



# AIXM Coding guidelines for the ICAO data sets

Interregional EUR/MID PANS AIM Workshop  
ICAO EUR/NAT, Paris, 10-12 July 2018

Eduard POROSNICU

DECMA/STR/SWM

July 2018

- 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...

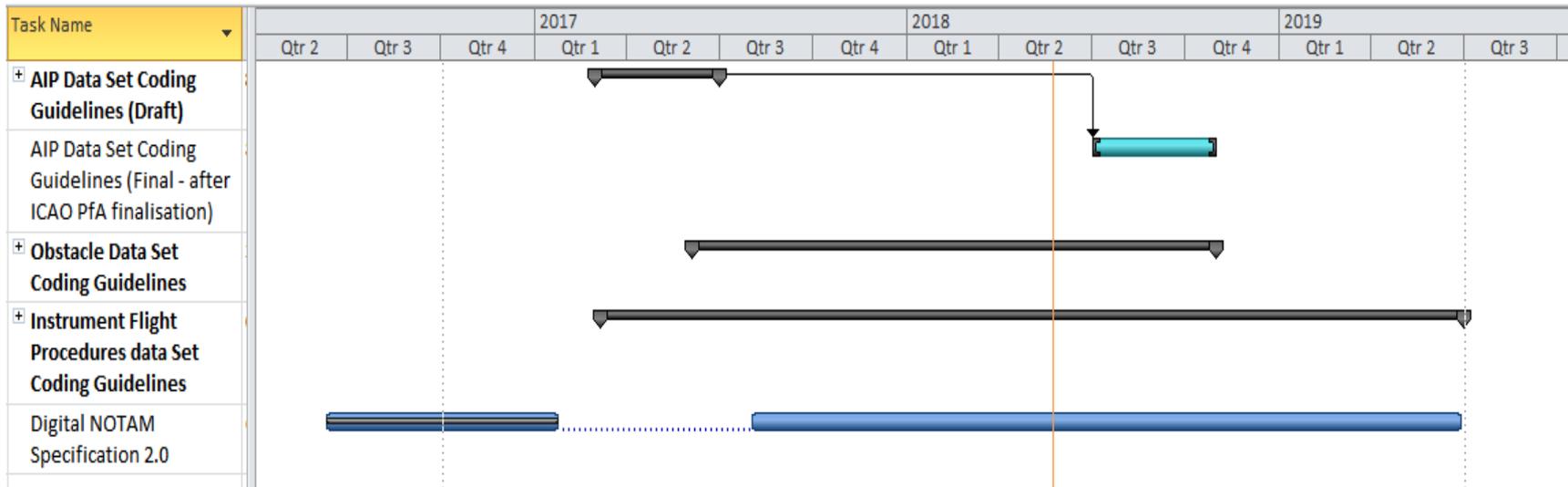
**Incentive** : if digital data sets are provided,  
no longer necessary to include the same data in the printed AIP!



# 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](http://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](http://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 <sup>[1]</sup> 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 <sup>[2]</sup> compatibility purposes) also [other additional data elements](#) may be included in the mapping and are marked correspondingly.

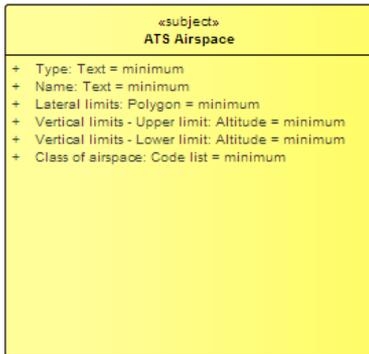
#### 3. Optional Data Items

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.

