



EASA
European Aviation Safety Agency



ARISE+

Funded by the European Union and implemented by the
European Aviation Safety Agency

AIXM Coding guidelines for the ICAO data sets



Paul Bosman,
Head of Aviation Cooperation
and Strategies, EUROCONTROL

Your safety is our mission.

An agency of the European Union 



➤ Restructured Annex 15

➤ Digital data sets

- AIP
- Obstacles
- Terrain
- Airport Mapping
- Instrument Flight Procedures

➤ New PANS-AIM

- More detailed requirements
- Based on data catalogue
 - Subjects
 - Properties
 - Sub-properties
 - Types
 - Description, data quality...

• **Incentive** : if digital data sets are provided, no longer necessary to include the same data in the printed AIP!



Objective

Mapping

PANS-AIM

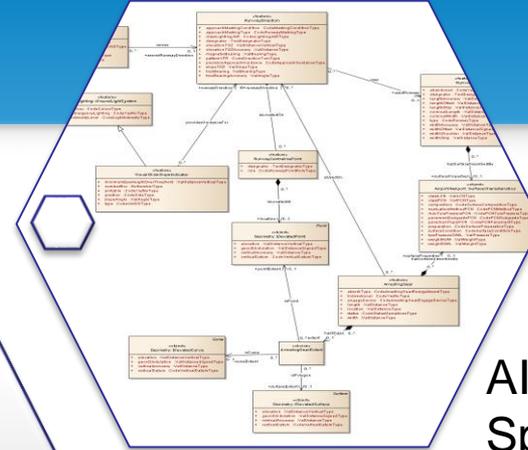
Table A1-1 Airspace data

Sub-Property	Type	Description	Min	Max	Unit
		Access to the airspace, airspace category, etc. which apply to the type of airspace and which are not service or information related			
Type	Text	Type of airspace according to ICAO Annex 11			
Area	Text	The region part of an airspace responsibility			
Latitude	Integer	The latitude of the lowest step of the airspace			see list 1
Longitude	Integer	The longitude of the lowest step of the airspace			
Upper Alt	Integer	The upper limit of the airspace			
Lower Alt	Integer	The lower limit of the airspace	0 or 1	meter	calculated
Class	Text	Classification of airspace which determines the operating rules, flight parameters, and service provided, and is defined in Annex 11, Section 3.1 and 3.2			

Sample

Coding Rules

AIXM Specification



Data Set

```

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<AIXM xmlns="http://www.aixm.aero/aixm/5.0.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.aixm.aero/aixm/5.0.1/aixm.xsd" >
  <DocumentHeader>
    <Title>AIXM Sample</Title>
    <Version>1.0</Version>
  </DocumentHeader>
  <Airspace>
    <Airspace>
      <Type>A</Type>
      <Area>
        <Area>
          <Latitude>52000000</Latitude>
          <Longitude>00000000</Longitude>
          <UpperAlt>5000</UpperAlt>
          <LowerAlt>0</LowerAlt>
          <Class>A</Class>
        </Area>
      </Area>
    </Airspace>
  </Airspace>
</AIXM>

