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NLR-CR-2025-222 | November 2025

# FUA above and below FL245

CUSTOMER: Knowledge & Development Centre (KDC) Schiphol



Royal NLR - Netherlands Aerospace Centre

## FUA above and below FL245



### Problem area

Dutch airspace is scarce and busy, and is being used for both civil and military purposes. To manage this as efficiently as possible, the concept of Flexible Use of Airspace (FUA) is used. This allows (mainly military) airspace to be shared between civil and military users based on needs rather than strict allocation, increasing efficiency and safety by dynamically allocating airspace. FUA enables more efficient flight routes for civil flights by utilising military airspace when not being used, leading to shorter routes flown and, consequently, to fuel and time savings for airlines.

Despite the introduction of the FUA cell by MUAC and the Royal Netherlands Air Force in 2020 for delegation of airspace above FL245, significant inefficiencies persist below FL245. Flights are filed to route around training areas (such as TRAs and EHDs), but are actually flying through them due to tactical rerouting. This results in shorter flights due to a more direct routing, but also requires airlines to carry more fuel than would have been necessary. This is seen as an area where further operational efficiencies can be achieved. Furthermore, instances have been observed where conditional routes (CDRs) were unavailable for flight planning, while the corresponding TRAs were open. This requires a possible need for more transparency on the availability of CDRs or improved airspace management.

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## Description of work

The goal of this study is to identify and find solutions for inefficiencies in the Flexible Use of Airspace concept applied in the Netherlands, especially below FL245. The main challenge of the tasks at hand lies in the balancing of military and civil interests. The input for this study has been retrieved by interviewing multiple stakeholders and by conducting a workshop.

## Applicability

By addressing these inefficiencies and improving FUA processes, airspace use in the Netherlands can be optimised, enhancing efficiency, safety, and cooperation between military and civil aviation stakeholders. Next steps have been identified to accomplish this improvement. The feasibility of these steps should be investigated as well as the impact they can have on the operation as a whole.

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## Summary

The Netherlands Aerospace Centre (NLR) was asked to investigate how to optimise airspace use in the Netherlands by identifying inefficiencies in sharing military airspace with civil users. The Dutch airspace is limited and busy, and used by both civil and military users. To manage this efficiently, Flexible Use of Airspace (FUA) allows sharing based on needs rather than strict allocation.

Despite introducing FUA above FL245 in 2020, inefficiencies remain below FL245. Flights are planned around training areas but often fly through them due to tactical changes, resulting in shorter flights but requiring more fuel than necessary. Furthermore, instances have been observed where conditional routes (CDRs) were unavailable for flight planning, while the corresponding TRAs were open.

Interviews with stakeholders identified areas for improvement:

1. Weekly meetings between military and civil planners could enhance transparency and understanding.
2. Reducing processing times for airspace changes within the Integrated Initial Flight Plan Processing System (IFPS) from three hours to 1.5 hours before flight departure could benefit airlines like KLM.
3. International cooperation with neighbouring countries is essential for managing cross-border airspace.
4. Utilising planning time differences between the military and FC-M.

The following points have been identified that require further investigation:

1. Determine how many flights would benefit from reduced processing times.
2. Examine if adapting the Network Manager IFPS is feasible.
3. Conduct operational analysis to identify specific flights or routes benefiting from short-notice airspace changes.
4. Investigate if and how airlines can submit flight plans using unplannable routes.
5. Dynamic sector division could allow military sectors to be subdivided for simultaneous use by military and civil traffic.

By addressing these inefficiencies and improving FUA processes, airspace use in the Netherlands can be optimised, enhancing efficiency, safety, and cooperation between military and civil aviation stakeholders.

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## Abbreviations

ACRONYM	DESCRIPTION
1ATM	One Air Traffic Management
AAA	Amsterdam Advanced Air traffic control system
ACC	Air Combat Command
AFMU	Airspace Flow Management Unit
AMC	Airspace Management Cell
ANSP	Air Navigation Service Provider
APOC	Airport Operations Centre
ASM	Airspace Management
ASMC	Airspace Management Council
ATMP	Air Traffic Management Portal
AUP	Airspace Use Plan
CBA	Cross-border Military Training Area
CCIS	Central Communication and Information System
CDR	Conditional Routes
CIAM	Collaboration Interface for Airspace Management
CLSK	Commander of the Royal Netherlands Air Force
EHD	Danger Area
FC-L	FUA Cell LVNL ISEA/OHD
FC-M	FUA Cell Maastricht/MUAC/AFMU
FIR	Flight Information Region
FMP	Flow Management Position
FRA	Free Route Airspace
FUA	Flexible Use of Airspace
HCC	Hub Control Centre
ICA	Intercontinental
iCAS	iTEC-based Centre Automation System (replacement of AAA)
IFPS	Integrated Initial Flight Plan Processing System
IFPZ	IFPS Zone
IFR	Instrument Flight Rules
IFS	Integrated Flight Support
ISEA	Impact Special Events on Airspace
KLM	Royal Dutch Airlines
LARA	Local and Sub-regional Airspace Management Support System
LIDO	Lufthansa Integrated Dispatch Operation
I&W	Ministry of Infrastructure and Water Management
LoA	Letter of Agreement



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LVC	Air Traffic Committee
LVNL	Air Traffic Control The Netherlands
MATCC	Military Air Traffic Control Centre
MLA	Military Aviation Authority
MUAC	Maastricht Upper Area Control Centre
NLR	Royal NLR - Netherlands Aerospace Centre
NMP	Network Manager Portal
OCC	Operations Control Centre
OHD	Operational Helpdesk
RAD	Route Availability Document
SOTA	Sector Opening Times Architect
TRA	Temporary Reserved Area
UUP	Updated Airspace Use Plan

The Knowledge Development Centre (KDC) has requested NLR to conduct an investigation that aims to optimize the use of airspace in the Netherlands, by identifying inefficiencies in the flexible use of military airspace between military and civil users.

