



## PROJECT REPORT

ETFMS

ENHANCED TACTICAL FLOW MANAGEMENT SYSTEM

Development 2002 - 2009

# COMSOFT

1988

CFMU



Slot allocation only based on Initial Flight Plan System at CFMU

2000

ETFMS



ETFMS contracted to COMSOFT

2002

ETFMS (DCS)



ETFMS operational; Kick-off with Belgium, Netherlands, Germany, France, Portugal, Denmark, Norway, Switzerland, Czech Republic, Slovakia, Ireland, Italy, Great Britain, Austria and Spain.

2004

ETFMS (DDS)



Implementation of DDS feature

New Members: Romania and Greece joined

2006

MEMBERS



New Members: Malta, Hungary and Finland joined

2008

MEMBERS



New Members: Lithuania and Sweden joined

2009

MEMBERS



New Members: Albania, Croatia and Bulgaria joined

## BACKGROUND

Since 1988 the Central Flow Management Unit (CFMU) in Brussels has been assigned the task of balancing demand and capacity within air traffic management as well as calculating the complex slot allocation. In particular this involves keeping delays to a minimum and avoiding congestion, bottlenecks and overload in the airspace controlled by the European Civil Aviation Conference (ECAC) member states. Since its inception the CFMU has mastered this challenge with great success.

Up to the year 2001, however, the data on which the CFMU planning was based was intrinsically incomplete. Based primarily on input from the EUROCONTROL Initial Flight Plan Processing System (IFPS), real positional data was missing - i.e. the assumed actual air situation was only an estimate rather than a fact.

This has changed since the deployment of the Enhanced Tactical Flow Management System (ETFMS) in 2002. Contracted to COMSOFT in July 2000 ETFMS now provides an overview of traffic over Europe and adjacent airspace based on most up to date traffic data. This has significantly improved the accuracy of traffic prediction. Moreover it facilitates additional functions such as statistical analysis and “what-if” extrapolations.

ETFMS is a distributed system with 26 involved countries as of today. At the current stage a total of 38 ATC centres all over Europe feed their data into the system contributing to its efficiency. During the initial years ETFMS has only been processing data for internal use at the CFMU and for evaluations to better serve the member states. Then, in 2004 the data distribution system (DDS) was introduced which now allows the simultaneous dissemination of information. On the following page the two distinct ways of communication are described. Whereas DDS depicts the process of distributing information to ATC service centres, DCS describes the data collection system.

## OBJECTIVES

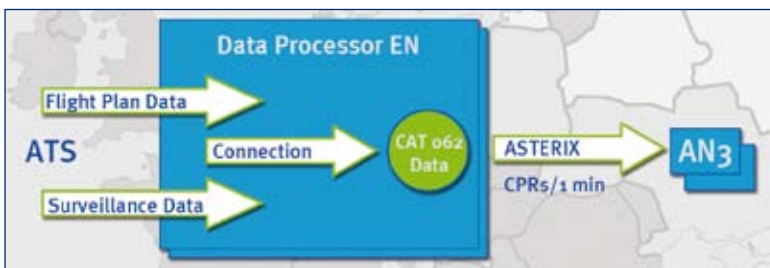
The major objective of ETFMS is to increase the accuracy of the CFMU flight database which serves as a critical prerequisite for any decision-making of flow management operators. This applies to all flights in the CFMU-monitored airspace as well as to incoming out-of-area traffic. Before, the flight plan data was often inaccurate, particularly for the latter type of traffic, due to unknown flight delays and data arriving too late to be taken into account for any flow management actions. With ETFMS, positional information from the surveillance systems has been made available and it constantly provides real-time knowledge of the air situation.

Increasing accuracy contributes both to safety and efficiency. In particular it avoids bunching effects or lulls in traffic, which occur when flow management decisions are based on incorrect or incomplete base data. Furthermore the resilience of the ATFM system and procedures during unexpected or emergency situations has been improved tremendously. Rather than making a decision based on possibly incomplete input data, operators can now work from a realtime picture on which they can rely.

