European ATM Service Description for the AeronauticalInformationMap Service

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Abstract
The AeronauticalInformationMap service provides the CDM for the provision of aeronautical information maps. This document is based on the service model designed in the ISRM repository (Ref.[5]).
The purpose of the service is the provision of digital aeronautical information maps resembling the current aeronautical AIP charts but improving its functionalities and usability.

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D65 - European ATM Service Description for AeronauticalInformationMap Service for AeronauticalInformationMap Service

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Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

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Executive summary

The AeronauticalInformationMap service provides the CDM for the provision of aeronautical information maps. This document is based on the service model designed in the ISRM repository (Ref.[5]).

The purpose of the service is the provision of digital aeronautical information maps resembling the current aeronautical AIP charts but improving its functionalities and usability.

The service builds on top of ISO "IS 19128:2005 Geographic information - Web map server interface." standard extending it to support the specific aeronautical information mapping needs.

The typical use case for the service is a request with input parameters regarding the map configuration needed and an image output provided by the service.
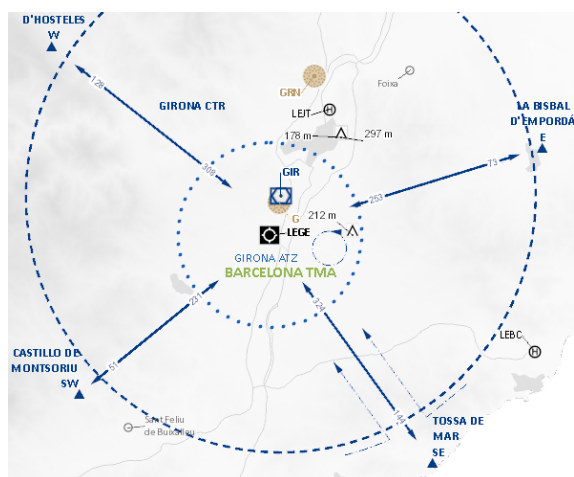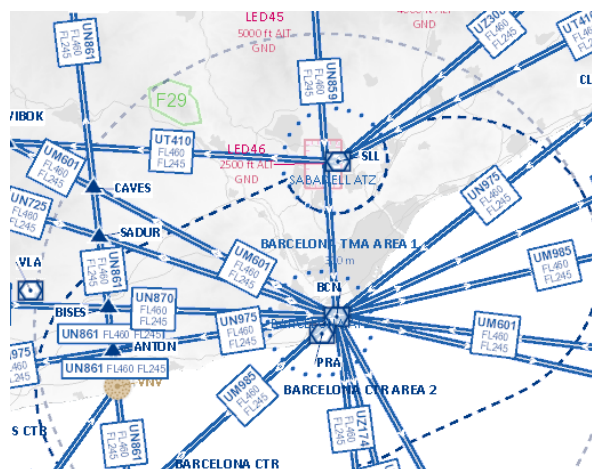
1 Introduction

1.1 Purpose of the document

The purpose of this Service Design Description is to give an overview of the service, its operations and functions. The document should be seen as a complement to the service model itself, included as one part of the deliverable for ISRM.

The AeronauticalInformationMap Service (AIMS) has been identified by P08.03.10 in the work of Fast Track 13 Digital Briefing.

The purpose of the service is the provision of digital aeronautical information maps resembling the current aeronautical AIP charts but improving its functionalities and usability.

While the service has been identified and defined using requirements mainly coming from the pre flight briefing process, it is presumed that the service could also support other ATM processes like planning, etc.

1.2 Intended readership

This service description is intended to be read by Enterprise Architects, Service Architects, Information Architects, System Engineers and Developers in pursuing architecting, design and development activities.

1.3 Acronyms and Terminology

1.3.1 Acronyms

Term	Definition
ADD	Architecture Description Document
AIMS	AeronauticalInformationMap Service
AIP	Aeronautical Information Publication
AMDT	AIP Amendment
ATM	Air Traffic Management
CC	Capability Configuration
DOD	Detailed Operational Description
EATMA	European Air Traffic Management Architecture
FAA	Federal Aviation Administration
IER	Information Exchange Requirement
ISRM	Information Service Reference Model
NAF	NATO Architecture Framework
NSOV	NATO Service Oriented View

Term	Definition
NOTAM	A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
NOV	NATO Operational View
NSV	NATO System View
OSED	Operational Service and Environment Definition
PIB	Pre Flight Briefing
QoS	Quality of Service
SDD	Service Description Document
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SoaML	Service Oriented Architecture Modelling Language
SUP	AIP Supplement
SWIM	System Wide Information Management
UML	Unified Modelling Language
V&V	Validation and Verification
WSDL	Web Services Definition Language
XSD	XML Schema Definition

Table 1: Acronyms

1.3.2 Terminology

Term	Definition	Source
Capability	The collective ability to deliver a specified type of effect or a specified course of action. Within the context of the SESAR Programme a capability is therefore the ability to support the delivery of a specific operational concept to an agreed level of performance.	Common working meeting between B41 EA study and B43 T5 [3]
Capability	A combination of organisational aspects (with their competencies) and equipment that combine to provide a	B43 ADD [4]

Term	Definition	Source
Configuration	capability. A Capability Configuration represents a recognisable set of resources (technical systems, human roles, and physical assets) derived from a generic stakeholder organisation. Note: Capability Configuration is a term used in NAF. The equivalent SoaML stereotype to be used is Participant. Also see note in Node term definition.	
Node	A logical entity that performs Operational Activities specified independently of any physical realisation e.g. a stakeholder type providing and/or consuming operational information within a network of others. Note: Node is a term used in NAF. The equivalent SoaML stereotype to be used is Participant. Be aware that the original intention of SoaML is that Participants are physical items and not logical constructs. Service architects must indicate whether the Participant is a logical (Node) or a physical (Capability Configuration) construct.	Common working meeting between B41 EA study and B43 T5 [3]
Service	The contractual provision of something (a non-physical object), by one, for the use of one or more others. Services involve interactions between providers and consumers, which may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures.	B43 T5 study [3]
Service attribute	A service attribute defines a property of a service. Examples: Response time, Frequency of invocation, Message Exchange Pattern.	B43 T5 study [3]
Service contract	A service contract represents an agreement between the stakeholders involved for how a service is to be provided and consumed.	B43 T5 study [3]
Service function	A service function describes what functionality is needed to provide or consume a service; it is the trigger for or is triggered by the service interactions. A service function can be automated to different extents depending on the context e.g. a service function supporting a complex activity may need more automation than a service function for a simple activity. Note: The equivalent SoaML stereotype is Capability, in WP8 Foundation documentation referred to as Service Capability.	B43 T5 study [3]
Service interaction	A service interaction is a description of an information exchange between ATM stakeholders' systems which can potentially be automated; phone calls / voice exchanges are considered as non-automated service interactions. In considering automated interactions, a service interaction is described by several modelling artefacts depicting the static and dynamic behaviour of a service. This includes service operations, data messages model and interaction behaviour.	B43 T5 study [3]
Service interface	The mechanism by which a service communicates. Service providers and consumers need to implement service	B43 T5 study [3]

Term	Definition	Source
	interfaces to be able to collaborate. A service interface includes service operations that enable access to the functionality of the services identified, as well as the data used in the service interaction.	