```



Eurocontrol Focus Group

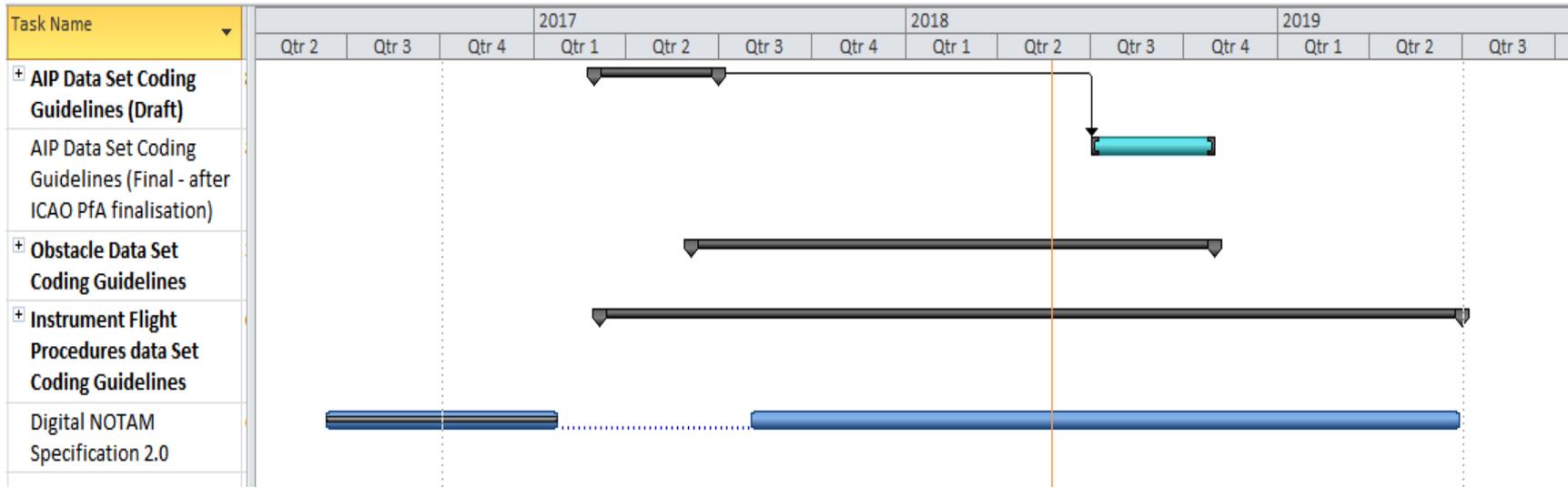
- Objective
 - interoperability of AIXM digital data sets through common coding rules
 - data set verification capabilities
 - globally applicable

- Participation
 - Eurocontrol Member States
 - data service provider
 - airline operational centres
 - FAA, NavCanada, etc.

- Work environment - online
 - Google Docs, Atlassian Confluence (drafting)
 - www.aixm.aero/confluence (publicly available)



Work plan





ICAO AIP Data Set Coding Guidelines

ICAO Annex 15 (AMDT 40)

“5.3.2.3 The AIP data set shall contain the digital representation of aeronautical information of lasting character (permanent information and long duration temporary changes) essential to air navigation.”

- Objectives
 - Ensure that AIP Data Sets can be efficiently ingested by commercial data providers (“data houses”) and airline operational systems
 - for flight planning systems
 - for conversion to ARINC 424 / FMS use
 - for take-off performance calculations
 - Ensure that AIP Data Sets can be efficiently exchanged between State AIS
 - For cross-border data coordination
 - In support of AIS processes, such as NOTAM verification, charting, etc.

This is important for at least the following reasons

- Provides criteria for data set verification/completeness
- Provides criteria for deciding which data is “core’ and which data is “supplementary”



ICAO AIP Data Set Coding Guidelines

Step 1 - Mapping

See www.aixm.aero/confluence

Mapping PANS-AIM AIP Data Set to AIXM 5

Created by Wolfgang SCHEUCHER (Solitec), last modified by EDUARD POROSNICU on 05 Jul 2018

Scope

These pages contain the mapping of the AIP data set subjects as defined in PANS-AIM ^[1] to the corresponding AIXM 5 features and attributes.

The mapping is limited to certain data items of PANS-AIM. For this purpose, three categories of data items have been defined:

1. Minimum Data Items:

According to [PANS - AIM chapter 5.3.3.1](#), the AIP data set shall include data about the following subjects, with the properties indicated in brackets being included as a minimum (if applicable):