## DATA COLLECTION SYSTEM (DCS)

### Entry Nodes

In general air traffic movements are surveyed regionally, and then, according to the locally installed equipment, the data is routed to national surveillance data processing (SDP) systems such as ARTAS. From there the processed positional data is forwarded to the next ETFMS Entry Node (EN). Each EN as such is a complex communication front-end and plays a fundamental role in the process of collecting data as it provides the interfaces to the two principal sources: the surveillance system as well as the flight plan data system. The conversion, correlation and filtering of data material are its cardinal tasks.



EN Architecture

Communication between EN and the CFMU is organized via a multinational IP network. The network applies the ASTERIX category o62 on application level, which is capable of expressing both the positional and flight plan elements required for tactical flow management decisions. In order to merge incoming tracks and flight plans into correlated position reports (CPRs) the conversion into category o62 is necessary, which is incidentally ETFMS' unique internal format. The format can carry position, speed, heading and callsign and, if available, also information about the departure airport, destination airport, time of departure etc. With the purpose of simplifying the data transfer, the ENs implement correlation algorithms and convert the positional data into a single coordinate system. Finally the CPRs are sent to the CFMU once every minute.

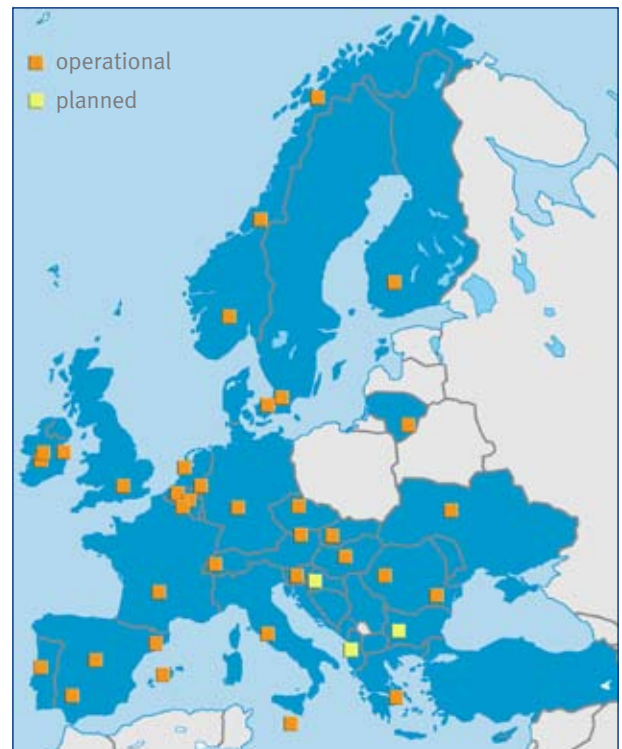
At the side: at present flight plans are primarily sent as AFTN messages. However, the emerging standard is AMHS, which is deemed to replace AFTN messaging within the next few years.

### Access Nodes

Today the ETFMS network incorporates about 40 entry nodes across Europe, all of which forward the preprocessed stream of CPR to a central node located at the CFMU, called Access Node or AN3. AN3 is supplied, akin to all EN, in a redundant hot standby configuration and is the last assembly point before the collected data enters the CFMU's central server.



