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Information Paper

Agenda item: 4.2 Review Trials and Implementation Activities

Italy experience on AIS Automation

Presented by
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SUMMARY

This information paper presents the experience achieved so far in Italy about the automation of Aeronautical Information Service (AIS) as well as future implementation of advanced techniques..

Italy experience on AIS Automation

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1. INTRODUCTION

The increase of the air traffic appeared on the horizon already in the early eighties, highlighting a growing need for timely information from Airlines and General Aviation.

ENAV, the Italian ATS Agency, took into account this need by developing and introducing, since 1985, the first AIS Automated System (AISAS).

AISAS supported the Italian AIS Office with the facilities to maintain a comprehensive on-line national data base of aeronautical information to provide pre-flight briefing and flight planning services to airlines, business and general aviation throughout Italy.

Two years later this system was again optimised and tailored to the needs of the European users according to the concepts of the "Integrated EUR Automated AIS System" developed by the European Air Navigation Planning Group (EANPG).

Ever since the AIS service has been progressively extended to foreign countries, in terms of availability of both static and dynamic data. At present the service coverage spans over the entire globe with the exception of few countries.

In the 1994 ENAV decided to upgrade once more AISAS in the spirit of EATCHIP, the European harmonisation and integration programme managed by EUROCONTROL; so a new AIS system (AISAS II) has been developed providing new and more sophisticated functions, mostly taking advantage of today's technologies.

Furthermore some other programmes have been launched by ENAV in the AIS Automation field; the most relevant concern the Electronic AIP production and the extension of AIS services to aircraft by means of the ICAO standardised air-ground VHF digital link (VDL).

2. AISAS: THE ITALIAN AIS AUTOMATED

2.1. GENERAL

The purpose of the AISAS system is to manage aeronautical information more efficiently by implementing automatic procedures that acquire, memorise and distribute to ATC staff operational data that require a continuous updating such as NOTAM messages and other auxiliary information.

The system permits:

- acquisition of NOTAM messages from the Aeronautical Fixed Telecommunication Network (AFTN) through the AFTN Message Switching System;
- automation of the International NOTAM Office (NOF) by supporting the insertion, storing and distribution of the national SYSTEM NOTAM messages on the AFTN;
- production of Pre-flight Information Bulletin (PIB), summaries and check-lists so as to guarantee the availability of the aeronautical information necessary for flight navigation;

- managing of a completely flexible airspace model containing full information on published airways, aerodromes, navigation and geographic fixes, control zone and restricted airspace.

The system provides services to the following user categories:

- Air Force
- Aircraft Operators including Airlines and Private Users
- AT-C Units
- European CFMU (Central Flow Management Unit)
- AIP Services
- Cartography Services
- AFTN Users

The system is compliant with ICAO standards and recommendations, in particular with those contained in the following documents:

- Aeronautical Information Services Manual (ICAO Doc 8126-AN/872);
- Guidance Material On ATS Automation In The European Region (Orange Book) - (ICAO EUR Doc 002, AIS - a/3);
- Manual of the common operating procedures for the integrated EUR Region Automated AIS system (Blue Book);
- ICAO Annex 15 Aeronautical Information Services.

2.2.FUNCTIONS

2.2.1. AFTN message Management

The AISAS system interfaces with the AFTN through the Message Switching System; for this purpose three independent full-duplex channels are available to receive and transmit AFTN messages with asynchronous start/stop protocol. Message character code comply with CCITT standard (ITA2 / IA5).

The AFTN message management function provides the following features:

AFTN Message Reception

Reception and decoding of AFTN messages including the following actions:

- checking of CSN (Channel Sequence Number) and automatic generation of the proper message in case of wrong sequence;
- recognition, and handling of service “SVC” and “CH” messages;
- automatic handling of NOTAM Repetition messages;
- re-composition of messages split in two or more AFTN messages;
- extraction of expected parameters from NOTAM, SNOWTAM and BIRDTAM;
- activation of the automatic processing for correct messages;
- rejection of formally incorrect messages into a correction queue.

AFTN Message Transmission

Transmission via AFTN of the messages generated by AISAS including DUPE, NOTAM RETRANSMISSION, REPETITION REQUESTS and FREE TEXT messages. Many other facilities are available such as use of standard pre-formatted messages, copying of existing or pending messages, interactive handling of AFTN addresses, etc..

2.2.2. NOTAM Management

The NOTAM Management function allows production, reception, storing and distribution of both Domestic and International NOTAMs.

Main features are:

- ***Automatic NOTAM Acquisition***

SYSTEM NOTAM, SNOWTAM and BIRDTAM are automatically decoded and stored in the system with relevant attributes; data are localised by means of a very sophisticated GEOREF square computing algorithm. Only NOTAMs in the ICAO format need manual intervention by AIS staff in order to allow the compilation of the “qualifiers line” to make them compatible to SYSTEM NOTAM format.

