



Assessing potential capacity gains from new concepts

Based around Traffic Flow Models

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The Problem – part 1

Gate to Gate project

- I am responsible for a report consolidating findings from many simulations (real time and fast time)
- Simulations of AMAN, DMAN, MSP, Dynamic Re-sectorisation, ETMA HMI (Stack Mangers), ASAS arrivals
- Most at early stage of development – no stable working procedures
- How to provide an overview of impact of all these ‘concepts’???
- How to provide overview of gains in different ACC’s and airports (LFV, DSNA, DFS, AENA and ENAV represented) at ECAC level????





The problem

Many Concepts – Many airspace

Work Package 1 – LFV airspace (Arlanda airport)

DMAN – AMAN – IRM

3 real time +3 fast time

WP 2 DFS-AENA – (Seville ACC & Karlsruhe ACC)

MSP, Dyn Resectorisation – Automation

Prototyping + 4 real time and several fast time

WP 3 DSNA & ENAV (Paris, Rome and Naples TMA's)

Stack management tools, Improved arrival flows

Prototyping + 4 real time + several fast time

WP 4 EEC – (Maastricht ACC and Rome TMA)

En-route tools (MTCD) TMA arrivals + datalink + ASAS

2 real time sims

What does this all mean at an ECAC level?





The problem – part 2

To support R&D Validation Methodology (E-OCVM) need

- To show how to address Key Performance Area –
 - a method for translating low level measures of task structure and task times into KPA's (ICAO – Capacity PRU – Delay)
- How to support case building –
 - Capacity and delay support to Business Case
- How to combine several 'models' and techniques to get meaningful results
 - Real-time, fast-time, logical, expert opinion.

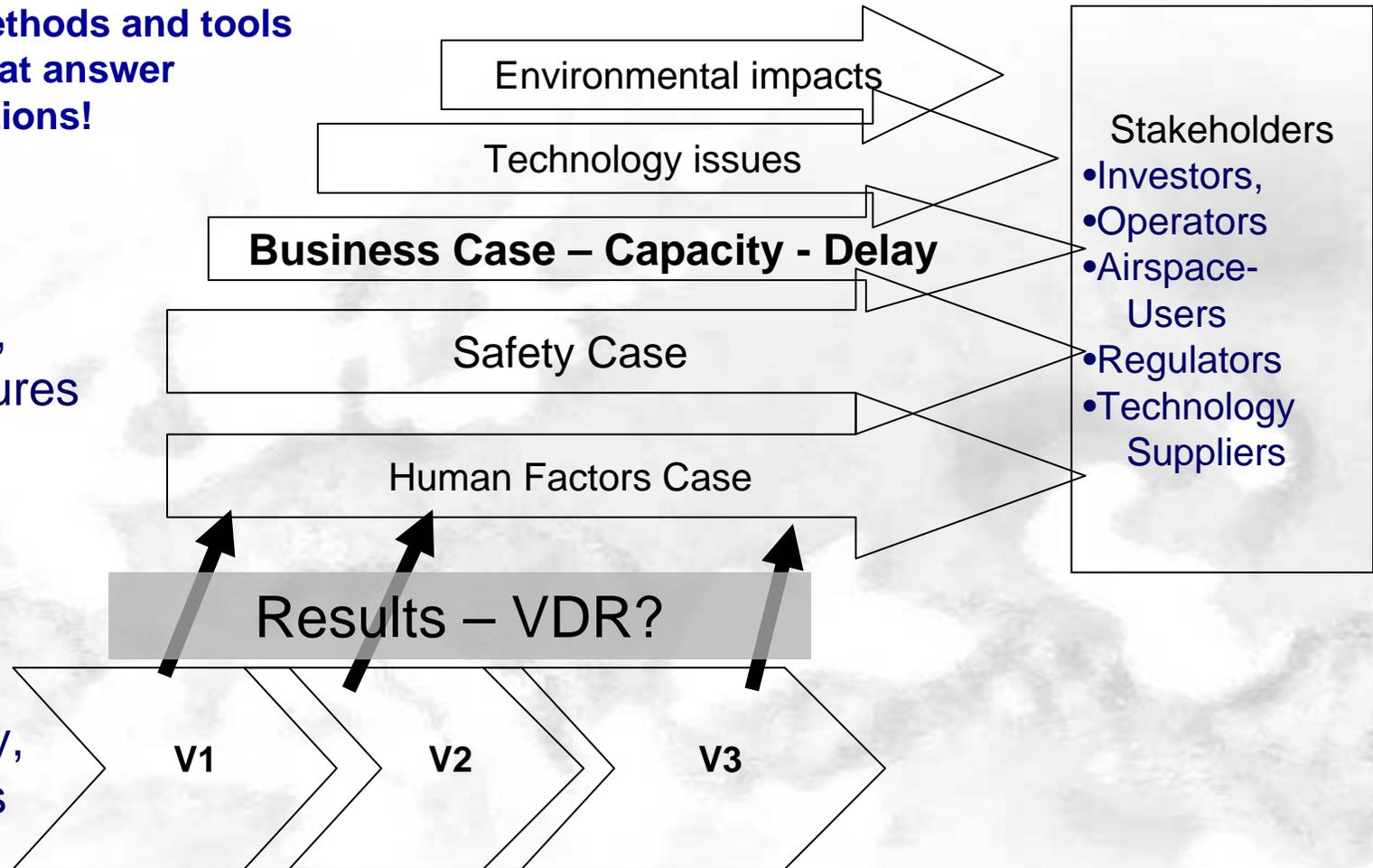


Problem Part 2 – Support to E-OCVM

Use outputs of various exercises using different methods and tools to build 'cases' that answer stakeholder questions!

Require Delay, flexibility, safety measures at this level

Measure Workload, usability, hazard analysis at this level





The solution

Provoke **expert assessment** of **capacity gains** at **local level** (ACC, TMA? and airport) based on knowledge gained in **real-time simulations**.

Extrapolate to other ACC's, TMA's and Airports using **COCA** structure for categorising airspace of similar complexity.

Then use FAP to assess network effects, bottlenecks and delay at **ECAC level**.

Base analysis around a future date so use traffic forecasts - demand (**STATFOR**) and ANSP capability – capacity (**LCIP**) for 2009





Benefit Assessment Methodology



Stéphanie VINCENT

Marc DALICHAMPT

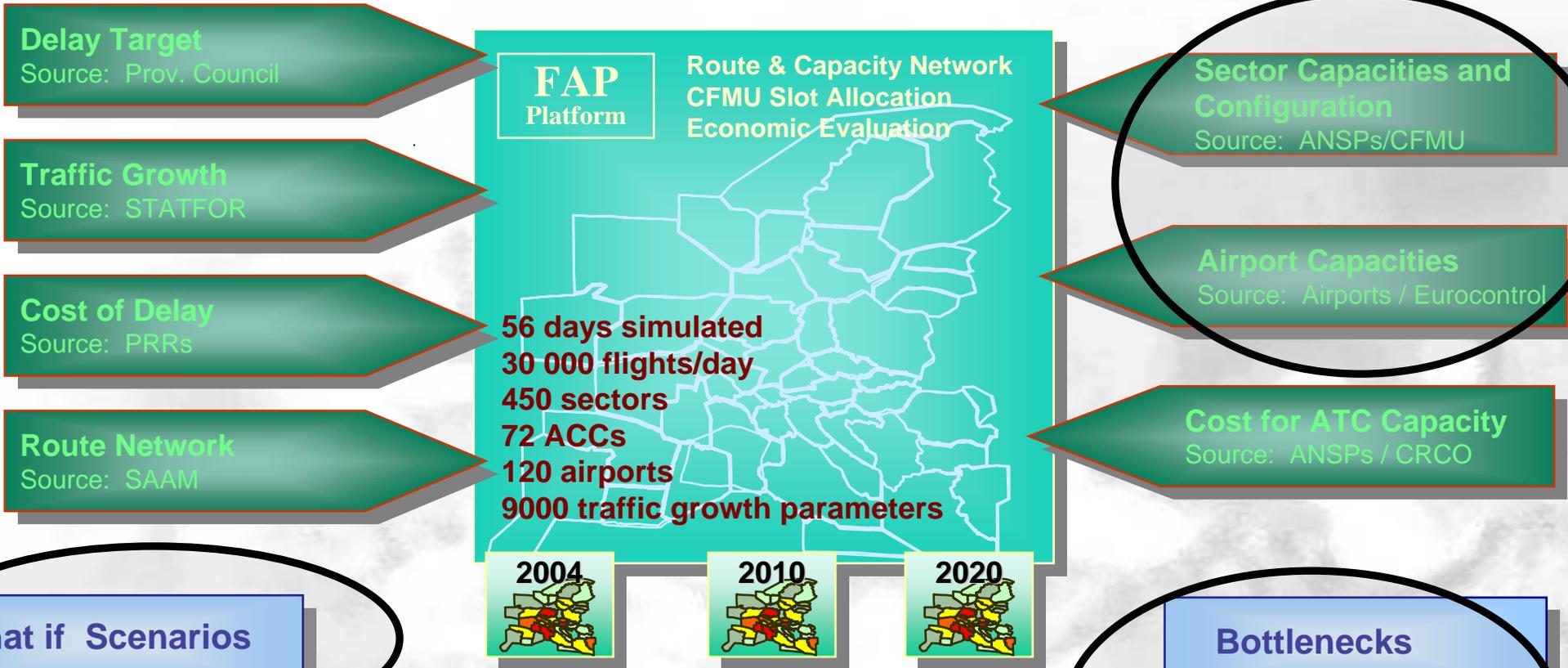
29/09/2005



Global Parameters:

Regional Parameters:

The FAP Network Model

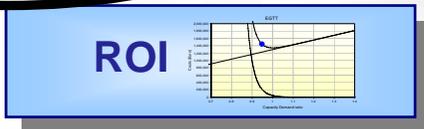


- Delay Target**
Source: Prov. Council
- Traffic Growth**
Source: STATFOR
- Cost of Delay**
Source: PRRs
- Route Network**
Source: SAAM

- Sector Capacities and Configuration**
Source: ANSPs/CFMU
- Airport Capacities**
Source: Airports / Eurocontrol
- Cost for ATC Capacity**
Source: ANSPs / CRCO

What if Scenarios

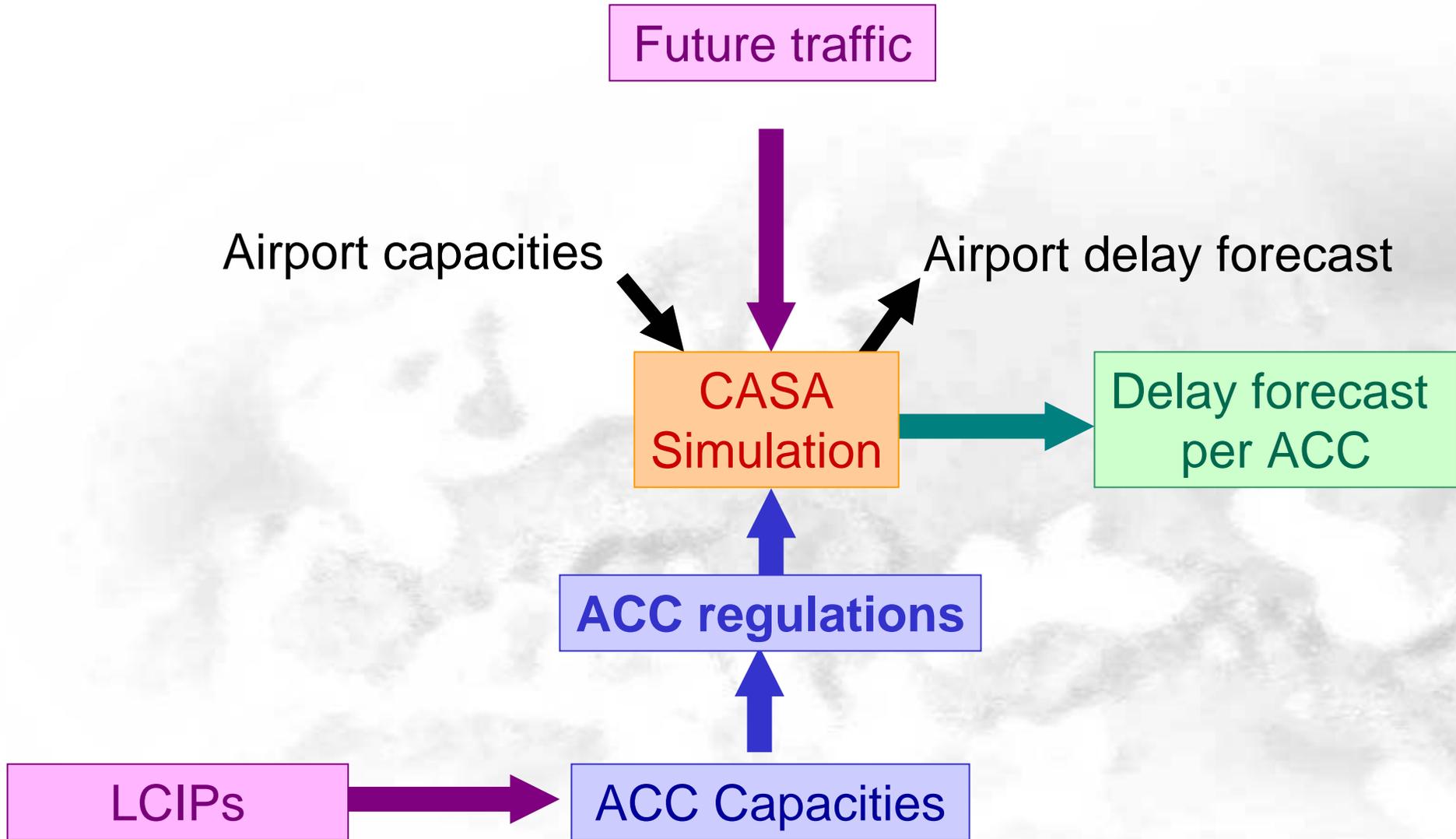
Bottlenecks
Delay Forecast



Capacity Profiles

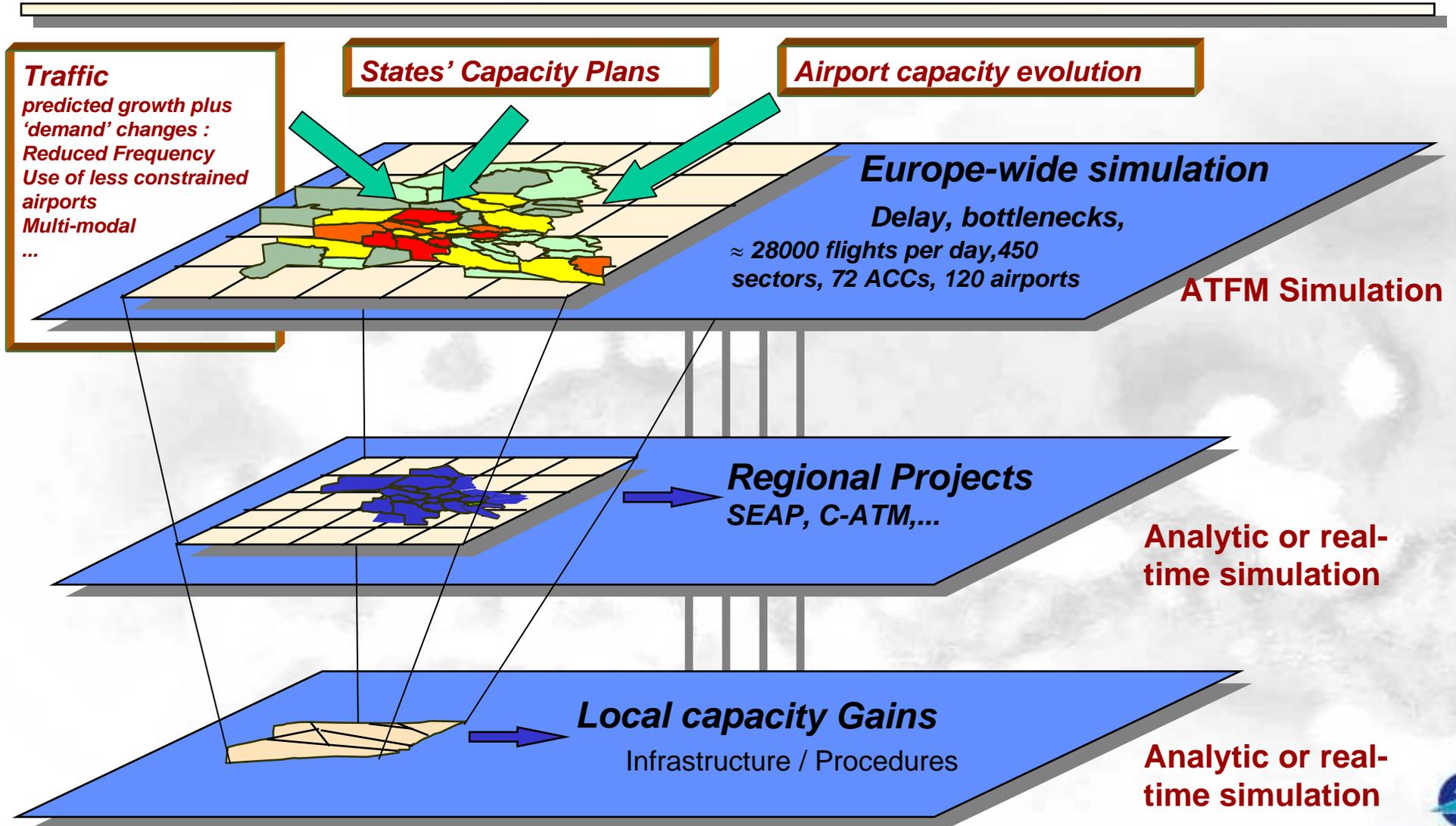


Delay forecast - Methodology





From a Local to a European perspective





Benefits – Capacity and Delays

Traffic Growth Hypothesis ??????