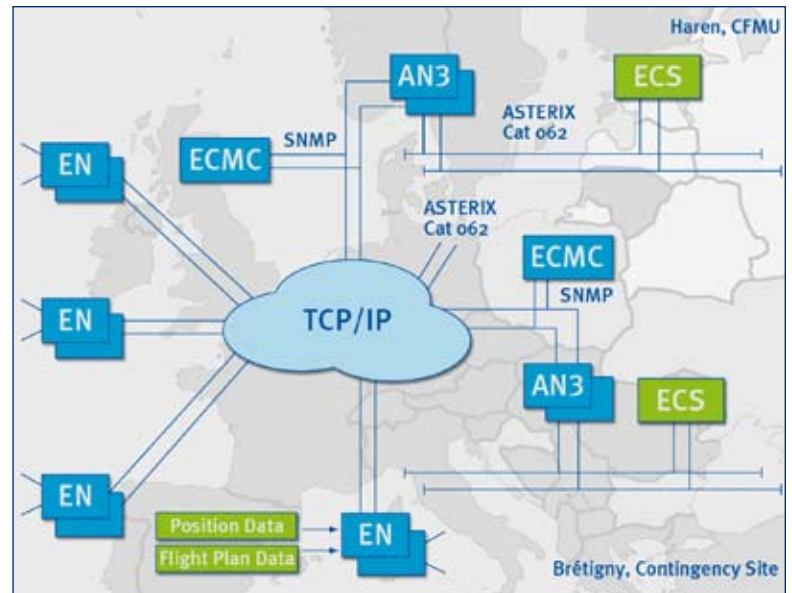
System Picture of Entry Node



Map of ETFMS Locations

- Albania
- Austria
- Belgium
- Bulgaria
- Croatia
- Czech Republic
- Denmark
- Germany
- France
- Finland
- Greece
- Hungary
- Ireland
- Italy
- Lithuania
- Malta
- Netherlands
- Norway
- Portugal
- Romania
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- UK

The ETFMS central server (ECS) is the main processing unit and is located in Haren close to Brussels, Belgium, with a replica in Brétigny, France. Likewise the redundant AN3 is also duplicated and located at both sites. Brétigny has been designed to act as contingency in case of catastrophic failure.



ETFMS Architecture

## HIGHLIGHTS OF ETFMS

- Environmental benefits through reduced emission
- Lower overall costs for airlines through operational improvements and higher efficiency
- Common view of actual and expected traffic situation
- Smoothing traffic
- Possibility of collaborative decision making
- Increase of air traffic capacity and reduction of flight delays
- Safety improvement through accuracy

## DATA DISTRIBUTION SYSTEM (DDS)

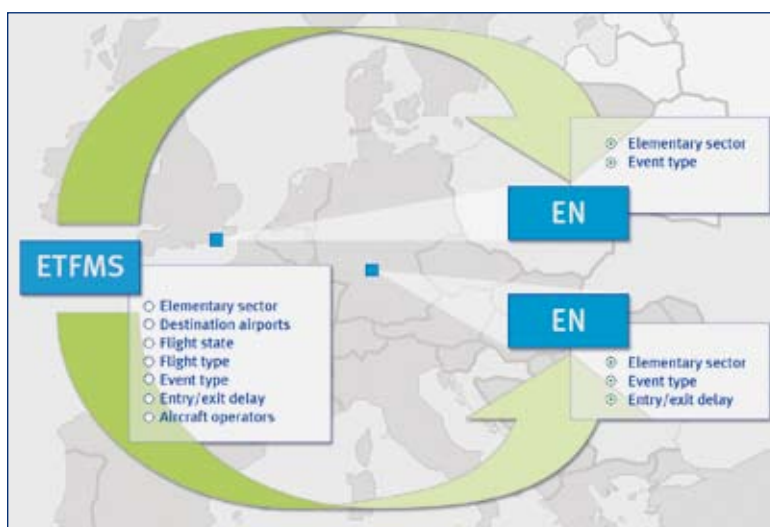
With the implementation of the ETFMS/DDS feature, the distribution of collected data has been made possible. ANSPs were given the chance to request valuable ETFMS flight data (EFD) in order to integrate it into their local ATM system, allowing a view on the same up-to-date air picture that was provided to flow management operators.