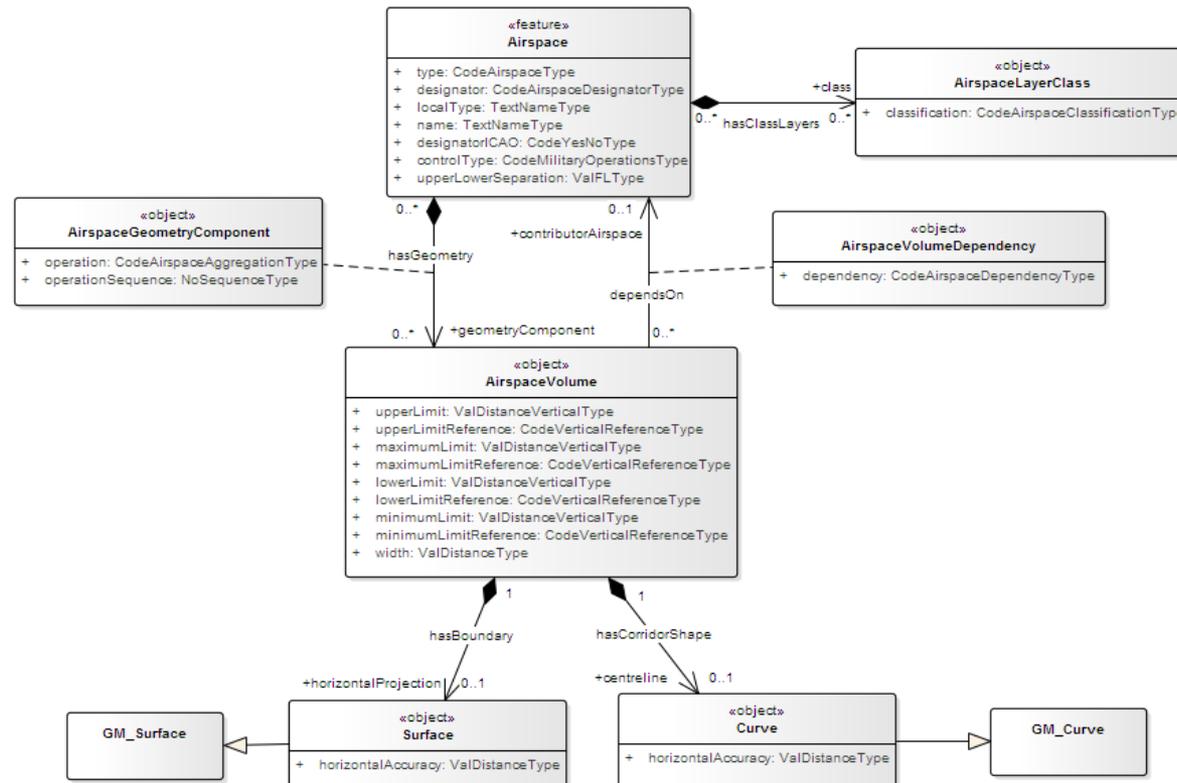
# ICAO AIP Data Set Coding Guidelines

## Step 1 - Mapping

PANS-AIM



AIXM 5.1.(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

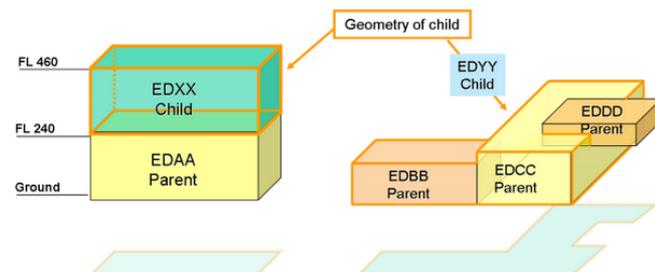
- Aggregation Chains (Hierarchy of Aggregation)
- Types for Airspace Geometry Components
  - BASE
  - UNION
  - Subtraction
  - Intersection
- Airspace Aggregation - Copying Geometry vs. Referencing
  - Copying Geometry
  - Referencing
- Coding Examples
  - Example 1-1: R-4912 Sand Springs, NV
  - Example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

