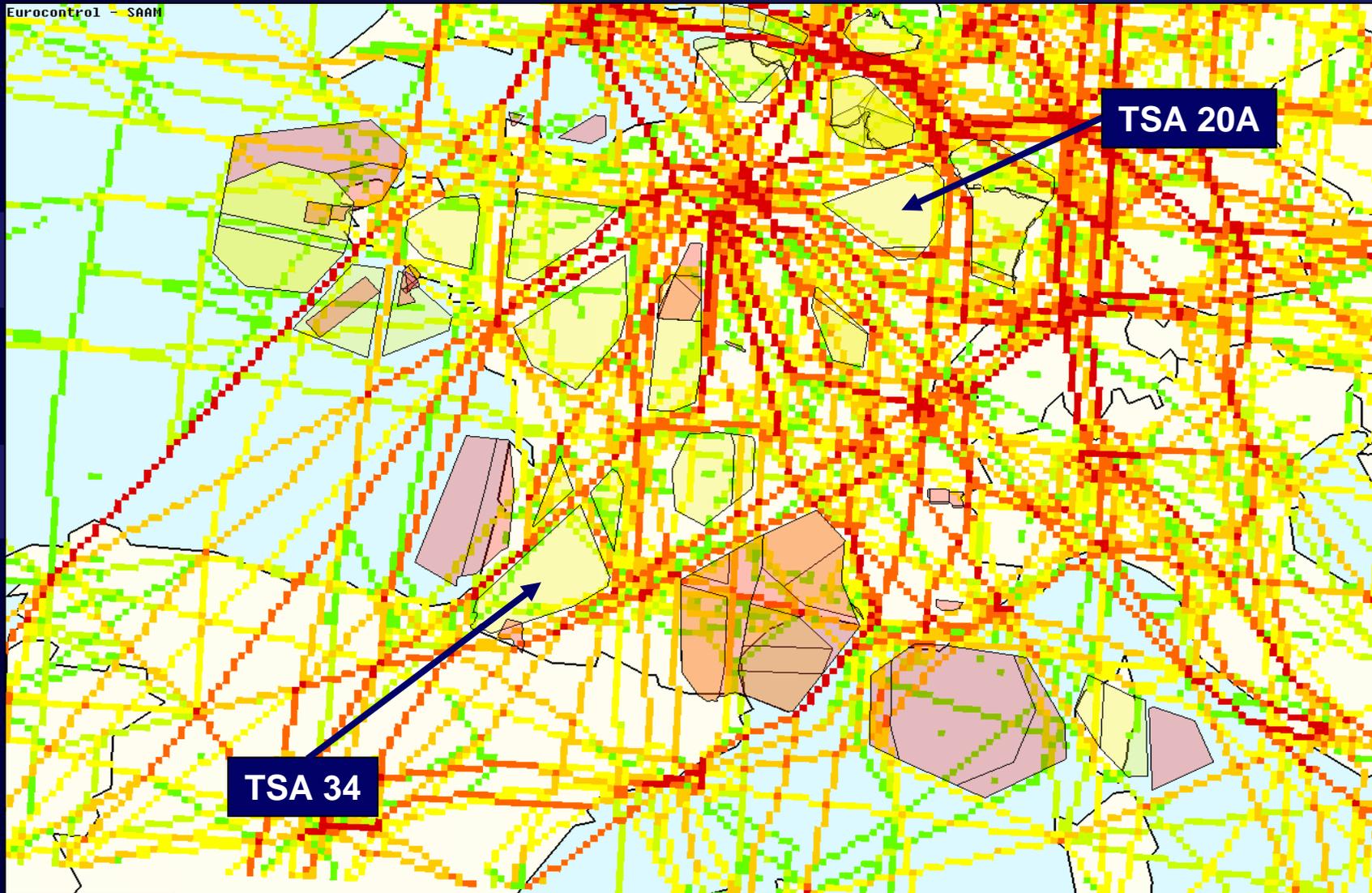
# DMEAN



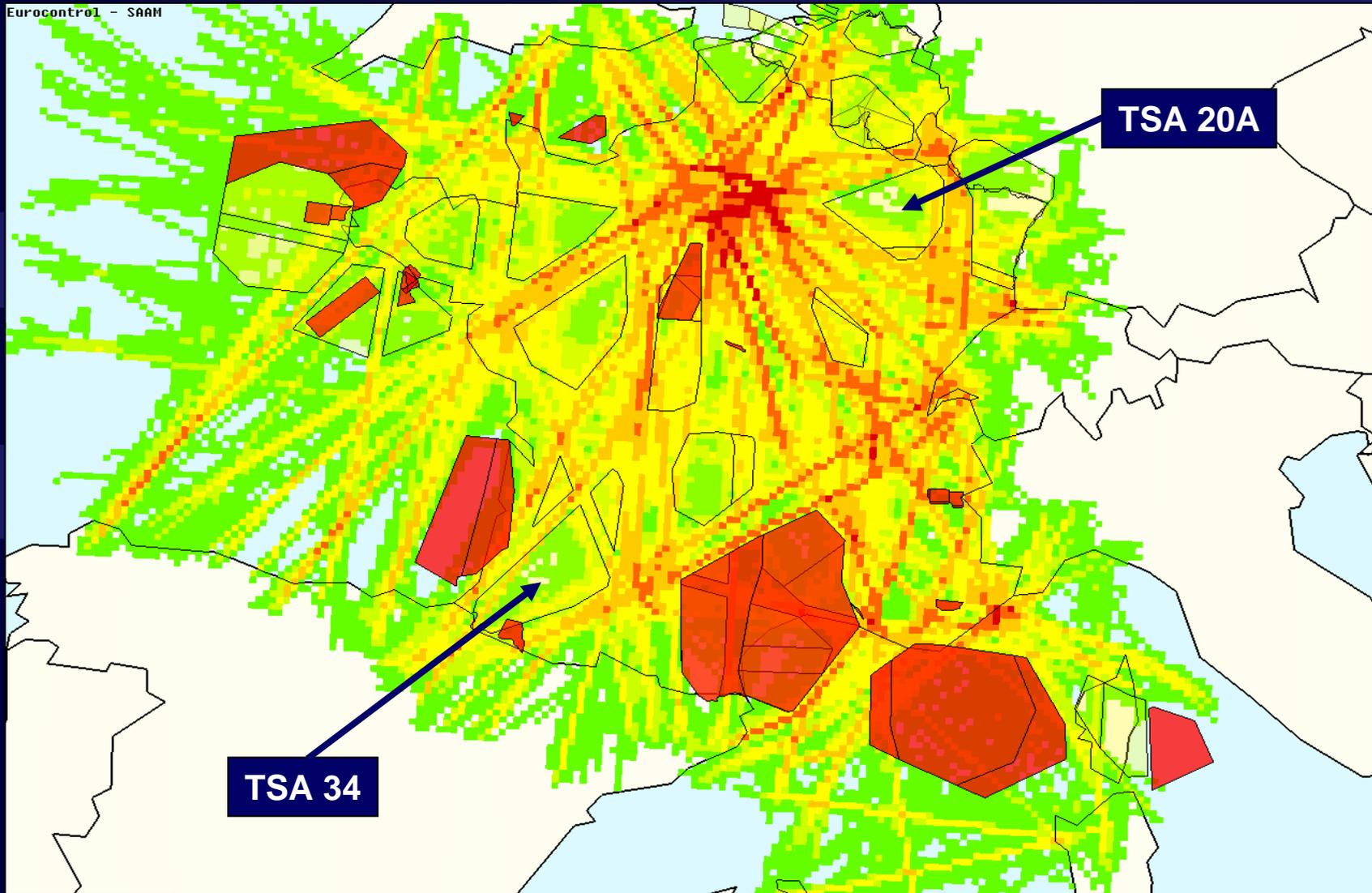
- Airspace available to all user groups
- Security and Military needs satisfied
- Shorter routings
- More optimum flight profiles
- Less fuel burn



