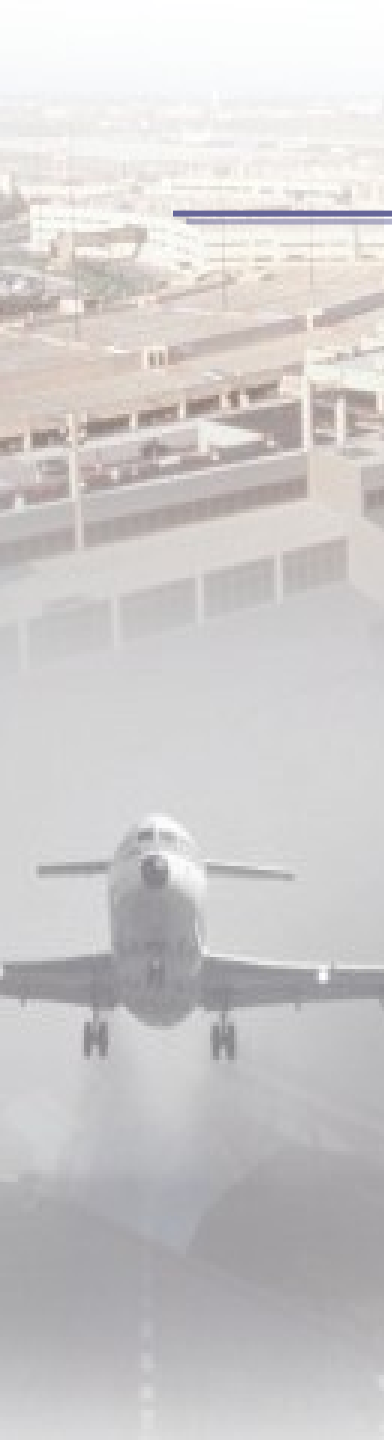


RVSM

North American D-RVSM Program &

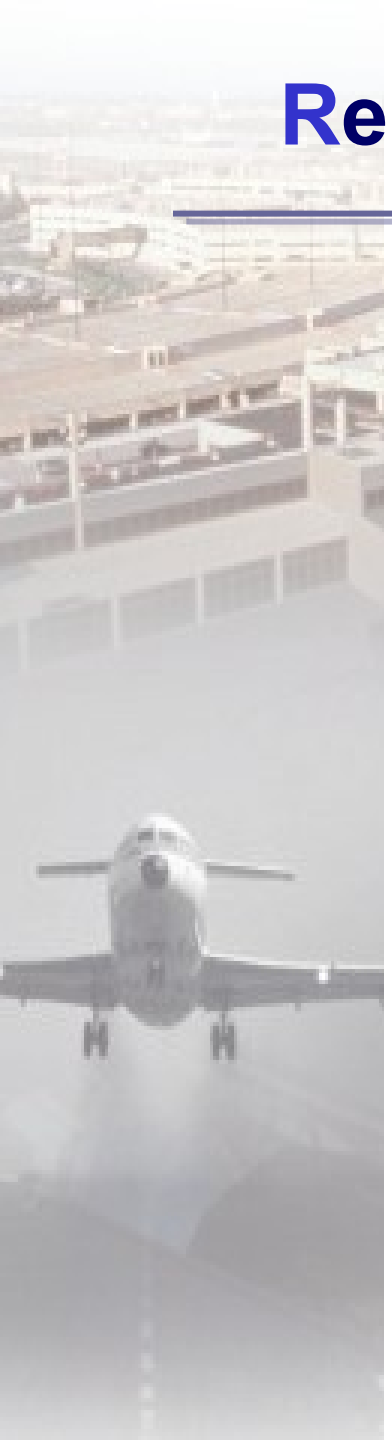
EUR RVSM experience

presented by

Chris Bouman

EUROCONTROL

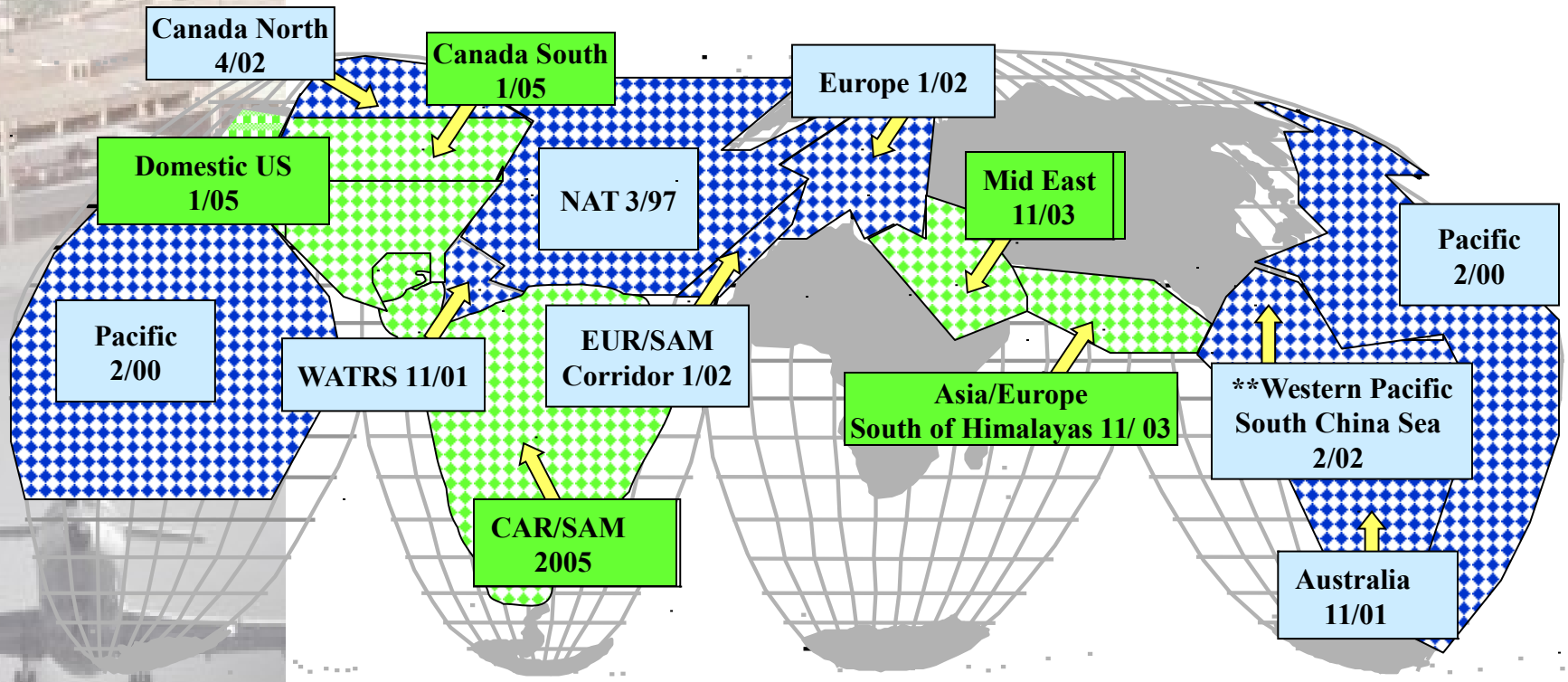
Reduced Vertical Separation Minimum



- Last 40 years: 1000ft VSM below FL290; 2000ft VSM above FL290
- early 1990's: ICAO requirements for applying 1000ft VSM up to FL410
- 6 additional Flight Levels between FL290 and FL410

RVSM Implemented & Planned

As of April 2003



Implemented Planned

** Western Pacific/South China Sea

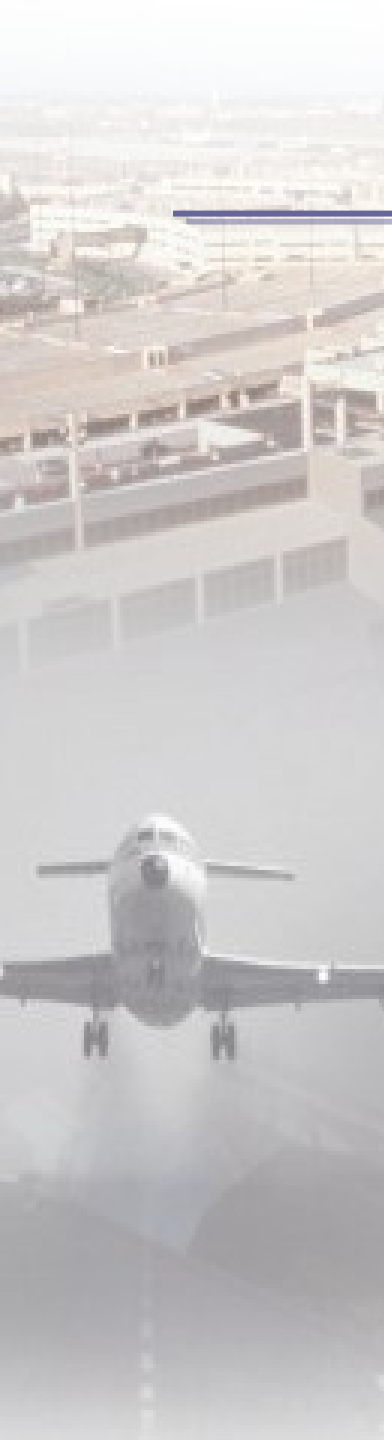
February 2002 Implementation

Bangkok, Ho Chi Minh, Kota Kinabalu, Kuala Lumpur, Manila, Phnom Penh, Sanya, Singapore, Taipei

