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Abstract. This article provides the information on current intentions and focuses on one of the development processes being currently performed within Eurocontrol - Centralised Services.

Keywords: advantages and disadvantages of the described system when compared to the present one; Air Traffic Management; system functionality state estimation.

1. Introduction

Eurocontrol was initially created with the main purpose of provision a seamless pan-European Air Traffic Management (ATM) to all its member states.

In other words, the organization tries to harmonize the procedures all over the Europe, keep the level of performance up-to-date by introducing and integrating different kind of new equipment, software and centralizing some services which can be provided to any European agency or an airspace user concerned.

Currently, Eurocontrol keeps three main centralized services available to all member states:

- Central Flow Management Unit (CFMU);
- European AIS Database (EAD);
- Central Route Charging Office (CRCO).

Now, the main challenge for the organization is to make the price for one flight hour twice as low as it is now because according to the manual called “US/Europe Comparison ATM-related Operational Performance”, the cost for 1 flight hour over the U.S. is exactly 50 % less than over Europe.

Consequently, the establishment of the CS in broader perspective is believed to lead to this price-related goal achievement.

2. Analysis of research

The ATM in Europe is on the very high level of development but the poor centralization in the ATM is what drags it back.

For this reason, a lot of studies and scientific works were devoted to this subject named as the structuralisation of the ATM information and services provision in European airspace.

Eurocontrol has set up the aim to develop such system and published the relevant documents on the topic so as to frame the main points of services' concepts.

3. Description of CSs

There are 9 CSs aimed at improving the European ATM from the various sides:

- CS1: Flight Plan and Airport Slot Consistency Service;
- CS2: 4D Trajectory Calculation for Planning Purposes (4DPP);
- CS3: European Tracker Service (ETKR);
- CS4: Advanced Flexible Use of Airspace;
- CS5: European ATM Information Management Service (EAIMS);
- CS6: Management of Common Network Resources Service;
- CS7: Network Infrastructure Performance Monitoring (NIPS);
- CS8: Pan-European Network Service (PENS);
- CS9: DATACOM.

CS1: Flight Plan and Airport Slot Consistency Service. CS1 is the first service among 9 planned. It is to ensure the consistency between submitted Flight Plans (FPL) and corresponding airport slots.

The core of the information is supposed to be a new database which will store all airport slots and compare those slots with FPL data taken from the Initial Flight Plan Processing System (IFPS).

The centralized airport slot database will update the information immediately should there be any changes or modification in airport slots.

The provision of the service requires the following tools:

- tools to collect and store airport slot data;

- tools to perform a consistence check between airport slots and the filed flight plans;
- tools to interact with European Airport Slot Coordinator.

The service will ensure the availability of the information necessary for the post operations analysis and investigation.

The service provision will be executed in the following way [1]:

- Obtainment and update of airport slot allocation from airport/slot coordinators into the centralized slot database;
- Obtainment of flight plan messages from NM (Network Manager) IFPS;
- Conformation of the consistency between FPL and Slot;
- Notification of the body concerned whether the airport slot is established or not.

The technical service specification development is planned to be accomplished by the end of 2013 and the demonstration of the system will commence before the end of 2015.

CS2: 4D Trajectory Calculation for Planning Purposes. The main objective of the CS2 is to ensure centralized 4D trajectory calculation for all ATM planning activities.

The calculations are anticipated to be much more precise than current NM trajectory calculation, thereby, reducing the buffers in the airspace capacity

planning process and consequently, make an airspace capacity rise.

The transition from the current state of equipment available to the future one, which will ensure the provision of the service, will consist in an upgraded Flight Data Processing System (FDPS) where input of the information required will be done by NM, not Air Traffic Control (ATC) unit.

The information (airport data, flight data, aeronautical data, aircraft performance data, meteo-data, flow management data and airspace management data, etc.) will be supplied to both Enhanced Traffic Flow Management System (ETFMS) and 4DPP which are planned to be both stationed at NM site.

