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OPTIMISATION OF THE PERFORMANCE OF THE ATM NETWORK IN EUROPE

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Abstract. *This article is devoted to the consideration of issues of the organization of the European ATM network, and the functional tasks that are under the responsibility of the body that is integrating them – Network Manager.*

Keywords: airspace management; benefits of the proposed concept; network management.

1. Introduction

Nowadays, aviation is progressing as never before. New inventions and their implementation in air transport field have led to the need of continuous enhancement of air traffic management.

Due to fast growth of air traffic volumes, the necessity to improve current Air Traffic Management (ATM) system, design more dynamic and flexible airspace structures and more efficient and transparent decision making process has arisen.

The solution on the problems mentioned above was found in the Network Manager (NM).

The ATM Network Manager is a new function which has been created by the European Commission to optimize the performance of aviation network in Europe.

2. Network Manager concept

The NM brings together the different aviation and ATM actors involved in the design, planning and management the European ATM network.

In practice, the NM is involved in every technical and operational domain that is required in ATM, i.e.:

– Capacity Planning;
– Route Network Development;
– Airspace Management;
– ATM Procedures;
– Airport Operations;
– Safety Management and Air Traffic Flow and Capacity Management.

The NM adds value to the European ATM network performance in the areas of capacity, environment/flight efficiency, safety and cost effectiveness.

The NM details improving and adding value from on-going operations and services, as well as specific improvements or short term evolutions to provide direct benefit or more effective support to Aeronautical Service Providers (ANSPs), airports and airspace users in the context of the Single European Sky performance [2].

In this context, it is important to establish some principles with respect to how NM treats the four performance areas in the execution of its duties.

1. NM does not compromise on safety in any circumstance. Network safety is paramount in terms of NM safe operations and also the safe operations of other stakeholders.

2. NM operates within its means. It respects the budget agreed by governing bodies and strives for cost efficiency at all times.

3. NM recognizes the different performance needs of all the network stakeholders. NM knows that operational decisions can impact stakeholder business results.

It uses operational experience, in collaboration with stakeholders, to balance the (often competing) needs.

This is particularly true with respect to capacity and flight efficiency.

NM's performance is presented below per key performance areas: capacity, environment/flight efficiency, safety and cost effectiveness.

3. Capacity

The "effective capacity" of the European ATM network needs to increase by 16 % between 2011 and 2014 to achieve and maintain the European Union (EU) annual en-route delay target of 0.5 minutes per flight and meet the 3.0 % forecast traffic increase [1].

The main performance contribution of NM is to partner and support ANSPs to ensure the delivery of the performance committed in performance plans.

NM will support all the ANSPs to deliver performance based on their individual capacity plans, and as a result the overall network forecast. In addition, NM will deliver additional operational benefits, estimated to be in the region of 10 % over and above what ANSPs have included in their plans.

But there are two significant risks to this seemingly ideal performance.

First, traffic levels may recover sooner than expected over the three years.

Second, there can be significant differences between ANSP plans and the reality of the day-to-day operations.

To manage the risks, NM will proactively monitor (in quasi real-time) traffic, delay and flight efficiency and, together with the affected operational stakeholders, will take timely action and specific targeted measures to correct any negative performance trend.

On the assumption that ANSPs stick to their capacity plans, NM will endeavor to ensure that the annual network delay target for each year is achieved.

NM value added support to stakeholders to improve capacity.

NM is pursuing several capacity initiatives that support stakeholders in achieving their individual capacity targets.

This support is offered to all ANSPs within the pan-European airspace which have the largest delay impact on the network.

In addition, the Network Manager Operations Centre (NMOC), formerly the Central Flow Management Unit Ops Room, works closely and collaboratively with Area Control Centers (ACC) and airspace users to implement the daily network operations plan and deliver the performance level offered by the ACC.

A summary of the different areas of NM contribution to ANSPs is hereunder.

Support at Strategic/Pre-tactical Phase. All the detailed collaborative work between NM and ANSPs 6 months from day of operations is aimed at ensuring that ACCs have the best possible capacity to meet the expected demand on the day of operations.

NM aims to strengthen this collaboration to ensure that every day ACCs have the best possible plan, including the best airspace and sector configurations to manage safely the expected demand. NM will also develop the axis management processes into regional performance management processes with a focus on common actions to reach en-route capacity targets.

