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Information Paper

Agenda item: 4.2 Review Trials and Implementation Activities

**IMPLEMENTATION OF AN EXPERIMENTAL NOTAM SERVICE AS A
NEW
AIR-GROUND FIS SERVICE**

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SUMMARY

This information paper presents the Working Paper that will be presented at next ADSP/WG-B meeting as contribution to the possible extension to the NOTAM service of the "Manual of ATS Data Link Applications". It presents the implementation of an experimental ATN FIS/NOTAM air-ground data link application done by SICTA (the Italian research centre in ATC field), in the framework of its ATN research activities. The paper presents: the project background, the implemented project, the requirements used for implementation.

AUTOMATIC DEPENDENT SURVEILLANCE PANEL

WORKING GROUP B MEETING

Adelaide, Australia February 1999

DEVELOPMENT OF AN EXPERIMENTAL NOTAM SERVICE AS A NEW AIR-GROUND DFIS SERVICE

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Presented by

1. Introduction

SICTA (the Italian research centre in ATC field), in the framework of its ATN research activities, implemented an experimental FIS/NOTAM air-ground data link application.

This paper presents: the project background, the implemented project, the requirements used for implementation.

2. Background

2.1. ENAV's AISAS system

AISAS is the operational ENAV's Aeronautical Information Services Automated System .

The first version of AISAS was developed in 1985 and supported the Italian AIS office with the facilities to maintain a comprehensive on-line national data-base to provide pre-flight briefing and flight planning services to airlines throughout Italy.

Two years later this system was again optimized and tailored to the needs of the European users according to the concepts of the "integrated EUR automated AIS systems" developed by the EANPG. Then it was progressively extended to foreign countries, in term of availability of both static and dynamic data. At present the service coverage spans over the entire globe with the exception of few countries.

Into 1994 it was decided to upgrade once more AISAS in the spirit of EATCHIP, the European harmonization and integration programs managed by Eurocontrol, so a new AIS system (AISAS II), has been developed providing new and more sophisticated functions.

The AISAS system permits:

- acquisition of international NOTAM messages from the Aeronautical Fixed Telecommunication Network (AFTN) through the AFTN switching system;

- automation of the international NOTAM office (NOF) by supporting the insertion, storing and distribution of national System NOTAM messages on the AFTN;
- production of PIB (Pre-flight Information Bulletin, that consist in NOTAMs correlated among them because relative to particular routes and valid for a determinate time);
- managing of completely flexible airspace model containing full information on: airways, aerodromes, navigation a geographic fixes control zone, and restricted airspace.

The system provides services to the following user categories:

- Air Force
- Aircraft Operator including Airlines and Private Users
- Air Traffic Control (ATC) units
- European “Central Flow Management Unit” (CFMU)
- Aeronautical Information Publication (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 AIS Automation In The Europe Region (Orange Book) - (ICAO EUR Doc 002, AIS - a/3),
- Manual of common operating procedures for the integrated EUR region Automated AIS system (Blue Book) and
- ICAO Annex 15 Aeronautical Information Services.

2.2. Experimental Mobile AISAS

Recently some other programs, based on the above AISAS system, have been launched in the AIS Automation Field. The most relevant concern the extension of AIS services to aircraft by means of the ICAO standardised air/ground data-link.

Target of this experimental project was to built a prototype able to transfer data, by means of VHF Digital Link (VDL), between an aircraft in flight and the AISAS ground system in order to provide AIS services on-board, providing pilots with up-to-date and timely information just as needs arise.

The project is now terminated with successful in flight trials in which an experimental VDL Mode 1 data link was used and in which the NOTAM application service made direct use of VDL protocol stack (i.e. no full seven layers protocol stack as defined in the ATN standard), furthermore the NOTAM application service was not inserted in a standard DFIS application framework.

The services provided on-board the aircraft were:

- NOTAM on request, by which the pilot can request NOTAM selected according to: ICAO indicator, specific area, specific object.
- PIB (Pre-flight Information Bulletin), here renamed as RB (Route Bulletin) because the information are provided in-flight.