Route Network hypothesis ??????

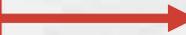
Time Horizon ??????

FIPS Parameters ??????

Traffic



Delay Forecast



Benefits

ACC Capacity



Cost per minute of delay ??????

Can be derived from ??????

-All sector capacities with PACT

-Capacity increase per type of sector with COCA



Benefits – Capacity and Delays

- Benefits can be assessed in terms of:
 - Workload and Capacity
 - Delay and Cost

Year	Total ATFM Delays (Minutes)	ATFM Delays > 15 minutes			Costs of ATFM delays		
		En route	Airport	Total	En-route	Airport	Total
2001	27.6 M	16.2 M	5.7 M	21.9 M	€1 150 M	€400 M	€1 550 M
2002	18.0 M	9.0 M	4.9 M	13.9 M	€650 M	€350 M	€1 000 M
2003	14.8 M	5.7 M	5.5 M	11.2 M	€400 M	€400 M	€800 M

Figure 28: Estimated ATFM delay costs (including reactionary)

The delay costs are computed for passenger flights, i.e. some 75% of all flights in Europe. The estimate cost of ground delay is €83 per minute in average for an aircraft of 140 seats. In order to account for other traffic (freight, military and general aviation), an approximate figure of 15% is added, which reduces the average estimated cost of ground delay to €71 per minute.



Benefits – System Access

Not assessed in Gate to Gate but potentially useful

For Baseline and Scenarios :



Traffic Growth Hypothesis ??????

Route Network hypothesis ??????

Time Horizon ??????

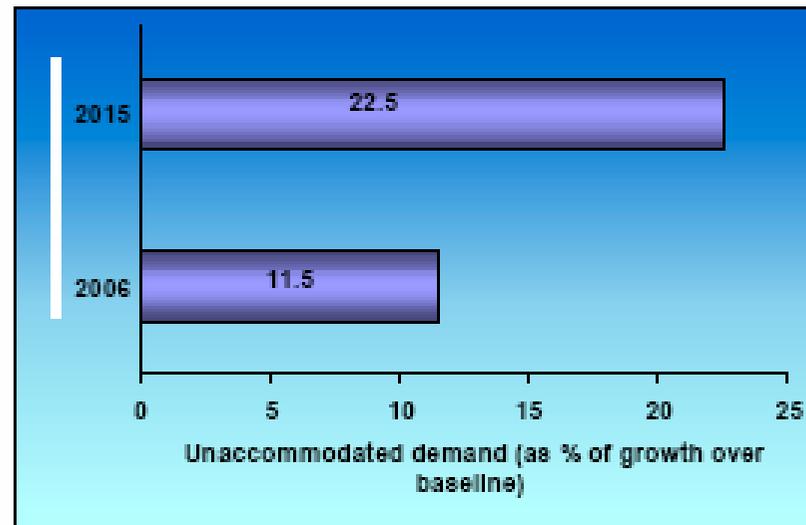
FIPS Parameters ??????

Benefits – System Access

- Benefits can be assessed in terms of:
 - **System Access**

The adjacent diagram indicates at the overall network level the potential demand growth that could not be accommodated at 2006 and 2015.

This figure indicates that some 22.5% of the predicted traffic augmentation beyond 2001 cannot be accommodated by the system as a result of the modelled airport capacity constraints.

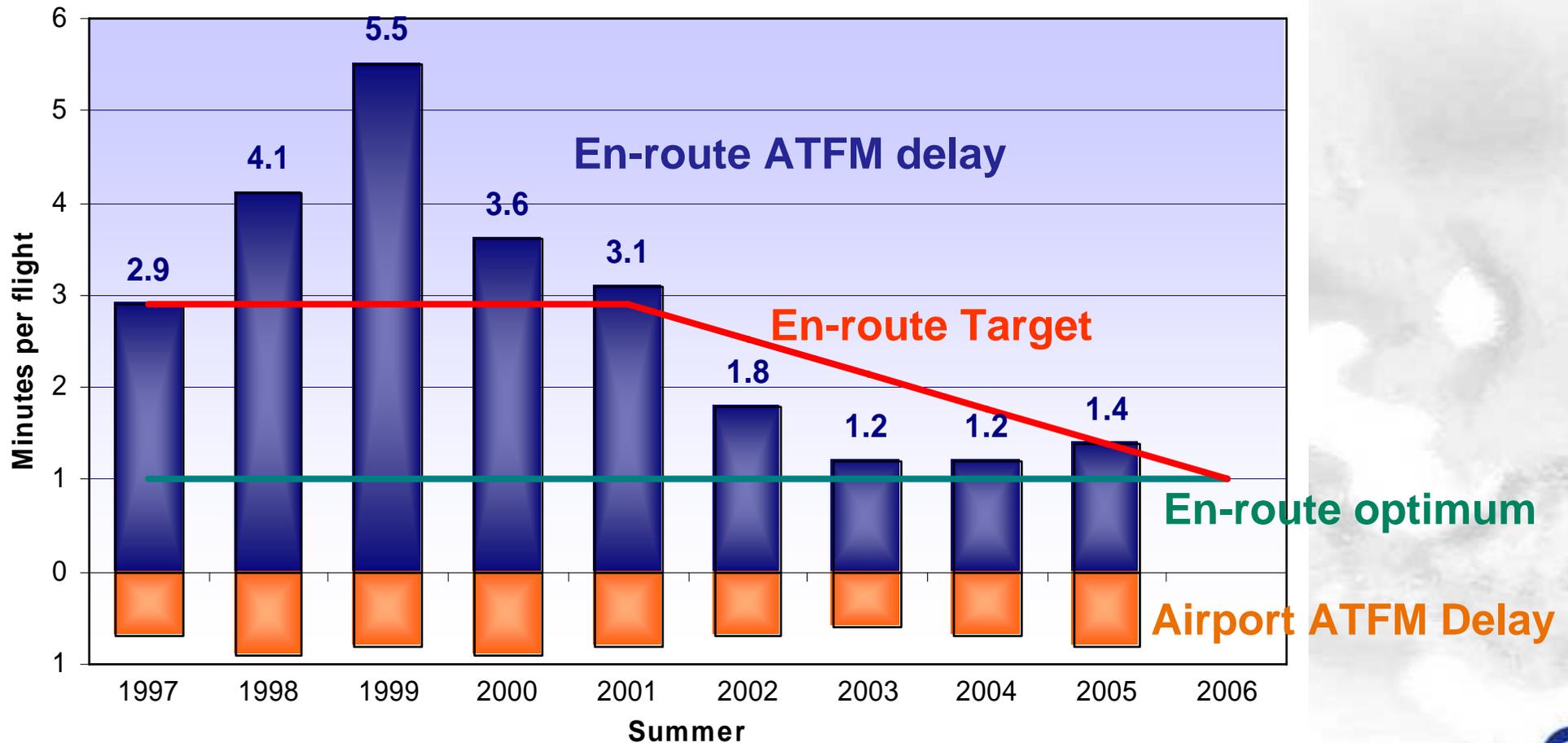


Medium-term European-wide capacity planning started in November 1998 :

- For each ACC/TMA unit capacity requirements are assessed from the overall network perspective.**
- Capacity needs are published in the European Convergence and Implementation Plan (ECIP).**
- Capacity Plans from ANSPs (5-years-rolling) published in their Local Convergence and Implementation Plan (LCIP).**
- Progress is monitored and plans are updated yearly.**