The Dutch airspace is scarce and busy, and is being used for both civil and military purposes. To manage this as efficiently as possible, the concept of Flexible Use of Airspace (FUA) is used. This allows (mainly military) airspace to be shared between civil and military users based on needs rather than strict allocation, increasing efficiency and safety by dynamically allocating airspace. FUA enables more efficient flight routes for civil flights by utilising military airspace when not being used, leading to shorter routes flown and, consequently, to fuel and time savings for airlines.

Despite the introduction of the FUA cell by MUAC and the Royal Netherlands Air Force in 2020 for delegation of airspace above FL245, significant inefficiencies persist below FL245. Flights are filed to route around training areas (such as TRAs and EHDs), but are actually flying through them due to tactical rerouting. This results in shorter flights due to a more direct routing, but also requires airlines to carry more fuel than would have been necessary. This is seen as an area where further operational efficiencies can be achieved. Furthermore, instances have been observed where conditional routes (CDRs) were unavailable for flight planning, while the corresponding TRAs were open. This requires a possible need for more transparency on the availability of CDRs or improved airspace management.

### 1.1 The Challenge

Flexible Use of Airspace (FUA) is a concept for airspace management where the use of airspace is not specifically allocated to either military or civil users. Instead, it is regarded as a continuum to meet the demands of various users. In the Netherlands, with its limited airspace and diverse users, it is even more important to make optimal use of this scarce airspace while balancing the interests of the various users. The European regulation (EC) 2150/2005<sup>1</sup> serves as a guideline to achieve this goal. It must be noted, however, that in the Netherlands, FUA is mainly used to make military airspace more efficiently available to civil users. There are far fewer instances of civil airspace being made available to military users.

Currently, the FUA implementation in the Netherlands, especially below FL245, faces significant inefficiencies:

- Routing inefficiencies: flight planning often bypasses training area, but flights still pass through them tactically;
- Misaligned route availability: Conditional Routes (CDRs) are sometimes closed despite training areas being open;
- Data gaps: the exact implementation status and benefits of the current FUA system are unclear for civil users;
- Implementation discrepancies: significant differences exist between FUA operations above and below FL245.

Although significant effort has been put in designing an efficient FUA concept below FL245, there is a feeling among civil stakeholders that there is room for improvement to maximize the effectiveness of FUA. A major challenge here is to align military and civil requirements.

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<sup>1</sup> Commission Regulation (EC) No 2150/2005 of 23 December 2005 laying down common rules for the flexible use of airspace. (2005). Official Journal of the European Union, L342, 20-28.

## 1.2 Background Knowledge

The main challenge of the tasks at hand lies in the balancing of military and civil interests. Partly based on a recent NLR project for the Military Aviation Authority (MLA), the following section briefly summarizes both the military and civil planning processes, including the relevant actors for each step and the associated systems.

The FUA process can be divided into three levels: the strategic decision-making of the Air Traffic Committee (LVC), and the executive tasks of the Airspace Management Cell (AMC) at the pre-tactical and tactical levels.

### 1.2.1 Military Planning Procedure

The military planning process follows a structured timeline. Air combat command starts long-term planning for the airbases in Volkel, Leeuwarden, and Eindhoven between a year to six months in advance. Subsequently, the squadrons develop a detailed plan, including the number of aircraft and pilots, from two months to two weeks before the tactical execution. Additionally, weekly meetings are held where the planning becomes increasingly precise as the period progresses. On Wednesday, Week-1, Air Defence (CRC BOP), on behalf of the RNLAF squadrons and other NATO units, the Royal Netherlands Navy and the Vlieland Range insert the next week planning into LARA. In parallel, the FC-L ensures that any other military input is inserted into LARA and MUAC inserts any military requirements of their own. If any conflicts exist between military bookings, Air Defence has the responsibility and authority to conduct the deconfliction.

The day before the planning execution (D-1), the AMC takes over. The AMC (FC-L and FC-M) integrates plans into the Local and Sub-regional Airspace Management Support System (LARA). LARA is a planning system for local and sub-regional airspace use by Eurocontrol that has been operational for more than 10 years. The FC-M enters the planning into the Airspace Use Plan (AUP) using the SOTA (Sector Opening Times Architect) AUP tool and coordinates with the Dutch Mil Supervisor to optimise airspace usage below FL245. At 4:00 PM, the plan is finalized and sent to the Network Manager via CIAM (Collaboration Interface for Airspace Management), an application in the Integrated Initial Flight Plan Processing system (IFPS). In parallel, the NL AUP is sent, via email, to 27 users operating in the Amsterdam FIR.

For the airspace below FL245; on the day of the planning execution (D-0), the Combat Command Supervisor ensures that the AUP is implemented in 3-hour blocks (from 8:00 AM to 11:00 AM and from 12:00 PM to 3:00 PM), occasionally with a third block in the evening. During these periods, the airspace is blocked for civil aviation, and an Updated Airspace Use Plan (UUP) can be entered into LARA with adjustments every 30 minutes. These UUPs are then processed in the IFPS; a centralised service of the Eurocontrol Network Manager (NM) designed to process and distribute flight plan data related to Instrument Flight Rules (IFR) flights within the IFPS zone (IFPZ). The AUP and UUP are shared via CIAM and can be accessed on the Eurocontrol Network Operations Portal.