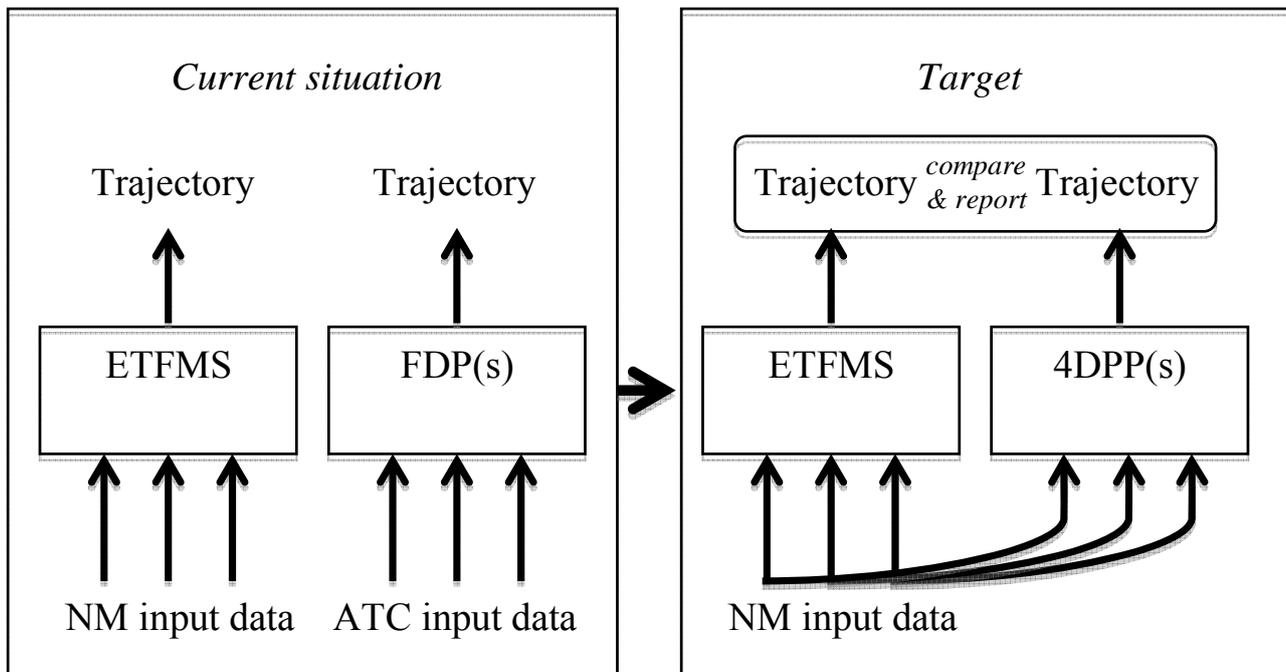
After that, the trajectories from ETFMS and 4DPP will be compared and analyzed.

The Figure describes this process [2].

The comparison of the trajectories derived from ETFMS and 4DPP will be performed with the help of both live data and archived data.

Then, each of the trajectories will be compared with the one already flown in order to evaluate the accuracy of the prediction and build the reliable statistics.

CS3: European Tracker Service. The vision of this service is also based on the flow of data to Eurocontrol's database with its further usage by airspace users or agencies concerned.



CS2 target visualization

The main objective of the service is to improve the Network performance (capacity, safety and cost reduction) through the introduction of a centralized pan-European Surveillance Data Processing System.

The Data Centre of the ETKR will be provided with the ECAC-wide Air Situation Picture Surveillance from different surveillance sources like Primary Surveillance Radar (PSR), Secondary Surveillance Radar (SSR), Automatic Dependent Surveillance (ADS), etc.

The different means of data collection will enrich each other resulting in better and more accurate picture.

The access to the data for the customers (any site or cluster of sites, civil and possibly military, making use of track data) will be done throughout its publication or delivery on the basis of a Sensor Information Sharing Agreement (SISA).

Upon the subscription to the service provision, the customer should indicate the following [3]:

- geographical coverage;
- period of update;
- composition of track messages, etc.

