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Abstract:

This report describes a EUROCONTROL fast-time simulation study carried out on the 5 States common focus area (Belgium, Northeast France, Germany, Luxembourg, The Netherlands and Maastricht UAC). The study measured the impact on controller workload of the new ARN V3, associated new sectorisations, a division flight level of FL295 (FL265 in France) and RVSM using 1997 and 2005 traffic samples.

The results showed that the airspace reorganisation and RVSM led to significant improvements in controller workload at 1997 traffic levels. However, when tested with 2005 traffic levels (1997 + 50%) the controller loadings and number of radar conflicts were found to be very high, particularly in the airspace over Belgium.

The 5 States area will be the subject of a real-time simulation to be carried out at the EEC in March 2001.

EXECUTIVE SUMMARY

This large model-based study of the 5 States common focus area, i.e. the Benelux countries, Northeast France, Germany and Maastricht UAC, was carried out at the Eurocontrol Experimental Centre between March 1998 and May 2000. A 24-hour traffic sample for Friday 12th September 1997, containing more than 9,000 aircraft, was selected from the CFMU archives and simulated using the RAMS fast-time simulator. The traffic sample included military traffic flying as OAT.

Geographically, the simulated area extended from London/Paris in the west to Berlin/Prague/Vienna in the east and from Copenhagen/Malmo in the north to Lyon/Milan in the south. More than 140 sectors from 24 ATC Centres were simulated. A total of 88 sectors were measured for controller workload. (The other sectors were simulated to ensure correct aircraft profiles into and out of the measured area.) Military areas were activated and deactivated during the simulation, in accordance with their published hours of activity.

Traffic in the 5 States core area is expected to grow by 50% between 1997 and 2005.

Four specific objectives were identified for this fast-time study:

- to validate different route network scenarios;
- to develop an optimised sectorisation plan based on users' requirements, free of national border constraints and balancing equally the ATC workload over the area taking the RVSM (reduced vertical separation minimum) implementation into consideration;
- to develop an optimised civil/military interface;
- to evaluate and analyse the impact that DFL295 (division flight level between high- and low-level sectors) in German airspace and DFL265 in French airspace may have on periphery States, and proposing solutions if required.

The simulation was conducted in three stages. The first stage established a reference organisation consisting of the traffic, route network and sectorisation in place on Friday 12th September 1997. The second stage applied the new ATS route network version 3 (ARN v3) with its associated resectorisations, a DFL of FL295 (FL265 in France) and RVSM. The traffic sample for this second stage remained at 1997 traffic levels. Finally, the third stage tested the new airspace configuration at 2005 traffic levels (1997+51%). Throughout the three stages the controller workload was calculated using a set of standard controller tasks, but which also included radar conflict resolution, ad hoc skip coordinations and dynamic level reclearances.

All input data was examined and validated by the 5 States Working Group, consisting of ATC experts from each of the countries involved. Meetings of the working group were arranged approximately every two months in order to review the simulation progress.

When tested with the traffic, route network and sectorisation (DFL245) in place on Friday 12th September 1997, the reference organisation showed that, of the 84 core sectors, 27 (32%) experienced sustained heavy to severe radar controller loadings over their busiest three-hour periods. Ten of these sectors were severely loaded, in other words, they had reached or exceeded their capacity, and six out of this group of ten were Maastricht sectors.

Applying the ARN v3, its associated resectorisations, RVSM and a DFL295 (DFL265 in France) at 1997 traffic levels produced very promising results throughout the new 88 core sectors. Only one

sector, CANAC South High, experienced a severe loading and 14 others returned a heavy loading over three hours. This amounted to 17% of the 88 core sectors, as compared to 32% in the 1997 organisation. Compared to the latter, the combination of the ARN v3 and RVSM led to a reduction of 40% in the total number of conflicts in the core area - 60% less above FL295 and 25% less below FL295. However, in the airspace between FL245 and FL295 (the volume concerned with the change of the division flight level) the number of conflicts remained virtually the same as in the 1997 reference scenario.

The promising results of the V3/RVSM 1997 traffic organisation were eclipsed when the traffic was increased to 2005 levels (1997+51%) and, globally, the results were worse than the 1997 reference scenario. Of the 88 core sectors, 46 (52%) were at least heavily loaded and 30 (34%) of these were severely loaded during their busiest three hours. Out of the 30 severely loaded sectors, 24 were sectors with upper limits at or below FL295. In addition, 5 sectors were just below the severe workload threshold and 9 just below the heavy threshold. Radar conflicts increased by 150% above FL295 and by 100% below FL295. Compared to the 1997 reference organisation, radar conflicts above FL295 showed a small increase of 1% but below FL295 they increased by 50%.

The high loadings in the 2005 scenario were undoubtedly influenced by a “bunching” effect - large numbers of aircraft arriving in the same place at roughly the same time and particularly noticeable with arrivals in the lower airspace - due to the 50% increase in the traffic sample. In reality, these streams would be smoothed out into more even flows. That said, “bunching” is a bigger factor in high controller loadings recorded over shorter periods, e.g. one hour, than over the three-hour periods reported here.

On the positive side, the on-going process of optimising the German sectors and the probable vertical splitting of the Reims UE sector will certainly lead to reduced controller loadings in those sectors. So, based on the results of this simulation, this leaves the main problem area as the airspace of the Brussels FIR/UIR.

One of the well-known difficulties with the Brussels FIR/UIR is the squeezing of mixed, high-density flows into narrow areas, particularly in the DIK/LNO/NTM area. Stated simply, the military areas are in the wrong places relative to the needs of the civil traffic using this airspace, and the sectorisation in the area does not fit well with the demands of the flows, e.g., the width of the Maastricht Luxembourg sector east of MEDOX is only 30nm between the French and German boundaries, hence the need to have Düsseldorf/Köln and Frankfurt arrivals below FL295 by the France/CANAC boundary. These elements require the development of quite complex procedures to make it all work.

By way of illustration, a 30% capacity increase was achieved with the implementation, in January 2000, of the Odyssée project in the airspace of Northern France. Part of this success was due to the structure of segregated routes for the Amsterdam, Brussels and Paris arrival and departure flows at the CIV interface. Unfortunately, the same possibility to adequately segregate the Brussels, Düsseldorf, Frankfurt and Köln arrival and departure flows in the DIK area does not exist, as the positioning and extent of the adjacent military TRAs creates a cross-shaped fillet of airspace, from LNO to GTQ and from RAPOR to HAN, too narrow in parts to permit efficient segregation during periods of military activity.

To put the CANAC results into some sort of context, the CANAC airspace is approximately one half the size of the Frankfurt airspace and one quarter the size of the simulated Germany Upper airspace (combined Hannover and Rhein UIRs). Yet, CANAC recorded 2005 traffic levels that were 75% of Frankfurt’s and 90% of Germany Upper’s. In addition, CANAC had to deal with more conflicts in its airspace during the 24 hours than either Germany Upper or Frankfurt (CANAC 982, Germany Upper 980 and Frankfurt 901). In a separate (and crude) experiment using the exact same 2005 scenario but changing all routes to direct routeing from simulation entry point to simulation exit point, the number of conflicts for the CANAC airspace fell by over 60% - from 982 to 375 (341 conflicts were recorded in the CANAC airspace for the 1997 reference scenario).

As is common in a simulation of this size, clear, definite conclusions are not easy to find and, in the end, come down to individual interpretation. However, one thing is clear - there was a considerable improvement in the global results when the airspace was tested with the V3/RVSM DFL295 airspace structure and 1997 traffic, compared to the reference 1997 scenario.

Perhaps the most significant factor in determining the DFL in the Amsterdam and CANAC airspace is the number and nature of the different level constraints that need to be applied to the main arrival flows for the major core area airports. Achieving these constraints, ranging from FL250 to FL290 (maximum levels by certain points), demands an airspace of sufficient vertical extent to permit efficient level allocation during periods of dense traffic. This presents three options:

- The first option is to leave CANAC and Amsterdam at their present vertical limits of FL245. This leaves the relevant Maastricht sectors with the responsibility of achieving the constraints but with insufficient levels for allocation for the lower FL250 and FL260 constraints during periods of dense traffic. Furthermore, with the tendency in complex traffic situations to get arrival traffic down as low and as early as possible, it is likely that the CANAC sectors would be involved more and more during periods of heavy traffic. Delegated airspace, windows and balconies will certainly help but these options are only limited-term solutions.

- The second option is to have a DFL between FL255 and FL285. None of these DFLs were simulated in fast-time and, as they would involve a certain amount of sector redesign and a review of the different level constraints and skipping procedures to be used, no relevant comments can be made. These DFLs will need to be tested in real-time.

- The third option is to set, as simulated, the DFL for CANAC and Amsterdam at FL295. Compared to the 1997 reference scenario, this configuration produced definite, overall improvements, although the improvement for CANAC was not as good as it was for Amsterdam. However, a DFL of FL295 does have the advantage of allowing the CANAC sectors, in particular, to retain complete control over level allocation in applying the arrival flow constraints. In some cases it will also reduce the severity of the level constraints to be applied (a FL290 constraint is less penalising than a FL250/FL240 constraint). That said, this option has its disadvantages too. These include a very high volume of mixed traffic in the CANAC sectors that will necessitate another look at the route structure through the airspace, probable level restrictions on Brussels and Düsseldorf departures via GTQ to keep them below the relevant Maastricht sectors, and a need to address the problem of climbing London TMA departures in the west of the airspace. It may also pose system problems for CANAC and an increase in the number of sectors required to manage the forecast traffic.

In all three options the same major obstacle remains: there is no real possibility to efficiently segregate the Brussels, Düsseldorf, Frankfurt and Köln arrival and departure routes in the DIK area without resiting or redefining the adjacent military TRAs.

Based on the overall simulation results, the recommendation is for a DFL of FL295 in the Amsterdam and Brussels FIR/UIRs.

Finally, it may be a little obvious to state that there is a need to fully exploit the advantages offered by FUA, and that the airspace structure and route network in this area need to be re-examined if the requirements of all airspace users are to be met, but the results for the 2005 traffic, even allowing for simulation inaccuracies, add a sense of urgency to these two points.

ACKNOWLEDGEMENTS

The simulation project leader would like to thank the 30, or so, ATC experts of the 5 States Working Group for their assistance, cooperation and patience, particularly during the long days of data validation.

Thanks must also go to the Eurocontrol RAMS support and development team, particularly Monique Verschaffel and Laurent Box, for their determined and enthusiastic support throughout.

Finally, many thanks to Ian Crook and Kenny Martin of ISA Software Ltd. (RAMS developers) for the swift development of the many RAMS enhancements and for their post-development support.

TABLE OF CONTENTS

LIST OF FIGURES

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ABBREVIATIONS

Abbreviation	Decode
ACC	**A**rea **C**ontrol **C**entre
AMS	**Ams**terdam ACC
ARN v3	**A**TS **R**oute **N**etwork **v**ersion **3**
ATC	**A**ir **T**raffic **C**ontrol
ATM	**A**ir **T**raffic **M**anagement
ATS	**A**ir **T**raffic **S**ervices
BRE	**Bre**men ACC
CANAC	**C**omputer-**A**ssisted **N**ational **A**TC **C**entre - Belgium
CAN	**CAN**AC ACC
CFMU	**C**entral **F**low **M**anagement **U**nit
DFL	**D**ivision **F**light **L**evel
DUS	**Düs**seldorf ACC
EATCHIP	**E**uropean **ATC** **H**armonisation and **I**ntegration **P**rogramme
ECAC	**E**uropean **C**ivil **A**viation **C**onference
EEC	**E**urocontrol **E**xperimental **C**entre
FIR	**F**light **I**nformation **R**egion
FL	**F**light **L**evel
FRA	**Fra**nkfurt ACC
FUA	**F**lexible **U**se of **A**irspace concept
GAT	**G**eneral **A**ir **T**raffic
GER	**Ger**many Upper UAC
KRH	**K**a**r**lsru**h**e (Rhein) UAC
LATCC	**L**ondon **A**ir **T**raffic **C**ontrol **C**entre
MAS	**Ma**a**s**tricht UAC
OAT	**O**perational **A**ir **T**raffic
ORG	**Org**anisation
PAR	**Par**is ACC
RAMS	**R**eorganised **A**TC **M**athematical **S**imulator
REI	**Rei**ms ACC/UAC
RHE	**Rhe**in (Karlsruhe) UAC
RVSM	**R**educed **V**ertical **S**eparation **M**inimum
TMA	**T**erminal **M**anoeuvring **A**rea
TRA	**T**emporary **R**eserved **A**irspace/**A**rea (military)
UAC	**U**pper **A**rea **C**ontrol (Centre)
UIR	**U**pper **I**nformation **R**egion
UTC	**U**niversal **T**ime **C**oordinates
V3	ATS Route Network **v**ersion **3**

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1. INTRODUCTION

This large model-based study of the 5 States common focus area, i.e. the Benelux countries, Northeast France, Germany and Maastricht UAC, was carried out at the Eurocontrol Experimental Centre between March 1998 and May 2000. A 24-hour traffic sample for Friday 12th September 1997, containing more than 9,000 aircraft, was selected from the CFMU archives and simulated using the RAMS fast-time simulator.

Geographically, the simulated area extended from London/Paris in the west to Berlin/Prague/Vienna in the east and from Copenhagen/Malmo in the north to Lyon/Milan in the south. More than 140 sectors from 24 ATC Centres were simulated. A total of 88 sectors were measured for controller workload. (The other sectors were simulated to ensure correct aircraft profiles into and out of the measured area.)

Traffic in the 5 States core area is expected to grow by 50% between 1997 and 2005.

This report presents the results and conclusions of the 5 States fast-time simulation. As the 5 States area will also be the subject of a real-time simulation to be carried out at the EEC in March 2001, this report will be concise and will outline only the more significant findings of the study. Furthermore, the main body of the report is composed of a series of tables so as to facilitate a quick search of the relevant results and pertinent information for any of the sectors reported on.

1.1. BACKGROUND

In November 1996, the inaugural meeting of the 5 States Route Structure Steering Group approved the establishment of a 5 States Working Group, with the mandate of proposing, evaluating and validating both short- and medium-term measures (year 2000+) aimed at:

- providing a better overall ATS product for civil and military airspace users whilst increasing the ATM capacity in the 5 States common focus area to meet the year 2005 traffic demand (1996 ±50%);
- improving the ATS route network and sector configurations whilst meeting the airspace requirements for military activities, including test and check flights;
- ensuring compatibility with the work of the EATCHIP ATS Route Network Development Sub-Group.

This fast-time simulation formed part of the working group's evaluation and validation programmes.

2. SPECIFIC OBJECTIVES

Four specific objectives were identified for the fast-time study:

- to validate different route network scenarios;
- to develop an optimised sectorisation plan based on users' requirements, free of national border constraints and balancing equally the ATC workload over the area taking the RVSM (reduced vertical separation minimum) implementation into consideration;
- to develop an optimised civil/military interface;
- to evaluate and analyse the impact that DFL295 (division flight level between high- and low-level sectors) in German airspace and DFL265 in French airspace may have on periphery States, and proposing solutions if required.

3. SIMULATION CONDUCT

The fast-time study used the RAMS simulator, based at the Experimental Centre. The simulation was divided into three stages. The first stage established a reference organisation consisting of the traffic, route network and sectorisation in place on Friday 12th September 1997. The second stage applied the new ARN v3 and its associated new sectorisations, a DFL of FL295 (FL265 in France) and RVSM. The traffic sample for this second stage remained at 1997 traffic levels. Finally, the third stage tested the new airspace configuration at 2005 traffic levels. Throughout the three stages the controller workload was calculated using a set of standard controller tasks, but which also included radar conflict resolution, ad hoc skip coordinations and dynamic level reclearances.

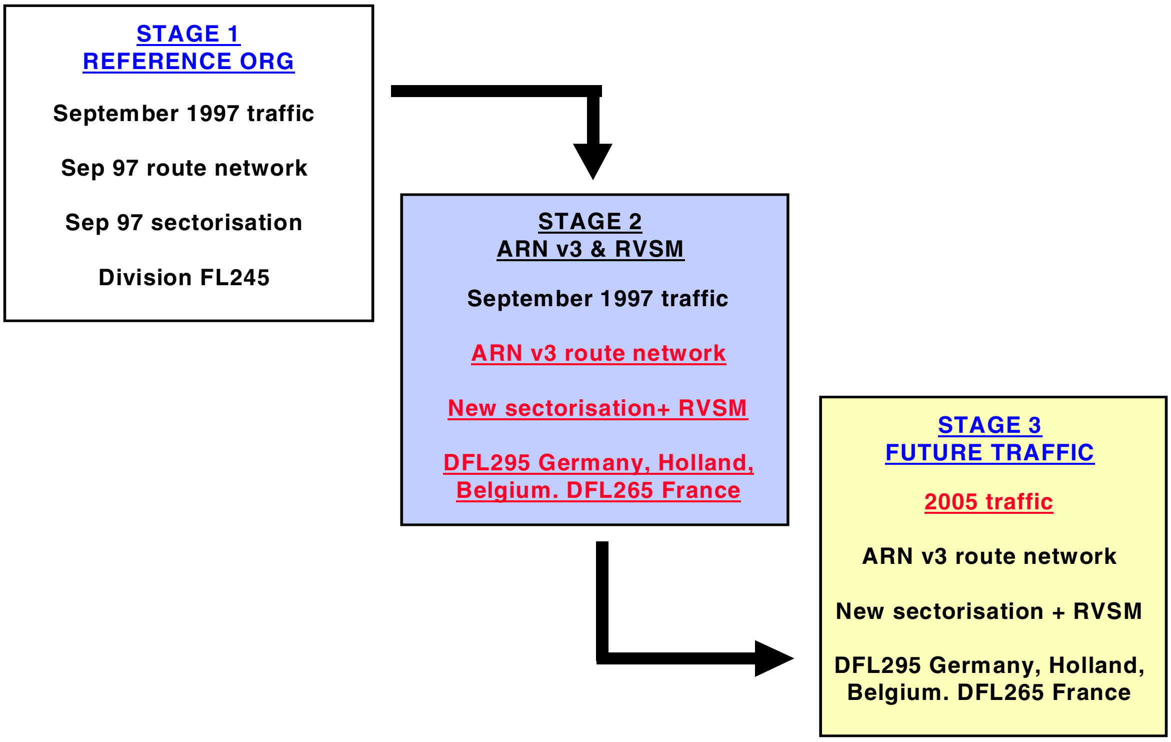

Figure 1: Organisation of the simulation

3.1. STAGE ONE – REFERENCE ORGANISATION - 1997 SITUATION

The purpose of the reference organisation was to simulate the airspace structure (including military areas), traffic and operational conditions of the 5 States area in order to validate the performance of the RAMS simulator and to provide a baseline against which proposed changes and future traffic could be measured. Validation of the data used for the study was carried out by the members of the working group at the various meetings held during the lifetime of the study.

3.2. STAGE TWO – NEW ORGANISATION – 1997 TRAFFIC

This organisation simulated the new ATS Route Network Version 3 (ARN v3), sectorisation and division flight levels (DFLs) with a reduced vertical separation minimum (RVSM) of 1000 feet between aircraft flying between FL290 and FL410.

The route network and sectorisation tested included that implemented in France on the 22nd February 1999 and the route network and sectorisation proposed by the other States for future implementation. With the rest of the airspace outside of France in continual development, particularly Germany, the ARN v3/RVSM organisation took account of the latest sectorisation configurations decided on by the States during the project. Therefore, several iterations of this scenario were required before the final version was tested.

As the future responsibility for control of the Hannover UIR had not been decided at the time of simulation, the German airspace above FL295 was simulated as a single entity consisting of the airspace presently controlled by Rhein UAC and the Hannover UIR of Maastricht UAC.

3.3. STAGE THREE – NEW ORGANISATION – 2005 TRAFFIC

The STATFOR unit of Eurocontrol increased the 1997 traffic sample to 2005 traffic levels (+51%) using economic indicators to determine the growth. The enhanced sample was simulated with the ARN v3/RVSM organisation.

3.4. TRAFFIC SAMPLE

The original 24-hour traffic sample taken from CFMU archives for Friday 12th September 1997 was a sub-set of the complete ECAC area traffic for that day. The sub-set sample contained over 12,700 aircraft during the 24 hours. Aircraft that flew through the peripheral simulated areas only and did not enter the core area were removed. This left a total of 9014 GAT aircraft for simulation.

Military samples were subsequently prepared by the military representatives of the working group and added to the base traffic sample. The final breakdown was as follows:

- GAT plus military traffic flying as GAT: 9014
- Military OAT traffic: 157
- Total traffic: 9171

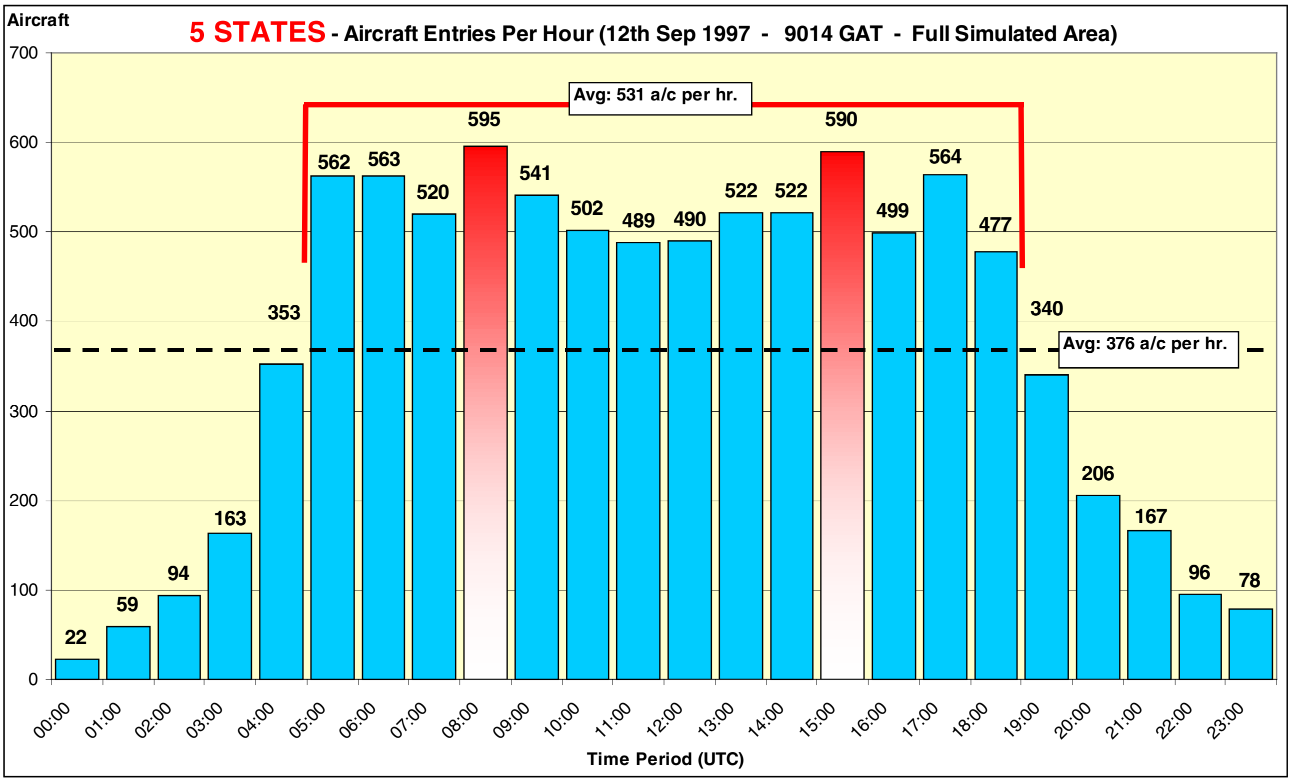

Figure 2: GAT entries per hour into the complete simulated area

- On average, over the 24 hours simulated, 375 aircraft entered the simulated airspace each hour, or 6 aircraft each minute.
- The busiest part of the day was from 0500-1900 UTC (0700-2100 local time) during which 82% of the traffic entered the core area. This 14-hour period produced an average of 531 aircraft per hour, or almost 9 aircraft per minute.
- The busiest one-hour periods, in terms of aircraft numbers, were between 0800-0900 and 1500-1600 UTC (10-11 and 17-18 local time) with almost 600 aircraft entering during each of these hours, 10 each minute.
- For the 84 sectors being measured in detail (en route sectors of the Amsterdam, Bremen, CANAC, Düsseldorf, Frankfurt, Karlsruhe, Maastricht, East Paris and Reims ACC/UACs) there was an average of 387 aircraft per sector over the 24 hours. One-third of these sectors had in excess of 480 aircraft and two, both Maastricht sectors, controlled 718 and 746 aircraft during the day.

