

EUROCONTROL Guidelines – Use of AIMX 5.1 in relation to the AIX Specification

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Abstract			
<p>This document contains the EUROCONTROL Guidelines for the use of the Aeronautical Information Exchange Model (AIXM) version 5.1 as common data set and common data format, in compliance with the Aeronautical Information Exchange (AIX) Specification of EUROCONTROL. It enables the standardised encoding and the distribution in digital format of the aeronautical information/data that is in the scope of Aeronautical Data Quality (ADQ) Regulation (EU) 73/2010, developed in accordance with the interoperability Regulation in the framework of the Single European Sky (SES).</p>			
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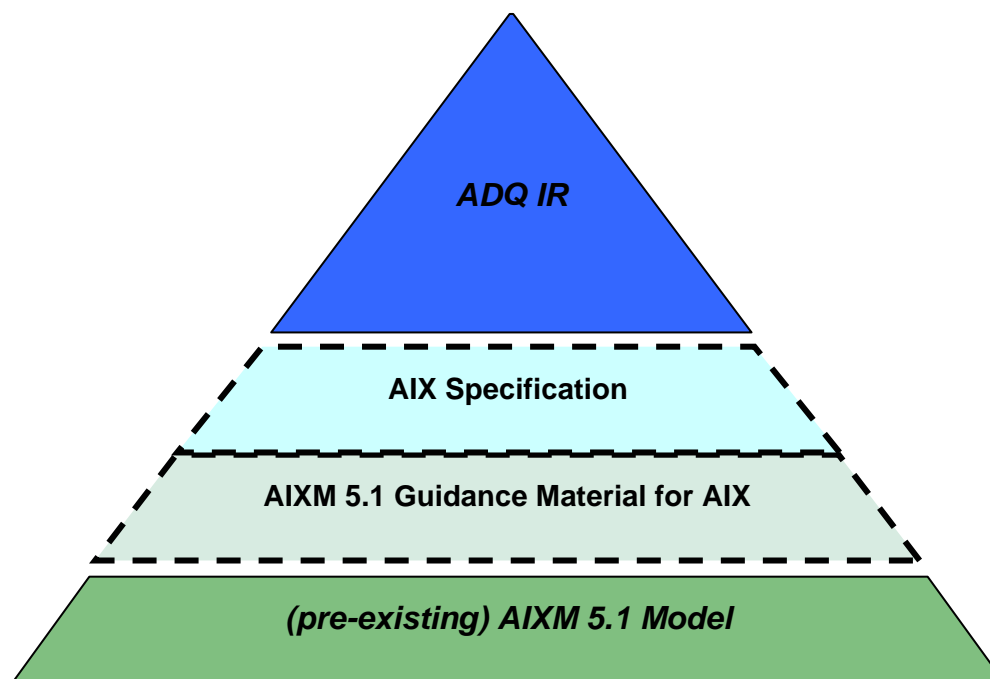
1. Introduction

1.1 Purpose and scope

Through this Guidelines document, the use of the AIXM 5.1 model is established as acceptable mean of compliance with the EUROCONTROL Specification for Aeronautical Information Exchange (AIX).

The Specification on Aeronautical Information Exchange (AIX) has been developed by the European Organisation for the Safety of Air Navigation (EUROCONTROL) in order to provide means of compliance with the Articles 4 and 5 of the interoperability implementing rule on the quality of aeronautical data and aeronautical information for the Single European Sky (SES)¹ (hereinafter the ADQ IR). The AIX Specification specifically addresses the Integrated Aeronautical Information Package (IAIP), aerodrome mapping and electronic obstacle data set specification² and data exchange format requirements³ respectively referred to in Article 4 and Article 5 of the ADQ IR.

A layered approach was followed in the development of the Guidelines, placing the AIX Specification and the supporting Guidelines in between the ADQ IR and the pre-existing Aeronautical Information Exchange Model (AIXM), as indicated in the diagram below:



The **AIX Specification** provides requirements defined in response to regulatory provision that are contained in Articles 4 and 5 of the ADQ IR.

The use of the Aeronautical Information Exchange Model (AIXM) V5.1 is proposed in order to comply with the data set specification and data exchange format requirements of this Specification. The **EUROCONTROL Guidelines – Use of AIXM 5.1 in relation to the AIX Specification** provides evidences of compliance of AIXM 5.1 with the requirements of the AIX Specification.

¹ Commission Regulation (EU) No. 73/2010, of 26 January 2010, laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky OJ L 23/6 (27.1.2010)

² Annex 1, part A of the ADQ IR

³ Article 5(2) – Annex II, Part A of the ADQ IR

1.2 About AIXM

The objective of the Aeronautical Information Exchange Model (AIXM) is to provide a globally applicable logical model for aeronautical information and an exchange format that can be used to facilitate the interoperability between both internal Aeronautical Information Services (AIS) systems as well as with external systems.

The model is needed because of the increasing dependence of aviation on timely, consistent, high quality aeronautical information, which can only be ensured through automation. AIS offices are moving from product-centric operations to data-centric operations. In a product-centric operation, each aeronautical product is maintained separately, which means that a change in aeronautical information must be manually propagated through every product. In a data-centric environment aeronautical products are created from a single logical data source, so that aeronautical data changes automatically propagate through all products.

AIXM satisfies the requirements for common conceptual model and common data exchange format stated by ICAO in the AIS to AIM Transition Roadmap and which are progressively being translated into ICAO Standards and Recommended Practices. The model provides:

- A common language for expressing aeronautical information for computer interpretation, but also human readable for development and validation/verification purpose;
- Cost savings through software reuse and data model reuse;
- Increased safety through improved data integrity and timeliness;
- Cost reduction through improvements in data quality checking and integration.

In addition, a common model for aeronautical information enables new products that will lead to improvements in aviation efficiency, capacity and safety.

In 1997 EUROCONTROL began the development of AIXM as a data exchange specification for establishing a centralized pan-European reference database of quality-assured aeronautical information for AIS: the European AIS Database (EAD). AIXM has gradually grown and was adopted as a de-facto aeronautical information exchange specification for new AIS systems worldwide. The model accommodates:

- ICAO standards and recommended practices (especially Annex 4 and 15);
- ICAO guidance material, e.g. DOC 8126;
- Industry requirements such as ARINC 424 and EUROCAE ED-99/RTCA DO-272;
- Civilian and military aeronautical data.

The most recent increment, AIXM 5.1, was released in March 2010 (www.aixm.aero). It is the result of a common effort by EUROCONTROL and the United States Federal Aviation Administration (FAA), supported by the international AIS community. This version was designed in order to fulfil the following objectives:

- Alignment with ISO 19100 series standards for geospatial information, including the use of the Geography Markup Language (GML);
- Inclusion of a temporality model, including support for distribution of information of temporary nature and of short duration contained in NOTAM;
- Support for the latest industry and ICAO requirements for aeronautical data, including obstacles, terminal procedures and airport mapping databases;
- Modularity and extensibility to support current and future aeronautical information messaging requirements.

The AIXM model has two main components. One component describes the concepts of the aeronautical information domain as a collection of features, properties and relationships. This component is referred to as the AIXM logical information model and it is defined using the Unified Modelling Language (UML). It can be used as the basis for the design of an AIS database and more general as a common data set specification.

The second component derives from AIXM logical information model and describes how to encode aeronautical data in a format that can be transmitted electronically between computer systems. The second component uses XML (Extensible Markup Language) as a language for system-to-system exchange. This component is also referred to as the XML Schema of AIXM.

More information about AIXM is available on the www.aixm.aero Web site.

1.3 Abbreviations

Term	Definition
ADQ	Aeronautical Data Quality
ADQ IR	Commission Regulation (EU) No. 73/2010, of 26 January 2010, laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky OJ L 23/6 (27.1.2010)
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation And Control
AIS	Aeronautical Information Service
AIX	Aeronautical Information Exchange
AIXM	Aeronautical Information eXchange Model
AMDB	Aerodrome Mapping Database
ANSP	Air Navigation Service Provider
ARINC	Aeronautical Radio, Incorporated
ATM	Air Traffic Management
BR	Business Rules
(REQ-)CHG	REQUIREment related to the exchange of baseline information as a result of permanent changes
(REQ-)DAT	REQUIREment related to the definition of each attribute DATA Type
(REQ-)DF	REQUIREment related to Data Format
DO	(RTCA) DOCUMENT
(REQ-)DS	REQUIREment related to the identify the common data set specification in use
DSS	Single Sky Directorate (in EUROCONTROL)
EAD	European AIS Database
EC	European Commission

ECTL	EUROCONTROL
ED	EUROCAE Document (EUROCAE)
ERAF	EUROCONTROL Regulatory and Advisory Framework (Cadre réglementaire et consultatif d'EUROCONTROL)
EU	European Union
(REQ-)FC	REQUIREMENT related to the documentation the common data set using a Feature Catalogue
(REQ-)GM	REQUIREMENT related to the use of the Geographic Information - Spatial Schema
GML	Geographical Markup Language
IAIP	Integrated Aeronautical Information Package
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Committee
IR	Implementing Rule (SES)
ISBN	International Standard Book Number
ISO	International Standards Organization
(REQ-)MD	REQUIREMENT related to Metadata
(REQ-)NAM	REQUIREMENT related to naming convention for features, attributes and associations
NOTAM	Notice to Airmen
OCL	(UML's) Object Constraint Language
OGC	Open Geospatial Consortium
OJ	Official Journal
OMG	Object Management Group
PDF	Portable Document Format
REG	Regulatory division (in EUROCONTROL Single Sky Directorate)
REQ	REQUIREMENT
RTCA	Radio Technical Commission for Aeronautics
SARPS	Standards And Recommended Practices
SBVR	Semantics of Business Vocabulary and Business Rules
SES	Single European Sky
SPEC	SPECIFICATION
(REQ-)STF	REQUIREMENT related to common data STructure Format if Feature Catalogue is used
(REQ-)STU	REQUIREMENT related to common data STructure Format if UML is used
(REQ-)TEM	REQUIREMENT related to Inclusion of a temporal model
UML	Unified Modelling Language

UTC	Coordinated Universal Time
VOR	Very High Frequency Omnidirectional Radio Range
(REQ-)XFE	REquirement related to exchange of data for both individual features and feature collections
XML	EXtensible Markup Language

1.4 Definitions

Term	Definition
aeronautical data	means a representation of aeronautical facts, concepts or instructions in a formalised manner suitable for communication, interpretation or processing
aeronautical information	means information resulting from the assembly, analysis and formatting of aeronautical data
aeronautical feature	means the abstract representation (in a model) of a real world phenomena, which falls in the scope of the aeronautical information domain
data quality	means a degree or level of confidence that the data provided meets the requirements of the data user in terms of accuracy, resolution and integrity
accuracy	means a degree of conformance between the estimated or measured value and the true value
resolution	means a number of units or digits to which a measured or calculated value is expressed and used
integrity	means a degree of assurance that a data item and its value have not been lost or altered since the data origination or authorised amendment
obstacle data	means data concerning all fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight
aeronautical information service provider	means the organisation responsible for the provision of an aeronautical information service, certified in accordance with Commission Regulation (EC) No 2096/2005
next intended user	means the entity that receives the aeronautical information from the aeronautical information service provider
direct electronic connection	means a digital connection between computer systems such that data may be transferred between them without manual interaction
data item	means a single attribute of a complete data set, which is allocated a value that defines its current status
NOTAM	means 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
digital NOTAM	means a data set that contains the information included in a NOTAM in a structured format which can be fully interpreted by an automated computer system without human intervention
data originator	means an entity responsible for data origination
data origination	means the creation of a new data item with its associated value, the modification of the value of an existing data item or the deletion of an existing data item
data validation	means the process of ensuring that data meets the requirements for the specified application or intended use
data verification	means the evaluation of the output of an aeronautical data process to ensure correctness and consistency with respect to the inputs and applicable data standards, rules and conventions used in that process

1.5 Document structure

This guideline document is split in two parts.

- The Section 2 demonstrates why the AIXM 5.1 can be considered as an acceptable mean of compliance to the AIX Specification requirements relative to the Article 4 and to the Annex I of the ADQ IR.
- The Section 3 demonstrates why the AIXM 5.1 can be considered as an acceptable mean of compliance to the AIX Specification requirements relative to the Article 5 and to the Annex II of the ADQ IR.

2. AIXM implementation allowing compliance with Section 2 of the AIX Specification and Article 4 of the COMMISSION REGULATION (EU) NO 73/2010

2.1 Identify the common data set specification in use

2.1.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1:

[REQ-DS-01] The regulated party shall ***declare the common data set specification that they use*** for the activities that fall within the scope of the ADQ IR.

[REQ-DS-02] The declaration of the common data set specification referred to in [REQ-DS-01] shall contain, as a minimum:

- the name (including the version, if applicable) by which the common data set specification is officially identified by its publishing authority;
- the necessary reference information (contact details, web site, etc.) enabling the regulator to obtain a copy of the common data set specification documentation.

[REQ-DS-03] The regulated party shall provide evidence that the declared data set specification is used as a common data set specification by relevant organisations within the Aeronautical Information domain.

[REQ-DS-04] The evidence referred to in [REQ-DS-03] shall be in the form of one (or more) of the following possibilities:

- agreements signed with a significant number of relevant next intended users for the provision of aeronautical data according to the declared data set specification, or
- agreements signed by similar organisations in the same or in other European States for the provision of aeronautical data to their next intended users according to the declared data set, or
- agreements signed with a significant number of relevant data originators for the reception of aeronautical data according to the declared data set specification, or
- agreements signed by similar organisations in the same or in other European States for the reception of aeronautical data according to the declared data set, or
- an agreement signed with the European AIS Database (EAD) for the provision of the data to EAD according to the declared data set specification, if applicable.

2.1.2 Use of AIXM 5.1 as common data set specification

2.1.2.1 Compliance with [REQ-DS-01] and [REQ-DS-02]

The Aeronautical Information Exchange Model (AIXM) version 5.1 is used as common data set specification. The relevant AIXM documentation is available on the www.aixm.aero Web site, in the Download section and can be downloaded in one of the following formats:

- 1) [AIXM 5.1 – UML model] The native AIXM UML model in the format used by the IBM Rational Rose modelling tool, which was used for its creation. This requires IBM Rational Rose Data Modeller Enterprise Edition (version 7.0) or another compatible tool/version in order to read the model.
- 2) [AIXM 5.1 – Web View] A zipped archive containing a set of HTML files generated from Rational Rose. This can be visualised with Internet Explorer (version 6 or higher), Mozilla Firefox (version 3 or higher) or other compatible Web browsers.

The model is also available as a series of “wiki” articles on www.aixm.aero/wiki. The advantage of this presentation of the model content and structure is that it does not require any special tool for consultation. Any recent version of standard Internet Browsers can be used in order to consult the model in this format.

2.1.2.2 Compliance with [REQ-DS-03] and [REQ-DS-04]

The AIXM data model is used by all the European States that are migrated as static data providers for the European AIS Database (EAD). The EAD has been using AIXM version 4.5 since 2007 and it has started the migration to version 5.1 since 2010.

At the time of writing of these Guidelines it was planned that a full AIXM 5.1 compliant implementation in EAD will be achieved in time for the ADQ implementation deadline, as established through the Commission Regulation (EU) NO 73/2012. Therefore, AIS offices of European States that are migrated to EAD will be able to claim compliance with [REQ-DS-04] using their EAD data provider agreement as main argument. This does not exclude the use of the other arguments indicated in [REQ-DS-04], but this depends on the local situation of each regulated party.

The AIXM version 5.1 is also being adopted as ICAO Guidance Material in support for the Annex 15 requirements for digital aeronautical data provision. This is being discussed through the AIS-AIMSG of ICAO. The following AIS-AIMSG Meetings Study Notes refer to this topic:

- 3) [AIS-AIMSG/1, SN.11](#)⁴ “Development of SARPs for Aeronautical Information Conceptual and Data Exchange Model Based on AIXM Version 5”;
- 4) [AIS-AIMSG/2, SN.12](#)⁵ “Guidance Material for the Aeronautical Information Conceptual Model”
- 5) [AIS-AIMSG/3, SN.5](#)⁶ “AIXM Governance and Configuration Control”
- 6) [AIS-AIMSG/4, SN.15](#)⁷ “AIXM Change Control Board Initiation Phase”

2.2 Document the common data set as UML or Feature Catalogue

2.2.1 Requirements of the EUROCONTROL AIX Specification

The AIXM model uses UML for documenting the data set specification, therefore the requirement relative to the use of a Feature Catalogue are not addressed in this document.

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (a):

[REQ-UML-01] If UML is used for documenting the data set specification, then the regulated party shall provide a document indicating, with reference to the OMG UML Specification version 2.1.1, which UML metamodel elements are actually used in the common data set specification referred to in [REQ-DS-01].

⁴ <http://www2.icao.int/en/ais-aimsg/Meetings/SNs/AIS-AIMSG.1.SN.011.en.doc>

⁵ <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN.12 - Guidance Material for the Aeronautical Information Conceptual Model.doc>

⁶ <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN 5 App.doc>

⁷ <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN 15.doc>

[REQ-UML-02] As a minimum, the list of UML metamodel elements referred to in [REQ-UML-01] shall include Class, DataType and Association.

[REQ-UML-03] The document referred to in [REQ-UML-01] shall include examples (real or fictitious) that demonstrate the use of the selected UML metamodel elements for documenting the data set.

2.2.2 Use of AIXM as common data set specification

2.2.2.1 Compliance with [REQ-UML-01]

The AIXM 5.1 logical data model consists in a set of UML Class Diagrams and the associated definitions of the classes, attributes, data types, lists of values, associations and roles that are part of the model. Annex A of these Guidelines contains a detailed description of the UML metamodel elements used in AIXM.

AIXM 5.1 was created using IBM Rational Rose Data Modeller (version 7), a widely used UML modelling tool. This also guarantees that the resulting UML model is compliant with the UML standards and practices.

2.2.2.2 Compliance with [REQ-UML-02]

The AIXM UML model uses Class elements for modelling the aeronautical information features, such as airspace, airport, route, runway, etc as detailed in Annex A (A.2.2) of these Guidelines. Each class has attributes (see A.2.2.2) and associations (see A.2.3) with other classes. The attributes of each class are fully defined, including data types, range of values and/or enumerated list of values (see A.2.2.2.1).

2.2.2.3 Compliance with [REQ-UML-03]

Annex A of these Guidelines includes examples (see A.2.2 and its sub-sections) that demonstrate the use of the UML classes, attributes, associations, stereotypes, enumerations, etc. for documenting the data set. These examples are realistic, but not always real; the exact list of attributes, associations and data types used as examples might be different from the current content of the AIXM UML model version 5.1.