October 2002 Implementation

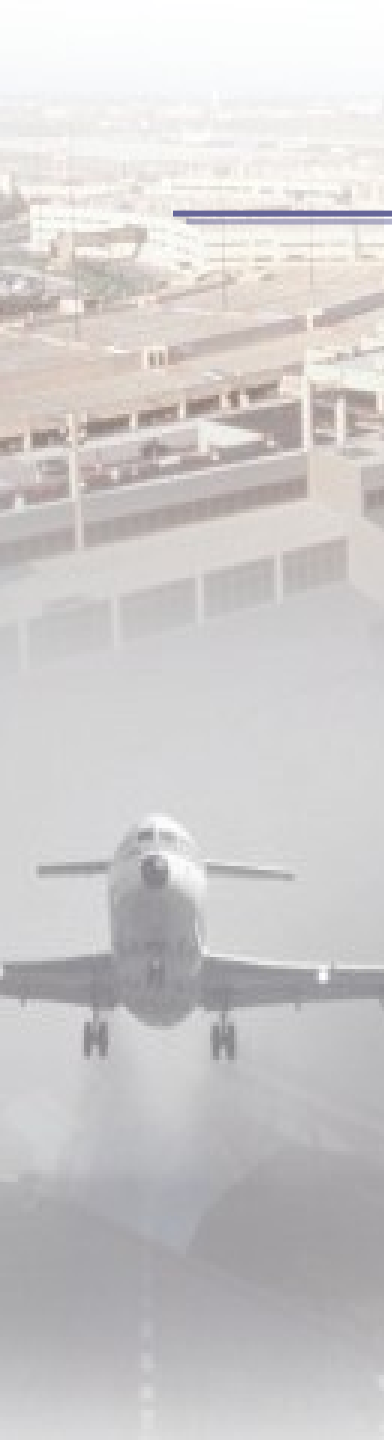
Hanoi, Hong Kong, Jakarta, Ujung Pandang, Vientiane

V. 6.8 5-23-02



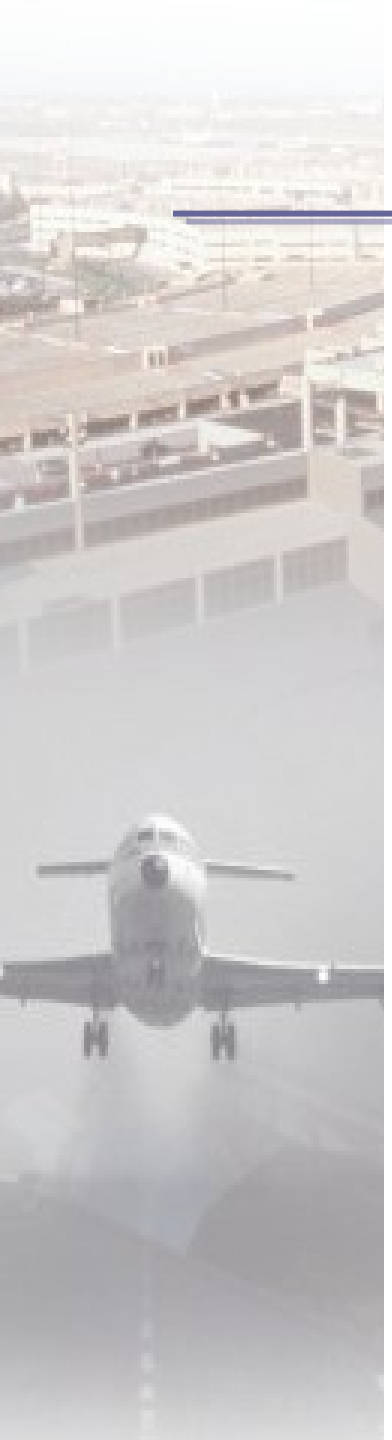
DRVSM Program Objectives

- Implement DRVSM from FL290-FL410 in the airspace of the United States, Alaska, the Gulf of Mexico where the FAA provides air traffic services and possibly the San Juan FIR.
- The United States, Canada, and Mexico are planning a joint implementation of RVSM.
- DRVSM is proposed to be implemented on January 20, 2005 0901UTC.



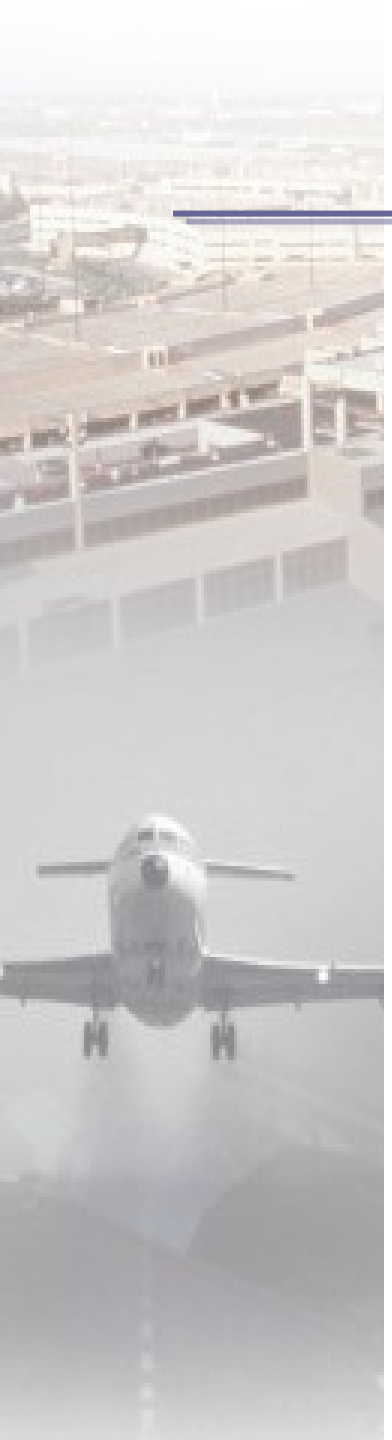
DRVSM Environment

- Creates six additional altitudes from FL 290 through FL 410 by the reduction of vertical separation from 2000 ft. to 1000 ft.
- Airspace will be exclusionary for DRVSM approved aircraft with the exception of accommodating DoD and Lifeguard aircraft.
- Non-DRVSM approved aircraft may transition through DRVSM airspace.



D-RVSM Key Events

- Publish Final Rule Jun 2003
- 3rd ATC simulation Jun 2003
- Monitoring system End 2003
- Safety Assessment/
  Fleet Readiness Jun 2004
- ATC System Mods Jul 2004
- Readiness Review Sep 2004
- Proposed Implementation Jan 20, ‘05



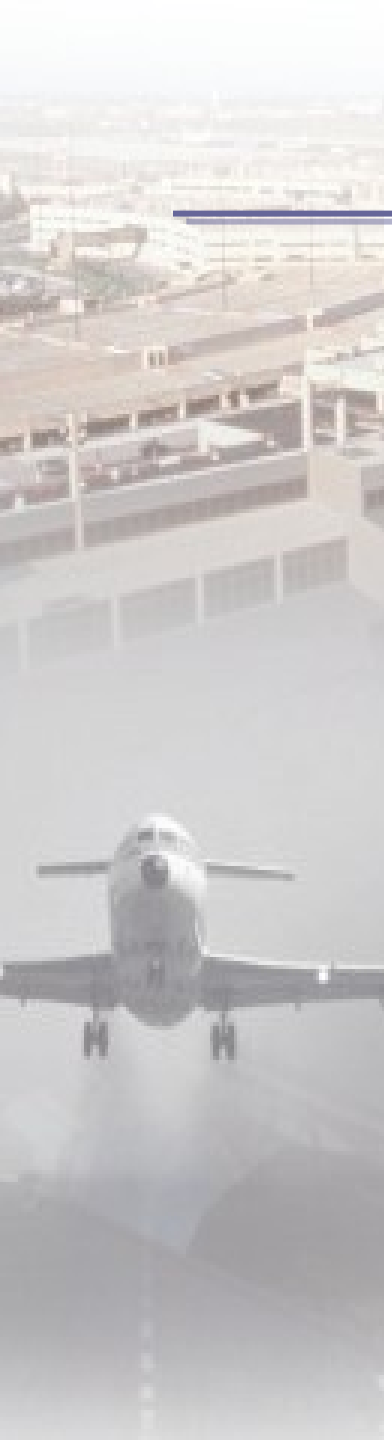
D-RVSM Benefits

Air Traffic:

- Improved Operational Efficiency
- Enhanced Airspace Capacity
- Enhanced controller flexibility
- Increased throughput of en-route traffic

Aircraft Operators:

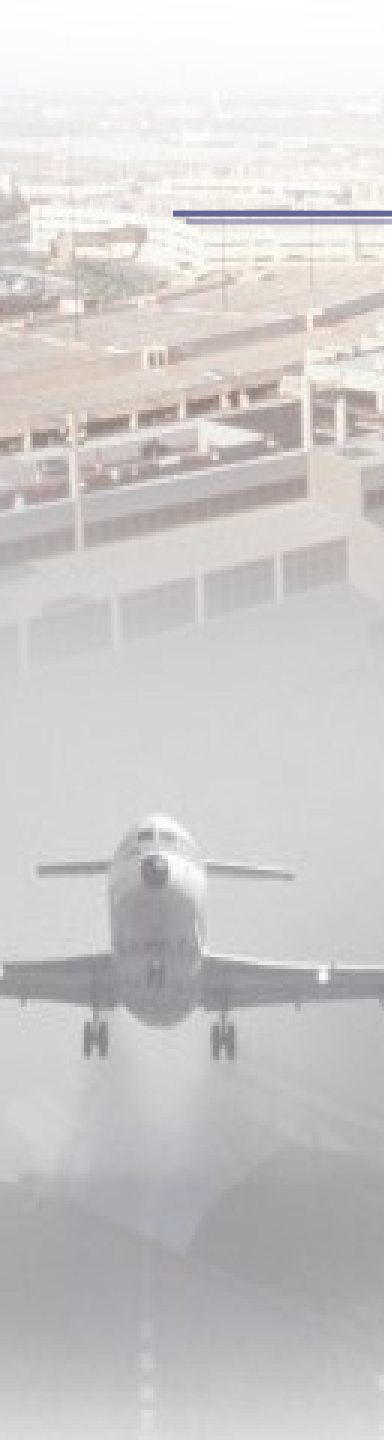
- Greater availability of the more efficient levels (expected fuel savings appr. 2 %)
- Greater availability of most fuel-economic routes
- Increased probability of clearance on desired route or altitude



Operator Costs 2002 - 2016

- **Operator Costs for Aircraft Approval:**
  - Large Transport Aircraft: $206 million
  - Small Commercial/GA: $530 million
  - Downtime if work not accomplished during scheduled Mx $74 million
  - TCAS II, Version 7.0 upgrade $46 million
  - Monitoring $4 million

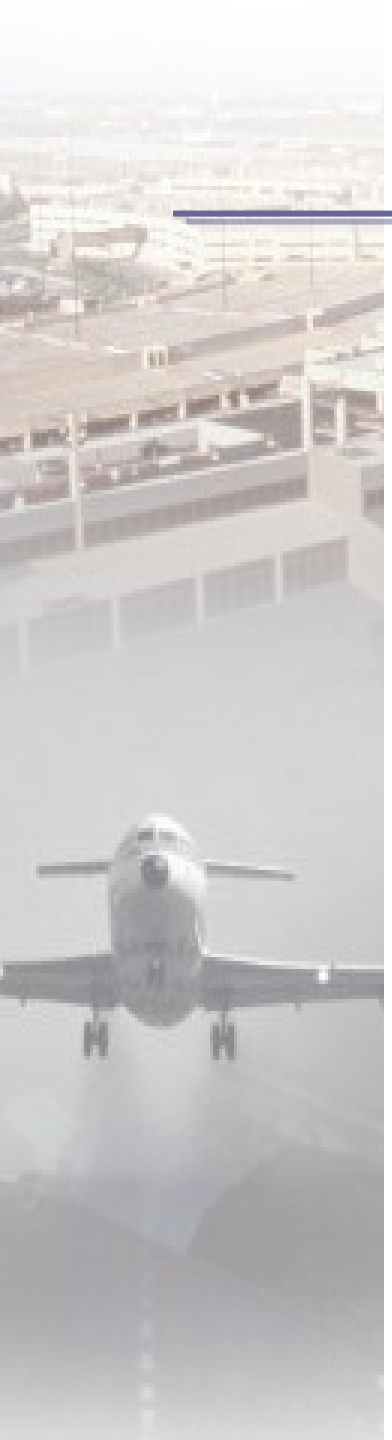
- **Major operators started RVSM work in 2002**



Benefits 2004 - 2018

- **Fuel Savings and Operating Efficiency Benefits 2005 – 2019:**
  - $5 billion
  - 6/1 benefit/cost ratio
  - **$359 m. first year savings---2.0% annual increase**

- **Benefits to air traffic operations:**
  - ATC Flexibility
  - Mitigate conflict points
  - Enhance sector throughput
  - Reduce controller workload…e.g., reduce vectoring



D-RVSM Monitoring

NAARMO

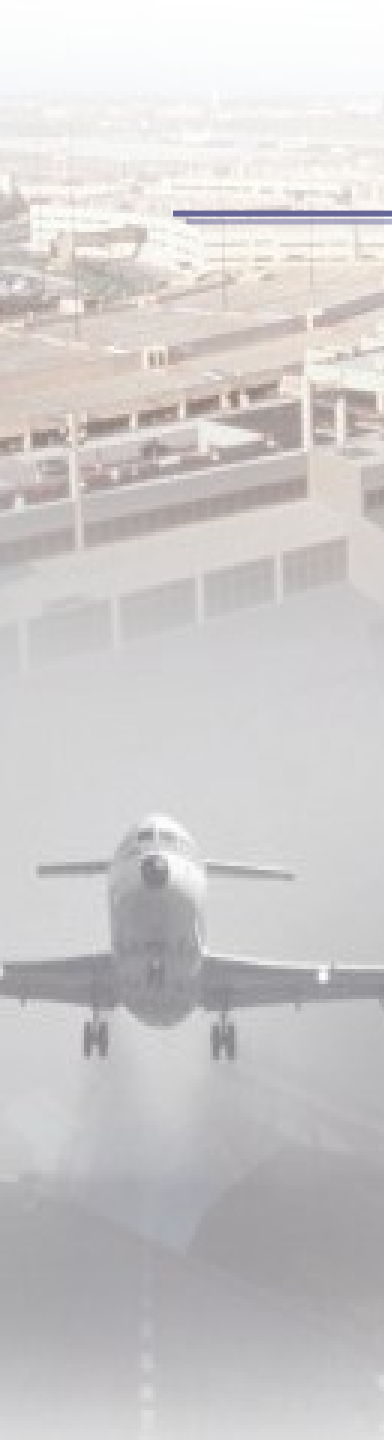
North American Approvals Registry and Monitoring Organisation

FAA Technical Center, Atlantic City, NY)

establishment and maintenance of State RVSM Approval Database, admin of aircraft height keeping performance monitoring, safety assessments and related safety oversight;

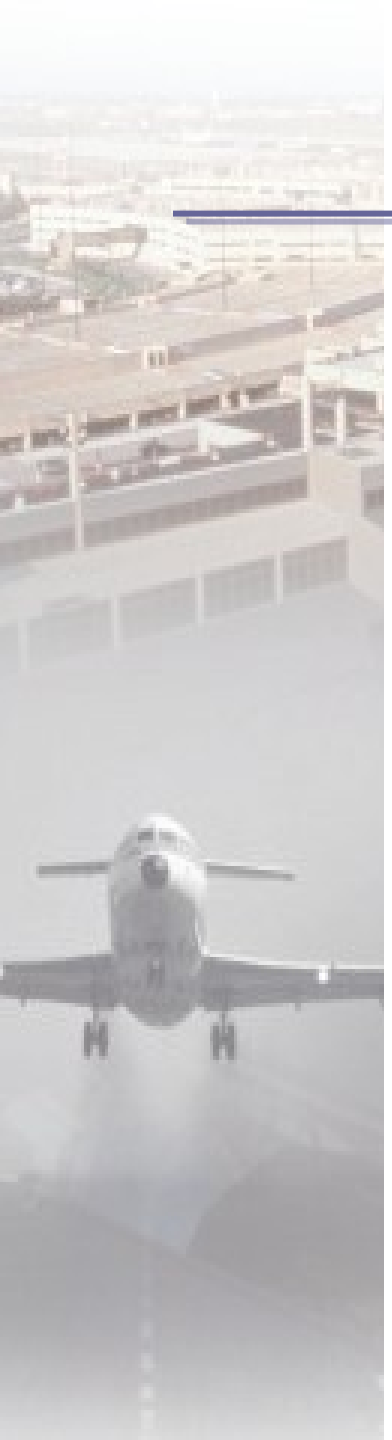
For GMS Monitoring:

CSSI Inc. or ARINC



Implementation Date Factors

- 4,000 aircraft (30%) already approved
- New airframes now delivered RVSM ready
- Project 90% of flights to be conducted by RVSM approved aircraft by January 2005 timeframe
- $359 m. first year fuel savings and ATM benefits at stake
- Aircraft Engineering Packages available for most aircraft
- Non-group/unique airframe process available



More Information…

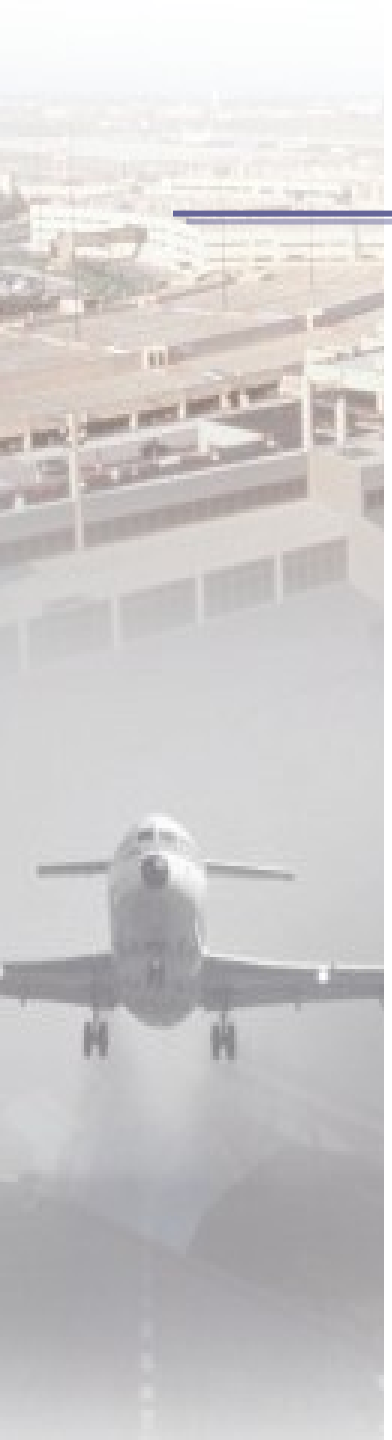
DRVSM Website

www.tc.faa.gov/act-500/niaab/drvsm/Default.asp

… or, type "**DRVSM**" on Google Search Engine

Airspace Redesign Website

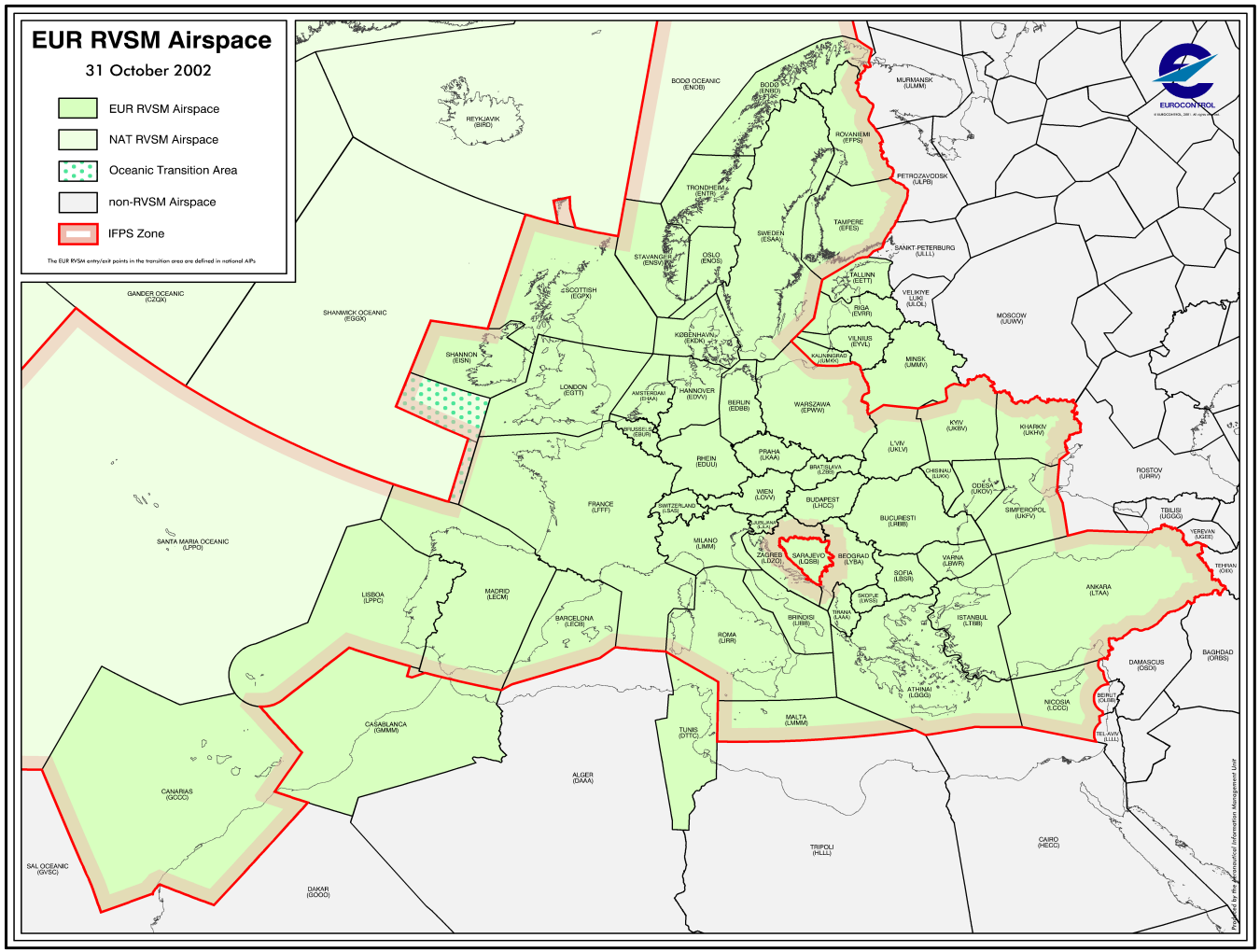
www1.faa.gov/ats/nar/index.html

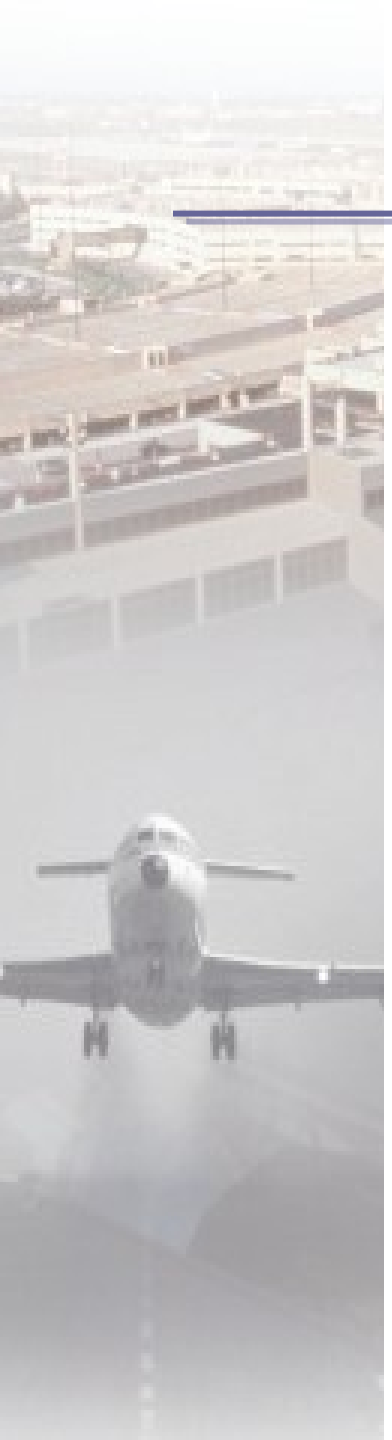


EUR RVSM

- Implemented 24 January 2002
- Operational in 41 States
- Unprecedented co-operation between EUROCONTROL, JAA, ICAO, States, ANSPs, Aircraft Operators, Pilots, Controllers, Industry.