Tactical Operations. On the day of operations, plans have to be adapted to react to the reality of operations. The ACCs and NMOC will work together to minimize local and network delays as far as possible.

Post Ops Monitoring. A proactive monitoring of operations was introduced in summer 2012. On one level, it will monitor the implementation of approved capacity enhancements in the Network Operation Plan. A collaborative process with ANSPs will track daily performance of each ACC, identify and address unforeseen delay events in sufficient time to minimize the impact on the delay performance target.

NM direct contribution to capacity improvement.

NM is pursuing several capacity initiatives that deliver additional and tangible delay reduction benefits resulting from its network centric operations.

These performance contributions will reduce the network delays further than the sum of all the capacity plans and close partially the gap to the network performance target by 2014.

Airport Operations. Airport operations have Air Traffic Flow Management (ATFM) delays attributed to them. To date, NM has focused on driving down delays at airports following major airport disruptions, in particular in the recovery phase. As of 2013, NM will reorient its activities to target and reduce airport operations delays across the pan-European network.

NM objective is to deliver an average 5% reduction of airport operations' generated delays at 5 targeted airports from the top 20 airports in 2013 and in 2014 in an agreed collaboration with airports concerned.

Reactionary Delays. NM will target morning delays which have more impact than afternoon and evening delays on airline operations as observed through reactionary delay. The intention was to understand the ATFM total impact on punctuality during 2012 and then work collaboratively with ANSPs and airports to reduce that impact.

Driving Down Delay. NM implemented a direct operational performance contribution in driving down delay in 2012. Daily delay targets for each ACC area are established during the strategic and pre-tactical phases. The focus of NM Operations Centre (NMOC) is to concentrate on:

Anticipated problem areas providing network solutions at the planning stage;

Minimizing global and individual flight delays;

Enhanced network operations procedures.

A number of quantifiable operational strategies are used to achieve and measure these objectives:

a. Network delay attribution:

This process uses scenarios to offload major congestion areas agreed via Collaborative Decision Making (CDM) in the pre-tactical phase, even if these will cause (or increase) delay in the area to be on-loaded, provided that the overall delay in the network is reduced and the delay performance in the on-load ACC will not suffer.

It is estimated that anticipated delays can be reduced by at least 25% for each event to which the procedure is applied.

NM objective is to reduce delays by around 50,000 minutes throughout the year using this process.

b. Targeting weekend delays:

There should be fewer delays and more available capacity during weekends as there is little or no military operations or temporary segregated areas and most conditional routes are available for flight planning.

However, as Fig. 1 shows, traffic at weekends is 16 % less but total delays are at least 23 % higher [3].

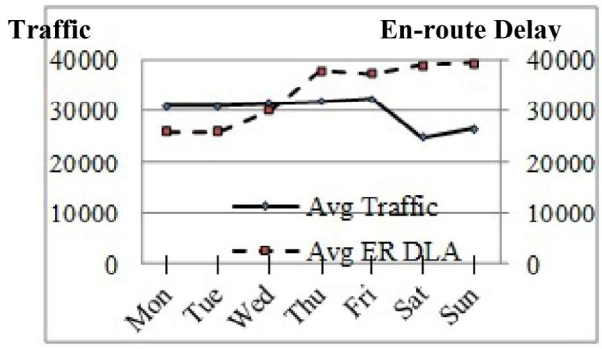

Fig. 1. Week en-route delays

Just making the weekend performance equivalent to the weekdays would remove at least 13,000 min of delay every summer weekend day, equivalent to 0.8 % of the total annual delay.

As part of its added contribution to the overall network delay target reduction, NM will analyze the causes across the network and target specific actions every weekend aimed at reducing, eliminating and eventually reversing the trend.

Since this a collaborative effort with ANSPs, NM proposes to claim as NM added value the one off reduction achieved in the first reporting period/year, on the understanding that the ANSP will maintain and take credit for the improved level of performance in subsequent years.

NM objective is to reduce weekend delays by 120,000 min (40 weekend days * 3000 mins) per year from 2013.

c. Minimizing individual flight penalties:

The application of Air Traffic Flow and Capacity Management (ATFCM) regulations leads to large numbers of flights receiving slot messages and delays.

