AIXM –Purpose, Scope, implementation and future evolution(Dakar, Senegal, 3-5 October 2016)

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RO/AIM

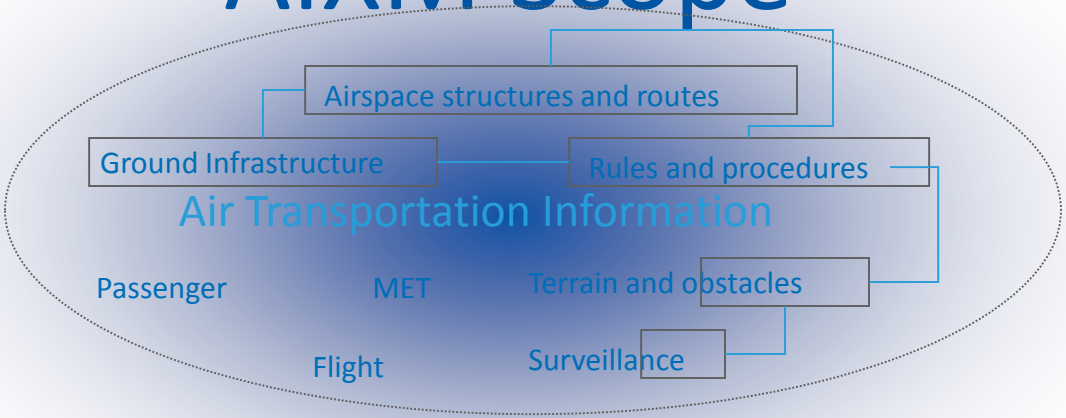
Agenda Items 6b

AIXM – why necessary

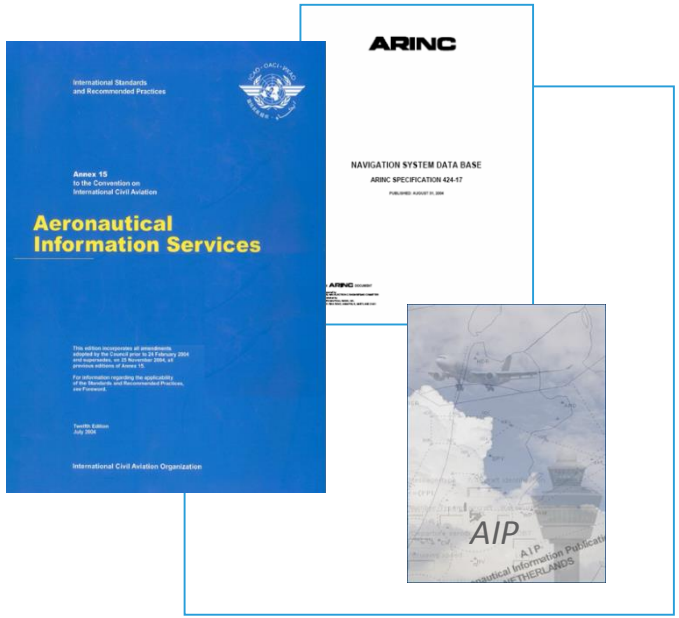
- EAD Feasibility Study (by “CAPdebis”) - 1993
  - *“The exchange of static data in an electronic format is rare for ground based systems. Other than ARINC 424 format, which was developed according to the demands of FMS, a state of the art, commonly used standard format for the exchange of static data information […] is not available.”*

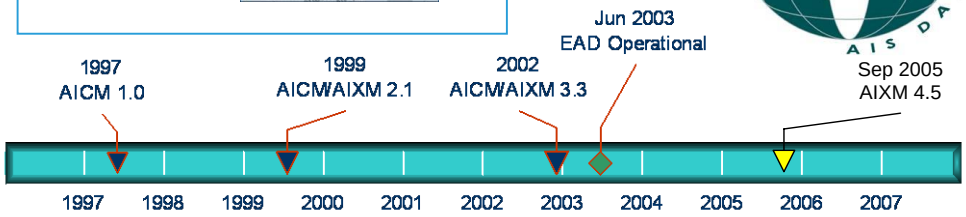
- Need for aeronautical information logical model + data exchange format
  - For the implementation of the European AIS Database (EAD)
  - Basis for eAIP
  - Contribution to ICAO (AIS/MAP Divisional Meeting of 1998)
  - For industry implementations
  - etc.