# DMEAN

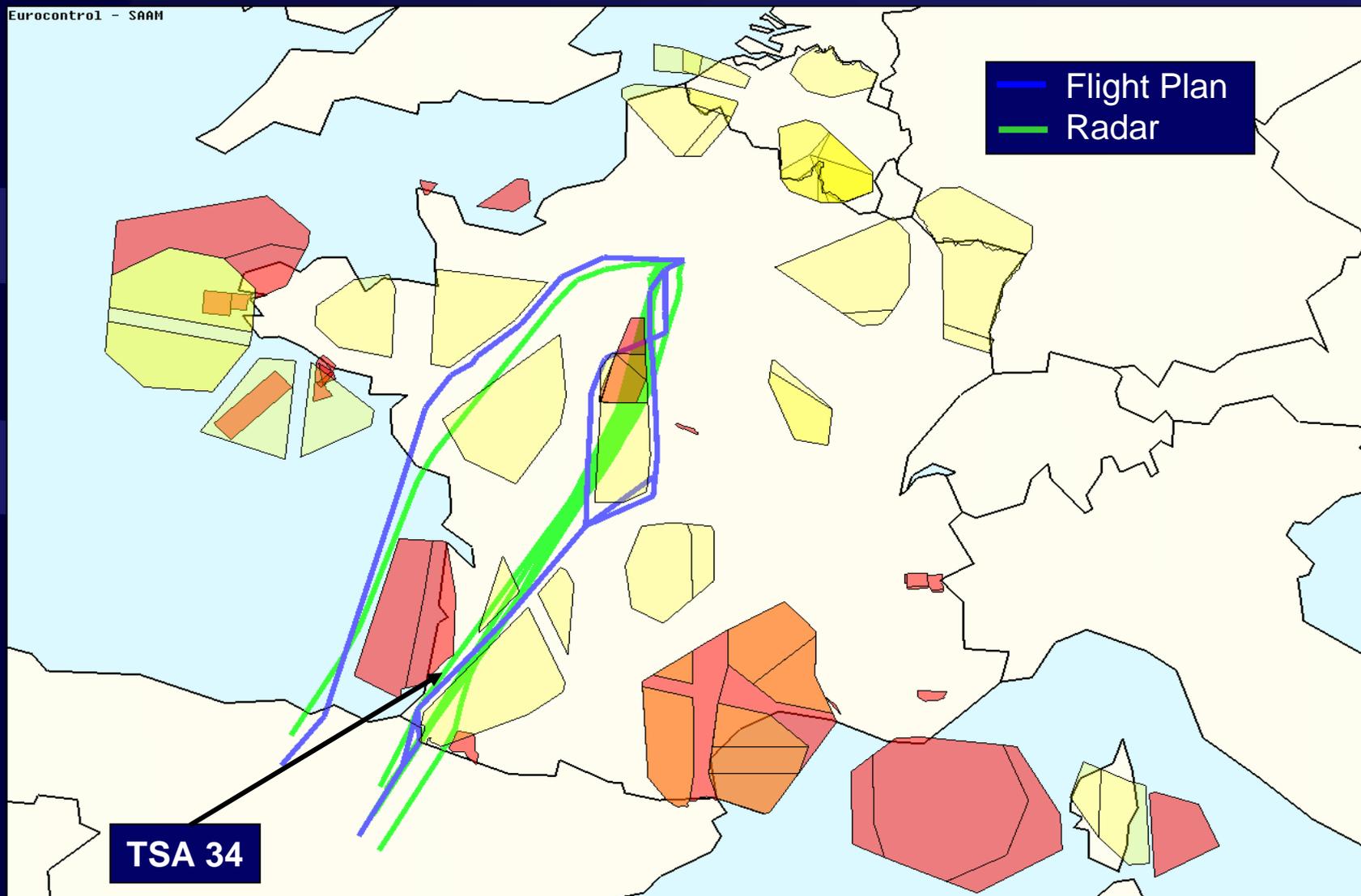


# DMEAN



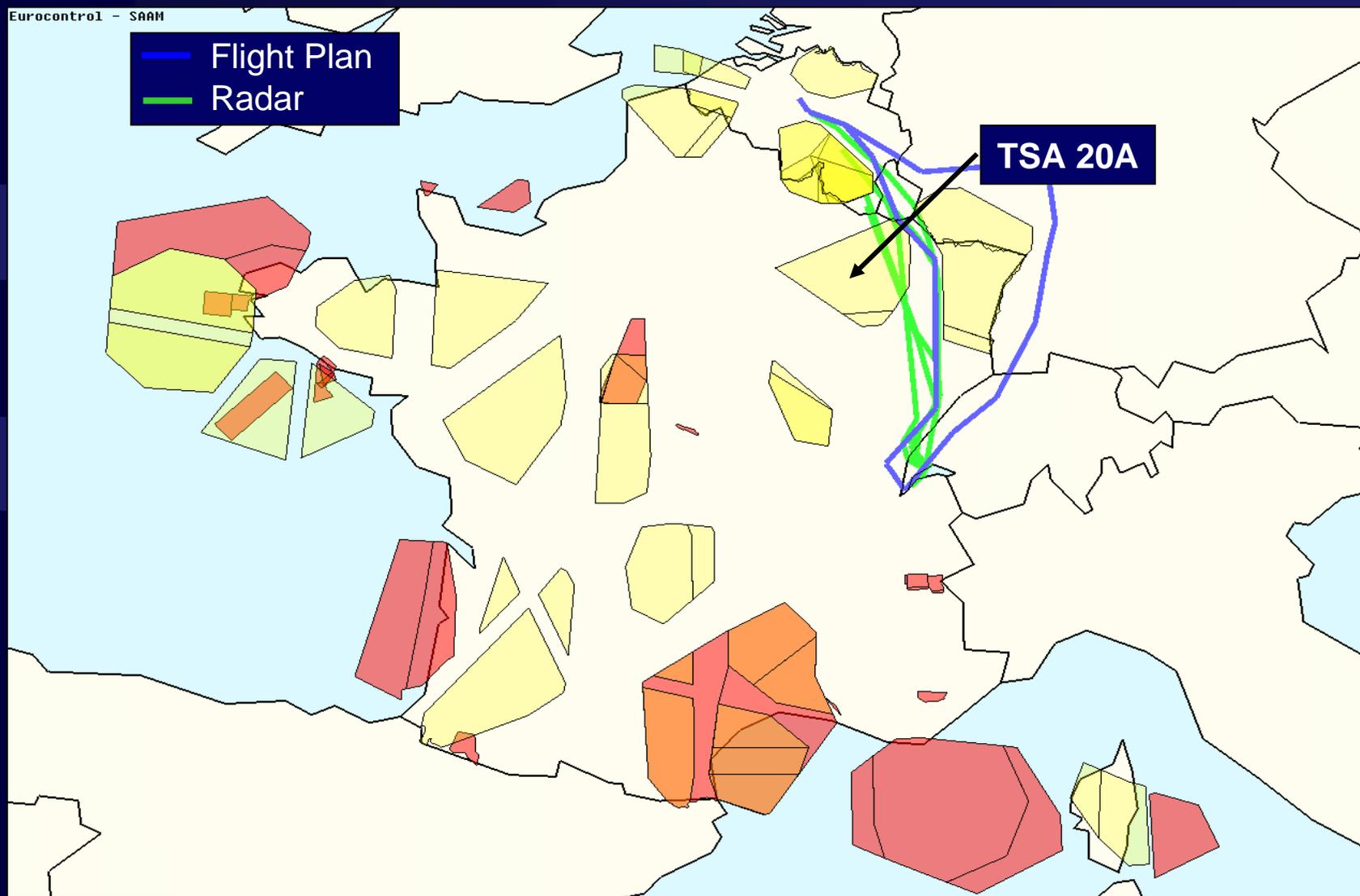