An important function of NM is to manage these regulations and ensure that flights do not suffer undue disproportionate penalties and that the available capacity is used to its maximum during the regulation period.

The NMOC will have internal performance objectives that are aimed at reducing the number of flights with high delays and consequently deliver network delay saving.

NM objective is to reduce the percentage of flights with ER DLA (en-route delay) > 15 min from 0.87% (2011 average) to 0.75% and reduce the percentage of flights with DLA (any cause) > 30 min from 2.6 % (2011 average) to 2.0 %.

The average direct effective delay reduction due to accepted rerouting proposals was 700 min per day (=2.27 % of average daily en-route delay).

NM objective is to achieve direct effective delay reduction due to accepted rerouting proposals by

1000 min per day (equivalent top 3.2 % of daily en-route delay).

d. Slot swapping, extensions and exclusions:

Slot swapping provides an opportunity for airspace users to minimize disruption to their operations during periods of ATFCM regulation by prioritising their flights.

Slot extensions are provided to airspace users on request via the e-Helpdesk when external reasons prevent adherence to the original Calculated Take-off Time.

Currently such extensions add artificially to the individual and overall delay situation.

Any slot extension delay due to a slot extension should be discounted from delay statistics and considered as a direct delay saving.

Slot exclusions are provided in order to optimize the use of available capacity and to minimize individual flight penalties.

f. Mitigation of Weather generated delays:

Weather is increasingly a factor/cause of delays both on the ground and in the air.

In 2011, weather briefings were introduced as a first step in the process of mitigation for weather disruptions across the network.

Trials have also been carried out with a number of ANSPs to validate procedures to avoid late and sudden flow regulations.

4. Environment/Flight Efficiency

The flight efficiency target is a network attributable target (reduction by 0.75% of the difference between flight planned route and great circle route) but is just one way of improving environment (flight efficiency and emissions reductions).

Network concepts implemented at local level, such as free route airspace and Continuous Approaches, will be major contributions to flight efficiency and emissions.

The NM will acknowledge all these emission mitigation contributions in a qualitative manner and quantify results at network level.

Stakeholders supporting NM to improve environment. NM is pursuing several environment initiatives whereby stakeholders support NM to achieve the environment target.

The annual target for route extension due to airspace design is shown in Table.

The annual target for route extension

Year	2009 baseline	2012	2013	2014
Efficiency target	3.45 %	3.0 %	2.85 %	2.70 %

This is an NM environment target.

The airspace design initiatives when implemented in 2014 will reduce the difference from the great circle from an average value of 3.45 % in 2009 to 2.80 % by the end of 2014. Further efforts will be required to further decrease the currently estimated value for 2014 to 2.70 %.

Free Route Airspace. In this airspace users are free to flight plan any route is the ultimate flight efficient operation in the en-route phase of flight.

Deployment has started in a number of States with the direction of NM for key network-wide aspects such as a common ops concept and flight planning implications.

Some ANSPs plan to introduce Free Route in phases, starting with night periods and when there is no temporary segregated airspace. NM will actively support local deployments to ensure network fit and smooth integration into network operations.

Free Route will become very important as 25 % of European airspace is planned to operate in various phases of Free Route by the end of 2014, which will add an additional 0.25 % improvement to flight efficiency.

Given the high levels of efficiency already achieved in the European route network, rapid expansion of free route is a key for achieving the flight efficiency targets [2].

Increasing the number and harmonization of Conditional Routes (CDRs). Another way of enhancing flight efficiency is through good airspace sharing and Flexible Use of Airspace procedures. NM intends to increase the number of CDR through existing military airspace and to ensure their appropriate cross-border harmonization, including transforming CDR2s and CDRS1/2 into CDR1s.

This will facilitate their usage by the airspace users.

NM objective is to increase the number of new CDRs through military airspace by 5% per annum.

NM direct contribution to environment improvement. NM is pursuing several environment initiatives where it delivers direct network benefits to ensure the network target is achieved.

Flight Efficiency:

– Use of CDRs:

Flight efficiency requires a route network design that offers the most direct routing opportunities to airspace users. NMOC provides additional direct flight efficiency benefits via automated notification of opportunities for airspace users following publication of the daily AUP.