AIXM Scope

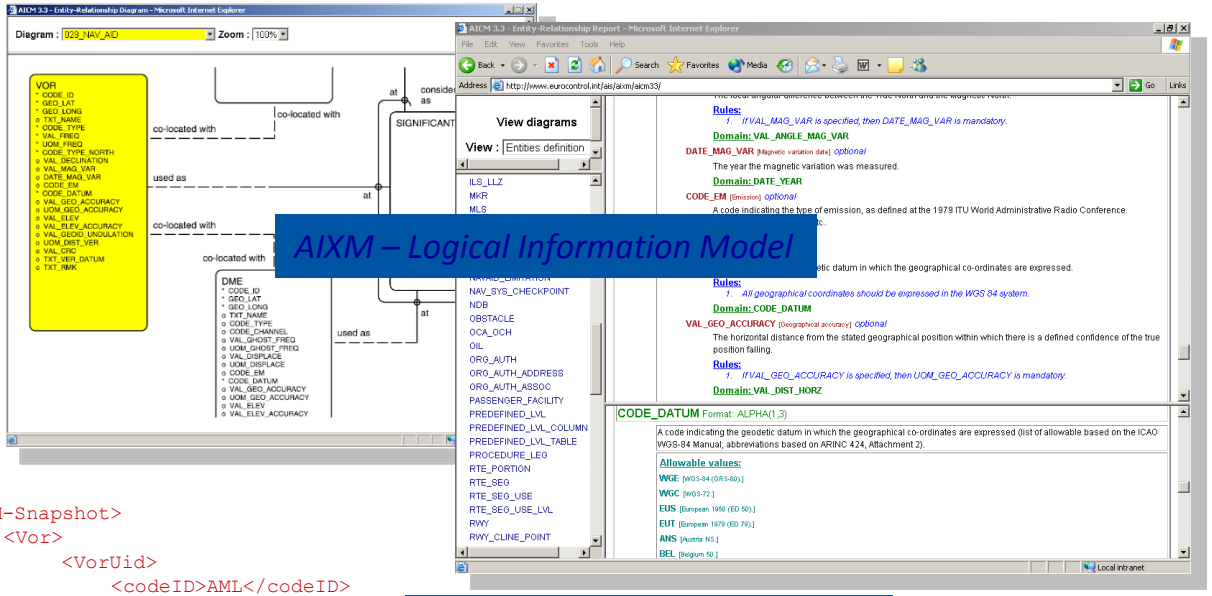

Airspace structures and routes
Ground Infrastructure
Rules and procedures
Air Transportation Information
Passenger
MET
Terrain and obstacles
Flight
Surveillance