- a) **ATS airspace** (type, name, lateral limits, vertical limits, class of airspace);
- b) **Special activity airspace** (type, name, lateral limits, vertical limits, restriction, activation);
- c) **Route** (identifier prefix, flight rules, designator);
- d) **Route segment** (navigation specification, startpoint, endpoint, track, distance, upper limit, lower limit, MEA, MOCA, direction of cruising level, reverse direction of cruising level, required navigation performance);
- e) **Waypoint - en-route** (reporting requirement, identification, location, formation);
- f) **Aerodrome/Heliport** (location indicator, name, designator IATA, served city, certified ICAO, certification date, certification expiration date, control type, field elevation, reference temperature, magnetic variation, airport reference point);
- g) **Runway** (designator, nominal length, nominal width, surface type, strength);
- h) **Runway Direction** (designator, true bearing, threshold, TORA, TODA, ASDA, LDA, rejected TODA);
- i) **FATO** (designation, length, width, threshold point);
- j) **TLOF** (designator, centre point, length, width, surface type);
- k) **Radio navigation aid** (type, identification, name, aerodrome served, hours of operation, magnetic variation, frequency/channel, position, elevation, magnetic bearing, true bearing, zero bearing direction).

2. Conditional Data Items

When the AIP data set (as specified in 5.3.3.1) is provided, certain sections of the AIP may be left blank and a reference to the data set availability shall be provided. In PANS-AIM these sections are marked with #AIP-DS# in [PANS-AIM Appendix 2 "Contents of the Aeronautical Information Publication \(AIP\)"](#). All data elements that are described in these sections are taken into account for the mapping.

Where required (e.g. for flight planning or ARINC 424 ^[2] compatibility purposes) also [other additional data elements](#) may be included in the mapping and are marked correspondingly.

3. Optional Data Items

Apart from the minimum and conditional properties, the [PANS-AIM Appendix 1 "Aeronautical Data Catalogue"](#) contains additional properties for the different subjects listed above. These are considered "optional" and are marked as such, but are currently not included in the mapping.