# DMEAN

## Paris - Madrid



# DMEAN

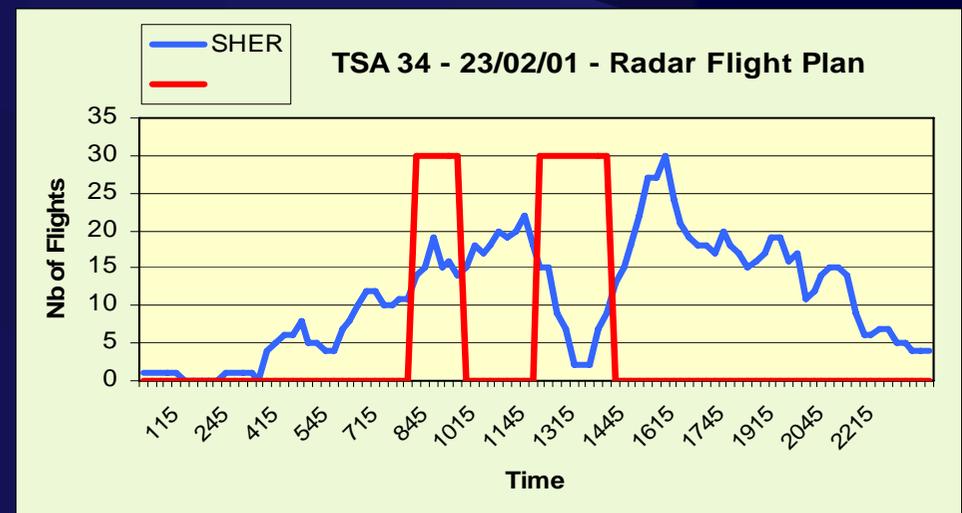
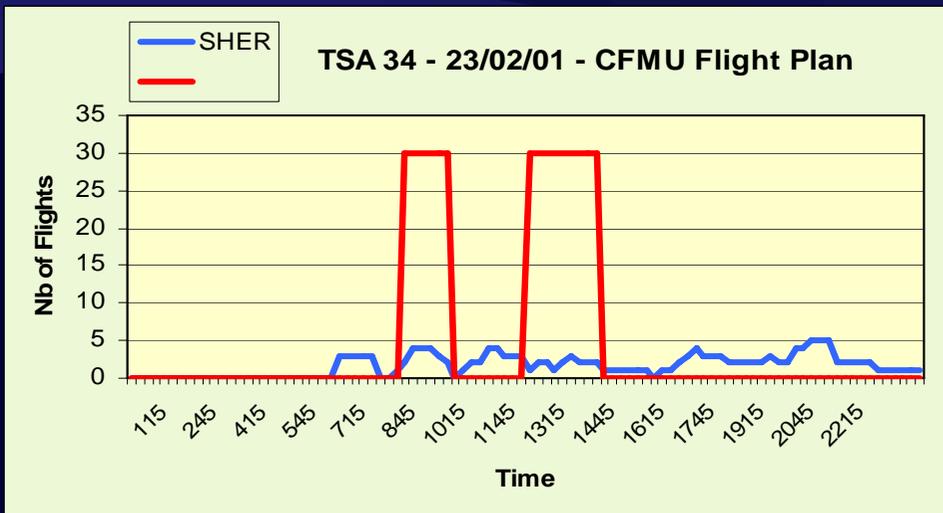