AIXM Development

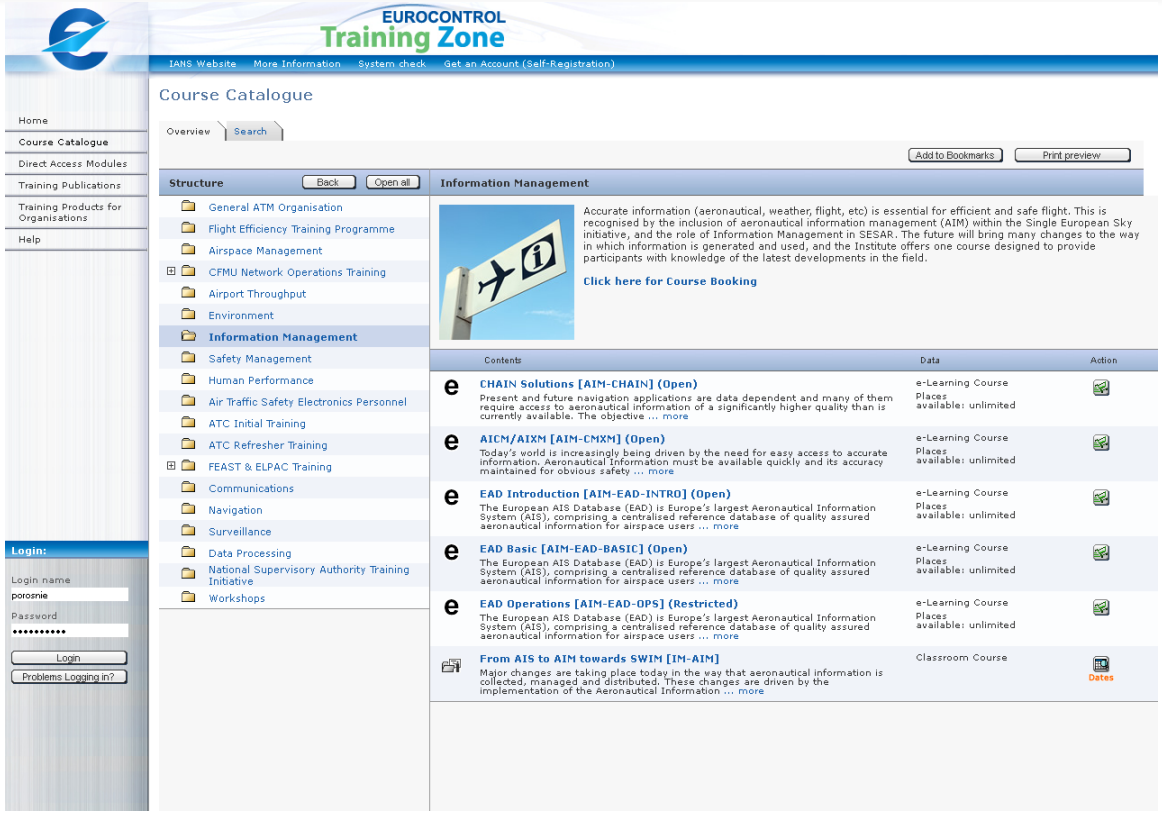




AIXM 4.5: two main components



AICM 4.5 Web Based Training

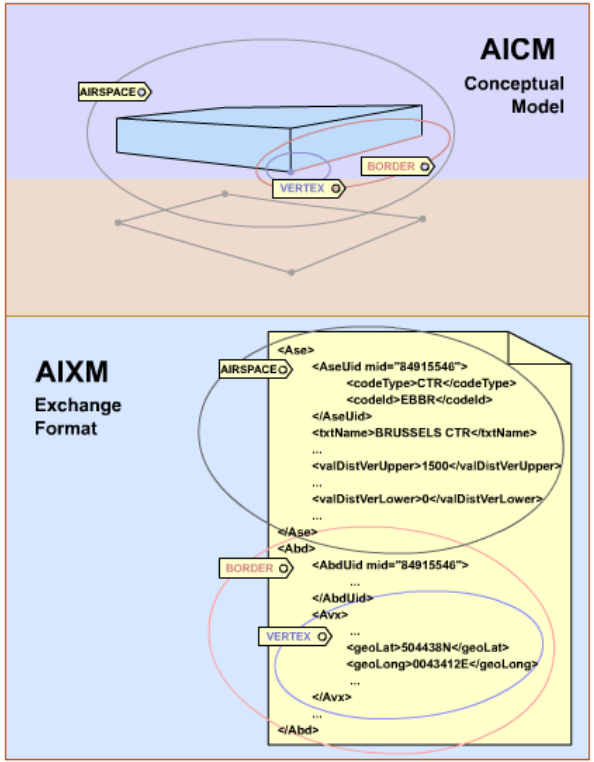


Be aware of the differences between these two models: AICM - the foundation and the conceptual model and, AIXM - model based on AICM, uses XML schema

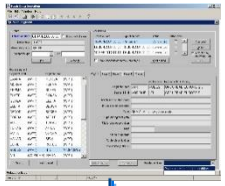
AICM was created first. Then AIXM was developed, providing an exchange format based on AICM.