ICAO AIP Data Set Coding Guidelines

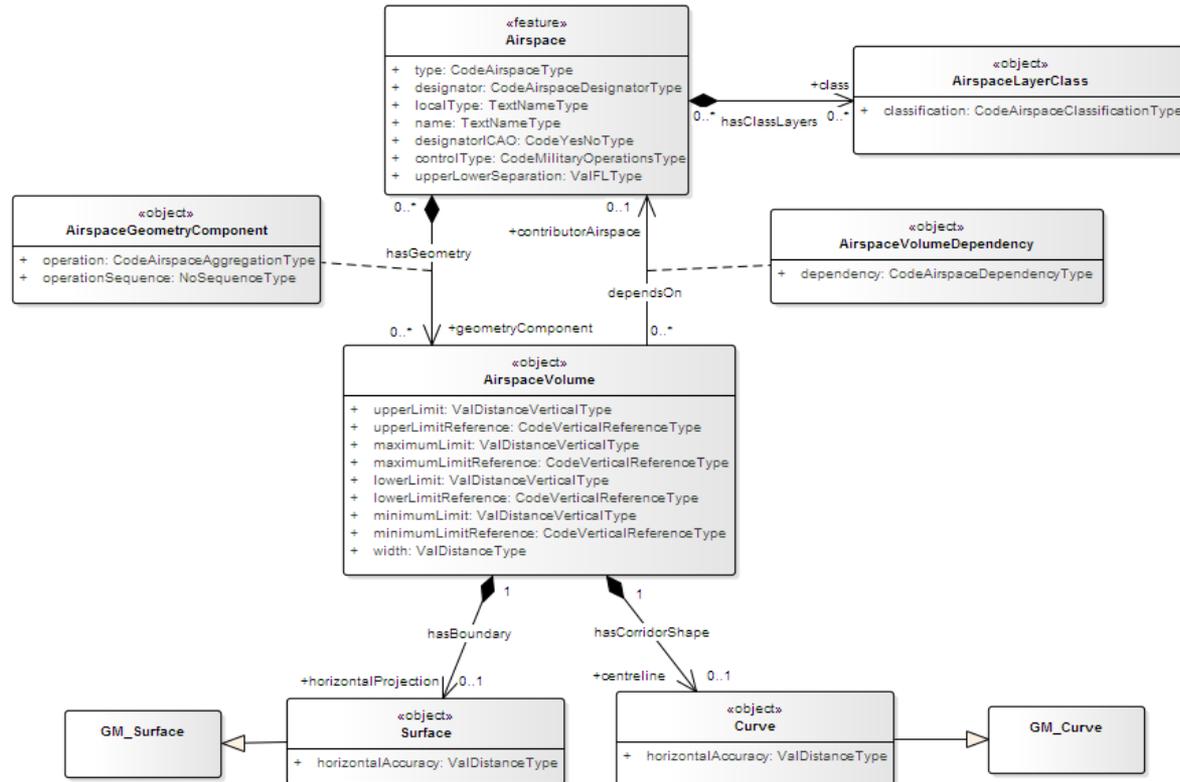
Step 1 - Mapping

PANS-AIM

«subject»
ATS Airspace

- + Type: Text = minimum
- + Name: Text = minimum
- + Lateral limits: Polygon = minimum
- + Vertical limits - Upper limit: Altitude = minimum
- + Vertical limits - Lower limit: Altitude = minimum
- + Class of airspace: Code list = minimum

AIXM 5.1.1(1)





ICAO AIP Data Set Coding Guidelines

Step 2 – Coding rules

Airspace Geometry by Aggregation (more than one AirspaceVolume)

Created by Wolfgang SCHEUCHER (Solitec), last modified by Wolfgang SCHEUCHER on 05 Jul 2018

Page Table of Content

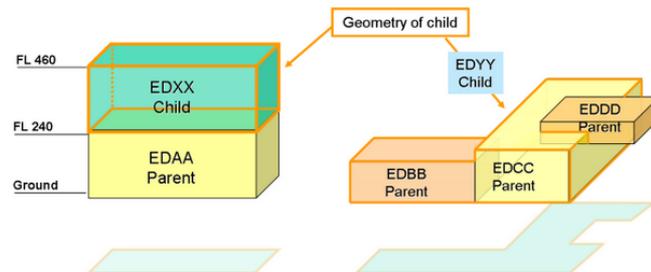
- Aggregation Chains (Hierarchy of Aggregation)
- Types for Airspace Geometry Components
 - BASE
 - UNION
 - Subtraction
 - Intersection
- Airspace Aggregation - Copying Geometry vs. Referencing
 - Copying Geometry
 - Referencing
- Coding Examples
 - Example 1-1: R-4912 Sand Springs, NV
 - Example 1-2: R-4804A Twin Peaks, NV

The geometry of an airspace may be constructed by the composition of other airspace.

The main concept behind these operations is the so called "Parent/Child relationship".

The figure below shows two examples. The geometry of the "child" airspace which derives the geometry from the "parent" airspace(s) may be

- the same horizontal shape as another airspace but with different vertical limits ("above-below" association).
- a composition by aggregation of airspace (e.g. union and subtraction operations).



In the first case, only one parent can be used (but it may be used for more than one child) and the derivation process is limited to the horizontal border.

In the second case, a combination of "parent" airspace (one to many relationship) will be used. The derivation process is extended to a total aggregation of airspace volumes (i.e. also takes the vertical limits of the parent Airspace into account).

In both cases, based on already defined airspace the geometry of a new airspace can be defined using a set of various operations.

The parent airspace(s) always determine(s) the geometry of the child airspace, i.e. the parent airspace has already a specified geometry which will be inherited by the child.



ICAO AIP Data Set Coding Guidelines

Step 3 – Coding examples

BRUSSELS TMA ONE			
Lateral limits	504036N 0040415E - 503852N 0035231E - 510207N 0040621E - 511005N 0044746E - 510251N 0045655E - 504111N 0042920E - 503823N 0042917E - 503205N 0040655E - an arc of circle, 6 NM radius, centred on 503532N 0035910E and traced counterclockwise to 504036N 0040415E.		
Vertical limits	FL 195 / 1500 ft AMSL		
Airspace class	C		
Control units	Brussels ACC	Call sign	Brussels Control (En)
		OPR HR	H24
		FREQ	See below (5.3)
	Brussels APP (f)	Call sign	Brussels Arrival, Brussels Departure (En)
		OPR HR	H24
		FREQ	See EBBB AD 2.18
Remarks	(f) Aircraft entering Brussels TMA below FL 65 shall contact Brussels Departure.		