2.3 Define each aeronautical feature requested to be published in the AIP

2.3.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (b):

[REQ-AIP-01] The regulated party shall provide formal evidence (e.g. in the form of a mapping table) that the common data set specification referred to in [REQ-DS-01] covers the scope of an Aeronautical Information Publication, as defined in ICAO Annex 15, Appendix 1.

[REQ-AIP-02] If an AIP data item is identified as “not covered” in the mapping table described in the [REQ-AIP-01], a justification shall be provided explaining why this occurs and what workaround is available.

[REQ-AMDB-01] The regulated party shall provide formal evidence (e.g. in the form of a mapping table) that documentation of the common data set specification referred to in [REQ-DS-01] covers the full scope of the User Requirements for Aerodrome Mapping Information, as defined in EUROCAE document ED-99A.

[REQ-AMDB-02] If an AIP data item is identified as “not covered” in the mapping table described in the [REQ-AMDB-01], a justification shall be provided explaining why this occurs and what workaround is available.

2.3.2 Use of AIXM as common data set specification

2.3.2.1 Compliance with [REQ-AIP-01]

A high-level mapping table is provided in ANNEX B – “AIXM v5.1 Mapping with AIP and with ED99 requirements”. It contains tables that list every AIP sub-section (e.g. AD 2.1) together with its particular requirements for data publication (e.g. Aerodrome location indicator and name). The mapping status indicated in these tables is based on the content of the “EUROCONTROL Guidelines for AIP to AIXM 5.1 Mapping”. This Guidance document contains the complete mapping details between the content of the AIP and the classes/properties defined in the AIXM 5.1 model.

2.3.2.2 Compliance with [REQ-AIP-02]

The mapping Guidelines mentioned in 2.3.2.1 also includes clear indications for non-mapping situations, where an information item listed as being in the AIP scope does not have a directly corresponding element in the AIXM UML model. In such situations (e.g. GEN 2.6, Conversion tables) an explanation is provided on the reason for the non-mapping situation (e.g. “*content of the AIP section are largely canonical and available from other sources. Work-around possible using the RulesAndProcedures class*”).

2.3.2.3 Compliance with [REQ-AMDB-01]

A high-level mapping is available in ANNEX B – “AIXM v5.1 Mapping with AIP and with ED99 requirements”. It contains tables that indicate how the airport mapping information items are supported by classes, attributes and associations of the AIXM UML model, in particular the AirportHeliport package. This is further detailed in the “EUROCONTROL Guidelines for ED-99 airport mapping requirements in AIXM 5.1”.

2.3.2.4 Compliance with [REQ-AMDB-02]

The mapping documentation mentioned in 2.3.2.3 also includes clear indications for non-mapping situations, where an information item listed as being in the AMDB scope does not have a directly corresponding element in the AIXM UML model. In such situations (e.g. “integrity level”) an explanation is provided on the reason for the non-mapping situation (e.g. “*not directly supported in the model, but supported as metadata element. Work-around: use metadata field...*”).

2.4 Provide for each attribute the definition of its data type

2.4.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (c):

[REQ-DAT-01] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] specifies a data type (e.g. character string, integer, decimal, etc.) for each class attribute (if UML is used) or feature attribute (if a Feature Catalogue is used).

[REQ-DAT-02] The data types mentioned in [REQ-DAT-01] may be further constrained through the provision of specified ranges of allowable values, between a minimum and a maximum value.

[REQ-DAT-03] The data types mentioned in [REQ-DAT-01] may be further constrained through the provision of exhaustive lists of allowable values.

2.4.2 Use of AIXM as common data set specification

2.4.2.1 Compliance with [REQ-DAT-01]

The AIXM UML model declares a data type for each class attribute, which can be easily verified by looking at the AIXM UML class diagrams: each attribute is followed by the name of the corresponding AIXM data type.

The AIXM list of data types is based on number or root data types, which map with widely used simple data types: character string, integer, decimal, etc. In order to facilitate the mapping of the AIXM UML model with the AIXM data exchange format, all AIXM data types are actually declared through an inheritance chain from basic Extensible Markup Language (XML) Schema – Data Types (e.g. xsd:string, xsd:decimal, etc.). This is further detailed in Annex A, Section A.2.2.2.1.

2.4.2.2 Compliance with [REQ-DAT-02]

For certain data types, a range of allowable values is declared in AIXM, as detailed in Annex A, Section A.2.2.2.1. For example, `ValBearingType`, which is used by the ‘magneticBearing’ attribute of the `RunwayDirection` class, is specified as:

- `minInclusive` = 0 (minimal allowable value)
- `maxInclusive` = 360 (maximal allowable value)

2.4.2.3 Compliance with [REQ-DAT-03]

For certain data types, an exhaustive list of allowable values is declared in AIXM, as detailed in Annex A, Section A.2.2.2.1. For example, `CodeAirportHeliportBaseType`, which is used by the ‘type’ attribute of the `AirportHeliport` class, is declared as having the following enumerated list of values:

- AD (Aerodrome only)
- AH (Aerodrome with heliport landing area)
- HP (Heliport only)
- LS (Landing site)
- OTHER (Other)

2.5 Include a temporal model

2.5.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (d):

[REQ-TEM-01] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] includes a temporal concept.

[REQ-TEM-02] The temporality concept referred in [REQ-TEM-01] shall enable time positions and time durations to be expressed with reference to the Coordinated Universal Time (UTC) standard.

[REQ-TEM-03] The temporality concept referred in [REQ-TEM-01] shall enable identifying the start of life (commissioning) and the end of life (decommissioning or withdrawal) of an aeronautical feature instance.

[REQ-TEM-04] The temporality concept referred in [REQ-TEM-01] shall enable identifying the time position when a permanent change in the properties of an aeronautical feature instance occurs.

[REQ-TEM-05] The temporality concept referred in [REQ-TEM-01] shall enable identifying the exact feature properties that have been modified at the time of the permanent change.

[REQ-TEM-06] The temporality concept referred in [REQ-TEM-01] shall include examples (real or fictitious) that demonstrate its use for encoding of the complete feature lifecycle: start of life, one or more permanent changes, end of life.

2.5.2 Use of AIXM as common data set specification

In order to satisfy the temporal requirements of aeronautical information systems, AIXM includes an exhaustive temporality model, which enables a precise representation of the states and events of aeronautical features. Detailed description of this temporality model is available on the www.aixm.aero Web site, in the Download section.

2.5.2.1 Compliance with [REQ-TEM-01]

The AIXM 5.1 temporality model description mentioned in 0 is formal evidence that the AIXM 5.1 includes a temporal concept. At the time of writing of this Guidance document, the current version of the AIXM Temporality Concept document was 1.0. The direct link to this version is provided here:

<http://www.aixm.aero/gallery/content/public/AIXM51/AIXM%20Temporality%201.0.pdf>

2.5.2.2 Compliance with [REQ-TEM-02]

The AIXM Time Slice concept described in the temporality model description mentioned in 0 is based on the ISO 19136 (GML) Time Slice concept. The ISO 19136 specifies that the primary temporal reference system for use with geographic information is the Gregorian Calendar and 24 hour local or Coordinated Universal Time (UTC). Therefore, the AIXM Temporality Concept enables time positions and time durations to be expressed with reference to the Coordinated Universal Time (UTC) standard.

2.5.2.3 Compliance with [REQ-TEM-03]

The encoding of the start of life (commissioning) of a defined aeronautical feature is addressed in section 4.2 of the AIXM 5.1 Temporality Concept document mentioned in 2.5.2.1. The start of life date/time value can be provided at any time using the featureLifetime/beginPosition property of an AIXM feature.

The encoding of the end of life (decommissioning) of a defined aeronautical feature is addressed in section 4.5 of the AIXM 5.1 Temporality Concept document mentioned in 2.5.2.1. The end of life date/time value can be provided at any time using the featureLifetime/endPosition property of an AIXM feature.

2.5.2.4 Compliance with [REQ-TEM-04] and [REQ-TEM-05]

The AIXM 5.1 temporality model enables identifying the time position when a permanent change occurs and the exact feature properties that have been modified at the time of the permanent change. This was one of the design criteria of the temporality concepts, as explained in section 2.5 of the AIXM 5.1 Temporality Concept document mentioned in 2.5.2.1.

The date/time of the change is provided by the validTime property of an AIXM TimeSlice. By definition, a PERMDELTA TimeSlice contains only the properties that have changed their values at the specified date/time. A usage example of permanent change is provided in the Section 4.3 of the AIXM 5.1 Temporality Concept document mentioned in 2.5.2.1.

2.5.2.5 Compliance with [REQ-TEM-06]

Sections 4.2 to 4.5 of the AIXM 5.1 Temporality Concept document mentioned in 2.5.2.1 provide abstract examples that demonstrate the use of the model for encoding of the complete feature lifecycle. Concrete examples, although fictitious, are provided in sections 4.1 and 4.6 of the same document.

2.6 Definition of the “business” rules

2.6.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (e):

[REQ-BR-01] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] includes the description of business rules.

[REQ-BR-02] The business rules referred to in [REQ-BR-01] shall define constraints on data values that reflect ICAO Standards and Recommended Practices, European or national operational rules and practices.

[REQ-BR-03] The business rules referred to in [REQ-BR-01] shall include the specification of data accuracy constraints, based on the requirements contained in ICAO Annex 11, Appendix 5 and Annex 14, Volume I, Appendix 5;

[REQ-BR-04] The business rules referred to in [REQ-BR-01] shall include the specification of data resolution constraints, based on the requirements contained in ICAO Annex 15, Appendix 7;

[REQ-BR-05] The business rules referred to in [REQ-BR-01] shall include the specification of publication date and advanced notification constraints, based on the AIRAC cycle requirements contained in ICAO Annex 15, Chapter 6;

[REQ-BR-06] The business rules referred to in [REQ-BR-01] may be formally defined using the specification for Semantics of Business Vocabulary and Business Rules, as provided on <http://www.omg.org/spec/SBVR/1.0/PDF>.

2.6.2 Use of AIXM as common data set specification

2.6.2.1 Compliance with [REQ-BR-01] [REQ-BR-01]

A proposed set of AIXM 5.1 business rules is provided on the AIXM web site⁸ in the form of an Excel file: [AIXM 5.1 Business Rules v1.0.xls](#).

Based on the experience gathered with previous AIXM versions, it was decided to keep the proposed business rules outside of the model itself, for two main reasons:

- Each group of stakeholders or each system might wish to choose from an existing pool of rules the ones that are really relevant for their applications and need to be checked. This concerns, for example, mandatory properties. The frequency of a navaid might be mandatory for a system that provides data for air navigation, while it has no relevance for a system that provides data for flight plan validation;
- Additional data validation rules might need to be added constantly during the life of the system, based on operational experience, for example in order to identify common data input errors.

Therefore, the Excel file provided on the AIXM Web site needs to be seen as a proposed set of rules that will be constantly updated and enhanced, based on the operational experience of the systems implementing the model. At the time of the writing, the current version of the Excel file was 1.0. Additional versions might have been made available in the meantime. The latest version is expected to be the most complete one.

2.6.2.2 Compliance with [REQ-BR-02]

The Business Rules contained in the Excel file mentioned in 2.6.2.1 contain proposed data verification rules that are drawn from ICAO Annexes (standards and recommended practices), such as:

- *The designator of a VOR shall not be duplicated within 600 NM of the location of the VOR” (ICAO Annex 11, Appendix 2, paragraph 2.2.2;*
- *Each VOR.frequency must be between 108,000MHz and 117,975MHz*
- *Etc.*

Other rules, in particular supporting the verification of procedure encodings, are drawn from the ARINC 424 Specification. The source of each rules is clearly identified in the Excel file mentioned in 2.6.2.1.

Currently, there are no European regional or national specific data validation rules. However, such rules might be added in future, for example considering the rules for NOTAM encoding contained in the Operating Procedures for AIS Dynamic Data (OPADD), which are not applied worldwide.

2.6.2.3 Compliance with [REQ-BR-03]

The Business Rules contained in the Excel file mentioned in 2.6.2.1 include proposed data accuracy verification rules that are based on the requirements stated in ICAO Annex 11, Appendix 5, such as:

- *“Each AirspaceVolume that is part of one Airspace that has type equal to 'CTA' or 'CTA_P' or 'CTR' or 'CTR_P' should have exactly one Surface.horizontalAccuracy at most 1 sec”;*
- *“Each Curve that has at least one GeoBorder.AirspaceVolume.AirspaceGeometryComponent.Airspace.type equal to 'FIR' or 'FIR_P' or 'UIR' or 'UIR_P' should have a horizontalAccuracy at most 1 min”*
- *Etc.*

⁸ https://extranet.eurocontrol.int/http://prisme-oas.hq.corp.eurocontrol.int/aixmwiki_public/bin/view/Main/AIXM_Business_Rules

The source of such rules is frequently given as Annex 15, Appendix 7-1, as they have been copied by ICAO in Aeronautical Information Services standards and recommended practices.

The Business Rules contained in the Excel file mentioned in 2.6.2.1 include proposed data accuracy verification rules that are based on the requirements stated in ICAO Annex 14, Volume 1, Appendix 5, such as:

- *“Each AirportHeliport.ARP must have horizontalAccuracy and AirportHeliport.ARP.horizontalAccuracy should be at most 1sec”;*
- *“Each DME that has at least one NavaidComponent.Navaid.AirportHeliport should have exactly one ElevatedPoint.horizontalAccuracy that is at most 1/10sec”*
- *Etc.*

The source of such rules is frequently given as Annex 15, Appendix 7-1, as they have been copied by ICAO in Aeronautical Information Services standards and recommended practices.

2.6.2.4 Compliance with [REQ-BR-04]

The Business Rules contained in the Excel file mentioned in 2.6.2.1 include proposed data resolution verification rules that are based on the requirements stated in ICAO Annex 15, Appendix 7, such as:

- *“Each RouteSegment.magneticTrack should have a resolution matching 1 degree”;*
- *“Each Runway.length should have a resolution matching 1m or 1ft”*
- *“Each DME that has type='PRECISION' must have an elevation resolution matching 30M or 100FT”*
- *Etc.*

2.6.2.5 Compliance with [REQ-BR-05]

The Business Rules contained in the Excel file mentioned in 2.6.2.1 include proposed data verification rules that are based on the requirements stated in ICAO Annex 15, Chapter 6 for data that needs to be published under the AIRAC cycle constraints. For example:

- **To be added. No example found in the current Excel file.**

2.6.2.6 Compliance with [REQ-BR-06]

The Business Rules contained in the Excel file mentioned in 2.6.2.1 include an SBVR definition for each such rule, in column D. For example:

- *“Each VOR1 that has VOR1.designator equal to VOR2.designator should have VOR1.ElevatedPoint at a geographical distance of more than 600 NM from VOR2.ElevatedPoint”*
- *Etc.*

At the time of writing, not all rules had a fully finalised SBVR description. The finalisation of this work is foreseen by Eurocontrol for end 2012. A document indicating how SBVR is used in the definition of AIXM Business Rules and what is the exact meaning of each keyword is in development and will be made available on the AIXM Web site.

2.7 Naming convention for features, attributes and associations

2.7.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (f):

[REQ-NAM-01] The regulated party shall provide formal evidence that the documentation of the common data set specification referred to in [REQ-DS-01] defines and consistently applies a naming convention for features, attributes and associations.

[REQ-NAM-02] If the use of abbreviations is permitted by the naming convention referred to in [REQ-NAM-01], such abbreviations should occur in less than 10% of the names of the model artefacts and shall be documented in a glossary.

2.7.2 Use of AIXM as common data set specification

2.7.2.1 Compliance with [REQ-NAM-01]

The classes, attributes, associations and role names that appear in the AIXM UML model follow a widely used naming convention, as described in Annex A, paragraph A.2.5:

- “UpperCamelCase” format for class (features and objects) names
- “lowerCamelCase” format for attributes, associations and role names

The tokens used in this naming convention are:

- either terms meaningful for the aeronautical information domain, such as “airport”, “route”, “navaid”, “aerial”, “elevation”, “location”, etc.
- or general English language terms such as “name”, “annotation”, “address”, etc.

2.7.2.2 Compliance with [REQ-NAM-02]

Annex A to this Specification in paragraph A.2.6 provides a glossary of the acronyms that appear in the AIXM 5.1 UML model in names of classes, attributes and associations. This represents less than 5% of the total number of names used in the model. In addition, such abbreviations are used only when they are considered well known in the aeronautical information domain. Frequently, the acronym is even better known than the fully expanded names, such as is the case for:

- VOR (instead of “VHF Omni Directional Radio Range”)
- NDB (instead of “Non-Directional Radio Beacon”)
- Etc.

2.8 Use of the Geographic Information - Spatial Schema (ISO-19107:2003)

2.8.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (g):

[REQ-GM-01] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] reuses the GM_Point (documented in ISO 19107:2003) for the definition of the location of aeronautical features that have point type geometry.

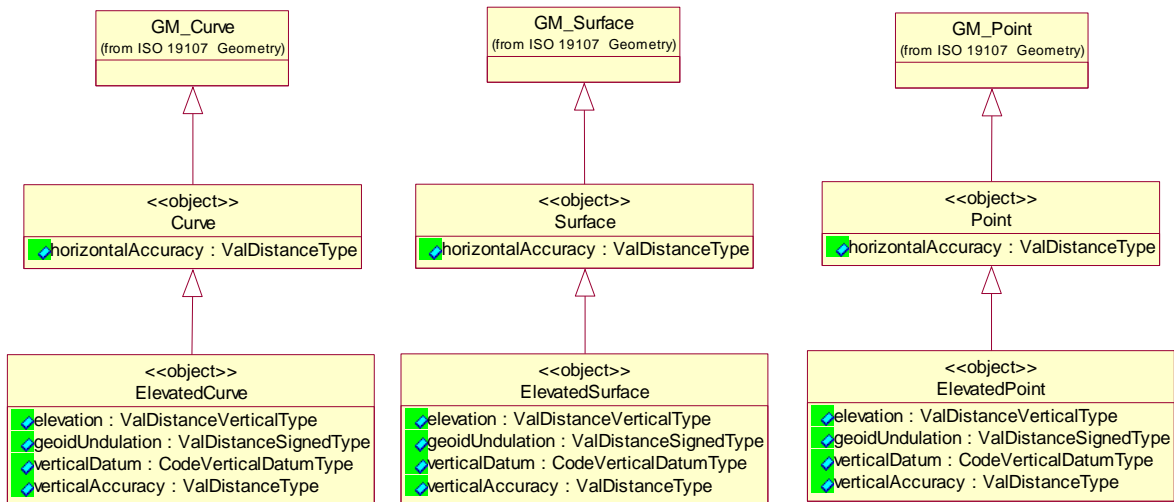
[REQ-GM-02] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] reuses the GM_Curve (documented in ISO 19107:2003) for the definition of the horizontal extent of aeronautical features that have line/curve type geometry.