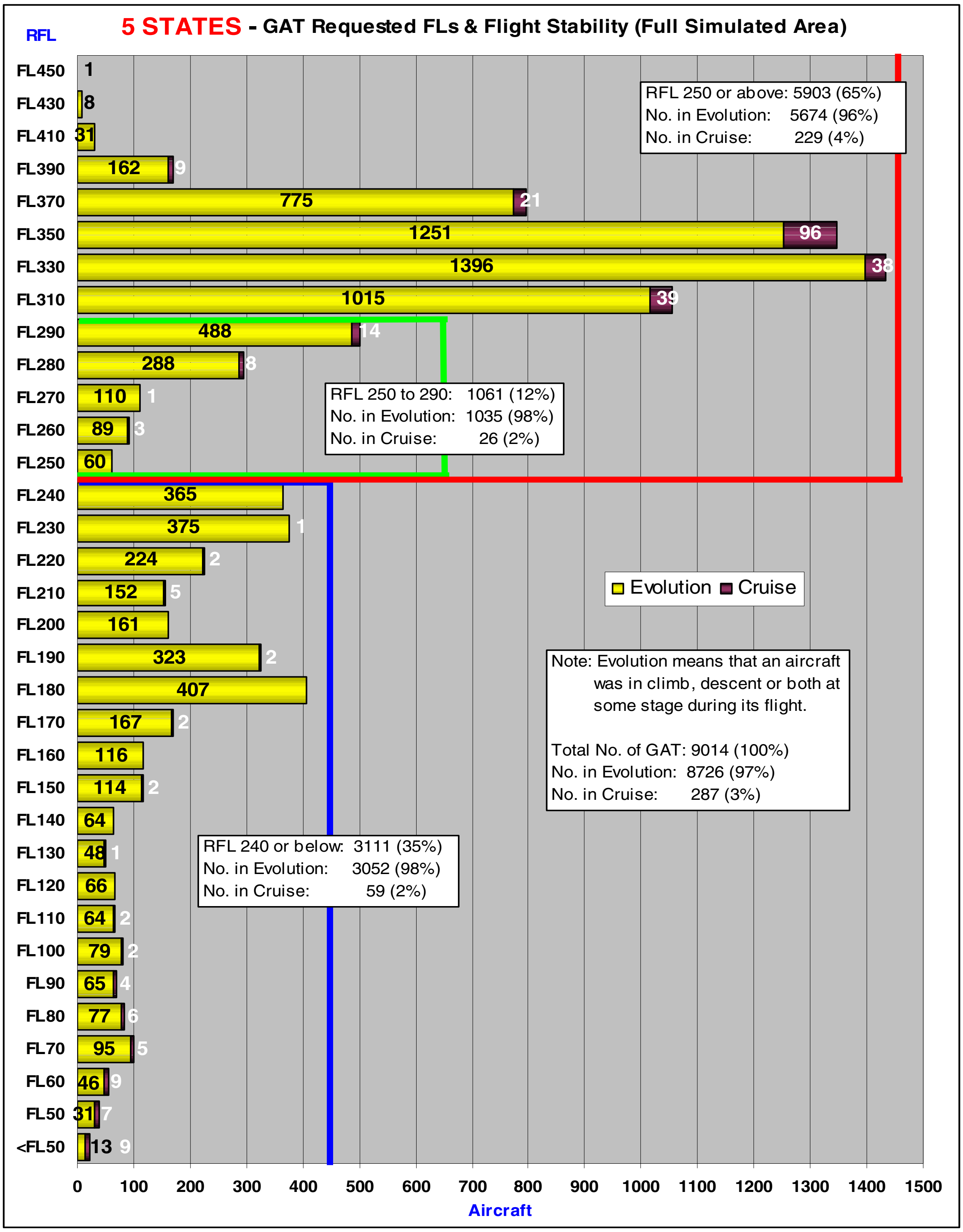

Figure 3: GAT requested flight levels and flight stability for the complete simulated area

- Almost 97% of the aircraft were either climbing, descending or both in the simulated airspace. Only 287 aircraft entered and remained at a stable flight level.

- Over 50% of the aircraft requested a cruising level at four specific flight levels – FL310, FL330, FL350 and FL370. This number does not include the “city-pair” aircraft (e.g. Frankfurt to Paris and other routes between major cities) that would normally fly at those levels but are “level-capped”, usually at FL230/FL240, to avoid the high-volume flows in the upper sectors.

3.5. RADAR SEPARATION STANDARDS

For the reference 1997 organisation, 5nm radar separation was used throughout the simulated airspace, except for Reims UAC where it was set at 8nm. The V3/RVSM organisations used 5nm separation everywhere.

3.6. CONTROLLER WORKLOAD CALCULATION

RAMS analyses all events in the progress of each flight transiting the simulated area in order to detect the ATC actions necessary to process the flight. In determining these ATC actions, the model is capable of identifying and recording any number of ATC tasks, grouped into five main categories:

- Flight data management tasks.
- Coordination tasks consisting of:
  - ⇒ External coordinations with other ATC units.
  - ⇒ Internal coordinations within the simulated ATC unit.
- Planning conflict search tasks to determine ATC clearances.
- Routine R/T communications.
- Radar tasks consisting of:
  - ⇒ Radar interventions.
  - ⇒ Radar surveillance.

Each simulation event, e.g. sector entry/exit, climb, descent, etc., can trigger a number of tasks that need to be defined in minute detail. Every task is assigned an appropriate number of seconds for its execution and one or more members of the control team to execute it. Due to the number of different centres involved and the difficulty in producing a detailed task specification for more than 80 sectors, the working group decided to use a simplified, standard set of controller tasks to calculate the controller workload, as follows:

Description	Controller	Secs	Conditions
TxCoordination	PlanningController	15	
RxCoordination	PlanningController	15	
TxCoordinationSKIP	RadarController	10	
RxCoordinationSKIP	RadarController	10	
TxCoordinationSKIPTransfer	PlanningController	15	
RxCoordinationSKIPTransfer	PlanningController	15	
TxCoordinationRouteExit	PlanningController	15	
Rx1stCall	RadarController	15	
Rx1stCallSkipTransfer	RadarController	15	
TxNewFL	RadarController	10	
RxFlightLevelReachedReport	RadarController	5	
TxChangeOfFrequency	RadarController	10	
TxChangeOfFrequencySkipTransfer	RadarController	10	
TxChangeOfFrequencyRouteExit	RadarController	10	
RadarSurveillance	RadarController	5	
RadarSurveillanceSkip	RadarController	5	
ResolveConflict	RadarController	60	Resolution Monitor
ResolveConflict	RadarController	60	Resolution Vector
ResolveConflict	RadarController	10	Resolution Level Change
ResolveConflict	RadarController	10	Resolution Speed Change

Results in this report are given only for the radar controller (executive, tactical controller). The planning controller's workload, in this particular simulation, was a direct function of the number of aircraft controlled by the sector – 30 seconds of work per aircraft.

3.6.1. Controller Percentage Loadings

Assigning a control position and an execution time to each task enables RAMS to calculate both the actual workload in minutes and the percentage loading on each working position, either over the entire simulation period or over certain peak periods.

There are two values generally used in the interpretation of controller loadings: the **peak 1-hour percentage loading** and the **3-hour percentage loading**. For the purposes of this report, only the 3-hour percentage loadings will be reported as these loadings, recorded over a longer period of time, are more representative than the isolated one-hour peaks and, therefore, comparison with other sectors is more reliable.

The **3-hour percentage loading** represents the total time spent by a working position on the tasks recorded during the busiest 3-hour period, and is expressed as a percentage of that time. Because it is over a reasonably long period, this percentage loading is used to assess the balance of workload between sectors. These loadings are also used to compare results of the different organisations tested.

To assist in the interpretation of these loadings, approximate terms corresponding to certain percentage thresholds are used to describe them:

"Severe" 3-hour loading: in excess of 50%. **"Heavy"** 3-hour loading: 40% - 49%.

These percentage levels may appear to be low. However, they do not include two essential components of a controller's workload: thinking time and the time needed to prioritise tasks and then to catch up on them later. These workload thresholds have evolved over many years of evaluating controller workload through fast-time simulation and are generally regarded as a realistic description of a controller's level of work.

3.7. PRESENTATION OF THE RESULTS

Because of the high number of sectors simulated, only those sectors that experienced a severe loading are commented on. In addition, results and comments are, for the most part, presented in table format so as to permit the quick location of any sectors relevant to the reader.

Currently, RAMS identifies conflicts according to strict rules – a distance of 5.1nm between two aircraft is considered to be full separation and requires no radar workload. In reality, a controller would supervise this situation until certain that no conflict would arise. This notion of the radar supervision was still under development in RAMS at the time of this study, so it is not reflected in the results. All this means that the controller percentage loadings presented here are probably understated. To cut a long explanation short, experience with the old Eurocontrol Airspace Model (EAM), where the radar supervision facility existed, indicates that the level of understatement is in the region of 10% of the 3-hour percentage loadings given; so, an overall loading of 50% would be approximately 55% if the radar supervisions had been taken into account.

4. RESULTS – 1997 REFERENCE ORGANISATION

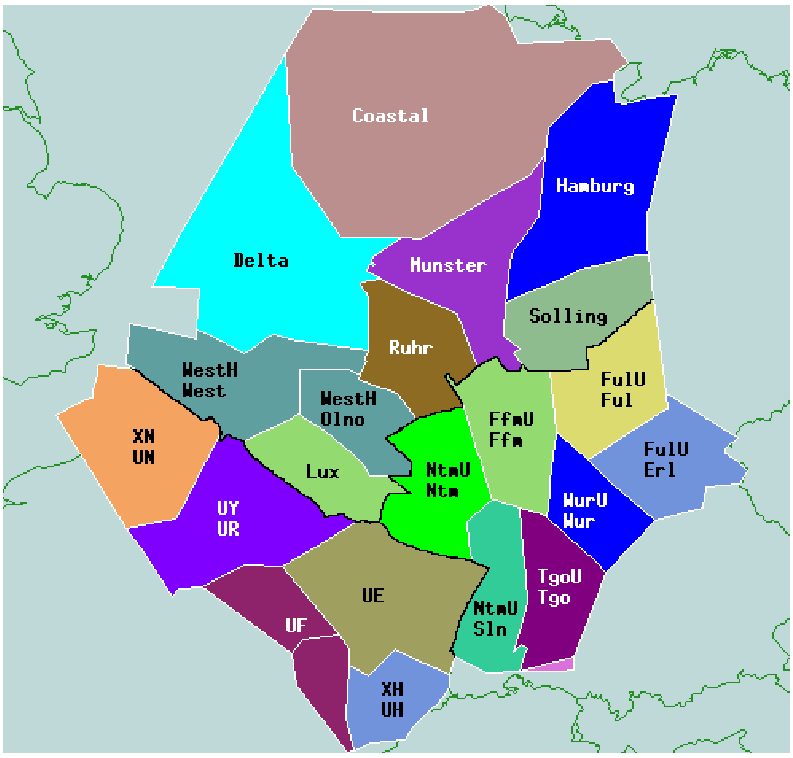

Figure 4: Core area en route sectors above FL245 (12th September 1997)

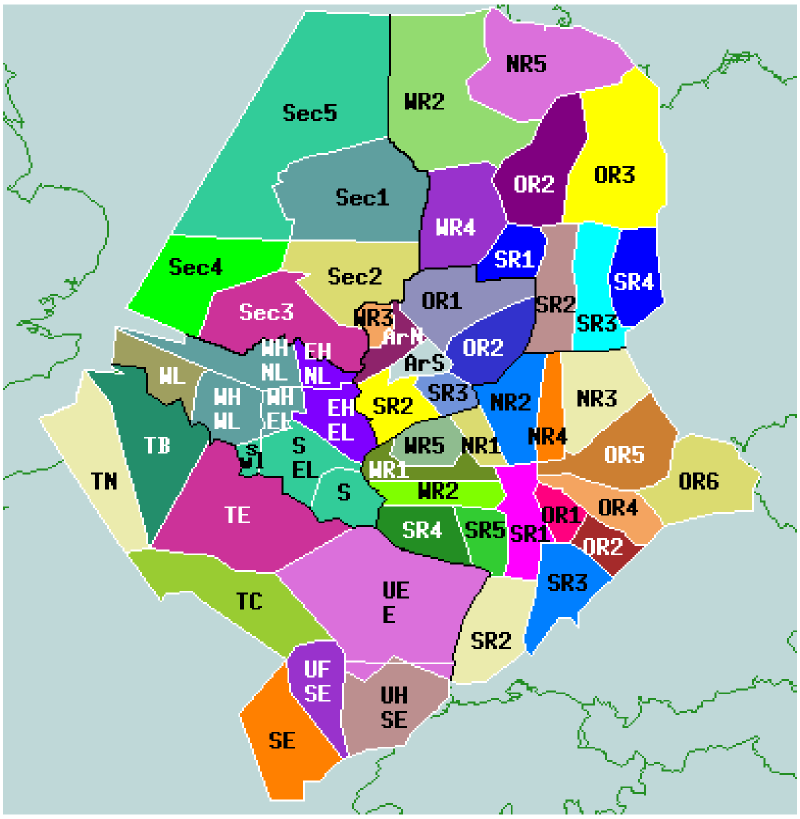

Figure 5: Core area en route sectors below FL245 (12th September 1997)

4.1. DESCRIPTION OF THE 1997 REFERENCE ORGANISATION

The reference organisation simulated the route network, sectorisation (DFL245), military activity and traffic as it was on Friday 12th September 1997. The military areas were activated and deactivated during the simulation in accordance with the published opening and closing times. Generally speaking, all military areas were activated at 0600 UTC and deactivated at 1000 UTC. The Belgian military continued until 1500 UTC, but activity was limited to FL195. The Dutch military areas remained open throughout the day but were limited to a maximum of FL95 before 0600 and after 1000.

4.2. LEVEL CONSTRAINTS (1997 REFERENCE ORG.)

In addition to a number of level changes applied at turning points in the airspace so as to keep correct semi-circular levels and to apply the French semi-circular system before entry into French airspace, a variety of level constraints needed to be applied to aircraft departing from and arriving at the major airports to ensure correct sector profiles. The following tables illustrate the main departure and arrival constraints applied.

(Note: in the following tables del means delegated, bdy means boundary and ~ means approximately. Points with an asterisk in front of the name are artificial points used by the CFMU and generally designate an FIR/UIR boundary.)

MAIN DEPARTURE LEVEL CONSTRAINTS – 1997 Reference Org.					
Departure	**MaxFL**	**To Point**	**Point Location**	**Route Segment**	**Comments**
EBBR	240	10WCOA	CanWH/LATCC bdy	COA-SASKI	Avoid MasWEST
	240	*EBH6	CanWH/AmsSec3 bdy	COA-TULIP	Avoid MasWEST
	230	*HED3	CanEH/DusSR2 bdy	LNO-GESBI	Avoid MasOLNO
EDDF	230	DFNDG	FraOR2/München bdy	KNG-NDG	Avoid RheWÜR
	240	DFRWR	RheNTM/MasLUX bdy	KIR-RUWER	Avoid RheNTM
	230	SWALM	~RheFFM/FUL bdy	GIN-FULNO	Avoid RheFFM
	240	RENNE	~RheFFM/MasMNSTR bdy	ARP-HMM	Avoid RheFFM
EDDL	240	DLFFM	~MasRUHR/RheFFM bdy	KAPEL-FFM	Avoid MasRUHR
	240	TENLI	~MasMNSTR/DELTA bdy	RKN-FLEVO	Avoid MasMNSTR
EDDS	240	DSSTR	RheSLN/ReiUE bdy	DENEL-STR	Avoid RheSLN
	240	DSTRA	RheSLN/Zürich bdy	RALIX-TRA	Avoid RheSLN
EDDV	230	DVHDO	MasSOLL/Berlin bdy	LINSI-ASLEP	Avoid MasSOLL
EDLN	240	DLFFM	~MasRUHR/RheFFM bdy	KAPEL-FFM	Avoid MasRUHR
EHAM	240	AMREF	MasDELTA/LATCC del. bdy	VOLLA-REFSO	Avoid MasDELTA
	240	NEPTU	MasDELTA/LATCC bdy	VOLLA-NEPTU	Avoid MasDELTA
	240	ELDIN	MasDELTA/LATCC bdy	UNIDO-BEENO	Avoid MasDELTA
	240	TOPPA	MasDELTA/LATCC bdy	UNIDO-SKATE	Avoid MasDELTA
EHRD	240	ELDIN	MasDELTA/LATCC bdy	ABKER-ELDIN	Avoid MasDELTA
LFSB	130	SBBLM	~Zürich/FraSR2 del. bdy	BLM-RALIX	Avoid Zürich del. airsp.

Out of the 19 departure level constraints, 18 concerned restrictions to keep aircraft below the upper sectors. In most instances, this was to prevent short sector flying times, usually in the order of two minutes. The number of aircraft affected by these 18 restrictions amounted to 556, or 23% of the total departures from the associated airports.

MAIN ARRIVAL LEVEL CONSTRAINTS – 1997 Reference Org.					
Arrival	**By Point**	**Max FL**	**Point Location**	**Route Segment**	**Comments**
EBAW	*LFB7	180	ParTB/CanWL bdy	CMB-CIV	Avoid CanWH
	10SPAM	260	10nm SW of PAM	PAM-WOODY	
	LARAS	240	28nm NE of WOODY	PAM-WOODY	
	WOODY	100	AmsSec3/CanNL bdy	WOODY-NIK	
EBBR	ADOMU	240	~MasMUNSTR/RUHR bdy	OSN-BOT	Avoid MasRUHR
	*HED3	180	DüsSR2/CanEL bdy	GESBI-LNO	Avoid CanEH
	*EBD4	240	FraWR1/CanEH bdy	NTM-GOTIL	
	*EDB0	240	FraWR1/CanEH bdy	ADENU-GOTIL	
	GOTIL	180		Ex S/SE-FLORA	
	*EBF3	180	ParTB/CanWL bdy	CMB-RODRI	Avoid CanWH
	VAXEL	240	LATCC/CanWL bdy	DET-GOROL	Avoid MasWEST
	KONAN	240	LATCC/CanWL bdy	DVR-KOK	Avoid MasWEST
	KOKBR	180	CanWL/WH bdy	KOK-KERKY	Avoid CanWH
	KERKY	90	~CanWL/NL bdy	KERKY-BUN	Avoid CanNL
	TULIP	260		TULIP-LARAS	
	10SPAM	260	10nm SW of PAM	PAM-WOODY	
	LARAS	240	28nm NE of WOODY	PAM-WOODY	
	WOODY	190	AmsSec3/CanNL bdy	WOODY-BUN	
EBCI	KONAN	240	LATCC/CanWL bdy	DVR-KOK	Avoid MasWEST
EBLG	RUWER	240	FraWR2/CanS bdy	KIR-DIK	
	*LFB3	240	ReiUR/MasLUX bdy	MEDIX-DIK	Avoid MasLUX
	*LFB7	240	ReiUN/MasWEST bdy	CMB-CIV	Avoid MasWEST
EBOS	*NV	260	16nm SW of PAM	PAM-COA	
	COA	100		COA-ONO	
EDDE	FULDE	240	RheWÜR/FUL bdy	LOHRE-FUL	Avoid RheFUL
EDDF	NETMA	240	~MasOLNO/RheNTM bdy	NTM-RUD	Avoid RheNTM
	RUD	90		RUD-FFM	
	KOBON	250	15nm E of NOR	ARKON-DOSEL	
	DOSEL	230	MasRUHR/RheNTM bdy	KOBON-RUD	Avoid RheNTM
	GMH	230	~MasRUHR/RheFFM bdy	GMH-SIGEN	Avoid RheFFM
	GED	90		GED-MTR	
	FTZ	240	~MasSOLL/RheFFM bdy	WRB -SWALM	Avoid RheFFM
	ERSIL	240	36nm NE of FUL	NENSA-FUL	
	WURE	240	RheERL/WÜR bdy	BAY-WUR-PSA	Avoid RheWÜR
	ALB	240		ALB-WUR-PSA	Avoid RheWÜR
	*1ZUE	310	~Zürich/RheTGO-U bdy	ZUE-NELLI	Avoid RheTGO-U
	TRADF	350	Zürich/RheNTM-U bdy	TRA-NELLI	
	LOPNI	240	45nm S of PSA	NELLI/TGO-PSA	
	PSA	90		LOPNI-CHA	
EDDK	RMBLN	240	~MasWEST/OLNO bdy	REMBA-SPI	Avoid MasOLNO
	ARCKY	210	39nm SW of NOR	MEDIX/DIK-NOR	
	LNO	250		SPI-NOR	
	DINKI	210	8nm NE of LNO	SPI-NOR	
	8EPAM	260	8nm E of PAM	PAM-NYKER	
	ARNEM	240	~MasDELTA/RUHR bdy	NYKER-ARKON	Avoid MasRUHR
	ARKON	230		ARNEM-ODINO	
	PODER	240	~MasSOLL/MNSTR bdy	HLZ/POVEL-GMH	Avoid MasMNSTR
	HAB	240	~RheERL/WÜR bdy	ERL/OKG-FFM	Avoid RheWÜR
	FFM	240		FFM-TAU/ALFAS	
	ALFAS	220	29nm E of COL	ALFAS-COL	

MAIN ARRIVAL LEVEL CONSTRAINTS – 1997 Reference Org. (continued)					
Arrival	**By Point**	**Max FL**	**Point Location**	**Route Segment**	**Comments**
EDDL	ROBNA	250	~CANAC/Düsseldorf bdy	MEDIX/DIK-KENUM	
	LNO	250		LNO-LMA	
	8EPAM	260	8nm E of PAM	PAM-NYKER	
	ARNEM	240	~MasDELTA/RUHR bdy	NYKER-ARKON	Avoid MasRUHR
	ARKON	230		ARNEM-ODINO	
	DENOL	240	MasHMBRG/MNSTR bdy	HLZ/MAG-DOM	Avoid MasMNSTR
	ARP	240	~RheFFM/MasMNSTR bdy	ARP-MOHNE-BAM	Avoid MasMNSTR
EDDM	DKBDM	240	RheWÜR/München bdy	DKB-WLD	
EDDN	*ERL1	130	~FraOR5/OR6 bdy	HAB-ERL	Avoid FraOR6
EDDS	TRADS	240	Zürich/RheSLN bdy	TRA-TGO	Avoid RheSLN
	STR	230	~ReiUE/RheSLN bdy	EPL-SUL	Avoid RheSLN
	RUD	230	~RheNTM/FFM bdy	RUD-FFM-NKR	Avoid RheFFM
	NKR	130	~FraSR1/SR3 bdy	FFM/RID-LBU	Avoid FraSR3
EDDV	LAUDV	280	RheFUL/MasSOLL bdy	FUL-LAU	
EDDW	LARBU	240	~MasSOLL/HMBRG	WRB-NIE	Avoid MasHMBRG
EDLN	RMBLN	240	~MasWEST/OLNO bdy	REMBA-SPI	Avoid MasOLNO
	KENUM	130		LNO-MHV	
EDLP	LARLP	140	BreSR2/SR3 bdy	NIE-WRB	
	LABLP	140	BreSR3/SR2 bdy	MAG-WRB	Avoid BreSR2
	WERLP	140	BreSR3/SR2 bdy	NENSA-WRB	Avoid BreSR2
	LAULP	140	FraNR3/BreSR3 bdy	LAU-WRB	Avoid BreSR2
ETAR	NTM	250		SPI-KIR	
ETUR	LNO	250		LNO-NOR	
	DINKI	210	8nm NE of LNO	LNO-NOR	
EGKK	COA	280		COA-SASKI	
LonTMA	ABB	350		CTL/MTD-ABB	
EHAM	FERDI	250		CMB-DENUT	
	DENUT	240		FERDI-HSD	
	BUB	250		DIK/BATTY-BUB	
	HELEN	240		BUB-HSD	
	REDFA	230	LATCC/MasDELTA bdy	REDFA-SUGOL	Avoid MasDELTA
	NEPTU	190	LATCC/AmsSec4 bdy	NEPTU-SUGOL	
	BLUFA	240	LATCC/MasDELTA bdy	BLUFA-SUGOL	Avoid MasDELTA
	TOPPA	240	LATCC/MasDELTA bdy	TOPPA-SUGOL	Avoid MasDELTA
	BEDUM	260	12nm NNW of EEL	GREFI-EEL	
	*EHD5	260	BreWR2/AmsSec1 bdy	JUIST-EEL	
	*EHD4	260	BreWR2/AmsSec1 bdy	GOLEN-EEL	
	*EDH8	260	BreWR2/AmsSec1 bdy	GASTU-EEL	
	*EHD1	260	BreWR4/AmsSec1 bdy	WSR-EEL	
	55EARTP	260	BreWR4/AmsSec2 bdy	HLZ-ARTIP	
	*EDH2	260	DusOR1/AmsSec2 bdy	OSN-RKN	
	*EHD2	260	DusOR1/AmsSec2 bdy	HMM-RKN	
EHBD	ROUSY	240	ReiUE/MasLUX bdy	EPL-DIK	Avoid MasLUX
	LNO	100		DIK-THN	
	THNEH	70	BeekTMA/CanNL bdy	LNO-THN	Avoid CanNL
EHBK	ROUSY	240	ReiUE/MasLUX bdy	EPL-DIK	Avoid MasLUX
	*LFB3	240	ReiUR/MasLUX bdy	MEDIX-DIK	Avoid MasLUX
	LNO	100		DIK-NW	
EHEH	FERDI	250		CMB-HELEN	
	HELEN	180		CMB/KOK-ALINA	
	REDFA	230	LATCC/MasDELTA bdy	REDFA-HSD	Avoid MasDELTA
	HSD	130		HSD-BREDA	
	LNO	100		LNO-THN	
	THNEH	70	BeekTMA/CanNL bdy	LNO-THN	Avoid CanNL

MAIN ARRIVAL LEVEL CONSTRAINTS – 1997 Reference Org. (continued)					
Arrival	**By Point**	**Max FL**	**Point Location**	**Route Segment**	**Comments**
EHRD	FERDI	250		CMB-HELEN	
	HELEN	180		CMB/ALINA	
	BLUFA	230	LATCC/MasDELTA bdy	BLUFA-HSD	Avoid MasDELTA
	LILSI	70	~AmsSec1/Sec2 bdy	EEL-PAM	Avoid AmsSec2
	FLEVO	70	19nm E of PAM	RKN-PAM	
ELLX	KOKLX	240	MasWEST/LUX bdy	KOK-DIK	Avoid MasLUX
	NIKLX	240	MasWEST/OLNO bdy	BUB-LNO	Avoid MasOLNO
	REMBA	240	~MasWEST/OLNO bdy	KOK-SPI	Avoid MasOLNO
	BOT	240		OSN-GESBI	
	ARCKY	180	27nm N of DIK	KENUM-DIK	
LFLL	VALDA	290	~ReiUH/Geneva bdy	HR-PAS	
LFPB/PG	EPLPG	220	ReiUE/UF bdy	EPL-TRO	Avoid ReiUF
ParTMA	MOROK	330		HOC/LASON-DIJ	
LFST	*EBF1	190	CanS/ReiUE bdy	DIK-GTQ	Avoid ReiUE

There were 118 different restrictions applied to arrival traffic and 37 (30%) of these kept traffic below the upper sectors. A total of 773 aircraft were affected by the upper sector restrictions, representing 26% of the total arrivals to the associated airports.