BRUSSELS TMA TWO			
Lateral limits	503059N 0034410E - 504012N 0033606E - 510855N 0035646E - 511005N 0041600E - 511807N 0043011E - 511835N 0043325E - 511005N 0044746E - 510207N 0040621E - 503852N 0035231E - 504036N 0040415E, an arc of circle, 6 NM radius, centred on 503532N 0035910E and traced clockwise to 503205N 0040655E - 503039N 0040151E - 502920N 0034840E - 503059N 0034410E.		
Vertical limits	FL 195 / 2500 ft AMSL		
Airspace class	C		
Control units	Brussels ACC	Call sign	Brussels Control (En)
		OPR HR	H24
		FREQ	See below (5.3)
	Brussels APP (f)	Call sign	Brussels Arrival, Brussels Departure (En)
		OPR HR	H24
		FREQ	See EBBB AD 2.18
Remarks	(f) Aircraft entering Brussels TMA below FL 65 shall contact Brussels Departure.		



BRUSSELS TMA ONE and BRUSSELS TMA TWO do not exist as separate Airspace features!



ICAO AIP Data Set Coding Guidelines

Step 3 – Coding examples

```

<geometryComponent>
  <AirspaceGeometryComponent>
    <operation>SUBTR</operation>
    <operationSequence>2</operationSequence>
    <theAirspaceVolume>
      <AirspaceVolume>
        <upperLimit uom="FL">180</upperLimit>
        <upperLimitReference>STD</upperLimitReference>
        <lowerLimit uom="FT">GND</lowerLimit>
        <lowerLimitReference>SFC</lowerLimitReference>
        <contributorAirspace>
          <AirspaceVolumeDependency>
            <dependency>HORZ_PROJECTION</dependency>
            <theAirspace xlink:href="#Airspace3"/>
          </AirspaceVolumeDependency>
        </contributorAirspace>
      </AirspaceVolume>
    </theAirspaceVolume>
  </AirspaceGeometryComponent>
</geometryComponent>