Table 2: Terminology

2 Service identification

Name	AeronauticalInformationMap
ID	{0FD5B1BE-93B2-4370-8C88-1953FD857D69}
Version	1.0
Keywords	Graphical display of data. AIM, WMS, Fast Track 13, Fast Track 6, Annex 15, Annex 4 Aeronautical Information, Map, Aeronautical Charts
Architect(s)	███████ Aena

Lifecycle status	Date	Reference
Identified	19.02.2014	SID [6] SCG11 meeting minutes [7]
Allocated	24.02.2014	FT13 service allocation report [8]
Designed	31/05/2014	ISRM 2.0 [5] (This document)
Validated	08/05/2015	Validation report EXE-13.02.02-VP-462, [16]
IOC	*Date for Initial Operational Capability*	*Reference to technical enabler hosting the service in the ATM master plan*
FOC	*Date for Full Operational Capability*	*Reference to technical enabler hosting the service in the ATM master plan*

3 Operational and Business context

The ATM system is relying increasingly and at all levels on automated systems, which depend on correct and up-to-date information in order to perform their functions. However, the content of a database, be it on-board, at the flight operations centre, at the airport, or in an ATC system, may be 'modified by NOTAM'. The task of remembering which information is overridden becomes the pilot's or controller's burden. Weather is also a key factor that affects the operations and that must be taken into account by all the stakeholders involved in a flight.

Today in Europe NOTAM information is made available as semi formatted text messages, resulting in limited filtering capabilities. Also the graphical representation is quite limited, resulting in hard to interpret and sometimes misleading maps.

The pre-flight briefing is done mainly in the form of a 'bulletin' given to the pilot and containing the list of valid NOTAMs that might be relevant for the flight, together with the expected weather for the route. These bulletins usually grow beyond the limit where the pilot can effectively manage, which creates a risk of missing key information.

More and more complex information very relevant to the operation is being distributed by NOTAM, which implies difficulties with automated systems (FMS as an example) that cannot update their databases accordingly.

The solution to this problem is the replacement of the current text messages with digital data, which enables improved data quality and usability, with positive impact on the safety and efficiency of the ATM system. This will be achieved through direct electronic data transfer along the whole data processing chain, automatic validation and customised presentation, according to user needs.

With digital aeronautical information, the briefing could be radically improved through more precise automatic filtering, by replacing/supplementing the NOTAM text with graphical information. The pre-flight briefing could take place directly on the EFB, using data provided by digital briefing applications on the ground and updated over a data link during the flight.

Digital data can (apart from being used by machines to process automatically...) be easily translated into the legacy bulletin format to avoid problems in human reception and to also continue to feed legacy systems as well (the latter will help in the transition phase).

The AeronauticalInformationMap service will provide the graphical representations needed to support these digital briefing concepts.

This service will provide digital aeronautical information maps, thus enabling automatic filtering and processing. As examples, airline flight centres could efficiently use the latest information available to improve their decision making process thus positively impacting in the efficiency of their planning and flight executions.

3.1 Information Exchange Requirements

Requirements in relation to the operational context are collected from:

- 13.02.02 D10 OSED for Step 2 (in particular Annex B "OSED IER") [9]

- 11.01.02 D01 OSED [10]

Not very detailed and precise information exchange requirements where explicitly present in the reference documents, coordination with the projects let to a better understanding of the needs and a common service proposals where formulated and agreed during the service identification phase (see 3.2)

Identifier	Name	Issuer	Intended Addressees	Information Element
IER-13.2.2-OSED.0001.0027	Request Airport Map with graphical NOTAM	Service Provider (Digital Briefing Application)	Other ATM Data Provider (Airport Map Provider)	Airport Map
REQ-13.02.02-OSED-0201.0068	The Pre-Flight Bulletin (ePIB) shall graphically represent and display meteorological and ATFM data, per phase of flight			Meteorological Maps

Table 3 IERS covered by the AeronauticalInformationMap service

Additional Requirements

Identifier	Name	Issuer	Intended Addressees	Information Element
IER-13.2.2-OSED.0001.0024	Request Aeronautical Info Data	Service Provider (Digital Briefing Application)	Other ATM Data Provider (Aeronautical Info Provider)	Aeronautical Data
REQ-11.01.02-OSED-D001.0040	Availability of ATM constraints (RAD, CDR, Restricted Areas, NOTAM Restrictions, AIP published restrictions)			ATM constraints

Table 4 Additional requirements
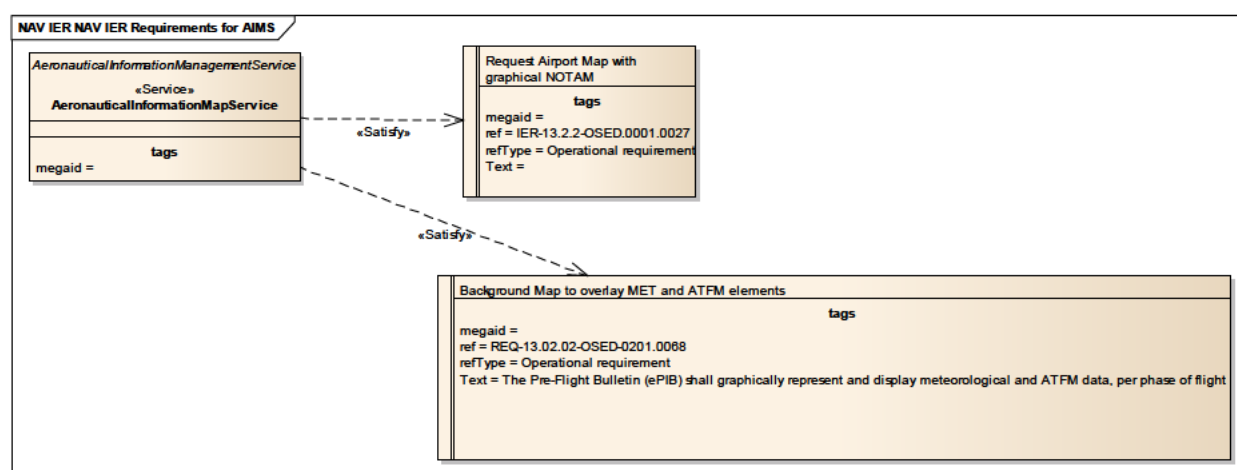
Figure 1: NAV IER AeronauticalInformationMap service requirements traceability

3.2 Other Requirements

ICAO has established requirements for Aeronautical Information in its Annex 15 and Annex 4.

It has been agreed by FT13 members and mainly by 13.02.02 and 11.01.02 projects where requirements come from, that whenever aeronautical information is mentioned without further details, it has to be understood that current standards apply, and thus Annex 15 and Annex 4 apply.

As this analysis and series of proposed services partially rely on ICAO Annexes for the temporality concepts and data content, it should be considered by operational project the definition of the SESAR concept for the aeronautical data management. For example, Annex 15 and Annex 3 temporality aspects need to be reviewed and brought up to date with the new capabilities that digital data and services bring. The same applies to Annex 4 mapping requirements.

While not directly related to the service identification process, it has been detected and pointed out by 11.01.02 that one aspect that is worth mentioning is related to the legal framework for data distribution. To really achieve all benefits from digital data distribution, all aspects related to copyright, use rights of data and liabilities need to be clearly stated.

3.2.1 Non Functional Requirements

The Information Exchange Requirements related to Safety and Performance (SPR) are detailed below, according to 13.02.02 and their D10 OSED.

These requirements have been very specifically defined for airport map data, and thus require further investigation and knowledge gain if they would also apply for all mapping needs.