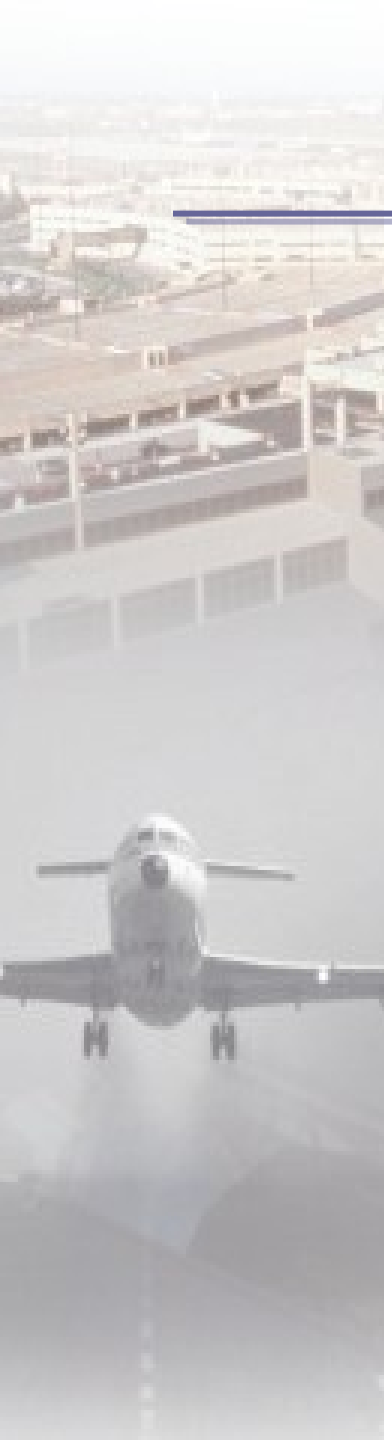
EUR RVSM Experience





Main Pre-Requisites EUR RVSM

- All aircraft operating in EUR RVSM, to be RVSM approved (JAA TGL6), except State aircraft;
- No transiting of non-RVSM approved aircraft through RVSM airspace (except NAT-EUR interface);
- ICAO safety objectives to be met & risk not to increase due to RVSM;
- Operators to participate in Monitoring Programme;



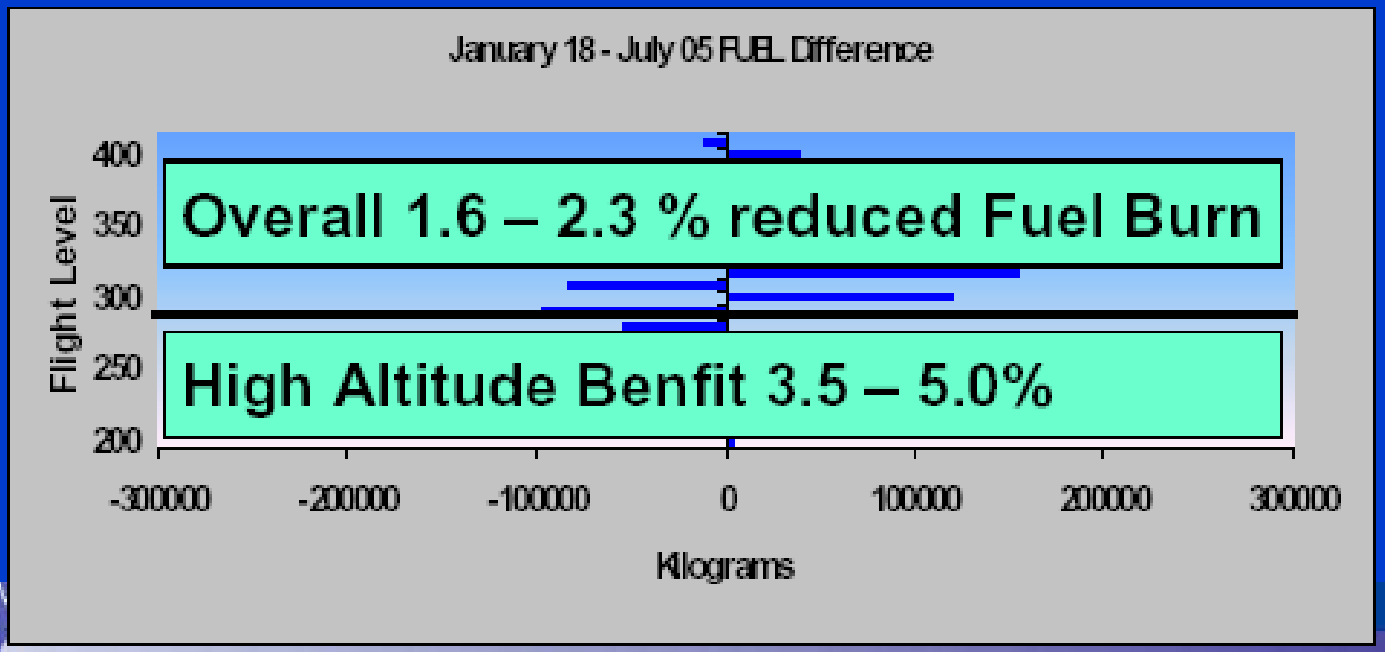
BENEFITS OF RVSM

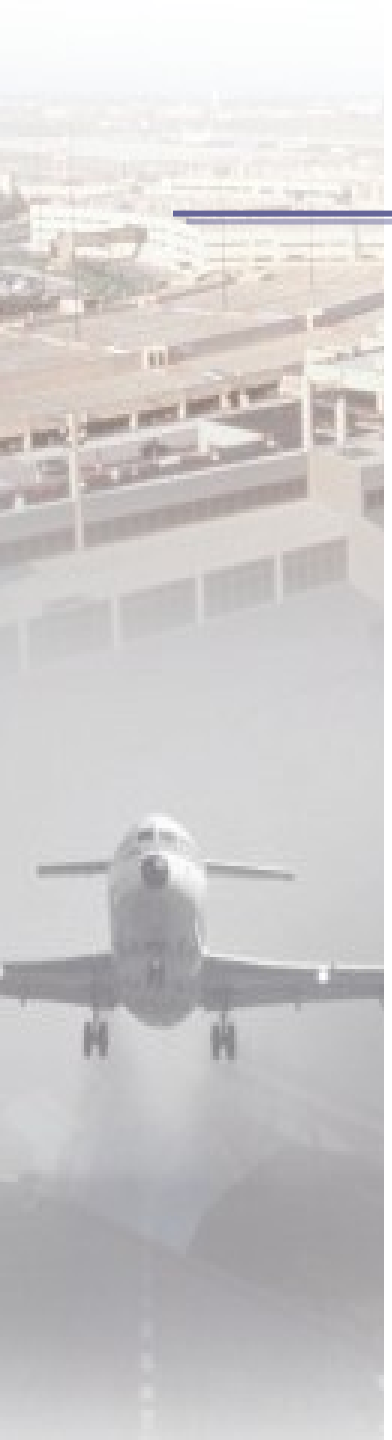
From 24 January 2002, above FL285:

- 6 extra flight levels available
- optimisation of airspace structure
  - improved ATS route network
  - more than 20 new sectors created
- ATC capacity increase (10-15%)
  - Reduction in controller workload
- Flight efficiency (Fuel savings 2%)