```

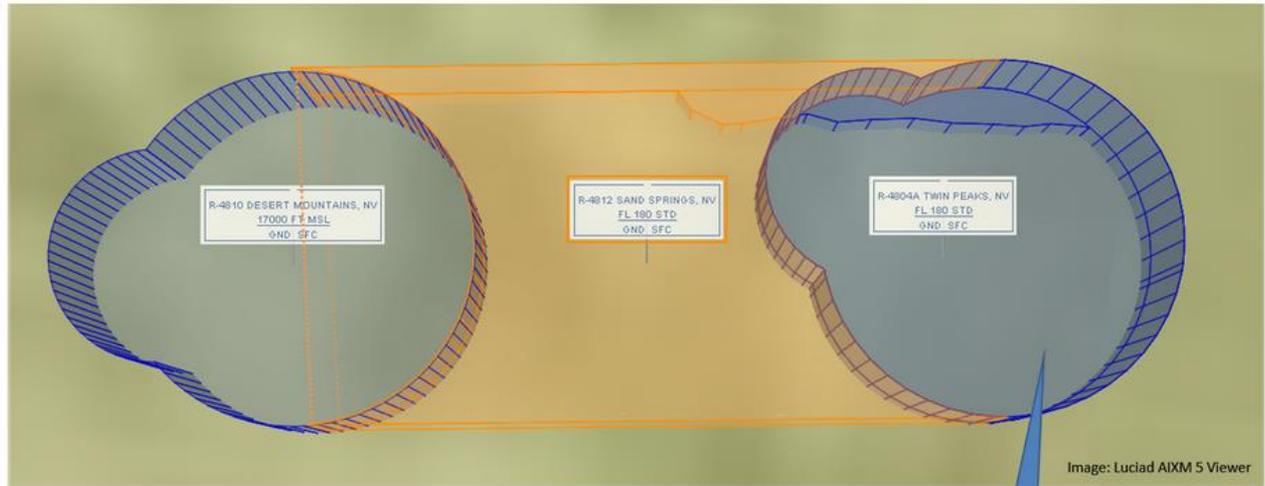


Image: Luciad AIXM 5 Viewer

```

<Airspace xmlns="http://www.aixm.aero/schema/5.0" gml:id="Airspace3">
  <identifier xmlns="http://www.opengis.net/gml/3.2" codeSpace="http://www.faa.gov/nasr">5c3e1f30-be2d-4b3b-aa75-bb8c2c6a5101</identifier>
  <timeSlice>
    <AirspaceTimeSlice gml:id="Airspace3_TS1">
      <validTime xmlns="http://www.opengis.net/gml/3.2">
        <interpretation>BASELINE</interpretation>
        <sequenceNumber>1</sequenceNumber>
        <correctionNumber>0</correctionNumber>
        <featureLifetime>
          <designator>R4804A</designator>
          <name>R-4804A TWIN PEAKS, NV</name>
        </featureLifetime>
      <geometryComponent>
        <geometryComponent>
          <geometryComponent>

```

SUBTR 2



ICAO AIP Data Set Coding Guidelines

Step 4 – Data verification rules

Coding Rules for Vertical Limits of Airspace

Identifier	Data Encoding Rule	Justification	Data Verification Rule (UID)	Remarks
ASE-300	An Airspace shall have defined vertical limits.	Minimum AIP data set	TBD	In case the airspace is defined by an airspace aggregation (i.e. more than one airspace volume), it has to be ensured that the derived geometry of the child airspace has consistent and complete vertical limits.
ASE-301	If AirspaceVolume.lowerLimit is specified, then AirspaceVolume.lowerLimitReference is mandatory, except AirspaceVolume.lowerLimit is equal-to 'GND'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CD (Rule does not take into account GND)	
ASE-302	If AirspaceVolume.upperLimit is specified, then AirspaceVolume.upperLimitReference is mandatory, except AirspaceVolume.upperLimit is equal-to 'UNL'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CB (Rule does not take into account UNL)	
ASE-303	If the lowerLimit.uom has the value 'FL' or 'SM', then the attribute AirspaceVolume.lowerLimitReference must have the value 'STD'.	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-1A4E61	
ASE-304	If the upperLimit.uom has the value 'FL' or 'SM', then the attribute AirspaceVolume.upperLimitReference must have the value 'STD'.	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-1A4E7A	
ASE-305	If AirspaceVolume.maximumLimit is specified, then AirspaceVolume.maximumLimitReference is mandatory, except AirspaceVolume.upperLimit is equal-to 'UNL'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CC (Rule does not take into account UNL)	
ASE-306	If AirspaceVolume.minimumLimit is specified, then AirspaceVolume.minimumLimitReference is mandatory, except AirspaceVolume.minimumLimit is equal-to 'GND'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CE (Rule does not take into account GND)	
ASE-307	AirspaceVolume.maximumLimitReference should have the value 'SFC' [The distance measured from the surface].	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-203A0	
ASE-308	AirspaceVolume.minimumLimitReference should have the value 'SFC' [The distance measured from the surface].	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-21340	

Objective -> enable data verification services !



ICAO AIP Data Set Coding Guidelines

Interoperability rules

- Why necessary
 - ensure that data integrators are able to ***seamlessly merge the digital data coming from different States***
 - ensure that ***States can exchange between themselves*** the data sets

Rules and Recommendations

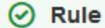
The following topics are subject to specific interoperability rules

- Format and distribution
- AIXM version
- Common ICAO AIP Data Subset
- Allowed feature types
- Baseline data and updates
- GML Profile
- Minimal Metadata Requirements
- Feature identification and reference
- Use of nilReason
- Use of extensions
- Use of OTHER:... values
- Other rules
- XML Usage Limitations
- Conformance testing



ICAO AIP Data Set Coding Guidelines

Interoperability rules



Rule

An AIP Data Set shall be valid against the AIXM 5.1.1 BasicMessage XMLSchema (http://www.aixm.aero/schema/5.1.1/message/AIXM_BasicMessage.xsd).