Both NOTAM and RB can be provided as synthetic lists or as extended text.

Now, as explained below, this experimental project has been extended by SICTA with the introduction of the ATN communications and a standard DFIS application framework.

2.3. Eurocontrol's TAR/TTS/TES software

The EUROCONTROL ATN project, as part of EATCHIP (European ATC Harmonisation and Integration Programme), is focused on the European implementation of the ATN. The activities of the project include, support to standardisation, validation, trials, development of trials and pre-operational systems and implementation planning.

In the framework of this project Eurocontrol created the European ATN Trials Infrastructure (ATIF). Complementary ATN components like the Trials End System (TES), the Trials ATN Router and Transport Server (TAR-TTS), and the Mode S Ground Data Link Processor have been developed and integrated into a distributed European ATN European ATN Trials Infrastructure which is being extended to other regions (e.g. the US and Australia).

In fact these ICAO-compliant ATN components have been distributed as widely as possible at low cost to member states for ATN Trials, in support of national or multi-national trials.

ATIF Users are given TAR, TTS and TES which are the first 7 layer ICAO CNS/ATM-1 Package compliant systems offering ATN communications services anywhere.

The TAR-TTS product comprises the ATN Internet functionality and as such is the most complex ATN component providing configurable Mobile and Ground ATN Routers.

The TES product comprises the ATN upper layers and ASEs (Application Service Element) that provide program interfaces in support to ADS, CPDLC and CM (Context Management) applications. Furthermore TES offers a DSI (Dialog Service Interface) in support to external developed ASEs for other applications.

The TES and TAR/TTS are integrated on the same platform. They have been developed for HP-UX and PC-Sun Solaris platform and are available both for air and ground configurations.

2.4. SICTA's ATN research activities

SICTA (Sistemi Innovativi per il Controllo del Traffico Aereo i.e. Advanced Systems for Air Traffic Control) is the Italian Research Centre in the Air Traffic Control field which studies, research and develop prototypes of advanced systems in this field to make an active contribution to the technological development, standardisation and harmonisation of Air Traffic Management systems in collaboration with similar R&D centres of other countries and European bodies.

SICTA research branches cover the most interesting areas envisaged by the ICAO CNS/ATM Concept: ADS, ATN ATM Application and Mode S Radar. Research activities include HMI implementation and fast time simulation.

As far as ATN research is concerned the objective is the study and development of ATN components and functions and their experimentation through the construction of various trial scenarios.

One of the objectives of these activities is to introduce ATN communications to existing SICTA's (e.g. ADS, CPDLC, CM) and ENAV's (e.g. AISAS) applications.

In its ATN activities SICTA make use of Eurocontrol's TAR/TTS/TES software.

Furthermore SICTA participates in the Eurocontrol ATIF (ATN Trials Infrastructure) and it is one of the major ATIF partners. SICTA ATN nodes are interconnected with Eurocontrol Experimental Centre at Bretigny in order to make trials in co-operation with Eurocontrol and other European centres.

3. Experimental FIS/NOTAM air-ground data link application

In the framework of its ATN research activities SICTA developed new air and ground ASEs (Application Service Element, i.e. the application dependant part of the seventh layer of ATN stack) for a FIS/NOTAM service. The developed ASEs make use of the Dialog Service Interface provided by the Eurocontrol TES. SICTA also developed, both on ground and air configurations, a user FIS application with the purpose to insert the existing NOTAM service (developed for the experimental Mobile AISAS) in a standard DFIS application framework as well as in a standard ATN environment using the TAR/TTS/TES software.

A first phase of the project (with the air ground subnetwork simulated on ground) has been successfully completed.

Next phases foresee the integration with real air-ground subnetworks and then flight trials.

The fig. 1 shows the system configuration of the first phase.

The appendix to this paper describes the requirements used to develop the FIS/NOTAM service.