### 1.2.2 Civil Planning Procedure

The scheduling process within aviation operations spans several days and involves various key actors (airport, policymakers, airlines, ATC, and the Network Manager). From a year to six months in advance, airports and policymakers are involved in determining and distributing slots for the entire season, based on the 'use it or lose it' principle, where airlines must use at least 80% of their allocated slots.

Up to a week before operational execution, the Hub Control Centre (HCC) and Operations Control Centre (OCC) manage internal planning. A weekly plan is established starting 14 days in advance, and from 7 days prior, coordination with the Airport Operations Centre (APOC) occurs.

The day before operational execution (D-1), the HCC/OCC generates the flight schedule using systems such as the Lufthansa Integrated Dispatch Operation (LIDO), used by KLM. The flight plan is sent to LVNL 6 hours before the flight's departure, allowing for any route adjustments. Simultaneously, the Network Manager (NM) shares traffic flow restrictions via Eurocontrol bulletins.

On the day of operational execution (D0), Eurocontrol releases the plan 8 hours before the flight's departure, and LVNL provides approval up to one hour before departure, although changes can be made up to departure. The OCC releases the flight plan to the pilots 1.5 hours before departure.

### **1.2.3 Decision making structure for airspace use**

The decision making structure for airspace use in the Netherlands is divided into three levels: strategic level 1, pre-tactical level 2 and tactical level 3.

#### **1.2.3.1 Strategic Level 1**

The Air Traffic Committee (LVC) is the strategic decision-making body for flexible and dynamic airspace use in the Netherlands and advises the Ministers of Infrastructure and Water Management and Defence. This involves policy matters related to the joint use of Dutch airspace by civil and military aircraft. In Eurocontrol terms, this is also known as the Airspace Management Council (ASMC). The first Level 1 contact for balancing the requirements of civil and military users is the H-AMC (Head of AMC).

#### **1.2.3.2 Pre-Tactical Level 2**

At the pre-tactical level, the AMC is the executive body of the LVC. In the Netherlands, since 2020, the tasks of the AMC have been divided between the FUA Cell LVNL (LVNL ISEA/OHD) and FUA Cell MUAC, with the Airspace Flow Management Unit (AFMU) as the military component of the AMC. At the planning level, the AMC allocates airspace structures to users in accordance with the priorities defined by the LVC. Their tasks also include defining temporary restricted areas, conditional routes (CDR), FUA restrictions and Dynamic RAD. The AMC produces and disseminates the Airspace Use Plan (AUP) and the corresponding updates (UUP) for the following day. The publishing of the activation of military airspace in the AUP and UUP is a task of the MUAC FUA Cell.

#### **1.2.3.3 Tactical Level 3**

The ATC supervisors at Schiphol Oost (LVNL and Dutch Mil), the MUAC supervisor and the Bandbox Fighter Allocator form the tactical level. The activation and deactivation of temporary reserved areas and conditional routes occur according to the approved daily Airspace Use Plan. Coordination between airspace planners takes place as necessary. Short-term changes are possible but are primarily managed through discussions between supervisors (combat control, air traffic control/1ATM, MUAC, FMP LVNL).



### 1.2.3.4 Planning summary

The following graphic summarizes both the military and civil process in one overview:

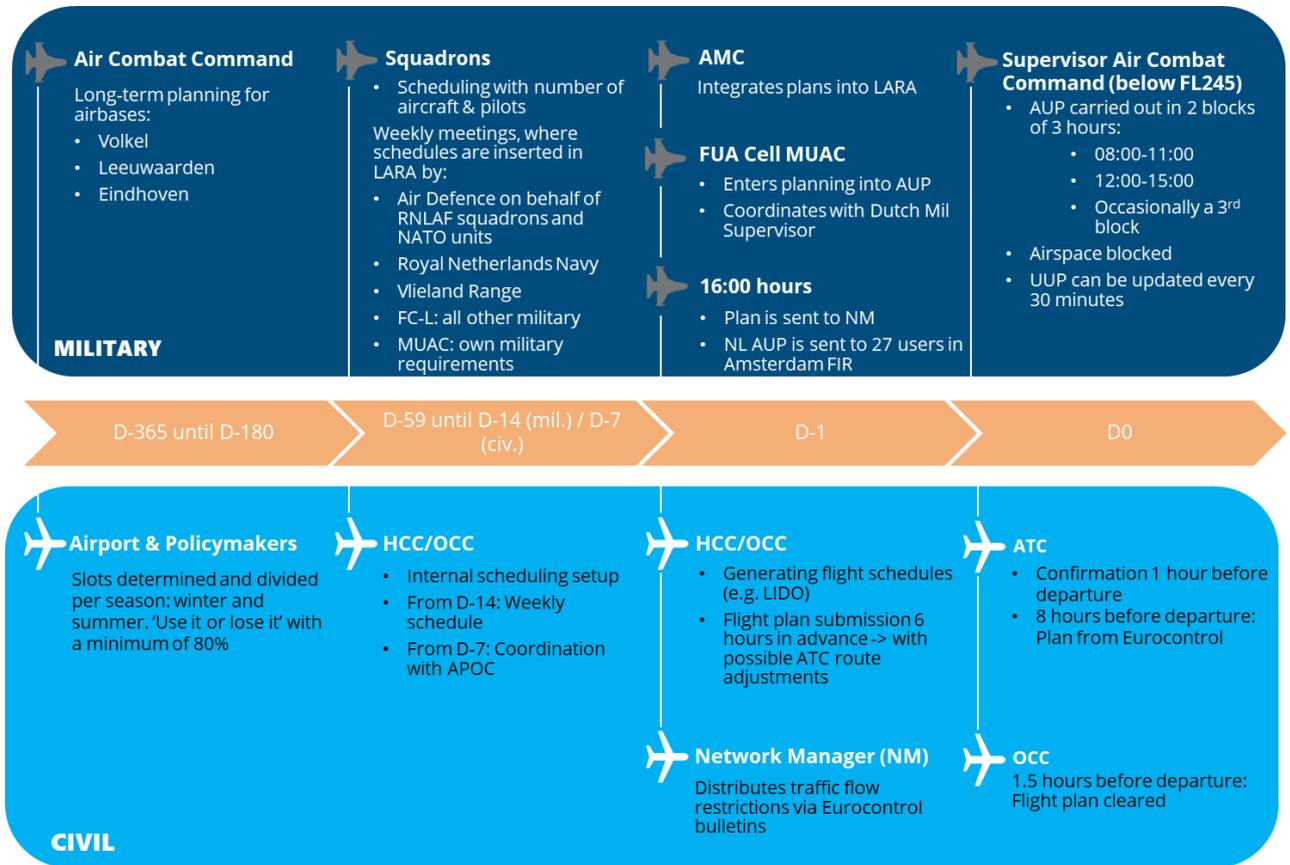


Figure 1: An overview of the timeline for the execution of both military and civilian operational planning

## 2

# Interview and workshop results

## 2.1 Methodology

Inputs for this study have been obtained from civil and military stakeholders by means of multiple interviews and a workshop. The summaries of these interviews and workshop were consequently shared with the stakeholders to confirm the content and to retrieve feedback. Additionally, draft versions of this study have been shared with stakeholders to receive feedback. This feedback has been incorporated into this final version.

## 2.2 Results

In this section, several possibilities for improving the FUA process are identified that emerged from the interviews and workshop. Firstly, it should be noted that regarding FUA, military and civil interests are conflicting. Additionally, the FUA process has primarily been applied in recent years to enhance the efficiency of military airspace for civil use, but given current global developments, it is expected that the military claim on these areas will increase. This will be driven not only by the Royal Netherlands Air Force (RNLAf) requiring more frequent and longer training periods, but also by increasing demands from foreign air forces for training areas in the Netherlands. Eventually, it can lead to the three-hour blocks being fully utilized and also to more bookings outside the three hour blocks used by the RNLAf F35 squadrons, resulting in more friction between the conflicting military and civil interests.

### **Weekly meetings between military and civil planners**

A weekly meeting between a central ACC planner and MUAC/LVNL could help minimize this friction. During this meeting, the weekly deployment and its impact on civil operations could be discussed to create more transparency and understanding. Any changes would then be implemented in the days up to D-1 and on the day itself.

### **Reducing IFPS processing times**

The potential last-minute changes are processed by the IFPS system of the Network Manager at Eurocontrol in a UUP up to 3 hours in advance. Currently, changes within this three-hour window cannot be processed in an updated plan. The processing system is technically unable to handle these messages within this time frame. This limitation is known, but Eurocontrol does not see any changes coming because, according to them, few airlines have planning cycles of less than three hours.

### **Clearer and better plannable FUA process**

From the interviews, it has also become clear that some airlines want more clarity on how the FUA process works and how they can better plan for it. There have been instances that CDRs are not available, even though the corresponding training areas were open. The military book the whole airspace block for training, but it is up to LVNL to make the CDRs available. LVNL is, however, reluctant to do this, because the airspace itself is not under their control. Besides, CDRs are difficult to plan in LARA, which is considered a system limitation. It is also noted that airlines often fly shorter routes through areas that were not available during flight planning. This results in a more direct route being flown, but also in more fuel being carried than would have been necessary. From the conversation with KLM and the workshop, it appears that KLM is able to apply changes to the planning until 1.5 hours before departure. These changes would not only affect the route, but also the corresponding amount of fuel carried by the plane. This means that an airline like KLM would benefit from shorter processing times than the current three hours of the IFPS system. It should, however, be noted that not all airlines are able to make changes so close to departure.

To address this issue, it could be explored whether the minimum processing time for a UUP can be shortened. Theoretically, this could be reduced to 30 minutes before the event. Ideally, the system should be able to process changes up to 1 hour before departure. This would result in the desired time of 1.5 hours, taking into account the 30 minutes needed to place and process the message in the system.

### **Plan unplannable routes**

If it is not possible to adapt the IFPS system to process changes within three hours, an intermediate solution could be explored. According to current regulations, it is not possible for airlines to let the amount of fuel onboard deviate from the amount of fuel needed for the planned route. Airlines are therefore not allowed to anticipate potential shorter routes that they cannot strategically plan, but which are tactically offered nonetheless. As an intermediate solution, it could be investigated if it is possible for airlines to plan routes that are currently not plannable at the NM because they are not yet available. This would comply with the regulations regarding fuel amounts for the planned route while allowing airlines to carry less fuel than they would have otherwise. However, it is crucial that communication between all parties involved is of a high and stable level to ensure that shared information is accurate and not subject to change after communication.

### **Increasing military demand**

The changing military interests should also be taken into account. If the military training demand increases and, henceforth, requires the full utilisation of the flight blocks, this will have a significant impact on the flexible use of airspace. As a result, the benefits of updating the IFPS system or the aforementioned intermediate solution may be partially or entirely lost, as it will be clear in advance that all planned blocks will be used. In other words, the planned routes of airlines will no longer differ from the actual routes flown. The airspace will not be available for civil traffic during both planning and execution. While there may still be benefits from the processing of changes up to 1.5 hours before departure, these will be of a different order of magnitude.