Recommendation

An AIP Data Set file should have the following name structure "CC_CC_CC...[Territory]_AIP_DS_Type[_Part]_YYYYMMDDDD[_AIRAC].xml", where:

- CC represents the 1-letter or 2-letters ICAO Country code(s) of the State(s) under which authority the data set is published, according to the ICAO DOC 7910 - Location Indicator;
Note: When a Data Set is published for an entire region, as result of a regional database agreement, CC may be replaced by a code representing that region, such as "EU" in the case of the European AIS Database.
- [_Territory] is optional and is the official name of the Territory covered by the data set, if applicable;
- AIP_DS is a fixed text (meaning "AIP Data Set");
- Type is a mandatory element and it can take one of the following values:
 - a. FULL - when the file contains a complete AIP data set or a subset thereof;
 - b. UP_DBL - when the the file contains an AIP Data Set - Baseline Update or a subset thereof;
 - c. UPD_DELTA - when the file contains an AIP Data Set - Delta Update or a subset thereof.
- [_Part] is optional and indicates that the file constitutes a subset of the complete AIP data set provided by the State. Note: the exact split in parts and their names is left at the discretion of each State;
- YYYYMMDD is the start of effective date in the format year, month, date;
- "_AIRAC" is optional and it shall be appended for Data Sets that contain changes complying with the AIRAC cycle rules.



Rule

An AIP data set shall not contain subjects that are specified in the PANS-AIM as part of another data set (such as obstacles, SID, STAR, Instrument Approach Procedures, etc.), except if that subject is explicitly listed as part of the AIP data set.



Permission

An AIP data set may contain additional subjects, which are not specified as part of any other data set (such as passenger facilities, etc.).

Etc.

See www.aixm.aero/confluence



Obstacle data sets

- Work in progress
 - Requirements mapping to AIXM

- Discussion topics
 - Association obstacle area to obstacle
 - Data source identifier
 - Data and time stamp
 - Designator and name
 - Type
 - Horizontal extent
 - Group of obstacles
 - Mobile obstacle
 - Unsupported data quality attributes in AIXM 5.1
 - How to identify obstacle data that is "not trusted"
 - Etc.

- Expected finalisation -> end 2018

Obstacle - basic properties
+ Area of coverage = mandatory
+ Data originator identifier = mandatory
+ Data source identifier = mandatory
+ Obstacle identifier = mandatory
+ Obstacle type = mandatory
+ Date and time stamp = mandatory
+ Effectivity = conditional
+ Integrity = mandatory

Obstacle - geometry and location
+ Geometry type = mandatory
+ Horizontal extent = mandatory
+ Horizontal position = mandatory
+ Horizontal reference system = mandatory
+ Horizontal accuracy = mandatory
+ Horizontal resolution = mandatory
+ Horizontal confidence level = mandatory
+ Elevation = mandatory
+ Height = optional
+ Vertical reference system = mandatory
+ Vertical accuracy = mandatory
+ Vertical resolution = mandatory
+ Vertical confidence level = mandatory
+ Unit of measurement used = mandatory
+ Operations = conditional

Obstacle - visual elements
+ Lighting = mandatory
+ Marking = mandatory
+ Material: int = optional



Instrument Flight Procedures data sets

- Initial work done in cooperation with members of the AIXM CCB
 - Small topics, such as coding of FAS Data Block, etc.
 - In support of the procedures model revision in AIXM 5.2

- Next step – Eurocontrol call for tender
 - Mapping
 - PANS-AIM subjects/properties to be considered, including references to other documents such as PANS-OPS and ICAO Annex 4
 - Coding guidelines
 - topics to be covered by the AIXM coding guidelines for instrument flight procedures data sets

- Expected finalisation -> Q2 2019



Digital NOTAM Specification

- Initial Digital NOTAM Event Specification 1.0 – published in 2011
- Version 2.0
 - Revision of coding/decoding scenarios based on feedback from trials and test implementations
 - Additional scenarios
 - Mature content – publicly available on www.aixm.aero/confluence