- **NOTAM Generation**

Both national and foreign NOTAM (type N,R,C) are compiled in the SYSTEM NOTAM format completely assisted by the computer in order to generate fully checked and error-free messages. In case of permanent NOTAM the system searches for possible AIP reference in the NOTAM text and creates a logical with the NOTAM number to be used in the electronic AIP production.

- **NOTAM REQUEST Generation**

NOTAM generate by national AIS units, connected to AISAS, have to be submitted by means of NOTAM REQUEST function to NOF for validation and transmission to AFTN relevant addresses.

- **NOTAM Inquiry**

A large set of inquiry functions is available to retrieve NOTAM, SNOWTAM, BIRDTAM and NOTAM REQUESTS stored in the system. Any NOTAM attribute (such as serial number, code, country, status, series, year, issue date, validity period, traffic, purpose, scope, etc..) or a combination of them can be used as searching criteria. Both valid and expired NOTAM can be searched and in case of updated NOTAM also old versions are presented to point out the changed information. In addition the system provides a geographical inquiry specifying either static items (Aerodromes, FIRS, FIXes and pre-defined Areas) or extemporaneous items, like not-pre-defined areas to be built dynamically by using a combination of known items (i.e. Aerodromes, FIXes, Coordinate, etc..).

2.2.3. AIS Report Generation

The AIS report function allows the user to request the generation of some kind of AIS information reports, such as:

- **NOTAM CHECKLIST**

The NOTAM CHECKLIST is a type "R" NOTAM (NOTAMR) whose text consists of a numbered list ordered by year of all the active NOTAMs belonging to the same series. The system provides capability to generate the Italian "NOTAM CHECKLIST" and transmit the relative SYSTEM NOTAM messages on the AFTN to all of the addresses corresponding to the NOTAM series.

AISAS is also capable to process foreign NOTAM Checklist in order to automatically update the NOTAM Data Base.

- **NOTAM SUMMARY**

The "NOTAM Summary" generated by the system is a list of all the active NOTAMS present at midnight of the last day of the month. The summary shall also contain all AIP variations, “AMENDMENT” and “SUPPLEMENT”, with the associated cancelled NOTAMs.

PIB (Pre-flight Information Bulletin)

The PIB function allows to produce the following type of bulletins:

- Area Bulletin: specifying an area known to the system or dynamically defined by the user;
- Aerodrome Bulletin: specifying one or more aerodromes known to the system;
- Route Bulletin: specifying the flight identification for planned traffic or the ATS route for not-planned traffic.

This capability also allows filtering of selected NOTAM information through the use of one or more optional input parameters.

Furthermore NOTAM Bulletins can optionally incorporate meteo information (METAR, TAF and SIGMET) relevant to the area, aerodrome or route selected by the user.

2.2.4. Support Functions

Support functions refer to a set of several facilities designed to help AIS staff to manage the system and the activities related to NOTAM operations in the most efficient, simple and secure way. Relevant facilities are:

- ***Geography Management***

Geography Management function allows the entering, updating, deletion and inquiry of the following ATS data:

- AERODROMES;
- RUNWAYS;
- FIXes;
- NAVAIDS;
- FIRs;
- ATS ROUTES (ICP, SID, AIRWAY, STAR, SIA);
- SPACE AREAS.

ATS information are managed using a Relational Data Base Management System and appropriate checks are automatically performed to ensure the correctness and consistency of the data entered in to the system.

- ***AIS Parameter Management***

ATS Parameters Management function allows AIS manager to set up and control all the parameters used by the system in the generation of NOTAM, SNOWTAM, BIRDTAM and other AIS messages.

- NOTAM parameters:
 - Series, Numbers and Addresses
 - Code letters
 - Selection criteria
- SNOWTAM & BIRDTAM parameters:
 - Number
 - Addresses
- AFTN parameters:
 - Maximum message text length
 - Number of message address lines

- ***User Authorisation Management***

User Authorisation Management function allows AIS manager to define an authorisation profile for each of the AIS users in order to specify the set of functionality that each user is enabled to use. The user profiles can be set up or modified on-line at any time simply flagging functions to be authorised on a list shown by the system for each user.

A personal password is also provided in each user profile to prevent not authorised access to the AIS system. Access are also handled at system level by means of specific product (RACF).

- ***Statistics***

Statistics function allows to produce reports containing information related to the system usage, the type and quantity of services requested, the quality of information processed. Information available are, for instance:

- number of peripheral users connected in a specified time period;
- number of NOTAM and PIB requested by each user;
- total number of NOTAM messages received;
- number of NOTAM messages processed automatically;
- number of NOTAM messages processed manually;
- etc....

The analysis of statistical parameters can allow the evaluation of system workload and, if necessary, the optimisation of resources allocated to the various capabilities or to each user.

3. AIS DATA LINK

3.1. GENERAL

The AIS Data Link is one of the ENAV's Research & Development programmes. Target of this programme is to build a prototype able to transfer data, by means of VHF Digital link, between an aircraft in flight, adequately equipped with VDL, and the AISAS ground system in order to supply AIS services on-board, providing pilots with up-to-date and timely information just as needs arise.