As soon as the customers receive the information on tracks, it is enriched with flight data.

Then, the information is sent out to other functional blocks for the use in controller tools, Airports, Air Defense units, Flow management units, etc.

Concerning the infrastructure, ETKR is responsible for the deployment of Surveillance Data Processing System (SDPS) which consists in upgrading the ARTAS (ATM Surveillance Tracker and Server) and so-called “dissimilar redundancy” concept within it, whereas the customer is required to create a track quality monitoring function and a service wrapper.

CS4: Advanced Flexible Use of Airspace. Since there is a very close cooperation between military and civil airspace users all over the Europe, it is essential to have one centralized database for the collection of such information and provide it further to every agency or airspace user concerned.

Upon the reason that the military site keeps its information as safe as possible, including the different levels of security, the database’s use-case shall include higher level of protection and service.

If not, the Eurocontrol member states may deny the proposal on the provision of their information from military site, though this information is not supposed to be under the highest or even average national security stamp.

The service provision constitutes in the collection, integration and provision of ASM data

related to airspace reservations and their utilization in Europe to efficiently exchange the ASM data.

For this, it is planned to establish a centralized database for network wide ASM in Eurocontrol which will be used to perform the activities of the basic phases of the FUA concept [4]:

- Support to Level 1 (Strategic Planning);
- Support to the FUA Level 2 (AUP Process);
- Support to the FUA Level 3 (tactical);
- Post operations evaluation and performance monitoring.

Support to Level 1 (Strategic Planning). The assistance of the CS4 lies in the support of the necessary flow of information for the strategic planning activities within the collaboration network: manageable airspace users, adjacent countries, ASM actors and NM.

The process of information provision to all actors described above will bring the benefit of enabling a better network planning through the NOP and ERNIP because the military long-term planning has a significant impact on the network design and performance.

The transparency of the different actors’ intentions (military and civil) will improve the performance of Airline Operators (AO), Air Navigation Service Providers (ANSP), Airspace Management Cell (AMC) and Flow Management Position (FMP).

Support to the FUA Level 2 (AUP Process). The introduction of CS4 will assist the transition to Advanced Flexible Use of Airspace (AFUA) by making the airspace availability data centrally available and easier for querying and modification within the ASM Support Systems and consequently, enable faster and simpler process of production, coordination and modification of the European AUP/UUP by the NM.

The actors involved in the production of the EAUP/EUUP are:

- AMCs for the provision of data;
- NM;
- All relevant actors for Network impact assessment at local, sub-regional and network level.

Support to the FUA Level 3 (tactical). The assistance for the tactical level of planning requires all ATC units and military controlling units to share the information on the real time airspace availability to enable the database to collect integrate and distribute it further to all relevant actors.

The process will consist of the support to tactical changes of the AUP and to the provision of the data on activation/deactivation to FMPs.

Post operations evaluation and performance monitoring. One of the main goals of the information possession is the ability to analyze it and come up with some conclusions allowing to fill the gaps in performance.

For this, the regulatory bodies or authorized ASM network actors will assess the data, report performance indicators on airspace usage, CDR utilization, mission effectiveness and civil use of released airspace.

Generally, CS will strongly improve ASM/ATFCM/ATC processes by moving from airspace to trajectory-based operations, planning cooperatively, and managing the airspace dynamically.

CS5: European ATM Information Management Service. EAIMS proposes the service of delivering an integrated solution for the preparing and maintaining ATM information and delivering it to the end user with the required characteristics necessary for flight operations from the unique database.

For now, the aeronautical information is scattered over two main sources:

- The Aeronautical Information Services (AIS);
- The Flight Operations Community (ATC/ATFCM, Airspace Users both civil and military).

The centralization of the ATM information storage will bring these two communities together, develop and deploy end-to-end service covering the operational ATM data needs of AIM, ASM, ATFCM, ATC, commercial flight plan/FMS (Flight Management System) data service providers and Airspace Users [5].

The ATM information will be entirely consolidated and made consistent.