4. Recommendation

It is recommended that the meeting note the work done in view of introduction the NOTAM service in the Manual of ATS Data Link Applications.

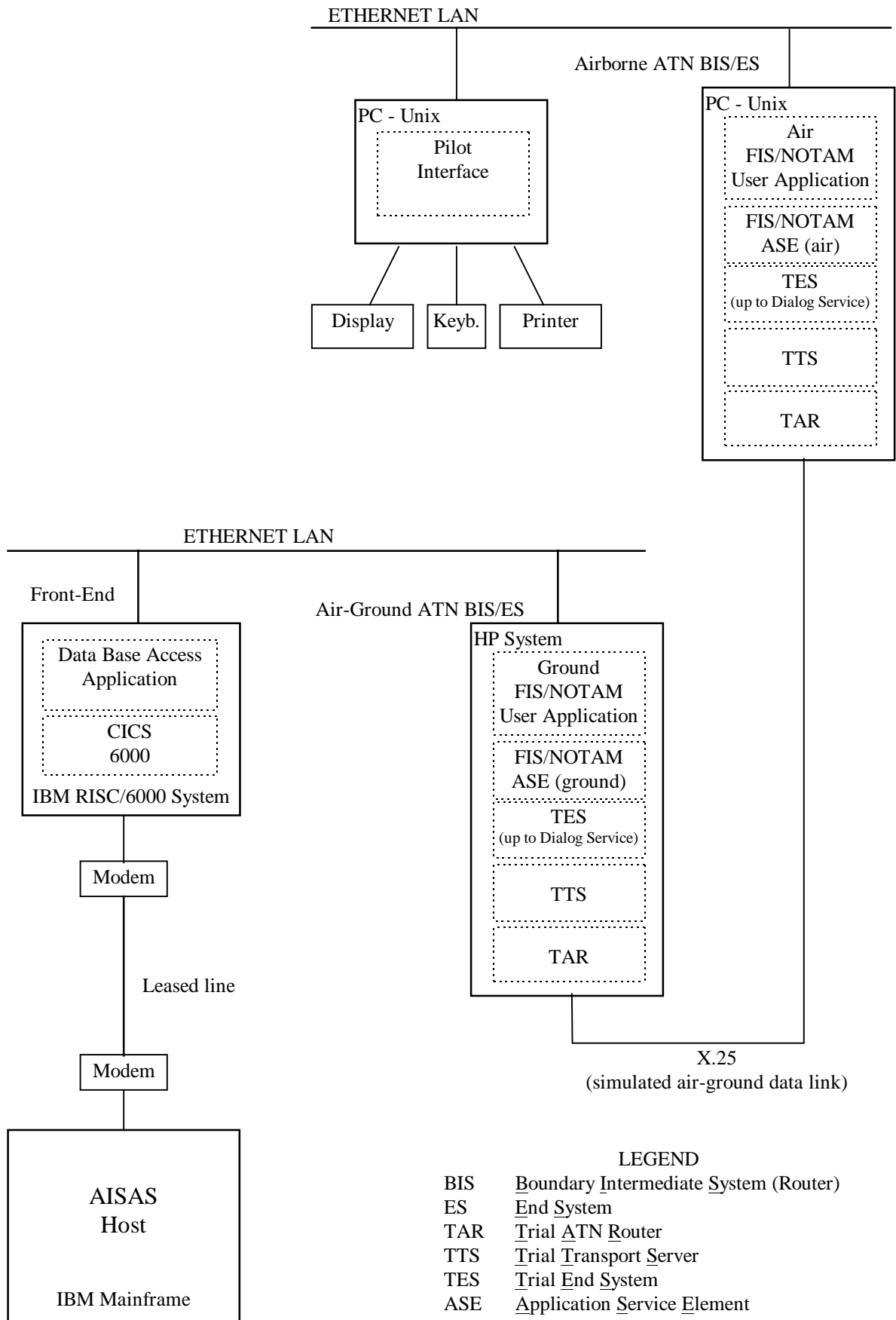


Fig. 1 ATN/AISAS project Phase 1 configuration

NOTICE TO AIRMAN SERVICE DESCRIPTION

1. Operating method in a data link environment

1.1. Service description

1.1.1 NOTAM operate only in Contract modes.

Note.— Contract mode used by NOTAM services is technically identical to Update contract mode (as used, for example, in ATIS service) the difference is that in the typical conditions the contract for NOTAM service is terminated by ground system rather by air system.