[REQ-GM-03] The regulated party shall provide formal evidence that the common data set specification referred to in [REQ-DS-01] reuses the GM_Surface (documented in ISO 19107:2003) for the definition of the horizontal limits of aeronautical features that have surface type geometry.

2.8.2 Use of AIXM as common data set specification

2.8.2.1 Compliance with [REQ-GM-01], [REQ-GM-02] and [REQ-GM-03]

The GM_Point, GM_Curve and GM_Surface classes defined in ISO 19107:2003 are used in the AIXM UML model as basis for an inheritance chain that defines the classes AIXM classes Point/ElevatedPoint, Curve/ElevatedCurve, Surface/ElevatedSurface. The class diagram below is extracted from the AIXM UML model:



The AIXM classes Point or ElevatedPoint as appropriate are used for modelling the location of aeronautical features that have point type geometry, such as Aerodrome Reference Point, Navaid, Designated Point, etc. Thus, the GM_Point is used for the definition of AIXM locations, as required in [REQ-GM-01].

The AIXM classes Curve or ElevatedCurve as appropriate are used for modelling the horizontal extent of aeronautical features that have line/curve type geometry, such as VerticalStructure (Obstacle), Airspace corridor, etc. Thus, the GM_Curve is used for the definition of AIXM horizontal shapes, as required in [REQ-GM-02].

The AIXM classes Surface or ElevatedSurface as appropriate are used for modelling the horizontal limits of aeronautical features that have surface type geometry, such as VerticalStructure (Obstacle), Airspace corridor, etc. Thus, the GM_Surface is used for the definition of AIXM horizontal boundaries, as required in [REQ-GM-03].

2.9 Metadata

2.9.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 4 of the ADQ IR and with the consequent requirement stated in Annex 1, Part A.1 (h) and (i):

[REQ-MD-01] The regulated party shall provide formal evidence that the documentation of the common data set specification referred to in [REQ-DS-01] includes metadata elements.

[REQ-MD-02] The metadata elements referred to in [REQ-MD-01] shall be drawn from the 19115:2003 — Geographic information — Metadata Standard.

[REQ-MD-03] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about the originator of the data.

[REQ-MD-04] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about amendments made to the data.

[REQ-MD-05] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about the persons or organisations that have interacted with the data and when.

[REQ-MD-06] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about any validation and verification of the data that has been performed.

[REQ-MD-07] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about the effective start date and time of the data.

[REQ-MD-08] The metadata elements referred to in [REQ-MD-01] shall include constructs which, for geospatial data, capture information about the Earth reference model used.

[REQ-MD-09] The metadata elements referred to in [REQ-MD-01] shall include constructs which, for geospatial data, capture information about the coordinate system used.

[REQ-MD-10] The metadata elements referred to in [REQ-MD-01] shall include constructs which, for numerical data, capture information about the statistical accuracy of the measurement or calculation technique used.

[REQ-MD-11] The metadata elements referred to in [REQ-MD-01] shall include constructs which, for numerical data, capture information about the data resolution.

[REQ-MD-12] The metadata elements referred to in [REQ-MD-01] shall include constructs which, for numerical data, capture information about the confidence level.

[REQ-MD-13] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about any functions applied if data has been subject to conversion/transformation.

[REQ-MD-14] The metadata elements referred to in [REQ-MD-01] shall include constructs that capture information about any limitations on the use of the data.

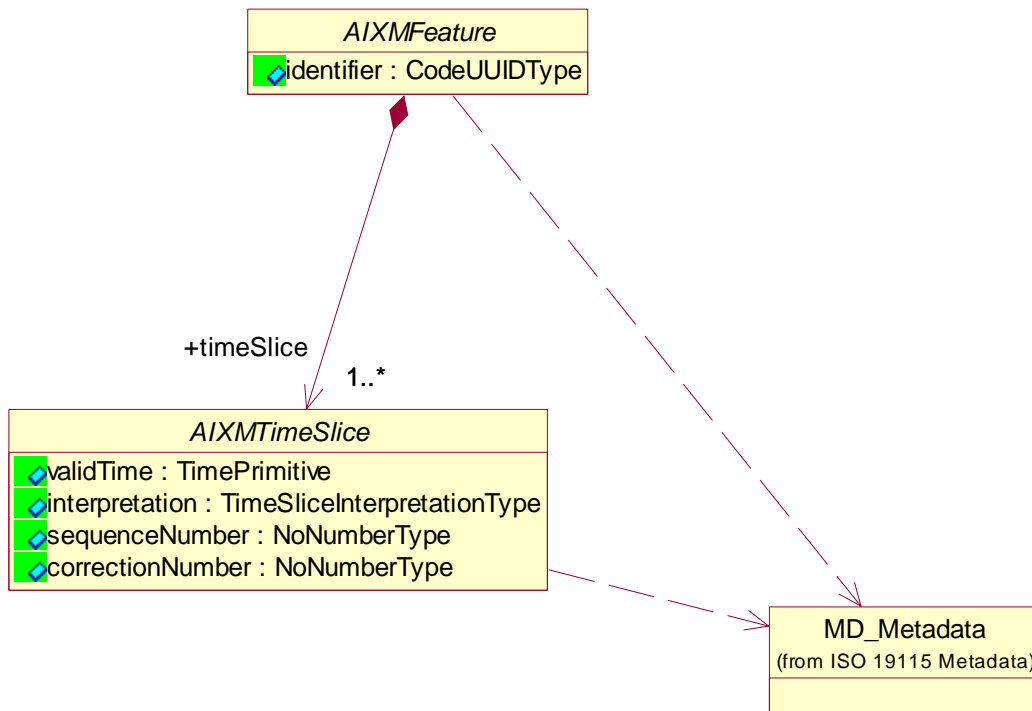
2.9.2 Use of AIXM as common data set specification

2.9.2.1 Compliance with [REQ-MD-01] and [REQ-MD-02]

The AIXM UML model re-uses directly the MD_Metadata element defined in the ISO 19115:2003 Geography Information – Metadata Standard. This enables the provision of metadata at two levels:

- AIXM Features – overall metadata, which is valid for the entire lifetime of the feature
- AIXM Feature Timeslices - metadata that is valid in relation with a specific set of feature properties, at a time moment or during a time period.

The two levels are visible in the class diagram below, which is copied from the AIXM UML model:



The metadata requirements for aeronautical information are further detailed in a series of documents developed under the Aviation Domain Working Group of the Open Geospatial Consortium (OGC) and which are available on the OGC Portal⁹:

- Requirements for Aviation Metadata [5], which details the user requirements for metadata based on the ICAO Annex 15 and the ADQ IR, combined with the requirements arising from the INSPIRE¹⁰ directive of the European Commission. The document contains explicit references to the metadata items listed in the ADQ IR, Annex 1, Part C, (a) to (i).
- Guidance on the Aviation Metadata Profile [6], which explains how to map the requirements for Aviation Metadata into a profile of ISO 19115:2003.

References to these two documents will be used in the next sub-sections in order to demonstrate the compliance with the requirements [REQ-MD-03] to [REQ-MD-14].

2.9.2.2 Compliance with [REQ-MD-03]

Section 5.7.1 and 5.7.2 of the Requirements for Aviation Metadata [5] indicate that information about the originator of the data (ADQ IR, Annex 1, Part C, (a)) corresponds to Responsible Party with role = Originator (according to the list of values in 7.2 of the same document).

According to the Guidance on the Aviation Metadata Profile [6] section 5.7, this maps to MD_Metadata/identificationInfo/MD_DataIdentification/pointOfContact/CI_ResponsibleParty class with role/CI_RoleCode = originator, as defined in the ISO 19115:2003 standard.

⁹ <http://www.opengeospatial.org/standards/dp>

¹⁰ COMMISSION REGULATION (EC) No 1205/2008 - INSPIRE Metadata

2.9.2.3 Compliance with [REQ-MD-04]

Section 5.5.1 of the Requirements for Aviation Metadata [5] indicate that information about amendments made to the data (ADQ IR, Annex 1, Part C, (b)) corresponds to Lineage. The list of possible functions (see 7.1 of the same document) includes Revision (any further manipulation of the data).

According to the Guidance on the Aviation Metadata Profile [6] section 5.7, this maps to MD_Metadata/dataQualityInfo/DQ_DataQuality/lineage/LI_Lineage class with processStep/LI_ProcessStep/processor/CI_ResponsibleParty/role/CI_RoleCode = processor, as defined in the ISO 19115:2003 standard.

2.9.2.4 Compliance with [REQ-MD-05]

Section 5.5.1 of the Requirements for Aviation Metadata [5] indicates that information about persons or organisations that have interacted with the data and when (ADQ IR, Annex 1, Part C, (c)) corresponds to Lineage:

- The name of the organization or entity performing the function;
- The date and time of operation.

According to the Guidance on the Aviation Metadata Profile [6] section 5.7, this maps to MD_Metadata/dataQualityInfo/DQ_DataQuality/lineage/LI_Lineage/processStep/LI_ProcessStep/processor/CI_ResponsibleParty class, as defined in the ISO 19115:2003 standard.

2.9.2.5 Compliance with [REQ-MD-06]

Section 5.5.1 of the Requirements for Aviation Metadata [5] indicates that information about any validation and verification of the data that has been performed (ADQ IR, Annex 1, Part C, (d)) corresponds to Lineage.

According to the Guidance on the Aviation Metadata Profile [6] section 5.7, this maps to MD_Metadata/dataQualityInfo/DQ_DataQuality/lineage/LI_Lineage class with processStep/LI_ProcessStep/processor/CI_ResponsibleParty/role/CI_RoleCode = processor, as defined in the ISO 19115:2003 standard.

2.9.2.6 Compliance with [REQ-MD-07]

The effective start date and time of the data is covered by the Temporality concept of AIXM (see 2.5.2.3). It is a distinct property of each AIXM Feature TimeSlice. Since this requirement is covered by the AIXM data set specification, it is not necessary to duplicate as metadata.

2.9.2.7 Compliance with [REQ-MD-08] and [REQ-MD-09]

Section 5.3.2 of the Requirements for Aviation Metadata [5] indicates that information about the Earth reference model used for data that is geospatial and about the coordinate system used (ADQ IR, Annex 1, Part C, (f)) corresponds to Spatial Reference System.

According to the Guidance on the Aviation Metadata Profile [6] section 5.3, this maps to the MD_Metadata/referenceSystemInfoMD_ReferenceSystem/referenceSystemIdentifier/RS_Identifier class.

2.9.2.8 Compliance with [REQ-MD-10], [REQ-MD-11] and [REQ-MD-12]

Section 5.5.2 of the Requirements for Aviation Metadata [5] indicates that information about the information about the statistical accuracy of the measurement or calculation technique used, the resolution of numerical data and the confidence level of numerical data accuracy (ADQ IR, Annex 1, Part C, (g)) is included in the Accuracy of Numerical Data requirements.

According to the Guidance on the Aviation Metadata Profile [6] section 5.5, this maps to the MD_Metadata/dataQualityInfo/DQ_DataQuality/report/DQ_QuantitativeAttributeAccuracy class.

2.9.2.9 Compliance with [REQ-MD-13]

Section 5.5.1 of the Requirements for Aviation Metadata [5] indicates that information about any functions applied if data has been subject to conversion/transformation (ADQ IR, Annex 1, Part C, (h)) corresponds to Lineage.

According to the Guidance on the Aviation Metadata Profile [6] section 5.7, this maps to MD_Metadata/dataQualityInfo/DQ_DataQuality/lineage/LI_Lineage class with processStep/LI_ProcessStep/processor/CI_ResponsibleParty/role/CI_RoleCode = processor, as defined in the ISO 19115:2003 standard.

2.9.2.10 Compliance with [REQ-MD-14]

Section 5.6.1 of the Requirements for Aviation Metadata [5] indicates that information about any limitations on the use of the data (ADQ IR, Annex 1, Part C, (h)) corresponds to Conditions Applying to Access and Use.

According to the Guidance on the Aviation Metadata Profile [6] section 5.6, this maps to MD_Metadata/identificationInfo/MD_DataIdentification/resourceConstraints property, which can contain MD_LegalConstraints or MD_SecurityConstraints, as defined in the ISO 19115:2003 standard.

3. AIXM implementation ALLOWING COMPLIANCE WITH ARTICLE 5 OF THE COMMISSION REGULATION (EU) NO 73/2010

3.1 Identify the common data format specification in use

3.1.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement, it is stated in Article 5(2) – Annex II, Part A.1 - Paragraph 1 that:

[REQ-DF-01] The regulated party shall declare the common data format specification that they use for the activities that fall within the scope of the ADQ IR [1].

[REQ-DF-02] The declaration of the common data format specification referred to in [REQ-DF-01] shall contain, as a minimum:

- the name (including the version, if applicable) by which the common data format specification is officially identified by its publishing authority;
- the necessary reference information (contact details, website, etc.) enabling the regulator to obtain a copy of the common data format specification documentation.

[REQ-DF-03] The regulated party shall provide evidence that the declared data format specification is indeed commonly used in the Aeronautical Information domain.

[REQ-DF-04] The evidence referred to in [REQ-DF-03] shall be in the form of:

- agreements signed with a significant number of relevant next intended users for the provision of aeronautical data according to the declared data format specification;
- agreements signed by similar organisations in the same or in other European States for the provision of aeronautical data to their next intended users according to the declared data format;
- agreements signed with a significant number of relevant data originators for the receipt of aeronautical data according to the declared data format specification;
- agreements signed by similar organisations in the same or in other European States for the receipt of aeronautical data according to the declared data format;
- an agreement signed with the European AIS Database (EAD) for the provision of the data to EAD according to the declared data format specification, if applicable.

3.1.2 Use of AIXM as common data format specification

3.1.2.1 Compliance with [REQ-DF-01] and [REQ-DF-02]

The Aeronautical Information Exchange Model (AIXM) version 5.1 is used as common data format specification. The relevant AIXM documentation is available on the www.aixm.aero Web site, in the Download section and can be downloaded in the form of an XML Schema. The “AIXM-5-1-20100201-xsd.zip” file contains the following schema files:

- AIXM_AbstractGML_ObjectTypes.xsd, which defines the abstract AIXMFeatureType, AIXMObjectType and AIXMTimesliceType by derivation from the corresponding GML types (ISO 19136). This includes the necessary links with the ISO 19139 Metadata schema.

- AIXM_Datatypes.xsd, which contains the XML representation of all the data types defined in the AIXM UML model.
- AIXM_Features.xsd, which contains the XML representation of all the AIXM features with all their properties (simple and complex).
- message/AIXM_BasicMessage.xsd, which contains the definition of a simple collection of AIXM features and can be used for the encoding of an AIXM data set. By contrast, the AIXM_Features.xsd enables the encoding of an individual feature, not a data set.

The rest of the files are local copies of the ISO 19136 (GML) schema files, ISO 19139 (Metadata) schema files and xlink schema files.

The AIXM 5.1 XML Schema is also available for direct use from the following Web page: <http://www.aixm.aero/gallery/content/public/schema/5.1/>. This reference location can be used programmatically, by a tool that needs access to the AIXM 5.1 XML Schema for reasons such as file validation, data encoding, etc.

3.1.2.2 Compliance with [REQ-DF-03] and [REQ-DF-04]

The AIXM data model is used by all the European States that are migrated as static data providers for the European AIS Database (EAD). The EAD has been using AIXM version 4.5 since 2007 and it has started the migration to version 5.1 since 2010.

At the time of writing of these Guidelines it was planned that a full AIXM 5.1 compliant implementation in EAD will be achieved in time for the ADQ implementation deadline, as established through the Commission Regulation (EU) NO 73/2012. Therefore, AIS offices of European States that are migrated to EAD will be able to claim compliance with [REQ-DS-04] using their EAD data provider agreement as main argument. This does not exclude the use of the other arguments indicated in [REQ-DS-04], but this depends on the local situation of each regulated party.

The AIXM version 5.1 is also being adopted as ICAO Guidance Material in support for the Annex 15 requirements for digital aeronautical data provision. This is being discussed through the AIS-AIMSG of ICAO. The following AIS-AIMSG Meetings Study Notes refer to this topic:

- 1) [AIS-AIMSG/1, SN.11](#)¹¹ “Development of SARPs for Aeronautical Information Conceptual and Data Exchange Model Based on AIXM Version 5”;
- 2) [AIS-AIMSG/2, SN.12](#)¹² “Guidance Material for the Aeronautical Information Conceptual Model”
- 3) [AIS-AIMSG/3, SN.5](#)¹³ “AIXM Governance and Configuration Control”
- 4) [AIS-AIMSG/4, SN.15](#)¹⁴ “AIXM Change Control Board Initiation Phase”

3.2 Use of the extensive mark-up language (XML) for data encoding

3.2.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 1:

¹¹ <http://www2.icao.int/en/ais-aimsg/Meetings/SNs/AIS-AIMSG.1.SN.011.en.doc>

¹² <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN.12 - Guidance Material for the Aeronautical Information Conceptual Model.doc>

¹³ <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN 5 App.doc>

¹⁴ <http://www2.icao.int/en/ais-aimsg/AISAIM Meeting MetaData/SN 15.doc>

[REQ-XML-01] The regulated party shall provide evidence that the common data format specification referred to in [REQ-DF-01] is based on the Extensible Markup Language (XML) specification, as defined on the [W3C website](#)¹³.

[REQ-XML-02] The evidence referred to in [REQ-XML-01] may be in the form of the results of parsing a sample data file with an XML parser (such as [Xerces](#)¹⁵), which verifies whether the XML file is well-formed.

3.2.2 Use of AIXM as common data set specification

3.2.2.1 Compliance with [REQ-XML-01] and [REQ-XML-02]

An AIXM 5.1 sample file is provided in Annex C.1. A direct visual inspection of the sample shows that it is formatted according to the XML syntax rules. The first line contains a typical XML processing instruction: `<?xml version="1.0" encoding="UTF-8"?>`. The file can also be opened and is correctly formatted when viewing with a standard Web browser that understands XML (such as Internet Explorer, Firefox, etc.)

In application of [REQ-XML-02] of the AIX Specification, the screenshot below shows the result of parsing the file using xerces. The file is found well-formed containing 37 XML elements and 42 XML attributes. This proves that AIXM 5.1 is conformant with the XML specification.