4.3. OVERVIEW OF THE RESULTS (1997 REFERENCE ORG.)

The following table gives a summary of the results for each ACC/UAC. Only the en route sectors have been included in the figures.

ACC/UAC (no. of sectors)	Individual flights through ACC/UAC (24 hrs)	Average flights per sector (24 hrs)	Average en route sectors used per flight	Average work per aircraft (seconds)	Number of conflicts (24 hrs)	Individual aircraft in conflict (% of flights)
Amsterdam (5)	1523	371	1.2	47”	217	330 (22%)
Bremen (9)	1300	223	1.5	56”	163	267 (21%)
CANAC (6)	1761	469	1.6	61”	341	436 (25%)
Düsseldorf (9)	1745	349	1.8	67”	266	418 (24%)
Frankfurt (18)	2684	299	2.0	78”	720	963 (36%)
Luxembourg (1)	160	160	1.0	35”	10	19 (12%)
Maastricht (10)	3316	637	1.9	78”	977	1337 (40%)
Paris (4)	1100	313	1.1	40”	70	124 (11%)
Reims (10)	2033	387	1.9	72”	467	628 (31%)
Rhein (12)	2408	529	2.6	101”	875	1074 (45%)

Taking the en route sectors of the core area as a whole, the next table shows the number of radar conflicts occurring above and below FL295, as well as those recorded in the level band FL245 to FL295, the volume concerned with the change of DFL.

RADAR CONFLICTS IN THE EN ROUTE CORE SECTORS	
Airspace	**Conflicts Detected**
Above FL295	1783
Below FL295	2323
Between FL245 and FL295	499
All Levels	4106

Of the 84 core sectors, 27 (32%) experienced sustained heavy to severe controller loadings over their busiest three-hour periods. Ten of these sectors were severely loaded, in other words, they had reached or exceeded their capacity, and six out of this group of ten were Maastricht sectors.

4.4. SECTOR RESULTS (1997 REFERENCE ORG.)

The following table gives, for each of the core sectors, the highest three-hour radar controller loadings for both the morning and afternoon. The centre columns show the number of aircraft controlled by the sector plus those skipping the sector during the full 24 hours simulated.

Note: Sectors with a "severe" loading (50%+ over 3 hours) are marked in red. Sectors with a "heavy" loading (40% to 49% over 3 hours) are marked in blue.											
Busiest Morning 3-hr Period					A/C 24hrs		Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	Skip	Sector	Period	Work'	% Load	Type
AMS_SEC1	05:40-08:40	30.42	17%		215	8	AMS_SEC1	14:10-17:10	35.58	20%	
AMS_SEC2	06:10-09:10	87.5	49%	Heavy	544	10	AMS_SEC2	15:10-18:10	76.58	43%	Heavy
AMS_SEC3	05:40-08:40	71.25	40%	Heavy	499	6	AMS_SEC3	15:10-18:10	78.58	44%	Heavy
AMS_SEC4	07:40-10:40	69.67	39%		383	5	AMS_SEC4	12:30-15:30	57.33	32%	
AMS_SEC5	07:50-10:50	35.42	20%		181		AMS_SEC5	12:40-15:40	21.58	12%	
BRE_NR5	08:20-11:20	15.5	9%		117		BRE_NR5	15:30-18:30	18.08	10%	
BRE_OR2	04:40-07:40	46.17	26%		336		BRE_OR2	13:10-16:10	42.33	24%	
BRE_OR3	07:40-10:40	50	28%		372	2	BRE_OR3	14:10-17:10	54.5	30%	
BRE_SR1	04:40-07:40	35.5	20%		241		BRE_SR1	15:30-18:30	34.17	19%	
BRE_SR2	05:00-08:00	34.83	19%		303		BRE_SR2	15:20-18:20	46.08	26%	
BRE_SR3	05:30-08:30	50.92	28%		329		BRE_SR3	13:40-16:40	47.58	26%	
BRE_SR4	06:20-09:20	13.58	8%		124		BRE_SR4	13:30-16:30	15.83	9%	
BRE_WR2	08:30-11:30	14.58	8%		64		BRE_WR2	15:20-18:20	5.92	3%	
BRE_WR4	09:00-12:00	12.67	7%		85		BRE_WR4	17:30-20:30	9.33	5%	
CAN_EH	05:30-08:30	63.5	35%		468	17	CAN_EH	13:20-16:20	64.08	36%	
CAN_EL	05:20-08:20	96.33	54%	Severe	616	14	CAN_EL	13:20-16:20	105.25	58%	Severe
CAN_NL	06:10-09:10	49.17	27%		345	8	CAN_NL	16:10-19:10	53.33	30%	
CAN_S	07:30-10:30	48.83	27%		419	19	CAN_S	13:30-16:30	60.42	34%	
CAN_WH	06:00-09:00	52.42	29%		386	58	CAN_WH	15:20-18:20	47.75	27%	
CAN_WL	05:20-08:20	73.08	41%	Heavy	438	16	CAN_WL	15:30-18:30	66.25	37%	
LUX_APP	08:00-11:00	23.25	13%		160		LUX_APP	13:50-16:50	23.67	13%	
DUS_ARN	05:50-08:50	44.83	25%		368		DUS_ARN	13:20-16:20	48.75	27%	
DUS_ARS	05:40-08:40	62.75	35%		485	1	DUS_ARS	12:50-15:50	60.83	34%	
DUS_OR1	05:50-08:50	66.08	37%		438		DUS_OR1	15:20-18:20	59.75	33%	
DUS_OR2	05:30-08:30	89.42	50%	Severe	483		DUS_OR2	15:20-18:20	81.92	46%	Heavy
DUS_OR3	06:40-09:40	21	12%		169		DUS_OR3	14:30-17:30	27.17	15%	
DUS_OR4	05:10-08:10	20.42	11%		156		DUS_OR4	13:20-16:20	29.58	16%	
DUS_SR2	05:40-08:40	42.33	24%		363	3	DUS_SR2	14:20-17:20	47.58	26%	
DUS_SR3	06:10-09:10	71.83	40%	Heavy	586	1	DUS_SR3	13:50-16:50	59.67	33%	
DUS_WR3	05:00-08:00	8.83	5%		62		DUS_WR3	13:50-16:50	8.33	5%	
FRA_NR1	06:00-09:00	51.75	29%		353		FRA_NR1	13:10-16:10	45.75	25%	
FRA_NR2	05:30-08:30	83.42	46%	Heavy	544		FRA_NR2	15:30-18:30	75	42%	Heavy
FRA_NR3	05:00-08:00	41.75	23%		275	15	FRA_NR3	13:20-16:20	44.5	25%	
FRA_NR4	05:10-08:10	45.17	25%		238	72	FRA_NR4	15:30-18:30	38.83	22%	
FRA_OR1	07:10-10:10	73.33	41%	Heavy	391		FRA_OR1	12:20-15:20	57.92	32%	
FRA_OR2	06:10-09:10	55.5	31%		407		FRA_OR2	13:50-16:50	62.58	35%	
FRA_OR4	05:00-08:00	63.08	35%		425		FRA_OR4	14:40-17:40	76.75	43%	Heavy
FRA_OR5	05:00-08:00	39.92	22%		282		FRA_OR5	13:20-16:20	38.92	22%	
FRA_OR6	05:00-08:00	39.17	22%		287	6	FRA_OR6	13:20-16:20	34.83	19%	
FRA_SR1	05:40-08:40	77.58	43%	Heavy	506		FRA_SR1	14:30-17:30	65.5	36%	
FRA_SR2	05:10-08:10	33.08	18%		222		FRA_SR2	15:10-18:10	34.25	19%	
FRA_SR3	05:10-08:10	80.33	45%	Heavy	561		FRA_SR3	15:20-18:20	84.75	47%	Heavy
FRA_SR4	07:00-10:00	13.17	7%		82		FRA_SR4	12:40-15:40	13.17	7%	
FRA_SR5	09:00-12:00	12.25	7%		88		FRA_SR5	14:20-17:20	12.33	7%	
FRA_WR1	06:00-09:00	43.17	24%		265	9	FRA_WR1	12:00-15:00	32.92	18%	
FRA_WR2	05:30-08:30	34.25	19%		249	8	FRA_WR2	14:00-17:00	40.25	22%	
FRA_WR4	06:00-09:00	8	4%		38		FRA_WR4	12:00-15:00	4.67	3%	
FRA_WR5	08:10-11:10	6.25	3%		27		FRA_WR5	16:10-19:10	4.33	2%	

Note: Sectors with a "severe" loading (50%+ over 3 hours) are marked in red.											
Sectors with a "heavy" loading (40% to 49% over 3 hours) are marked in blue.											
Busiest Morning 3-hr Period					A/C 24hrs		Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	Skip	Sector	Period	Work'	% Load	Type
KRH_ERL	07:40-10:40	91.67	51%	Severe	508		KRH_ERL	15:40-18:40	73.33	41%	Heavy
KRH_FFM	07:50-10:50	86.58	48%	Heavy	593	54	KRH_FFM	14:10-17:10	64	36%	
KRH_FUL	06:30-09:30	65.5	36%		469		KRH_FUL	15:10-18:10	75.33	42%	Heavy
KRH_NTM	08:20-11:20	58.17	32%		468	6	KRH_NTM	13:10-16:10	46	26%	
KRH_SLN	08:10-11:10	78.67	44%	Heavy	567	1	KRH_SLN	13:10-16:10	67.25	37%	
KRH_TGO	08:00-11:00	69.17	38%		460	1	KRH_TGO	15:30-18:30	61.17	34%	
KRH_WUR	04:50-07:50	65	36%		501	17	KRH_WUR	15:40-18:40	64.58	36%	
KRH_FFMU	08:50-11:50	99.92	56%	Severe	678	1	KRH_FFMU	16:10-19:10	83.08	46%	Heavy
KRH_FULU	08:40-11:40	58.92	33%		411		KRH_FULU	14:20-17:20	59.67	33%	
KRH_NTMU	07:40-10:40	62.58	35%		505		KRH_NTMU	13:00-16:00	59.83	33%	
KRH_TGOU	08:00-11:00	65.42	36%		496		KRH_TGOU	13:40-16:40	66.08	37%	
KRH_WURU	07:20-10:20	79.83	44%	Heavy	606		KRH_WURU	14:10-17:10	73	41%	Heavy
MAS_COAST	05:30-08:30	73.83	41%	Heavy	564	15	MAS_COAST	13:00-16:00	86	48%	Heavy
MAS_DELTA	06:00-09:00	103.08	57%	Severe	718	27	MAS_DELTA	15:50-18:50	102.08	57%	Severe
MAS_HMBRG	07:30-10:30	110.17	61%	Severe	746	6	MAS_HMBRG	13:50-16:50	103.17	57%	Severe
MAS_LUX	08:30-11:30	99.25	55%	Severe	695	4	MAS_LUX	17:30-20:30	90.92	51%	Severe
MAS_MNSTR	08:20-11:20	98.42	55%	Severe	567	12	MAS_MNSTR	15:10-18:10	82.75	46%	Heavy
MAS_OLNO	07:00-10:00	115	64%	Severe	689	36	MAS_OLNO	15:10-18:10	78.42	44%	Heavy
MAS_RUHR	08:10-11:10	68.67	38%		412	15	MAS_RUHR	12:00-15:00	46.42	26%	
MAS_SOLL	06:10-09:10	106	59%	Severe	656		MAS_SOLL	16:00-19:00	112.5	63%	Severe
MAS_WEST	05:40-08:40	82.92	46%	Heavy	675	7	MAS_WEST	15:10-18:10	87.17	48%	Heavy
MAS_WESTH	09:00-12:00	71.75	40%	Heavy	489	11	MAS_WESTH	13:30-16:30	66.5	37%	
PAR_TB	06:00-09:00	42.75	24%		303		PAR_TB	16:00-19:00	52.33	29%	
PAR_TC	05:10-08:10	27.33	15%		256		PAR_TC	16:40-19:40	30.75	17%	
PAR_TE	05:40-08:40	63.42	35%		499		PAR_TE	15:40-18:40	66	37%	
PAR_TN	07:40-10:40	28.75	16%		194		PAR_TN	13:50-16:50	21.75	12%	
REI_E	05:10-08:10	56.92	32%		312	4	REI_E	13:40-16:40	52.5	29%	
REI_SE	04:50-07:50	39.33	22%		297	3	REI_SE	17:00-20:00	37.75	21%	
REI_UE	07:50-10:50	58.83	33%		500	6	REI_UE	17:10-20:10	61.58	34%	
REI_UF	04:40-07:40	54.08	30%		447		REI_UF	16:50-19:50	50.42	28%	
REI_UH	07:10-10:10	55.5	31%		396	2	REI_UH	15:10-18:10	53.42	30%	
REI_UN	08:40-11:40	57.58	32%		355		REI_UN	16:00-19:00	50.17	28%	
REI_UR	09:00-12:00	75	42%	Heavy	567	5	REI_UR	14:30-17:30	64.83	36%	
REI_UY	09:00-12:00	58.58	33%		431	1	REI_UY	14:30-17:30	52.33	29%	
REI_XH	04:20-07:20	22.33	12%		163		REI_XH	13:00-16:00	17.67	10%	
REI_XN	09:00-12:00	64.08	36%		378		REI_XN	17:20-20:20	49.42	27%	

4.5. SEVERELY LOADED SECTORS (1997 REFERENCE ORG.)

The tables that follow give a further breakdown of the three-hour period for each of the severely loaded sectors, morning and afternoon, where applicable. The percentages under the time periods are a reminder of the three-hour loadings recorded (50% is the "severe" loading threshold) and the other percentages are based on the total number of controlled flights entering the sector during the three-hour period assessed. The figures underneath the percentage loading give the average and maximum instantaneous aircraft counts (number of aircraft on the frequency at any one time) during the three-hour period.

<table>
<tr><th colspan="9">CANAC East Low (CAN_EL) – FL195 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">05:20-08:20
(54%)
Ave: 5 a/c
Max: 14 a/c</td><td>115</td><td>16
(14%)</td><td>49
(43%)</td><td>50
(43%)</td><td>2</td><td>Brussels TMA arrs (40%)
Brussels TMA deps (32%)</td><td>47</td><td>51
(44%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The Brussels TMA arrivals and departures represented 70% of the sector's traffic and 75% of the individual aircraft in conflict. 80% of the conflicts involved a Brussels TMA arrival, with these aircraft making up 60% of the aircraft in conflict. Two thirds of all conflicts occurred at or above FL160. The main concentration of conflicts was a triangle 10nm SE of a line joining LNO and GOTIL to an apex 10nm SE of FLORA.</td></tr>
<tr><td rowspan="2">13:20-16:20
(58%)
Ave: 6 a/c
Max: 13 a/c</td><td>128</td><td>23
(18%)</td><td>39
(30%)</td><td>66
(52%)</td><td>4</td><td>Brussels TMA arrs (41%)
Brussels TMA deps (19%)</td><td>42</td><td>54
(42%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
In the afternoon the Brussels TMA departures were less pronounced in both numbers and conflicts. The Brussels TMA arrivals, however, gave a similar picture to the morning period, being involved in 75% of all conflicts and equalling 55% of the aircraft in conflict. 70% of all conflicts for the sector occurred at or above FL160. The main conflict area was a triangle 10nm SE of a line joining GOTIL and SPI to 15nm SE of FLORA.</td></tr>
</table>

<table>
<tr><th colspan="9">Düsseldorf OR2 (DUS_OR2) – FL245 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">05:30-08:30
(50%)
Ave: 4 a/c
Max: 10 a/c</td><td>115</td><td>42
(37%)</td><td>28
(24%)</td><td>45
(39%)</td><td></td><td>Düss'dorf TMA arrs (32%)
(EDDL, EDLE, EDLN)</td><td>28</td><td>46
(44%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
All but one of the conflicts involved an aircraft arriving or departing from the Düsseldorf FIR. Although only one third of the sector's traffic, the Düsseldorf TMA arrivals were involved in 70% of the conflicts and represented 50% of the individual aircraft in conflict. 85% of all conflicts occurred at or above FL190. The main conflict area was the axis ARP/RENNE/MOHNE to 15nm W of MOHNE.</td></tr>
</table>

<table>
<tr><th colspan="9">Rhein Erlangen (KRH_ERL) – FL245 to FL340</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:40-10:40
(51%)
Ave: 5 a/c
Max: 11 a/c</td><td>120</td><td>73
(61%)</td><td>39
(32%)</td><td>8
(7%)</td><td></td><td>East Europe arrs (23%)
(EP, LH, LK, LO)
München deps (18%)</td><td>31</td><td>49
(41%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The conflicts were spread throughout the various flows, with the highest number being the München departures with 11 of the 31 conflicts. 85% of all conflicts occurred at or above FL310. Most conflicts were along the ESTAR/SULUS axis, but there was also a large cluster within an 8nm radius of ERL.</td></tr>
</table>

<table>
<tr><th colspan="9">Rhein Frankfurt Upper High (KRH_FFMU) – FL320 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:50-11:50
(56%)
Ave: 6 a/c
Max: 14 a/c</td><td>142</td><td>94
(66%)</td><td>44
(31%)</td><td>4
(3%)</td><td></td><td>East Europe arrs (18%)
(EP, LH, LK, LO)
Düss'dorf TMA arrs (14%)</td><td>35</td><td>49
(35%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Conflicts spread throughout the various flows. 90% of the conflicts occurred at or below FL350 and the main area for conflicts was within a 10nm radius of FFM.</td></tr>
</table>

Maastricht Delta (MAS_DELTA) – FL245 lower limit								
Period	Controlled Flights Entering				Skip	Main Flow(s)	Conflicts	Acft. In Conflict
	Tot	Crse	Clmb	Desc				
06:00-09:00 (57%) Ave: 11 a/c Max: 19 a/c	140	106 (76%)	34 (24%)		18	Scandinavia deps (19%) Scandinavia arrs (14%)	32	47 (34%)
	Comments All skipped aircraft were military crossers. Conflicts were spread amongst the flows. Two thirds of all conflicts were at or below FL330. The main areas for conflicts were the SPY/PAM/FLEVO/LILSI area and from EHAM to 15nm SW of EHAM.							
15:50-18:50 (57%) Ave: 12 a/c Max: 20 a/c	147	102 (69%)	41 (28%)	4 (3%)		Scandinavia arrs (22%) Scandinavia deps (18%)	27	44 (30%)
	Comments Very similar picture to the morning period with 60% of all conflicts for the sector occurring at or below FL330. The main conflict area was within a 15nm radius of PAM.							

Maastricht Hamburg (MAS_HMBRG) – FL245 lower limit								
Period	Controlled Flights Entering				Skip	Main Flow(s)	Conflicts	Acft. In Conflict
	Tot	Crse	Clmb	Desc				
07:30-10:30 (61%) Ave: 9 a/c Max: 18 a/c	152	115 (76%)	34 (22%)	3 (2%)	3	Scandinavia deps (20%)	36	59 (39%)
	Comments This sector had the highest number of aircraft of all sectors during the 24 hours (746) and during its severely loaded three-hour period. No particular flow was prominent in the list of conflicts. Almost 85% of all conflicts occurred at or above FL310, and most were recorded in the southern part of the sector above the Hannover TMA.							
13:50-16:50 (57%) Ave: 9 a/c Max: 18 a/c	150	107 (71%)	40 (27%)	3 (2%)		Scandinavia deps (20%) Hamburg TMA deps (15%)	25	43 (29%)
	Comments Similar to the morning period with 80% of all conflicts occurring at or above FL310. The main conflict area was between HLZ and ROBEG.							

Maastricht Luxembourg (MAS_LUX) – FL245 lower limit								
Period	Controlled Flights Entering				Skip	Main Flow(s)	Conflicts	Acft. In Conflict
	Tot	Crse	Clmb	Desc				
08:30-11:30 (55%) Ave: 5 a/c Max: 11 a/c	122	96 (79%)	23 (19%)	3 (2%)	2	London TMA deps (12%) Paris TMA deps (11%)	30	49 (40%)
	Comments Other significant flows were departures from Spain and Portugal (19%) and traffic to Spain (14%). 75% of all conflicts were at or above FL310 with the majority occurring within a 20nm radius of DIK.							
17:30-20:30 (51%) Ave: 6 a/c Max: 13 a/c	125	98 (78%)	21 (17%)	6 (5%)		London TMA deps (24%) Düss'dorf TMA arrs (12%)	25	39 (31%)
	Comments Spain and Portugal departures made up 14% of the sector's traffic. 75% of the conflicts were at or above FL310 and most occurred within a 20nm radius of DIK.							