AICM is the conceptual model, which defines every single piece of information and groups them at an abstraction level defined by domain experts. It defines the vocabulary of the common language, the concepts and the relations between the concepts.

AIXM is the exchange format used at data exchange points. AIXM defines the format and the grammar of the common language or, in other words, it specifies how to combine the words of the language (these words are individual data items in structured messages exchanged between systems). This grammar is formalised using an XML-based grammar language (called a schema). XML stands for eXtensible Markup Language. XML is a standardised computer language that enables communication between different systems. XML allows a concrete implementation of AICM and the schema validates the XML.



AIXM in EAD (today)



Static data
Update

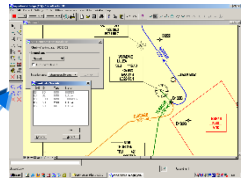
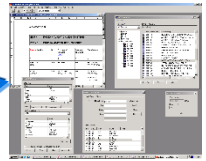
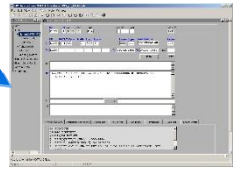


Chart Production



(e)AIP Production



Support NOTAM production

(SDO) Based on AIXM 4.5

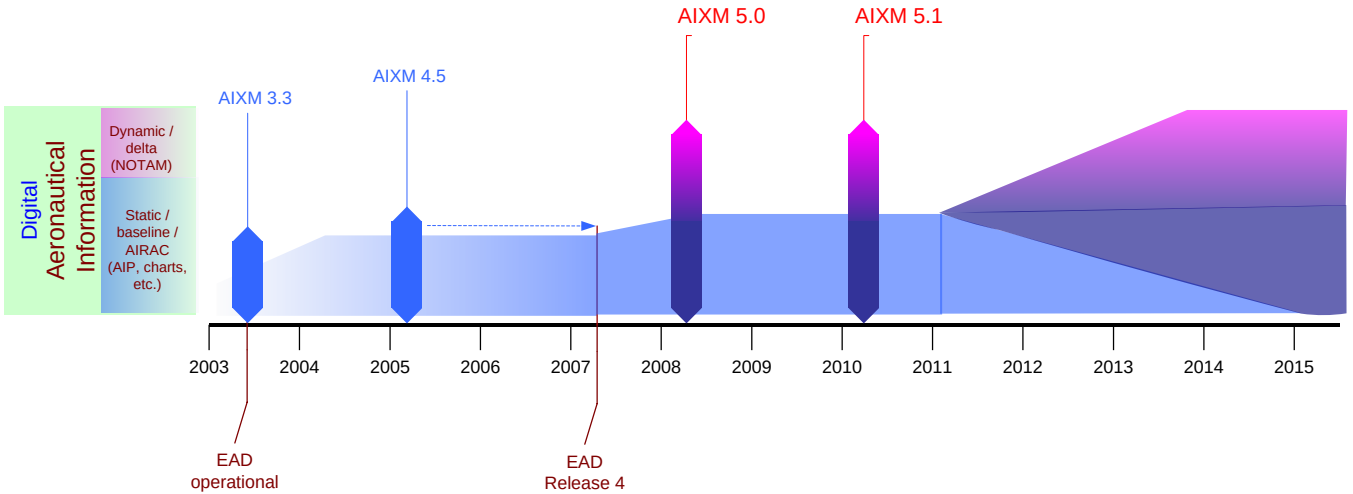
Digital Data Input
(AIXM 4.5 XML)