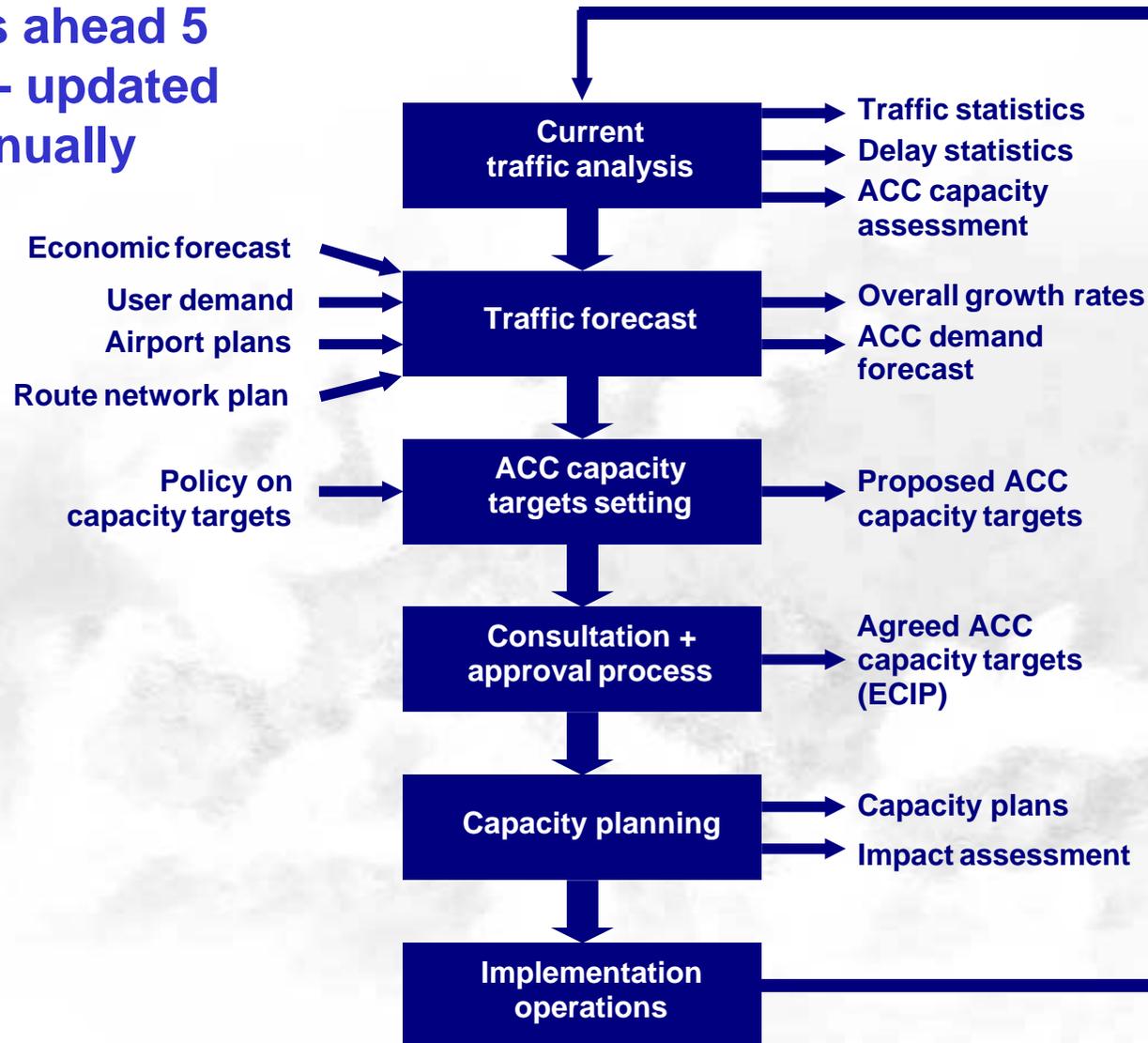
The European ATC Capacity Planning Process (2/3)

Strategic Objective: 1 minute en-route ATFM delay per flight



The European ATC Capacity Planning Process (3/3)

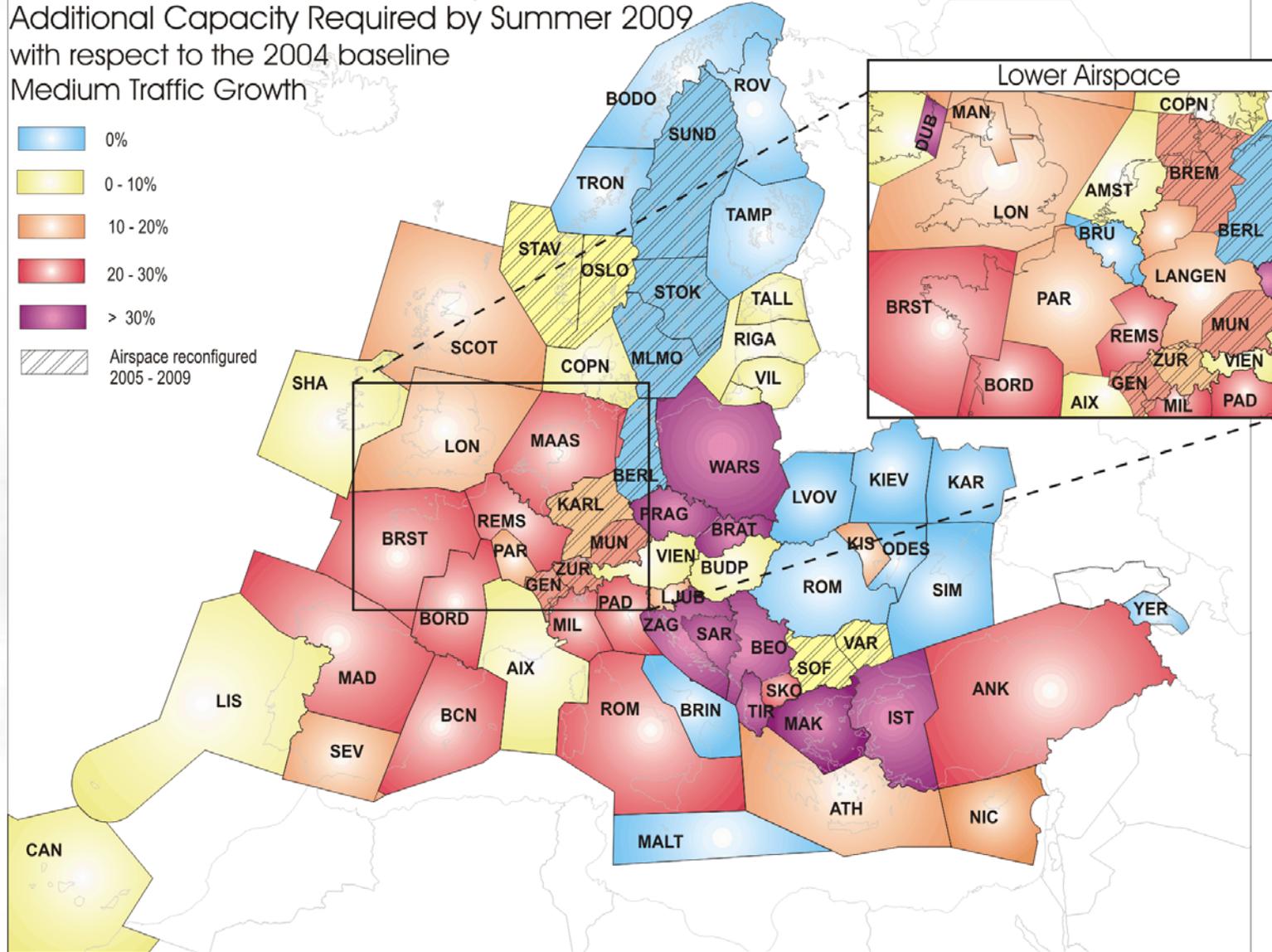
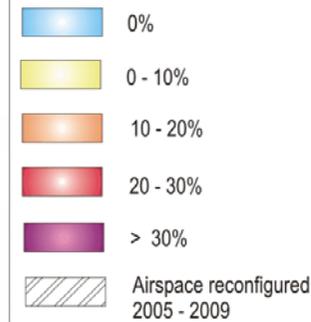
Looks ahead 5 years - updated annually