¹⁵ <http://xerces.apache.org/xerces-c/>


```

C:\WINDOWS\system32\cmd.exe
C:\AIXM 5.1 Workspace>
C:\AIXM 5.1 Workspace>java dom.Counter
usage: java dom.Counter <options> uri ...

options:
  -p name      Select parser by name.
  -x number    Select number of repetitions.
  -n ! -N      Turn on/off namespace processing.
  -v ! -U      Turn on/off validation.
  -s ! -S      Turn on/off Schema validation support.
               NOTE: Not supported by all parsers.
  -f ! -F      Turn on/off Schema full checking.
               NOTE: Requires use of -s and not supported by all parsers.
  -hs ! -HS    Turn on/off honouring of all schema locations.
               NOTE: Requires use of -s and not supported by all parsers.
  -va ! -UA    Turn on/off validation of schema annotations.
               NOTE: Requires use of -s and not supported by all parsers.
  -dv ! -DU    Turn on/off dynamic validation.
               NOTE: Not supported by all parsers.
  -xi ! -XI    Turn on/off XInclude processing.
               NOTE: Not supported by all parsers.
  -xb ! -XB    Turn on/off base URI fixup during XInclude processing.
               NOTE: Requires use of -xi and not supported by all parsers.
  -xl ! -XL    Turn on/off language fixup during XInclude processing.
               NOTE: Requires use of -xi and not supported by all parsers.
  -h          This help screen.

defaults:
Parser:      dom.wrappers.Xerces
Repetition: 1
Namespaces: on
Validation:  off
Schema:      off
Schema full checking:      off
Honour all schema locations: off
Validate annotations:      off
Dynamic:      off
XInclude:     off
XInclude base URI fixup:  on
XInclude language fixup:  on

C:\AIXM 5.1 Workspace>validate_xerces_2-8-0.bat "Sample 2 - Airport.xml"
C:\AIXM 5.1 Workspace>java dom.Counter -v -s -f file:"Sample 2 - Airport.xml"
file:Sample 2 - Airport.xml: 1438;0;0 ms (37 elems, 42 attrs, 0 spaces, 420 char
s)
C:\AIXM 5.1 Workspace>_

```

Further more, in order to demonstrate that xerces does effectively detect a not correctly formatted XML, the sample AIXM 5.1 file from Annex C.1 can be manually corrupted, for example by inserting a "`<wrongElement>error</wrongElement>`" at the beginning of the file. The screenshot below indicates that xerces immediately detects this non-conformance with the XML specification:

```

C:\WINDOWS\system32\cmd.exe

C:\AIXM 5.1 Workspace>validate_xerces_2-8-0.bat "Sample 2 - Airport - corrupted.xml"

C:\AIXM 5.1 Workspace>java dom.Counter -v -s -f file:"Sample 2 - Airport - corrupted.xml"
[Error] file:Sample%202%20-%20Airport%20-%20corrupted.xml:2:15: cvc-elt.1: Cannot find the declaration of element 'wrongElement'.
[Fatal Error] file:Sample%202%20-%20Airport%20-%20corrupted.xml:3:2: The markup in the document following the root element must be well-formed.
C:\AIXM 5.1 Workspace>_

```

3.3 Use of XML schema

3.3.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR and with the consequent requirement States in Annex 2, Part A.1 - Paragraph 2:

[REQ-XSD-01] The regulated party shall provide evidence that the common data format specification referred to in [REQ-DF-01] is compliant with the “[XML Schema Part 1: Structures](#)” and “[XML Schema Part 2: Data Types](#)”, as defined on the W3C web site.

[REQ-XSD-02] The evidence referred to in [REQ-XSD-01] may be in the form of results of parsing a sample data file with a schema-validating XML parser (such as Xerces¹⁶), which verifies if the XML file is valid against the XML Schema.

[REQ-SCH-01] If computer code is provided for supporting the verification of the business rules referred to in [REQ-BR-01], then the regulated party may provide evidence that this is in the form of Schematron code.

[REQ-SCH-02] The evidence referred to in [REQ-SCH-01] may be in the form of result of verifying a sample data file with Schematron validating software referenced on the Schematron Web site: <http://www.schematron.com/validators.html>.

3.3.2 Use of AIXM as common data format specification

3.3.2.1 Compliance with [REQ-XSD-01] and [REQ-XSD-02]

An AIXM 5.1 sample file is provided in Annex C.1. A direct visual inspection of the file shows that the first element includes the declaration of the “xsi:” namespace, which refers to the W3C XML Schema specification:

- `xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance`

Then, the namespace of the root element (`aixm:AirportHeliport`) is linked with an XML Schema location declaration:

- `xsi:schemaLocation=http://www.aixm.aero/schema/5.1
http://www.aixm.aero/schema/5.1/AIXM_Features.xsd`

¹⁶ <http://xerces.apache.org/xerces-c/>

The AIXM 5.1 schema file is directly accessible at the address indicated in the schema location declaration: http://www.aixm.aero/schema/5.1/AIXM_Features.xsd. It can be visualised with any standard Web browser. The default namespace of the AIXM 5.1 schema file is the standard W3C Schema URI: `xmlns="http://www.w3.org/2001/XMLSchema"`. The extension '.xsd' is typically used for XML Schema files that comply with the W3C XML Schema specification. These are clear indications that the data format specification of AIXM 5.1 is compliant with the XML Schema Specification (Part 1 and Part 2) of W3C.

In application of [REQ-XSD-02] of the AIX Specification, the screenshot below shows the result of parsing the file using xerces [REQ-XML-02]. The schema validation option "-s" is selected, which proves that the validation is done against a valid XML Schema. The file is found valid, containing 37 XML elements and 42 XML attributes. This proves that AIXM 5.1 Schema complies with the W3C XML Schema specification.

```

C:\WINDOWS\system32\cmd.exe
C:\AIXM 5.1 Workspace>
C:\AIXM 5.1 Workspace>java dom.Counter
usage: java dom.Counter <options> uri ...

options:
-p name      Select parser by name.
-x number    Select number of repetitions.
-n | -N      Turn on/off namespace processing.
-v | -U      Turn on/off validation.
-s | -S      Turn on/off Schema validation support.
             NOTE: Not supported by all parsers.
-f | -F      Turn on/off Schema full checking.
             NOTE: Requires use of -s and not supported by all parsers.
-hs | -HS    Turn on/off honouring of all schema locations.
             NOTE: Requires use of -s and not supported by all parsers.
-va | -VA    Turn on/off validation of schema annotations.
             NOTE: Requires use of -s and not supported by all parsers.
-dv | -DU    Turn on/off dynamic validation.
             NOTE: Not supported by all parsers.
-xi | -XI    Turn on/off XInclude processing.
             NOTE: Not supported by all parsers.
-xb | -XB    Turn on/off base URI fixup during XInclude processing.
             NOTE: Requires use of -xi and not supported by all parsers.
-xl | -XL    Turn on/off language fixup during XInclude processing.
             NOTE: Requires use of -xi and not supported by all parsers.
-h          This help screen.

defaults:
Parser:      dom.wrappers.Xerces
Repetition: 1
Namespaces: on
Validation:  off
Schema:      off
Schema full checking:      off
Honour all schema locations: off
Validate annotations:      off
Dynamic:      off
XInclude:     off
XInclude base URI fixup:  on
XInclude language fixup:  on

C:\AIXM 5.1 Workspace>validate_xerces_2-8-0.bat "Sample 2 - Airport.xml"
C:\AIXM 5.1 Workspace>java dom.Counter -v -s -f file:"Sample 2 - Airport.xml"
file:Sample 2 - Airport.xml: 1438;0;0 ms <37 elems, 42 attrs, 0 spaces, 420 char
s>
C:\AIXM 5.1 Workspace>_

```

3.3.2.2 Compliance with [REQ-SCH-01] and [REQ-SCH-02]

At the time of writing, computer code for the validation of the business rules referred to in [REQ-BR-01] is available to a limited extent. The Excel file mentioned in 2.6.2.1 includes, for some rules, draft Schematron code. For example, line 450 contains the definition of an ICAO Annex 15 Appendix 7-1 business rule: “*Each AeronauticalGroundLight.ElevatedPoint.horizontalAccuracy should be at most 1/10 sec*”. The following Schematron code is provided for this rule:

AIXM - Schematron Rule Context	AIXM - Schematron rules - full description
//aixm:AeronauticalGroundLightTimeSlice[aixm:interpretation='BASE LINE' or aixm:interpretation='SNAPSHOT']	(./aixm:location/aixm:ElevatedPoint/aixm:horizontalAccuracy[@uom='M']) and (./aixm:location/aixm:ElevatedPoint/aixm:horizontalAccuracy = 3) or (./aixm:location/aixm:ElevatedPoint/aixm:horizontalAccuracy[@uom='FT']) and (./aixm:location/aixm:ElevatedPoint/aixm:horizontalAccuracy = 10)

However, not all the rules contained in the Excel file are complemented with the equivalent Schematron encoding. This is expected to be improved in future releases of the AIXM 5.1 proposed set of Business Rules. Considering that this is an option, not a mandatory requirement in the AIX Specification, the full compliance of AIXM 5.1 with requirements [REQ-SCH-01] and [REQ-SCH-02] is left to be demonstrated at a later stage.

3.4 Exchange of data for both individual features and feature collections

3.4.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 3:

[REQ-XFE-01] The regulated party shall provide evidence that the XML Schema referred to in [REQ-XSD-01] enables the creation of data files that contain a single feature.

[REQ-XFE-02] The evidence referred to in [REQ-XFE-01] may be in the form of a sample data file that contains data about a single aeronautical feature (such as an airport, a waypoint, etc.) and which passes the validation test described in [REQ-XSD-02].

[REQ-XFE-03] The regulated party shall provide evidence that the XML Schema referred to in [REQ-XSD-01] enables the creation of data files that contain more than one feature.

[REQ-XFE-04] The evidence referred to in [REQ-XFE-03] may be in the form of a sample data file that contains data about several aeronautical features (such as an airport and all runways, taxiways, aprons, etc.) and which passes the validation test described in [REQ-XSD-02].

3.4.2 Use of AIXM as common data format specification

The AIXM 5.1 data format enables to provide XML file containing either a single feature or a full data set selection. This is achieved by the provision¹⁷ of both:

- the [AIXM_Features.xsd](#) XML Schema file, which defines the structure of an AIXM 5.1 file that contains data about a single aeronautical feature;

¹⁷ see <http://www.aixm.aero/gallery/content/public/schema/5.1/>

- the [AIXM BasicMessage.xsd](#) XML Schema, which includes the AIXM_Features.xsd and defines on top of it the structure of an AIXM 5.1 file that contains data about one or more aeronautical features.

3.4.2.1 Compliance with [REQ-XFE-01] and [REQ-XFE-02]

An AIXM 5.1 sample file that contains data about only one feature (a heliport) is provided in Annex C.1. A direct visual inspection of the file shows that the file contains data about a fictitious “Donlon” heliport, such as: name, airport reference point position, magnetic variation, etc. The complete list of properties that can be encoded in AIXM 5.1 for an airport/heliport feature can be consulted (for example) by using the AIXM Wiki: https://extranet.eurocontrol.int/http://prisme-oas.hq.corp.eurocontrol.int/aixmwiki_public/bin/view/AIXM/Class_AirportHeliport

The evidence that this sample file passes the validation test described in [REQ-XSD-02] was already provided in section 3.3.2.1.

3.4.2.2 Compliance with [REQ-XFE-03] and [REQ-XFE-04]

An AIXM 5.1 sample file that contains data about several aeronautical features at once (an airport, a runway and an obstacle/antenna) is provided in Annex C.2.

```

C:\WINDOWS\system32\cmd.exe

C:\AIXM 5.1 Workspace>java dom.Counter
usage: java dom.Counter <options> uri ...

options:
  -p name      Select parser by name.
  -x number    Select number of repetitions.
  -n | -N      Turn on/off namespace processing.
  -v | -U      Turn on/off validation.
  -s | -S      Turn on/off Schema validation support.
               NOTE: Not supported by all parsers.
  -f | -F      Turn on/off Schema full checking.
               NOTE: Requires use of -s and not supported by all parsers.
  -hs | -HS    Turn on/off honouring of all schema locations.
               NOTE: Requires use of -s and not supported by all parsers.
  -va | -VA    Turn on/off validation of schema annotations.
               NOTE: Requires use of -s and not supported by all parsers.
  -dv | -DU    Turn on/off dynamic validation.
               NOTE: Not supported by all parsers.
  -xi | -XI    Turn on/off XInclude processing.
               NOTE: Not supported by all parsers.
  -xb | -XB    Turn on/off base URI fixup during XInclude processing.
               NOTE: Requires use of -xi and not supported by all parsers.
  -xl | -XL    Turn on/off language fixup during XInclude processing.
               NOTE: Requires use of -xi and not supported by all parsers.
  -h          This help screen.

defaults:
  Parser:      dom.wrappers.Xerces
  Repetition: 1
  Namespaces: on
  Validation:  off
  Schema:      off
  Schema full checking:      off
  Honour all schema locations: off
  Validate annotations:      off
  Dynamic:      off
  XInclude:     off
  XInclude base URI fixup:  on
  XInclude language fixup:  on

C:\AIXM 5.1 Workspace>validate_xerces_2-8-0.bat "Data set sample - extract from
Donlon.xml"

C:\AIXM 5.1 Workspace>java dom.Counter -v -s -f file:"Data set sample - extract
from Donlon.xml"
file:Data set sample - extract from Donlon.xml: 1500;15;0 ms (124 elems, 97 attr
s, 0 spaces, 1857 chars)
C:\AIXM 5.1 Workspace>_

```


In application of [REQ-XFE-04] of the AIX Specification, the screenshot below shows the result of parsing the file using xerces. The schema validation option “-s” is selected, which proves that the validation is done against a valid XML Schema. The file is found valid, containing 124 XML elements and 97 XML attributes. This proves that sample is valid against the AIXM 5.1 XML Schema.

Further more, it shall be noted that AIXM 5.1 enables the creation of application-oriented schemas, which support the provision of a selected sub-set of AIXM features, as necessary for a particular application. For example, it is possible to derive from AIXM a custom schema that supports the digital encoding and exchange of airport data only, if necessary for a particular application. The rules are detailed in the “[AIXM Application Schema Generation](#)” document, available¹⁸ on the www.aixm.aero Web site. This also enables the local extension of the AIXM model/schema with features/properties, which might be of interest for a specific group of stakeholders.

The AIXM_BasicMessage.xsd is, as the name suggests, a “basic” example of applying the rules for the creation of dedicated schemas, that enable the exchange of data for a particular set of aeronautical features.

3.5 Exchange of baseline information as a result of permanent changes

3.5.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 4:

[REQ-CHG-01] The regulated party shall provide evidence that the XML Schema referred to in [REQ-XSD-01] enables the explicit identification of the feature properties that have changed their values permanently.

[REQ-CHG-02] The evidence referred to in [REQ-CHG-01] may be in the form of a data sample file that contains only the values of the properties that have changed for a given feature (such as an airport, runway, etc.) and which passes the validation test described in [REQ-XSD-02].

[REQ-CHG-03] The evidence referred to in [REQ-CHG-01] may be in the form of a data sample file that contains the data for a complete feature but in which the values of the properties that have changed for a feature (such as an airport, runway, etc.) are clearly marked and which passes the validation test described in [REQ-XSD-02].

[REQ-CHG-04] The regulated party shall provide evidence that the XML Schema referred to in [REQ-XSD-01] makes it possible to encode and communicate the complete list of property values of a feature after a permanent change of a one or more of these properties.

[REQ-CHG-05] The evidence referred to in [REQ-CHG-04] may be in the form of a data sample file that contains both the changed properties clearly marked (as requested in [REQ-CHG-02] or in [REQ-CHG-03]) and the complete feature data which results from the change and which passes the validation test described in [REQ-XSD-02].

3.5.2 Use of AIXM as common data format specification

The possibility to explicitly identify the feature properties that change value in a data set was one of the design objectives of the AIXM 5.1. This is explained in section 2.5 of the [AIXM 5.1 Temporality Concept](#)¹⁹, with some particularities being explained in sections 3.4 (“Delta” for complex properties), 3.5 (“Delta” for multi-occurring properties) and 3.6 (Identifying the feature affected by a Delta Time Slice). Some usage examples for PERMDELTA Time Slices are provided in chapter 4 of the Temporality Concept document.

¹⁸ see http://www.aixm.aero/public/standard_page/download.html

¹⁹ see <http://www.aixm.aero/gallery/content/public/AIXM51/AIXM%20Temporality%201.0.pdf>

It shall be noted that the AIXM 5.1 Temporality Concept also enables the explicit encoding of temporary changes using “TEMPDELTA” Time Slices. These are quite similar to PERMDELTA Time Slices, except that they have a validity period instead of a time instant. This supports the encoding of changes of temporary nature currently promulgated by NOTAM (the so-called “Digital NOTAM” concept).

3.5.2.1 Compliance with [REQ-CHG-01] (applying [REQ-CHG-02])

An AIXM 5.1 sample file that contains data about changes in the values of properties of an aeronautical feature (the width of a runway) is provided in Annex C.3. A direct visual inspection of the file shows that the file contains two RunwayTimeSlice elements.

The first RunwayTimeSlice element (having `gml:id="RNWTS2121"`) contains the encoding of the change. It can be seen that only the properties that effectively change values (runway length and strip length) are included in this TimeSlice, together with the date/time when the change occurs (2012-03-01 at 00:00). This indicates that AIXM 5.1 complies with the requirement [REQ-CHG-01].

In application of [REQ-CHG-02] of the AIX Specification, the screenshot below shows the result of parsing the sample file of Annex C.3 using xerces. The schema validation option “-s” is selected, which proves that the validation is done against a valid XML Schema.

```

C:\WINDOWS\system32\cmd.exe

C:\AIXM 5.1 Workspace>java dom.Counter
usage: java dom.Counter <options> uri ...

options:
  -p name      Select parser by name.
  -x number    Select number of repetitions.
  -n ! -N      Turn on/off namespace processing.
  -v ! -U      Turn on/off validation.
  -s ! -S      Turn on/off Schema validation support.
                NOTE: Not supported by all parsers.
  -f ! -F      Turn on/off Schema full checking.
                NOTE: Requires use of -s and not supported by all parsers.
  -hs ! -HS    Turn on/off honouring of all schema locations.
                NOTE: Requires use of -s and not supported by all parsers.
  -va ! -VA    Turn on/off validation of schema annotations.
                NOTE: Requires use of -s and not supported by all parsers.
  -dv ! -DU    Turn on/off dynamic validation.
                NOTE: Not supported by all parsers.
  -xi ! -XI    Turn on/off XInclude processing.
                NOTE: Not supported by all parsers.
  -xb ! -XB    Turn on/off base URI fixup during XInclude processing.
                NOTE: Requires use of -xi and not supported by all parsers.
  -xl ! -XL    Turn on/off language fixup during XInclude processing.
                NOTE: Requires use of -xi and not supported by all parsers.
  -h          This help screen.

defaults:
  Parser:      dom.wrappers.Xerces
  Repetition:  1
  Namespaces:  on
  Validation:  off
  Schema:      off
  Schema full checking:  off
  Honour all schema locations:  off
  Validate annotations:  off
  Dynamic:     off
  XInclude:    off
  XInclude base URI fixup:  on
  XInclude language fixup:  on

C:\AIXM 5.1 Workspace>validate_xerces_2-8-0.bat "Sample 3 - Runway length change.xml"

C:\AIXM 5.1 Workspace>java dom.Counter -v -s -f file:"Sample 3 - Runway length change.xml"
file:Sample 3 - Runway length change.xml: 1625;0;0 ms <33 elems, 40 attrs, 0 spaces, 350 chars>
C:\AIXM 5.1 Workspace>

```

The file is found valid, containing 33 XML elements and 40 XML attributes. This proves that sample is valid against the AIXM 5.1 XML Schema.