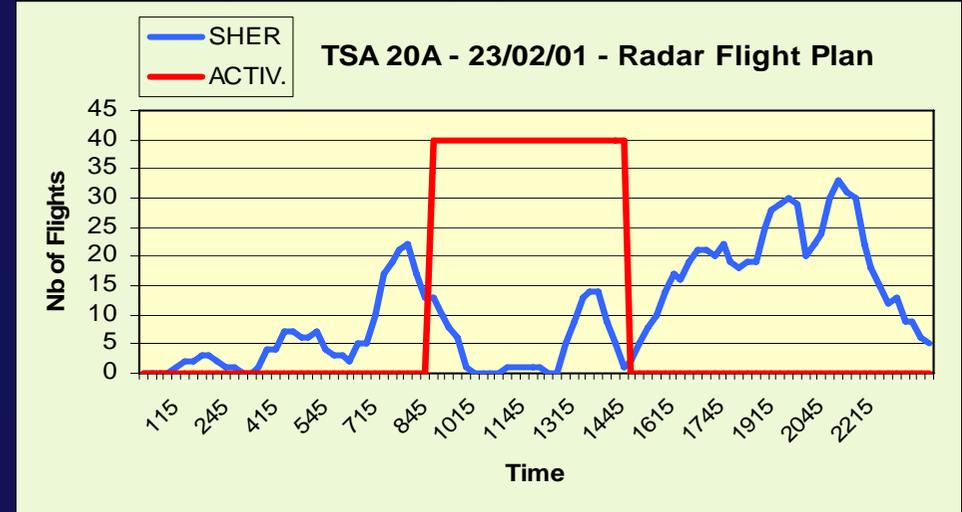
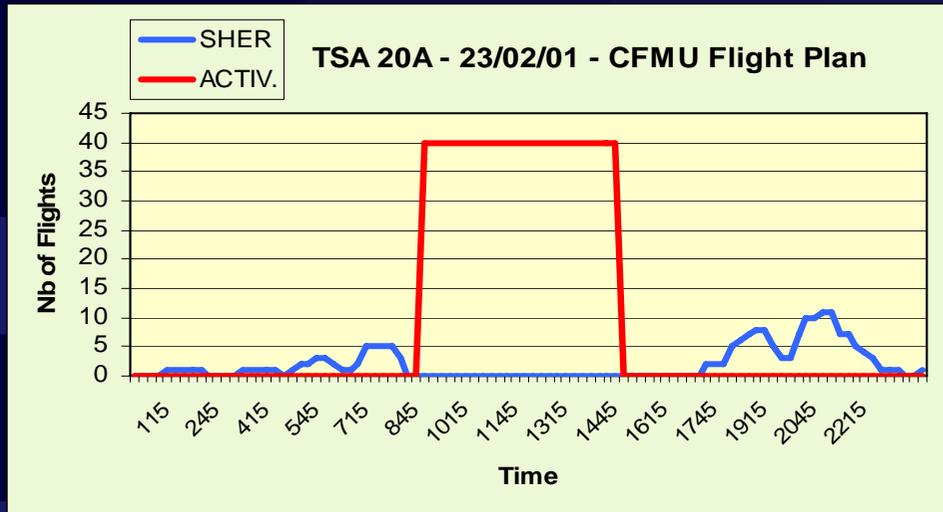
## Bruxelles - Genève