There will be developed suitable infrastructure based on Service-Oriented Architecture (SOA) principle and will rely on the System Wide Information Management (SWIM) interoperability standards to interconnect this service with its customers over an IP-based network.

Worth to note that most of the enhancements will be demonstrated in Pilot Briefing materials (weather data, digital NOTAMs, graphical displays, etc.)

CS6: Management of Common Network Resources Service. The provision of any service within the network automatically requires a database within which all network's resources are stored and managed for their further day-to-day usage within European ATM.

The management of the resources, e. g. network addresses, will build fast and efficient exchange of

information for the reason that the data will be structuralized and easy to use.

Moreover, CS6 is divided into 5 sub-activities which will ensure the quick response to each request among a critical volume for potential business [6].

These sub-activities are:

1. Radio Frequency Function (RFF);
2. European Messaging Directory Service (EMDS);
3. European IPS Repository (EIPR);
4. Security Certificate Service (SCS);
5. Operation and Coordination of Network Security (OCNS).

Radio Frequency Function. All aeronautical frequencies within Europe must operate without any interference that means there should be a common database with all the operational frequencies stored and constantly collated.

Being a regulated NM function, the RFF performs the function described hereabove. It provides the automation systems and procedures that analyze the set of frequencies and assign them to all airspace users and service providers and register them.

European Messaging Directory Services. This service centralizes all messages into one database improving the current state in which the ATS Messaging Management Centre is outsourced to National ANSP and publish routing tables for each COM center of the EUR/NAT Regions separately.

European IPS Repository. The EIPR will centralize all technical infrastructure data for Voice and Data, fixed and mobile communication services.

It will ensure the communication between all stakeholders (MIL, airports, airspace users, etc.) to support current and future operational needs as the database of EIPR is to contain the interoperability information (e.g. IP address ranges and identifiers).

The realization of the sub-activity will be performed through the establishment WEB-based service on which all stakeholders can find all the data needed to establish the link necessary for their operations.

Security Certificate Service. SCS will ensure that the information flow within ATM infrastructure is properly secured. It will perform user authentication and encryption/decryption when needed delivering network keys.

The service will be available 24 hours every day in a week.

Operation and Coordination of Network Security. SCS is an operational part of CS6 whereas OCNS is administrative side that defines an efficient security framework for ATM services in Europe.

Establishment of OCNS requires a central center of coordination of network security which performs the following functions:

- Definition and rollout of network security best practices across Europe;
- Provision of support to the investigation of potential security breaches;
- Operation of Central emergency security service which will monitor the security threads and react appropriately.

In general about CS6, part of the services are already operational but need the enhancement while others (SCS and OCNS) are totally new.

The establishment of CS6 requires close cooperation with military side of ATM as they are the actors which require the highest level of security compared to others.

CS7: Network Infrastructure Performance Monitoring.

The high safety and efficient performance of CNS infrastructure can be reached only with its constant monitoring and management.

Upon that reason, CS7 will be created in order to provide necessary rectification at the lowest cost should any problem be encountered.

The scope of the service includes [7]:

- aircraft installation performance;
- air-ground data-link performance;
- satellite infrastructure performance.

Also the service encompasses:

- The performance monitoring of Data-link communication;
- The functional and performance analysis on surveillance avionics;
- The altimetry system error performance analysis;
- The monitoring and prediction of satellite navigation;
- The performance analysis of TCAS function;
- The performance of 1030/1090 RF bands.

The main objective of the service introduction lies in the need to solve the problem with the collection of anomalies met by users and the storage of data at multiple places in Europe.

The centralization of the information alters the performance monitoring to be much easier and more reliable.

The main manager of NIPS is the NM who will estimate the impact on the network operations and take the decisions upon the further actions.

Worth to note that the NIPS requires various tools to perform systematic monitoring of service quality and report performance anomalies.

CS8: Pan-European Network Service. PENS is an international ground/ground communication

infrastructure created to provide a common IP-based network service across the European region covering voice and data communication.