<table>
<tr><th colspan="10">Maastricht Münster (MAS_MNSTR) – FL245 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:20-11:20
(55%)
Ave: 8 a/c
Max: 18 a/c</td><td>124</td><td>87
(70%)</td><td>36
(29%)</td><td>1
(1%)</td><td>7</td><td>Amsterdam arrs (24%)</td><td>38</td><td>50
(40%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The main conflict flows here were the Amsterdam TMA arrivals and departures. Combined, they were involved in 70% of all conflicts, and the arrivals were involved in 55% of them. Each flow made up 40% of the aircraft in conflict (there were multiple conflicts with some aircraft). Two thirds of all conflicts occurred at or above FL310 and the conflicts were along the sides of a triangle RKN/OSN/HMM and also in the area immediately SE of HMM.</td></tr>
</table>

<table>
<tr><th colspan="9">Maastricht Olno (MAS_OLNO) – FL245 to FL340</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:00-10:00
(64%)
Ave: 6 a/c
Max: 11 a/c</td><td>146</td><td>74
(51%)</td><td>41
(28%)</td><td>31
(21%)</td><td>9</td><td>Brussels TMA deps (16%)
London TMA deps (16%)</td><td>48</td><td>67
(46%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Three flows, Brussels TMA departures, London TMA departures and Frankfurt TMA arrivals, were involved in 75% of all conflicts and represented 45% of the individual aircraft in conflict. 85% of all conflicts occurred at or above FL295 and most of the conflicts were concentrated along the SPI/NTM axis.</td></tr>
</table>

<table>
<tr><th colspan="9">Maastricht Solling (MAS_SOLL) – FL245 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:10-09:10
(59%)
Ave: 6 a/c
Max: 12 a/c</td><td>140</td><td>82
(59%)</td><td>46
(33%)</td><td>12
(8%)</td><td></td><td>Hamburg TMA arrs (11%)
Hamburg TMA deps (11%)
Frankfurt TMA deps (11%)</td><td>34</td><td>51
(36%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Flights from Scandinavia made up 20% of the traffic for this sector. The Frankfurt TMA arrivals and departures were the main conflict flows, being involved in 67% of the conflicts and equalling 30% of the aircraft in conflict. 75% of all conflicts were above FL295 and the main conflict area was from 5nm S of WRB to 5nm N of LARBU.</td></tr>
<tr><td rowspan="2">16:00-19:00
(63%)
Ave: 6 a/c
Max: 14 a/c</td><td>148</td><td>91
(61%)</td><td>44
(30%)</td><td>13
(9%)</td><td></td><td>Hamburg TMA arrs (11%)
Hamburg TMA deps (11%)</td><td>40</td><td>60
(41%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Scandinavia arrivals (18%) and departures (14%) were the main long-distance flows. The Frankfurt TMA departures and Hamburg TMA arrivals were the main conflict flows, involved in 33% and 25% of the conflicts, respectively. Almost 80% of all conflicts were above FL295 and the majority occurred between 10nm S of WRB to 5nm N of LARBU.</td></tr>
</table>

5. RESULTS – V3/RVSM ORGANISATION – 1997 TRAFFIC

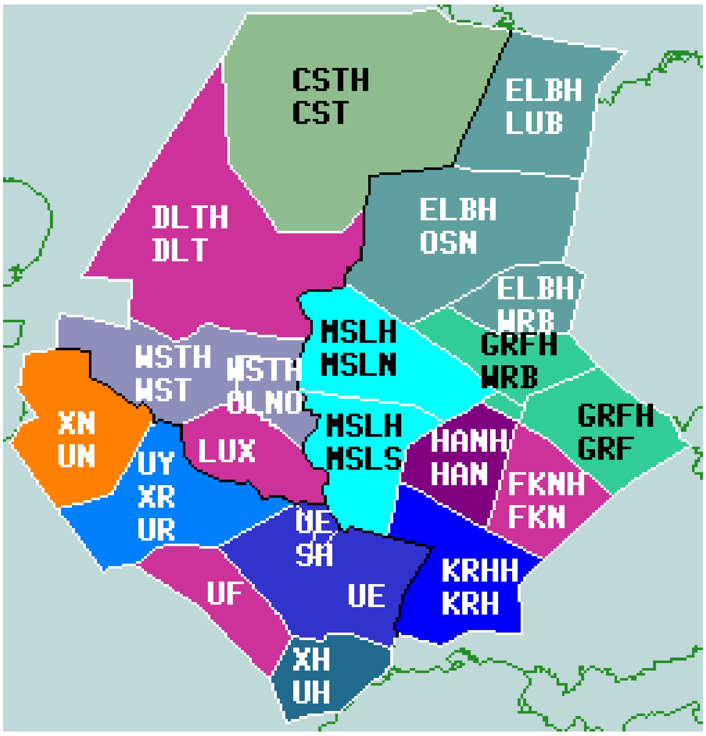

Figure 6: V3/RVSM core area en route sectors above FL295 (FL265 France)

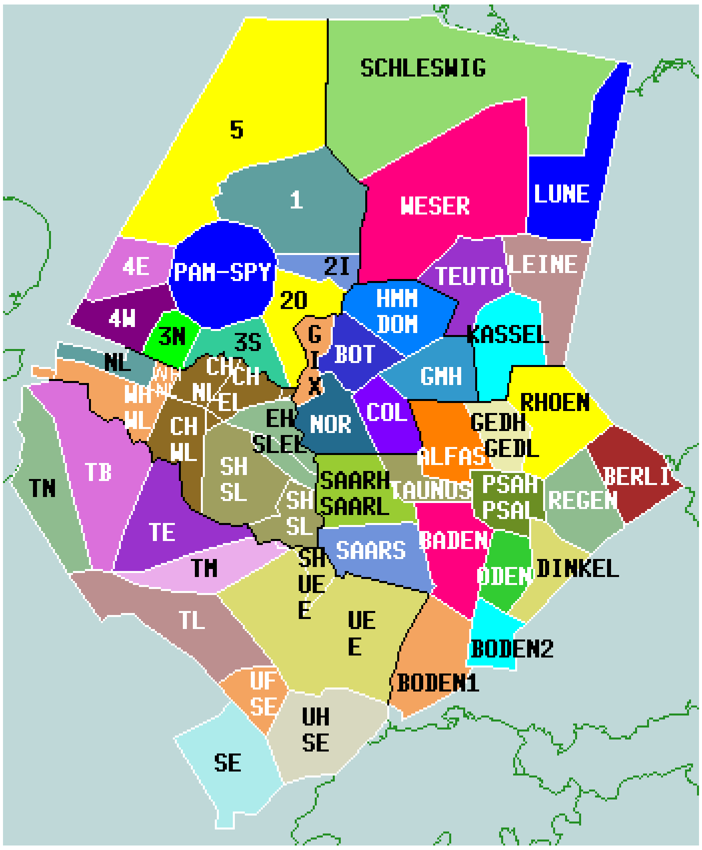

Figure 7: V3/RVSM core area en route sectors below FL295 (FL265 France)

NOTES ON THE SECTORS		
Centre	**Sector**	**Comments**
Amsterdam	Amsterdam TMA	Max FL95.
	PAM-SPY	Max FL295, 30nm radius centred on SPL. Manned by a planning controller only whose function was to assess potential conflicts between aircraft crossing the Amsterdam area. No aircraft were controlled by this sector.
	Other en route sectors	Max FL295
Bremen	TMAs	Bremen, Hamburg and Hannover TMAs max FL135.
	Other en route sectors	Max FL295
CANAC	Brussels TMA	Max FL95.
	Central High (CAN_CH)	FL195-FL295 above parts of the East Low, North Low, South Low and West Low sectors. FL235-FL295 above the southeast part of the West Low sector.
	East High (CAN_EH)	FL195-FL295 above the southeast part of the East Low sector and the northeast part of the South Low sector.
	East Low (CAN_EL)	Max FL195
	North Low (CAN_NL)	Max FL195 underneath Central High and West High. Max FL265 in the west half of the sector, underneath the Maastricht West sector.
	South High (CAN_SH)	FL245-FL295 above South Low. Delegated airspace from Reims, south of Luxembourg.
	South Low (CAN_SL)	Max FL195 underneath East High and Central High. Max FL245 underneath South High. FL135-FL245 above Luxembourg TMA.
	West High (CAN_WH)	FL195-FL295 above North Low and West Low. Delegated airspace FL215-FL295 from London starting at 15nm west of KONAN.
	West Low (CAN_WL)	Max FL195 underneath West High and, in the northeast part of the sector, underneath Central High. Max FL235 in the southeast part of the sector underneath Central High.
Luxembourg	Luxembourg TMA	Max FL135.
Düsseldorf	TMA	Max FL145 covering the whole of the Düsseldorf FIR.
	DOM (DUS_DOM)	FL145-FL215 underneath the HMM sector.
	HMM (DUS_HMM)	FL215-FL295 above the DOM sector.
	Other en route sectors	FL145-FL295.
Frankfurt	TMAs	Frankfurt TMA max FL115, Nürnberg TMA max FL135, Stuttgart TMA max FL145
	Emil (FRA_EMILE)	Not shown on map. Max FL125 underneath SAAR-L and SAAR-S.
	Gedern (FRA_GED)	Split vertically at FL205 into GEDH and GEDL.
	Main (FRA_MAINE)	Not shown on map. Max FL205 underneath the southern half of ALFAS, northern half of BADEN and most of TAUNUS. The sector only works Frankfurt TMA departures. Other flights skip the sector.
	Spessart (FRA_PSA)	Split vertically at FL205 into PSAH and PSAL.
	Saar (North)	Split vertically at FL205 into SAARH and SAARL.
	Other en route sectors	Max FL295
Germany Upper	Note: The airspace consisting of the Rhein UIR and the Hannover UIR, currently controlled by Maastricht UAC, was simulated as a single entity in this organisation. At the time of simulation, no decision had been made as to the future involvement of Maastricht UAC with the Hannover UIR. As the only future sectorisation plan available for the ARN v3/RVSM scenario for Northern Germany was not compatible with the existing sectorisation, it was decided to simulate the two UIRs as one unit. However, the Maastricht Coastal sector remained over Northern Germany but was realigned with the proposed sector boundaries of the Lübeck, Osnabrück and Elbe sectors. This should be borne in mind when comparing the results of this organisation with the 1997 organisation.	
	Elbe (GER_ELBH)	Min FL335, above the Lübeck, Osnabrück and northeast part of the Warburg sector.
	Grafenwöhr-High (GER_GRFH)	Min FL335, above Grafenwöhr-Low, the small northeastern part of Hanau-Low and the south and west parts of Warburg.

NOTES ON THE SECTORS (continued)		
Centre	**Sector**	**Comments**
Germany Upper	Mosel-High (GER_MSLH)	Min FL335 above the Mosel North and Mosel South sectors.
	Other en route sectors	All high sectors FL295-FL335, all upper-high sectors min FL335.
Maastricht	Coastal (MAS_CST)	Coastal FL295-FL335, Coastal-High FL335+.
	Delta (MAS_DLT)	Delta FL295-FL335, Delta-High FL335+.
	West-High (MAS_WSTH)	Min FL335 above the West (FL295-FL335) and Olno (FL295-FL335) sectors.
	Luxembourg (MAS_LUX)	Min FL295. This was the only Maastricht sector that was not split vertically.
Paris	Paris TMA	Max FL195.
	TL (PAR_TL)	Max FL265. This was the TC sector in the 1997 organisation.
	TM (PAR_TM)	Max FL265. The south and east part of the 1997 TE sector, designed to handle the Paris TMA departures to the east.
	Other en route sectors	Max FL265
Reims	TMAs	Bale-Mulhouse and Strasbourg max FL115, Metz max FL195.
	SE (REI_SE)	Max FL195.
	UE (REI_UE)	Min FL195 above the E sector. Delegated airspace to CANAC FL245-FL295 south of Luxembourg.
	UF (REI_UF)	Min FL195 over the SE sector, min FL265 over the Paris TL sector.
	UH (REI_UH)	Min FL195 over the SE sector, max FL325 beneath the XH sector.
	UN (REI_UN)	Min FL265 above most of the Paris TB and TN sectors and max FL325 under the XN sector.
	UR (REI_UR)	Min FL265 over the Paris TE and TM sectors and parts of the TB, TL and TN sectors. Max FL305 below the XR sector.
	XR (REI_XR)	FL305-FL345 above the UR sector and beneath the UY sector.
Military Areas	Various	Generally speaking, all military areas were activated at 0600 UTC and deactivated at 1000 UTC. The Belgian military continued until 1500 UTC, but activity was limited to FL195. The Dutch military areas remained open throughout the day but activity before 0600 and after 1000 was confined to a maximum of FL95.

5.1. DESCRIPTION OF THE V3/RVSM ORGANISATION (1997 TRAFFIC)

This organisation simulated the new ARN v3, associated sectorisation and DFLs (FL265 in France and FL295 elsewhere) plus RVSM between FL290 and FL410, inclusive. Radar separation for the Reims ACC/UAC was reduced from 8nm to 5nm.

The route network and sectorisation tested included that implemented in France on the 22nd February 1999 and the route network and sectorisation proposed by the other States for future implementation. With the rest of the airspace outside of France in continual development, particularly Germany, the ARN v3/RVSM organisation took account of the updated sectorisation configurations decided on by the States during the project. Therefore, several runs of this scenario were required before the final version was tested.

As the future responsibility for control of the Hannover UIR had not been decided at the time of simulation, the German airspace above FL295 was simulated as a single entity consisting of the airspace presently controlled by Rhein UAC and the Hannover UIR of Maastricht UAC. However, the Maastricht Coastal sector remained over northern Germany but was realigned with the proposed sector boundaries of the Lübeck, Osnabrück and Elbe sectors.

5.2. TRAFFIC SAMPLE CHANGES (V3/RVSM ORG. - 1997 TRAFFIC)

Applying the ARN v3 resulted in different routes for virtually every aircraft. Some flights were no longer in the core area under v3 or because of changes to the military areas and these flights (311 GAT + 3 OAT) were removed. The new sample simulated consisted of:

- GAT plus military traffic flying as GAT: 8703
- Military OAT traffic: 154
- Total traffic: 8857

5.3. APPLICATION OF RVSM LEVELS (V3/RVSM ORG. – 1997 TRAFFIC)

After removing the 226 GAT flying between FL310 and FL410 in the reference scenario that no longer entered the core area under ARN v3, the non-RVSM levels were changed to RVSM levels in the following manner:

- All affected aircraft were examined and adjusted for their correct RVSM levels according to the ARN v3 routes flown. Where required, adjustments were made to a higher level. OAT aircraft were left at non-RVSM levels.

- The numbers of aircraft at the new RVSM level pairs (FL300/FL320, FL310/FL330, etc.) were then readjusted to ensure that their combined total of flights was in the same proportion to the total number of flights as their related non-RVSM level was in the reference scenario, e.g. the combined total for FL340 and FL360 was in the same proportion to the total number of flights as FL350 was before. The flights were then distributed randomly 50-50 within each level pair. Further level adjustments were made to ensure that no conflict existed at the new simulation entry points.

The following table and figure show the final outcome of the change to RVSM levels. The difference of approximately 100 aircraft between the non-RVSM and the RVSM totals (2439 to 2546 for the even levels and 2168 to 2066 for the odd levels) is due to the removal of opposite direction levels flown in the reference scenario because of the various flight level allocation systems in use.

Non-RVSM FL	Flights	% of Total	RVSM FL	Flights	FL Pair Flights	% of Total
FL310	1019	42%	**FL300**	499	1010	40%
			FL320	511		
FL350	1260	52%	**FL340**	647	1282	50%
			FL360	635		
FL390	160	7%	**FL380**	141	254	10%
			FL400	113		
TOTAL	**2439**	**100%**			**2546**	**100%**
FL330	1375	63%	**FL310**	677	1348	65%
			FL330	671		
FL370	765	35%	**FL350**	343	687	33%
			FL370	344		
FL410	28	1%	**FL390**	17	31	2%
			FL410	14		
TOTAL	**2168**	**100%**			**2066**	**100%**

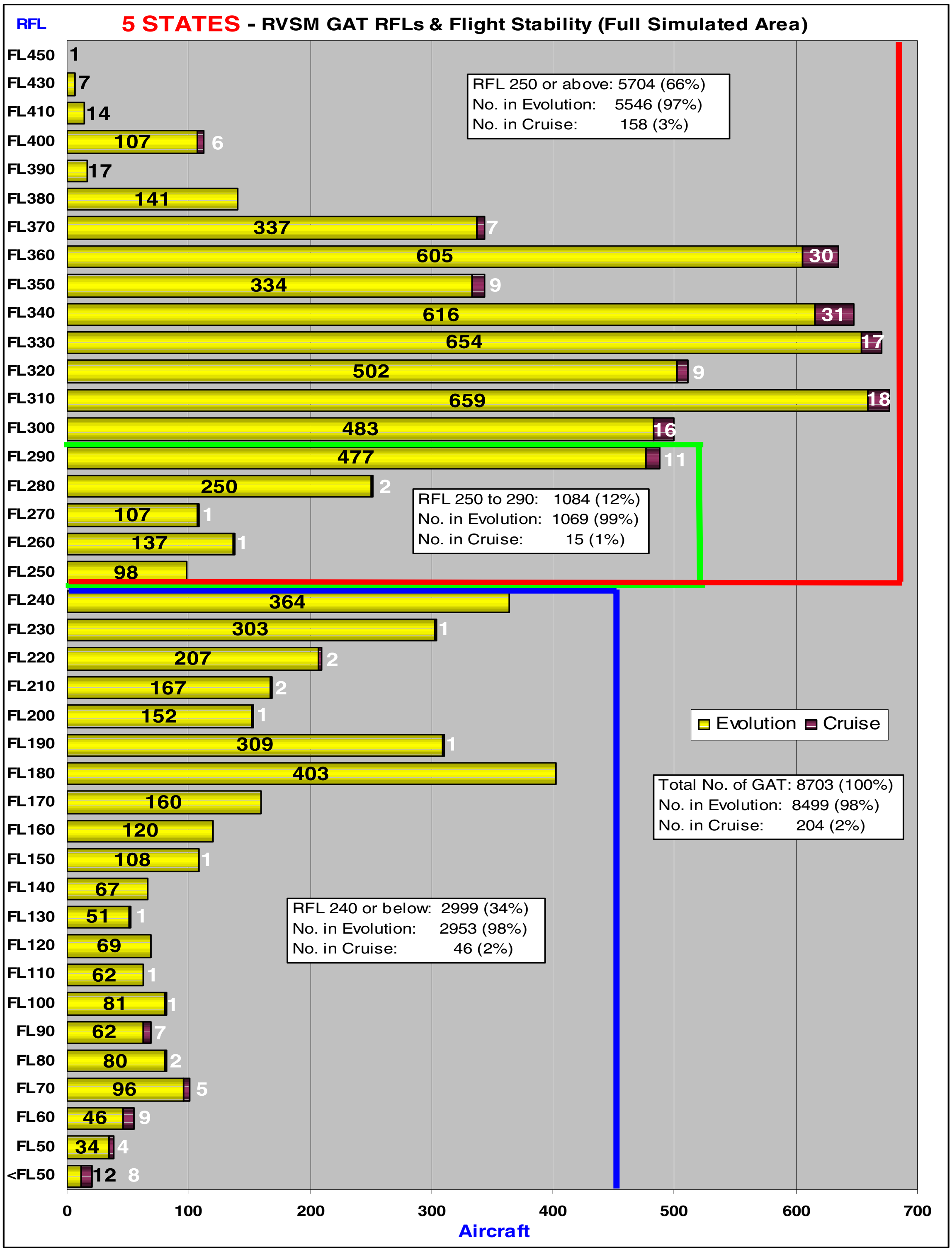

Figure 8: RVSM GAT cruising levels and flight stability for the complete simulated area

There was an imbalance created as a result of distributing the traffic proportionately, quite noticeable at FL350, FL360 and FL370. This resulted from having to fill the RVSM levels from an existing level allocation, which, although operationally realistic, was mathematically disproportionate to begin with.

Another contributory factor was the way that the new even and odd RVSM levels were populated. Flights which were at an even non-RVSM level were moved either up or down 1000', whereas those at odd non-RVSM levels either stayed where they were or were moved down 2000'. Reversing the direction of movement for the odd non-RVSM levels would have had an adverse effect on the numbers of aircraft at FL290 as these aircraft would have had to be used to populate FL310 in RVSM.

5.4. LEVEL CONSTRAINTS (V3/RVSM ORG. - 1997 TRAFFIC)

With the complete reorganisation of the airspace it was necessary to redefine the level constraints that would be required to ensure efficient sector profiles. This was done by simulating the traffic with no level constraints and examining the resultant profiles with the working group. From this it was possible to define both the level constraints and skip sector procedures that would be required in the new airspace structure. The following tables give the new departure and arrival constraints applied:

MAIN DEPARTURE LEVEL CONSTRAINTS – V3/RVSM Org.					
Departure	**MaxFL**	**To Point**	**Point Location**	**Route Segment**	**Comments**
EBAW	230	MEDIL	CanWL/ParTB bdy	CIV-KOVIN	
EBBR	190	BRCOA	CanWH/NL bdy	HELEN-COA	Avoid CanWH
	230	MEDIL	CanWL/ParTB bdy	CIV-KOVIN	
	290	ROUSY	CanSH/ReiUE bdy	NORPA-GTQ	Avoid MasLUX
EBLG	260	MEDIL	CanCH/ParTB bdy	CIV-KOVIN	Avoid MasWST
EBOS	230	MEDIL	CanWL/ParTB bdy	CIV-KOVIN	
	290	ROUSY	CanSH/ReiUE bdy	NORPA-GTQ	Avoid MasLUX
EDDK	140	DKALF	DüsCOL/FraALFAS bdy	COL-ALFAS	Avoid DusCOL
EDDL	290	BRUSE	~MasLNO/MasLUX bdy	LNO-NORPA	Avoid MasLNO
LonTMA	290	KONAN	LATCC/CanWH bdy	DVR-KOK	
EHAM	290	ELDIN	AmsSec5/LATCC bdy	UNIDO-ELDIN	Avoid MasDLT
	290	TOPPA	AmsSec5/LATCC bdy	UNIDO-TOPPA	Avoid MasDLT
	290	ARKOS	AmsSec2O/DüsBOT bdy	ARKON-CROSS	Avoid MasDLT
EHRD	290	TOPPA	AmsSec5/LATCC bdy	UNIDO-TOPPA	Avoid MasDLT
ParTMA	260	GUBAR	ParTN/LATCC bdy	OPALE-GUBAR	Avoid ReiUN
	260	SOVAT	ParTN/LATCC bdy	AMOGA-SOVAT	Avoid ReiUN

There were 16 departure level constraints required and 10 of these concerned restrictions to keep aircraft below the upper sectors. This compares with 18 out of 19 restrictions for the 1997 reference organisation. The number of aircraft affected by these 10 restrictions was 204 (11% of the total departures from the relevant airports), as opposed to 556 (23%) for the reference organisation.

MAIN ARRIVAL LEVEL CONSTRAINTS – V3/RVSM Org.					
Arrival	**By Point**	**MaxFL**	**Point Location**	**Route Segment**	**Comments**
EBAW	GOEEL	310	Bremen/Amsterdam bdy	GOLEN-EEL	
	JUEEL	310	Bremen/Amsterdam bdy	JUIST-EEL	
	SUSET	260	50nm NE of WOODY	LILSI-BATAK	
	PERON	260	22nm SW of CMB	EVX-CMB	
EBBR	BLUFA	330	LATCC/MasDLT bdy	BLUFA-MONIL	Avoid MasDLTH
	TOPPA	330	LATCC/MasDLT bdy	TOPPA-MONIL	Avoid MasDLTH
	GOEEL	310	Bremen/Amsterdam bdy	GOLEN-EEL	
	JUEEL	310	Bremen/Amsterdam bdy	JUIST-EEL	
	SUSET	260	50nm NE of WOODY	LILSI-BATAK	
	WOODY	190	AmsSec3S/CanNL bdy	WOODY-NIK	Avoid CanCH
	AACHE	180	DüsNOR/CanEL bdy	BRUDE-GOTIL	Avoid CanEH
	PILBA	240	FraSAAR-H/CanEH bdy	PILUM-BATTY	
	BATTY	200		BATTY-FLORA	
	IBERA	290	ReiUE/MasLUX bdy	SORAL-DIK	Avoid MasLUX
	DIK	250		DIK-BATTY	
	BELDI	260	26nm SW of CMB	EVX-RODRI	
	NURMO	260	28nm SW of CMB	MTD-CMB	
	ARVOL	180	ParTB/CanWH bdy	Evx/Mtd-RODRI	Avoid CanWH
	KRKBN	90	CanWL/NL bdy	KERKY-BUN	Avoid CanNL
EBCI	DIK	250		DIK-LNO	
	BKCIA	190	CanSL/EL bdy	DIK-LNO	Avoid CanEH
EBOS	GOEEL	310	Bremen/Amsterdam bdy	GOLEN-EEL	
	JUEEL	310	Bremen/Amsterdam bdy	JUIST-EEL	
	SUSET	260	50nm NE of WOODY	LILSI-BATAK	
	WOODY	190	AmsSec3S/CanNL bdy	WOODY-NIK	Avoid CanCH
	NURMO	260	28nm SW of CMB	DIDOR-CMB	
	ADUTO	190	ParTB/CanWH bdy	CMB-FERDI	Avoid CanWH
EDDF	REIDF	290	ReiUR/MasLUX bdy	MEDOX-LUXIE	Avoid MasLUX
	LUXDF	250	CanSH/FraSAAR-H bdy	LUXIE-IDARO	
	REMBA	290	~MasWST/LUX bdy	REMBA-IDARO	Avoid MasLUX
	BRUDF	250	CanSH/FraSAAR-H bdy	REMBA-IDARO	
	KIRDF	110	FraSAAR-L/MAIN bdy	KIR-RUDEL	Avoid FraMAIN
	ALBIE	290	~München/GerFKN bdy	LUKAS-WOLFI	Avoid GerFKN
EDDK	REIDF	290	ReiUR/MasLUX bdy	MEDOX-LUXIE	Avoid MasLUX
	IBERA	290	ReiUE/MasLUX bdy	SORAL-LUXIE	Avoid MasLUX
	VOGEL	190	~CanEH/DüsNOR bdy	LUXIE-NOR	
	DKDLA	190	CanEH/DüsNOR bdy	SPI-NOR	
	DURIN	140	~DüsGMH/COL bdy	CROSS-WYP	Avoid DüsCOL
	DUSEL	140	~DüsGMH/COL bdy	WRB/Arkol-WYP	Avoid DüsCOL
EDDL	REIDF	290	ReiUR/MasLUX bdy	MEDOX-LUXIE	Avoid MasLUX
	KOSIT	290	ReiUE/MasLUX bdy	SORAL-VOGEL	Avoid MasLUX
	VOGEL	250	~CanEH/DüsNOR bdy	KOSIT-NOR	
	GABAD	290	~LATCC/MasDLT bdy	CLN-ARNEM	Avoid MasDLT
	8EPAM	290	8nm SE of PAM	PAM-ARNEM	
	DKDLA	230	CanEH/DüsNOR bdy	SPI-NOR	
EDLN	BULUX	190	~CanSH/EH bdy	Bulux-SPI-NOR	Avoid CanEH
	DKDLA	110	CanEL/DüsTMA bdy	SPI-NOR	
EGKK/GW/SS/KB/LC	GORLN	270	5nm W GORLO	SPY-REFSO	
	GORLS	270	4nm S GORLO	ARNEM-REFSO	
	15WCOA	270	15nm W of COA	COA-LOGAN	
	BULAM	270	35nm WNW of DENUT	DENUT-REPLO	
EGLL/WU/LF	GORLN	Odd FL	5nm W GORLO	SPY-REFSO	Max FL370
	GORLS	Odd FL	4nm S GORLO	ARNEM-REFSO	Max FL370
	15WCOA	Odd FL	15nm W of COA	COA-LOGAN	Max FL370