3.5.2.2 Compliance with [REQ-CHG-04] (applying [REQ-CHG-05])

The second RunwayTimeSlice element (having `gml:id="RNWTS2120"`) of the AIXM 5.1 sample file contained in Annex C.3 contains the encoding of the Runway data after the change. It can be seen that this TimeSlice is valid after the date/time of the change encoded in the first TimeSlice (2012-03-01 at 00:00) and that it contains values for all properties considered for the sample. The values of the runway length and strip length are equal with the values contained in the PERMDELTA Time Slice included above in the sample. This indicates that AIXM 5.1 complies with the requirement [REQ-CHG-04].

The demonstration that this sample files is valid against the AIXM 5.1 XML Schema was already provided in 3.5.2.1. Therefore, in application of [REQ-CHG-05] of the AIX Specification, it can be stated that AIXM 5.1 complies with the [REQ-CHG-04].

3.6 Structure the format

3.6.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 5:

3.6.1.1 If UML is used for data set

[REQ-STU-01] If UML is used for the data set specification, then the regulated party shall provide evidence that each element of the UML metamodel referred to in [REQ-UML-01] maps to a specific construct in the XML Schema referred to in [REQ-XSD-01].

[REQ-STU-02] The evidence requested in [REQ-STU-01] shall be in the form of a document that describes, as a minimum, how the classes, attributes and association elements of the UML metamodel referred to in [REQ-UML-01] are mapped into elements of the XML Schema referred to in [REQ-XSD-01].

[REQ-STU-03] The document referred to in [REQ-STU-02] should include examples (real or fictitious) that illustrate, for one or more selected classes of the UML model, how these are translated into XML Schema constructs.

3.6.2 Use of AIXM as common data format specification

3.6.2.1 Compliance with [REQ-STU-01] and [REQ-STU-02]

The AIXM 5.1 logical data model consists in a set of UML Class Diagrams and the associated definitions of the classes, attributes, data types, lists of values, associations and roles that are part of the model. The AIXM exchange format is codified as a series of XML schemas. There is a direct link between the AIXM Conceptual Model and the AIXM XML Schema.

The [AIXM UML to XML Schema Mapping](#)²⁰ document, which can be downloaded from the www.aixm.aero, contains a detailed description of how the AIXM UML data set specification is used in order to generate the AIXM XML Schema. In this document:

- Sections 4.5, 4.6 and 4.7 describe how classes from the AIXM 5.1 UML model are mapped into XML Schema data type and element definitions;
- Sections 4.6.1.1 and 4.7.1.2 describe how each attribute of a class from the AIXM 5.1 UML model is mapped into an element of a “Property Group” in the XML Schema;

²⁰ see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

- Section 4.9 describes how each association between classes from the AIXM 5.1 UML model is mapped into an element of a “Property Group” in the XML Schema.

Further details are provided in the same mapping document on particular aspects such as classes with stereotype <<choice>>, associations classes, data types, lists of values, etc. The document also defines the mechanism by which the AIXM Temporality Concept based on Time Slices is applied when generating the AIXM 5.1 XML Schema.

3.6.2.2 Compliance with [REQ-STU-03]

The [AIXM UML to XML Schema Mapping](#)²¹ document contains examples that illustrate, for one subset of classes of the UML model, how these are translated into XML Schema constructs. The mapping of the Runway class is used as an example in section 4.6 to explain the mapping of a class having <<feature>> stereotype and the mapping of its properties and associations. The mapping of the City class is used as an example in section 4.7 to explain the mapping of a class having <<object>> as stereotype and the mapping of its properties and associations.

These examples are realistic, but not always real; the exact list of attributes, associations and data types used as examples might be different from the current content of the AIXM UML model version 5.1.

3.7 Enumerated lists of values and range of values for each attribute

3.7.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 5:

[REQ-XDT-01] The regulated party shall provide evidence that each data type specified in [REQ-DAT-01] maps into a specific XML data type in the XML Schema referred to in [REQ-XSD-01].

[REQ-XDT-02] The regulated party shall provide evidence that each range of values specified in [REQ-DAT-02] maps into a specific XML data type constrain in the XML Schema referred to in [REQ-XSD-01].

[REQ-XDT-03] The regulated party shall provide evidence that each enumerated list of values specified in [REQ-DAT-03] maps into a specific XML data type constrain in the XML Schema referred to in [REQ-XSD-01].

[REQ-XDT-04] The evidence requested in [REQ-XDT-01], [REQ-XDT-02] and [REQ-XDT-03] shall be in the form of a document that describes how the data types, value ranges and enumerated lists of values are mapped into elements of the XML Schema referred to in [REQ-XSD-01].

[REQ-XDT-05] The document referred to in [REQ-XDT-04] should include examples (real or fictitious) that illustrate, for one or more selected attribute data types of the UML model, how these are translated into XML Schema constructs.

3.7.2 Use of AIXM as common data format specification

3.7.2.1 Compliance with [REQ-XDT-01][REQ-XDT-04]

The [AIXM UML to XML Schema Mapping](#)²² document contains a detailed description of how the data types, value ranges and enumerated lists of values are mapped into elements of the XML Schema referred to in [REQ-XSD-01].

3.7.2.2 Compliance with [REQ-XDT-01]

Section 4.11 of the mapping document mentioned in 3.7.2.1 defines the mapping between the

²¹ see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

²² see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

various data types used in the AIXM UML model for attributes of classes. The default situation is described in 4.11.2 of the mapping document:

- In the first step, a simple “BaseType” is created, as restriction of an existing XML Schema simple type (e.g. xsd:date, xsd:string, xsd:decimal, etc.)
- In the second step, a complex type is created, as extension of that simple type, through the addition of a “nil reason” property; this enables the provision of a justification for feature properties that are left empty on purpose in an AIXM 5.1 data file.

Some AIXM data types (vertical distances, lengths, time, speed, etc.) might require a unit of measurement in order to be completely defined. The encoding of this information is provided in the form of a uom attribute, as defined in section 4.11.3 of the mapping document.

3.7.2.3 Compliance with [REQ-XDT-02]

As described in [REQ-DAT-02] and exemplified in Annex A, Section A.2.2.2.1, some AIXM data types are further constrained by a range of values, between a minimum and a maximum value. These are specified in the AIXM 5.1 UML model using directly XSD “facets” minInclusive and maxInclusive. Therefore, they are mapped directly into the XML Schema as xsd:minInclusive and xsd:maxInclusive restrictions of the corresponding simple data type mentioned in 3.7.2.2, as in the following sample:

```
<simpleType name="ValBearingBaseType">  
  <restriction base="decimal">  
    <minInclusive value="000"/>  
    <maxInclusive value="360"/>  
  </restriction>  
</simpleType>
```

3.7.2.4 Compliance with [REQ-XDT-03]

Data types used in the AIXM UML model that are further constrained through the provision of exhaustive lists of allowable values are mapped into an explicit enumeration in the AIXM XML Schema. The mapping details are provided in section 4.11.1 of the mapping document mentioned in 3.7.2.1.

3.7.2.5 Compliance with [REQ-XDT-05]

The mapping document mentioned in 3.7.2.1 includes as an example the mapping of two classes from the AIXM UML model (Runway in section 4.6.1 and City in section 4.7.1). Examples of mapping for some of the data types referred to by the attributes of these two classes appear in section 4.11:

- the “DateType” example is provided in section 4.11.2, for a simple data;
- the “CodeAircraftEngineType” example is provided in section 4.11.1, for a data type that is constrained by an exhaustive list of values.

These examples are realistic, but not always real; the exact list of attributes, associations and data types used as examples might be slightly different from the current content of the AIXM UML model version 5.1.

3.8 Comply with the geography mark-up language (GML)

3.8.1 Requirements of the EUROCONTROL AIX Specification

In order to comply with Article 5 of the ADQ IR [1] and with the consequent requirement stated in Article 5(2) – Annex II, Part A.1 - Paragraph 4:

[REQ-GML-01] The regulated party shall provide evidence that the XML Schema referred to in [REQ-XSD-01] complies with the Conformance rules stated in Chapter 2 “Conformance” of the ISO 19136:2007 — Geographic information — Geography Mark-up Language (GML) International Standard, Edition 1 — 23.8.2007.

3.8.2 Use of AIXM as common data format specification

3.8.2.1 Compliance with [REQ-GML-01]

Chapter 2 “Conformance” of the ISO 19136:2007 — Geographic information — Geography Mark-up Language (GML) International Standard, Edition 1 — 23.8.2007 contains a list of abstract test suites that need to be passed in order to claim compliance with the GML specification for an application schema, such as AIXM 5.1. These are detailed in Annex 1 (normative) of the GML Standard, which contains in A.1.1 “Test cases for mandatory conformance requirements”.

Note that section “A.1.2 Test cases for GML application schemas converted from an ISO 19109 Application Schema in UML” is not applicable to AIXM, as the AIXM UML model does not claim compliance with the ISO 19109 Standard. A future AIXM version might become fully ISO 19109 compliant as well.

3.8.2.1.1 Compliance with “A.1.1.1 Use of XML namespaces”

The standard requires declaring a target Namespace. This shall not be the GML namespace (<http://www.opengis.net/gml/3.2>). A target namespace is declared in an application schema using the targetNamespace attribute of the schema element from XML Schema.

The [AIXM Features.xsd](#) schema does define his proper target namespace: `targetNamespace="http://www.aixm.aero/schema/5.1`.

The rule is satisfied.

3.8.2.1.2 Compliance with “A.1.1.2 General rules”

The standard requires to inspect the schema and to check that it satisfies the general rules described in 21.2.1 of the GML Standard, which describes a number of permissions (“an application schema may...”) for the use of the GML schemas. With reference to these usage permissions:

- the [AIXM Features.xsd](#) schema does reference directly concrete GML elements, such as `gml:Point` and GML attributes such as `gml:id`;
- the [AIXM AbstractGML ObjectTypes.xsd](#) schema, which is included in the [AIXM Features.xsd](#) schema file, does declare a new attribute `nilReason` in the `aixm` namespace using a GML type `gml:nilReasonEnumeration`, in order to have it available for all AIXM feature properties;
- the [AIXM Features.xsd](#) schema does derive new types such as `aixm:Point`, `aixm:Curve` and `aixm:Surface`, which extend the GML types `gml:Point`, `gml:Curve` and `gml:Surface` respectively, in order to include additional, domain specific properties, such as `horizontalAccuracy` (as defined in ICAO Annex 15 for the aeronautical information domain);
- the [AIXM AbstractGML ObjectTypes.xsd](#) schema, which is included in the [AIXM Features.xsd](#) schema file, does derive a new `AbstractAIXMFeatureBaseType` type in the `aixm` namespace by restriction of the `gml:DynamicFeatureType`, in order to restrict the list of properties of an AIXM dynamic feature;
- Etc.

The rule is satisfied.

3.8.2.1.3 Compliance with “A.1.1.3 Import of GML schema components”

An application schema shall import, directly or indirectly, the full GML 3.2 schema.

The [AIXM_Features.xsd](#) schema does import the GML namespace:

```
<import namespace="http://www.opengis.net/gml/3.2"
schemaLocation="./ISO_19136_Schemas/gml.xsd" />
```

Rule satisfied.

3.8.2.1.4 Compliance with “A.1.1.4 Valid XML Schema”

An application schema shall be a valid XML Schema. This can be tested by using an appropriate software tool for validation or be a manual process that checks all relevant definitions from the XML Schema specification.

In section 3.3.2.1, this was demonstrated by using the xerces schema validating parser.

Rule satisfied.

3.8.2.1.5 Compliance with “A.1.1.5 Support for the GML model and syntax”

An application schema shall follow the rules for the encoding of objects and properties, also known as “the object/property” model. The AIXM XML Schema generation rules contained in the [AIXM UML to XML Schema Mapping](#)²³ document ensure the compliance with this requirement. Every property of an AIXM object is defined of a simple or complex type.

For example, the inclusion of the aixm:Note object in the list of properties of an AIXM feature is done through an intermediate aixm:NotePropertyType:

```
<element name="annotation" type="aixm:NotePropertyType" nillable="true"
minOccurs="0" maxOccurs="unbounded" />
```

The same mechanism is applied everywhere in the AIXM Schema.

Rule satisfied.

3.8.2.1.6 Compliance with “A.1.1.6 Substitution group of object elements, type derivation”

In an application schema, all object elements with identity need to be (directly or indirectly) in the substitution group of gml:AbstractGML.

All AIXM Features (aixm:AirportHeliport, aixm:Runway, aixm:Navaid, etc.), which can appear as roots in an AIXM document, are in the substitution group of aixm:AbstractAIXMFeature, which is in the substitution group of gml:AbstractFeature, which is in the substitution group of gml:AbstractGML.

Rule satisfied.

3.8.2.1.7 Compliance with “A.1.1.7 Property elements are not object elements”

In an application schema, every child element of every object element shall be neither directly nor indirectly in the substitution group of gml:AbstractObject. This rule re-enforces the object/property model mentioned in 3.8.2.1.5.

The AIXM XML Schema generation rules contained in the [AIXM UML to XML Schema Mapping](#)²⁴ document ensure the compliance with this requirement. No child element of an object is in the substitution group of gml:AbstractObject.

Rule satisfied.

²³ see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

²⁴ see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

3.8.2.1.8 Compliance with “A.1.1.8 Content model of property elements”

In an application schema all property elements must have a valid content model.

The AIXM XML Schema generation rules contained in the [AIXM UML to XML Schema Mapping](#)²⁵ document ensure the compliance with this requirement. Every property has a declared simple or complex type.

Rule satisfied.

3.8.2.1.9 Compliance with “A.1.1.9 Metadata and data quality properties”

In an application schema, the content model of all metadata valued property elements needs to be derived by extension from `gml:AbstractMetadataPropertyType`.

AIXM is not defining any additional metadata elements. The schema is using directly the already existing ISO 19139 metadata elements that are embedded in the GML schema. The [Guidance on the Aviation Metadata Profile](#) [6] indicates which metadata elements are considered necessary in relation with an AIXM 5.1 data set.

Rule satisfied.

3.8.2.1.10 Compliance with rule “A.1.1.10 Spatial geometry properties”

Application-specific names shall be chosen for geometry properties in GML application schemas. The names of the properties should be chosen to express the semantics of the value. The property value of a geometry property shall be a geometry object substitutable for `gml:AbstractGeometry`.

AIXM uses names that are meaningful within the aviation domain for object properties that have geometrical meaning, such as: *location*, *horizontalProjection*, *extent*, etc. The only geometrical object types used in AIXM are:

- `aixm:Point`, `aixm:ElevatedPoint`, which are derived by extension from `gml:Point`, which is in the substitution group for `gml:AbstractGeometry`;
- `aixm:Curve`, `aixm:ElevatedCurve`, which are derived by extension from `gml:Curve`, which is in the substitution group for `gml:AbstractGeometry`;
- `aixm:Surface`, `aixm:ElevatedSurface`, which are derived by extension from `gml:Surface`, which is in the substitution group for `gml:AbstractGeometry`;

Rule satisfied.

3.8.2.1.11 Compliance with “A.1.1.11 Spatial topology properties”

The AIXM application schema does not have any properties with a topological object or a collection of such objects.

Rule satisfied.

3.8.2.1.12 Compliance with “A.1.1.12 Temporal properties”

Like for geometry and topology properties, the definition of temporal property elements is in the responsibility of the application schema designer.

AIXM uses names that are meaningful in the aviation domain for object properties that have a temporal meaning, such as *featureLifetime*, *validTime*, etc. They occur, for example, within in the `aixm:timeSlice` property, which has as content an object that is in the substitution group of `gml:AbstractTimeSlice` type.

Rule satisfied.

²⁵ see http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

3.8.2.1.13 Compliance with “A.1.1.13 Location properties”

The AIXM application schema does not have any properties with a location reference or location description.

Rule satisfied.

3.8.2.1.14 Compliance with “A.1.1.14 GML object collections”

In an application schema, all objects that are collections of GML objects shall have one or more property elements with a content model that extend gml:AbstractMemberType.

The AIXM application schema does not define objects as collections of GML objects. The aixm:AbstractAIXMMessageType defined in the [AIXM_AbstractGML_ObjectTypes.xsd](#) schema could eventually be considered as a GML object collection, although its purpose is to provide a basic structure for an AIXM file that contains more than one feature. In a future AIXM version, this might be considered to become a true GML object collection.

Rule partially satisfied. The AIXM Schema can be used directly at feature level, without using the AbstractAIXMMessageType.

3.8.2.1.15 Compliance with “A.1.1.15 Substitution group of feature elements”

In an application schema, all object elements representing features need to be (directly or indirectly) in the substitution group of gml:AbstractFeature.

In AIXM, all features are in the substitution group of aixm:AbstractAIXMFeature, which is in the substitution group of gml:AbstractFeature.

Rule satisfied.

3.8.2.1.16 Compliance with “A.1.1.16 GML feature collections”

In an application schema, all features that are collections of GML Features shall have one or more property elements with a content model that extend gml:AbstractFeatureMemberType.

The AIXM application schema does not define features as collections of GML Features. The aixm:AbstractAIXMMessageType defined in the AIXM_AbstractGML_ObjectTypes.xsd schema could eventually be considered as a GML feature collection, although its purpose is to provide a basic structure for an AIXM file that contains more than one feature. In a future AIXM version, this might be considered to become a true GML feature collection.

Rule partially satisfied. The AIXM Schema can be used directly at feature level, without using the AbstractAIXMMessageType.