The increasing military demand will not only be fed by increasing national demand, but also by international demand from neighbouring countries willing to train together, also in Dutch airspace. International cooperation with neighbouring countries is, therefore, also seen as one of the areas for improvement for the FUA process. Within the Netherlands, the airspace Management Cell (AMC) is divided into two parts: FUA MUAC and FUA LVNL. MUAC is a service provider in the field of air traffic control in four member states, but only the AMC for the Netherlands. Two possibilities for shaping this international cooperation would be to merge FUA Cells or create an overarching Airspace Cell. The key question then is who is responsible and allowed to make decisions, i.e. where to allocate responsibility. These are ultimately Level 1 decisions. Additionally, a kind of allocation key needs to be applied to fairly distribute the exercise areas and associated times among the different parties. The recent establishment of a LoA for CBA North (a Dutch and German cross-border military training area) can be seen as a good example of how cross-border airspace can be managed and could be used as a basis for the development of other military cross-border areas.

### **Utilising planning time differences**

Another possible area for improvement is the use of planning time differences between the military and FC-M. When planning for training exercises, FC-M uses the opening hours of military airfields as reference, a procedure inherited from the RNLAf. However, in practice, the times used for activating the training areas occur shortly before (15-30 minutes) the actual usage of the training areas. If this difference can be shortened, this could mean that areas remain available longer for civil users which would lead to a more efficient and flexible use of airspace.

### **International cooperation**

As the European military training demand continues to rise in the current political situation, international cooperation will also become increasingly essential. Neighbouring countries will place a bigger claim on the training areas which will

require a more coherent approach between the countries. To optimize the use of limited airspace and resources, European nations must work together to identify synergies and utilize common training areas whenever possible. This will require strategic and pre-tactical cooperation among neighbouring countries, such as Germany, the UK, and Belgium, to ensure a coherent and coordinated planning of military activities. By sharing airspace and expertise, European militaries can enhance their training effectiveness while minimizing disruptions to civilian air traffic, ultimately strengthening their collective defence capabilities.

A summary of the interviews and the workshop can be found in the appendices.

1. Airspace Management Cell
2. Air Combat Command
3. Maastricht Upper Area Control
4. KLM
5. Workshop

From the interviews and workshop, it has become clear that some airlines wish to be informed of changes and be able to process them up to 1.5 hours before flight departure, instead of three hours. As a first step, it should be determined how many flights would make use of this possibility. In other words: how many extra changes will be implemented inside the additional time slot. This should then be quantified to determine the impact on the entire sector. This includes investigating how many airlines are actually able to apply changes up to 1.5 hours before flight departure.

### **IFPS adaptation**

As a next step, it should be examined whether it is feasible to adapt the IFPS system so that the desired minimum submission time for airspace changes is reduced to 1.5 hours before. For this, an analysis should be made to define what the limiting factors are and if it is possible to overcome them, both technically as well as economically.

### **Operational analysis**

An operational analysis could be carried out to determine if there are specific flights or routes that would benefit from airspace changes being submitted on short notice, with filed flight plan changes to the IFPS up to 1.5 hours before departure. The Network Manager could, as a trial, apply reduced minimum flight plan filing times to these specific flights and routes. The advantages of this approach include the ability to test the potential benefits, a significant impact due to targeted application on selected routes, and minimal impact on the IFPS system, requiring fewer changes compared to a broader implementation across all flights.

In order to obtain a complete picture of the impact of reducing the minimum times of flight plan filing, the influence of a different (shorter) route on, for example, the connections of these flights should also be determined, as well as aspects such as the availability of airport facilities (e.g. stands and gates) or ground handling staff and equipment.

### **Plan unplannable routes**

If it appears that adjustments to the IFPS system are neither technically nor economically feasible, it should be examined whether it is possible for airlines to submit flight plans that use unplannable routes. It should become evident what is required for this and whether this is possible at all, given the regulations and system limitations.

### **Dynamic Sector Division**

Additionally, and only applicable to the airspace below FL245, there appears to be a shared interest between military and civil stakeholders in the concept of dynamic sector division. In practice this means that military sectors can be subdivided, based on military and civil requirements, to offer sector space for both military and civil traffic simultaneously. However, there are concerns about the feasibility of implementing such a concept due to existing system limitations. It should be determined if such a concept is feasible and what the benefits can be.

# Appendix A Airspace Flow Management Unit & Military Air Traffic Control Centre

## Appendix A.1 Present

**René Francken:** Commandant Military Air Traffic Control Centre (ATCC) Schiphol, (procedures) Programma Luchtruim Herziening (PLRH), supervisor and air combat command (MATCC)

**Sander Hingstman:** AMC & AFMU

**Marc van Gastel:** Manager Operations MilATCC Schiphol

## Appendix A.2 Summary of interview

There is a trial with MUAC to test whether we are able to change our morning bookings. The morning block is already fixed the afternoon before (4:00 PM), and we don't usually make any changes to it in the morning. Changes can still be made to the afternoon sessions and within the planned blocks, but generally not to the disadvantage of civil operations. The military planning on D-1 is very stable with the exception of incidental weather changes, but last-minute changes in personnel or material have less impact. They mostly concern a single flight not the training exercise in its entirety.

The bookings we made can be cancelled through LARA, regardless of whether it still makes sense. It can be tactically arranged by phone. MUAC is usually LARA-based, but also phone calls can be used to deregister areas. LVNL has direct access to the time block that we enter via CCIS, but there is little benefit to releasing airspaces earlier since MUAC and LVNL are not able to act swiftly. They need at least two hours between two bookings to make it plannable. They keep flight planning buffers in place 30 minutes before and after an airspace reservation. Two hours between two reservations, therefore, lead to effectively only one hour of planning space, of which they consider the benefit to be too small compared to the necessary implementation effort.