MAIN ARRIVAL LEVEL CONSTRAINTS – V3/RVSM Org. (continued)					
Arrival	**By Point**	**MaxFL**	**Point Location**	**Route Segment**	**Comments**
EHAM	REDFA	290	LATCC/MasDLT bdy	REDFA-SUGOL	Avoid MasDLT
	ADUTO	290	ReiUN/MasWST bdy	CMB-FERDI	Avoid MasWST
	DENUT	200		FERDI-HSD	
	REMBA	280	~MasLUX/WST bdy	DIK-BUB	Avoid MasWST
	HELEN	200		BUB-HSD	
	BEDUM	260	12nm NW of EEL	GREFI-EEL	
	DHEEL	260	BreWESR/AmsSec1 bdy	EDDH-EEL	
	GOEEL	260	BreSWIG/AmsSec1 bdy	GOLEN-EEL	
	JUEEL	260	BreSWIG/AmsSec1 bdy	JUIST-EEL	
	STEEL	260	BreWESR/AmsSec1 bdy	STADE-EEL	
	NORKU	240	DüsHMM/AmsSec2I bdy	AMSAN-ROBIS	
EHBK	DENIN	280	~ReiUN/MasWST bdy	CMB-CIV	Avoid MasWST
	IBERA	290	ReiUE/MasLUX bdy	SORAL-DIK	Avoid MasLUX
	DIK	250		DIK-LNO	
	BKCIA	190	CanSL/EL bdy	DIK-LNO	Avoid CanEH
	BULUX	190	~CanSH/EH bdy	Bulux-SPI-LNO	Avoid CanEH
	PILBA	180	FraSAAR-L/CanEL bdy	PILUM-BATTY	Avoid CanEH
EHEH	BLUFA	290	LATCC/MasDLT bdy	BLUFA-HSD	Avoid MasDLT
	ADUTO	290	ReiUN/MasWST bdy	CMB-FERDI	Avoid MasWST
	DENUT	190		DENUT-ALINA	
	HELEN	190		HELEN-ALINA	
	RDEHA	160	CanNL/AmsSec3N bdy	HELEN-ALINA	
	METRO	90	AmsSec2O/Sec3S bdy	RKN-EHN	Avoid AmsSec3S
EHRD	BLUFA	290	LATCC/MasDLT bdy	BLUFA-HSD	Avoid MasDLT
ELLX	REMBA	290	~MasWST/LNO bdy	REMBA-SPI	Avoid MasLNO
	LNOLX	190	CanSH/EH bdy	DEN-LNO	Avoid CanEH
	RUWER	130	FraSAARL/LuxTMA bdy	RUWER-DIK	Avoid CanSL
ParTMA	PARIN	290	CanSH/ReiUR bdy	SUDOL-RAPOR	Avoid ReiXR
	XERAM	260	18nm N of REM	RAPOR-LORTA	
	GIMER	260	4nm N of REM	RAPOR-VILER	
	WOODY	290	MasDLT/MasWST bdy	WOODY-NIK	Avoid MasWST
	PAREX	290	10nm ENE of CIV	HORTA-MOPIL	
	CANPG	260	CanCH/ReiUR bdy	Nik/Den-MOPIL	Avoid ReiUR
LFSB	GTQLX	330	8nm NNW of GTQ	DIK-GTQ	
	LULSB	190	ReiUF/UH bdy	MANAG-LUL	Avoid ReiUH
	PARSB	190	ReiUF/UH bdy	PILON-LUL	Avoid ReiUH
LFST	ROUSY	170	CanSL/MetzTMA bdy	NORPA-GTQ	

The number of arrival level constraints was reduced from 118 in the reference organisation to 91 in the V3/RVSM organisation, and the constraints to keep aircraft below the upper sectors was similarly reduced from 37 to 21. The number of aircraft affected by the upper sector restrictions was 557 (20% of the total arrival traffic to the associated airports), as compared to 773 (26%) for the reference organisation.

5.5. OVERVIEW OF THE RESULTS (V3/RVSM ORG. - 1997 TRAFFIC)

In the following summary results for each ACC/UAC, only the en route sectors have been included in the figures. For Germany Upper, no comparison is made with the Rhein UAC and for Maastricht the comparison is made for the Amsterdam and Brussels sectors only.

Differences (preceded by +/-) or direct comparisons between this organisation and the 1997 reference are shown in green. The 1997 organisation values for Düsseldorf only include those aircraft above FL145 in order to enable a like-with-like comparison.

ACC/UAC (no. of sectors)	Individual flights through ACC/UAC (24 hrs)	Average flights per sector (24 hrs)	Average en route sectors used per flight	Average work per aircraft (seconds)	Number of conflicts (24 hrs)	Individual aircraft in conflict (% of flights)
Amsterdam (8) (5)	1622 +99 (+7%)	262 (-29%)	1.3 (1.2)	47” (47”)	161 (-26%)	249 (15%) 330 (22%)
Bremen (6) (9)	1581 +281 (+22%)	432 (+48%)	1.6 (1.5)	51” (56”)	136 (-17%)	223 (14%) 267 (21%)
CANAC (8) (6)	2288 +527 (+30%)	488 (+4%)	1.7 (1.6)	65” (61”)	432 (+27%)	601 (26%) 436 (25%)
Düsseldorf (7) (7)	1682 +262 (+18%)	352 (+9%)	1.5 (1.6)	50” (n/a)	182 (+8%)	264 (16%) 255 (18%)
Frankfurt (19) (18)	3047 +363 (+14%)	414 (+38%)	2.6 (2.0)	88” (78”)	613 (-15%)	721 (24%) 963 (36%)
Germany Upper (15)	2444	404	2.5	88”	377	539 (22%)
Luxembourg (1) (1)	172 +12 (+8%)	172 (+8%)	1.0 (1.0)	37” (35”)	22 (+120%)	31 (18%) 19 (12%)
Maastricht (8) (6) AMS/BRU only	1582 -780 (-33%)	356 (-46%)	1.8 (1.7)	59” (67”)	164 (-73%)	271 (17%) 853 (32%)
Paris (5) (4)	1073 -27 (-2%)	258 (-18%)	1.2 (1.1)	43” (40”)	70 (+0%)	122 (11%) 124 (11%)
Reims (11) (10)	1862 -171 (-8%)	335 (-13%)	2.0 (1.9)	72” (72”)	280 (-40%)	428 (23%) 628 (31%)

The following table shows for the en route core sectors the number of radar conflicts occurring above and below FL295 and in the level band concerned with the change of DFL. The 1997 figures exclude the 97 conflicts in Düsseldorf below FL145.

RADAR CONFLICTS IN THE EN ROUTE CORE SECTORS			
Airspace	**Conflicts v3/RVSM**	**Conflicts 1997 Org**	**% Change**
Above FL295	735	1783	-59%
Below FL295	1702	2226	-24%
Between FL245 and FL295	494	499	-1%
All Levels	2437	4009	-39%

This organisation produced very promising results. Only one sector, CANAC South High, experienced a severe loading and 14 others returned a heavy loading over three hours. This amounted to 17% of the 88 core sectors, as compared to 32% before.

Compared to the 1997 organisation, the combination of ARN v3 and RVSM led to a reduction of 40% in the total number of conflicts in the core area, with a reduction of 60% in the number above FL295 and 25% below FL295. However, in the airspace between FL245 and FL295 the number of conflicts remained virtually the same.

5.6. SECTOR RESULTS (V3/RVSM ORG. - 1997 TRAFFIC)

Note: Sectors with a "severe" loading (50% + over 3 hours) are marked in red.
Sectors with a "heavy" loading (40% to 49% + over 3 hours) are marked in blue.

Busiest Morning 3-hr Period					A/C 24hrs		Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	Skip	Sector	Period	Work'	% Load	Type
AMS_SEC1	05:20-08:20	37	21%		271	5	AMS_SEC1	15:20-18:20	47.75	27%	
AMS_SEC2I	04:20-07:20	33.75	19%		159	5	AMS_SEC2I	15:20-18:20	25.5	14%	
AMS_SEC2O	06:30-09:30	54.5	30%		358	8	AMS_SEC2O	16:20-19:20	41.92	23%	
AMS_SEC3N	05:30-08:30	34.58	19%		224	32	AMS_SEC3N	14:40-17:40	36.75	20%	
AMS_SEC3S	05:40-08:40	52.5	29%		256	28	AMS_SEC3S	15:10-18:10	51.75	29%	
AMS_SEC4E	06:00-09:00	33.67	19%		179	109	AMS_SEC4E	13:50-16:50	29.58	16%	
AMS_SEC4W	05:30-08:30	30.5	17%		207	11	AMS_SEC4W	15:10-18:10	31	17%	
AMS_SEC5	07:50-10:50	38.92	22%		232	4	AMS_SEC5	15:20-18:20	23.42	13%	
BRE_KASL	05:00-08:00	42.58	24%		387	44	BRE_KASL	14:50-17:50	59.25	33%	
BRE_LEIN	**06:10-09:10**	**71.42**	**40%**	**Heavy**	492	32	BRE_LEIN	16:00-19:00	60.5	34%	
BRE_LUNE	07:40-10:40	37.5	21%		289	3	BRE_LUNE	14:00-17:00	41.25	23%	
BRE_SWIG	07:00-10:00	36.83	20%		310	131	BRE_SWIG	15:40-18:40	43.75	24%	
BRE_TEUT	06:30-09:30	40.08	22%		347	87	BRE_TEUT	12:50-15:50	38.75	22%	
BRE_WESR	04:50-07:50	64.17	36%		455	5	BRE_WESR	15:40-18:40	63.17	35%	
CAN_CH	**05:40-08:40**	**74**	**41%**	**Heavy**	377	41	CAN_CH	15:10-18:10	68.58	38%	
CAN_EH	**07:20-10:20**	**83.83**	**47%**	**Heavy**	621	57	**CAN_EH**	**13:00-16:00**	**75.92**	**42%**	**Heavy**
CAN_EL	06:00-09:00	49.08	27%		322	97	CAN_EL	13:20-16:20	55.92	31%	
CAN_NL	06:00-09:00	71	39%		366	30	CAN_NL	15:50-18:50	70	39%	
CAN_SH	**06:00-09:00**	**93.33**	**52%**	**Severe**	487	58	**CAN_SH**	**17:30-20:30**	**77**	**43%**	**Heavy**
CAN_SL	07:20-10:20	53.92	30%		393	80	CAN_SL	15:20-18:20	51.17	28%	
CAN_WH	08:50-11:50	68.25	38%		443	99	CAN_WH	19:20-22:20	60.08	33%	
CAN_WL	05:30-08:30	57.25	32%		388	37	CAN_WL	16:10-19:10	62.5	35%	
LUX_APP	07:30-10:30	25.5	14%		169	3	LUX_APP	14:20-17:20	28.5	16%	
DUS_BOT	07:00-10:00	59.42	33%		456	46	DUS_BOT	12:00-15:00	51.08	28%	
DUS_COL	07:00-10:00	33.42	19%		231	50	DUS_COL	12:10-15:10	24.75	14%	
DUS_DOM	05:50-08:50	29.58	16%		232	1	DUS_DOM	14:30-17:30	29.67	16%	
DUS_GIX	07:10-10:10	27.83	15%		223	2	DUS_GIX	15:30-18:30	22.42	12%	
DUS_GMH	**05:40-08:40**	**82.83**	**46%**	**Heavy**	517		**DUS_GMH**	**13:40-16:40**	**74.17**	**41%**	**Heavy**
DUS_HMM	05:00-08:00	48.33	27%		368	25	DUS_HMM	14:50-17:50	45.5	25%	
DUS_NOR	07:40-10:40	32.33	18%		307	2	DUS_NOR	16:40-19:40	32.42	18%	
FRA_ALFAS	**05:30-08:30**	**75.08**	**42%**	**Heavy**	508		FRA_ALFAS	13:20-16:20	60.5	34%	
FRA_BADEN	**07:00-10:00**	**75.42**	**42%**	**Heavy**	510	1	FRA_BADEN	14:00-17:00	67.17	37%	
FRA_BERLI	05:40-08:40	28.92	16%		261		FRA_BERLI	15:30-18:30	34.17	19%	
FRA_BODN1	05:50-08:50	44.25	25%		325		FRA_BODN1	14:40-17:40	47.33	26%	
FRA_BODN2	07:20-10:20	39.75	22%		316		FRA_BODN2	12:40-15:40	33.83	19%	
FRA_DINKL	**07:20-10:20**	**77.08**	**43%**	**Heavy**	610		FRA_DINKL	15:10-18:10	55.25	31%	
FRA_EMILE	07:00-10:00	32.75	18%		204		FRA_EMILE	12:30-15:30	25.25	14%	
FRA_GEDH	05:00-08:00	45.42	25%		370		FRA_GEDH	15:40-18:40	47	26%	
FRA_GEDL	05:00-08:00	37.42	21%		306		FRA_GEDL	15:30-18:30	46.67	26%	
FRA_MAINE	05:50-08:50	62.67	35%		632	163	FRA_MAINE	13:10-16:10	68.17	38%	
FRA_ODENN	**05:10-08:10**	**78.17**	**43%**	**Heavy**	563		FRA_ODENN	15:00-18:00	68.25	38%	
FRA_PSAH	05:10-08:10	36.42	20%		316	2	FRA_PSAH	16:30-19:30	36.92	21%	
FRA_PSAL	05:00-08:00	57.75	32%		408		FRA_PSAL	15:20-18:20	60	33%	
FRA_REGEN	05:00-08:00	65.25	36%		557		FRA_REGEN	15:00-18:00	70.67	39%	
FRA_RHOEN	**04:50-07:50**	**74.75**	**42%**	**Heavy**	575		**FRA_RHOEN**	**15:10-18:10**	**73.75**	**41%**	**Heavy**
FRA_SAARH	07:30-10:30	66.5	37%		470	10	FRA_SAARH	13:40-16:40	54.5	30%	
FRA_SAARL	07:30-10:30	44.58	25%		363	5	FRA_SAARL	12:00-15:00	37	21%	
FRA_SAARS	07:30-10:30	16	9%		114	2	FRA_SAARS	12:40-15:40	13.58	8%	
FRA_TAUNS	07:10-10:10	29.25	16%		212		FRA_TAUNS	12:10-15:10	16	9%	

Note: Sectors with a "severe" loading (50% + over 3 hours) are marked in red. Sectors with a "heavy" loading (40% to 49% + over 3 hours) are marked in blue.											
Busiest Morning 3-hr Period					A/C 24hrs		Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	Skip	Sector	Period	Work'	% Load	Type
GER_FKN	**07:40-10:40**	**83**	**46%**	**Heavy**	590		GER_FKN	13:40-16:40	63.83	35%	
GER_GRF	07:40-10:40	65.83	37%		483		GER_GRF	13:40-16:40	54.42	30%	
GER_HAN	**07:30-10:30**	**72.08**	**40%**	**Heavy**	503		GER_HAN	16:20-19:20	59.33	33%	
GER_KRH	08:00-11:00	58.33	32%		507		GER_KRH	12:20-15:20	56.5	31%	
GER_LUB	07:00-10:00	15.67	9%		117	1	GER_LUB	16:20-19:20	18.5	10%	
GER_MSLN	07:10-10:10	51.75	29%		310	1	GER_MSLN	12:10-15:10	42.17	23%	
GER_MSLS	08:30-11:30	46.33	26%		383	33	GER_MSLS	12:00-15:00	40.67	23%	
GER_OSN	09:00-12:00	60.5	34%		457	5	GER_OSN	14:20-17:20	54.5	30%	
GER_WRB	08:30-11:30	70.42	39%		587		**GER_WRB**	**13:20-16:20**	**73.67**	**41%**	**Heavy**
GER_ELBH	05:50-08:50	48.5	27%		362		GER_ELBH	15:30-18:30	44.75	25%	
GER_FKNH	08:40-11:40	44	24%		331		GER_FKNH	15:40-18:40	37.25	21%	
GER_GRFH	08:40-11:40	54.33	30%		447		GER_GRFH	15:40-18:40	51.92	29%	
GER_HANH	08:50-11:50	33.5	19%		301		GER_HANH	14:00-17:00	32.33	18%	
GER_KRHH	05:40-08:40	30.42	17%		247		GER_KRHH	15:10-18:10	31.92	18%	
GER_MSLH	08:20-11:20	48.67	27%		379		GER_MSLH	12:30-15:30	40.08	22%	
MAS_CST	05:50-08:50	29.75	17%		199	93	MAS_CST	13:00-16:00	32.92	18%	
MAS_DLT	08:10-11:10	31.25	17%		246	119	MAS_DLT	14:10-17:10	29.25	16%	
MAS_LNO	09:00-12:00	34.92	19%		263	84	MAS_LNO	17:10-20:10	25.5	14%	
MAS_LUX	08:00-11:00	36	20%		256	2	MAS_LUX	14:50-17:50	30.25	17%	
MAS_WST	**08:50-11:50**	**75.67**	**42%**	**Heavy**	549	17	MAS_WST	17:10-20:10	61.5	34%	
MAS_CSTH	05:30-08:30	28.5	16%		205	56	MAS_CSTH	13:10-16:10	29.42	16%	
MAS_DLTH	07:20-10:20	39.67	22%		289	6	MAS_DLTH	14:00-17:00	40.17	22%	
MAS_WSTH	09:00-12:00	67.75	38%		443	4	MAS_WSTH	15:20-18:20	50.08	28%	
PAR_TB	06:10-09:10	49.92	28%		392		PAR_TB	16:00-19:00	64.25	36%	
PAR_TE	05:40-08:40	49.58	28%		264		PAR_TE	14:20-17:20	47.83	27%	
PAR_TL	04:50-07:50	27.58	15%		267		PAR_TL	16:50-19:50	30.08	17%	
PAR_TM	05:30-08:30	22.17	12%		187		PAR_TM	16:10-19:10	23	13%	
PAR_TN	05:50-08:50	24	13%		176		PAR_TN	17:30-20:30	24.92	14%	
REI_E	05:20-08:20	49.33	27%		299	2	REI_E	13:40-16:40	46.92	26%	
REI_SE	05:00-08:00	48.5	27%		277	12	REI_SE	16:10-19:10	38.25	21%	
REI_UE	**08:30-11:30**	**78.17**	**43%**	**Heavy**	575	7	**REI_UE**	**15:10-18:10**	**73.92**	**41%**	**Heavy**
REI_UF	08:30-11:30	34.75	19%		271		REI_UF	17:00-20:00	32.75	18%	
REI_UH	07:50-10:50	59.5	33%		412	5	REI_UH	15:10-18:10	52.83	29%	
REI_UN	08:50-11:50	39.92	22%		298		REI_UN	15:50-18:50	38.25	21%	
REI_UR	07:50-10:50	33.83	19%		296	3	REI_UR	15:50-18:50	32.25	18%	
REI_UY	09:00-12:00	29.17	16%		250	1	REI_UY	12:00-15:00	25	14%	
REI_XH	08:20-11:20	34.83	19%		275		REI_XH	16:10-19:10	29.08	16%	
REI_XN	09:00-12:00	45.67	25%		318	1	REI_XN	13:50-16:50	41.17	23%	
REI_XR	09:00-12:00	47.67	26%		377	1	REI_XR	12:30-15:30	42.42	24%	

5.7. SEVERELY LOADED SECTOR (V3/RVSM ORG. - 1997 TRAFFIC)

CANAC South High (CAN_SH) – FL245 to FL295								
Period	Controlled Flights Entering				Skip	Main Flow(s)	Conflicts	Acft. In Conflict
	Tot	Crse	Clmb	Desc				
06:00-09:00 (52%) Ave: 5 a/c Max: 10 a/c	106	41 (39%)	8 (7%)	57 (54%)	22	Frankfurt TMA arrs (26%) London TMA deps (21%)	27	37 (35%)
	Comments 10 of the skipped aircraft were OAT crossers and 9 were Amsterdam arrivals going from the Luxembourg sector to the Central High sector. The Frankfurt TMA arrivals were the most prominent conflict group with 40% of all conflicts involving one of these aircraft. 85% of all conflicts occurred at FL280 or above, and most were recorded between DIK and SORAL							

6. RESULTS – V3/RVSM – 2005 TRAFFIC

6.1. DESCRIPTION OF THE V3/RVSM 2005 TRAFFIC ORGANISATION

All that was contained in the previous organisation was carried over to this organisation, with the exception of an enhanced traffic sample. The STATFOR unit of Eurocontrol increased the 1997 traffic sample to 2005 traffic levels using economic indicators to determine the growth. This resulted in an increase of 51% in the sample.

6.2. ANALYSIS OF THE 2005 TRAFFIC SAMPLE

The following table lists all the core area airports with at least 50 arrivals and departures during the 24 hours of the 12th September 1997. The increase applied to each airport is shown in the middle section of the table.

Original 1997 Sample				Increase						Future 2005 Sample		
Airport	**Dep**	**Arr**	**Total**	**Dep**	**% Inc**	**Arr**	**% Inc**	**Total**	**% Inc**	**Dep**	**Arr**	**Total**
EBBR	420	444	864	211	**50%**	218	**49%**	429	**50%**	631	662	1293
EBFS	42	42	84	6	**14%**	6	**14%**	12	**14%**	48	48	96
EBAW	29	27	56	16	**55%**	14	**52%**	30	**54%**	45	41	86
EDDF	620	609	1229	57	**9%**	51	**8%**	108	**9%**	677	660	1337
EDDL	319	310	629	203	**64%**	220	**71%**	423	**67%**	522	530	1052
EDDK	286	267	553	128	**45%**	135	**51%**	263	**48%**	414	402	816
EDDH	243	245	488	130	**53%**	137	**56%**	267	**55%**	373	382	755
EDDS	213	211	424	129	**61%**	126	**60%**	255	**60%**	342	337	679
EDDV	174	172	346	124	**71%**	122	**71%**	246	**71%**	298	294	592
EDDN	107	79	186	68	**64%**	55	**70%**	123	**66%**	175	134	309
EDDW	60	57	117	58	**97%**	42	**74%**	100	**85%**	118	99	217
EDDG	49	47	96	19	**39%**	23	**49%**	42	**44%**	68	70	138
ETAR	43	42	85	40	**93%**	42	**100%**	82	**96%**	83	84	167
EDLW	40	43	83	36	**90%**	33	**77%**	69	**83%**	76	76	152
EDLP	33	32	65	28	**85%**	28	**88%**	56	**86%**	61	60	121
EDDR	28	29	57	15	**54%**	17	**59%**	32	**56%**	43	46	89
EHAM	556	566	1122	292	**53%**	285	**50%**	577	**51%**	848	851	1699
EHRD	48	51	99	31	**65%**	24	**47%**	55	**56%**	79	75	154
EHBK	35	35	70	7	**20%**	12	**34%**	19	**27%**	42	47	89
EHEH	38	32	70	13	**34%**	14	**44%**	27	**39%**	51	46	97
ELLX	75	84	159	54	**72%**	51	**61%**	105	**66%**	129	135	264
LFPG	357	252	609	83	**23%**	71	**28%**	154	**25%**	440	323	763
LFSB	84	86	170	26	**31%**	28	**33%**	54	**32%**	110	114	224
LFST	81	82	163	37	**46%**	39	**48%**	76	**47%**	118	121	239
LFPO	58	57	115	14	**24%**	6	**11%**	20	**17%**	72	63	135
LFQQ	47	47	94	20	**43%**	19	**40%**	39	**41%**	67	66	133

The next table shows the increases in the various flows to and from the core area States. The flow names are those used by STATFOR, so "Frankfurt" means EDDF only, while "Rest of Germany" means all airports except Frankfurt. Similarly, "Rest of France" means all airports except LFPB, LFPG and LFPO (Paris TMA) and "Rest of UK" means all UK airports except EGGW, EGKK, EGLL and EGSS (London TMA). The flows do not differentiate between arrivals and departures, and only those flows with at least 10 flights in 2005 are shown individually (flows with less than 10 are grouped in "Other Flows").