Environmental Benefits of RVSM

Vertical Analysis of Fuel Burn, CO2, H2O and SOx emissions

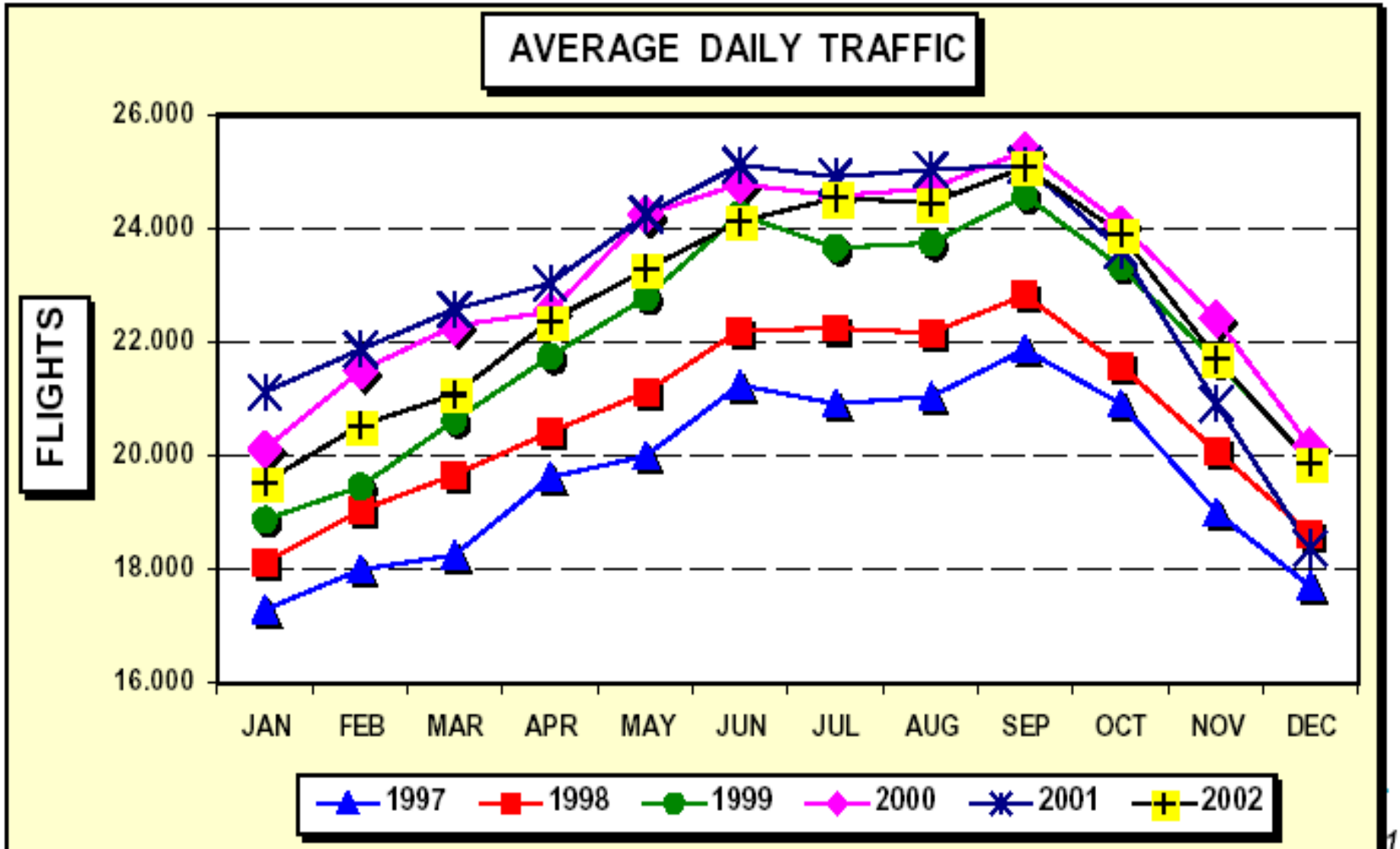




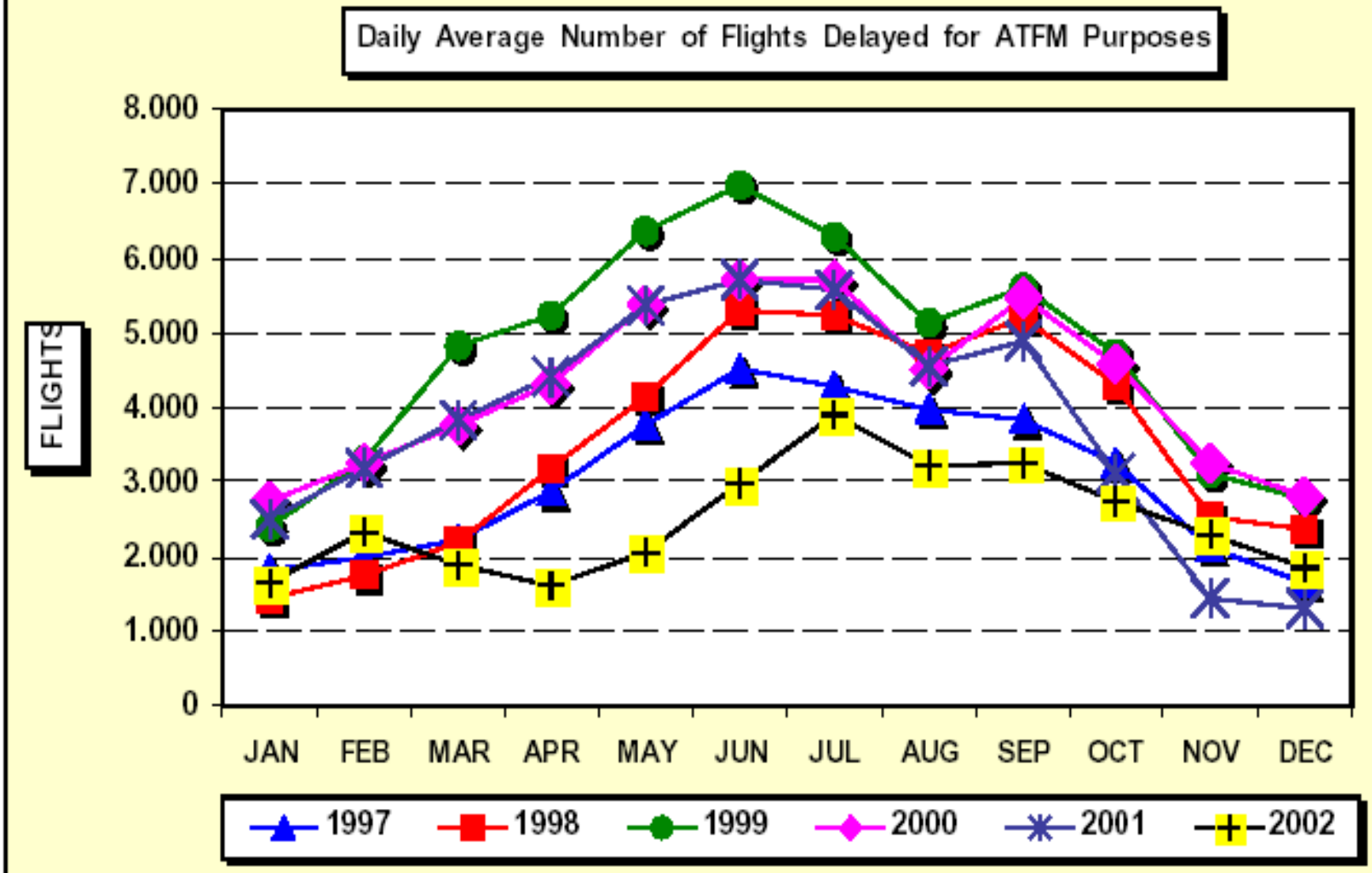
First Results RVSM Operations

- Extremely positive reactions from controllers and aircraft operators
- Capacity restrictions lifted much earlier than expected
- Some problems with flight planning
- Confirmation sought about RVSM approval status of some aircraft
- Increase of traffic at FL 270-280 due to non-RVSM approved aircraft excluded from RVSM airspace (but manageable)

