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3.3: Air traffic flow management (ATFM)

EUROPEAN EXPERIENCE IN NETWORK MANAGEMENT

(Presented by Austria on behalf of the European Union and its Member States[1] and the other Member States of the European Civil Aviation Conference[2] and by EUROCONTROL)

EXECUTIVE SUMMARY

This information paper describes the evolution of the air traffic network management incorporating various functions, challenges and legal ramifications specific to the European context. It also presents European concepts on addressing ever-growing traffic and improving the performance of the network. It also describes interregional network management in Europe.

1. INTRODUCTION

1.1. Air traffic flow management (ATFM) has been in existence for more than thirty years. The function commenced in the early 1980s in both North America and Europe. Both these systems cover large geographical areas, in the case of Europe the ATFM system consists of a centralised central flow management function operating in close cooperation with national ATFM units in the airspace of forty-three States. New ATFM services have been and are being rapidly deployed in many other areas of the world.

1.2. At the beginning of year 2000, ATFM was enhanced by including aspects of capacity management, hence the term air traffic flow and capacity management (ATFCM) used in some regions. The addition of capacity management shifted the focus to providing required capacity in the parts of airspace where the traffic demand exceeded or was at the limits of the available capacity. Appropriate

[1] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Iceland, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

operational techniques have been developed such as use of various sector configurations, flexible rostering, ‘cherry-picking’, etc. ATFCM relied heavily on the exchange of information related to flight plans, airspace availability and capacity. Some mature ATF(C)M systems also use real-time data (surveillance and air traffic control (ATC) activation information, and short-term airport departure planning information) to improve the predictability of demand, enabling the optimum use of capacity and the application of less penalising and more refined ATF(C)M measures that facilitate the user choices and minimise any negative performance impact.

1.3. Next phase in the evolution was development of the network management concept in parts of the European region (‘network manager’s area’) in the years after 2009. The concept focuses on network performance and it incorporates various functions (e.g. ATFM, the design of the route network, scarce resources such as the coordination of radio frequencies and transponder interrogator codes) and activities (e.g. planning, provision of an alerting or alarming system). Network management concept also comprises coordination of management of response to crises that may impact aviation.

1.4. In this concept the network includes airports, airspace and interfaces that connect them, and infrastructure, resources and capabilities of the ATM network that together serve the civil and military airspace users to meet their needs and requirements as well as the defined level of performance. The planning, design, operation, interoperability, interconnectivity and monitoring of these network components support the network optimisation and the achievement of the agreed local and regional performance targets.

1.5. Inter-regional cooperation in the field of network management is essential regardless whether regions operate an ATFM, ATFCM or network management system that includes cooperative airspace design and management of scarce resources. This will be facilitated by inter-regional data exchange, which is a concept that will optimise the use of capacity on a daily basis, and will also facilitate the collaborative management of traffic flows among regions and eventually regional and inter-regional network performance, in particular when security situations and other disruptive factors disturb or threaten to disturb normal traffic patterns.

2. CHALLENGES IN THE EUROPEAN CONTEXT

2.1 In the case of Europe the EUROCONTROL network manager system includes a centralized flow management function operating in close cooperation with national ATFM units in the airspace of forty-three States. As regards the “network management system”, in the EUROCONTROL network manager (NM) area, “network” is defined: “The airports, airspace and interfaces that connect them, air traffic management/communication, navigation, surveillance (ATM/CNS) infrastructure, resources and capabilities of the European ATM network that together serve the aircraft operators and military”.

2.2 In the EUROCONTROL network manager’s area the European air traffic management system is operated by air navigation service providers (ANSPs) designated by States to provide services in respect of national airspace blocks under their responsibility in the ICAO European (EUR) Region. The provision of services has been organised within sixty-seven area control centres (ACCs) whose areas of operation are mainly contained within national flight/upper flight information regions (FIRs/UIRs). While air navigation service provision remains fragmented in Europe with thirty-eight different ANSPs for the whole European Civil Aviation Conference (ECAC) airspace, the execution of the network management functions allows for a continuous evolution, optimisation and operational performance improvement, while connecting them at the level of the functions.

2.3 Network efficiencies need to be found through a collaborative approach towards airspace organisation and rapid implementation of new operational concepts supported by state-of-art technologies. The defragmentation of the European ATM system and the enhancement of its overall performance are at the core of the Single European Sky ATM Research (SESAR) Project and of the network management functions. Supporting the notion of trajectory based operations and relying on the provision of air navigation services in support of the execution of the business or mission trajectory — meaning that aircraft can fly their preferred trajectories without being constrained by airspace configurations. This vision of trajectory based operations is supported by digital technologies and enabled by a free-route airspace implementation, an evolution of the European ATM architecture, a progressive increase in the level of automation support, the implementation of virtualisation technologies and the use of standardised and interoperable systems.

3. SINGLE EUROPEAN SKY REGULATORY FRAMEWORK

3.1 In 2009, the network management functions and their execution by a single body – the network manager - were laid out in the Single European Sky (SES) II legislative package of the European Union. In particular, Regulation (EC) No551/2004 for the design and the use of the airspace in the single European sky provided the legal basis for the centralised network functions and the central AFTM in particular. The regulatory framework was detailed with implementing act focusing of the description of the functions and the related tasks of the network manager. The functions and the tasks are delivered on the basis of a collaborative decision-making (CDM) process, whereby decisions are made based on a constant interaction and consultation with States, operational stakeholders and other actors as appropriate, so contributing to the network performance.

3.2 The network manager shall comply with various regulatory requirements, including to be certified by European Aviation Safety Agency (EASA) as a competent authority for the provision of the functions as laid out in the implementing acts (Commission Implementing Regulation 2017/373).