4. LIST OF REFERENCES

- [1] Single European Sky (SES) interoperability implementing rule on the quality of aeronautical data and information, COMMISSION REGULATION (EU) NO 73/2010
- [2] Internal guidelines for the development of EUROCONTROL specifications and EUROCONTROL guidelines. Edition 1.0 dated 16 October 2007. Ref. ECTL_SPEC_GUID_1.0 191007
- [3] EUROCONTROL Specification for Aeronautical Information Exchange. Proposed Issue 0.23 dated 06 MAR 2012. Ref ...
- [4] AIP to AIXM 5.1 Mapping Guidelines, version 1.0, dated 20 JAN 2012. Ref. ECTL_GUID_...
- [5] Requirements for Aviation Metadata, OGC 10-195, Discussion Paper, edition 28 March 2011, http://portal.opengeospatial.org/files/?artifact_id=41667.
- [6] Guidance on the Aviation Metadata Profile, OGC 10-196r1, Discussion Paper, edition 28 March 2011, http://portal.opengeospatial.org/files/?artifact_id=41668

ANNEX A – AIXM UML Model Documentation

A.1 Introduction

The content of this Annex is based on the “AIXM - UML to XML Schema Mapping” document version 1.1, which is available²⁶ on the www.aixm.aero Web site. That document was originally created for the needs of the AIXM development team, in order to document the UML metamodel elements used in AIXM and how they are later converted into XML Schema elements. The text was further adapted in order to satisfy the precise requirements stated in the AIX Specification, section 2.3.2.2.1.

A.2 AIXM UML Model Conventions

The AIXM 5.1 logical data model consists in a set of UML Class Diagrams and the associated definitions of the classes, attributes, data types, lists of values, associations and roles that are part of the model. AIXM 5.1 was created using IBM Rational Rose Data Modeler (version 7), a commonly used UML modeling tool.

This section describes the UML metamodel elements actually used in the definition of the AIXM 5.1 UML model.

A.2.1 Diagram types

Two types of diagrams are used in the model:

- Classes diagram [section 10.2 of the OMG UML Specification version 2.1.1] – Used to represent the features, properties, relationships and inheritance between features;
- Package diagrams [section 10.4 of the OMG UML Specification version 2.1.1] – Used to split the model into modules and identify dependencies among sets of classes.

A.2.2 Classes

Classes are defined in section 10.2.1 of the OMG UML Specification version 2.1.1 and are the key constituents of the AIXM UML model. They group together and define the characteristics of tangible or abstract components in the aeronautical operations domain and its environment.

Classes have attributes and associations and participate in inheritance hierarchies. Multiple inheritance is not allowed in AIXM.

When a class is abstract it cannot have any direct instances. Any direct instance of a concrete (i.e., non-abstract) class is also an indirect instance of its class's superclasses.

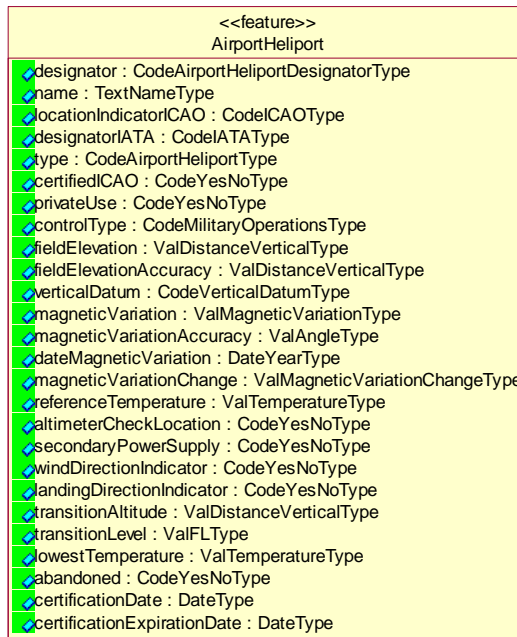
A.2.2.1 Stereotypes

The classes are distinguished by their stereotypes. Stereotypes are used to further define and extend standard UML concepts. The stereotypes used in AIXM are <<feature>>, <<object>>, <<choice>>, <<datatype>> and <<odelist>>.

²⁶ http://www.aixm.aero/gallery/content/public/AIXM51/AIXM_UML_to_AIXM_XSD_Mapping-1.1.pdf

A.2.2.1.1 <<Feature>>

Features describe real world entities and are fundamental in AIXM. AIXM features can be concrete and tangible, or abstract and conceptual and can change in time. Features are represented as classes with a stereotype <<feature>>. Examples include Runway, AirportHeliport, Navaid, etc.

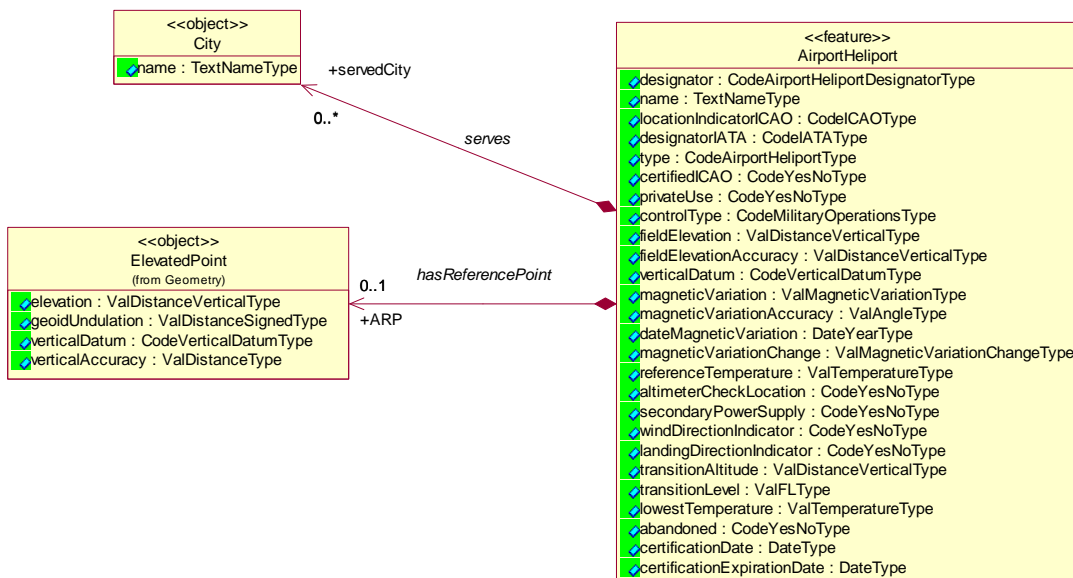


A.2.2.1.2 <<Object>>

Objects are abstractions of real world entities or, more frequently, of properties of these entities, which do not exist outside of a feature. An object is created for two reasons in AIXM:

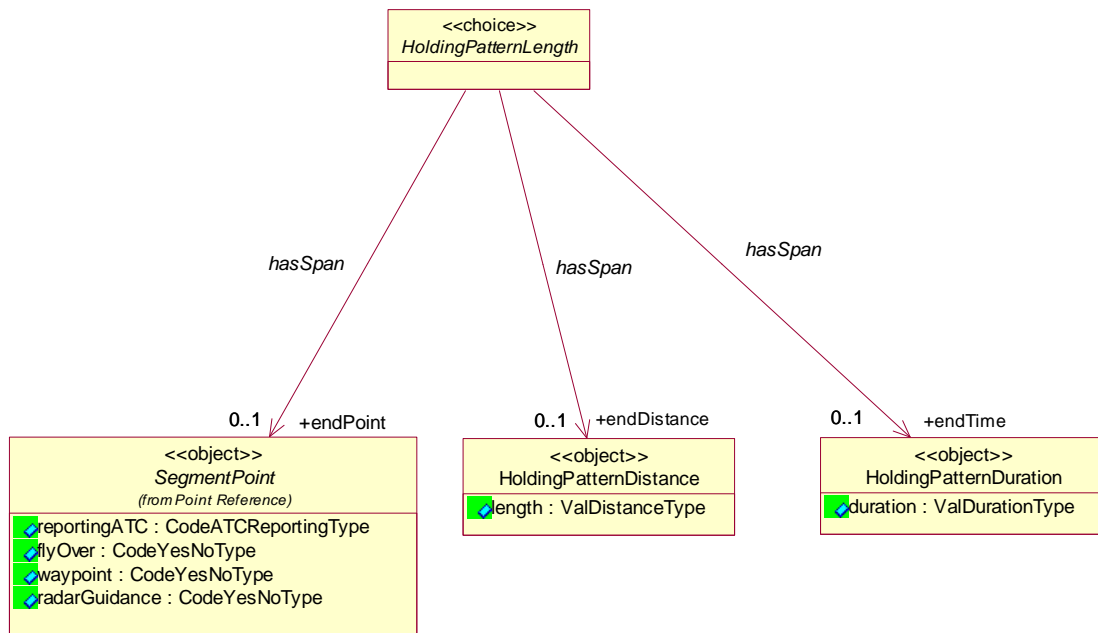
- When a property has a multiplicity greater than one (such as the city served by an AirportHeliport), or
- The object has its own attributes that are reused throughout the model, such as ElevatedPoint.

In both cases, the property is represented as an object with the proper UML composition relationship as shown below.



A.2.2.1.3 <<Choice>>

Some classes are marked as <<choice>>. These are used to model XOR (one of a set of multiple choices) relationships. For example, the length of a Holding Pattern can be expressed using a HoldingPatternDistance, a HoldingPatternDuration or a SegmentPoint defining the end of the outbound leg. This choice is indicated by the <<choice>> stereotype of the HoldingPatternLength abstract class.



A.2.2.2 Attributes

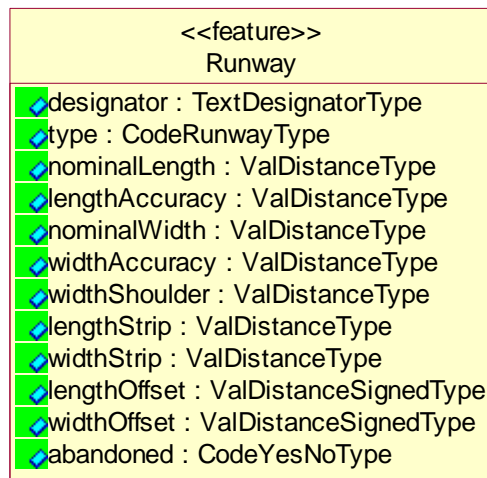
Attributes are used to characterise a class of features or objects. An attribute has the following format:

Visibility / stereotype name : type multiplicity

For AIXM 5.1 the following values are used:

- Visibility – Public
- / – not used
- Stereotype – not used
- Name – name of the property
- Type – property type
- Multiplicity – not specified in AIXM for reasons related to the AIXM Temporality model, an implementation should assume that all properties are optional, [0..1]

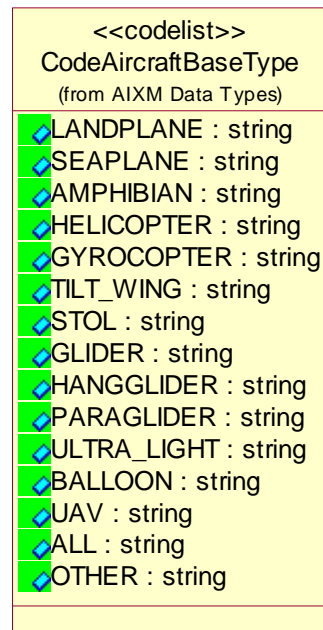
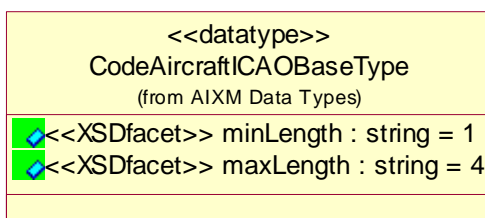
To illustrate, the Runway feature has several simple properties e.g. designator and type. These properties are assigned a datatype; for example, the designator attribute is of type TextDesignatorType.



A.2.2.2.1 DataTypes

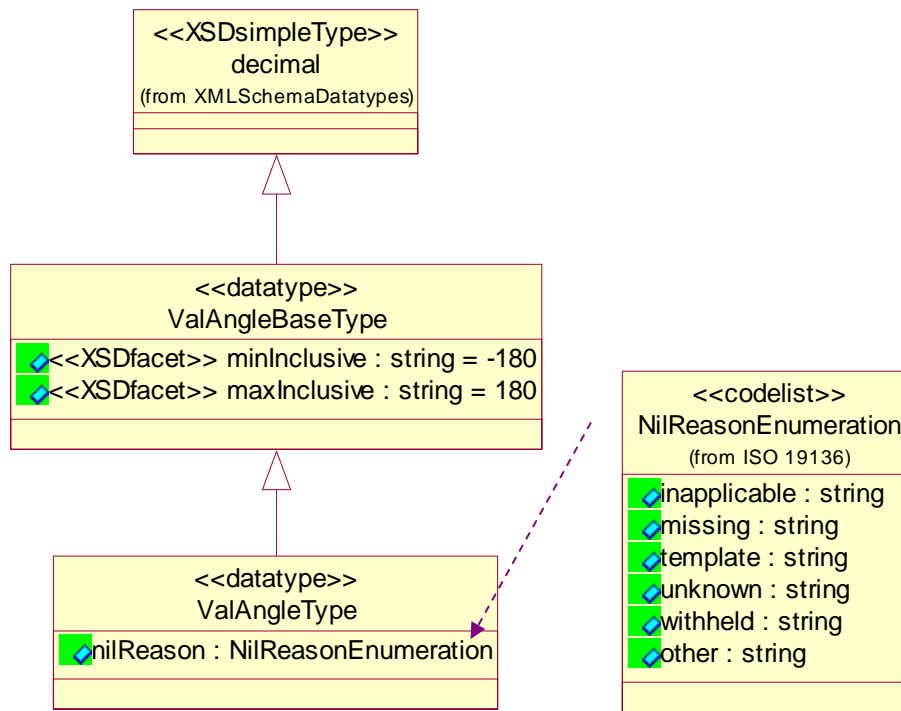
DataTypes are defined in section 10.3.1 of the OMG UML Specification version 2.1.1. In AIXM, they are given one of the two following stereotypes:

- <<datatype>> - This is basic data type that specifies a pattern to use.
- <<codelist>> - This is a data type which codes a predefined list of values. The <<codelist>> includes the value OTHER which can be expanded with some free text in uppercase (“OTHER:MY_VALUE”). This is an extension mechanism that enables the encoding of values that were not foreseen by the AIXM designers.

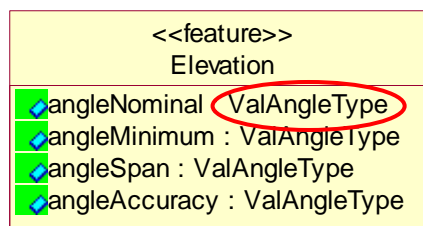


All the data types used to type AIXM simple properties define a nilReason, which is used to indicate the reason for a null value. This is realized in AIXM 5.1 by introducing

- A base type, which contains the core “business” information, such as a range of value for <<datatype>>, or the list of string values for <<odelist>>
- A derived data type, which explicitly declares the nilReason attribute, and which is used to type the corresponding AIXM simple properties.

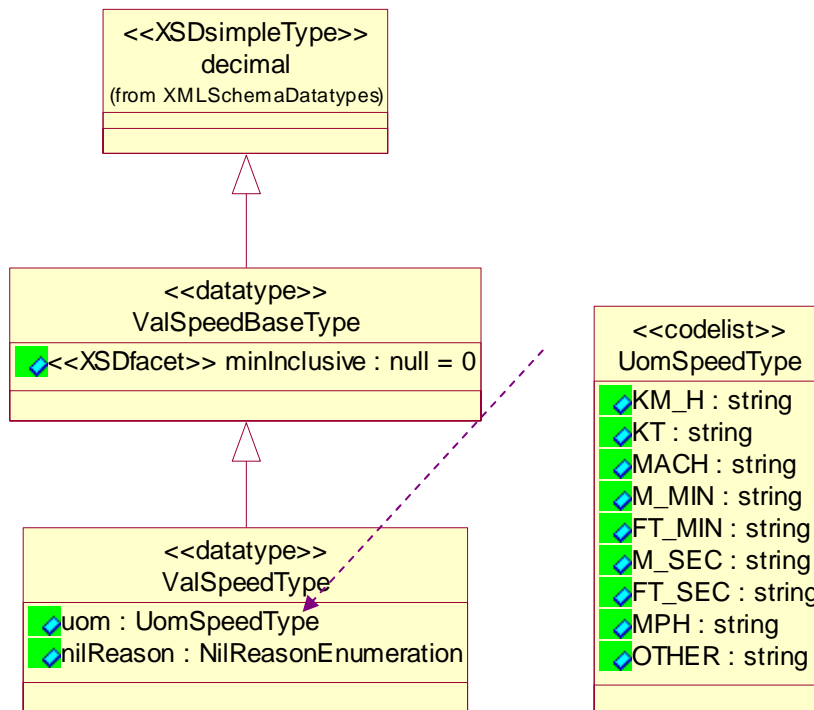


On the example above, the base type used to represent an angle is named **ValAngleBaseType**. It derives from decimal and defines the range of values allowed for an angle ([-180;180]). The derived datatype **ValAngleType** inherits from ValAngleBaseType and includes the nilReason, typed with NilReasonEnumeration. ValAngleType is always used to type the percentages specified in AIXM features or AIXM objects.



A limited set of data types defined in the AIXM 5.1 UML model are not used to type directly AIXM simple properties but are basic classes from which several AIXM data types inherit. These data types are: AlphaType, AlphaNumericType, Character1, Character2, Character3. They do not require a nilReason attribute, and consequently, no corresponding BaseType types are defined in the AIXM UML model.

In addition, certain `<<datatype>>` might have an associated Unit Of Measurement. This is indicated in the model by the inclusion of a “uom” attribute at the same level as the `nilReason` attribute, i.e in the definition of the derived `<<datatype>>` class. The type of the `uom` attribute is typically a `<<codelist>>` class, as shown below:



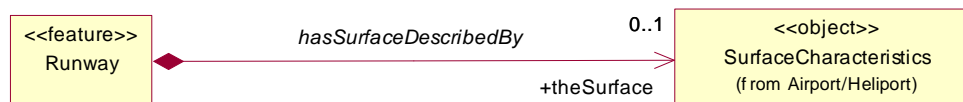
Note that the `<<codelist>>` types representing Units of Measurement do not require a `nilReason`. As a consequence, no base type is created for `uom`.

A.2.3 Associations

Associations are defined in section 11.3.1 of the OMG UML Specification version 2.1.1. Association in AIXM are used to define a relationship that exists between a class and another class.

A.2.3.1 Associations with `<<object>>` classes

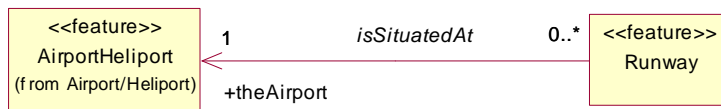
Relationships to objects are depicted by the standard UML composition (*aggregation by value*) association. Composition is a form of aggregation with strong ownership and coincident lifetime of the parts by the whole. The part is removed when the whole is removed.