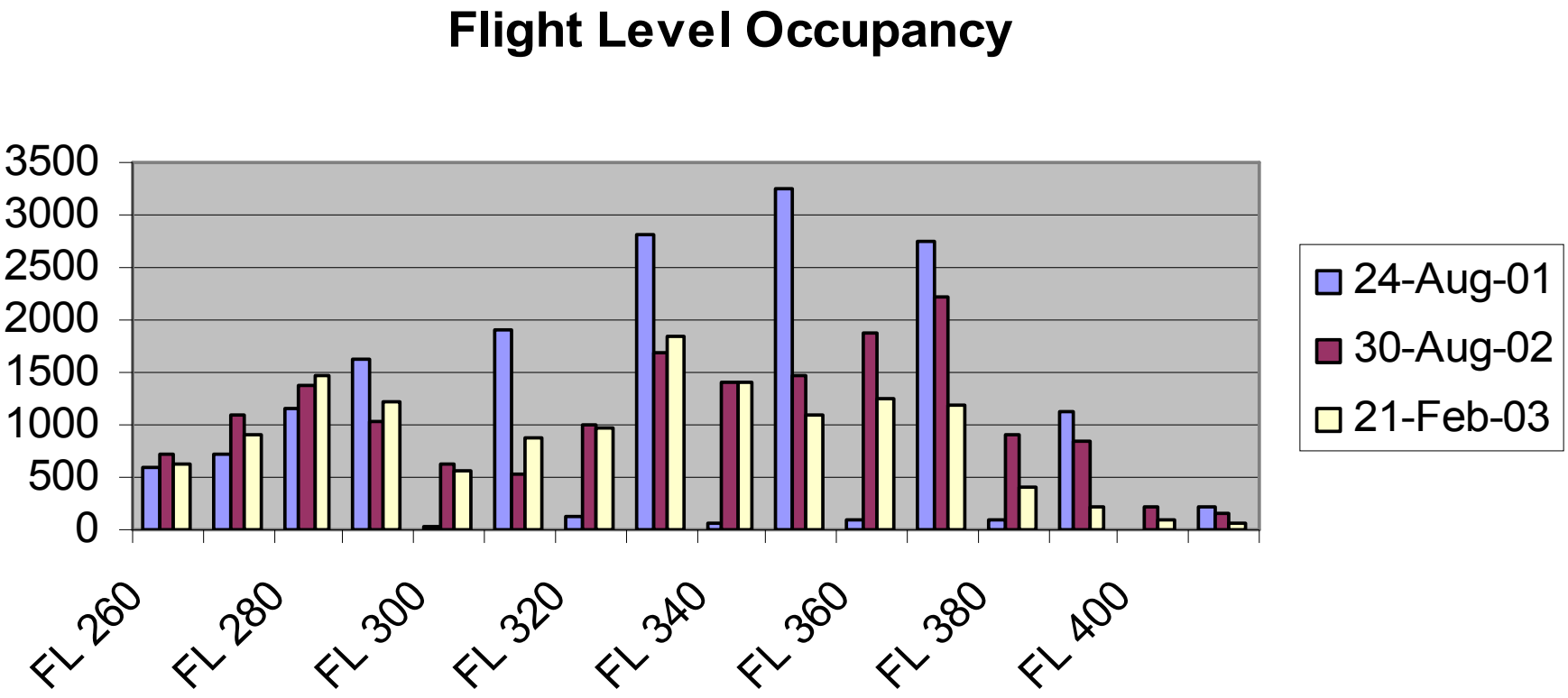
Daily Traffic in CFMU Area



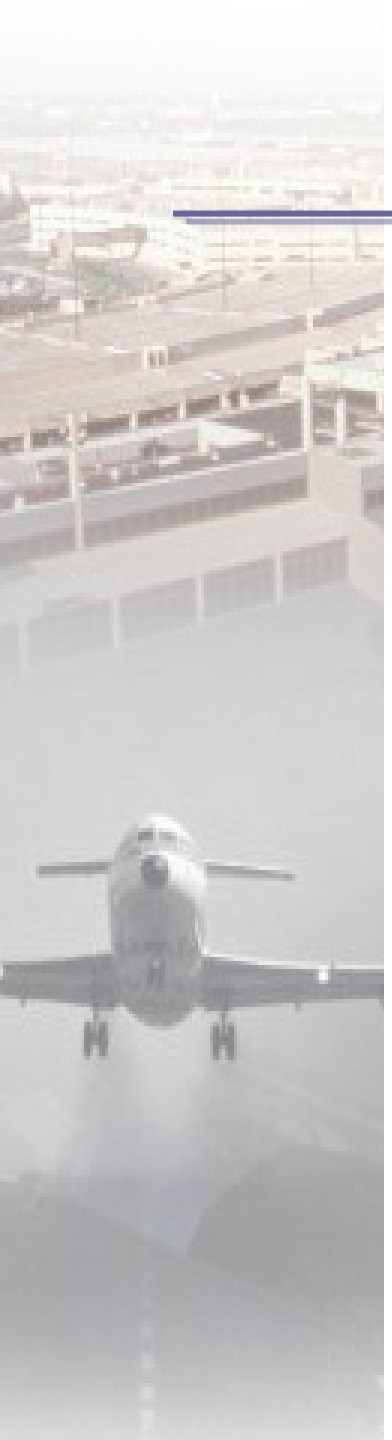
ATFM Delays 1997 - 2002



Vertical Traffic Distribution



W in the Flight Plan



- Two assessments on the validity of W in the FPL
- 1st study results - at least 0.3% of flights in RVSM airspace were non-RVSM approved
- 2nd study results - improvement (0.15%) but 100 flights out of a total of 67,585 estimated as non-RVSM approved. Although number is relatively low - - still considered as a serious RVSM violation and a safety issue within the context of the EUR RVSM Post-Implementation Safety Case
- Follow-ups conducted and action taken with operators concerned and State certification authorities
- Further review planned April/May 2003

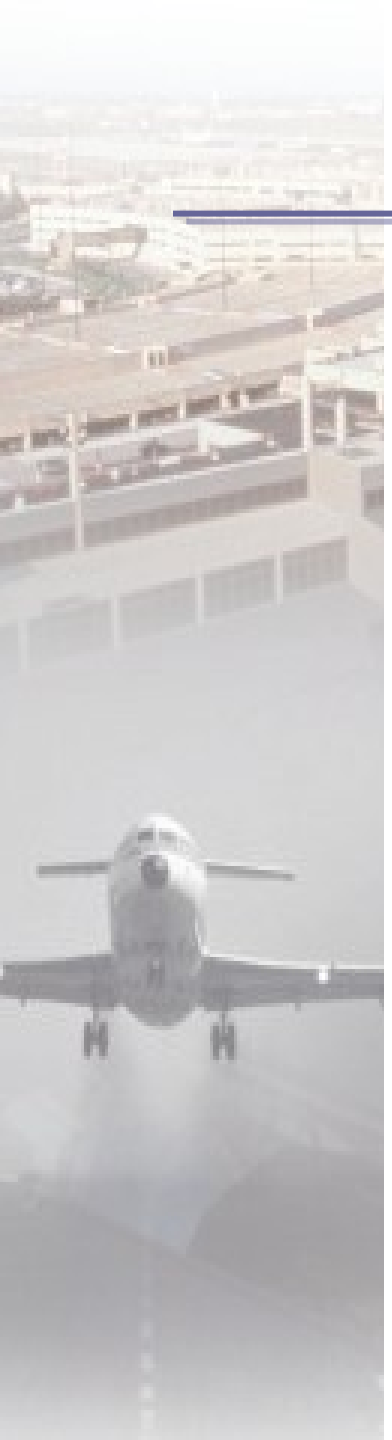
ADR + Turbulence Reports in 2002

10 Wake Vortex reports in RVSM airspace
(2 significant roll disturbances)

Further Independent Study does not indicate any RVSM related issues

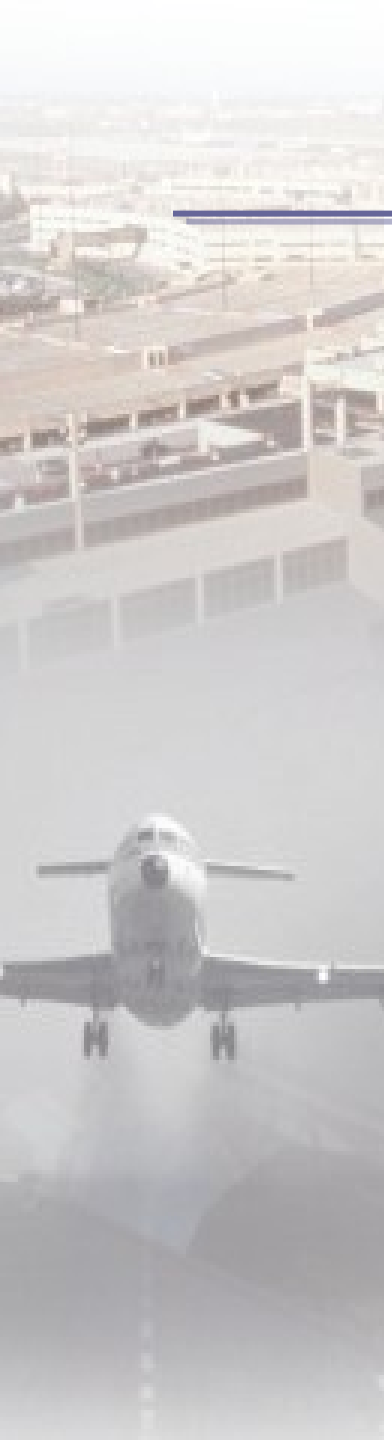
Controllers and pilots are urged to continue submitting
reports as part of Safety Monitoring

Dryden Flight Research Center ECN 4242 Photographed 1974
B-747 vortex study NASA photo



ACAS - RVSM compatibility

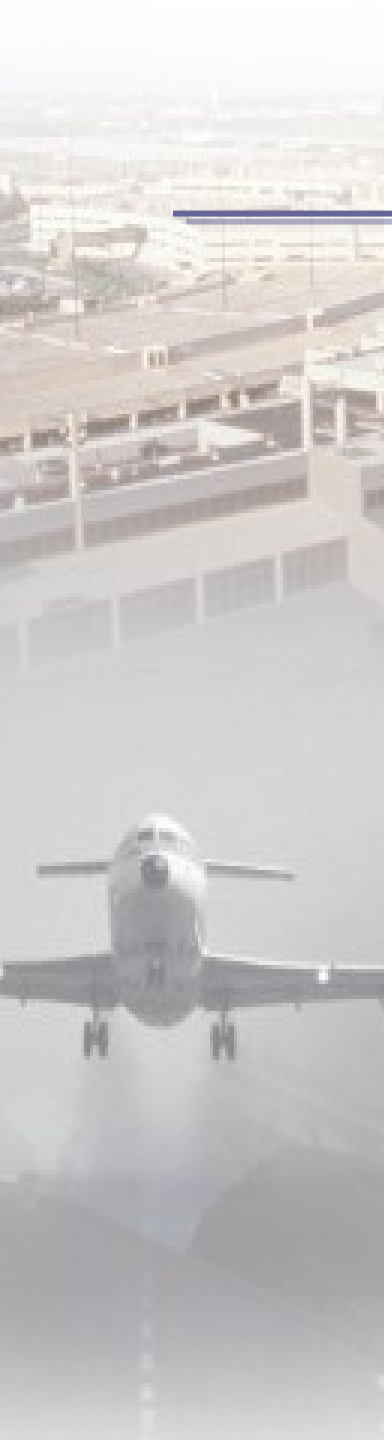
- ACAS Programme assessments confirm that TCAS V7.0 performs well in RVSM airspace - numbers of RAs in line with forecasts
- TCAS operational monitoring and analysis will continue
- ICAO developing guidance on < 1500 ft vertical speed in last 1000ft before level off
- ACAS Bulletin 2 - on RAs & 1000ft level-off manoeuvres available



RVSM Certification Experience

Problems have included:

- **Design errors**
  - Corrections applied in the wrong sense
- **Variability in the aircraft build standard for the static sensors causing altitude errors**
  - Probe alignment errors
  - Static plate sealing
  - Fuselage contour anomalies.
- **Poorly defined Flight Manual limitations**
  - Standby altimeter not addressed
  - Alternate static source not addressed
  - Auto-flight mode limitations not addressed.