Future Capacity Needs - ECIP

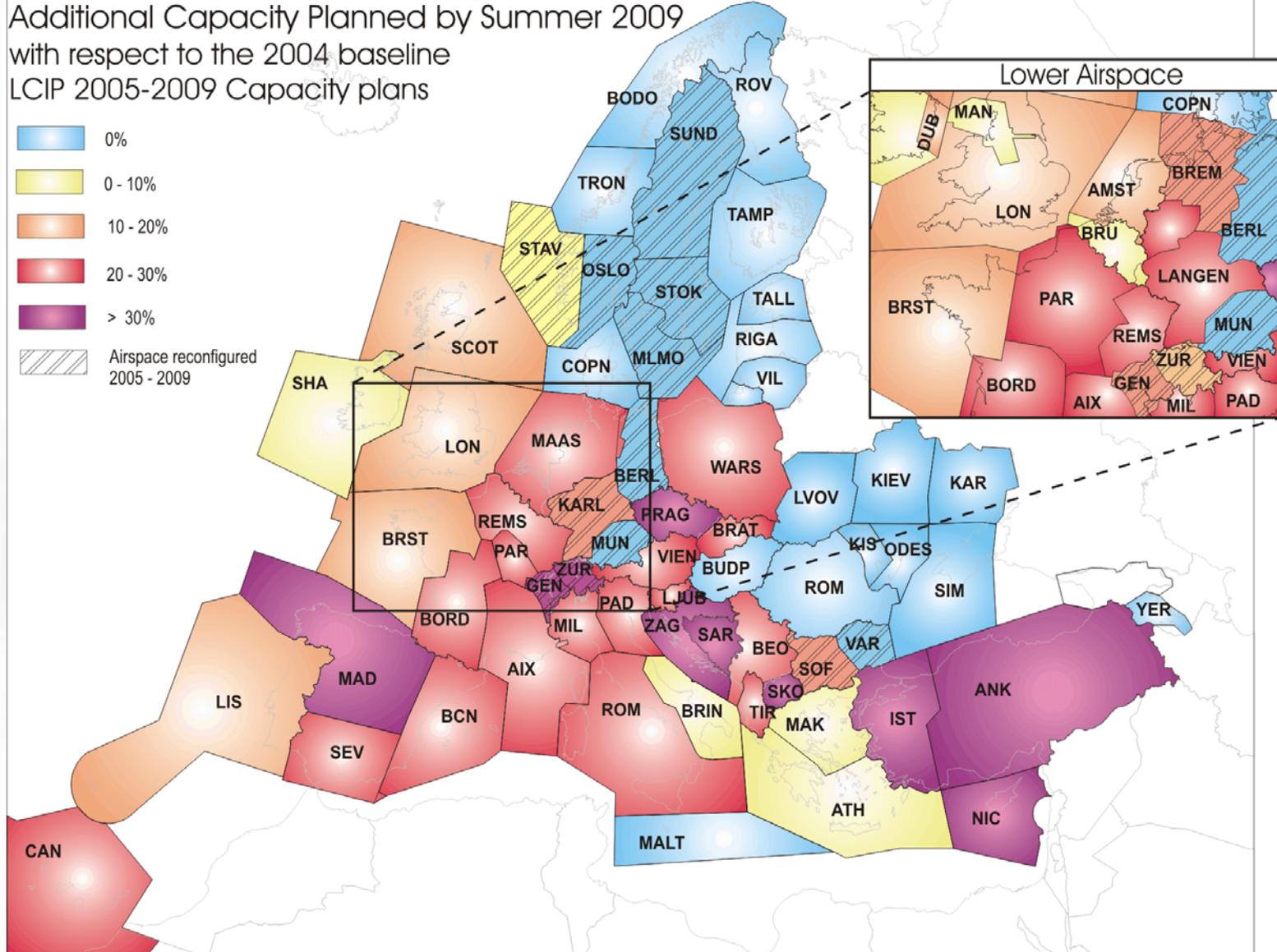
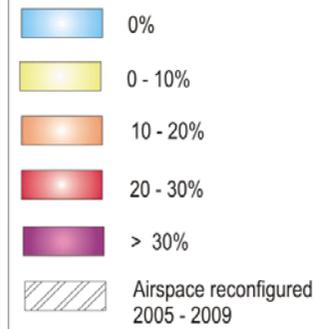
Additional Capacity Required by Summer 2009
with respect to the 2004 baseline
Medium Traffic Growth





Future Capacity planned - LCIP

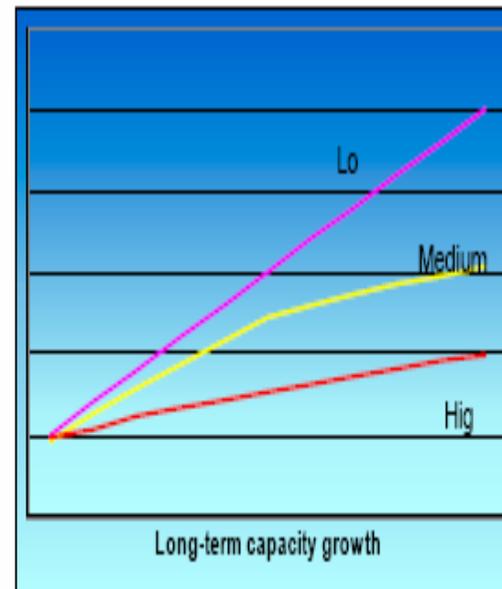
Additional Capacity Planned by Summer 2009
with respect to the 2004 baseline
LCIP 2005-2009 Capacity plans



Future ACC Capacities (Long-Term)

For Long Term and to assist extrapolating impact from one ACC to others (use of COCA):

Complexity classification	Assumed capacity growth
Low	linear growth ⁰
Medium	logarithmic function. More constrained than the linear case
High Complexity	Power function. Further constrained in the long-term.