Provided by industry.
Similar implementation
in local AIS systems

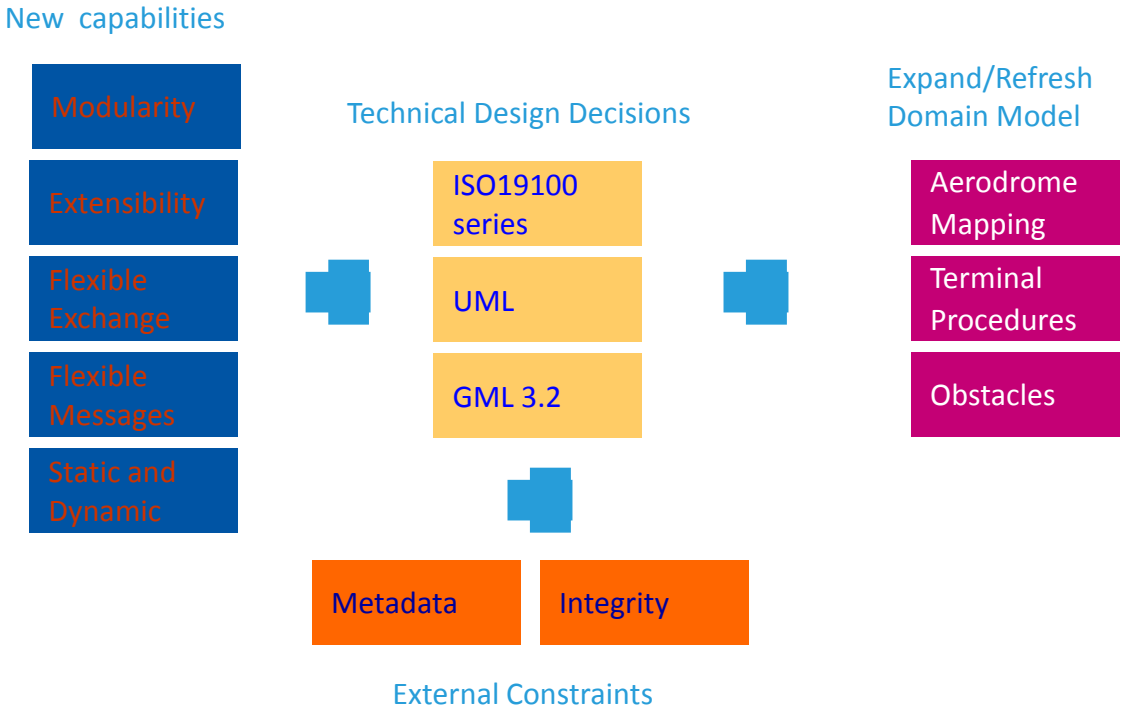
AIXM 4.5 / 5.1 XML output

AIXM version 5

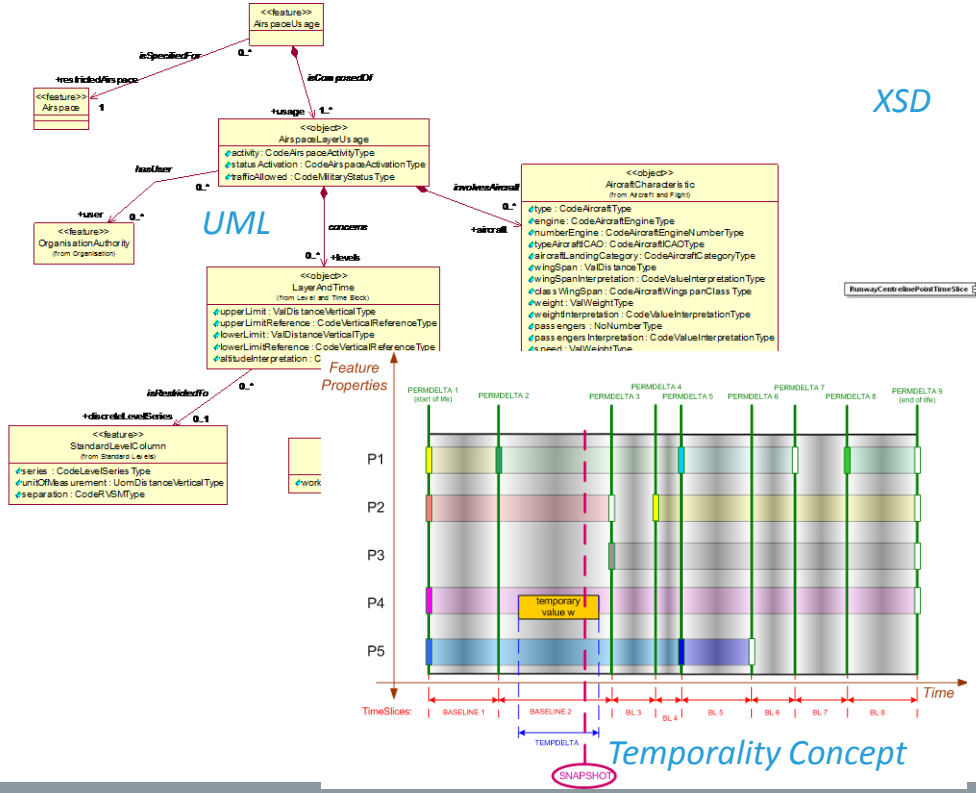
Joint development EUROCONTROL – FAA
(with the support of the international AIS community)