The system's architecture is compliant to ATN ICAO standards, which foresee a seven layers structure (ISO-OSI). Being the VHF Digital Link a subnetwork, it only consists of the three lower layers (network, link and physical). It is important to highlight that only changing the physical layer it will be possible to upgrade the whole system, according to standards expected to be applicable, for ICAO Annex 10, from November 1997 onwards (i.e. Mode 1 and Mode 2 for VDL).

Technical solutions adopted are compliant to VDL mode 1, as defined in the mentioned ICAO SARPs and in accordance with COM/T decisions, (a Eurocontrol Body that deals with communications policy in Europe), which, after studies made about the feasibility of an initial air/ground data sub-network to be implemented in the mid-term within ECAC area by the year 2005, proposed the VDL Mode 2 as the main choice for Europe.

The principal features of VDL are:

- ATN compliant;
- bit oriented protocols;
- CSMA (Carrier Sense Multiple Access) to randomly manage the access to the RF VHF carrier;
- AM-MSK modulation scheme for Mode 1 and D8PSK for Mode 2;
- channel rate of 2400 bit/sec for Mode 1 and 31.500 bps for Mode 2.

3.2. EXPERIMENTAL PHASE

To support the experimental phase only two services will be initially implemented. They are: Pre-flight information bulletin (PIB) and NOTAM on request. During the experimental phase several aspects will be analysed such as:

- integration activities carried out in laboratory using the prototype and supporting tools to simulate line attenuation as well as to verify line analogic parameters such as: attenuation distortion and delay; in addition error characteristics determination of digital transmission (Bit Error Rate, Block Error Rate) will be assessed.
- flight test to verify:
 - ⇒ digital transmission supported by a radio channel in the real environment;
 - ⇒ operational AIS connection in terminal area, (connection initiation and data transmission);
 - ⇒ operational en-route connection (connection initiation and data transmission).
- results validation, through the analysis of data and parameters recorded during the integration and flight test phases. In particular the following parameters will be taken into account:
 - ⇒ coverage
 - ⇒ connectivity
 - ⇒ throughput
 - ⇒ residual error rate
 - ⇒ availability
 - ⇒ recovery capability.

Reference will be made to the values parameters contained in the VHF Digital Link Standard and Recommended practices (VDL SARPs)

3.3. INITIAL SERVICES

The "Pre-flight information bulletin" (PIB) consists in NOTAMs correlated among them because relative to particular routes and valid for a determinate time. The pilot can choose a specific route and some NOTAM selection rules; the request will be forwarded via VDL to the ground station, which in turn will activate the transaction on the AISAS mainframe. When ready, the buffer containing data will be transmitted on board, and displayed on a screen in the form of a synthetic NOTAM list with essential information relative to the route considered. The same data can also be printed on board for further reference.

The reasons to have a synthetic list is in order to avoid channel congestion since the channel rate reduced (2400 Bit/sec of Mode 1), and to give immediate and essential information to the pilot.

The second service implemented is "NOTAM on request", by which the pilot can request NOTAMs selected according to:

- ICAO indicator;
- specific areas (forbidden, restricted, etc.);
- specific object (NOTAM code, AIP material).

In the same way the pilot may request the information by means of an input device by choosing the correct selection, which follows the same steps written above. The information will be received from the mainframe and will be displayed or printed on board.

3.4. EXPERIMENTAL SYSTEM

The AIS Data Link system is mainly composed by three parts:

- The ON-BOARD segment, which consists of :
 - ⇒ VHF transmitting unit, working in CSC (Common Signalling Channel), through which information about frequency used in a defined area to provide the AISAS service will be given, as well as particular information on the kind of services available;
 - ⇒ VHF transceiver unit, capable of establishing and maintaining the physical connection to the ground segment;
 - ⇒ an input/output device used by the pilot to request the service and to display and/or to print the output information.
- The GROUND segment, which consists of :
 - ⇒ receiving VHF unit, with CSC functions (capable of automatically tuning the other transceiver on the frequency where the services are provided);
 - ⇒ transceiver VHF unit capable of connecting one or more aircraft under the service coverage;
 - ⇒ mainframe Aeronautical Operations Information System (AOIS) of Rome ACC;
 - ⇒ a front-end computer operating as a gateway to the AISAS services, working on UNIX operative system.
- The SOFTWARE COMMUNICATION segment
which implements the air/ground transmission protocols, handles the communication sessions and takes care of displaying information on board.

The AIS Data Link programme is going toward an experimentation phase, flight tests are planned at beginning of next year in Rome ACC area.

In the next future it is ENAV's intention to provide these services in the entire Italian airspace, while expanding the service to other applications such for instance: ATIS, METEO, etc..

4. Conclusion

This information paper highlights the effort that ENAV made since 80's to develop the AIS automation according to ICAO recommendations and using the best technological solutions.

Today's objectives are:

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- harmonisation and integration of already operational system in the spirit of EATCHIP programme managed by Eurocontrol;
- development of research programs toward new standards and technologies under definition by International Organisations.

The final goal is of course to keep the Italian ATS systems always at maximum level of efficiency in the contest of world automation.