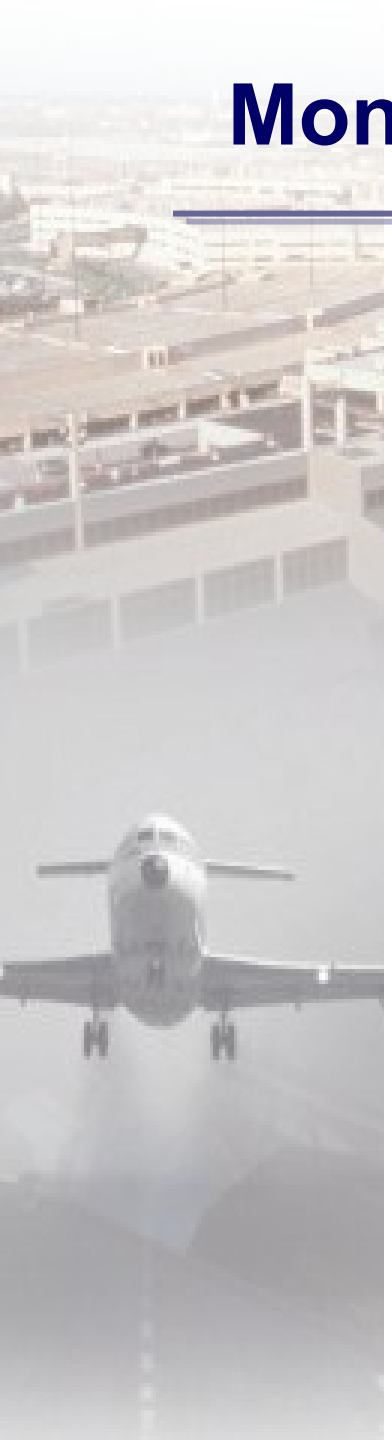


Operator Experience

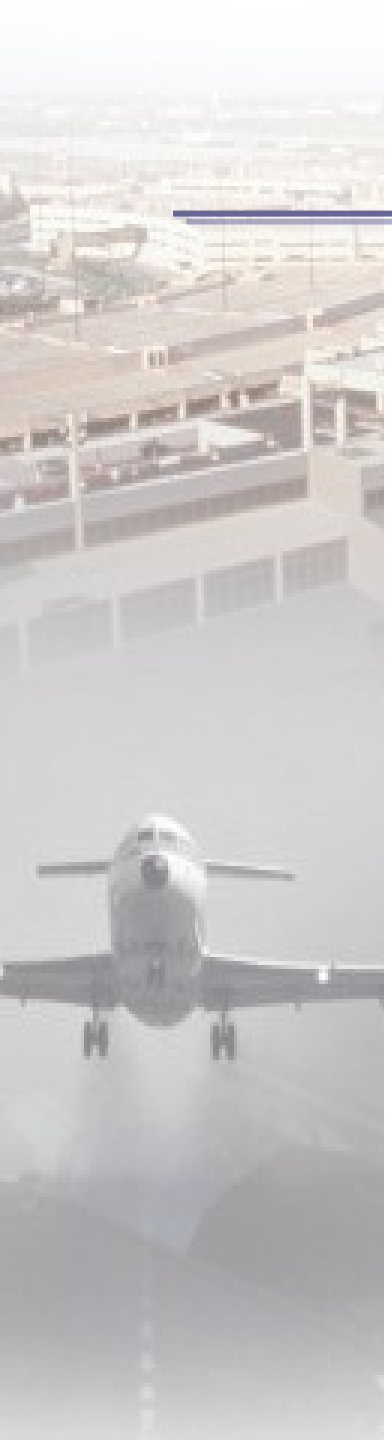
Operator problems:

- **Response to reported altimetry system errors**
  - Several attempts to correct reported errors
  - Failing to involve aircraft manufacturer
  - Manufacturers not always reacting effectively to type RVSM solution issues
- **Procedures**
  - Wrong regional RVSM procedures used

Monitoring height keeping performance



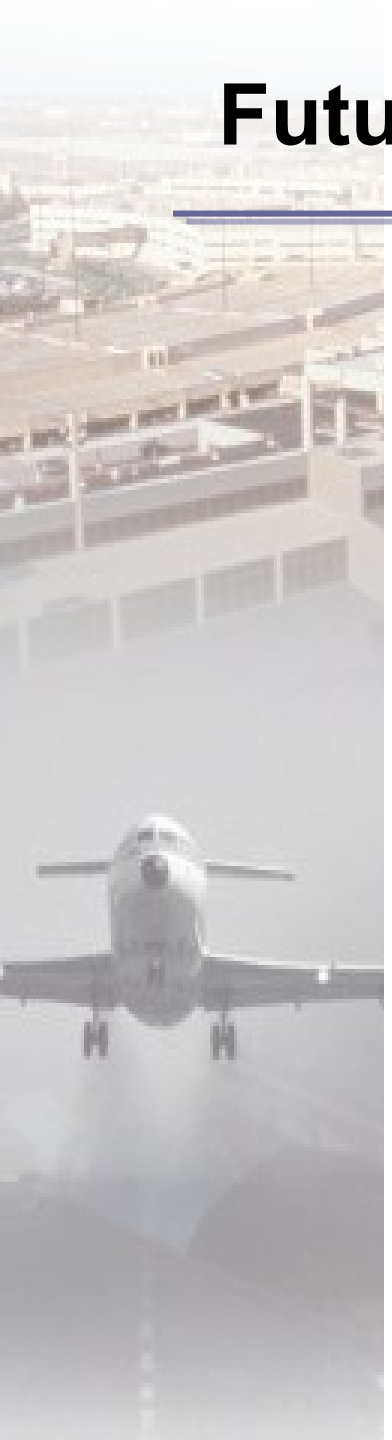
- Setting up monitoring infrastructure was major task (3 HMUs, 25 GMUs);
- Monitoring started May'00, full infrastructure operational Sept'00;
- Some Aircraft Types identified not to meet ICAO requirements; Action taken and performance improved;
- Conclusion: monitoring works,and continues to be important;
- Still some unresolved performance issues;



In retrospect, major elements:

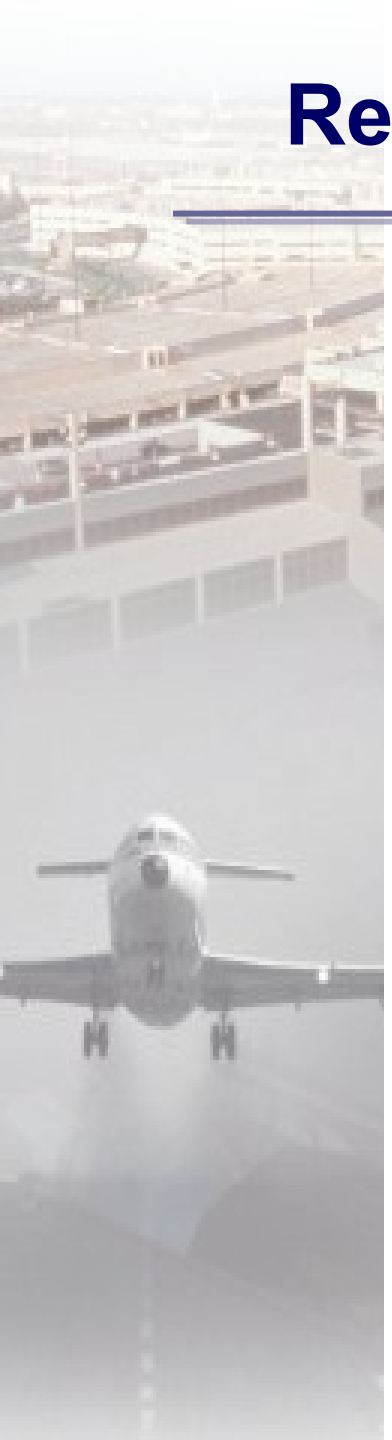
- Extensive co-operation between all Stakeholders, central co-ordination & progress tracking (1 date-time for all!)
- Extensive Awareness activities, especially towards aircraft operators and pilots
- Early availability of RVSM compliant aircraft
- One common basis for all to work towards (Guidance, Manuals, Training Support material, etc)
- ATC System Modifications, LoA's, ATC training, RVSM/non-RVSM transitions
- Pre-Implementation Safety Case

Future RVSM Airspace, adjacent to EUR



- **ICAO MID Region - 27 November 2003**
  - Bahrain, Egypt, I.R. Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.
- **Russian Federation - December 2004**
  - plus Georgia, Armenia & Azerbaijan.

Reduced Vertical Separation Minimum



END OF PRESENTATION