4. KEY DRIVERS FOR THE FUTURE — EMPHASIS ON PERFORMANCE

4.1 The key drivers for the evolution of the European network management system are those related to the achievement of the strategic objectives of the SES in terms of safety, capacity, environmental impact and flight efficiency into operational and service provision requirements and ultimately implementation objectives.

4.2 These operational performance improvements will need to be addressed in the context of a continued traffic growth and the possible evolution of other types of users (e.g. remotely piloted aircraft systems (RPAS), high-altitude platforms stations (HAPS)).

4.3 Historically, operational performance never anticipated the expected increase in demand and cycles of traffic evolution have not been used properly to deliver in anticipation operational improvements to address the future growth cycle. This was linked to a short term vision on how to immediately address cost-effectiveness concerns without evaluating in the longer term the required operational performance evolutions.

4.4 One of the key challenges of the evolution of the European network management system is to address current shortcomings and lessons learned from past evolutions. ATC capacity currently tends to be rigid while traffic demand is variable, both predictably and unpredictably. This results in considerable spare capacity and excess load at the same time. These capacity margins generate costs and capacity shortages generate delay costs, both of which are borne by airspace users. Savings in both capacity and delay costs can be achieved by better aligning capacity with demand. This requires seamless airspace design, improved prediction of traffic as well as the possibility to flexibly adjust capacity to match demand. Adequate margin would have to be maintained balancing the risk of over-delivery with that of capacity shortage.

4.5 It is paramount to establish operating conditions that would allow enhancing the cumulated cost of capacity and delays. However, if operating conditions change, e.g. if capacity becomes more flexible, demand more predictable, and/or both match better, it is possible to produce the required capacity at a lower cost, and to save on both capacity and delay costs. This results in a more favourable trade-off between capacity and delay costs. At the new optimum, cost-efficiency would be significantly improved and delay marginally improved, with higher certainty of meeting the delay target as more flexible capacity yields better responsiveness to unforeseen traffic changes.

4.6 Improvements are expected beyond 2020, through enhanced seamless airspace design, delivery of new operational concepts through the network management functions and from research and development starting under SESAR 2020. Further progress is expected in particular from more flexible capacity in space (virtual centres) and more predictable demand (4D trajectory-based operations (TBO)). The development and deployment of enablers will need to be encouraged as well as the development of tools to decrease air traffic control officer (ATCO) workload.

4.7 The main improvements in flight efficiency are expected to have been already achieved during the period 2020 - 2025 and to be maintained afterwards as, currently, environment/flight efficiency targets are almost achieved. 4D TBO will better respond to expressed intentions by the airspace users. The approach towards en-route charging will need also to be addressed to facilitate appropriate trade-offs between capacity, cost-effectiveness and environment.

5. CHALLENGES OF THE INTER-REGIONAL NETWORK MANAGEMENT

5.1 Network management concept can deliver most effective results in an environment that respects the flows of traffic and is open for cross-border initiatives. New (cross-border) network management solutions need to be developed and deployed to accommodate the expected traffic growth in the coming years. Given the increased focus on performance in ATM (including cost-efficiency), on top of safety and operational priorities, network management solutions need also to take account of the economic/financial aspects.

5.2 Given its significant impact on the economy, establishment of a network management concept within a region requires strong political and legal support. In Europe it made possible implementation of the network management operational arrangements in the eighties in order to resolve significant imbalance between traffic demand and capacity and reduce delays. From 2010 the SES initiative raised ATFM rules to the level of legal requirements for European Union Member States. There are some other regions involving a mix of smaller and bigger States, which are struggling to accommodate ever growing traffic increase, which however have not been able to reach a political agreement to implement a network management concept.

5.3 Another important element is ensuring equity within the network and across the networks, i.e. treating all flights in the same way regardless which region they are originating from. Adoption of equity as the global principle would pave a way for smooth deployment of the network management concept globally.

5.4 Network management concept is supposed to deliver an enhanced mobility of people and goods. Therefore, intermodal solutions might be required amongst different kinds of modes of transportation. Even though the multimodality is still in the process of being developed, if confirmed by the evolution, it might shift focus of the network management from flights to passengers and cargo in case of civil flights, or operational goals in case of military flight operations.

6. LOOKING INTO THE FUTURE

6.1 Europe will have to embrace a new era of innovation and digital technologies in line with the European Aviation Strategy. Its future European ATM system will be based on better airspace organisation, efficient service provision and the enabling infrastructure. The challenge would be to translate the strategic objectives of the SES in terms of safety, capacity, environmental impact and flight efficiency into operational and service provision requirements and ultimately implementation objectives, which would allow an effective evolution into the future.

6.2 Recent developments in ATM have shown the potential of new operational concepts to reduce the fragmentation of the European airspace. The European ATM Master Plan foresees for example free-route airspace, advanced flexible use of the airspace, dynamic and cross-border sectorisation, dynamic air traffic flow and capacity management, virtual centres would further optimise the use of airspace and the choice of preferred trajectories by airspace users.

6.3 The network management evolution in Europe (NM Area) will take into account SESAR-related operational concepts and technologies in view of defining a high-level deployment scenario to ensure airspace continuity and appropriate harmonisation of operational concepts and associated infrastructure. It would also support the development of a SES vision towards the 2035 horizon and associated high-level goals in particular with regards to the contribution to performance in terms of safety, capacity, environmental impact and flight efficiency, resulting in further updates to the European ATM Master Plan.

7. CONCLUSION

The Thirteenth Air Navigation Conference is invited to take note of the European experience in network management presented in this information paper.

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