Identifier	Name

Identifier	Name
IER-13.2.2-OSED.0001.0027	Request Airport Map with graphical NOTAM

Table 5 Non functional requirements

It should be noted that the column "Safety Criticality" defined in the SPR IER template has mostly been left blank in this section. The reason is that it is not appropriate to provide the requested values without a proper safety analysis of the Information Exchange Requirements based on a validated methodology.

For future update of these NFR requirements a consideration also could be done taking into account the Business Continuity Plan of EAD for instance, whose services are related to that we are defining. It could be stated that if, after 1 hour of outage, the duration is still unknown, the clients shall be advised to apply their fallback procedure, for example.

3.2.2 Industrial Standards

In addition to the SESAR related requirements above, industry standardization activities within EUROCAE/RTCA and ARINC, throughout the past 10 years, have defined User Requirements as well as Interchange Standard for aeronautical data.

Those requirements have not directly been referred to, or requested by the Operational/System projects identified by project P08.03.10. Nevertheless, WP8 projects shall consider and analyse applicability of standardization and harmonization activities towards interoperability outside SESAR research programme.

In this context, it has been pointed out by 11.01.02 that to ensure a smooth transition to SESAR SWIM, protect current investments and ensure international interoperability, support for these formats should be taken into account.

The ADD states the following in regard to Essential SWIM standards:

SYSTEM WIDE INFORMATION MANAGEMENT (ESSENTIAL)

Electronic terrain and obstacle database (eTOD)	2012	Ongoing ICAO Annex 15
Data Exchange specification for Airport Mapping Database	2012	Ongoing WG-44 ED-99c ED-119b ARINC816 ICAO Annex 15
AIS and MET Data-link Services	2013	Ongoing WG76/SC206 OSED
Guidelines for Electronic AIP	2014	Ongoing ICAO Doc8126
Aeronautical Information Exchange data model (AIXM)	2016	Ongoing ICAO Annex 15
Digital NOTAM at global level	2018	Ongoing EUROCONTROL/FAA ICAO Annex 15
ATC to ATC flight data exchange updated following validation results	2013	Planned ED-133a
Weather information exchange model	2014	Ongoing EUROCONTROL/FAA WXXM
Use of military surveillance data by civil aviation	2018	TBD

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3.2.3 Nodes

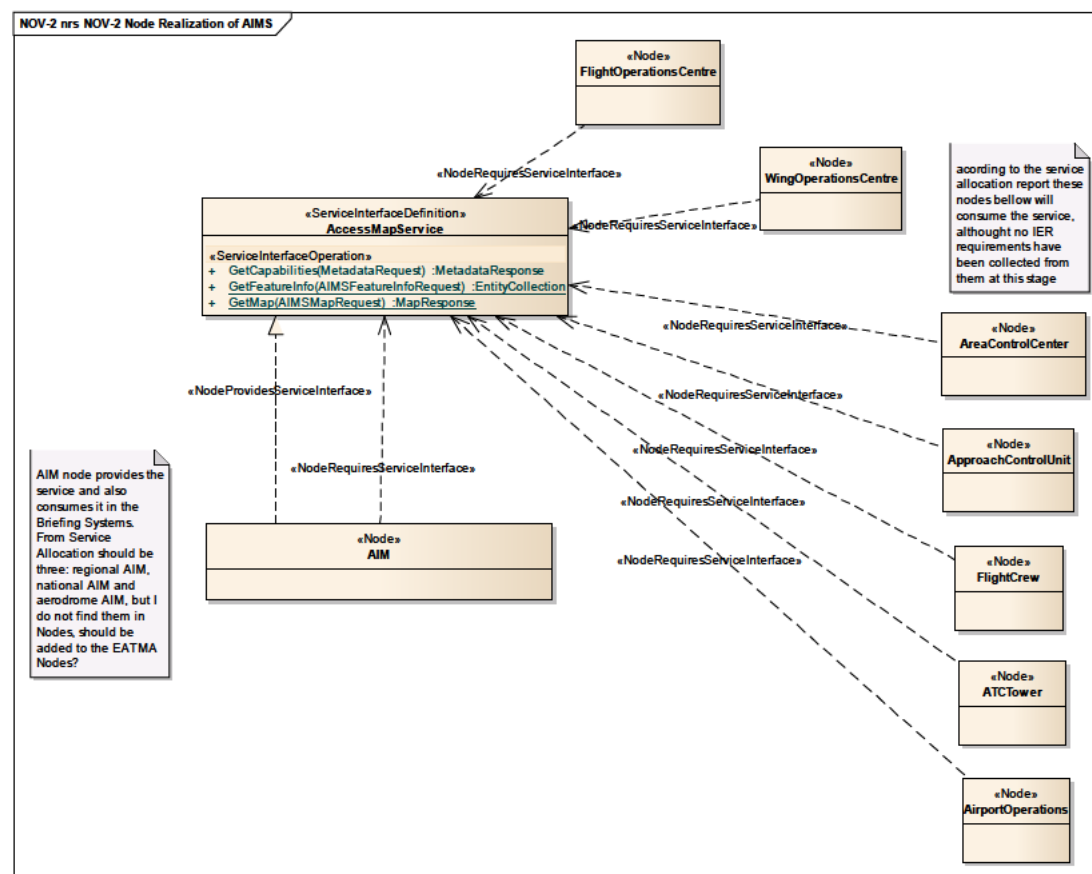The consumers and provider nodes are depicted below.

Figure 2 NOV-2 AeronauticalInformationMap service node realization diagram

4   Service overview

The main purpose of the AeronauticalInformationMap service is to provide maps as raster images to consumers. To do so in a flexible and functional way the services supports:

- -A mechanism by which the consumer will know which data is available for the map; which features/layers.

- -A mechanism to specify which features/layers to include in the map based on their location and/or attributes.

- -A mechanism to specify conditions (queries) on the features/layers to include in the map.

- -A mechanism to specify the temporality conditions for the map. (Valid for a certain time, etc.)