AIXM 5 Design Objectives



AIXM version 5.1



www.aixm.aero

www.aixm.aero

EUROCONTROL > FAA > Download

- Home
- Introduction
- Key Concepts
- **Download**
- Implementation
- Community
- Archive

Download

This page contains the latest AIXM 5 Release: **AIXM 5.1**.

The Downloads

AIXM 5.1: AIXM Conceptual Model

This is the AIXM Conceptual Model.

The UML comes in a zip file that contains the Rational Rose model file (.mdl). There is a matching XMI export.

The following support material is available:
- the model exported as a Rational Rose Webview
- a simple HTML dictionary of the classes in the UML.

UML Model - 527 KB
XMI - 325 KB
WebView - 12, 818 KB
Dictionary - 3, 572 KB

Date: 01/02/2010

AIXM 5.1: AIXM XML Schema

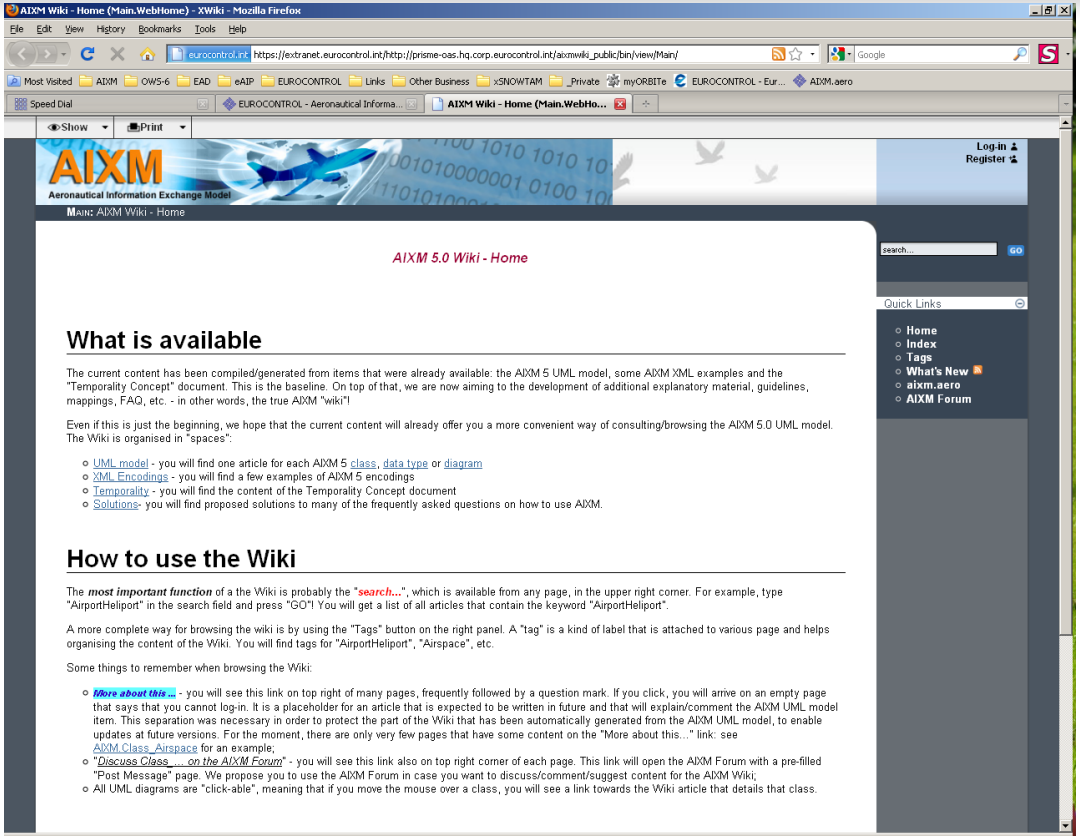
The first zip file contains the AIXM XML Schema files. These include the core AIXM Schema files as well as the Schemas for ISO 19136 and ISO 19139 and the AIXM Basic Message.