# DMEAN

## CFMU Flight Plan

## Associated RADAR path



# DMEAN

## Planning Phase

**ATM issues are discussed,  
Solutions are negotiated.**

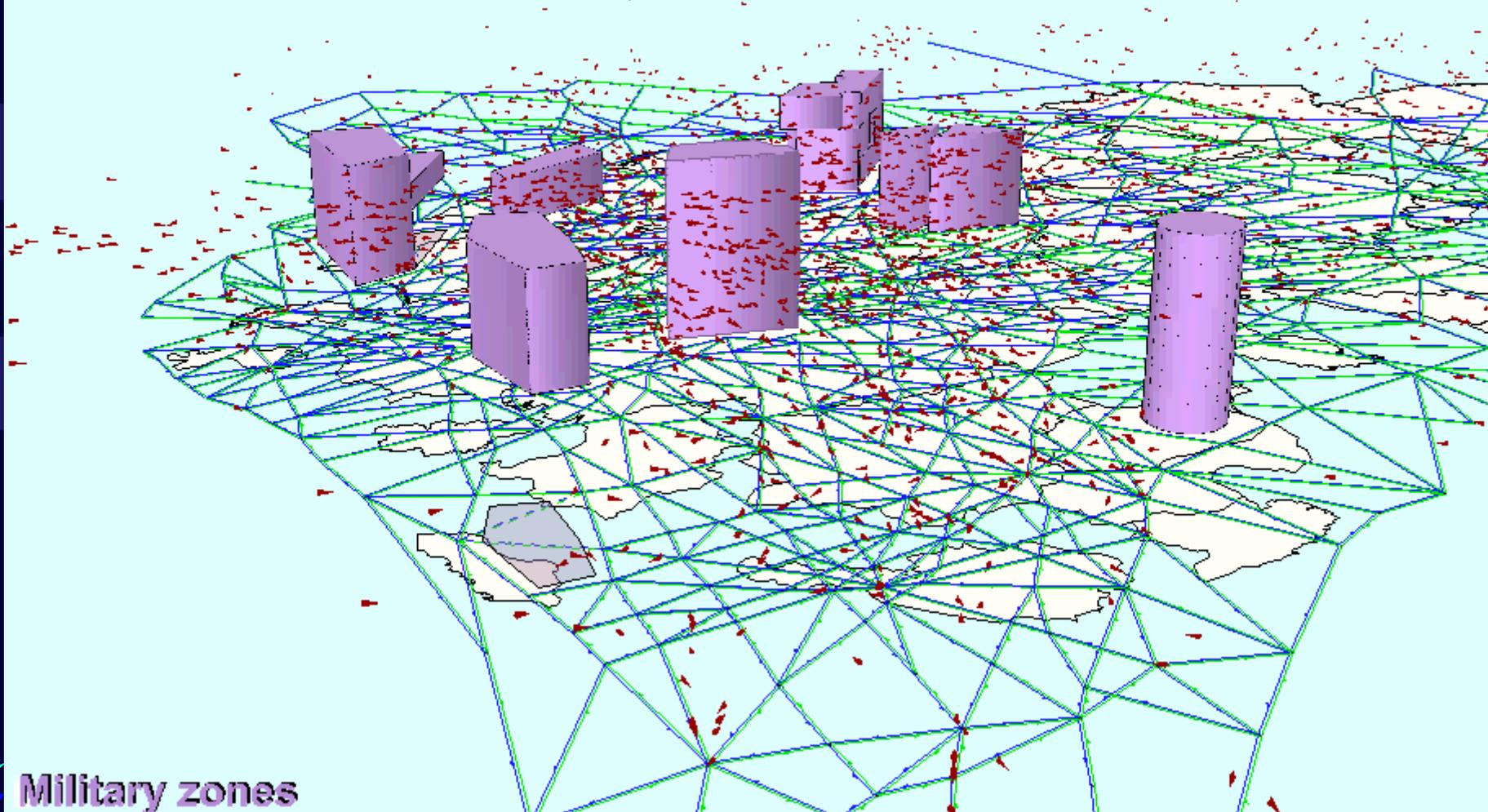
**Scenarios are prepared, defined  
and introduced in a catalogue.**