The AeronauticalInformationMap service will have the capability to disseminate all aeronautical maps properly symbolized and annotated.
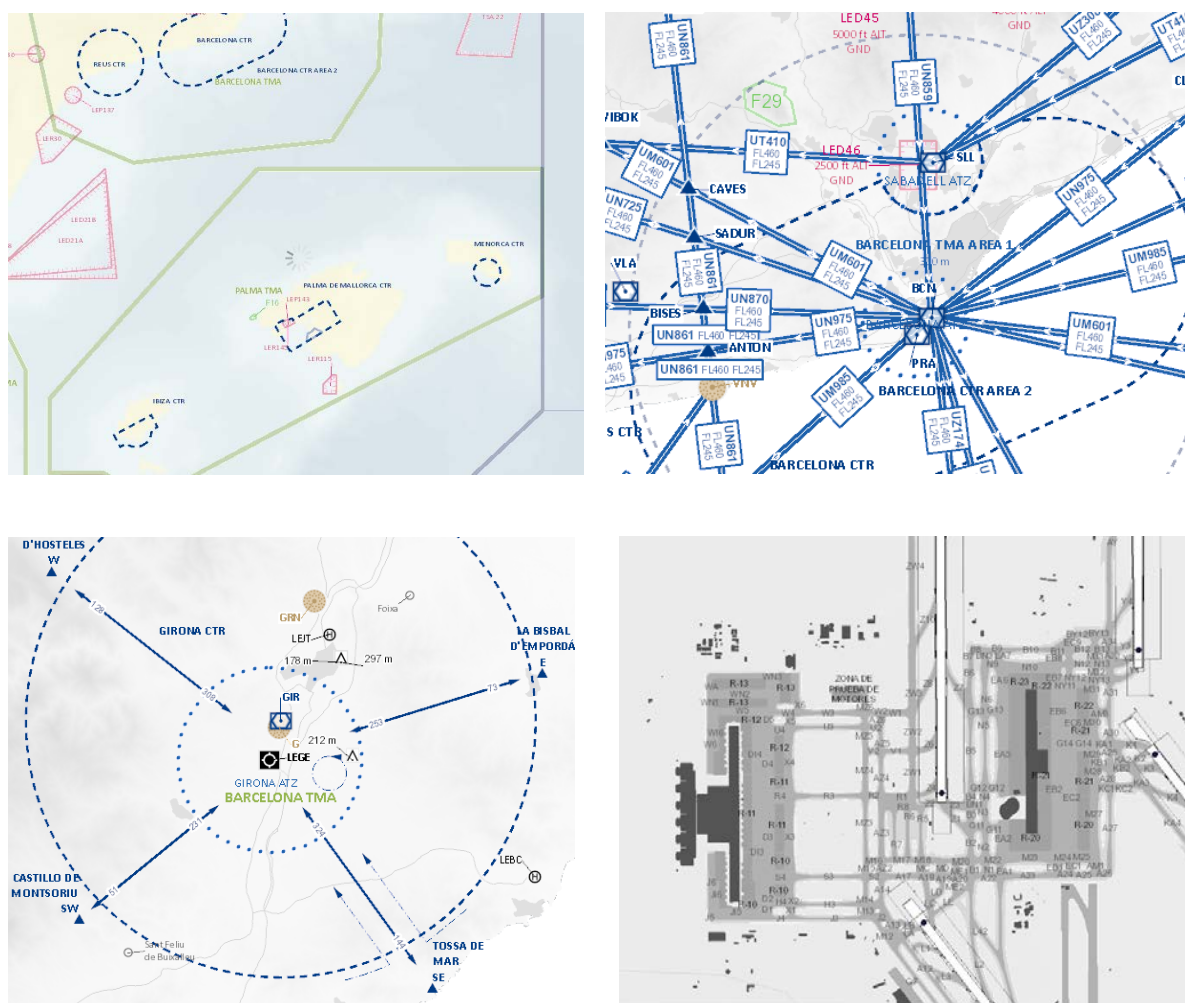
Figure 3: AeronauticalInformationMap service maps examples

4.1 Service Taxonomy

The service taxonomy is described in the ISRM Service Portfolio document [15].

4.2 Service Attributes (QoS)

Due to the lack of specific non functional requirement for the service, so far only one empty service level has been defined, it will be updated when the requirements become available, more that probably during its validation.
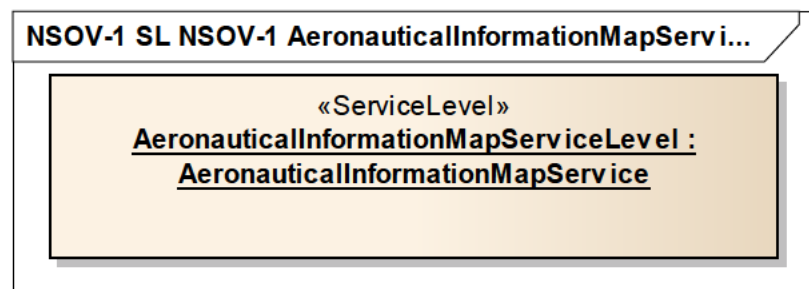

Figure 4 NSOV-1 AeronauticalInformationMap service levels

4.3 Service Functions and Capabilities

The AeronauticalInformationMap service has one interface to access all its mapping functionalities trough tree operations.

The service interface is designed to be compatible with the ISO "IS 19128:2005 Geographic information - Web map server interface" standard.
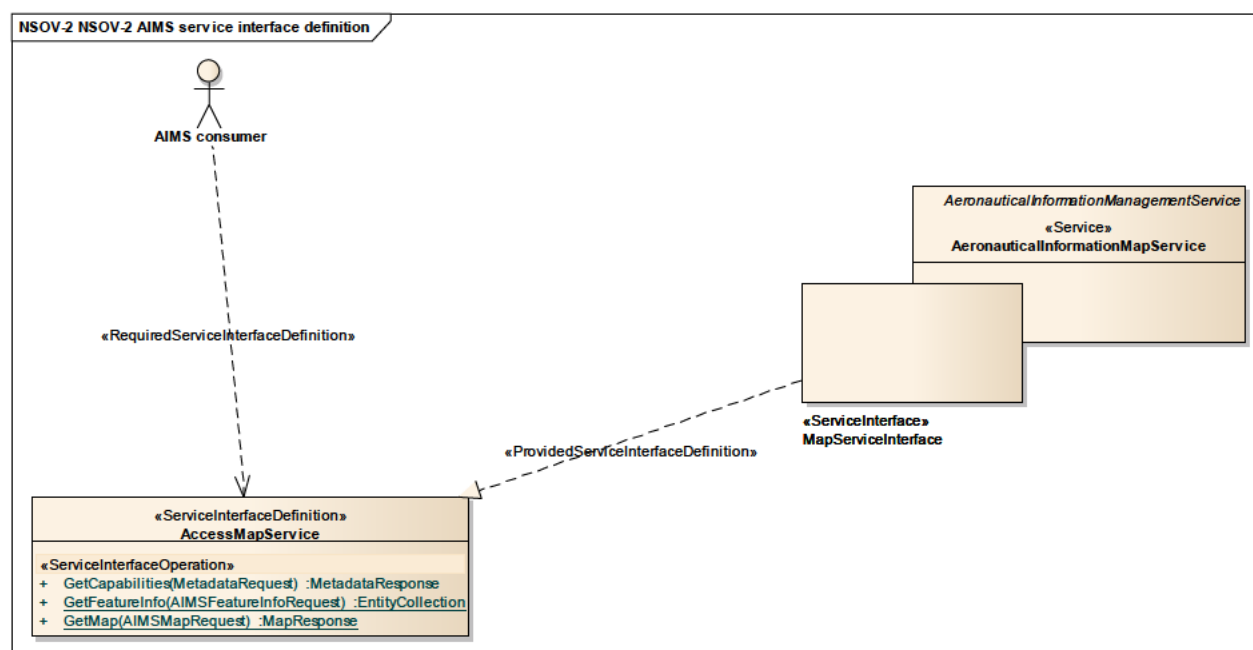
Figure 5: NSOV-2 AeronauticalInformationMap service interface definition