The second zip file contains the same files as the first. However, the annotations are included in the AIXM XML Schemas for those who need that information.

The last zip file contains some short examples of AIXM 5.1 XML.

AIXM Wiki

www.aixm.aero/wiki



AIXM Forum


AIXM Forum - Mozilla Firefox
File Edit View History Bookmarks Tools Help
EUROCONTROL - Aeronautical Informati...
AIXM Forum
www.eurocontrol.int/agor/BrowseMessages.do?browseAction=browseSearchedMessage&messageId=17577#17577
puy du fou
Most Visited AIXM EAD eAIP EUROCONTROL SJU Aviation Other Business xNOWTAM OWS-8 _Private
EUROCONTROL
Forum
AIXM
contact us | FAQ | your privacy | policy | disclaimer | you are logged in as EDUARD POROSNICU [EUROCONTROL]
Tuesday, Apr 24, 2012
Members connected: 2
Home
Post a Message
Search
Guestbook
Tell a friend
Forum List
AI Operations
AIS Agora
AIXM Forum
eTOD Forum
View postings by:
Author
Posting Date
AIXM Version
Conceptual Model
Digital NOTAM
Events
XML Schema
Customise
Edit Account
Edit Profile
Update Picture
Facilitate
Logoff
Audience : All Users
Conceptual Model : General
XML Schema : Timeslices
AIXM Version : 5.1
Events : (Not Applicable)
Digital NOTAM : (Not Applicable)
Author: MARÓY, Ákos (TYRELL CORPORATION, Hungary)
Posting: Fri 20/04/2012 15:06
Subject: name collision in schema for element "name" for types extending AbstractGMLType?
Attachment:
Reply Reply/quote Forward Print-friendly frnt
Hi, I'm new to the AIXM XML Schema, and I'm in the process of studying it, and trying to use JAXB to generate a Java API to work with AIXM data. Having done a naive JAXB code generation based on the AIXM schema, I found a name collision for some of the types which exted AbstractGMLType. in short, AbstractGMLType has an element by the name 'gml:name', whereas some types defined by AIXM also have an element by the name 'name'. For example AirspaceTimeSliceType is such a type. in addition, types of these conflicting elements is different. to be specific: AirspaceTimeSliceType refers to AirspacePropertyGroup, which contains the following element: while AirspaceTimeSliceType extends AbstractAIXMTimeSliceType extends AbstractAIXMTimeSliceBaseType extends gml:AbstractTimeSliceType extends AbstractGMLType, where AbstractGMLType contains the group gml:StandardObjectProperties, which defines a 'name' element as well: I wonder how this naming collision is supposed to be handled. Akos
Author: NEIDBALLA, Rich (AERONAVDATA, United States of America)
Posting: Fri 20/04/2012 15:59
Subject: Re: name collision in schema for element "name" for types extending AbstractGMLType?
Attachment:
Reply Reply/quote Forward Print-friendly frnt
Hello:
I am a .Net Developer, but this issue has been discussed and I believe solved for Java developers who have used XmlBeans to generate an API for AIXM. If I remember right, it involved using a config file to handle these naming collisions.
Not familiar with JAXB (or XmlBeans even), but I would think you