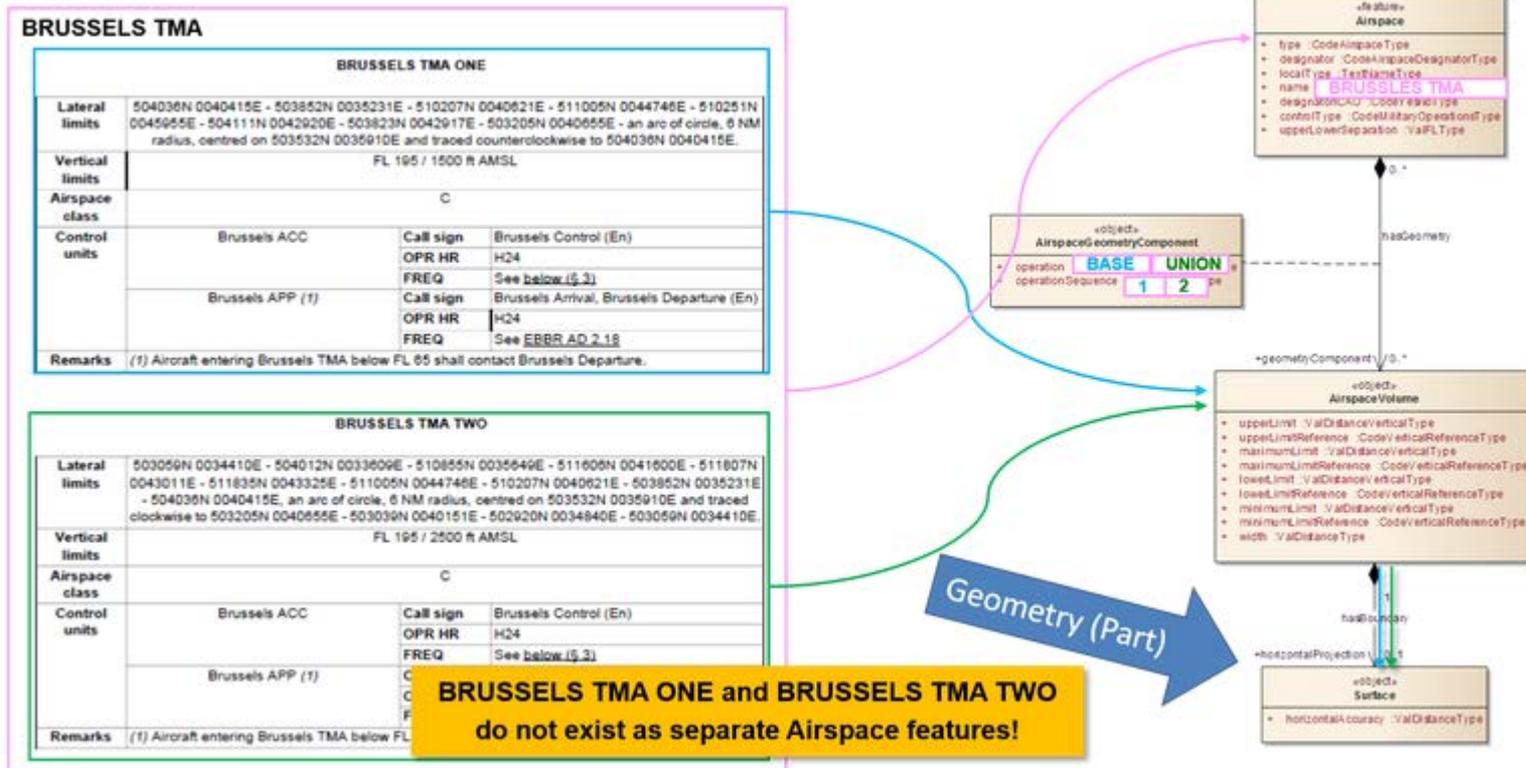
In the second case, a combination of "parent" airspace (one to many relationship) will be used. The derivation process is extended to a total aggregation of airspace volumes (i.e. also takes the vertical limits of the parent Airspace into account).

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.