BELGIUM

To & From	1997	2005	Inc	% Inc
AUSTRIA	9	13	4	44%
BELGIUM	64	72	8	13%
DENMARK	16	25	9	56%
FRANKFURT	10	11	1	10%
GREECE	9	12	3	33%
ITALY	37	52	15	41%
LONDON TMA	50	64	14	28%
NETHERLANDS	23	33	10	43%
NORTH AMERICA	14	19	5	36%
PARIS TMA	15	17	2	13%
PORTUGAL	8	12	4	50%
REST OF AFRICA	6	10	4	67%
REST OF FRANCE	58	91	33	57%
REST OF GERMANY	59	113	54	92%
REST OF UK	47	83	36	77%
SPAIN	30	44	14	47%
SWEDEN	18	24	6	33%
SWITZERLAND	16	21	5	31%
TURKEY	7	11	4	57%
Other Flows	68	115	47	69%
TOTAL	**564**	**842**	**278**	**49%**

FRANKFURT

To & From	1997	2005	Inc	% Inc
ASIA + AUSTRALIA	39	41	2	5%
AUSTRIA	29	30	1	3%
BALEARICS	10	11	1	10%
BELGIUM	10	11	1	10%
DENMARK	10	11	1	10%
GREECE	12	13	1	8%
ITALY	35	35	0	0%
LONDON TMA	27	28	1	4%
NETHERLANDS	9	10	1	11%
NORTH AMERICA	42	43	1	2%
PARIS TMA	15	17	2	13%
POLAND	10	11	1	10%
REST OF AMERICA	10	11	1	10%
REST OF FRANCE	17	18	1	6%
REST OF GERMANY	147	147	0	0%
REST OF UK	13	14	1	8%
RUSSIAN FEDERATION	10	11	1	10%
SPAIN	21	22	1	5%
SWEDEN	10	11	1	10%
SWITZERLAND	17	19	2	12%
TURKEY	30	31	1	3%
Other Flows	97	132	35	36%
TOTAL	**620**	**677**	**57**	**9%**

REST OF GERMANY

To & From	1997	2005	Inc	% Inc
AUSTRIA	60	98	38	63%
BALEARICS	95	167	72	76%
BELGIUM	60	113	53	88%
BOSNIA	9	14	5	56%
BULGARIA	11	17	6	55%
CANARY ISLANDS	17	33	16	94%
CROATIA	9	15	6	67%
CYPRUS	4	10	6	150%
CZECH REPUBLIC	23	39	16	70%
DENMARK	42	65	23	55%
FINLAND	8	13	5	63%
FRANKFURT	142	144	2	1%
GREECE	39	85	46	118%
HUNGARY	17	26	9	53%
IRELAND	6	12	6	100%
ITALY	59	127	68	115%
LONDON TMA	88	156	68	77%
LUXEMBOURG	10	22	12	120%
MALTA	4	10	6	150%
NETHERLANDS	85	159	74	87%
NORTH AMERICA	24	41	17	71%
NORWAY	12	20	8	67%
PARIS TMA	75	108	33	44%
POLAND	17	27	10	59%
PORTUGAL	7	13	6	86%
REST OF FRANCE	75	107	32	43%
REST OF GERMANY	1145	1732	587	51%
REST OF UK	72	129	57	79%
RUSSIAN FEDERATION	10	17	7	70%
SPAIN	45	83	38	84%
SWEDEN	20	31	11	55%
SWITZERLAND	76	123	47	62%
TUNISIA	23	54	31	135%
TURKEY	96	201	105	109%
Other Flows	29	62	33	114%
TOTAL	**2514**	**4073**	**1559**	**62%**

The NETHERLANDS

To & From	1997	2005	Inc	% Inc
ASIA + AUSTRALIA	28	50	22	79%
AUSTRIA	13	19	6	46%
BELGIUM	22	30	8	36%
CZECH REPUBLIC	8	12	4	50%
DENMARK	15	22	7	47%
FRANKFURT	9	10	1	11%
GREECE	21	31	10	48%
HUNGARY	8	12	4	50%
IRELAND	7	10	3	43%
ITALY	27	37	10	37%
LONDON TMA	74	94	20	27%
NETHERLANDS	92	119	27	29%
NORTH AMERICA	34	52	18	53%
NORWAY	12	17	5	42%
PARIS TMA	23	26	3	13%
PORTUGAL	14	20	6	43%
REST OF AFRICA	7	13	6	86%
REST OF AMERICA	8	14	6	75%
REST OF FRANCE	27	41	14	52%
REST OF GERMANY	77	148	71	92%
REST OF UK	90	156	66	73%
SPAIN	20	27	7	35%
SWEDEN	20	28	8	40%
SWITZERLAND	21	30	9	43%
TURKEY	12	15	3	25%
Other Flows	50	85	35	70%
TOTAL	**739**	**1118**	**379**	**51%**

LUXEMBOURG

To & From	1997	2005	Inc	% Inc
LONDON TMA	8	12	4	50%
REST OF GERMANY	11	20	9	82%
SWITZERLAND	8	12	4	50%
Other Flows	48	85	37	77%
TOTAL	**75**	**129**	**54**	**72%**

PARIS TMA

To & From	1997	2005	Inc	% Inc
ASIA + AUSTRALIA	32	33	1	3%
AUSTRIA	15	17	2	13%
BELGIUM	15	17	2	13%
DENMARK	12	14	2	17%
FRANKFURT	17	17	0	0%
IRELAND	9	11	2	22%
LONDON TMA	54	60	6	11%
NETHERLANDS	23	26	3	13%
REST OF FRANCE	57	61	4	7%
REST OF GERMANY	76	111	35	46%
REST OF UK	42	64	22	52%
SWEDEN	10	12	2	20%
SWITZERLAND	17	20	3	18%
Other Flows	66	88	22	33%
TOTAL	**445**	**551**	**106**	**24%**

REST OF FRANCE

To & From	1997	2005	Inc	% Inc
BELGIUM	61	88	27	44%
FRANKFURT	16	17	1	6%
LONDON TMA	33	37	4	12%
NETHERLANDS	26	40	14	54%
PARIS TMA	63	69	6	10%
REST OF FRANCE	258	377	119	46%
REST OF GERMANY	70	104	34	49%
REST OF UK	17	26	9	53%
Other Flows	32	59	27	84%
TOTAL	**576**	**817**	**241**	**42%**

6.3. OVERVIEW OF THE RESULTS (V3/RVSM ORG. - 2005 TRAFFIC)

Figures referring to the V3/RVSM 1997 traffic organisation are shown in green.

ACC/UAC (no. of sectors)	Individual flights through ACC/UAC (24 hrs)	Average flights per sector (24 hrs)	Average en route sectors used per flight	Average work per aircraft (seconds)	Number of conflicts (24 hrs)	Individual aircraft in conflict (% of flights)
Amsterdam (8)	2489 +867 (+53%)	405 (+55%)	1.3 (1.3)	51" (47")	375 (+133%)	575 (23%) 249 (15%)
Bremen (6)	2566 +985 (+62%)	693 (+60%)	1.6 (1.6)	55" (51")	339 (+149%)	514 (20%) 223 (14%)
CANAC (8)	3379 +1091 (+48%)	732 (+50%)	1.7 (1.7)	70" (65")	982 (+127%)	1202 (36%) 601 (26%)
Düsseldorf (7)	2679 +997 (+59%)	554 (+57%)	1.4 (1.5)	54" (50")	372 (+104%)	581 (22%) 264 (16%)
Frankfurt (19)	4389 +1342 (+44%)	585 (+41%)	2.5 (2.6)	92" (88")	901 (+47%)	1292 (29%) 721 (24%)
Germany Upper (15)	3777 +1333 (+55%)	639 (+58%)	2.5 (2.5)	95" (88")	980 (+160%)	1273 (34%) 539 (22%)
Luxembourg (1)	285 +113 (+66%)	285 (+66%)	1.0 (1.0)	35" (37")	55 (+150%)	83 (29%) 31 (18%)
Maastricht (8) AMS/BRU only	2414 +832 (+53%)	538 (+51%)	1.8 (1.8)	60" (59")	399 (+143%)	583 (24%) 271 (17%)
Paris (5)	1447 +374 (+35%)	354 (+37%)	1.2 (1.2)	45" (43")	124 (+77%)	209 (14%) 122 (11%)
Reims (11)	2745 +883 (+47%)	490 (+46%)	2.0 (2.0)	75" (72")	616 (+120%)	846 (31%) 428 (23%)

The following table shows the number of radar conflicts occurring above and below FL295 and in the level band concerned with the change of DFL.

RADAR CONFLICTS IN THE EN ROUTE CORE SECTORS			
Airspace	**Conflicts V3 2005**	**Conflicts V3 1997**	**% Change**
Above FL295	1807	735	+146%
Below FL295	3336	1702	+96%
Between FL245 and FL295	1018	494	+106%
All Levels	5143	2437	+111%

The promising results of the V3/RVSM 1997 traffic scenario were eclipsed by the increase to 2005 traffic levels and, overall, the results were worse than the 1997 reference organisation. Of the 88 core sectors, 46 (52%) were at least heavily loaded and 30 (34%) of these were severely loaded during their busiest three hours. Out of the 30 severely loaded sectors, 24 were sectors below FL295. In addition, 5 sectors were just below the severe workload threshold and 9 just below the heavy threshold. Radar conflicts increased by 150% above FL295 and 100% below FL295. Compared to the 1997 reference organisation, radar conflicts above FL295 showed a small increase of 1% but below FL295 they had increased by 50%.

These high loadings were undoubtedly influenced by a “bunching” effect (large numbers of aircraft arriving in the same place at roughly the same time and particularly noticeable with arrivals in the lower airspace) due to the 50% increase in the traffic. In reality, these streams would be smoothed out into more even flows. However, “bunching” does have less of an effect over a three-hour period than over shorter periods.

6.4. SECTOR RESULTS (V3/RVSM ORG. - 2005 TRAFFIC)

Note: Sectors with a "severe" loading (50% + over 3 hours) are marked in red.

Sectors with a "heavy" loading (40% to 49% + over 3 hours) are marked in blue.

Busiest Morning 3-hr Period					Tot Flights 24 Hours				Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	% Inc	Skip	% Inc	Sector	Period	Work'	% Load	Type
AMS_SEC1	05:30-08:30	58.67	33%		424	56%	9	80%	AMS_SEC1	15:00-18:00	73.25	41%	Heavy
AMS_SEC2I	05:30-08:30	46.5	26%		257	62%	7	40%	AMS_SEC2I	15:20-18:20	31.75	18%	
AMS_SEC2O	07:40-10:40	99.25	55%	Severe	599	67%	16	100%	AMS_SEC2O	12:40-15:40	97.92	54%	Severe
AMS_SEC3N	06:10-09:10	45.92	26%		320	43%	42	31%	AMS_SEC3N	15:20-18:20	49.42	27%	
AMS_SEC3S	05:40-08:40	71.17	40%	Heavy	364	42%	36	29%	AMS_SEC3S	15:10-18:10	74.33	41%	Heavy
AMS_SEC4E	06:20-09:20	50.58	28%		283	58%	159	46%	AMS_SEC4E	14:00-17:00	37.92	21%	
AMS_SEC4W	07:50-10:50	45.5	25%		308	49%	11		AMS_SEC4W	14:40-17:40	48.5	27%	
AMS_SEC5	07:40-10:40	60.25	33%		374	61%	8	100%	AMS_SEC5	12:40-15:40	45.17	25%	
BRE_KASL	08:20-11:20	65.5	36%		609	57%	53	20%	BRE_KASL	15:00-18:00	84.08	47%	Heavy
BRE_LEIN	06:20-09:20	113.17	63%	Severe	798	62%	50	56%	BRE_LEIN	16:00-19:00	114.25	63%	Severe
BRE_LUNE	07:50-10:50	62.33	35%		482	67%	6	100%	BRE_LUNE	14:10-17:10	79.5	44%	Heavy
BRE_SWIG	08:20-11:20	65.67	36%		510	65%	196	50%	BRE_SWIG	15:40-18:40	64.33	36%	
BRE_TEUT	06:30-09:30	60.67	34%		538	55%	144	66%	BRE_TEUT	14:00-17:00	69.42	39%	
BRE_WESR	06:10-09:10	94.58	53%	Severe	747	64%	8	60%	BRE_WESR	12:30-15:30	100.33	56%	Severe
CAN_CH	06:10-09:10	87	48%	Heavy	542	44%	47	15%	CAN_CH	15:10-18:10	94.58	53%	Severe
CAN_EH	08:50-11:50	145.83	81%	Severe	1046	68%	65	14%	CAN_EH	15:10-18:10	138.75	77%	Severe
CAN_EL	08:40-11:40	74.75	42%	Heavy	525	63%	140	44%	CAN_EL	15:30-18:30	83.17	46%	Heavy
CAN_NL	06:20-09:20	86.92	48%	Heavy	541	48%	42	40%	CAN_NL	15:40-18:40	91.75	51%	Severe
CAN_SH	06:10-09:10	117.83	65%	Severe	721	48%	71	22%	CAN_SH	17:30-20:30	101.17	56%	Severe
CAN_SL	07:10-10:10	83.58	46%	Heavy	624	59%	111	39%	CAN_SL	15:30-18:30	85.67	48%	Heavy
CAN_WH	06:30-09:30	98.25	55%	Severe	642	45%	115	16%	CAN_WH	19:20-22:20	81.5	45%	Heavy
CAN_WL	06:30-09:30	105.17	58%	Severe	559	44%	43	16%	CAN_WL	16:40-19:40	97.83	54%	Severe
LUX_APP	07:30-10:30	31.33	17%		280	66%	5	67%	LUX_APP	14:20-17:20	41	23%	
DUS_BOT	07:40-10:40	94.42	52%	Severe	725	59%	66	43%	DUS_BOT	12:10-15:10	81.17	45%	Heavy
DUS_COL	07:00-10:00	47.92	27%		348	51%	62	24%	DUS_COL	15:50-18:50	35.08	19%	
DUS_DOM	07:30-10:30	47.5	26%		363	56%	2	100%	DUS_DOM	16:00-19:00	53.5	30%	
DUS_GIX	07:30-10:30	46.58	26%		369	65%	1	-50%	DUS_GIX	14:40-17:40	42.92	24%	
DUS_GMH	06:00-09:00	127.75	71%	Severe	760	47%			DUS_GMH	15:50-18:50	122.75	68%	Severe
DUS_HMM	08:30-11:30	78.08	43%	Heavy	602	64%	34	36%	DUS_HMM	15:30-18:30	73.83	41%	Heavy
DUS_NOR	09:00-12:00	58.92	33%		544	77%	3	50%	DUS_NOR	16:10-19:10	73	41%	Heavy
FRA_ALFAS	05:40-08:40	96.5	54%	Severe	715	41%			FRA_ALFAS	13:20-16:20	90.67	50%	Severe
FRA_BADEN	07:10-10:10	116.5	65%	Severe	758	49%	2	100%	FRA_BADEN	14:40-17:40	91.5	51%	Severe
FRA_BERLI	07:20-10:20	57.67	32%		441	69%			FRA_BERLI	15:30-18:30	62.83	35%	
FRA_BODN1	05:50-08:50	59.33	33%		469	44%			FRA_BODN1	14:40-17:40	70.42	39%	
FRA_BODN2	07:20-10:20	72.08	40%	Heavy	513	62%			FRA_BODN2	12:30-15:30	60.25	33%	
FRA_DINKL	08:40-11:40	123.5	69%	Severe	946	55%			FRA_DINKL	13:30-16:30	96.67	54%	Severe
FRA_EMILE	07:00-10:00	55.08	31%		368	80%			FRA_EMILE	13:50-16:50	53.75	30%	
FRA_GEDH	06:00-09:00	60.08	33%		487	32%			FRA_GEDH	15:20-18:20	67	37%	
FRA_GEDL	05:00-08:00	47.92	27%		401	31%			FRA_GEDL	15:10-18:10	65.75	37%	
FRA_MAINE	08:40-11:40	95.75	53%	Severe	728	15%	215	32%	FRA_MAINE	13:10-16:10	99.42	55%	Severe
FRA_ODENN	06:20-09:20	93.75	52%	Severe	752	34%			FRA_ODENN	15:10-18:10	84.92	47%	Heavy
FRA_PSAH	06:10-09:10	51.33	29%		480	52%	1	-50%	FRA_PSAH	16:00-19:00	53.17	30%	
FRA_PSAL	05:40-08:40	62.75	35%		529	30%			FRA_PSAL	15:40-18:40	74.58	41%	Heavy
FRA_REGEN	05:50-08:50	96.25	53%	Severe	778	40%			FRA_REGEN	15:00-18:00	110.08	61%	Severe
FRA_RHOEN	05:10-08:10	95	53%	Severe	827	44%			FRA_RHOEN	15:00-18:00	118.5	66%	Severe
FRA_SAARH	07:30-10:30	91.17	51%	Severe	635	35%	12	20%	FRA_SAARH	14:50-17:50	71.25	40%	Heavy
FRA_SAARL	07:30-10:30	68.75	38%		463	28%	8	60%	FRA_SAARL	12:00-15:00	58.42	32%	
FRA_SAARS	07:30-10:30	22.08	12%		186	63%	4	100%	FRA_SAARS	12:00-15:00	23.17	13%	
FRA_TAUNS	07:30-10:30	45.83	25%		298	41%			FRA_TAUNS	17:00-20:00	23.25	13%	

Note: Sectors with a "severe" loading (50% + over 3 hours) are marked in red.													
Sectors with a "heavy" loading (40% to 49% + over 3 hours) are marked in blue.													
Busiest Morning 3-hr Period					Tot Flights 24 Hours				Busiest Afternoon 3-hr Period				
Sector	Period	Work'	% Load	Type	Ctrld	% Inc	Skip	% Inc	Sector	Period	Work'	% Load	Type
GER_FKN	09:00-12:00	132.33	74%	Severe	915	55%			GER_FKN	13:40-16:40	102.5	57%	Severe
GER_GRF	09:00-12:00	107.42	60%	Severe	778	61%			GER_GRF	15:30-18:30	97.25	54%	Severe
GER_HAN	09:00-12:00	108.75	60%	Severe	813	62%			GER_HAN	13:40-16:40	93	52%	Severe
GER_KRH	08:40-11:40	89.58	50%	Severe	777	53%			GER_KRH	15:10-18:10	92.33	51%	Severe
GER_LUB	07:00-10:00	21.67	12%		178	52%	2	100%	GER_LUB	17:20-20:20	24.17	13%	
GER_MSLN	09:00-12:00	76.75	43%	Heavy	473	53%	2	100%	GER_MSLN	12:00-15:00	65.67	36%	
GER_MSLS	08:50-11:50	72.17	40%	Heavy	595	55%	36	9%	GER_MSLS	12:00-15:00	69.75	39%	
GER_OSN	08:20-11:20	92.5	51%	Severe	727	59%	17	240%	GER_OSN	15:40-18:40	84.58	47%	Heavy
GER_WRB	08:40-11:40	122.5	68%	Severe	901	53%			GER_WRB	15:40-18:40	126.25	70%	Severe
GER_ELBH	08:20-11:20	80.25	45%	Heavy	577	59%			GER_ELBH	16:50-19:50	68	38%	
GER_FKNH	09:00-12:00	77.83	43%	Heavy	559	69%			GER_FKNH	12:10-15:10	66.17	37%	
GER_GRFH	08:50-11:50	95.42	53%	Severe	719	61%			GER_GRFH	12:50-15:50	84.67	47%	Heavy
GER_HANH	09:00-12:00	52.83	29%		497	65%			GER_HANH	15:10-18:10	51.83	29%	
GER_KRHH	08:00-11:00	55.75	31%		385	56%			GER_KRHH	15:40-18:40	52.42	29%	
GER_MSLH	09:00-12:00	85.67	48%	Heavy	596	57%			GER_MSLH	12:30-15:30	65	36%	
MAS_CST	05:10-08:10	40.75	23%		314	58%	130	40%	MAS_CST	13:00-16:00	45.25	25%	
MAS_DLT	08:10-11:10	50.83	28%		401	63%	161	35%	MAS_DLT	15:40-18:40	56.5	31%	
MAS_LNO	09:00-12:00	54.08	30%		391	49%	172	105%	MAS_LNO	18:30-21:30	43.83	24%	
MAS_LUX	06:10-09:10	55.25	31%		382	49%	2		MAS_LUX	15:10-18:10	43.25	24%	
MAS_WST	09:00-12:00	108.67	60%	Severe	791	44%	29	71%	MAS_WST	17:40-20:40	87	48%	Heavy
MAS_CSTH	05:50-08:50	38.92	22%		295	44%	85	52%	MAS_CSTH	15:30-18:30	44.25	25%	
MAS_DLTH	07:20-10:20	56.75	32%		435	51%	12	100%	MAS_DLTH	15:30-18:30	58.25	32%	
MAS_WSTH	09:00-12:00	94.75	53%	Severe	680	53%	6	50%	MAS_WSTH	17:10-20:10	73.58	41%	Heavy
PAR_TB	06:10-09:10	62.92	35%		555	42%			PAR_TB	16:00-19:00	79.33	44%	Heavy
PAR_TE	05:40-08:40	55.08	31%		358	36%			PAR_TE	15:20-18:20	57.83	32%	
PAR_TL	09:00-12:00	32.17	18%		341	28%			PAR_TL	12:00-15:00	38.42	21%	
PAR_TM	07:00-10:00	33.92	19%		267	43%			PAR_TM	16:10-19:10	34	19%	
PAR_TN	06:50-09:50	35.67	20%		244	39%			PAR_TN	15:40-18:40	33.75	19%	
REI_E	07:20-10:20	67.08	37%		437	46%	2		REI_E	15:10-18:10	67.83	38%	
REI_SE	07:00-10:00	59.75	33%		388	40%	19	58%	REI_SE	16:10-19:10	65.33	36%	
REI_UE	08:20-11:20	131.67	73%	Severe	858	49%	10	43%	REI_UE	15:10-18:10	120.33	67%	Severe
REI_UF	08:50-11:50	41.58	23%		363	34%			REI_UF	17:00-20:00	47.5	26%	
REI_UH	08:00-11:00	81.5	45%	Heavy	591	43%	7	40%	REI_UH	15:10-18:10	71.83	40%	Heavy
REI_UN	08:50-11:50	53.67	30%		423	42%			REI_UN	16:00-19:00	51.75	29%	
REI_UR	08:10-11:10	56.67	31%		429	45%	6	100%	REI_UR	16:00-19:00	49	27%	
REI_UY	09:00-12:00	45.25	25%		394	58%	2	100%	REI_UY	12:00-15:00	38.67	21%	
REI_XH	06:20-09:20	44.67	25%		417	52%			REI_XH	17:10-20:10	42.08	23%	
REI_XN	09:00-12:00	65.92	37%		475	49%	2	100%	REI_XN	13:50-16:50	56.67	31%	
REI_XR	09:00-12:00	63	35%		562	49%	2	100%	REI_XR	17:20-20:20	63.75	35%	

6.5. SEVERELY LOADED SECTORS (V3/RVSM ORG. - 2005 TRAFFIC)

In the following tables, the percentages under the time periods are a reminder of the three-hour loadings recorded (50% is the "severe" loading threshold) and the other percentages are based on the total number of controlled flights entering the sector during the three-hour period assessed. The figures underneath the percentage loading give the average and maximum instantaneous aircraft counts (number of aircraft on the frequency at any one time) during the three-hour period.

Flow names will sometimes be grouped into large areas, depending on the relevance to the sector analysed. Where appropriate, these grouped flow names will be broken down into their constituent TMA flows, so, for example:
Düsseldorf ACC means all airports within the Düsseldorf FIR, including EDDL and EDDK;
Düsseldorf TMA means the airports EDDL, EDLE and EDLN;
Köln TMA means the airports EDDK, EDKB and ETNN;
Bremen ACC means all airports within the Bremen FIR, including EDDH and EDDV.