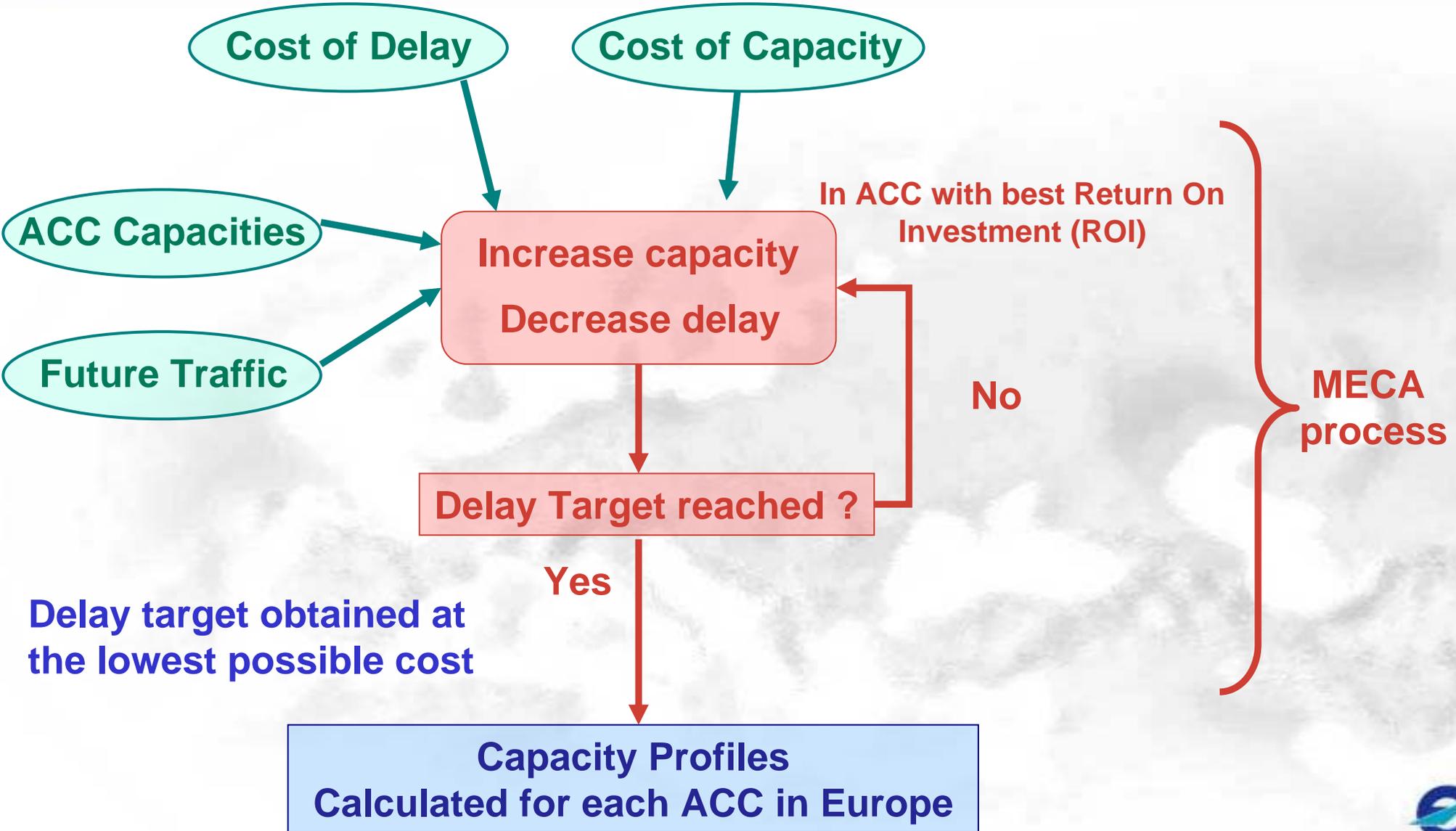


Questions

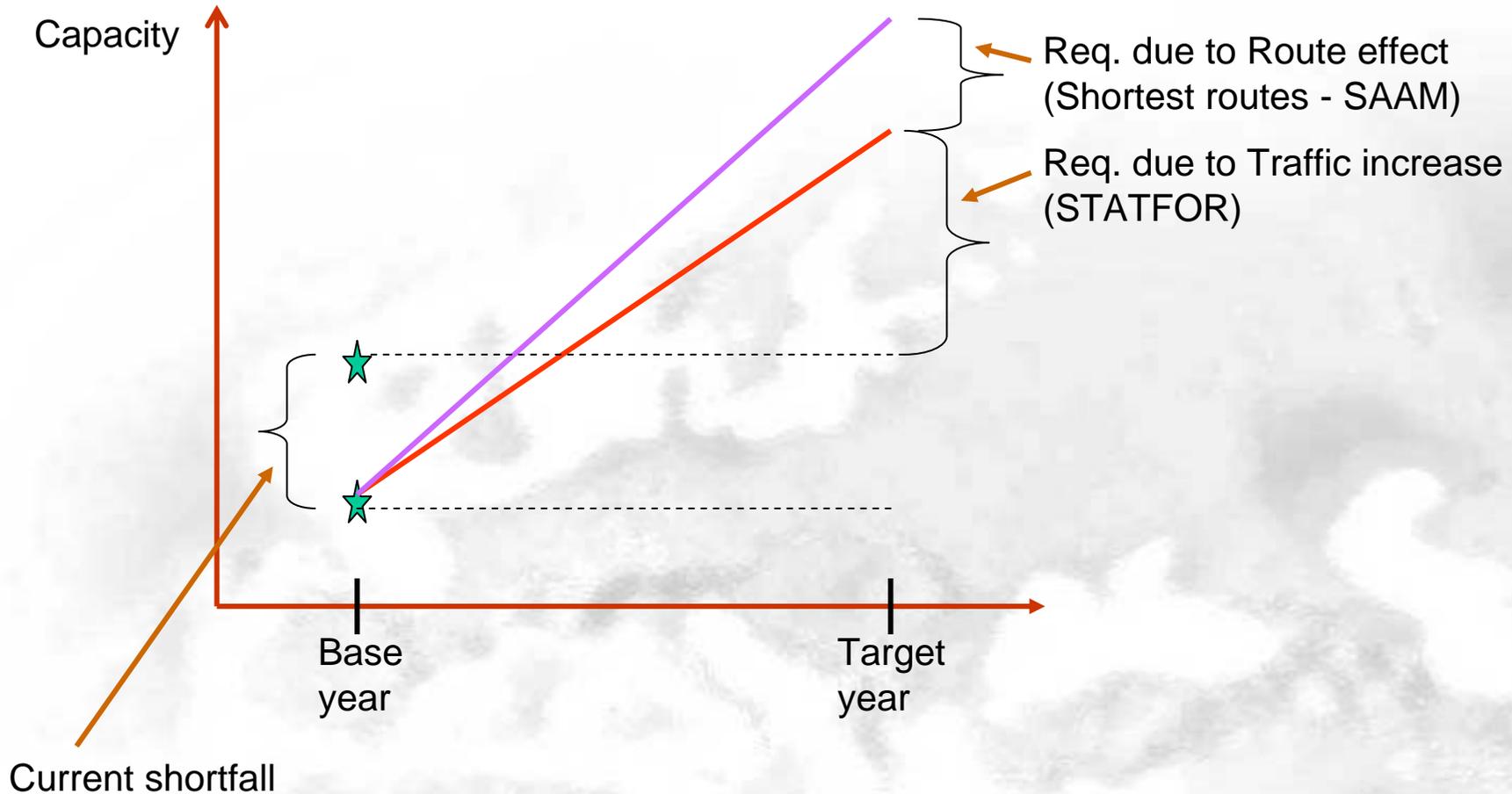


Spare slides after here

Capacity Profiles (MECA)