The Airspace TEMPELTA and the new Event BASELINE

```
<?xml version="1.0" encoding="UTF-8"?>
<message:AIXMBasicMessage xmlns:message="http://www.aixm.aero/schema/5.1.1/message"
xmlns:sd="http://www.aixm.aero/2005/gsd" xmlns:geo="http://www.aixm.aero/2005/geo"
xmlns:sd="http://www.aixm.aero/2005/gsd" xmlns:qml="http://www.aixm.aero/2005/gml/3.2"
xmlns:geo="http://www.aixm.aero/2005/geo" xmlns:aixm="http://www.aixm.aero/schema/5.1.1"
xmlns:event="http://www.aixm.aero/schema/5.1/event" xmlns:aixmLink="http://www.aixm.aero/1999/aixmLink"
xmlns:air="http://www.aixm.aero/2005/aixmLink-namespace"
xmlns:schemaLocation="http://www.aixm.aero/schema/5.1.1/message http://www.aixm.aero/schema/5.1.1/message/AIXM_BasicMessage.xsd
http://www.aixm.aero/schema/5.1/event http://www.aixm.aero/schema/5.1.1/event/Version_5.1-1-Event_Features.xsd"
qml:sd="M00001">
<message:hasMember>
<aixm:Airspace qml:id="uid.20e6905-699a-4ea7-a736-2a07870dcf57">
<qml:identifier codeSpace="urn:uuid":"020e6905-699a-4ea7-a736-2a07870dcf57"/>
<qml:TimeSlice>
<aixm:AirspaceTimeSlice qml:id="ID_30">
<qml:validTime>
<qml:TimePeriod qml:id="ID_31">
<qml:beginPosition>2018-06-30T06:00:00Z</qml:beginPosition>
<qml:endPosition>2018-06-30T18:30:00Z</qml:endPosition>
</qml:TimePeriod>
</qml:validTime>
<aixm:interpretation>TEMPELTA</aixm:interpretation>
<aixm:sequenceNumber>1</aixm:sequenceNumber>
<aixm:activation>(23 lines)
<aixm:extension>
<event:AirspaceExtension qml:id="ID_80">
<event:isActive true/>
<event:isActive true/>
<event:isActive true/>
</event:AirspaceExtension>
</aixm:extension>
</aixm:AirspaceTimeSlice>
</aixm:Airspace>
</message:hasMember>
</message:AIXMBasicMessage>
```

Legend

- 1 The overall container of the Digital NOTAM can be an AIXMBasicMessage, which is simply a collection of AIXM features.
- 2 This is the Airspace TEMPELTA TimeSlice that contains the data about the activation. Note the following elements:
 - <qml:validTime> indicates the period when the TimeSlice is valid, which corresponds to the period when the Digital NOTAM is active
 - <aixm:interpretation> indicates the type of TimeSlice (TEMPELTA in this case)
 - <aixm:activation> contains the actual data about the activation. In this view, this element is collapsed, note that there are in fact 22 hidden lines. This will be discussed in more detail further down.
- 3 Note
Note that the TEMPELTA contains strictly the Airspace feature properties that have a different value during the event, as compared to the baseline situation. For example, the name, designator, etc. properties are not modified and thus not included in the TEMPELTA.
- 4 This <eventtheEvent> element associates the Airspace TEMPELTA TimeSlice with the Event. The association is encoded as an "abstract reference" in this example (see the AIXM Feature Identification and Reference, chapter 3.4 for further details about this topic).
- 5 The Event element is also present in the Digital NOTAM encoding. Note that in this view this element also is collapsed, there are 49 hidden lines. The details are will be discussed further down.

- Work in progress – coding /decoding scenarios (Google Docs)
- Finalisation -> Q2 2019





EASA
European Aviation Safety Agency



ARISE+

Funded by the European Union and implemented by the
European Aviation Safety Agency

Thank you for your attention!

Your safety is our mission.

An agency of the European Union 