The service provides aeronautical information which main purpose is enabling a common infrastructure picture (airspace availability, airport infrastructure availability, etc.) to be used in planning and during operations.
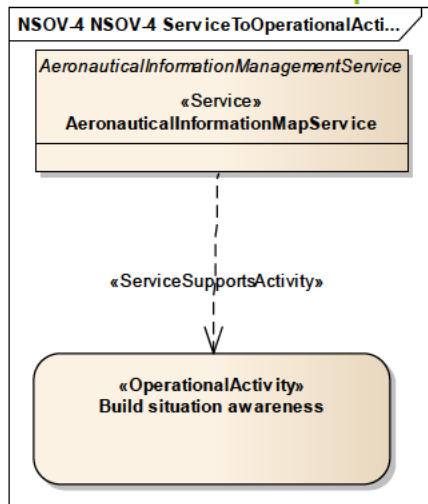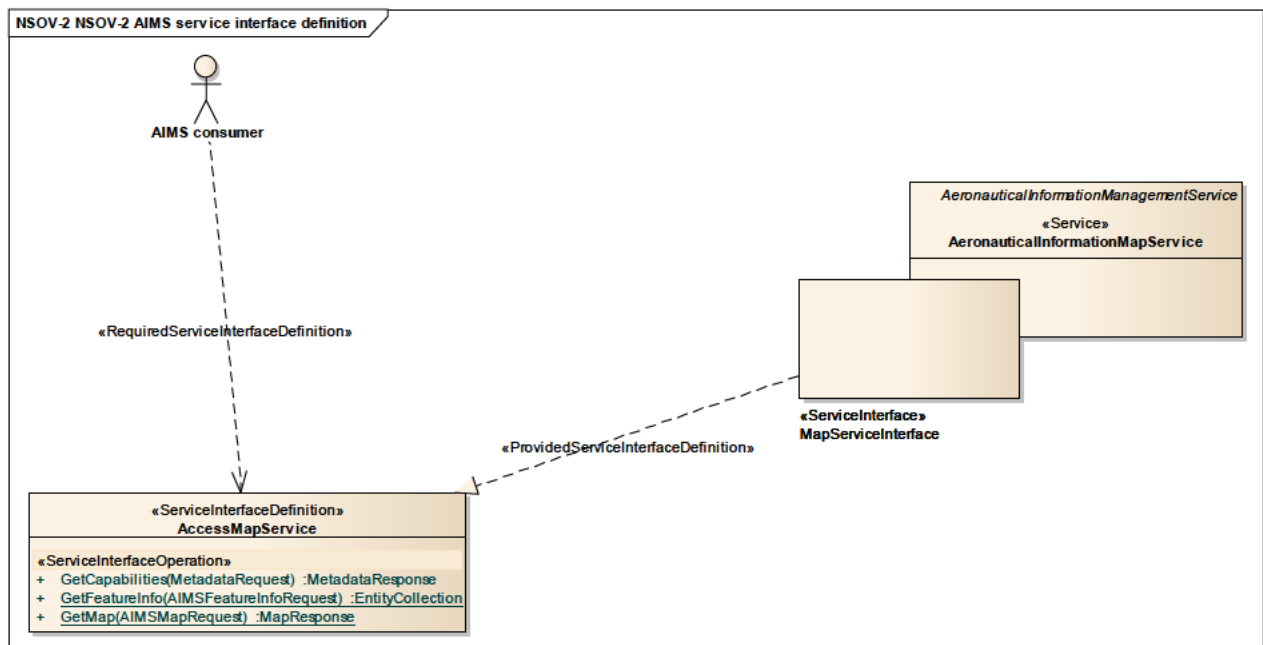
Figure 6: NSOV-4 AeronauticalInformationMap service to operational activity mapping

4.4 Service Interfaces

The AeronauticalInformationMap service has one interface to access all its mapping functionalities trough tree operations.

The service interface is designed to be compatible with the ISO "IS 19128:2005 Geographic information - Web map server interface" standard.

Figure 7: NSOV-2 AeronauticalInformationMap service interface definition

5 Service interface specifications

5.1 AeronauticalInformationMap Service Interface AccessMapService

The service interface is designed to be compatible with the ISO "IS 19128:2005 Geographic information - Web map server interface" standard and defines the three Queryable-WMS standard operations.

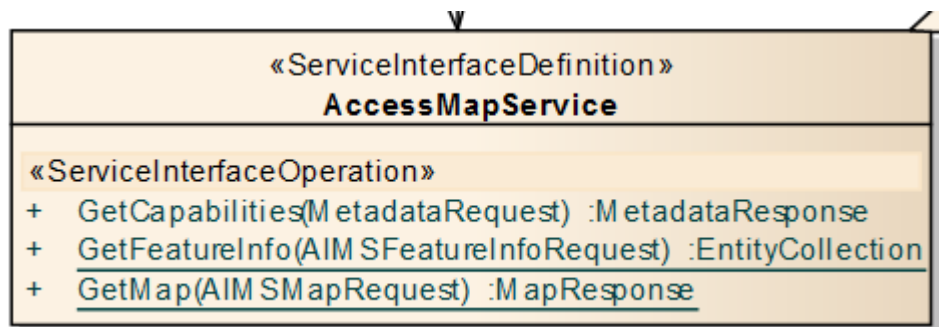The AeronauticalInformationMap service interface has tree operations.

Figure 8 AeronauticalInformationMap service interface operations

The AeronauticalInformationMap service relies on AIXM 5.1 standard for data exchange of aeronautical information features; this has also an important impact on the map itself that will be detailed in different operations and parameters.

5.1.1 Operation GetCapabilities

The purpose of the GetCapabilities operation is to obtain service metadata, which is a machine readable description of the server's information content and acceptable request parameter values.

This information is necessary to properly prepare a GetMap request.

The AeronauticalInformationMap service has some discovery functionalities; by using the operation the consumers will discover the service available map layers, extent, etc.