Up to three hours in advance, changes to the airspace planning can be made by sending out a UUP. Within these three hours, any changes will be communicated with civil supervisors and if accepted will be applied tactically. The reasons for this is that the network manager's planning system (IFPS) is not able to process these short notice changes without becoming overloaded.

At a tactical level, the benefits are primarily realized by ATC. For the airline, this translates to gaining a few track miles, but often this has little benefit as the flight is then waiting at an occupied gate. Since LVNL has no access to LARA (LARA will be introduced with the implementation of iCAS), short tactical changes have to be manually put into CCIS by the Military Supervisor (who is located in the same operations room). LVNL is then able to act immediately upon these changes.

There is a difference in the planning between the military and MUAC. MUAC takes the opening hours of military bases into account, where we plan activation time of the airspace itself plus a buffer to get from the airbases to the airspace. Also, the 30 minute buffer used by MUAC before and after plannable airspace is the same for every airspace, though times to cross or vacate these different airspace volumes depends on their size. There might be some room for increasing civil efficiency by aiming for airspace activation times instead of airbase opening hours. The question is, however, how this will impact the use of airspace, for we have a great need for flexibility.

Interests are typically balanced between military and civil aviation during major exercises. However, the military often expresses frustration as the anticipated impact of an exercise frequently fails to occur. To achieve a more objective assessment, thorough preparation and coordination are essential, as demonstrated by the Frisian Flag exercise. Providing notice six months in advance is necessary for this purpose. The decision-making process for temporary airspace is a state responsibility, with the Air Navigation Service Provider (ANSP) playing a vital role under government oversight.

Data from LARA can be utilized for analytical purposes, enabling the examination of the evolution of reservations. However, there is rarely any subsequent discussion, as this typically pertains to the nominal utilization of airspace in accordance with planning. In cases of shorter planning periods, it is possible to assess how actual usage diverged from planned usage, but no substantial margins are typically observed. Furthermore, even when completion occurs ahead of schedule, there is only a limited need to adjust the planning. Any premature termination is managed through ATS delegation as it is difficult to determine, beforehand, when training finishes.

The Airspace Flow Management Unit (AFMU) is the military component of the Airspace Management Cell (AMC). In general, the AMC is composed of two Flexible Use of Airspace (FUA) cells: Maastricht/MUAC (FC-M) and LVNL ISEA/OHD (FC-L). The Maastricht/MUAC cell is responsible for nominal flow control management and issues AUPs and UUPs, whereas non-nominal restrictions and exercises are handled by the FC-L at Schiphol. There is considerable collaboration between AMCs and ANSPs regarding planning, but less so with end-users such as CLSK and airlines. Regular consultation with Schiphol Airport and KLM is necessary to discuss peak periods and requirements. The implementation of requests through the D-1 planning can be enhanced by CLSK and MUAC working together. Larger airlines already have a fixed planning schedule within a week, but CLSK can still be flexible within certain frameworks. It is possible to add an extra layer to improve planning capabilities.

## Appendix B Air Combat Command

### Appendix B.1 Present

**Martijn Pijnenburg:** Lead planner A5, National Air & Space Operations Center (NASOC)

### Appendix B.2 Summary of interview

There needs to be an understanding from all parties that it is not possible to plan rigidly and why this is the case. For large-scale exercises, agreements can be made in advance. Small daily local exercises have a different character, requiring some flexibility to accommodate last-minute changes caused by weather conditions, but also issues such as a technical problem with an aircraft, a specific configuration required for a test flight, or unavailable staff.

UUPs are agreed upon by supervisors over the phone. Ad hoc adjustments, such as adding an extra piece of airspace, are handled with a UUP. This happens daily for all exercise blocks. Once the exercise is complete, it is reported back, and this process typically takes less than five minutes.

Nieuw-Milligen already has direct contact with MUAC and LVNL to involve operators as well. Agreements can be made for potential exceptions, but there is no set procedure for this, and it depends on the person working at the time. Given MUAC's and the air force's flexibility, we are able to adapt.

If the minimum processing time of three hours at MUAC is fixed, we still need to have flexibility. We share the airspace outside our national borders; it's not our territory, but it is our Flight Information Region (FIR). The expectation is that there will be more claims in the future, not just from the Netherlands but also from countries like Belgium and Germany. The Netherlands and MUAC currently work well together, but if Belgium and Germany start making claims on the airspace, there should ideally be a kind of overarching Airspace Management Cell where a distribution key is applied among users. The expectation is that within those three hours, additional sectors will be added if there is demand for them. However, conditions should be attached to ensure that external parties train within the same time blocks.

The expectation is that there will be more flying in the near future. Previously, we used the third exercise block (during American presence), but not recently. This will likely happen again as all countries have new equipment and want to use it. Additionally, aircraft are currently often grounded due to noise restrictions, which is expected to change. This will lead to more efficient use of the available blocks, with the full three hours being utilized.

Ultimately, civil and military interests are conflicting. A weekly meeting between a central ACC planner and MUAC/LVNL to discuss the weekly schedule and its impact on flow management could lead to a mutual understanding on both sides. On the day of the exercise, final agreements can then be made, usually without any changes.

The introduction of new systems and tools, such as LARA at LVNL, can help improve efficiency. However, the question remains why this needs to be done digitally when it can already be done over the phone. The advantage of LARA would be that both parties can look at the same planning when they speak to each other on the phone.