This is due to the fact that the requested information could not be provided using only one report message, because of the unpredictable length of the replay in term of number of NOTAMs and their length. Then when the information provided meet the request the ground system terminate the contract.

1.1.2 The pilot transmits a NOTAM Request message to the appropriate ground system. The request indicates the DFIS mode Contract.

1.1.3 Upon receipt of a valid NOTAM request message, the ground system:

- a) starts sending the appropriate NOTAM delivery message within the required response time and continues to send reports when available until the overall information sent meet the request, or
- b) detects that the requested NOTAM information can be retrieved but is not yet available or the first message report cannot be sent within the required response time, then:
 - 1) sends a processing message, and
 - 2) when the information becomes available, starts sending the NOTAM delivery message and continues to send reports when available until the overall information sent meet the request, or
- c) detects that the requested NOTAM information cannot be retrieved and sends a reject message

1.2. Initiation Conditions

1.2.1 The NOTAM services may be solicited by the pilot during any phase of operation.

1.3. Sequence of services

1.3.1 This service is capable of being solicited by the pilot independently of any other service.

1.4. Additional guidelines

1.4.1 The priority for ATIS messages will be “notice to airman service messages” as determined by the ATN Internet Priority categorization.

1.4.2 The ground system will be able to support multiple concurrent NOTAM Contracts with the same aircraft or with several aircraft.

1.4.3 An aircraft may request NOTAM information that are relative to aerodrome, geographic fixes or FIR

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1.4.4 An aircraft may request a Route Bulletin (RB), that consist in NOTAMs correlated among them because relative to a particular route indicated by means of a combination of aerodrome and/or geographic fixes and/or airways or a route of a particular flight indicated by flight identifier.

1.4.5 An aircraft may indicate in the request several filters to be applied in the retrieval process of NOTAM.

1.4.6 An aircraft may send more than one NOTAM information request by means of multiple NOTAM contracts.

1.5 *Exception handling*

1.5.1 *No response*

1.5.1.1 If the pilot does not receive a valid message response within the specified time, then aircraft system will alert the pilot.

1.5.2 *No NOTAM delivery after receiving a processing message*

1.5.2.1 If an NOTAN processing message has been received by the aircraft and the first NOTAM delivery is not received within a specified time, the aircraft system will alert the pilot.

1.5.3 *Interruption of NOTAM delivery*

1.5.3.1 If a report message of the NOTAM delivery is not received within a specified time from the previous report message, the aircraft system will alert the pilot.

1.6 *Termination conditions*

1.6.1 NOTAM data link service will be terminated by the aircraft system upon receipt of one of the following messages:

- a) a reject message; or
- b) a NOTAM cancel contract message (after receipt of report messages of NOTAM Delivery).