### Entry Nodes

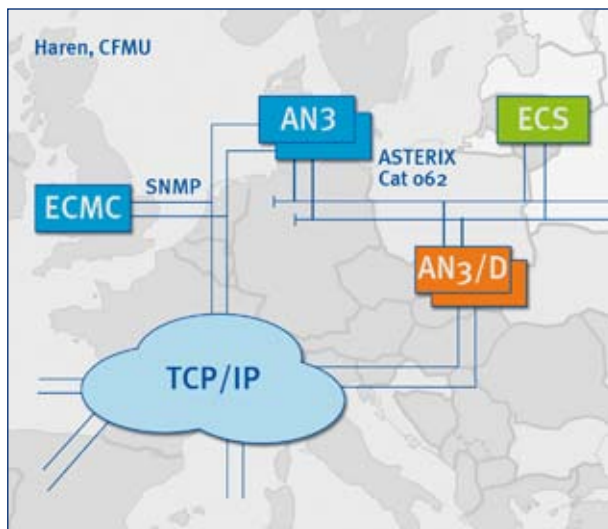
Akin to the collection process, the EN again plays a significant role in the process of distribution. The information leaving the CFMU always exits as a whole, meaning as a correlated data stream. The included information depicts the air situation of most of Europe. Therefore the EN is used as filter, separating the requested data according to the user-defined criteria of a specific ATC centre. Depending on the area of interest or event in question, the criteria can be set in order to reduce the amount of hits. Consequently only incoming EFD messages, relevant to local ATM operations are forwarded.

Currently the following filter criteria are assigned to each message and can be filtered by the EN:

- Elementary sector (included/excluded)
- Destination airports
- Flight state
- Flight type
- Event type
- Entry/exit delay
- Aircraft operators



ETFMS Filtering



Architecture including AN3/D

## Access Nodes

The newly introduced AN3/D node at the CFMU, as well as at its replica site Brétigny, is responsible for disseminating information which is done by means of multicast. Multicast is a communication technique to distribute information to an unknown number of receivers within an IP network. The distribution format for EFD messages is called ADEXP (ATS Data Exchange Presentation) and it was specified by EUROCONTROL. Designed for the exchange of messages containing aeronautical and tactical data necessary for flight planning operations, it is ideally suited for communication between the CFMU and the ATS systems of the participating ANSPs.

The principal advantage of the bilateral exchange of data is the reduction of inconsistencies in data between the CFMU and ATC centres. Moreover, this development significantly improves the quality of information, and at the same time allows all users to receive and view common, standard flight data. The beneficial effect is that its users are now capable of collaborative decision making.

CFMU's launch of the distribution system and the opportunity for its users to obtain data consistent with that in the central server also induced the development of tools for statistics, traffic prediction and planning with the purpose of further assisting ATFM operations.

## CONTROL AND MONITORING

The ETFSMS Central Monitoring and Control (ECMC) component is responsible for the management of the ETFSMS application at the CFMU. Equipped with a user-friendly graphical interface, it provides access to the individual system components via the TCP/IP network using SNMP. The status of the AN3/D and all the ENs are then assessed by means of the existing ETFSMS/DCS ground-based network.

ECMC is responsible for:

- Administration of EN and AN3/D systems
- Configuration management
  - Definition of monitored nodes with all objects and their status
  - Description of connection settings
  - Synchronization settings
  - Download of changed configuration to remote node
- Reporting and diagnostics
- Synchronization
  - Storage of EN and AN3/D configuration changes
- Reboot of EN and AN3/D
- Switch to DDS