There also needs to be clarity on what the annual additional costs are for an airline between flown and planned routes. Then, it should be determined how much gain this can generate for the entire sector, considering not all companies can adjust up to 1.5 hours before departure. If it's desirable to work towards changes that can still be made 1.5 hours before departure, the conditions for this need to be established and be feasible. Currently, communication is lacking, the IFPS system is technically unable to handle it, and according to current regulations, it's not possible because the fuel taken on board must be based on the filed flight plan.

## Appendix C Maastricht Upper Area Control

### Appendix C.1 Present

**Ralf Hendriks:** ATS Expert & OPS Manager, FC-M Eurocontrol  
**Herbert Koppe:** Airspace Design Expert, Eurocontrol

### Appendix C.2 Summary of interview

Until D-1, we work completely independently. Decisions are made on the day itself by supervisors. Until D-1, this process occurs through FUA Cells as preparation for the AUP. NM does not accept UUPs within three hours; in practice, this means 3.5 hours beforehand due to a minimal processing time of 30 minutes.

We use a flight plan buffer zone of 30 minutes to account for delays or early arrivals of flights. A gap of 1 hour or less between two airspace reservations plus two buffers of 30 minutes (totalling 2 hours) will not result in opening up the airspace for booking. It is possible for ATC to tactically use this airspace, but it cannot be booked in the flight plan. This means that, while ATC can provide information about the availability of airspace during this time period, it cannot be officially reserved or included in the flight plan due to the buffer zone requirements.

Information reaches airlines through the AUP and the UUP. LARA serves as our national booking tool; by D-1, all bookings are entered into LARA. The Germans use a different system (STANLY ACOS); although we can see their activities, there's no direct link between our systems. LARA and STANLY information is converted to be available at the NM. Airlines use business-to-business tools to obtain the AUP and UUP information from NM; we don't foresee changes here since it works reasonably well. Few airlines have planning cycles shorter than three hours.

FMP communication primarily occurs via phone calls. An Air Traffic Management Planning (ATMP) tool has been set up for FMPs to coordinate certain flights (e.g. shorter routes). No specific tools are currently used for FUA.

FUA application below FL245 becomes less feasible closer to airports due to fixed routes; MUAC does not face these limitations due to Free Route Airspace (FRA).

Capacity is automatically (6 hours in advance) adjusted to accommodate expected airspace closures, but it is currently not possible to verify internationally if there is availability for missions. This still requires interaction via phone. Ideally, there should be one cross-border booking system, transparent to everyone, and Letters of Agreement (LoA) to determine who is responsible for bookings, decision-making, who is responsible for the AUP and UUP, etc.

Improvement opportunities clearly lie across borders; however, little progress has been made despite recognition of these needs. Merging FUA Cells requires Level 1 decision-making; subsequent questions involve who will oversee this process and who will make decisions. It's possible that future tools may become available for this purpose.

Notable successes include the introduction of Dynamic RAD, which has led to improved flight planning and reduced delays. Dynamic RAD has never been introduced before because all the necessary knowledge was not in one place, but

now it is. The air force can activate airspace up to 3 hours in advance, in that time intercontinental (ICA) flights are already airborne and cannot be rerouted by us due to flight plan limitations. Rerouting can be done tactically, but this is not ideal. Progressive insight has led to a better understanding of when the military actually fly. In practise, for example, no bookings are made after 17:30 hours, something we can respond to by allowing ICA flights to plan through these blocks of airspace (see Figure 2).

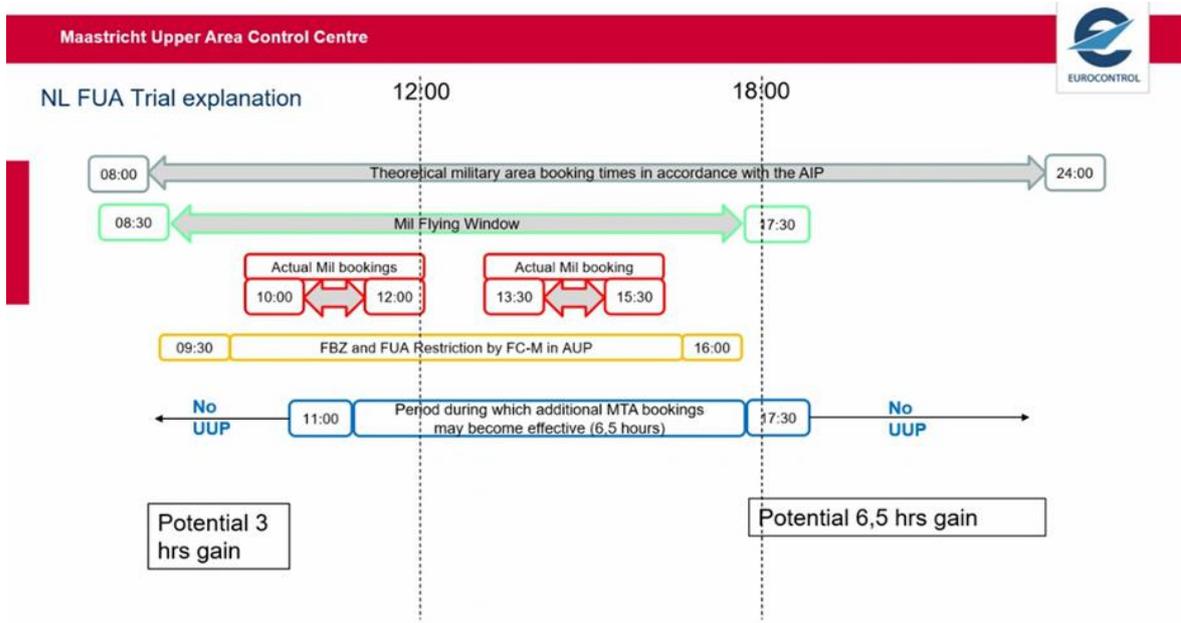


Figure2: Dynamic RAD potential gains

Theoretically, the military can still claim the area, but in practice, this does not happen. The benefits of Dynamic RAD for intercontinental flights do not apply to EU flights because they are shorter than the three hours that the military can use to claim an area. This means that the advantages of Dynamic RAD are mainly seen in intercontinental flights, where the flexibility to fly through military airspace after a certain time can lead to more efficient routing and reduced fuel consumption. Cooperation between CLSK and civil authorities has improved, with more space allocated to the military. The impact of shorter flights on LVNL has become more apparent. The military impact on our network is minimal, we give more space for longer times to the military.