2. NOTAM message sequence diagram

2.1 Figure 2-1 illustrates a NOTAM (Contract mode) message sequence with a NOTAM request and response.

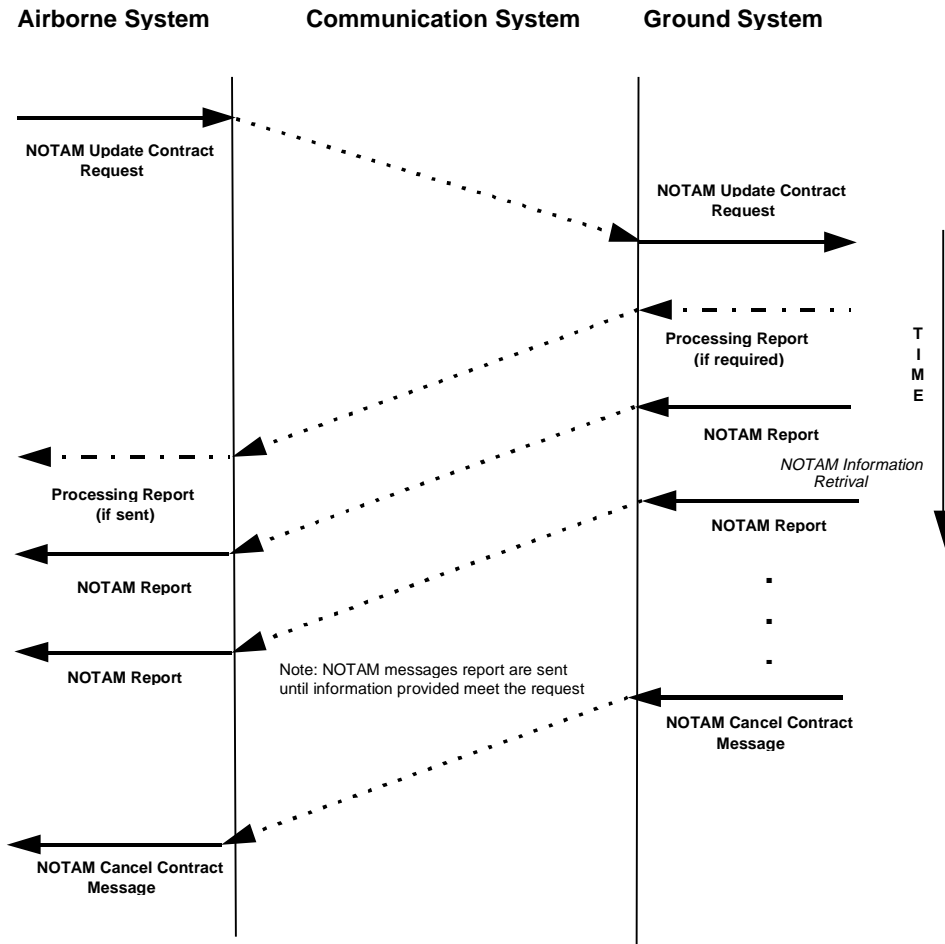


Figure 2-1. NOTAM Contract request and NOTAM Report sequence diagram

3. NOTAM messages

3.1 Table 3-1 presents NOTAM message requirements.

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Table 3-1. NOTAM message requirements

Message	Information Required	Type											Event/ trigger	Source/ destination	Alert	Response required
		00	01	02	03	04	05	06	07	08	09	10				
NOTAM Request	RequestId	M	M	M	M	M	M	M	M	M	M	M	Pilot input	Aircraft/ ground system	None required	yes
	MessageType	M	M	M	M	M	M	M	M	M	M	M				
	Airport	M	M													
	FixName			M	M											
	FIR					M	M									
	NumericKey											M				
	Date	M	M	M	M	M	M	M	M	M	M	M				
	UpLevel	M	M	M	M	M	M	M	M	M	M	M				
	LowLevel	M	M	M	M	M	M	M	M	M	M	M				
	Traffic	U	U	U	U	U	U	U	U	U	U	U				
	Purpose	U	U	U	U	U	U	U	U	U	U	U				
	Scope	U	U	U	U	U	U	U	U	U	U	U				
	Class	U	U	U	U	U	U	U	U	U	U	U				
	LastDays	U	U	U	U	U	U	U	U	U	U	U				
	FlightId								M	M						
	DepartureAirport								M	M	M	M				
	ArrivalAirport								M	M	M	M				
Alt1									U	U	U					
Alt2									U	U	U					
Route									M	M	M					
NOTAM Delivery *	RequestId	M	M	M	M	M	M	M	M	M	M	Receipt of a valid NOTAM Request	Ground system / Aircraft	Medium	No	
	NotamId	M		M	M	M	M	M	M	M	M					
	Aip	M		M		M		M		M						
	NotamCode	M		M		M		M		M						
	SVD	M		M		M		M		M						
	Airport	M						O		O						
	FixName			M				O		O						
	FIR					M		O		O						
	Scope	M		M		M		M		M						
	Traffic	M		M		M		M		M						
	NumericKey	M		M		M		M		M						
	NotamText		M		M		M		M		M					
	NOTAM termination	RequestId	M	M	M	M	M	M	M	M	M					M
Contract termination		M	M	M	M	M	M	M	M	M	M					