The example above shows that the `<<feature>> Runway` has a property named `theSurface`. This property is modelled in UML using a composition association between the `<<feature>> Runway` and an object representing the characteristics of a geometric surface.

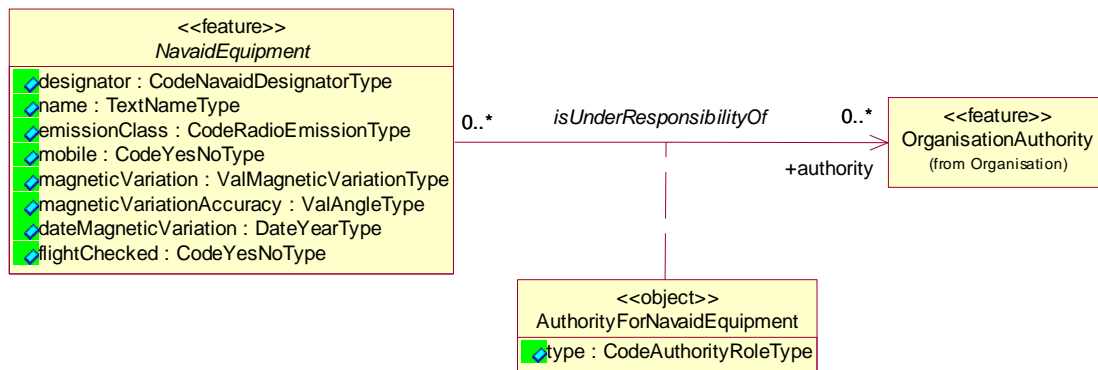
A.2.3.2 Associations with <<feature>> classes

Relationships to features are described with a standard UML association. All of the associations are navigable in only one direction. This shows that the two classes are related but only one class knows that the relationship exists. In the example below the Runway feature knows about the AirportHeliport but the AirportHeliport does not know about the Runway.



A.2.3.3 Association Classes

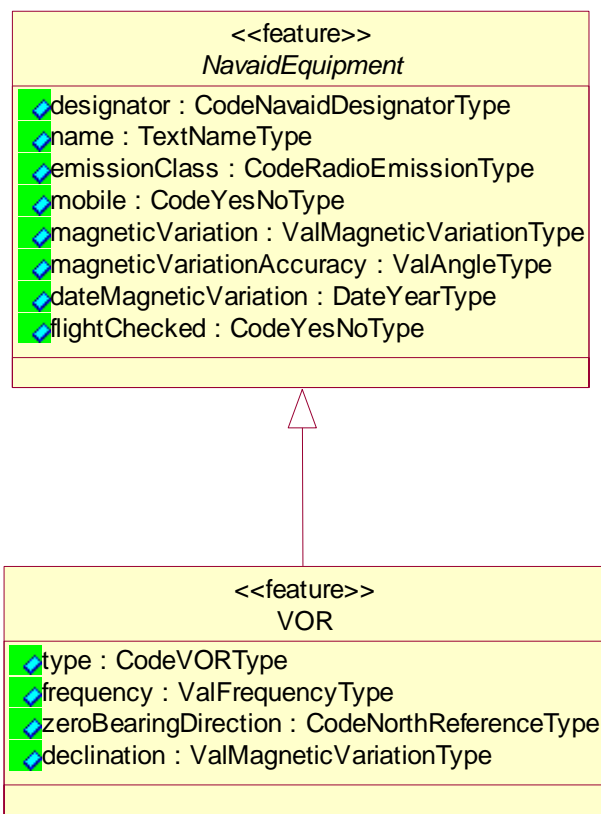
When information about a relationship is required, a UML “association class” is used. The association class is attached to the relationship with a dotted line.



A.2.4 Inheritance

Inheritance refers to the ability of one class (the specialized or child class) to inherit the properties of another class (the generalized or parent class), and then add new properties of its own. In AIXM, classes with stereotype <<feature>> must only inherit from other classes with the same <<feature>> stereotype. Similarly, classes with stereotype <<object>> must only inherit from other classes with stereotype <<object>>. **Multiple inheritance is not allowed in AIXM 5.1.**

In the example below the VOR is a kind of NavaidEquipment. This is modelled as an inheritance relationship from the abstract NavaidEquipment class to the VOR class.



A.2.5 Naming conventions

Feature, Object and Choice names are written in UpperCamelCase e.g. NavaidEquipment.

Simple property names (i.e. attributes) are written in lowerCamelCase e.g. widthShoulder. Relationship names are written in lowerCamelCase but as present tense verbs e.g. isSituatingAt. Relationship Role names are also written in lowerCamelCase and they are nouns that express the role played by the class in the association.

Datatype names are written in UpperCamelCase and end with 'Type' e.g. CodeAircraftType.

A.2.6 Acronym and abbreviations used in AIXM5.1 names of classes, attributes and associations

HAT	High Altitude Transition
Absorb	Absorption/Absorber
ARINC	Aeronautical Radio, Incorporated
ARP	Airport
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
AUW	All-Up Weight

Baro	barometric
Col	Column
Vnav	Vertical NAVigation
CRC	Cyclic Redundancy Check / Computer ressource center?
DME	Distance Measuring Equipment
FACF	Final Approach Course Fix
FAS	Final Approach Segment
FL	Flight Level
Geo	Geographical
GNSS	Global Navigation Satellite Systems
Hex	Hexadecimal
IAF	initial approach fix
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
INOP	inoperable
INS	Inertial Navigation System
	Joint Airworthiness Requirements or Joint Aviation
JAR	Requirements/ Regulations/ Rules
LCN	Load Classification Number
MAPT	Missed Approach Point
Meteo	Meteorological
MLS	Microwave Landing System
Navaid	Navigation/al Aid
NDB	Non-Directional (radio) Beacon
PAR	Prevision Approach Radar
PCN	Pavement Classification Number
RDH	Reference Datum Height
RNAV	Area/RADAR Navigation
RNP	Required navigation performance
RVR	Runway Visual range
RVSM	Reduced Vertical Separation Minima
SAR	Search And Rescue centre
SBAS	Satellite-based augmentation system
SDF	Simplified Directional Facility
SID	Standard Instrument Departure
SIWL	Single Isolated Wheel Load
STAR	Standard Terminal Arrival
TAA	Terminal Arrival Area

TACAN	TACtical Air Navigation
TDZ	Touch Down Zone
TLOF	Touchdown Lift-Off Surface
Uom	Unit of measurement
Val	Value
VASIS	Visual Approach Slope Indicator
VFR	Visual Flight Rule
VOR	VHF Omnidirectional Range
WAAS	Wide Area Augmentation System
XHTML	eXtensible HyperText Markup Language
seq	sequence

ANNEX B – AIXM v5.1 Mapping with AIP and with ED99 requirements

B.1 Introduction

This Annex contains a short summary of the mapping status for the different AIP sections, based on the content of the “EUROCONTROL Guidelines for AIP to AIXM 5.1 Mapping”, **draft version 0.9.1, dated 20 Jan 2012.**

The goal of the AIXM – AIP mapping project is to define mappings between information formats. On the one hand, there are the "traditional" publication formats for aeronautical information: the AIP together with supplements and circulars, and NOTAM and SNOWTAM formats. As a print publication, with a verbally defined format, AIPs as issued by states often contain more or less informal additional material whose content and structure may therefore fall outside the scope of the verbal descriptions and example documents. NOTAM and SNOWTAM formats are much more completely defined.

On the other hand, AIXM represents a fully specified model for aeronautical information, which in its later versions appears capable of representing almost completely the information conveyed by the traditional formats mentioned above. A mapping between the contents of these formats will ultimately support greater automation in the fields of AIP and NOTAM production, publishing and interchange, as well as facilitating the dissemination of content previously held in AIP or NOTAM formats in the more flexible AIXM format.

The mapping document includes those parts of the real world AIP that have been identified as ‘extra information’, published by many European States in their national AIPs. However, these are not considered in the scope of the summary provided in this Annex, which is limited to the ICAO AIP standard structure and content.

The overall conclusion is that a comprehensive mapping from AIP content to AIXM 5.1 is feasible. With remarkably few exceptions, AIXM 5.1 provides appropriate, dedicated means for the expression of AIP content. Where AIXM 5.1 does not explicitly provide support for representation of a specific kind of information, the extensibility mechanisms built into the standard model still allow that information to be represented in an appropriate way.

B.2 AIXM – AIP Mapping - Compliance assessment summary

B.2.1 GEN

AIP	Status	Mapping with AIXM v5.1
PART 1 — GENERAL (GEN)		All mappings are in the sub-sections
GEN 0.1 Preface		All items mapped
GEN 0.2 Record of AIP Amendments		All items mapped
GEN 0.3 Record of AIP Supplements		All items mapped
GEN 0.4 Checklist of AIP pages		Not applicable. AIP document editorial element.
GEN 0.5 List of hand amendments to the AIP		All items mapped
GEN 0.6 Table of contents to Part 1		Not applicable. AIP document editorial element.
GEN 1. NATIONAL REGULATIONS AND REQUIREMENTS		All mappings are in the sub-sections
GEN 1.1 Designated authorities		All items mapped
GEN 1.2 Entry, transit and departure of aircraft		All items mapped
GEN 1.3 Entry, transit and departure of passengers and crew		All items mapped
GEN 1.4 Entry, transit and departure of cargo		All items mapped
GEN 1.5 Aircraft instruments, equipment and flight documents		All items mapped
GEN 1.6 Summary of national regulations and international agreements/conventions		All items mapped
GEN 1.7 Differences from ICAO Standards, Recommended Practices and Procedures		All items mapped
GEN 2. TABLES AND CODES		All mappings are in the sub-sections
GEN 2.1 Measuring system, aircraft markings, holidays		All items mapped
GEN 2.1.1 Units of measurement		All items mapped
GEN 2.1.2 Temporal reference system		All items mapped
GEN 2.1.3 Horizontal reference system		All items mapped
GEN 2.1.4 Vertical reference system		All items mapped
GEN 2.1.5 Aircraft nationality and registration marks		All items mapped
GEN 2.1.6 Public holidays		All items mapped
GEN 2.2 Abbreviations used in AIS publications		All items mapped
GEN 2.3 Chart symbols		All items mapped
GEN 2.4 Location indicators		Indirect mapping. This section recapitulates data from elsewhere in AIP.
GEN 2.5 List of radio navigation aids		Indirect mapping. This section recapitulates data from elsewhere in AIP.
GEN 2.6 Conversion tables		The contents of this section are largely canonical and available from other authoritative sources. If it is necessary to map other content, e.g. under point 4), this may be done in the manner of GEN 2.1.1.
GEN 2.7 Sunrise/sunset tables		All items mapped
GEN 3. SERVICES		All items mapped
GEN 3.1 Aeronautical information services		All items mapped
GEN 3.1.1 Responsible service		All items mapped

GEN 3.1.2	Area of responsibility		All items mapped
GEN 3.1.3	Aeronautical publications		All items mapped
GEN 3.1.4	AIRAC system		All items mapped
GEN 3.1.5	Pre-flight information service at aerodromes/heliports		All items mapped
GEN 3.1.6	Electronic terrain and obstacle data		All items mapped
GEN 3.2	Aeronautical charts		All items mapped
GEN 3.2.1	Responsible service(s)		All items mapped
GEN 3.2.2	Maintenance of charts		All items mapped
GEN 3.2.3	Purchase arrangements		All items mapped
GEN 3.2.4	Aeronautical chart series available		All items mapped
GEN 3.2.5	List of aeronautical charts available		All items mapped
GEN 3.2.6	Index to the World Aeronautical Chart (WAC) — ICAO 1:1 000 000		All items mapped
GEN 3.2.7	Topographical charts		All items mapped
GEN 3.2.8	Corrections to charts not contained in the AIP		All items mapped
GEN 3.3	Air traffic services		All items mapped
GEN 3.3.1	Responsible service		All items mapped
GEN 3.3.2	Area of responsibility		All items mapped
GEN 3.3.3	Types of services		All items mapped
GEN 3.3.4	Coordination between the operator and ATS General		All items mapped
GEN 3.3.5	Minimum flight altitude		All items mapped
GEN 3.3.6	ATS units address list		All items mapped
GEN 3.4	Communication services		All items mapped
GEN 3.4.1	Responsible service		All items mapped
GEN 3.4.2	Area of responsibility		All items mapped
GEN 3.4.3	Types of service		All items mapped
GEN 3.4.4	Requirements and conditions		All items mapped
GEN 3.5	Meteorological services		All items mapped
GEN 3.5.1	Responsible service		All items mapped
GEN 3.5.2	Area of responsibility		All items mapped
GEN 3.5.3	Meteorological observations and reports		All items mapped
GEN 3.5.4	Types of services		All items mapped
GEN 3.5.5	Notification required from operators		All items mapped
GEN 3.5.6	Aircraft reports		All items mapped
GEN 3.5.7	VOLMET service		All items mapped
GEN 3.5.8	SIGMET and AIRMET service		All items mapped
GEN 3.5.9	Other automated meteorological services		All items mapped
GEN 3.6	Search and rescue		All items mapped
GEN 3.6.1	Responsible service(s)		All items mapped
GEN 3.6.2	Area of responsibility		All items mapped
GEN 3.6.3	Types of service		All items mapped
GEN 3.6.4	SAR agreements		All items mapped
GEN 3.6.5	Conditions of availability		All items mapped

GEN 3.6.6 Procedures and signals used		All items mapped
GEN 4. CHARGES FOR AERODROMES/HELIPORTS AND AIR NAVIGATION SERVICES		All mappings are in the sub-sections
GEN 4.1 Aerodrome/heliport charges		All items mapped
GEN 4.2 Air navigation services charges		All items mapped

B.2.2 ENR

AIP	Status	Mapping with AIXM v5.1
PART 2 — EN-ROUTE (ENR)		All mappings are in the sub-sections
ENR 0.		All mappings are in the sub-sections
ENR 0.6 Table of contents to Part 2		Not applicable. AIP document editorial element.
ENR 1. GENERAL RULES AND PROCEDURES		All items mapped
ENR 1.1 General rules		All items mapped
ENR 1.2 Visual flight rules		All items mapped
ENR 1.3 Instrument flight rules		All items mapped
ENR 1.4 ATS airspace classification		All items mapped
ENR 1.5 Holding, approach and departure procedures		All items mapped
ENR 1.5.1 General		All items mapped
ENR 1.5.2 Arriving flights		All items mapped
ENR 1.5.3 Departing flights		All items mapped
ENR 1.6 ATS surveillance services and procedures		All items mapped
ENR 1.6.1 Primary radar		All items mapped
ENR 1.6.2 Secondary surveillance radar (SSR)		All items mapped
ENR 1.6.3 Automatic dependent surveillance — broadcast (ADS-B)		All items mapped
ENR 1.7 Altimeter setting procedures		All items mapped
ENR 1.8 Regional supplementary procedures		All items mapped
ENR 1.9 Air traffic flow management		All items mapped
ENR 1.10 Flight planning		All items mapped
ENR 1.11 Addressing of flight plan messages		All items mapped
ENR 1.12 Interception of civil aircraft		All items mapped
ENR 1.13 Unlawful interference		All items mapped
ENR 1.14 Air traffic incidents		All items mapped
ENR 2. AIR TRAFFIC SERVICES AIRSPACE		All mappings are in the sub-sections
ENR 2.1 FIR, UIR, TMA		All items mapped
ENR 2.2 Other regulated airspace		All items mapped
ENR 3. ATS ROUTES		All mappings are in the sub-sections
ENR 3.1 Lower ATS routes		As these mappings are exactly as per (AIP-TS-ENR-3.1) they are not duplicated.
ENR 3.2 Upper ATS routes		As these mappings are exactly as per (AIP-TS-ENR-3.1) they are not duplicated.
ENR 3.3 Area navigation routes		As these mappings are exactly as per (AIP-TS-ENR-3.1) they are not duplicated.
ENR 3.4 Helicopter routes		As these mappings are exactly as per (AIP-

		TS-ENR-3.1) they are not duplicated.
ENR 3.5	Other routes	All items mapped
ENR 3.6	En-route holding	All items mapped
ENR 4.	RADIO NAVIGATION AIDS/SYSTEMS	All mappings are in the sub-sections
ENR 4.1	Radio navigation aids — en-route	All items mapped
ENR 4.2	Special navigation systems	All items mapped
ENR 4.3	Global navigation satellite system (GNSS)	All items mapped
ENR 4.4	Name-code designators for significant points	All items mapped
ENR 4.5	Aeronautical ground lights — en-route	All items mapped
ENR 5.	NAVIGATION WARNINGS	All mappings are in the sub-sections
ENR 5.1	Prohibited, restricted and danger areas	All items mapped
ENR 5.2	Military exercise and training areas and air defence identification zone (ADIZ)	All items mapped
ENR 5.3	Other activities of a dangerous nature and other potential hazards	All items mapped
	ENR 5.3.1 Other activities of a dangerous nature	All items mapped
	ENR 5.3.2 Other potential hazards	All items mapped
ENR 5.4	Air navigation obstacles	All items mapped
ENR 5.5	Aerial sporting and recreational activities	All items mapped
ENR 5.6	Bird migration and areas with sensitive fauna	All items mapped
ENR 6.	EN-ROUTE CHARTS	Limited mapping details are provided for charts contained in the AIP.