<table>
<tr><th colspan="9">Amsterdam Sector 2 Out (AMS_SEC2O) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:40-10:40
(55%)
Ave: 6 a/c
Max: 11 a/c</td><td>134</td><td>47
(35%)</td><td>84
(63%)</td><td>3
(2%)</td><td>13</td><td>Amsterdam deps (56%)
Amsterdam arrs (13%)</td><td>22</td><td>36
(27%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The skipped aircraft were military crossers. The Amsterdam TMA departures were involved in 20 of the 22 conflicts and amounted to 75% of the individual aircraft in conflict. All but one of the conflicts occurred below FL240 and the main conflict area was between IVLUT and 10nm E of ARNEM.</td></tr>
<tr><td rowspan="2">12:40-15:40
(54%)
Ave: 6 a/c
Max: 13 a/c</td><td>120</td><td>45
(38%)</td><td>72
(60%)</td><td>3
(2%)</td><td></td><td>Amsterdam deps (53%)
Amsterdam arrs (13%)</td><td>22</td><td>36
(30%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Aircraft coming from the Düsseldorf ACC made up 14% of the flights through the sector. The Amsterdam TMA departures were involved in 19 of the 22 conflicts and represented 60% of the individual aircraft in conflict. Only one conflict occurred above FL240. The main conflict area was between IVLUT and ARKON.</td></tr>
</table>

<table>
<tr><th colspan="9">Bremen Leine (BRE_LEIN) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:20-09:20
(63%)
Ave: 6 a/c
Max: 12 a/c</td><td>154</td><td>89
(58%)</td><td>12
(8%)</td><td>53
(34%)</td><td>7</td><td>Hannover TMA arrs (37%)
Hamburg TMA arrs (12%)</td><td>23</td><td>36
(23%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Other significant flows were Berlin ACC arrivals (18%) and Düsseldorf ACC departures (13%). The skipped aircraft were Bremen, Hamburg and Hannover high-performance departures that climbed through the sector for less than a minute. The most prominent conflict flow was the Hannover TMA arrivals with 55% of the conflicts and 50% of the aircraft in conflict. 80% of the conflicts were below FL240. The two main conflict areas were ASLEP to 10nm SE of ELEIN and HEHLE to 10nm E of ELEIN.</td></tr>
<tr><td rowspan="2">16:00-19:00
(63%)
Ave: 6 a/c
Max: 12 a/c</td><td>164</td><td>89
(54%)</td><td>18
(11%)</td><td>57
(35%)</td><td>7</td><td>Hannover TMA arrs (21%)
Hamburg TMA arrs (16%)</td><td>13</td><td>24
(15%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Berlin ACC departures made up 23% of the sector's traffic. The skipped aircraft were the same as for the morning. Conflicts were spread amongst the flows, 75% below FL240, and the main conflict area was around HEHLE.</td></tr>
</table>

<table>
<tr><th colspan="9">Bremen Weser (BRE_WESR) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:10-09:10
(53%)
Ave: 8 a/c
Max: 15 a/c</td><td>132</td><td>43
(33%)</td><td>74
(56%)</td><td>15
(11%)</td><td>5</td><td>Hamburg TMA deps (32%)
Hamburg TMA arrs (16%)</td><td>17</td><td>28
(21%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The skipped aircraft were military crossers. Hamburg TMA departures were involved in 11 of the 17 conflicts (65%). All conflicts occurred below FL240, and were confined to the eastern part of the sector with the majority occurring between 20nm N and S of STADE.</td></tr>
<tr><td rowspan="2">12:30-15:30
(56%)
Ave: 8 a/c
Max: 16 a/c</td><td>140</td><td>50
(36%)</td><td>68
(49%)</td><td>22
(15%)</td><td>1</td><td>Hamburg TMA arrs (25%)
Hamburg TMA deps (24%)</td><td>23</td><td>35
(25%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Hamburg TMA departures and arrivals were concerned in 55% of the conflicts and equal to 50% of the aircraft in conflict. 80% of all conflicts occurred below FL240. As with the morning, the main area of conflicts was between 20nm N and S of STADE.</td></tr>
</table>

<table>
<tr><th colspan="9">CANAC Central High (CAN_CH) – FL195/FL235 to FL295</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">15:10-18:10
(53%)
Ave: 4 a/c
Max: 10 a/c</td><td>120</td><td>73
(61%)</td><td>27
(22%)</td><td>20
(17%)</td><td>2</td><td>Paris TMA arrs (34%)
Amsterdam deps (21%)</td><td>13</td><td>24
(20%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Conflicts were spread throughout the flows and around the sector, and most occurred above FL240.</td></tr>
</table>

<table>
<tr><th colspan="9">CANAC East High (CAN_EH) – FL195 to FL295</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:50-11:50
(81%)
Ave: 6 a/c
Max: 12 a/c</td><td>190</td><td>65
(34%)</td><td>89
(47%)</td><td>36
(19%)</td><td>21</td><td>Brussels TMA arrs (22%)
Brussels TMA deps (19%)</td><td>28</td><td>46
(24%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
This sector recorded the highest number of aircraft during the 24 hours (1046) and was the most severely loaded sector over three hours. Other significant flows were the Düsseldorf ACC departures (24%) and arrivals (22%). Military crossers accounted for 14 of the skipped aircraft, Luxembourg arrivals 4, and the other 3 were in the sector for less than 2 minutes. Conflicts were spread amongst the flows and half of them occurred above FL240. The two main conflict areas were: the quadrant of a circle 10nm N to 10nm E of LNO and along the eastern part of the sector in the ETIEN-PILBA-VOGEL area.</td></tr>
<tr><td rowspan="2">15:10-18:10
(77%)
Ave: 5 a/c
Max: 12 a/c</td><td>184</td><td>58
(32%)</td><td>92
(50%)</td><td>34
(18%)</td><td>6</td><td>Brussels TMA arrs (22%)
Brussels TMA deps (20%)</td><td>24</td><td>45
(24%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Also significant were the Düsseldorf ACC departures (24%) and arrivals (18%). The skipped aircraft were Brussels arrivals coming from the Frankfurt airspace at FL220 or below. Conflicts were spread amongst the flows and just over 50% occurred above FL240. There were three main conflict areas: LNO/BATTY to 10nm E of that line; PILBA and up to 8nm W and NW of PILBA; and, thirdly, the BRUSE area.</td></tr>
</table>

CANAC North Low (CAN_NL) – FL195/FL245 upper limit								
Period	**Controlled Flights Entering**				**Skip**	**Main Flow(s)**	**Conflicts**	**Acft. In Conflict**
	Tot	**Crse**	**Clmb**	**Desc**				
15:40-18:40 (51%) Ave: 5 a/c Max: 10 a/c	119	57 (48%)	56 (47%)	6 (5%)	3	Brussels TMA deps (43%) Brussels TMA arrs (28%)	36	49 (41%)
	Comments Brussels TMA departures were involved in 27 (75%) of the conflicts, and equalled 55% of the individual aircraft in conflict. Of the 9 remaining conflicts, 8 involved a Brussels TMA arrival. All but one of the conflicts occurred below FL195 and most conflicts were on the NIK-COA axis, the NIK-WOODY axis and between NIK and 6nm SE of NIK.							

CANAC South High (CAN_SH) – FL245 to FL295								
Period	**Controlled Flights Entering**				**Skip**	**Main Flow(s)**	**Conflicts**	**Acft. In Conflict**
	Tot	**Crse**	**Clmb**	**Desc**				
06:10-09:10 (65%) Ave: 6 a/c Max: 13 a/c	140	57 (41%)	10 (7%)	73 (52%)	25	Frankfurt TMA arrs (22%) London TMA deps (19%)	46	57 (41%)
	Comments Traffic to the Düsseldorf ACC comprised 26% of the sector's traffic. 14 of the skipped flights were OAT crossers and, of the remainder, 7 were Amsterdam arrivals. All GAT skipped aircraft were in the sector for less than 2 minutes. There were three main flows involved in 85% of the conflicts: Brussels TMA arrivals were in 50%, Düsseldorf TMA arrivals in 45% and Frankfurt TMA arrivals in 35%. Combined, these flights accounted for 75% of the aircraft in conflict. 90% of all conflicts occurred above FL280 and most conflicts were concentrated along either side of the DIK-LUXIE-15nm SE of LUXIE axis.							
17:30-20:30 (56%) Ave: 5 a/c Max: 10 a/c	130	48 (37%)	14 (11%)	68 (52%)	7	Düss'dorf TMA arrs (29%) Frankfurt TMA arrs (16%)	39	57 (44%)
	Comments Flights to the Düsseldorf ACC amounted to 38% of the traffic. Departures from Spain and Portugal, all bound for the Düsseldorf ACC or the Frankfurt TMA, represented 18% of the flights. The skipped aircraft were Amsterdam arrivals, in the sector for less than 2 minutes. Two flows were involved in 75% of all conflicts: Düsseldorf TMA arrivals in 55% and Brussels TMA arrivals in 40%. Aircraft on these two flows made up 70% of the individual aircraft in conflict. 85% of all conflicts occurred above FL280. As with the morning period, most conflicts occurred along either side of the DIK-LUXIE-15nm SE of LUXIE axis.							

CANAC West High (CAN_WH) – FL195 to FL295								
Period	**Controlled Flights Entering**				**Skip**	**Main Flow(s)**	**Conflicts**	**Acft. In Conflict**
	Tot	**Crse**	**Clmb**	**Desc**				
06:30-09:30 (55%) Ave: 6 a/c Max: 9 a/c	121	86 (71%)	33 (27%)	2 (2%)	37	London TMA deps (59%) Brussels TMA arrs (22%)	25	37 (31%)
	Comments 22 of the skipped aircraft were military crossers. Of the remaining 15 GAT skips, 8 were Amsterdam arrivals descending to FL200 by the Amsterdam/Brussels boundary, remaining under the control of the Central High sector. Two flows, the London TMA departures and the Brussels arrivals were involved in 90% of all conflicts and, together, consisted of 85% of the aircraft in conflict. Almost all the conflicts occurred in two areas: 15nm W of KONAN to 10 E of KONAN and in an area 15nm E of KOK to 5nm W of FERDI.							

<table>
<tr><th colspan="10">CANAC West Low (CAN_WL) – FL195/FL235 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:30-09:30
(58%)
Ave: 5 a/c
Max: 11 a/c</td><td>117</td><td>54
(46%)</td><td>32
(27%)</td><td>31
(27%)</td><td>25</td><td>Brussels TMA arrs (58%)
Brussels TMA deps (22%)</td><td>17</td><td>29
(25%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
All but 5 of the skipped aircraft were OAT flights. The 5 GAT skips were Amsterdam to Paris flights at FL230 working Central High. 14 of the 17 conflicts involved a Brussels TMA arrival and 16 of the conflicts occurred at or below FL190. The main conflict area was along the axis 20nm W of KERKY to KERKY to 8nm ENE of KERKY.</td></tr>
<tr><td rowspan="2">16:40-19:40
(54%)
Ave: 6 a/c
Max: 13 a/c</td><td>105</td><td>66
(63%)</td><td>24
(23%)</td><td>15
(14%)</td><td>5</td><td>Brussels TMA arrs (49%)
Brussels TMA deps (20%)</td><td>20</td><td>28
(27%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Brussels TMA arrivals were involved in 70% and Brussels TMA departures in 55% of the conflicts. Only one conflict did not involve an aircraft on either of these two flows. 19 of the 20 conflicts occurred at or below FL190. As well as a concentration of conflicts around KERKY, there was also a similar number between 8nm NE of CIV and 10nm SW of CIV.</td></tr>
</table>

<table>
<tr><th colspan="9">Düsseldorf BOT (DUS_BOT) – FL145 to FL295</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:40-10:40
(52%)
Ave: 3 a/c
Max: 9 a/c</td><td>159</td><td>26
(16%)</td><td>98
(62%)</td><td>35
(22%)</td><td>8</td><td>Düs'dorf TMA deps (32%)
Amsterdam deps (23%)</td><td>10</td><td>17
(11%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Overall, Düsseldorf ACC departures and Düsseldorf ACC arrivals accounted for 38% and 24%, respectively, of the sector's traffic. Seven of the skipped flights were Amsterdam departures entering at FL 265, or above, climbing above FL290. No particular flow was dominant in the conflicts, but there was a small concentration of conflicts SE of ARKON.</td></tr>
</table>

<table>
<tr><th colspan="9">Düsseldorf GMH (DUS_GMH) – FL145 to FL295</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:00-09:00
(71%)
Ave: 6 a/c
Max: 16 a/c</td><td>145</td><td>72
(50%)</td><td>36
(25%)</td><td>37
(25%)</td><td></td><td>Düs'dorf TMA arrs (28%)
Köln TMA arrs (26%)</td><td>44</td><td>69
(48%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
63% of the sector's flights were Düsseldorf ACC arrivals. The Köln TMA arrivals (55% of the conflicts) and the Düsseldorf TMA arrivals (50%) were involved in 42 of the 44 conflicts. Two thirds of the individual aircraft in conflict were flights on these two flows. 85% of all conflicts were at or below FL245. The majority of conflicts were contained in an area bounded by the points ARKOL/PETER/DURIN/DUSEL.</td></tr>
<tr><td rowspan="2">15:50-18:50
(68%)
Ave: 6 a/c
Max: 11 a/c</td><td>136</td><td>67
(49%)</td><td>22
(16%)</td><td>47
(35%)</td><td></td><td>Düs'dorf TMA arrs (36%)
Köln TMA arrs (22%)</td><td>37</td><td>56
(41%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Almost 80% of the sector's flights were Düsseldorf ACC arrivals. The Düsseldorf TMA arrivals were more prominent in the conflicts in the afternoon, being involved in 65%. Köln TMA arrivals were involved in 40% of all conflicts. Only 3 conflicts did not involve an aircraft from one of these two flows. 90% of all conflicts were below FL245 and almost all occurred in same area as for the morning period.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Alfas (FRA_ALFAS) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">05:40-08:40
(54%)
Ave: 7 a/c
Max: 13 a/c</td><td>145</td><td>74
(51%)</td><td>66
(46%)</td><td>5
(3%)</td><td></td><td>Frankfurt TMA deps (24%)
Köln TMA deps (22%)
Düs’dorf TMA deps (21%)</td><td>37</td><td>55
(38%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
In total, the Düsseldorf ACC departures amounted to 52% of the sector’s traffic. Köln TMA departures (65%) and Frankfurt TMA departures (30%) were the two flows involved in the most conflicts, 32 out of the 37 conflicts and 55% of the aircraft in conflict. 34 of the conflicts were below FL245. The conflicts were concentrated in two areas: 15nm W of ALFAS to ALFAS to 5nm SE of ALFAS and between 10nm SW and SE of GIN.</td></tr>
<tr><td rowspan="2">13:20-16:20
(50%)
Ave: 6 a/c
Max: 11 a/c</td><td>136</td><td>48
(35%)</td><td>79
(58%)</td><td>9
(7%)</td><td></td><td>Frankfurt TMA deps (32%)
Düs’dorf TMA deps (27%)</td><td>23</td><td>34
(25%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
As with the morning period, just over half of the sector’s traffic (51%) was Düsseldorf ACC departures. The Köln TMA departures (45%), the EDLW/ETUR departures (45%) and the Frankfurt TMA departures (40%) were the three main conflict flows and together equalled 70% of the aircraft in conflict. All conflicts took place at or below FL230 and most of them were concentrated along the ALFAS/GIN axis.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Baden (FRA_BADEN) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:10-10:10
(65%)
Ave: 7 a/c
Max: 12 a/c</td><td>183</td><td>89
(49%)</td><td>62
(34%)</td><td>32
(17%)</td><td></td><td>Frankfurt ACC deps (24%)
Switzerland arrs (16%)</td><td>16</td><td>30
(16%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Conflicts were spread amongst the flows. All but three of the conflicts were below FL245 and most occurred in the southern half of the sector.</td></tr>
<tr><td rowspan="2">14:40-17:40
(51%)
Ave: 6 a/c
Max: 13 a/c</td><td>154</td><td>68
(44%)</td><td>44
(29%)</td><td>42
(27%)</td><td>1</td><td>Stuttgart TMA arrs (22%)
Switzerland arrs (21%)</td><td>13</td><td>24
(16%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Very similar picture to the morning period with 10 of the conflicts for the sector occurring below FL245. The conflicts were spread around the southern half of the sector.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Dinkel (FRA_DINKL) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:40-11:40
(69%)
Ave: 5 a/c
Max: 12 a/c</td><td>207</td><td>88
(42%)</td><td>86
(42%)</td><td>33
(16%)</td><td></td><td>München arrs (27%)
Frankfurt TMA deps (23%)</td><td>12</td><td>23
(11%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
With 207 controlled flights, this was the sector with the highest number of aircraft during the busiest three-hour period. The number of radar conflicts was quite low, despite the high number of flights. Conflicts were spread around the sector.</td></tr>
<tr><td rowspan="2">13:30-16:30
(54%)
Ave: 4 a/c
Max: 9 a/c</td><td>161</td><td>78
(48%)</td><td>58
(36%)</td><td>25
(16%)</td><td></td><td>München arrs (27%)
Frankfurt TMA deps (26%)</td><td>1</td><td>2
(1%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Very similar picture to the morning period and only 1 conflict recorded.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Main (FRA_MAINE) – FL205 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:40-11:40
(53%)
Ave: 2 a/c
Max: 7 a/c</td><td>143</td><td>4
(3%)</td><td>136
(95%)</td><td>3
(2%)</td><td>31</td><td>Frankfurt TMA deps (96%)</td><td>4</td><td>7
(5%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
This sector is designed to act as an interface between the Frankfurt TMA and the relevant en route sector for all Frankfurt departures. All other flights skip the sector except for a handful of flights that might conflict with the Frankfurt departures. All 4 conflicts occurred in the ODEWA area.</td></tr>
<tr><td rowspan="2">13:10-16:10
(55%)
Ave: 2 a/c
Max: 6 a/c</td><td>147</td><td>3
(2%)</td><td>143
(97%)</td><td>1
(1%)</td><td>35</td><td>Frankfurt TMA deps (98%)</td><td>5</td><td>10
(7%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
3 of the 5 conflicts occurred in the vicinity of ODEWA.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Oden (FRA_ODENN) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">06:20-09:20
(52%)
Ave: 6 a/c
Max: 12 a/c</td><td>155</td><td>57
(37%)</td><td>72
(46%)</td><td>26
(17%)</td><td></td><td>Frankfurt TMA deps (26%)
Stuttgart TMA deps (23%)</td><td>30</td><td>53
(34%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The three main conflict flows here were the Frankfurt TMA departures (55%), the Frankfurt TMA arrivals (40%) and the Stuttgart TMA departures (40%). These flows accounted for 70% of the aircraft in conflict. All conflicts were below FL245 and most occurred around BERON in the centre of the sector and around ANDRA in the northern half of the sector.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Regen (FRA_REGEN) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">05:50-08:50
(53%)
Ave: 5 a/c
Max: 11 a/c</td><td>125</td><td>72
(58%)</td><td>25
(20%)</td><td>28
(22%)</td><td></td><td>Frankfurt TMA arrs (30%)
München deps (24%)</td><td>12</td><td>16
(13%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The Frankfurt TMA arrivals were involved in 11 of the 12 conflicts. All conflicts occurred above FL195 and just over half above FL245. Most conflicts happened between ALBIE and WOLFI.</td></tr>
<tr><td rowspan="2">15:00-18:00
(61%)
Ave: 6 a/c
Max: 15 a/c</td><td>163</td><td>87
(53%)</td><td>28
(17%)</td><td>48
(30%)</td><td></td><td>Frankfurt TMA arrs (30%)
Nürnberg TMA arrs (20%)</td><td>13</td><td>21
(13%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The Frankfurt TMA arrivals were involved in 8 of the 13 conflicts. As for the morning period, all conflicts occurred above FL195 and just over half above FL245. Conflicts were divided between the ALBIE/WOLFI axis and between 10nm NW and 10 SE of SWEIN.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Rhoen (FRA_RHOEN) – FL295 upper limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">05:10-08:10
(53%)
Ave: 8 a/c
Max: 14 a/c</td><td>163</td><td>135
(83%)</td><td>20
(12%)</td><td>8
(5%)</td><td></td><td>München deps (20%)
Hannover TMA arrs (15%)</td><td>13</td><td>25
(15%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The Düsseldorf ACC arrivals (27%) and the Berlin ACC arrivals (16%) were two other significant flows. Conflicts were spread throughout the sector and amongst the flows and 12 of the 13 conflicts were below FL245.</td></tr>
<tr><td rowspan="2">15:00-18:00
(66%)
Ave: 8 a/c
Max: 14 a/c</td><td>196</td><td>146
(74%)</td><td>28
(14%)</td><td>22
(11%)</td><td></td><td>München deps (12%)
Frankfurt TMA arrs (12%)</td><td>7</td><td>14
(7%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
There were three other significant flow groups: Düsseldorf ACC arrivals (26%), Berlin ACC departures (17%) and arrivals (13%). Conflicts were spread around the sector and amongst the flows.</td></tr>
</table>

<table>
<tr><th colspan="9">Frankfurt Saar-H (FRA_SAARH) – FL205 to FL295</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">07:30-10:30
(51%)
Ave: 5 a/c
Max: 9 a/c</td><td>138</td><td>63
(46%)</td><td>37
(27%)</td><td>38
(27%)</td><td>9</td><td>Frankfurt TMA arrs (22%)
Frankfurt TMA deps (15%)</td><td>23</td><td>40
(29%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
8 of the 9 skips were OAT crossers. One third of the conflicts involved a Frankfurt TMA arrival and two thirds of all conflicts were below FL245. The conflicts were spread throughout the sector.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Franken (GER_FKN) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">09:00-12:00
(74%)
Ave: 6 a/c
Max: 12 a/c</td><td>198</td><td>120
(61%)</td><td>64
(32%)</td><td>14
(7%)</td><td></td><td>Düs'dorf ACC deps (17%)
München arrs (14%)</td><td>35</td><td>58
(29%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Traffic to East European and East Mediterranean countries accounted for 35% of the sector's traffic. The München arrivals were involved in 45% of all conflicts. The conflicts occurred at all levels and most were concentrated in two main areas: around SPEZL and between 10nm NW of NORAS and 10nm SE of NORAS.</td></tr>
<tr><td rowspan="2">13:40-16:40
(57%)
Ave: 6 a/c
Max: 14 a/c</td><td>169</td><td>112
(66%)</td><td>41
(24%)</td><td>16
(10%)</td><td></td><td>München arrs (16%)
Düs'dorf ACC deps (15%)</td><td>27</td><td>51
(30%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Flights with East European and East Mediterranean destinations made up 30% of the sector's traffic. The München arrivals were involved in 35% of all conflicts. The conflicts were spread around the sector but with a cluster in the SPEZL/WURZE/NURNI area.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Grafenwöhr (GER_GRF) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">09:00-12:00
(60%)
Ave: 7 a/c
Max: 15 a/c</td><td>164</td><td>117
(71%)</td><td>39
(24%)</td><td>8
(5%)</td><td></td><td>Amsterdam arrs (10%)
Düs'dorf ACC arrs (10%)</td><td>35</td><td>54
(33%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Half of the sector's traffic was composed of flights to and from East European and East Mediterranean countries. Departures from the Prague TMA were the ones most often involved in conflicts (30% of all conflicts). The majority of conflicts occurred along the OKG/HAMEB axis.</td></tr>
<tr><td rowspan="2">15:30-18:30
(54%)
Ave: 6 a/c
Max: 12 a/c</td><td>149</td><td>97
(65%)</td><td>41
(28%)</td><td>11
(7%)</td><td></td><td>Düs'dorf ACC arrs (20%)
München deps (18%)</td><td>14</td><td>23
(15%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Traffic from East European and East Mediterranean countries made up 30% of the flights. The conflicts were much reduced in the afternoon, with no particular flow prominent and they were distributed around the sector.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Grafenwöhr-High (GER_GRFH) – FL335 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:50-11:50
(53%)
Ave: 8 a/c
Max: 15 a/c</td><td>143</td><td>108
(76%)</td><td>30
(21%)</td><td>5
(3%)</td><td></td><td>Scandinavia arrs (15%)
Amsterdam arrs (11%)</td><td>22</td><td>34
(24%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Flights from East Europe and the East Mediterranean countries accounted for 30% of the traffic. Conflicts were spread around the sector and amongst the flows, and 20 of the 22 conflicts occurred between FL340 and FL360.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Hanau (GER_HAN) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">09:00-12:00
(60%)
Ave: 6 a/c
Max: 12 a/c</td><td>167</td><td>121
(73%)</td><td>42
(25%)</td><td>4
(2%)</td><td></td><td>Düs'dorf ACC deps (28%)
Amsterdam deps (14%)</td><td>41</td><td>68
(41%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
30% of the traffic was to East European and East Mediterranean destinations. Conflicts involving Düsseldorf ACC departures were the most common - 60% of all conflicts and 33% of the individual aircraft involved in conflicts. The main concentration of conflicts was in the northeast of the sector on the GIN/GELNI/SPEZL and GEDNO/GELNI/HANAU axes.</td></tr>
<tr><td rowspan="2">13:40-15:40
(52%)
Ave: 6 a/c
Max: 11 a/c</td><td>141</td><td>119
(84%)</td><td>17
(12%)</td><td>5
(4%)</td><td></td><td>Düs'dorf ACC deps (23%)
Amsterdam deps (16%)</td><td>21</td><td>35
(25%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Traffic to East Europe and the East Mediterranean countries comprised 26% of the sector's traffic. The Düsseldorf ACC departures were involved in almost half of all conflicts. Almost all of the conflicts occurred within a 10nm radius of GELNI.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Karlsruhe (GER_KRH) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:40-11:40
(50%)
Ave: 7 a/c
Max: 13 a/c</td><td>139</td><td>94
(68%)</td><td>32
(23%)</td><td>13
(9%)</td><td></td><td>Brussels TMA deps (12%)
Zürich TMA deps (12%)</td><td>18</td><td>29
(21%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Northern Italy arrivals made up 14% of the flights. Conflicts were spread amongst the flows and the majority occurred in the SPM/WEKAR/KARLS triangle.</td></tr>
<tr><td rowspan="2">15:10-18:10
(51%)
Ave: 6 a/c
Max: 11 a/c</td><td>144</td><td>93
(65%)</td><td>28
(19%)</td><td>23
(16%)</td><td></td><td>Zürich TMA arrs (19%)
Zürich TMA deps (10%)</td><td>15</td><td>29
(20%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
15% of the traffic had Spanish destinations. In a small number of conflicts, the Zürich TMA arrivals were involved in 40% of them. The conflicts were spread across the northern part of the sector, from SPM and WEKAR in the west to ETAGO and TEGOS in the east.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Osnabrück (GER_OSN) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:20-11:20
(51%)
Ave: 6 a/c
Max: 14 a/c</td><td>142</td><td>53
(37%)</td><td>58
(41%)</td><td>31
(22%)</td><td>5</td><td>Amsterdam arrs (25%)
Amsterdam deps (11%)</td><td>25</td><td>41
(29%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The skipped flights were high-performance Hamburg departures to the south. The Amsterdam arrivals were involved in 60% of all conflicts. Although a significant number of conflicts were spread across the sector on the HEHLE/AMSAN axis, there was a large cluster of them between WEHAM and AMSAN.</td></tr>
</table>