5.1.1.1 Operation parameters
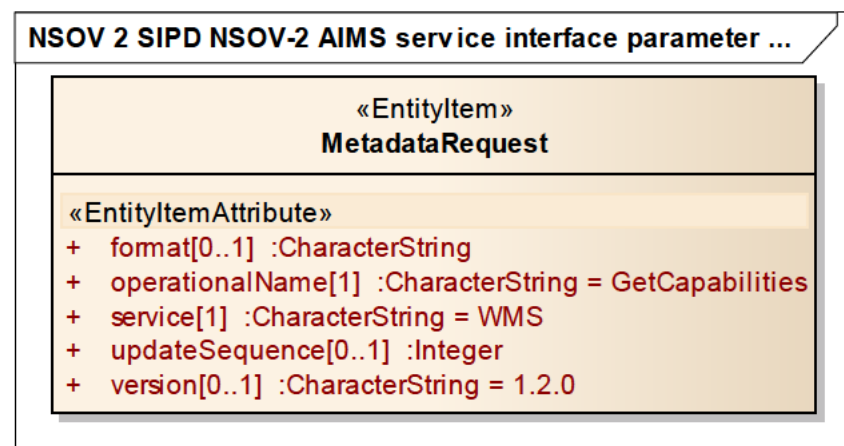
MetadataRequest

Figure 9 GetCapabilities MetadataRequest parameter

MetadataResponse

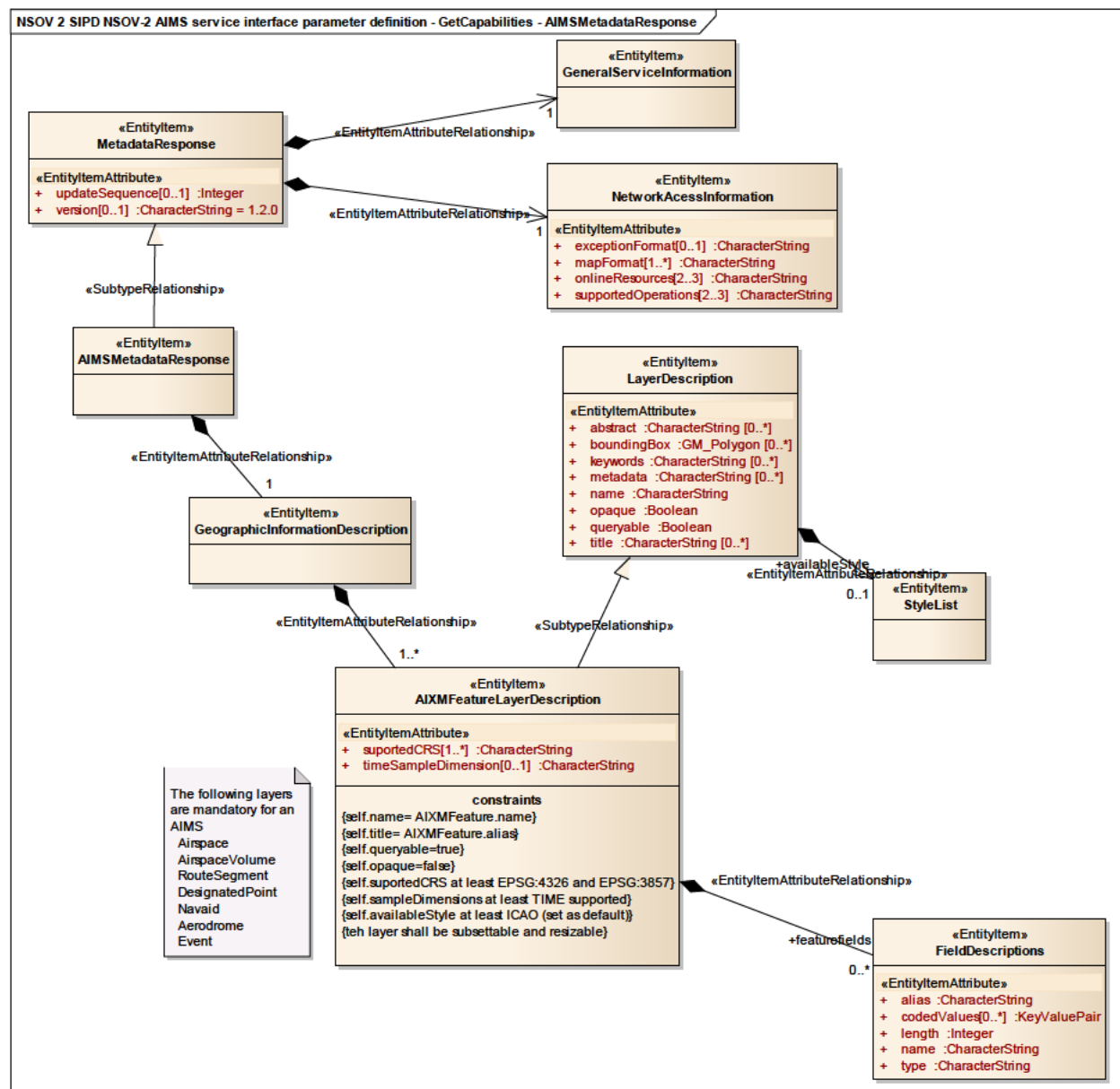This output parameter is a direct reflection of the ISO WMS one.

Figure 10 GetCapabilities MetadataResponse parameter

The AeronauticalInformationMap service imposes a number of rules on the available layers the
service must support and the layers properties.

The layers must represent directly a number of AIXMFeatures:

AIXMFeature	Geometry for map coming from
Airspace	Consolidation of component airspace volumes
Airspace (Volume)	Geometry of each individual volume
Route segment	Own feature geometry
DesignatedPoint	Own feature geometry
NavAid	Own feature geometry
Aerodrome	Own feature geometry
Event	Consolidation of aggregated component features geometry

Table 6 Minimum supported layers

Additional layers can be supported and will be discovered trough the GetCapabilities operation.

5.1.2 Operation GetMap

The GetMap operation returns a map. It accepts a series of parameter to customize the map output.

5.1.2.1 Operation parameters

AIMSMapRequest

This input parameter is an extension of the ISO WMS one to support layer filtering display capabilities in the map. It extends the ISO WMS MapRequest parameter with two additional optional properties.
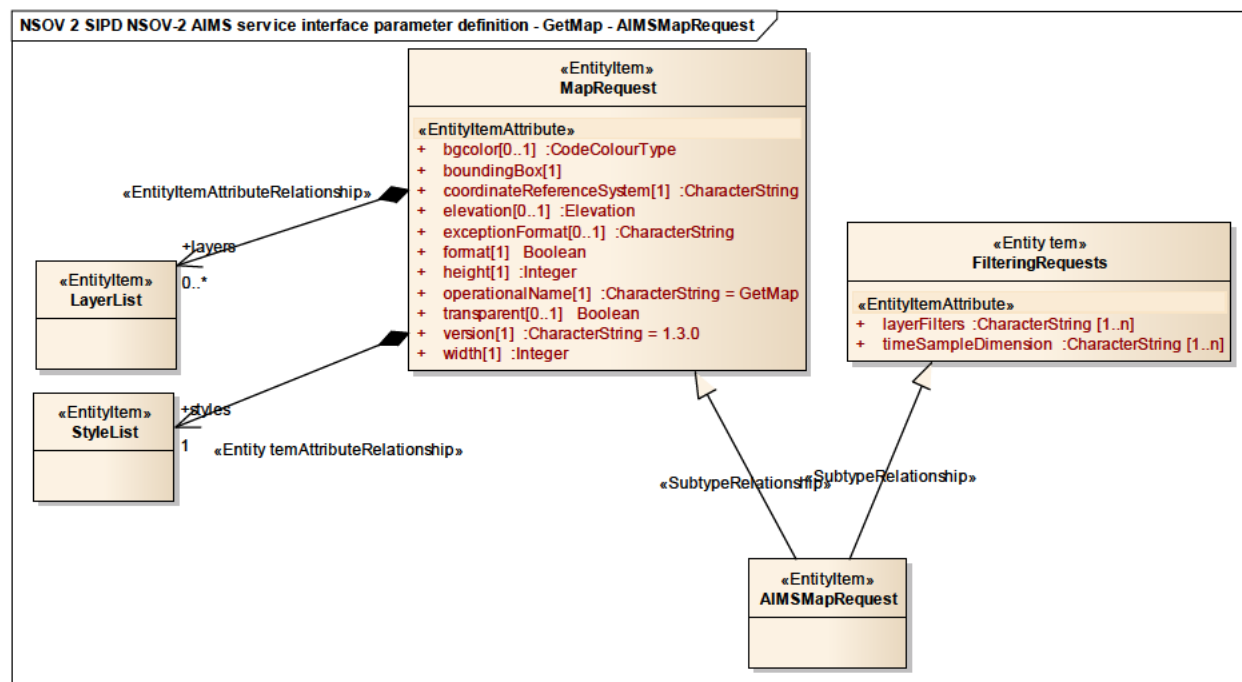

Figure 11 GetMap AIMSMapRequest parameter

layerFilters is an string array with the SQL syntax query to apply to each underlining layer feature.

timeSampleDimension is an string array with time filtering to be applied to each layer.