ECMC GUI

## OUTLOOK

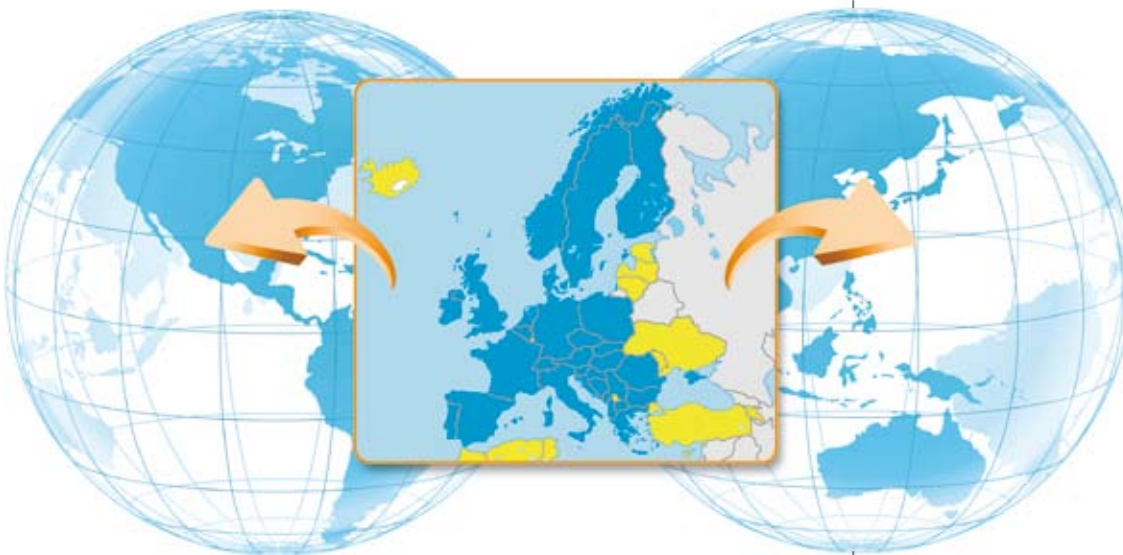
During the deployment phase of the ETFMS network, COMSOFT has made use of its extensive experience and expertise in infrastructure programmes both in the surveillance and AFTN/CIDIN/AMHS area. One of these projects was the design and implementation of the European RADNET. Similar to ETFMS, the objective with RADNET has been to share data across country borders. As its cornerstone COMSOFT developed the Radar Message Conversion and Distribution Equipment (RMCDE), which significantly provided a valuable contribution towards the European surveillance infrastructure in the past.

In the future, the ETFMS umbrella will cover the whole of Europe. With initially 16 countries taking part, this year the number has grown to 26 and it is anticipated that all 38 ECAC member states, many of which are Eastern countries, will participate in the near future. This gives air traffic flow management in Europe a new quality and will greatly help to manage the steadily growing international air traffic. The ETFMS project is therefore a further important milestone in the EUROCONTROL strategy contributing to an increased level of safety and improved air traffic efficiency. Especially now, with the recently launched SESAR (the Single European Sky ATM Research Programme) project these factors play a significant role. SESAR's aim is the improvement of the European ATM system, for the first time involving the aviation players (civil and military, legislators, industry, operators and users, both ground and airborne).



*“ETFMS represents a major step forward in Air Traffic Flow Management as it provides a tool that allows the CFMU to compensate for the multitude of variables that cause differences between planned traffic and actual traffic.”*

[http://www.cfm.eurocontrol.int/cfm/public/standard\\_page/developments\\_etfms\\_conclusion.html](http://www.cfm.eurocontrol.int/cfm/public/standard_page/developments_etfms_conclusion.html)



Potential Expansion of ETFMS Network



## ACRONYMS AND ABBREVIATIONS

ADEXP	ATS Data Exchange Presentation
AFTN	Aeronautical Fixed Telecommunication Network
AMHS	ATS Message Handling System
AN <sub>3</sub> (/D)	Access Node 3 (Distribution)
ANSP	Air Navigation Service Provider
ARTAS	ATM Surveillance Tracker And Server
ASTERIX	All-purpose Structure EUROCONTROL Radar Information Exchange
ATFM	Air Traffic Flow Management
ATS	Air Traffic Services
CFMU	Central Flow Management Unit
CIDIN	Common ICAO Data Interchange Network
CPR	Correlated Position Report
DCS	Data Collection System
DDS	Data Distribution System
ECAC	European Civil Aviation Conference
ECMC	ETFMS Central Monitoring and Control
ECS	ETFMS Central Server
EFD	ETFMS Flight Data
EN	Entry Node
ETFMS	Enhanced Tactical Flow Management System
FDPS	Flight Data Processing System
IFPS	Initial Flight Plan Processing System
MIB	Management Information Base
RADNET	Radar Network in Europe
RMCDE	Radar Message Conversion and Distribution Equipment
SDP	Surveillance Data Processing
SNMP	Simple Network Management Protocol
SESAR	Single European Sky ATM Research Programme



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