More proactive strategies will be followed as a priority to improve the civil/military CDM processes in areas where military mission effectiveness is constrained or availability and effective usage of the CDR1/2 network is unnecessarily restricted. NM objective is to increase the CDR1/2 usage by an average of 5% per annum in a collaborative effort with airspace users who remain responsible for flight plan route choices.

– Vertical Flight Efficiencies:

A second element of flight efficiency is the vertical profile. One way for sectors to be protected from overloads is through flight level capping of flights. ATFCM level capping scenarios are often used to reduce complexity and/or traffic in order to avoid regulations.

However the cost of such level caps needs to be offset against the delay saving.

NM objective is to reduce these vertical flight inefficiencies by a total of 5 % in 2014.

The NM, together with its stakeholders, will ensure that the environmental targets are met and additional emissions reductions are delivered.

5. Safety

The NM added value in the safety performance area is focused on enhancing the network operations safety.

Therefore, the NM identifies network safety issues through proactive monitoring of the network operations, which supports ANSPs in identifying and managing safety hazards in their areas of responsibility.

In addition, NM assists ANSPs to meet their operational safety targets while implementing the safety culture across the network.

Safety Nets. In 2010 approximately two thirds of European ANSPs surveyed did not have some form of tool for analyzing safety nets and fewer than 20% were using all four safety nets (Short Term Conflict Alerts – STCA, Minimum Safe Altitude Warning – MSAW, Approach Path Monitor – APM and Area Proximity Warning – APW) [3].

This analysis is shown in Fig. 2.

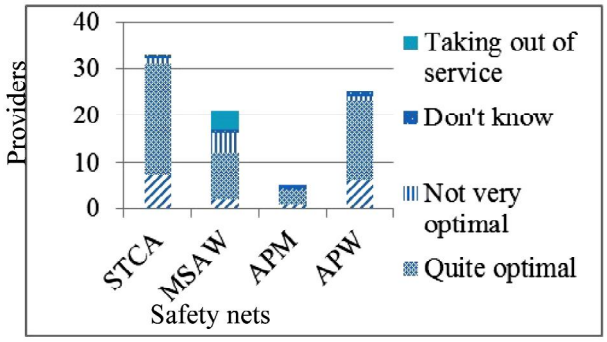

Fig. 2. Using of safety nets by ANSPs in 2010

NM will support the implementation of effective "level 2" ground-based safety nets in all EUROCONTROL member States by end of 2016 and support the definition of "level 3" ground-based safety nets by end of 2013 and implementation in the European core area by end of 2016.

Airport safety. NM supports stakeholders at airports (ANSPs, Airlines and Aerodrome operators) to mitigate the contributing factors in order to reduce runway safety events, using 2010 data as a baseline.

A new airside safety project cumulating initiatives such as prevention of runway incursions and excursions and unsterilized approaches will be the main vehicle to improve the safety of aerodromes operations.

NM's unique position and access to the network safety performance data enables identification and prioritization of concrete actions that aim at enhancing network operations safety.

NM direct contribution to safety improvement. NM objective is to establish the Top 5 pan-European ATM operational safety risks and develop action plans collaboratively with all concerned to reduce risks.

In addition, known network operations risk areas (e.g. airspace infringements, runway incursions/excursions, level busts, air/ground communications, unsterilized approaches) will be continuously monitored as to the effectiveness of the implemented mitigations and continued awareness activities.

A key activity for NM is the deployment of automatic safety monitoring tool at local level to improve the systemic view over the hotspots at Network level.

Also NM has established a technical monitoring office through which the technical systems such as radio frequencies interferences, height keeping equipment and airborne surveillance avionics are monitored, anomalies detected, severity and safety implications assessed and rectification actions coordinated.

Scarce Resources. The Radio Frequency Function (RFF): The NM-RFF contributes to network capacity by providing to the stakeholders an accurate network view, of the usage of radio frequencies aligned with the airspace design in order to meet capacity requirements. RFF is also providing recommendations for improvement that will be implemented through the CDM process.

In addition, the RFF will allow a common equitable sharing of the 8.33 kHz expansion benefit, contributing to the Network capacity and performances.