MapResponse

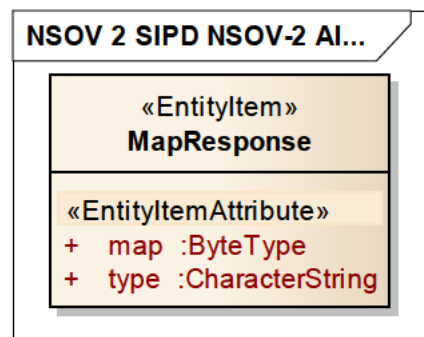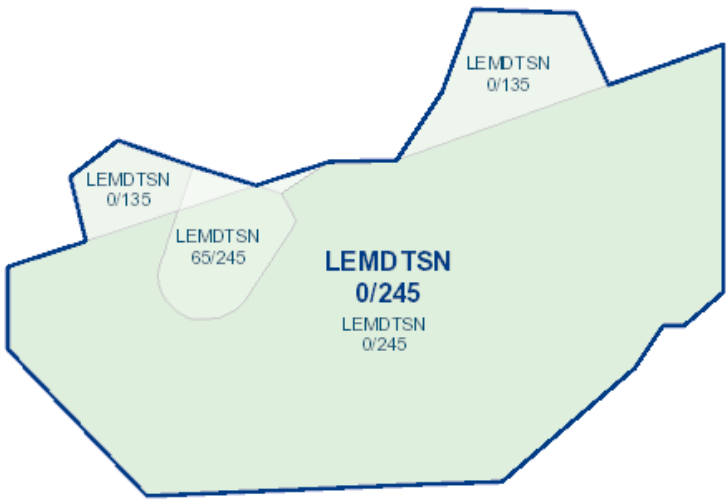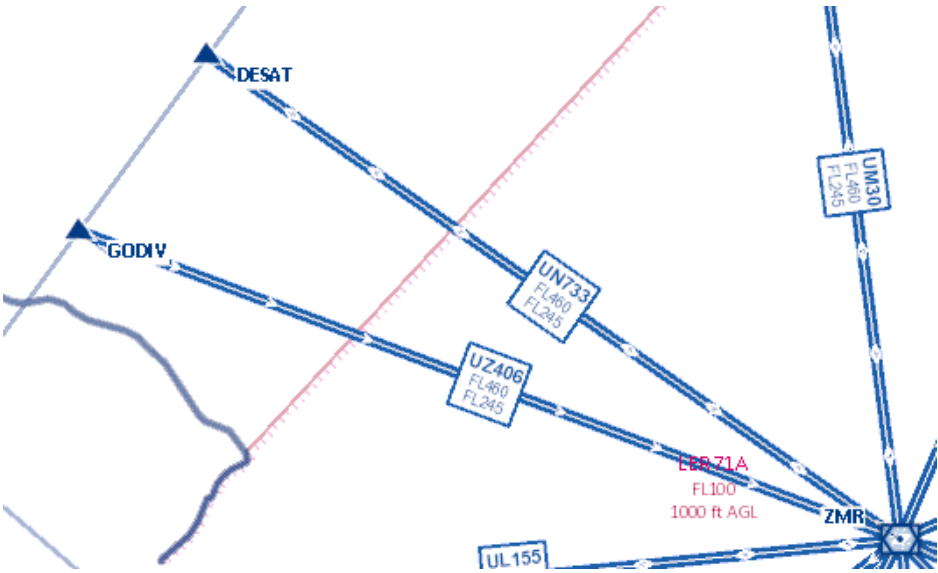This output parameter is a direct reflection of the ISO WMS one.

Figure 12 GetMap AIMSMapRequest parameter

It is a bitmap representing the map. The concrete symbology and labelling to be applied to the map is beyond the scope of this document, anyhow, an IACO style shall be present in the map following Annex 4 requirements.

Some examples of layers symbology follow:

Layer	Example output
Airspace	

Airspace (Volume)	
Route segment and DesignatedPoint	
NavAid	

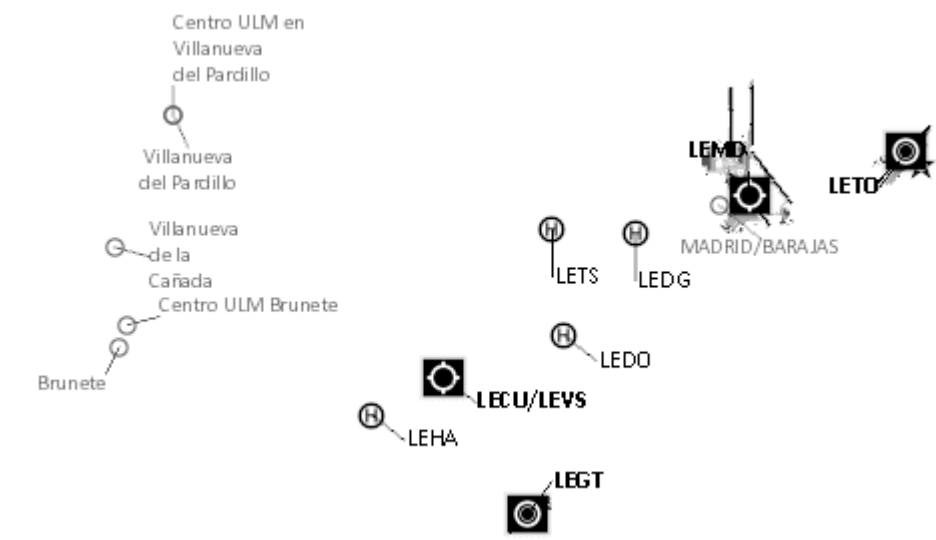| Aerodrome	
Event	

Table 7 Example map output for minimum supported layers

5.1.3 Operation GetFeatureInfo

The GetFeatureInfo operation is designed to provide service consumers with more information about features in the pictures of maps that were returned by previous Map requests. In order to enable a rich and interactive map experience.

The function provides the ability for a client to specify which pixel is being asked about, which layer(s) should be investigated, and what format the information should be returned in.

Because the service is stateless, the GetFeatureInfo request indicates to the map service what map the user is viewing by including relevant original GetMap request parameters.

5.1.3.1 Operation parameters

AIMSFeatureInfoRequest

This input parameter is an extension of the ISO WMS one to support layer filtering display capabilities in the map. It extends the ISO WMS FeatureInfoRequest parameter with two additional optional properties.
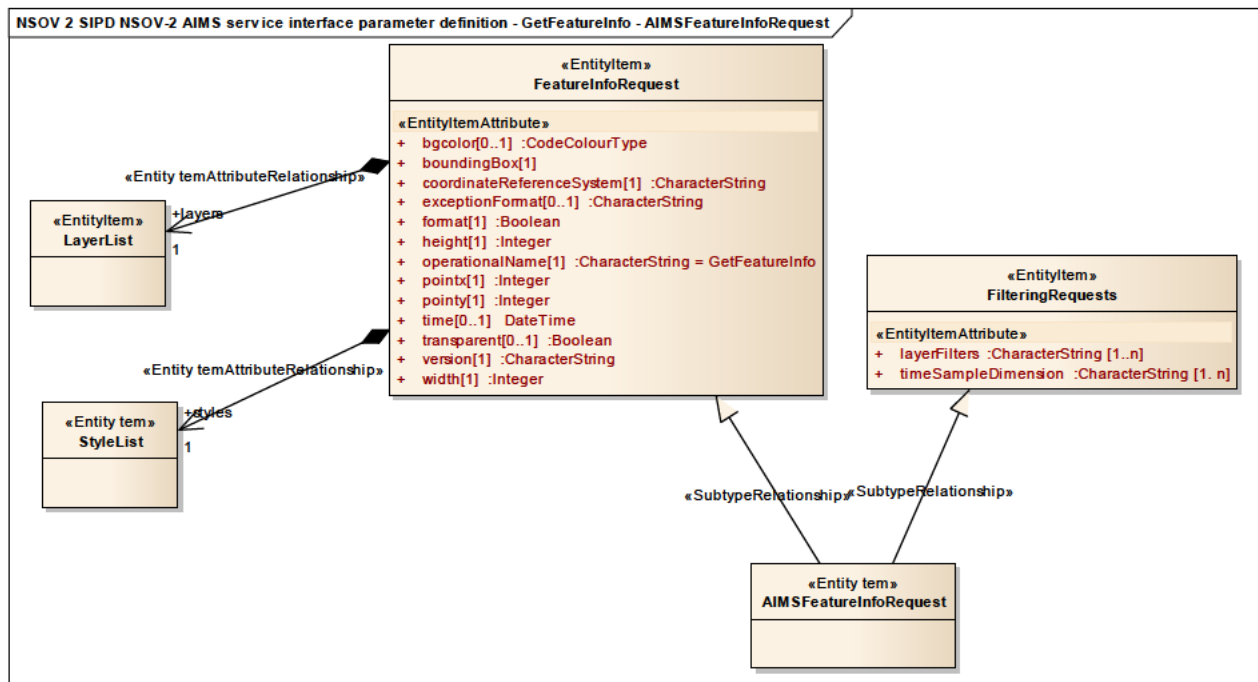