However, challenges remain to be addressed, such as integrating FUA processes across borders and finding a solution to the problem of limited knowledge about military operations at civil air traffic control. Communication between military and civil planners must also be enhanced. It is anticipated that the integration of FUA processes will occur naturally with the introduction of 1ATM, leading to improved understanding and awareness among parties of each other's activities.

## Appendix D KLM

### Appendix D.1 Present

**Frans Huisman:** Director ATM Strategy & Tactical Planning, KLM

### Appendix D.2 Summary of interview

Delays frequently occur due to the utilization of military areas that intersect with flight planning. Airlines are not integrated into the information flow, while Eurocontrol is supposed to have access to all relevant information. Occasionally, Eurocontrol rejects flight plans because they traverse specific areas, yet air traffic control still directs them through these areas. The issue lies with the flight planning system. Airlines often receive notification from the military that they are not utilizing a particular segment of airspace, but this information has not been incorporated into Eurocontrol's planning and therefore flight plans through this airspace cannot be filed.

Airlines have the ability to modify their routes up to 1.5 hours prior to departure. In the event of changes to the planning, such as alterations to slot times, routes, or altitudes, the dispatcher contacts the relevant parties to report these changes, after which all subsequent processes become automated.

## Appendix E Workshop

### Appendix E.1 Present

<b>Paula Moll:</b>	Flight Support Manager, KLM
<b>Sander Hingstman:</b>	AMC & AFMU
<b>Evert Westerveld:</b>	KDC; Senior Strategy Consultant, LVNL
<b>Julie van Beurden:</b>	KDC; Strategy Expert, LVNL

### Appendix E.2 Summary of workshop

#### Appendix E.2.1 AMC & AFMU

The reason KLM does not receive updates within three hours is not because they are not sent as UUPs by the air force. These are sent to the Network Manager (NM), but the fact that they cannot do anything with them is a different problem. The NM does not want UUPs to be sent within three hours because it has too great an impact on NM systems (e.g. IFPS). The fact that bookings between blocks of two hours or less are not opened is, like the minimum processing time of three hours, a civil limitation.

MUAC uses buffers of 30 minutes before and after an airspace reservation. If there is an hour or less between them, they do not want to release it. These two hours are fixed because they are needed by the air force to land the aircraft, debrief the crew, refuel, brief the next crew, etc. If training stops earlier, this is immediately communicated to MUAC, and this extra space can then be used tactically. In principle, the blocks cannot be extended, as the time blocks are fixed. If it happens, it is based on a request to civil authorities. The extensions will usually be less than 15 minutes, which falls within the civil buffer of 30 minutes, but in principle, it never happens.

The booking tool LARA will be available after the introduction of iCAS at LVNL, but it is not yet known when. LVNL should have implemented LARA over 4-5 years ago. For the military, there are no direct benefits to LVNL using it. The planning is now in LARA, and this information is entered manually into the Central Communication and Information System (CCIS) that LVNL uses by the military supervisor. The military component of air traffic control is part of LVNL (1ATM), and the civil and military supervisors positions are located next to each other. The military supervisor uses LARA, but the civil one does not.

There is a desire to develop a kind of Airspace Management (ASM) system, similar to what the Germans use. Requests can then be placed in this tool and are directly shared with, for example, air traffic control towers, including maps. This system can also automatically reject requests. The Ministry of Infrastructure and Water Management (I&W) has plans to start developing an ASM tool, but due to limited resources no progress has been made.

## Appendix E.2.2 KLM

KLM uses the relatively old Lufthansa Integrated Dispatch Operation (LIDO) system to generate flight plans. For intercontinental (ICA) flights, this system will continue to be used in the coming 1.5-2 years. The newer version of LIDO, Lido Flight 4D IFS, will be used for the European network. Six hours before departure, work on the flight plan begins, and for ICA flights, this is done manually by a dispatcher. Until 1.5 hours before departure, the final flight plan can still be changed after consulting the flight crew.

To determine the optimal route, we use fixed company routes with a minimum cost track for flights within Europe. We often receive offers for shorter routes via the Network Manager Portal (NMP). Dispatchers adjust routes for weather, turbulence, slots, etc. At Eurocontrol, we cannot make in-flight changes to the flight plan, which could bring significant benefits to KLM ICA flights if we could.

Having a modified route checked by a dispatcher also takes time, and if there are many changes, it is no longer possible to plan so finely. There are additional costs that result from carrying extra fuel for a route that is not flown. The costs associated with the use of airspace are based on the flown route. In other words, the flown route is billed, not the planned route.

It is not possible to anticipate potential shorter routes that we are not allowed to plan, but which will be expected tactically. The regulations stipulate that we cannot carry a different amount of fuel than what is suitable for the planned route. This means that if we receive communication, in any way other than an UUP, that airspace is available or will become available, we are not allowed to act on this information by reducing the amount of fuel onboard.



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