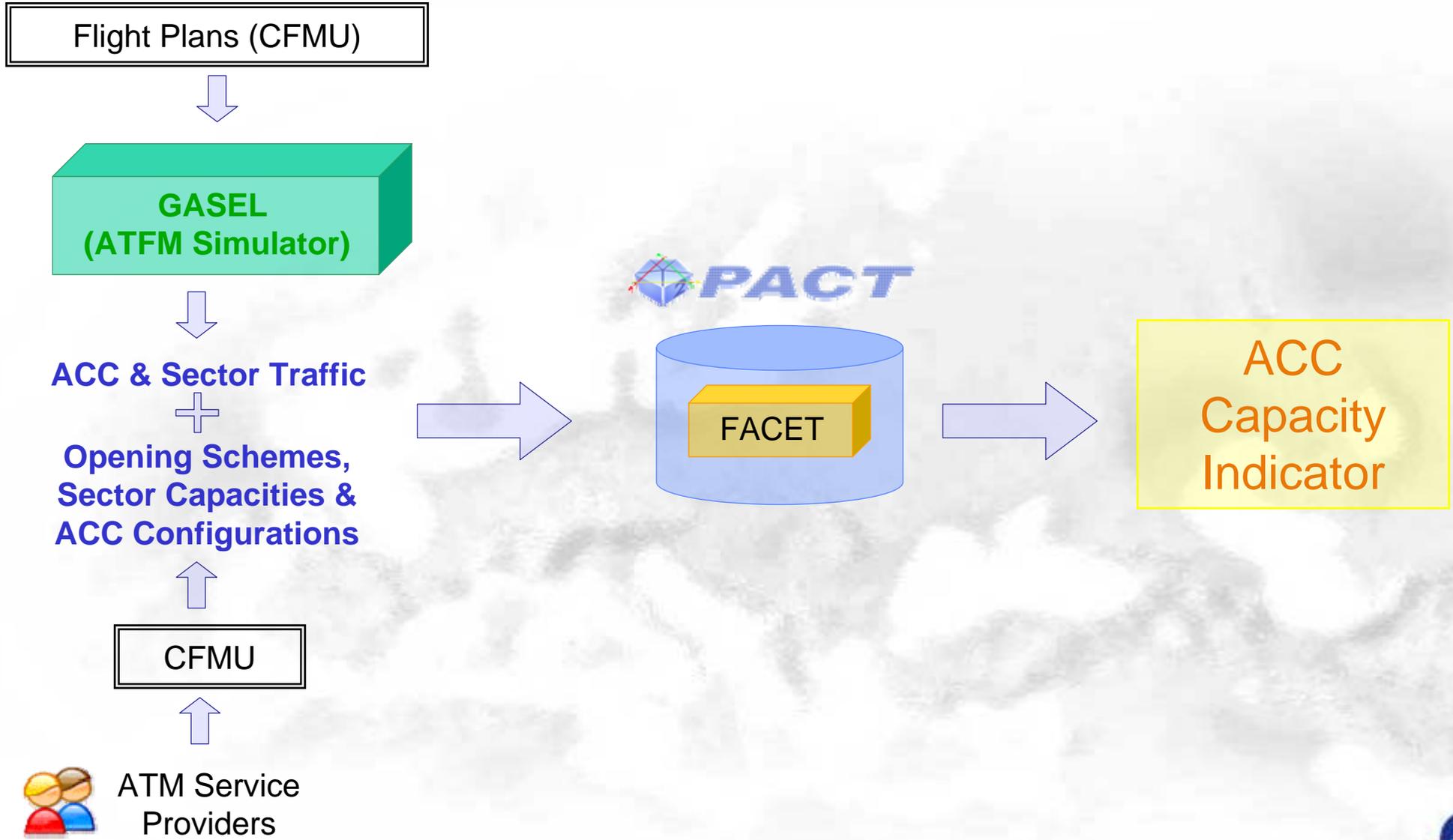


How capacity requirements are assessed



Capacity Target = Capacity Shortfall + Traffic effect + Shortest Routes effect

PACT Overview

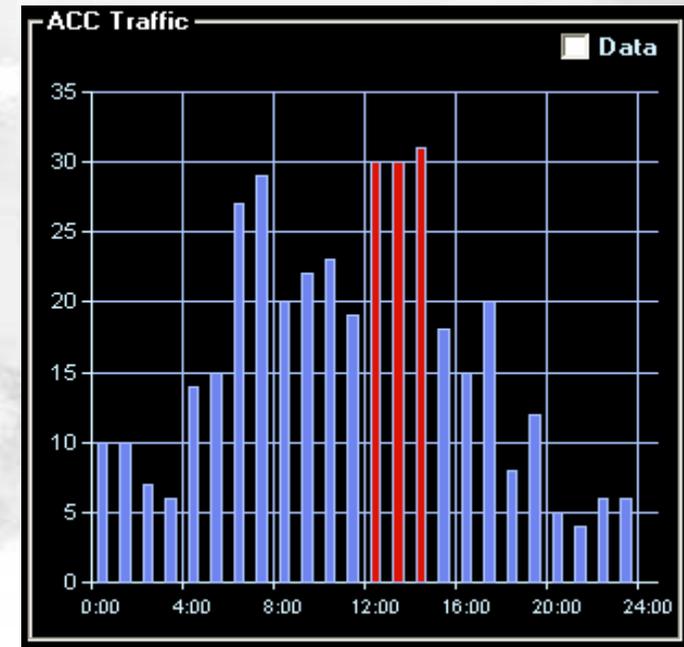
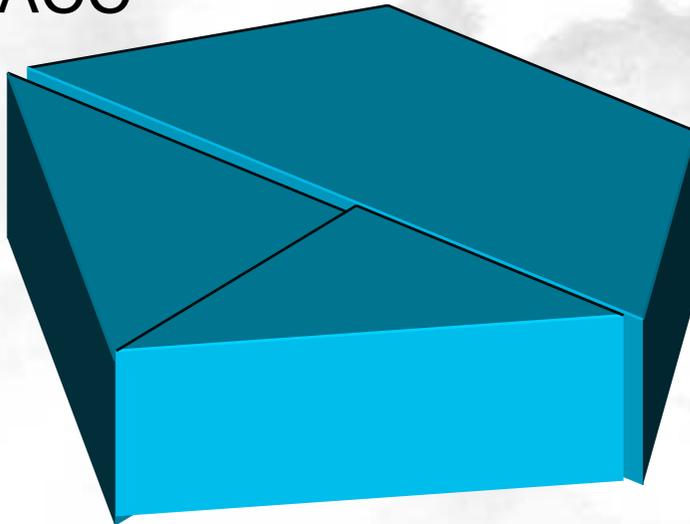


ATM Service Providers



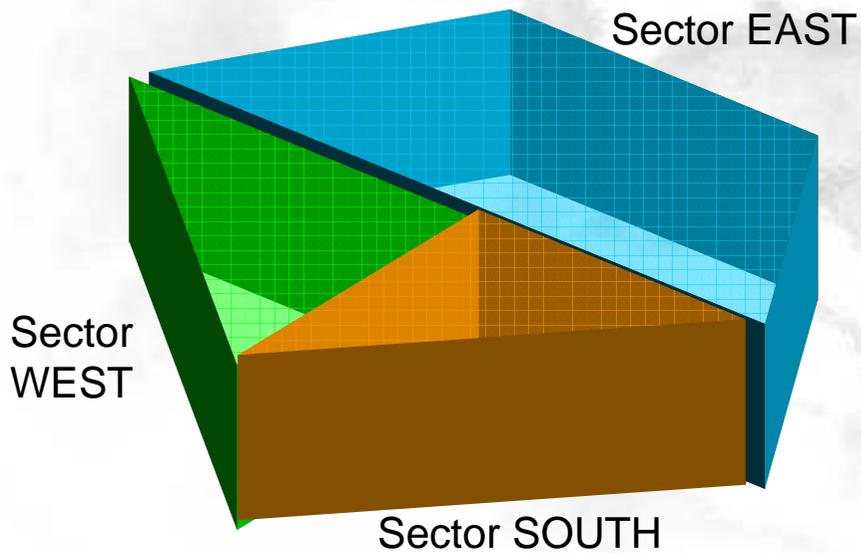
- ◆ ACC Capacity example
 - Step 1 : Find the busiest 3-hour period of the day
 - ⇒ Average 30 flights/hr

ACC



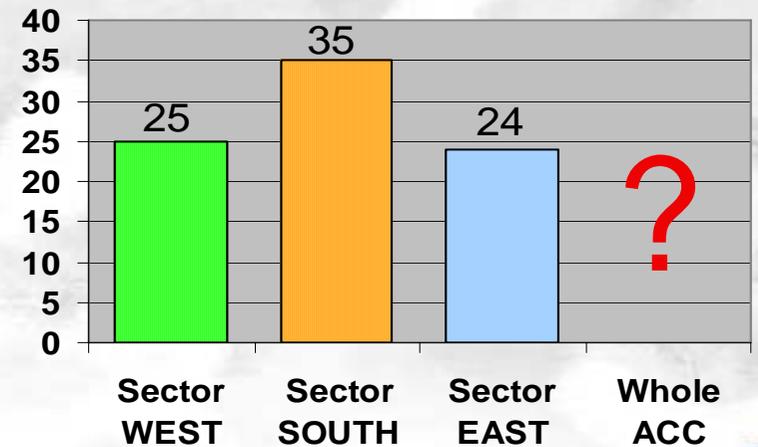
Flights/hr for the whole ACC

◆ ACC Capacity example



Sector Capacities

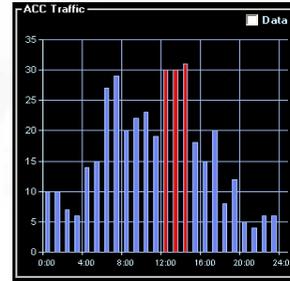
ACC & Sector Capacity (flights/hr)



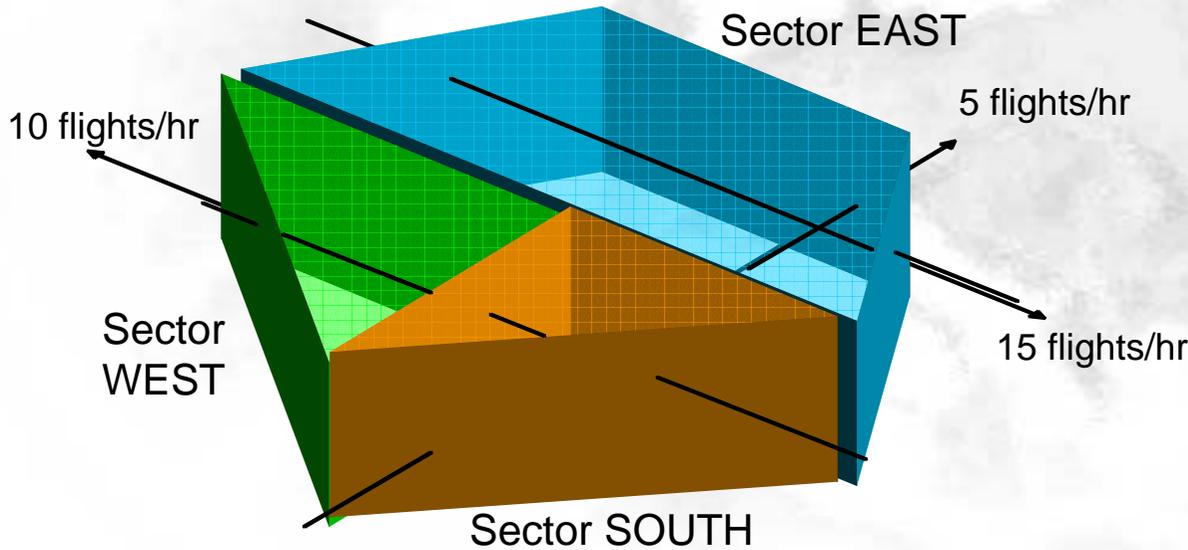


FACET Methodology

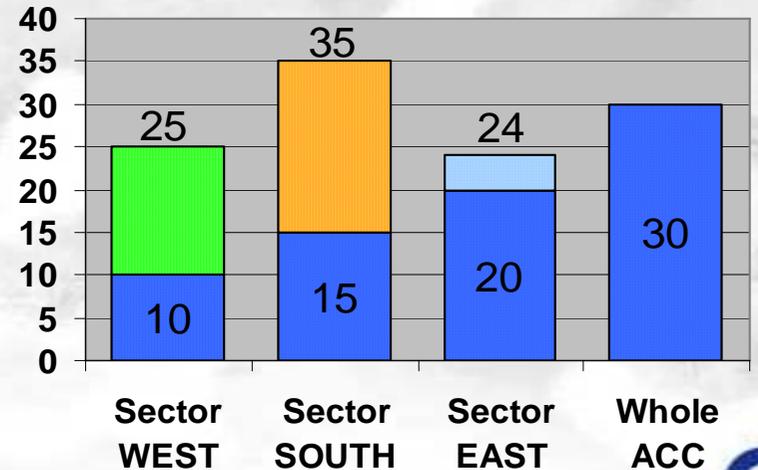
◆ ACC Capacity example



Starting Point:
 busiest 3-hour Traffic
 period
 = 30 flights/hr



ACC Traffic / Capacity (flights/hr)