Figure 13 GetFeatureInfo AIMSFeatureInfoRequest parameter

layerFilters is an string array with the SQL syntax query to apply to each underlining layer feature.

timeSampleDimension is an string array with time filtering to be applied to each layer.

EntityCollection

The ISO WMS standard does not specify a return type for the GetfeatureInfo operation, it leaves it open for the service implementers. The AeronauticalInformationMap service restricts this to be more concrete, a collection of AIXM features
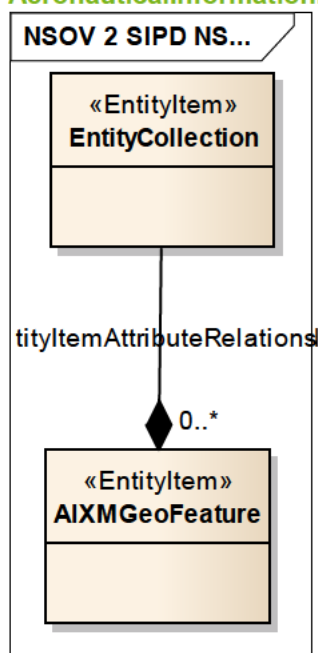
See lower part of the diagram

Figure 14 GetFeatureInfo EntityCollection parameter

6   Service dynamic behaviour

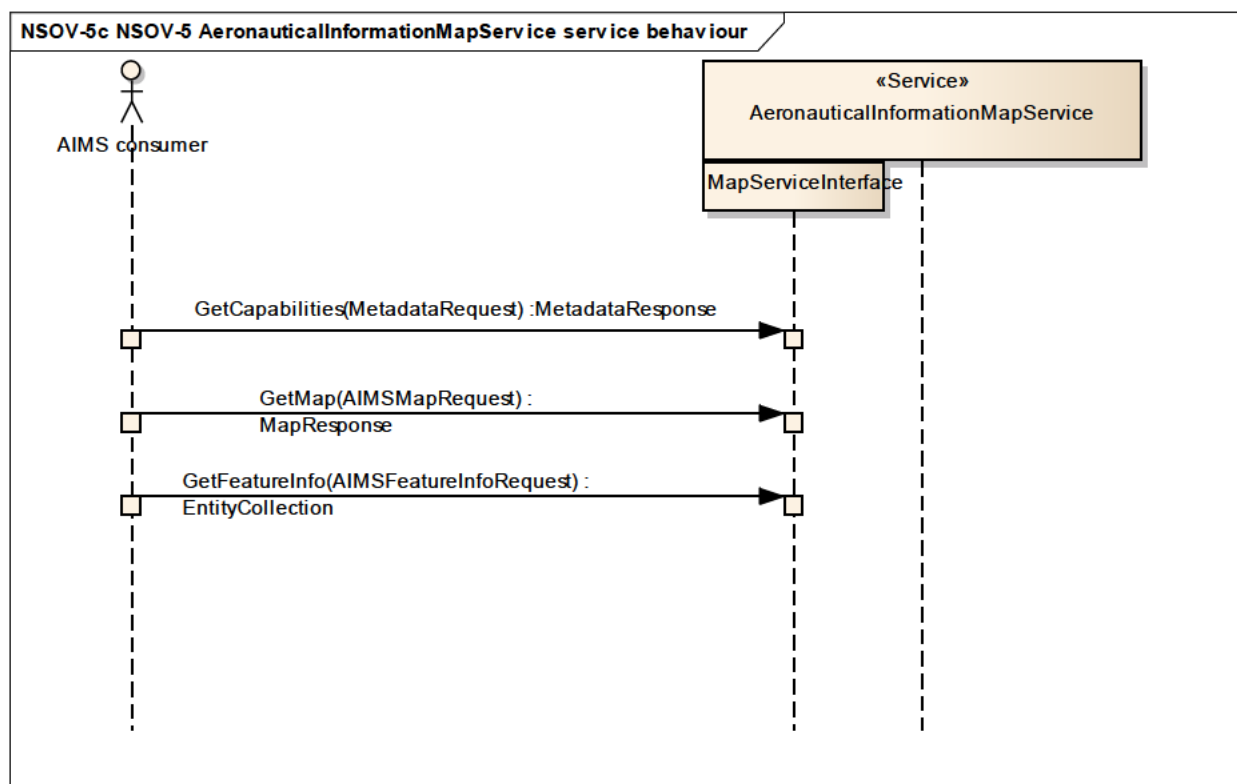The AeronauticalInformationMap service is stateless; the diagram below depicts the simple service dynamic behaviour.

Figure 15 NSOV-5 Service Definition Dynamic aspects of the Service

7 Service provisioning

N/A.

8 Validation and Verification

AeronauticalInformationMap service has been verified following WP08.03.10 standard working methods.

A verification report is available, see reference [12].

8.1 Validation exercises

This service was used in Validation Exercise EXE-13.02.02-VP-462, see reference [16].

9   References

Name	Version	Document ID / Location
[1] FAA Web Service Description Document	2008-16-10	http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/atc_comms_services/swim/documentation/media/briefings/WSDD%20FPS%20EXAMPLE%2008-16-10.pdf
[2] NATO Architecture Framework	v3.0 & 3.1	http://www.nhqc3s.nato.int/
[3] Working method on services (2nd edition)	00.03.00	B.04.03 D46
[4] ADD Step 1	00.01.09	B.04.03 D73
[5] ISRM 2.0 Delivery report	00.01.00	08.03.10 D65
[6] FT13 Service Identification Document	00.00.03	08.03.10 internal document
[7] SCG11 Meeting minutes	N/A	B.04.03 internal document
[8] FT13 Service Allocation Report	0.9	B.04.03 internal document
[9] OSED for Step 2	00.06.00	13.02.02 D10
[10] OSED	00.01.04	11.01.02 D01
[11] Preliminary MET IER & Use Cases	00.00.04	11.02 internal document
[12] AeronauticalInformationMap Service Verification Report		08.03.10 D65
[13]ISRM Tooling Guidelines	00.04.00	08.03.10 D41
[14]ISRM Modelling Guidelines	00.04.00	08.03.10 D41
[15]ISRM Service Portfolio	00.08.01	08.03.10 D65
[16]Validation report Validation exercise EXE-13.02.02-VP-462	00.01.01	13.02.02 D18

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