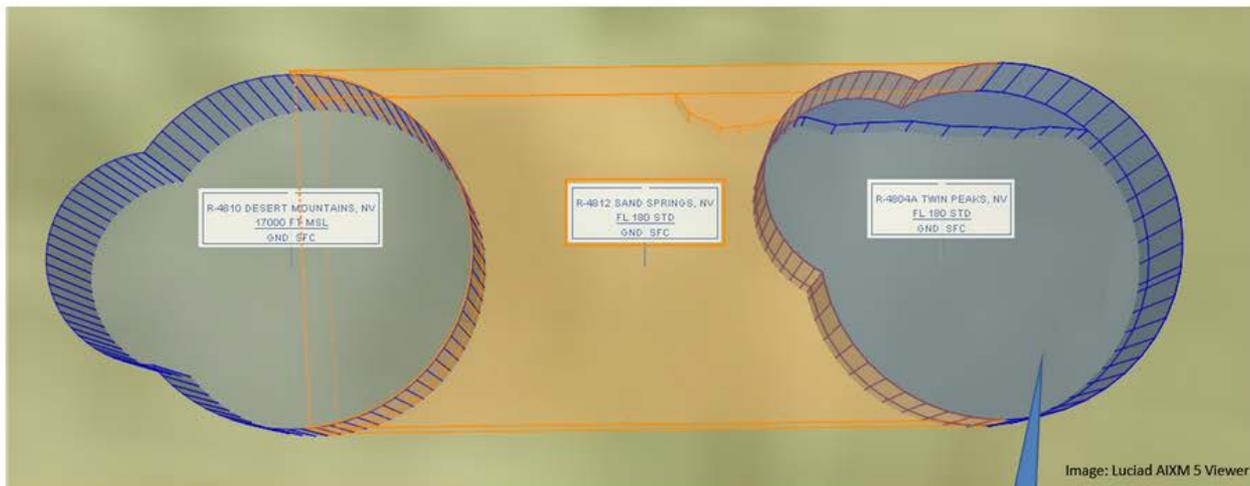
# ICAO AIP Data Set Coding Guidelines

## Step 3 – Coding examples



# 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>

```

```

<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>
      </AirspaceTimeSlice>
    </timeSlice>
  <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 <a href="#">Airspace</a> 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 <a href="#">AirspaceVolume.lowerLimit</a> is specified, then <a href="#">AirspaceVolume.lowerLimitReference</a> is mandatory, except <a href="#">AirspaceVolume.lowerLimit</a> is equal-to 'GND'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CD (Rule does not take into account GND)	
ASE-302	If <a href="#">AirspaceVolume.upperLimit</a> is specified, then <a href="#">AirspaceVolume.upperLimitReference</a> is mandatory, except <a href="#">AirspaceVolume.upperLimit</a> 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 <a href="#">lowerLimit.uom</a> has the value 'FL' or 'SM', then the attribute <a href="#">AirspaceVolume.lowerLimitReference</a> must have the value 'STD'.	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-1A4E61	
ASE-304	If the <a href="#">upperLimit.uom</a> has the value 'FL' or 'SM', then the attribute <a href="#">AirspaceVolume.upperLimitReference</a> must have the value 'STD'.	AIXM 4.5 Business Rules / Data consistency	AIXM-5.1_RULE-1A4E7A	
ASE-305	If <a href="#">AirspaceVolume.maximumLimit</a> is specified, then <a href="#">AirspaceVolume.maximumLimitReference</a> is mandatory, except <a href="#">AirspaceVolume.upperLimit</a> is equal-to 'UNL'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CC (Rule does not take into account UNL)	
ASE-306	If <a href="#">AirspaceVolume.minimumLimit</a> is specified, then <a href="#">AirspaceVolume.minimumLimitReference</a> is mandatory, except <a href="#">AirspaceVolume.minimumLimit</a> is equal-to 'GND'.	AIXM Model / Minimal data rule	AIXM-5.1_RULE-1A13CE (Rule does not take into account GND)	
ASE-307	<a href="#">AirspaceVolume.maximumLimitReference</a> 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	<a href="#">AirspaceVolume.minimumLimitReference</a> 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](http://www.aixm.aero/schema/5.1.1/message/AIXM_BasicMessage.xsd)).

### i 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.

### i 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.

# 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