<table>
<tr><th colspan="9">Germany Upper Warburg (GER_WRB) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:40-11:40
(68%)
Ave: 7 a/c
Max: 13 a/c</td><td>173</td><td>94
(54%)</td><td>43
(25%)</td><td>36
(21%)</td><td></td><td>Düs'dorf ACC arrs (23%)
Bremen ACC deps (15%)</td><td>37</td><td>57
(33%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
No particular flow was prominent in the list of conflicts. The largest concentration of conflicts was in the southeast of the sector in the SULAU/SITKA/SALZU/OBERS area.</td></tr>
<tr><td rowspan="2">15:40-18:40
(70%)
Ave: 7 a/c
Max: 14 a/c</td><td>169</td><td>103
(61%)</td><td>40
(24%)</td><td>26
(15%)</td><td></td><td>Düs'dorf ACC arrs (25%)
Bremen ACC deps (15%)</td><td>23</td><td>38
(22%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
As with the morning period, there was a similar grouping of conflicts in the southeast of the sector.</td></tr>
</table>

<table>
<tr><th colspan="9">Maastricht West (MAS_WST) – FL295 to FL335</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">09:00-12:00
(60%)
Ave: 7 a/c
Max: 15 a/c</td><td>151</td><td>34
(23%)</td><td>97
(64%)</td><td>20
(13%)</td><td>5</td><td>London TMA deps (38%)
London TMA arrs (14%)</td><td>41</td><td>67
(44%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
London TMA departures (60%) and Amsterdam departures (33%) were the two main conflict flows. The London TMA departures accounted for 40% of the individual aircraft in conflict, but were more prominent in conflicts in the eastern half of the sector than in the western half. In fact, the main conflict area was bounded by the points HELEN/FERDI/REMBA/BUB.</td></tr>
</table>

<table>
<tr><th colspan="9">Maastricht West-High (MAS_WSTH) – FL335 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">09:00-12:00
(53%)
Ave: 12 a/c
Max: 18 a/c</td><td>141</td><td>78
(55%)</td><td>63
(45%)</td><td></td><td>1</td><td>London TMA arrs (22%)
London TMA deps (19%)</td><td>40</td><td>57
(40%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The main conflict flows were the London TMA departures (35%) and the London TMA arrivals (25%). 34 of the 40 conflicts were at FL350 or below. Most of the conflicts occurred along two axes: KOK to REMBA and HORTA to COA.</td></tr>
</table>

<table>
<tr><th colspan="9">Reims UE (REI_UE) – FL195 lower limit</th></tr>
<tr><th rowspan="2">Period</th><th colspan="4">Controlled Flights Entering</th><th rowspan="2">Skip</th><th rowspan="2">Main Flow(s)</th><th rowspan="2">Conflicts</th><th rowspan="2">Acft. In Conflict</th></tr>
<tr><th>Tot</th><th>Crse</th><th>Clmb</th><th>Desc</th></tr>
<tr><td rowspan="2">08:20-11:20
(73%)
Ave: 12 a/c
Max: 21 a/c</td><td>174</td><td>151
(87%)</td><td>21
(12%)</td><td>2
(1%)</td><td>4</td><td>Düs'dorf ACC arrs (22%)
Düs'dorf ACC deps (13%)</td><td>31</td><td>55
(32%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
Düsseldorf ACC arrivals (45%) and Brussels TMA arrivals (35%) were the two main conflict flows. Two thirds of all conflicts occurred between FL300 and FL330, and the highest concentration of conflicts was above the delegated airspace to CANAC South High, between ROUSY/SUTAL and GTQ.</td></tr>
<tr><td rowspan="2">15:10-18:10
(67%)
Ave: 10 a/c
Max: 20 a/c</td><td>158</td><td>124
(78%)</td><td>34
(22%)</td><td></td><td></td><td>Düs'dorf ACC arrs (13%)
Düs'dorf ACC deps (13%)
Paris TMA deps (13%)</td><td>23</td><td>38
(24%)</td></tr>
<tr><td colspan="8"><u>Comments</u>
The conflicts were spread amongst the flows and, as with the morning, two thirds occurred between FL300 and FL330. The main conflict areas were the ROUSY/SUTAL to GTQ area, as for the morning, and the POGAL/LASIT/DANAR triangle.</td></tr>
</table>

7. SUMMARY, COMMENTS AND CONCLUSIONS

7.1. SUMMARY

The reference 1997 organisation (DFL245) showed that, of the 84 core sectors, 27 (32%) experienced sustained heavy to severe radar controller loadings over their busiest three-hour periods. Ten of these sectors were severely loaded, in other words, they had reached or exceeded their capacity, and six out of this group of ten were Maastricht sectors.

The new ARN V3/RVSM DFL295/265 organisation, simulated with 1997 traffic, produced very promising results. Only one sector, CANAC South High, experienced a severe loading and 14 others returned a heavy loading over three hours. This amounted to 17% of the 88 core sectors, as compared to 32% in the 1997 organisation. Compared to the latter, the combination of the ARN v3 and RVSM led to a reduction of 40% in the total number of conflicts in the core area - 60% less above FL295 and 25% less below FL295. However, in the airspace between FL245 and FL295 the number of conflicts remained virtually the same as in the 1997 reference scenario.

The promising results of the V3/RVSM 1997 traffic organisation were eclipsed when the traffic was increased to 2005 levels and, globally, the results were worse than the 1997 reference scenario. Of the 88 core sectors, 46 (52%) were at least heavily loaded and 30 (34%) of these were severely loaded during their busiest three hours. Out of the 30 severely loaded sectors, 24 were sectors with upper limits at or below FL295. In addition, 5 sectors were just below the severe workload threshold and 9 just below the heavy threshold. Radar conflicts increased by 150% above FL295 and by 100% below FL295. Compared to the 1997 reference organisation, radar conflicts above FL295 showed a small increase of 1% but below FL295 they had increased by 50%.

7.2. COMMENTS

The high loadings in the 2005 scenario were undoubtedly influenced by a “bunching” effect - large numbers of aircraft arriving in the same place at roughly the same time and particularly noticeable with arrivals in the lower airspace - due to the 50% increase in the traffic sample. In reality, these streams would be smoothed out into more even flows. That said, “bunching” is a bigger factor in high controller loadings recorded over shorter periods, e.g. one hour, than over the three-hour periods reported here.

On the positive side, the on-going process of optimising the German sectors and the probable vertical splitting of the Reims UE sector will certainly lead to reduced controller loadings in those sectors. So, based on the results of this simulation, this leaves the main problem area as the airspace of the Brussels FIR/UIR.

One of the well-known difficulties with the Brussels FIR/UIR is the squeezing of mixed, high-density flows into narrow areas, particularly in the DIK/LNO/NTM area. Stated simply, the military areas are in the wrong places relative to the needs of the civil traffic using this airspace, and the sectorisation in the area does not fit well with the demands of the flows, e.g., the width of the Maastricht Luxembourg sector east of MEDOX is only 30nm between the French and German boundaries, hence the need to have

Düsseldorf/Köln and Frankfurt arrivals below FL295 by the France/CANAC boundary. These elements require the development of quite complex procedures to make it all work.

By way of illustration, a 30% capacity increase was achieved with the implementation, in January 2000, of the Odyssée project in the airspace of Northern France. Part of this success was due to the structure of segregated routes for the Amsterdam, Brussels and Paris arrival and departure flows at the CIV interface. Unfortunately, the same possibility to adequately segregate the Brussels, Düsseldorf, Frankfurt and Köln arrival and departure flows in the DIK area does not exist, as the positioning and extent of the adjacent military TRAs creates a cross-shaped fillet of airspace, from LNO to GTQ and from RAPOR to HAN, too narrow in parts to permit efficient segregation during periods of military activity.

To put the CANAC results into some sort of context, the CANAC airspace is approximately one half the size of the Frankfurt airspace and one quarter the size of the simulated Germany Upper airspace. Yet, CANAC recorded 2005 traffic levels that were 75% of Frankfurt's and 90% of Germany Upper's. In addition, CANAC had to deal with more conflicts in its airspace than either Germany Upper or Frankfurt (CANAC 982, Germany Upper 980 and Frankfurt 901). In a separate (and crude) experiment using the exact same 2005 scenario but changing all routes to direct routeing from simulation entry point to simulation exit point, the number of conflicts for the CANAC airspace fell by over 60% - from 982 to 375 (341 conflicts were recorded in the CANAC airspace for the 1997 reference scenario).

7.3. CONCLUSIONS

As is common in a simulation of this size, clear, definite conclusions are not easy to find and, in the end, come down to individual interpretation. However, one thing is clear - there was a considerable improvement in the global results when the airspace was tested with the V3/RVSM DFL295 airspace structure and 1997 traffic, compared to the reference 1997 scenario.

Perhaps the most significant factor in determining the DFL in the Amsterdam and CANAC airspace is the number and nature of the different level constraints that need to be applied to the main arrival flows for the major core area airports. Achieving these constraints, ranging from FL250 to FL290 (maximum levels by certain points), demands an airspace of sufficient vertical extent to permit efficient level allocation during periods of dense traffic. This presents three options:

- The first option is to leave CANAC and Amsterdam at their present vertical limits of FL245. This leaves the relevant Maastricht sectors with the responsibility of achieving the constraints but with insufficient levels for allocation for the lower FL250 and FL260 constraints during periods of dense traffic. Furthermore, with the tendency in complex traffic situations to get arrival traffic down as low and as early as possible, it is likely that the CANAC sectors would be involved more and more during periods of heavy traffic. Delegated airspace, windows and balconies will certainly help but these options are only limited-term solutions.

- The second option is to have a DFL between FL255 and FL285. None of these DFLs were simulated in fast-time and, as they would involve a certain amount of sector redesign and a review of the different level constraints and skipping procedures to be used, no relevant comments can be made. These DFLs will need to be tested in real-time.

- The third option is to set, as simulated, the DFL for CANAC and Amsterdam at FL295. Compared to the 1997 reference scenario, this configuration produced definite, overall improvements, although the improvement for CANAC was not as good as it was for Amsterdam. However, a DFL of FL295 does have the advantage of allowing the CANAC sectors, in particular, to retain complete control over level allocation in applying the arrival flow constraints. In some cases it will also reduce the severity of the level constraints to be applied (a FL290 constraint is less penalising than a FL250/FL240 constraint). That said, this option has its disadvantages too. These include a very high volume of mixed traffic in the CANAC sectors that will necessitate another look at the route structure through the airspace, probable level restrictions on Brussels and Düsseldorf departures via GTQ to keep them below the relevant Maastricht sectors, and a need to address the problem of climbing London TMA departures in the west of the airspace. It may also pose system problems for CANAC and an increase in the number of sectors required to manage the forecast traffic.

In all three options the same major obstacle remains: there is no real possibility to efficiently segregate the Brussels, Düsseldorf, Frankfurt and Köln arrival and departure routes in the DIK area without resiting or redefining the adjacent military TRAs.

Based on the overall simulation results, the recommendation is for a DFL of FL295 in the Amsterdam and Brussels FIR/UIRs.

Finally, it may be a little obvious to state that there is a need to fully exploit the advantages offered by FUA, and that the airspace structure and route network in this area need to be re-examined if the requirements of all airspace users are to be met, but the results for the 2005 traffic, even allowing for simulation inaccuracies, add a sense of urgency to these two points.

Traduction en Langue Française du Sommaire

RÉSUMÉ

Cette vaste étude par modèle portant sur la région d'intérêt commun pour les 5 États, à savoir les pays du Bénélux, le nord-est de la France, l'Allemagne et l'UAC de Maastricht, a été menée par le Centre expérimental d'EUROCONTROL entre mars 1998 et mai 2000. Un échantillon de trafic de 24 heures, du vendredi 12 septembre 1997, contenant plus de 9 000 aéronefs, a été sélectionné dans les archives du CFMU et testé au moyen du simulateur en temps accéléré RAMS. Cet échantillon de trafic comprenait également des vols militaires effectués en tant que circulation opérationnelle militaire (COM).

Géographiquement parlant, la zone simulée s'étendait de Paris/Londres à l'ouest à Berlin/Prague/Vienne à l'est et de Copenhague/Malmö au nord à Lyon/Milan au sud. Plus de 140 secteurs appartenant à 24 centres ATC différents ont été simulés. Pour 88 de ces secteurs, des mesures de la charge de travail des contrôleurs ont été effectuées. (Les autres secteurs étaient simulés pour que les profils des aéronefs à l'entrée et à la sortie de la zone testée soient corrects.) Les zones militaires ont été activées et désactivées au cours de la simulation, suivant leurs heures d'activité publiées.

Le trafic dans la zone centrale des 5 pays devrait augmenter de 50% entre 1997 et 2005.

Cette étude en temps accéléré visait 4 objectifs bien déterminés :

- valider différents scénarios de réseau de routes ;
- mettre au point un plan de sectorisation optimisé sur la base des besoins des usagers, qui soit dégagé des contraintes des frontières nationales et répartisse de manière équilibrée la charge de travail ATC dans la zone, tout en tenant compte de la mise en œuvre du RVSM (minimum réduit de séparation verticale) ;
- mettre en place une interface civile-militaire optimisée ;
- évaluer et analyser les incidences que peut avoir sur les États périphériques la fixation du DFL (niveau de vol de démarcation entre les secteurs supérieurs et inférieurs) au FL295 dans l'espace aérien allemand et au FL265 dans l'espace aérien français, et proposer des solutions si nécessaire.

Cette simulation s'est déroulée en trois phases. La première phase a défini une organisation de référence basée sur le trafic, le réseau de routes et la sectorisation du vendredi 12 septembre 1997. La deuxième phase a mis en application la Version 3 du réseau de routes ATS (ARN v3), les resectorisations connexes, un DFL au FL295 (FL265 en France) et le RVSM. L'échantillon de trafic utilisé pour cette deuxième phase a été maintenu aux niveaux de trafic de 1997. Enfin, la troisième phase a testé la nouvelle configuration de l'espace aérien avec les niveaux de trafic de 2005 (1997 + 51%). Tout au long de ces trois phases, la charge de travail du contrôleur a été calculée sur la base d'un ensemble de tâches standard, mais en tenant également compte des activités suivantes : résolution des conflits radar, coordinations ad hoc des manœuvres d'évitement de secteur et modifications des autorisations de niveau en cours de vol.

Toutes les données saisies ont été examinées puis validées par le groupe de travail "5 États", composé d'experts ATC provenant de tous les pays concernés. Ce groupe de travail s'est réuni environ tous les deux mois pour évaluer l'état d'avancement de la simulation.

Lorsqu'elle a été testée avec le trafic, le réseau de routes et la sectorisation (DFL245) du vendredi 12 septembre 1997, l'organisation de référence a montré que, dans 27 (32%) des 84 secteurs de la région centrale, les contrôleurs ont connu une charge de travail soutenue, de forte à très forte, pendant les périodes de trois heures les plus chargées. Dix de ces secteurs – parmi lesquels six secteurs de Maastricht – ont été fortement chargés, c'est-à-dire qu'ils ont atteint, voire dépassé les limites de leur capacité.

L'application de la version 3 de l'ARN, des resectorisations connexes, du RVSM et du DFL295 (DFL265 en France) aux niveaux de trafic de 1997 a donné des résultats très prometteurs dans l'ensemble des 88 nouveaux secteurs de la région centrale. Un seul secteur, CANAC South High, a connu une densité de trafic très importante tandis que celle de 14 autres secteurs a été importante pendant trois heures. Ces secteurs ne représentent plus que 17% des 88 secteurs de la zone centrale, contre 32% avec l'organisation de 1997. Par rapport à cette dernière, la combinaison de la version 3 de l'ARN et du RVSM a permis de diminuer de 40% le nombre total de conflits dans la zone centrale, 60% de moins au-dessus du FL295 et 25% de moins au-dessous du FL295. Cependant, dans l'espace aérien se situant entre le FL245 et le FL295 (volume concerné par le changement de niveau de vol de démarcation), le nombre de conflits a été très semblable à celui du scénario de référence de 1997.

Quand l'échantillon a été porté aux niveaux de trafic de 2005 (1997 + 51%), les résultats se sont avérés beaucoup moins prometteurs que ceux de l'organisation V3/RVSM du trafic de 1997 et se sont même, dans l'ensemble, révélés pires que ceux du scénario de référence de 1997. Quarante-six secteurs (ce qui représente 52% des 88 secteurs de la région centrale) ont été, au moins, fortement chargés, dont 30 (34% des 88 secteurs) l'on été très fortement pendant les périodes de trois heures les plus chargées. Sur ces 30 secteurs très fortement chargés, 24 avaient une limite supérieure se situant au FL295 ou au-dessous. En outre, 5 secteurs se trouvaient juste au-dessous du seuil de charge très forte et 9 autres se situaient juste au-dessous du seuil de charge forte. Les conflits radar ont augmenté de 150% au-dessus du FL295 et de 100% au-dessous. Par rapport à l'organisation de référence de 1997, les conflits radar n'ont augmenté que de 1% au-delà du FL295, contre 50% au-dessous.

Ces charges élevées dans le scénario de 2005 ont sans aucun doute été provoquées en partie par des arrivées "en grappe" – un grand nombre d'aéronefs arrivant en un même lieu à peu près en même temps, phénomène particulièrement observable dans l'espace aérien inférieur – imputables à l'accroissement du trafic de 50%. En réalité, ces courants se seraient davantage égalisés. Cela étant dit, ce phénomène de grappe a plus d'incidence sur les charges enregistrées par les contrôleurs pendant des périodes plus courtes, d'une heure par exemple, que pendant des périodes de trois heures auxquelles on fait référence ici.

Plus positivement, le processus en cours d'optimisation des secteurs allemands et l'éventuelle division verticale du secteur UE de Reims feront certainement baisser les charges des contrôleurs dans ces secteurs. Au vu des résultats de cette simulation, c'est l'espace aérien de la FIR/UIR de Bruxelles qui demeure en définitive la principale zone à problèmes.

L'une des difficultés notoires de la FIR/UIR de Bruxelles se situe au niveau de la compression de courants mixtes de forte densité dans des régions étroites, en particulier dans la zone DIK/LNO/NTM. Pour simplifier, les zones militaires sont mal situées par rapport aux besoins du trafic civil qui utilise cet espace aérien, et la sectorisation dans cette région ne répond pas de manière satisfaisante aux exigences des courants ; par exemple, la largeur du secteur Maastricht-Luxembourg, à l'est de MEDOX, n'est que de 30mn entre les frontières française et allemande, ce qui oblige les arrivées à Düsseldorf/Cologne et à Francfort à descendre au-dessous du FL295 au moment du passage de la frontière France/CANAC. Ces éléments nécessitent la mise au point de procédures assez complexes pour que tout fonctionne correctement.

A titre d'illustration, on a obtenu une augmentation de 30% de la capacité grâce à la mise en œuvre, en janvier 2000, du projet Odyssée dans l'espace aérien du Nord de la France. Une partie de ce succès tenait à la séparation des routes, à l'interface CIV, pour les courants à l'arrivée et au départ des aéroports d'Amsterdam, de Bruxelles et de Paris. Malheureusement, il n'est pas possible de faire de même dans la zone DIK pour les courants à l'arrivée et au départ de Bruxelles, Düsseldorf, Francfort et Cologne, l'emplacement et l'étendue des TRA (espaces aériens temporairement réservés) militaires adjacents créant un mince filet d'espace aérien en forme de croix, de LNO à GTQ et de RAPOR à HAN, trop étroit à certains endroits pour permettre une ségrégation efficace pendant les périodes d'activité militaire.

Pour replacer les résultats du CANAC dans leur contexte, il faut savoir que le volume de l'espace aérien CANAC équivaut à la moitié environ de l'espace aérien de Francfort et au quart de l'espace aérien supérieur allemand simulé (les UIR de Hanovre et Rhein réunis). Or, les niveaux de trafic de 2005 qu'a enregistrés le CANAC représentaient 75% des niveaux de trafic de Francfort et 90% de ceux de l'espace aérien supérieur allemand. De plus, le CANAC a dû faire face à plus de conflits en 24 heures que l'espace supérieur de l'Allemagne ou que Francfort (982 pour CANAC, 980 pour l'espace supérieur de Allemagne et 901 pour Francfort). Lors d'une autre expérimentation (assez approximative) basée sur le même scénario de 2005, mais avec remplacement de toutes les routes par des acheminements directs du point d'entrée au point de sortie de la simulation, le nombre de conflits enregistrés dans l'espace aérien CANAC a chuté de 60% - de 982 à 375 (341 conflits ont été enregistrés dans l'espace aérien CANAC dans le cas du scénario de référence de 1997).

Comme à l'accoutumée dans une simulation de cette ampleur, il est difficile de tirer des conclusions claires et définitives qui, en fin de compte, seront soumises à l'interprétation de chacun. Cependant, une chose est certaine : les résultats globaux se sont améliorés de manière remarquable quand l'espace aérien a été testé avec la structure de l'espace aérien V3/RVSM DFL295 et le trafic de 1997, par rapport au scénario de référence de 1997.

Sans doute le facteur le plus important pour déterminer le DFL dans l'espace aérien d'Amsterdam et du CANAC tient-il dans le nombre et la nature des diverses restrictions de niveau qui doivent être appliquées aux principaux courants à l'arrivée pour les grands aéroports de la zone centrale. L'application de ces restrictions, du FL250 au FL290 (niveaux maximum à certains points), nécessite un espace aérien suffisamment étendu dans le plan vertical pour que l'attribution de niveaux puisse se faire de manière efficace en période de forte densité de trafic. Trois options se présentent alors :

- La première consiste à ne pas modifier le niveau actuel de démarcation (FL245) du CANAC et d'Amsterdam, ce qui laisse aux secteurs correspondants de Maastricht la responsabilité d'appliquer les restrictions, mais avec un nombre de niveaux insuffisant cependant pour l'application de restrictions inférieures, au FL250 et FL260, en cas de forte densité de trafic. En outre, vu la tendance à faire descendre le trafic à l'arrivée aussi bas et aussi tôt que possible en cas de situations de trafic complexes, il est probable que les secteurs CANAC seront de plus en plus sollicités pendant les périodes de forte densité de trafic. La délégation de l'espace aérien, les fenêtres et les balcons offriront certes des solutions, mais à court terme uniquement.

- La deuxième option consiste à fixer le DFL entre le FL255 et le FL285. Aucun de ces DFL n'a été simulé en temps accéléré et, étant donné qu'ils appellent une certaine réorganisation des secteurs et une analyse des différentes restrictions de niveau et des procédures d'évitement de secteurs à mettre en œuvre, aucun commentaire pertinent ne peut être formulé. Ces DFL devront être testés en temps réel.

- La troisième option consiste à porter le DFL du CANAC et d'Amsterdam au FL295, comme dans la simulation. Par rapport au scénario de référence de 1997, cette configuration a donné lieu à des améliorations globales nettes, bien que moins convaincantes pour le CANAC que pour Amsterdam. Toutefois, un DFL au FL295 présente l'avantage de permettre aux secteurs CANAC en particulier de garder le contrôle total de l'attribution des niveaux lors de l'application des restrictions aux courants à l'arrivée. Dans certains cas, cela atténuera la sévérité des contraintes de niveau à appliquer (une contrainte au FL290 est moins pénalisante qu'une contrainte au FL250/FL240). Cela dit, cette option a aussi quelques inconvénients, notamment un volume très élevé de trafic mixte dans les secteurs CANAC, nécessitant un réexamen de la structure des routes dans l'ensemble de l'espace aérien, d'éventuelles restrictions de niveau pour les départs de Bruxelles et de Düsseldorf via GTQ, qui devront être maintenues au-dessous des secteurs correspondants de Maastricht, et la nécessité d'aborder le problème que pose la montée des départs de la TMA de Londres dans l'ouest de l'espace aérien. Cette option pourrait aussi poser des problèmes de système pour le CANAC et entraîner une augmentation du nombre de secteurs nécessaires pour la gestion du trafic prévu.

Dans ces trois options, le même obstacle principal subsiste : il n'est pas réellement possible de séparer de manière efficace les routes d'arrivée et de départ des aéroports de Bruxelles, Düsseldorf, Francfort et Cologne dans la zone DIK sans déplacer ou redéfinir les TRA militaires adjacents.

Au vu de l'ensemble des résultats de la simulation, le DFL recommandé pour les FIR/UIR d'Amsterdam et Bruxelles est le FL295.

Enfin, il va sans dire qu'il est nécessaire d'exploiter tous les avantages qu'offre le FUA, et que la structure de l'espace aérien et du réseau de routes dans cette zone doit être revue afin de répondre aux besoins de tous les usagers de l'espace aérien. Cependant, même en tenant compte des imprécisions liées à la simulation, les résultats obtenus avec le trafic de 2005 démontrent clairement que ces deux éléments doivent être pris en compte d'urgence.

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