* The Complete NOTAM Delivery could be composed by a set of report messages each one containing the required information as indicated in the table

Table Key:

M: Mandatory

U: User option

O: Mandatory if applicable

- 00: Request of "NOTAM in synthetic text" relative to an Airport, which code is contained in "Airport" field.
- 01: Request of "NOTAM in extended text" relative to an Airport, which code is contained in "Airport" field
- 02: Request of "NOTAM in synthetic text" relative to a FIX, which code is contained in "FixName" field.
- 03: Request of "NOTAM in extended text" relative to a FIX, which code is contained in "FixMamame" field.
- 04: Request of "NOTAM in synthetic text" relative to a FIR, which code is contained in "FIR" field.
- 05: Request of "NOTAM in extended text" relative to a FIR, which code is contained in "FIR" field.
- 06: Request of "RB in synthetic text" relative to explicit flight, which code is contained in "IdFlight" field.
- 07: Request of "RB in extended text" relative to explicit flight, which code is contained in "IdFlight" field.
- 08: Request of "RB in synthetic text" relative to explicit route, which code is contained in "DepartureAirport", "ArrivalAirport", "Route" fields.
- 09: Request of "RB in extended text" relative to explicit route, which code is contained in "DepartureAirport", "ArrivalAirport", "Route" fields.
- 10: Request of "NOTAM in extended text" relative to explicit numerical key, which code is contained in "NumericalKey" field.

APPENDIX

NOTAM MESSAGE DATA GLOSSARY

Aip.	NOTAM AIP (Aeronautical publication code).
Alt1.	ICAO Code for the first alternate airport
Alt2.	ICAO Code for the second alternate airport
ArrivalAirport.	ICAO Code for destination airport.
Class.	'1' or '2', 1= notam msg transmitted by telecommunication means; 2= NOTAM msg sent by normal mail
Date.	Requested date (year, month, day, hour, minute and second)
DepartureAirport.	ICAO Code for departure airport
FIR.	Flight information region.
FlightId.	Flight identifier.
LastDays.	NOTAM valid in last "LastDays"
LowLevel.	Lower flight level interested by NOTAM.
NotamCode. QXXXX)	ICAO Code which defines the treated argument (AGA, COM, RAC, if others Examples QAGXX=AGA (Aerodrome and ground aids) QCOXX=COM (Communications) QRCXX=RAC (Rules of the air and Air Traffic Services)
NotamId	NOTAM identifier. Syntax of this Key is: csnnnnnn/yyyyxx c= Class ('1' or '2', 1= notam msg transmitted by radio; 2= NOTAM msg sent by mail) s= Serial (A= long international flight, B = short international flight, C= domestic flight) n= NOTAM number y= emission year xx= ICAO Code of emitting country (Example LI = Italy)
NumericKey.	NOTAM numerical Key (server database specified and univocal in database).
Purpose.	Possible choices: N = immediate notification; B = route bulletin O = operational interest M = miscellaneous
RB.	Route bulletin.
RequestId	Request numerical identifier.
Route.	list of route fixes and/or aerodrome and/or airways.
Scope.	Possible choices: A = aerodrome E = en route W = warning
SVD.	Start Validity Date.
Traffic.	Traffic interested : I =IFR V =VFR IV = both
UpLevel.	Upper flight level interested by NOTAM.