B.2.3 AD

AIP	Status	Mapping with AIXM v5.1
PART 3 — AERODROMES (AD)		Not applicable. This text refers to AIP production.
AD 0.		All mappings are in the sub-sections
AD 0.6 Table of contents to Part 3		Not applicable. AIP document editorial element.
AD 1. AERODROMES/HELIPORTS — INTRODUCTION		All mappings are in the sub-sections
AD 1.1 Aerodrome/heliport availability		All items mapped
AD 1.2 Rescue and firefighting services and snow plan		All items mapped
	AD 1.2.1 Rescue and firefighting services	All items mapped
	AD 1.2.2 Snow plan	All items mapped
AD 1.3 Index to aerodromes and heliports		All items mapped
AD 1.4 Grouping of aerodromes/heliports		All items mapped
AD 1.5 Status of certification of aerodromes		All items mapped
AD 2. AERODROMES		All mappings are in the sub-sections
AD 2.1 Aerodrome location indicator and name		All items mapped
AD 2.2 Aerodrome geographical and administrative data		All items mapped
AD 2.3 Operational hours		All items mapped
AD 2.4 Handling services and facilities		All items mapped

AD 2.5 Passenger facilities		All items mapped
AD 2.6 Rescue and firefighting services		All items mapped
AD 2.7 Seasonal availability — clearing		All items mapped
AD 2.8 Aprons, taxiways and check locations/positions data		All items mapped
AD 2.9 Surface movement guidance and control system and markings		All items mapped
AD 2.10 Aerodrome obstacles		All items mapped
AD 2.11 Meteorological information provided		All items mapped
AD 2.12 Runway physical characteristics		All items mapped
AD 2.13 Declared distances		All items mapped
AD 2.14 Approach and runway lighting		All items mapped
AD 2.15 Other lighting, secondary power supply		All items mapped
AD 2.16 Helicopter landing area		All items mapped
AD 2.17 Air traffic services airspace		All items mapped
AD 2.18 Air traffic services communication facilities		All items mapped
AD 2.19 Radio navigation and landing aids		All items mapped
AD 2.20 Local traffic regulations		All items mapped
AD 2.21 Noise abatement procedures		All items mapped
AD 2.22 Flight procedures		All items mapped
AD 2.23 Additional information		All items mapped
AD 2.24 Charts related to an aerodrome		Limited mapping details are provided for charts contained in the AIP.
AD 3. HELIPORTS		All mappings are in the sub-sections
AD 3.1 Heliport location indicator and name		All items mapped
AD 3.2 Heliport geographical and administrative data		All items mapped
AD 3.3 Operational hours		All items mapped
AD 3.4 Handling services and facilities		All items mapped
AD 3.5 Passenger facilities		All items mapped
AD 3.6 Rescue and firefighting services		All items mapped
AD 3.7 Seasonal availability — clearing		All items mapped
AD 3.8 Aprons, taxiways and check locations/positions data		All items mapped
AD 3.9 Markings and markers		All items mapped
AD 3.10 Heliport obstacles		All items mapped
AD 3.11 Meteorological information provided		All items mapped
AD 3.12 Heliport data		All items mapped
AD 3.13 Declared distances		All items mapped
AD 3.14 Approach and FATO lighting		All items mapped
AD 3.15 Other lighting, secondary power supply		All items mapped
AD 3.16 Air traffic services airspace		All items mapped
AD 3.17 Air traffic services communication facilities		All items mapped
AD 3.18 Radio navigation and landing aids		All items mapped
AD 3.19 Local traffic regulations		All items mapped
AD 3.20 Noise abatement procedures		All items mapped
AD 3.21 Flight procedures		All items mapped

AD 3.22 Additional information		All items mapped
AD 3.23 Charts related to a heliport		Limited mapping details are provided for charts contained in the AIP.

B.3 AIXM – ED99A Compliance summary

Work in progress!

ANNEX C – Sample AIXM 5.1 data

C.1 Single feature sample

This sample AIXM 5.1 file containing data about a single airport feature has been copied from the www.aixm.aero Web site.

```
<?xml version="1.0" encoding="UTF-8"?>
<aixm:AirportHeliport gml:id="urn:uuid.dd062d88-3e64-4a5d-bebd-89476db9ebea"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:aixm="http://www.aixm.aero/schema/5.1"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.aixm.aero/schema/5.1
http://www.aixm.aero/schema/5.1/AIXM_Features.xsd">
  <gml:identifier codeSpace="urn:uuid:">dd062d88-3e64-4a5d-bebd-89476db9ebea</gml:identifier>
  <aixm:timeSlice>
    <aixm:AirportHeliportTimeSlice gml:id="ahts1EADH">
      <gml:validTime>
        <gml:TimePeriod gml:id="vtnull0">
          <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
          <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <aixm:interpretation>BASELINE</aixm:interpretation>
      <aixm:sequenceNumber>1</aixm:sequenceNumber>
      <aixm:correctionNumber>0</aixm:correctionNumber>
      <aixm:featureLifetime>
        <gml:TimePeriod gml:id="ltnull0">
          <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
          <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
        </gml:TimePeriod>
      </aixm:featureLifetime>
      <aixm:designator>EADH</aixm:designator>
      <aixm:name>DONLON/DOWNTOWN HELIPORT</aixm:name>
      <aixm:magneticVariation>-3</aixm:magneticVariation>
      <aixm:dateMagneticVariation>1990</aixm:dateMagneticVariation>
      <aixm:magneticVariationChange>0.03</aixm:magneticVariationChange>
      <aixm:servedCity xsi:nil="true" nilReason="missing"></aixm:servedCity>
      <aixm:responsibleOrganisation>
        <aixm:AirportHeliportResponsibilityOrganisation gml:id="ID01">
          <aixm:role>OPERATE</aixm:role>
          <aixm:theOrganisationAuthority xlink:title="DONLON_HELIPORT_AUTHORITY"
xlink:href="urn:uuid:74efb6ba-a52a-46c0-a16b-03860d356882"></aixm:theOrganisationAuthority>
        </aixm:AirportHeliportResponsibilityOrganisation>
      </aixm:responsibleOrganisation>
      <aixm:ARP>
        <aixm:ElevatedPoint gml:id="elpoint1EADH" srsName="urn:ogc:def:crs:EPSG::4326">
          <gml:pos>52.288888888888884 -32.035</gml:pos>
          <aixm:elevation uom="M">18.0</aixm:elevation>
          <aixm:geoidUndulation xsi:nil="true" nilReason="unknown"></aixm:geoidUndulation>
        </aixm:ElevatedPoint>
      </aixm:ARP>
      <aixm:availability xsi:nil="true" nilReason="withheld"></aixm:availability>
      <aixm:annotation>
        <aixm:Note gml:id="ID03">
          <aixm:propertyName xsi:nil="true" nilReason="missing"></aixm:propertyName>
          <aixm:translatedNote>
            <aixm:LinguisticNote gml:id="ID04">
              <aixm:note lang="fr-fr">Note en Français</aixm:note>
            </aixm:LinguisticNote>
          </aixm:translatedNote>
        </aixm:Note>
      </aixm:annotation>
    </aixm:AirportHeliportTimeSlice>
  </aixm:timeSlice>
</aixm:AirportHeliport>
```

```

    </aixm:translatedNote>
  </aixm:Note>
</aixm:annotation>
</aixm:AirportHeliportTimeSlice>
</aixm:timeSlice>
</aixm:AirportHeliport>

```

C.2 Data set sample

This sample AIXM 5.1 file containing data about several features has been extracted from a larger file (the “Donlon” data set) available on the www.aixm.aero Web site.

```

<?xml version="1.0" encoding="UTF-8"?>
<message:AIXMBasicMessage xmlns:message="http://www.aixm.aero/schema/5.1/message"
xmlns:aixm="http://www.aixm.aero/schema/5.1" xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.aixm.aero/schema/5.1/message
http://www.aixm.aero/schema/5.1/message/AIXM_BasicMessage.xsd" gml:id="uniqueid">
  <gml:boundedBy>
    <gml:Envelope srsName="urn:ogc:def:crs:EPSG::4326">
      <gml:lowerCorner>52.36833333333333 -32.31632162667984</gml:lowerCorner>
      <gml:upperCorner>52.29638464616918 -32.546517283367514</gml:upperCorner>
    </gml:Envelope>
  </gml:boundedBy>
  <message:hasMember>
    <aixm:AirportHeliport gml:id="urn:uuid.1b54b2d6-a5ff-4e57-94c2-f4047a381c64">
      <gml:identifier codeSpace="urn:uuid:">1b54b2d6-a5ff-4e57-94c2-f4047a381c64</gml:identifier>
      <aixm:timeSlice>
        <aixm:AirportHeliportTimeSlice gml:id="ahts1EADD">
          <gml:validTime>
            <gml:TimePeriod gml:id="vtEADH1">
              <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
              <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
            </gml:TimePeriod>
          </gml:validTime>
          <aixm:interpretation>BASELINE</aixm:interpretation>
          <aixm:sequenceNumber>1</aixm:sequenceNumber>
          <aixm:correctionNumber>0</aixm:correctionNumber>
          <aixm:featureLifetime>
            <gml:TimePeriod gml:id="ltEADH1">
              <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
              <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
            </gml:TimePeriod>
          </aixm:featureLifetime>
          <aixm:designator>EADD</aixm:designator>
          <aixm:name>DONLON</aixm:name>
          <aixm:magneticVariation>3.0</aixm:magneticVariation>
          <aixm:dateMagneticVariation>1990</aixm:dateMagneticVariation>
          <aixm:magneticVariationChange>0.03</aixm:magneticVariationChange>
          <aixm:responsibleOrganisation>
            <aixm:AirportHeliportResponsibilityOrganisation gml:id="A-bf72b7b4">
              <aixm:role>OPERATE</aixm:role>
              <aixm:theOrganisationAuthority xlink:href="#urn:uuid.1e1bdf59-3dd6-4f96-9166-
e6095e7231fc"></aixm:theOrganisationAuthority>
            </aixm:AirportHeliportResponsibilityOrganisation>
          </aixm:responsibleOrganisation>
          <aixm:ARP>
            <aixm:ElevatedPoint gml:id="elpoint1EADD">
              <gml:pos>52.38833333333335 -31.949444444444445</gml:pos>
              <aixm:elevation uom="M">30.0</aixm:elevation>
            </aixm:ElevatedPoint>
          </aixm:ARP>
        </aixm:AirportHeliportTimeSlice>
      </aixm:timeSlice>
    </aixm:AirportHeliport>
  </message:hasMember>

```

```

</aixm:ElevatedPoint>
</aixm:ARP>
<aixm:availability>
  <aixm:AirportHeliportAvailability gml:id="A-eef5b53b">
    <aixm:timeInterval>
      <aixm:Timesheet gml:id="T-c5fdb917">
        <aixm:timeReference>UTC</aixm:timeReference>
        <aixm:day>ANY</aixm:day>
        <aixm:startTime>07:00</aixm:startTime>
        <aixm:endTime>22:00</aixm:endTime>
      </aixm:Timesheet>
    </aixm:timeInterval>
    <aixm:operationalStatus>NORMAL</aixm:operationalStatus>
  </aixm:AirportHeliportAvailability>
</aixm:availability>
<aixm:availability>
  <aixm:AirportHeliportAvailability gml:id="A-ff34d2b9">
    <aixm:timeInterval>
      <aixm:Timesheet gml:id="T-e921a1ce">
        <aixm:timeReference>UTC</aixm:timeReference>
        <aixm:day>ANY</aixm:day>
        <aixm:startTime>06:00</aixm:startTime>
        <aixm:endTime>07:00</aixm:endTime>
      </aixm:Timesheet>
    </aixm:timeInterval>
    <aixm:timeInterval>
      <aixm:Timesheet gml:id="T-d9e420be">
        <aixm:timeReference>UTC</aixm:timeReference>
        <aixm:day>ANY</aixm:day>
        <aixm:startTime>22:00</aixm:startTime>
        <aixm:endTime>23:00</aixm:endTime>
      </aixm:Timesheet>
    </aixm:timeInterval>
    <aixm:operationalStatus>LIMITED</aixm:operationalStatus>
    <aixm:usage>
      <aixm:AirportHeliportUsage gml:id="A-d38f0d0f">
        <aixm:type>FORBID</aixm:type>
        <aixm:selection>
          <aixm:ConditionCombination gml:id="C-ad9e4d95">
            <aixm:logicalOperator>NONE</aixm:logicalOperator>
            <aixm:aircraft>
              <aixm:AircraftCharacteristic gml:id="A-a10bc8d4">
                <aixm:type>HELICOPTER</aixm:type>
              </aixm:AircraftCharacteristic>
            </aixm:aircraft>
          </aixm:ConditionCombination>
        </aixm:selection>
        <aixm:operation>ALL</aixm:operation>
      </aixm:AirportHeliportUsage>
    </aixm:usage>
  </aixm:AirportHeliportAvailability>
</aixm:availability>
<aixm:availability>
  <aixm:AirportHeliportAvailability gml:id="A-e9a4bdb0">
    <aixm:timeInterval>
      <aixm:Timesheet gml:id="T-a56ba915">
        <aixm:timeReference>UTC</aixm:timeReference>
        <aixm:day>ANY</aixm:day>
        <aixm:startTime>23:00</aixm:startTime>
        <aixm:endTime>06:00</aixm:endTime>
      </aixm:Timesheet>

```

```

    </aixm:timeInterval>
    <aixm:operationalStatus>CLOSED</aixm:operationalStatus>
    </aixm:AirportHeliportAvailability>
    </aixm:availability>
    </aixm:AirportHeliportTimeSlice>
  </aixm:timeSlice>
</aixm:AirportHeliport>
</message:hasMember>
<message:hasMember>
  <aixm:Runway gml:id="urn.uuid.9e51668f-bf8a-4f5b-ba6e-27087972b9b8">
    <gml:identifier codeSpace="urn:uuid:">9e51668f-bf8a-4f5b-ba6e-27087972b9b8</gml:identifier>
    <aixm:timeSlice>
      <aixm:RunwayTimeSlice gml:id="RNWTS2120">
        <gml:validTime>
          <gml:TimePeriod gml:id="vtILURU94">
            <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <aixm:interpretation>BASELINE</aixm:interpretation>
        <aixm:sequenceNumber>1</aixm:sequenceNumber>
        <aixm:featureLifetime>
          <gml:TimePeriod gml:id="ltILURU94">
            <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
          </gml:TimePeriod>
        </aixm:featureLifetime>
        <aixm:designator>09L/27R</aixm:designator>
        <aixm:nominalLength uom="M">2800.0</aixm:nominalLength>
        <aixm:nominalWidth uom="M">45.0</aixm:nominalWidth>
        <aixm:lengthStrip uom="M">2920.0</aixm:lengthStrip>
        <aixm:widthStrip uom="M">300.0</aixm:widthStrip>
        <aixm:surfaceProperties>
          <aixm:SurfaceCharacteristics gml:id="S-e5eb234d">
            <aixm:composition>CONC</aixm:composition>
          </aixm:SurfaceCharacteristics>
        </aixm:surfaceProperties>
        <aixm:associatedAirportHeliport xlink:href="#urn.uuid.1b54b2d6-a5ff-4e57-94c2-
4047a381c64"></aixm:associatedAirportHeliport>
      </aixm:RunwayTimeSlice>
    </aixm:timeSlice>
  </aixm:Runway>
</message:hasMember>
<message:hasMember>
  <aixm:VerticalStructure gml:id="urn.uuid.5f68d835-828c-4ccd-91b7-791058d9dd4d">
    <gml:identifier codeSpace="urn:uuid:">5f68d835-828c-4ccd-91b7-791058d9dd4d</gml:identifier>
    <aixm:timeSlice>
      <aixm:VerticalStructureTimeSlice gml:id="VSRUCTTS1121">
        <gml:validTime>
          <gml:TimePeriod gml:id="vt120131">
            <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
          </gml:TimePeriod>
        </gml:validTime>
        <aixm:interpretation>BASELINE</aixm:interpretation>
        <aixm:sequenceNumber>1</aixm:sequenceNumber>
        <aixm:featureLifetime>
          <gml:TimePeriod gml:id="lt120131">
            <gml:beginPosition>2009-01-01T00:00:00.000</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
          </gml:TimePeriod>
        </aixm:featureLifetime>
      </aixm:VerticalStructureTimeSlice>
    </aixm:timeSlice>
  </aixm:VerticalStructure>
</message:hasMember>

```

```

</aixm:featureLifetime>
<aixm:type>ANTENNA</aixm:type>
<aixm:group>NO</aixm:group>
<aixm:part>
  <aixm:VerticalStructurePart gml:id="V-af4ee6d6">
    <aixm:horizontalProjection_location>
      <aixm:ElevatedPoint gml:id="p1121">
        <gml:pos>52.36171388888889 -32.03756666666666</gml:pos>
        <aixm:elevation uom="M">93</aixm:elevation>
      </aixm:ElevatedPoint>
    </aixm:horizontalProjection_location>
  </aixm:VerticalStructurePart>
</aixm:part>
</aixm:VerticalStructureTimeSlice>
</aixm:timeSlice>
</aixm:VerticalStructure>
</message:hasMember>
</message:AIXMBasicMessage>

```

C.3 Permanent change and new baseline sample

```

<?xml version="1.0" encoding="UTF-8"?>
<aixm:Runway gml:id="urn:uuid:9e51668f-bf8a-4f5b-ba6e-27087972b9b8"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:aixm="http://www.aixm.aero/schema/5.1"
xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.aixm.aero/schema/5.1
http://www.aixm.aero/schema/5.1/AIXM_Features.xsd">
  <gml:identifier codeSpace="urn:uuid:">9e51668f-bf8a-4f5b-ba6e-27087972b9b8</gml:identifier>

  <aixm:timeSlice>
    <!-- this Time Slice contains the Runway change data - runway length and strip length values -->
    <aixm:RunwayTimeSlice gml:id="RNWTS2121">
      <gml:validTime>
        <gml:TimeInstant gml:id="vtILURU95">
          <gml:timePosition>2012-03-01T00:00:00Z</gml:timePosition>
        </gml:TimeInstant>
      </gml:validTime>
      <aixm:interpretation>PERMDELTA</aixm:interpretation>
      <aixm:sequenceNumber>2</aixm:sequenceNumber>
      <aixm:nominalLength uom="M">3000.0</aixm:nominalLength>
      <aixm:lengthStrip uom="M">3140.0</aixm:lengthStrip>
    </aixm:RunwayTimeSlice>
  </aixm:timeSlice>

  <aixm:timeSlice>
    <!-- This Time Slice contains the complete runway data after the change -->
    <aixm:RunwayTimeSlice gml:id="RNWTS2120">
      <gml:validTime>
        <gml:TimePeriod gml:id="vtILURU94">
          <gml:beginPosition>2012-03-01T00:00:00Z</gml:beginPosition>
          <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <aixm:interpretation>BASELINE</aixm:interpretation>
      <aixm:sequenceNumber>2</aixm:sequenceNumber>
      <aixm:correctionNumber>0</aixm:correctionNumber>
      <aixm:featureLifetime>
        <gml:TimePeriod gml:id="ItILURU94">
          <gml:beginPosition>2009-01-01T00:00:00Z</gml:beginPosition>
          <gml:endPosition indeterminatePosition="unknown"></gml:endPosition>

```

```
</gml:TimePeriod>
</aixm:featureLifetime>
<aixm:designator>09L/27R</aixm:designator>
<aixm:nominalLength uom="M">3000.0</aixm:nominalLength>
<aixm:nominalWidth uom="M">45.0</aixm:nominalWidth>
<aixm:lengthStrip uom="M">3140.0</aixm:lengthStrip>
<aixm:widthStrip uom="M">300.0</aixm:widthStrip>
<aixm:surfaceProperties>
  <aixm:SurfaceCharacteristics gml:id="S-e5eb234d">
    <aixm:composition>CONC</aixm:composition>
  </aixm:SurfaceCharacteristics>
</aixm:surfaceProperties>
<aixm:associatedAirportHeliport xlink:href="#urn.uuid.1b54b2d6-a5ff-4e57-94c2-
f4047a381c64"></aixm:associatedAirportHeliport>
</aixm:RunwayTimeSlice>
</aixm:timeSlice>
</aixm:Runway>
```