The RFF contributes also to safety minimising the number of interferences. NM objective is to reduce the number of reported RF interferences by 5 % year on year from 2013.

The Transponder Code Function (TCF): The NM-TCF will contribute to improving safety by seeking to eliminate code conflicts, reducing surveillance system flight correlation enabling unique aircraft identification and controllers' workload.

Mode S Interrogator Code Allocation (MICA): The operation of Mode S Secondary Surveillance Radars requires the use of scarce (78) Interrogator Codes (ICs).

Strict management of such codes is necessary because each Mode S sensor, or cluster of Mode S sensors, requires a unique Code.

The use of duplicate codes in neighboring Mode S sensors causes severe surveillance data degradation including loss of detection of targets.

Therefore, assignments need to be carefully organized to ensure the same codes are not used in overlapping Mode S coverage areas.

6. Cost effectiveness

NM's contribution to cost effectiveness is three fold.

It is the result of the cost effectiveness of its operations and execution of its work programmer and also the deployment/provision of central services on behalf and in support of operational stakeholders.

In addition, NM capitalizes on best practice in the industry and promotes its use wherever possible.

NM will provide support to stakeholders to improve the cost effectiveness of the network.

In broad terms this support will be provided along the following axes.

– The management of scarce resources. In doing so NM will ensure that scarce resources are managed to deliver the highest benefit for the network rather than delivering the highest benefit locally at the expense of global network effectiveness.

– The provision of agreed support to the deployment of new or enhanced ATM concepts identified in the NSP, to ensure a coordinated approach across the network.

In doing so, NM will ensure that benefits are achieved in a timely manner and can be maximized across the network. NM will therefore provide a coordinating function to establish requirements to enable network performance improvements and, in particular, the required CNS related airborne capabilities and global interoperability requirements.

– The central monitoring of the performance of the network and infrastructure, especially in those areas there local monitoring would lead to duplications of efforts or where the monitoring must be done at the level of the network to enable common actions to be initiated and to produce more meaningful and efficient results.

– The provision of tools for shared or common use supporting the CDM processes and efficient scarce resource allocation mechanisms

– The provision of agreed services to achieve economies of scale through the deployment of common technical products, e.g. surveillance related services contributing to safety and capacity network objectives.

– NM provides harmonized common core content training material for operational ATM staff.

This delivers substantial savings in development costs for NM stakeholders.

To maximize the cost effectiveness of the value added support provided by NM it is essential that those functions are performed in a cost effective manner by NM.

7. Military dimension

Military authorities are an important CDM partner of NM influencing all performance areas due to their different role and type of operation.

Effective CDM processes have allowed airspace design projects to take due account of military airspace needs, and facilitated the introduction of better and targeted conditional routes and enabled more efficient utilization of military use airspace and the ATM route network.

Sharing of status of military use airspace up to quasi real time gives more route options to proactive aircraft operators.

It is also a prerequisite for the full implementation of free route airspace and the deployment of Initial 4D trajectory planning.

The sharing of tools supporting Civil/military coordination and the setting up of real time data provision of availability of airspace and routes are 2 activities included in NM work programmer.

Military users are important operational stakeholders. NM strives to ensure that military users can perform their missions in a cost effective manner.

8. Conclusions

The Network Manager brings together the different aviation and air traffic management actors involved in the design, planning and management the European ATM network.

In practice, the Network Manager is involved in every domain that is required in air traffic management.

The Network Manager also provides daily support to the air traffic operations across the 'network', which covers the 39 Member States of the EUROCONTROL organization.

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О.Є. Луппо[1], Г.Ф. Аргунов[2], Н.С. Горленко[3], В.Г. Чайка[4]. Оптимізація характеристик інформаційної мережі системи організації повітряного руху в Європі
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Подано структуру новітньої мережі обміну інформації щодо організації повітряного руху в європейському повітряному просторі. Розглянуто основні процедури, що забезпечують її функціонування.
Ключові слова: інформаційна мережа; організація повітряного простору; переваги концепції.

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Представлена структура современной сети обмена информации, касающейся организации воздушного движения в европейском воздушном пространстве. Рассмотрены основные процедуры, обеспечивающие ее функционирование.
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