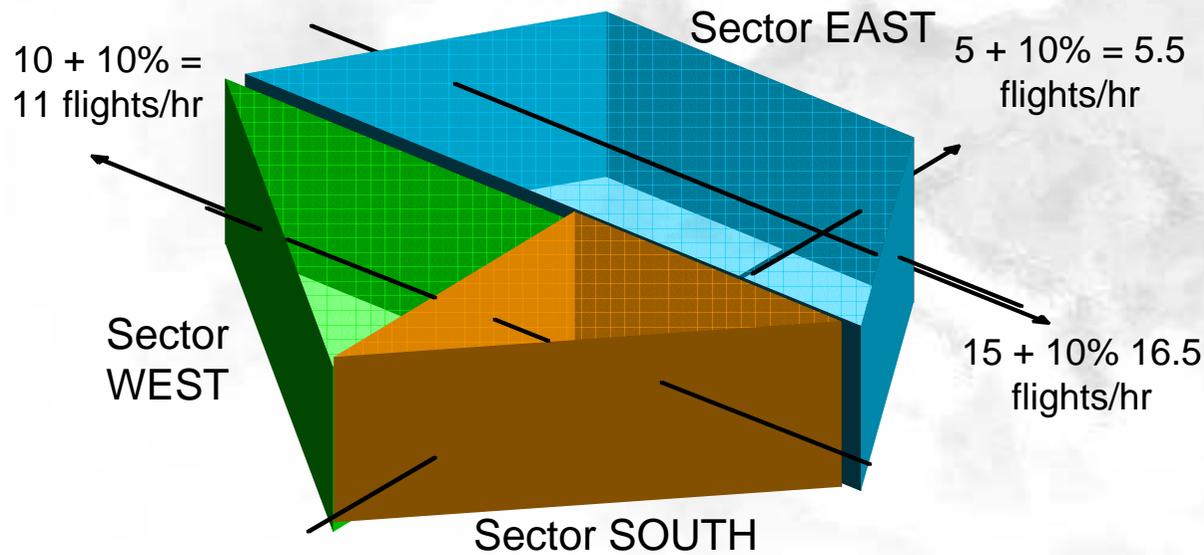


FACET Methodology

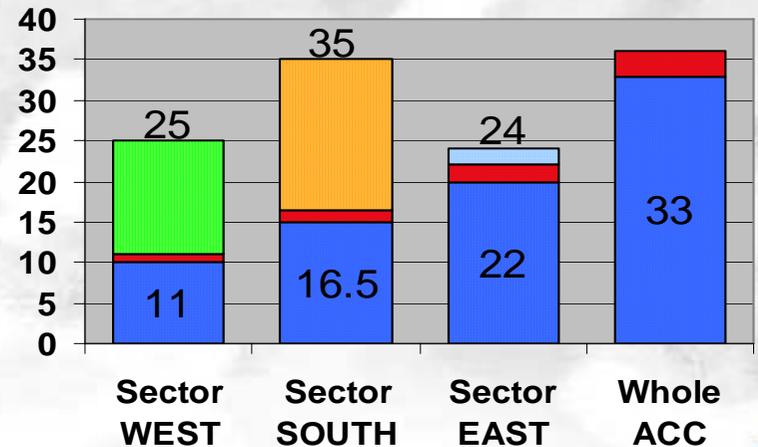
◆ ACC Capacity example

- ➔ Step 2 : Increase the ACC traffic until a sector becomes saturated

Homogeneous (10%)
Increase to
33 flights/hr



ACC Traffic / Capacity (flights/hr)



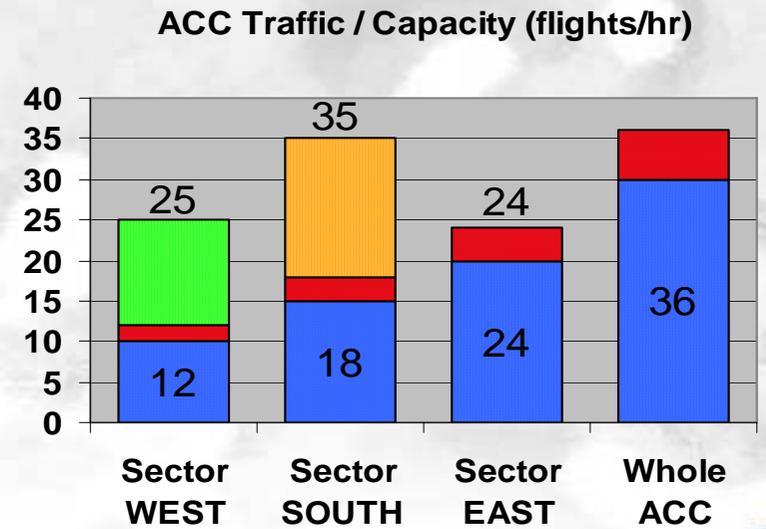
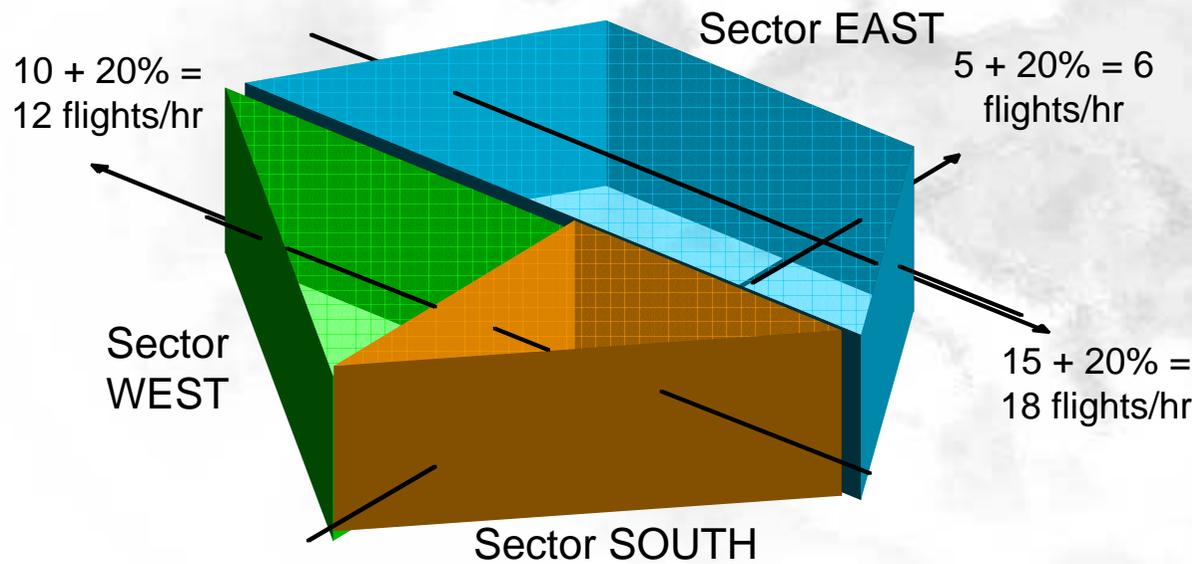


FACET Methodology

- ◆ ACC Capacity example
 - ➔ Step 2 : Increase the ACC traffic until a sector becomes saturated

Sector EAST is saturated after a 20% Increase

ACC Capacity = 36 flights/hr





FACET Methodology

◆ FACET equation

$$\text{ACC Capacity} = \text{Load ACC} \times \frac{1}{\text{max saturation}}$$

Example

$$\text{ACC Capacity} = 30 \times \frac{1}{(20/24) = 0.83} = 36$$