Network Manager Operational Centre (NMOC) and EAD are currently based on this infrastructure and now it is necessary to integrate it into ANSP/ATM applications [8].

PENS provides:

- IP service for ATM communication;
- Communication services for centralized application;
- Potential common infrastructure for global interconnection;
- Platform for further developments;
- Centralized network supervision.

As the PENS is already operational, CS8 constitutes in its enhancement adding new functions like:

- Central supervision (one network supervision for all ANSP);
- Bridge with other stakeholders (interfaces with Airport, Airlines, MIL, etc.);
- The backbone of the centralized services (the exchange of data between the centralized services centers and the stakeholders).

CS9: DATACOM. SESAR ConOps indicate that there is a constant increasing need for the enhancement in the interaction between aircraft and ground systems.

The DATACOM infrastructure promises the seamless integration of the air/ground (A/G) component with the G/G IP communications environment to ensure the end-to-end connectivity [9].

For now, A/G communication and application services are provided by different operators in Europe that makes them extensively coordinate to share and operate a fragmented system.

The DATACOM is to provide the following services:

- Centrally maintaining and operating an integrated coherent A/G infrastructure;
- Being a focal point where A/G related data is concentrated and then securely distributed;
- Facilitating harmonized interfaces with the external users and legacy systems (e.g. military).

4. Conclusions

For the time being, there are no ConOps (Concepts of Operation) for CSs since they are planned to be released at the end of 2013.

Therefore, the information may be updated or changed in due time (some additional functions which are not described in this article might appear, some functions might be changed or modified).

However, according to the initial description of them by Eurocontrol they are aimed to support the SESAR

developments on a central basis by taking under one single cap the management of the main services in the way to harmonize Europe as much as possible (because the main goal of SESAR is the seamless European sky without any state boundaries).

CSs will enable the service providers/ATM manufactures to collaborate and provide the service outside the national boundaries encompassing a pan-European level.

The ratification of CSs will allow the implementation of the money flow among the airspace users, AO ANSP and Eurocontrol with an open and understandable system of value and time trade offs producing the best provision of the services. Consequently, Eurocontrol and all service providers will sign the performance-based contracts which will serve as the common and identical guidelines for all Eurocontrol member states.

References

[1]. *Description of Services. CS1. Flight Plan and Airport Consistency Service.* Belgium. Brussels. Eurocontrol. 2013.

[2]. *Description of Services. CS2. 4D Trajectory Calculation for Planning Purposes (4DPP).* Belgium. Brussels. Eurocontrol. 2013.

[3]. *Description of Services. CS3. European Tracker Service (ETKR).* Belgium. Brussels. Eurocontrol. 2013.

[4]. *Description of Services. CS4. Advanced Flexible Use of Airspace.* Belgium. Brussels. Eurocontrol. 2013.

[5]. *Description of Services. CS5. European ATM Information Management Service (EAIMS).* Belgium. Brussels. Eurocontrol. 2013.

[6]. *Description of Services. CS6. Management of Common Network Resources Service.* Belgium. Brussel, Eurocontrol. 2013.

[7]. *Description of Services. CS7. Network Infrastructure Performance Monitoring (NIPS).* Belgium. Brussels. Eurocontrol. 2013.

[8]. *Description of Services. CS8. Pan-European Network Service (PENS).* Belgium. Brussels. Eurocontrol. 2013.

[9]. *Description of Services. CS9. DATACOM.* Belgium. Brussels. Eurocontrol. 2013.

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Розглянуто нову концепцію Євроконтролю. Проаналізовано різні види послуг для країн-членів Євроконтролю. Показано переваги та недоліки реалізації запропонованої концепції.

Ключові слова: організація повітряного руху; оцінка функціонування системи; переваги та недоліки запропонованої концепції.

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Рассмотрена новая концепция Евроконтроля. Проанализированы разные виды обслуживания для стран-членов Евроконтроля. Показаны преимущества и недостатки предложенной концепции.

Ключевые слова: организация воздушного движения; оценка функциональности системы; преимущества и недостатки предложенной концепции.

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