# DMEAN

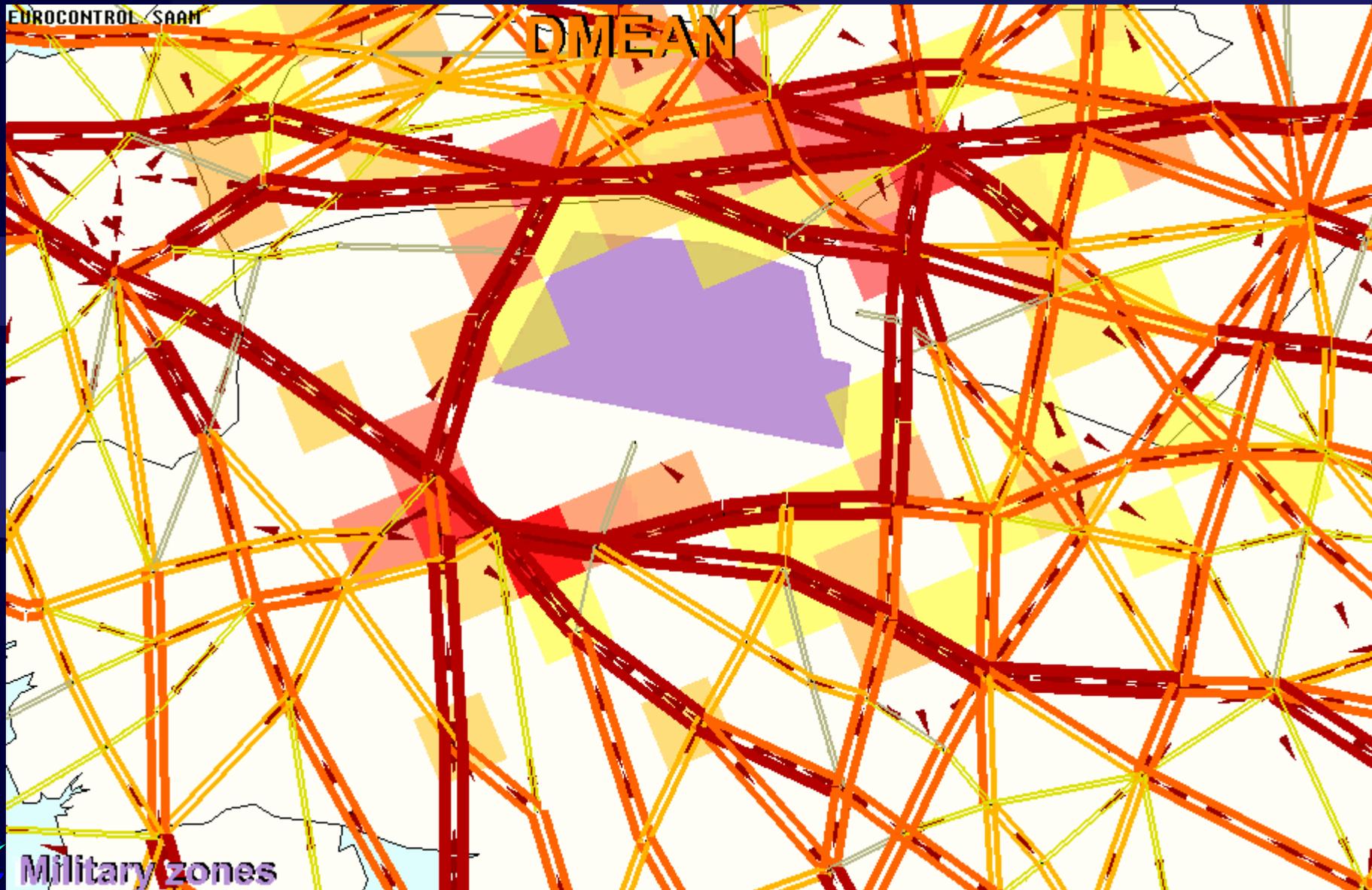
EUROCONTROL SAAM

## STRATEGIC



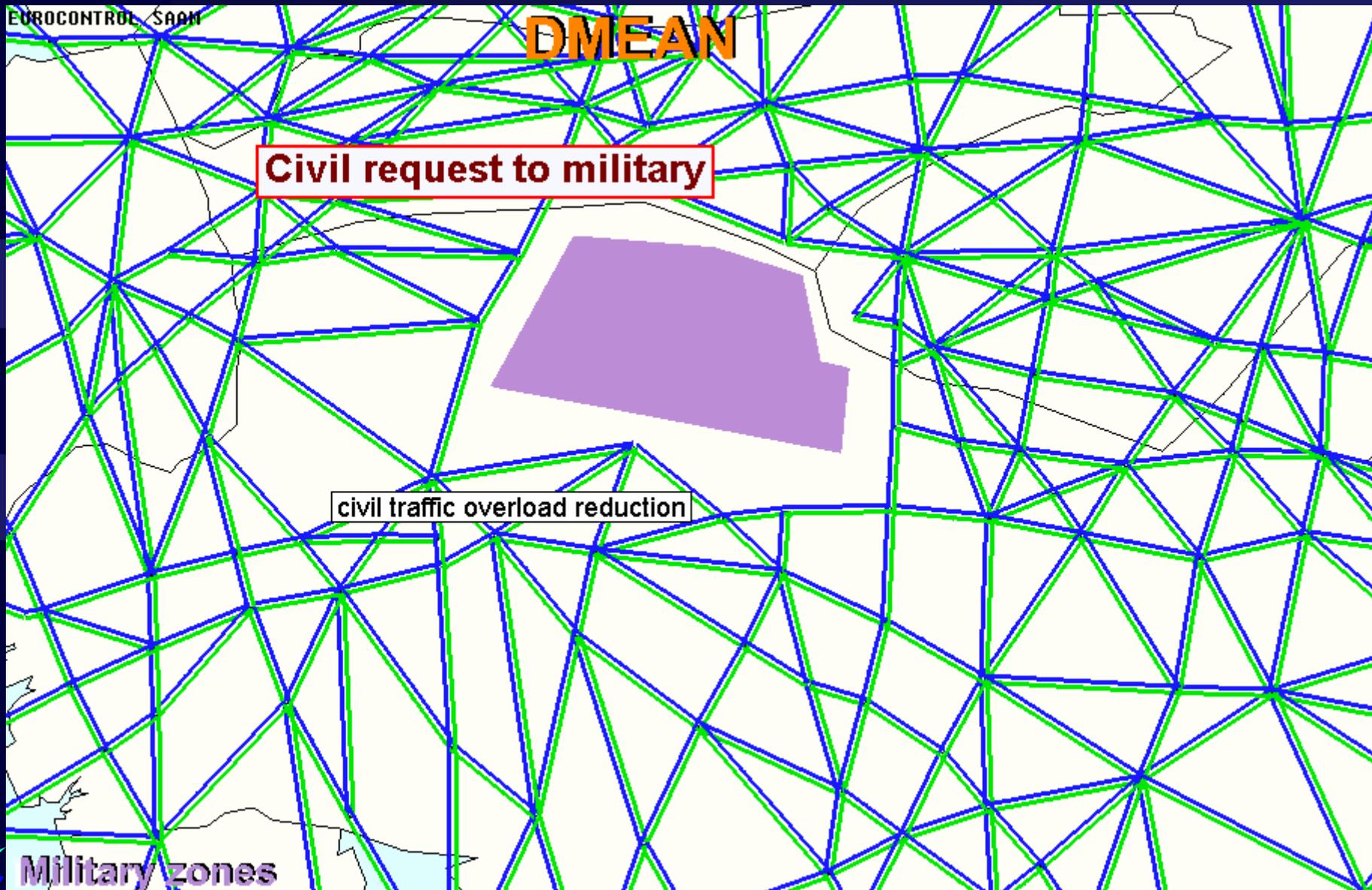
Military zones

# DMEAN



Military zones

# DMEAN



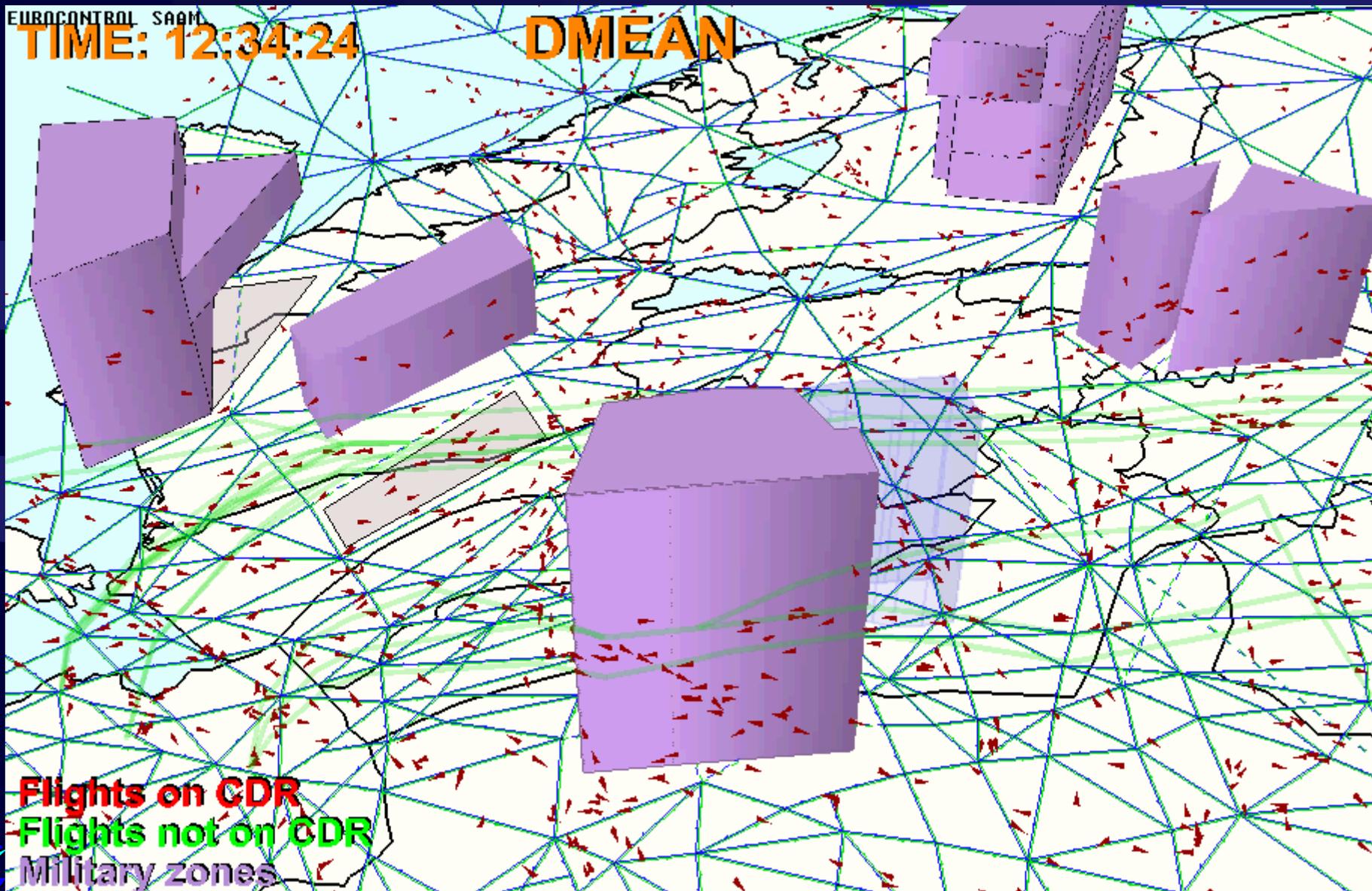
Military zones

# DMEAN

EUROCONTROL SAAM

TIME: 12:34:24

DMEAN



# DMEAN

## DMEAN will improve reactivity of The ATM system in Europe

- AOs will benefit of shorter routes / less delay
- Military will get greater flexibility

However, extra flexibility provided by DMEAN  
must be accommodated with the need  
for structure stability