AIXM 5.1 – Digital NOTAM capability

TWY closure

- Currently, published as NOTAM

A0874/03 NOTAMN
Q) EBBU/QMXLC/IV/M/A/000/999/5054N00429E005
A) EBBR
B) 0308250500 C) 0310271600 <OK for computers>
E) TAXIWAYS OUTER 7 AND E6 CLSD <not OK for computers>

- With Digital NOTAM - AIXM 5.1 encoded message
  - Something like this …

```
<taxiway>
  <name>OUTER 7</name>
  <status>CLOSED</status>
</taxiway>
<taxiway>
  <name>E6</name>
  <status>CLOSED</status>
</taxiway>
```

AIXM Temporality document

1. The need for a temporality model

Time is an essential aspect on the aeronautical information world, where change notifications are usually made well in advance of their effective dates. Aeronautical information systems are requested to store and to provide both the current situation and the future changes. The expired information needs to be archived for legal investigation purposes.

For operational[1] reasons, a distinction is usually made between:

- *permanent changes* (the effect of which will last until the next permanent change or until the end of the lifetime of the feature) and
- *temporary status* (changes of a limited duration that are considered to be overlaid on the permanent state of the feature).

A temporary change includes the concepts of overlay and reversion. The temporary change is overlaid on the permanent feature state. When the temporary change ends, the temporary changes no longer apply and we revert back to the permanent feature state.

Note that, from an operational point of view, "temporary status" also includes the concept of "temporary features". However, from the AIXM point of view, temporary features are in no way different from normal features. The feature is created and withdrawn, just that the life span is shorter than usual.

In order to satisfy the temporal requirements of aeronautical information systems, AIXM must include an exhaustive temporality model, which enables a precise representation of the states and events of aeronautical features. In particular, this shall enable the development and the implementation of digital **NOTAM**. By digital NOTAM we mean replacing the free text contained in a NOTAM message with structured facts, which enable the automated processing of the information.

A general temporal model should be uniformly applied to all aeronautical feature types and the temporality concept should be abstracted from the task of modeling object properties. At the conceptual level, the model should describe the temporal evolution of the features, as they occur in the real world. This shall be done in compliance with the following rules:

- Completeness - all temporal states must be representable;
- Minimalism - use of minimal number of elements;
- Consistency - no sense of elements with different meaning;
- Context-free - meaning of (atomic) elements independent of context; no functional dependency of (atomic) elements at the data encoding level;

The data exchange specification shall support the conceptual model. In addition, convenience elements ("views") may be introduced in the data exchange specification in order to facilitate the operations. This means that the data exchange specification may deviate from the "minimalism" rule.

[1] For example, systems that produce printed aeronautical documentation (AIP, charts) tend to ignore temporary status information; only the static data is represented on such printed products.

2. Building the Temporality Model

2.1 (step 1) Time varying properties

There are two levels at which aeronautical feature instances are affected by time:

- Every feature has a start of life and an end of life;
- The properties of a feature can change within the lifetime of the feature; this includes the possibility for a property to not be defined over a time period.

The start of life and the end of life may also be considered as feature properties (attributes). This gives the following high-level list of properties for any AIXM feature:

- a global unique identifier;
- the start of life (date and time);
- the end of life (date and time);
- attributes and associations that qualify, quantify or relate in some form that feature.

It is considered that any feature property may change in time, except for the global unique identifier. This is a key assumption of the AIXM Temporality model.

The first step in the construction of the AIXM temporality model is represented by the diagram below, which shows the values of a feature's properties (P1, P2, … P5) along a timeline.

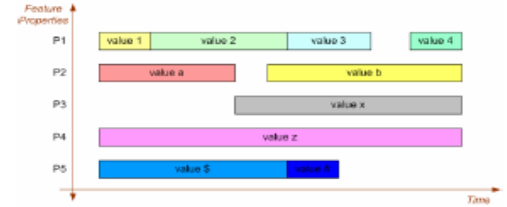


Figure 1

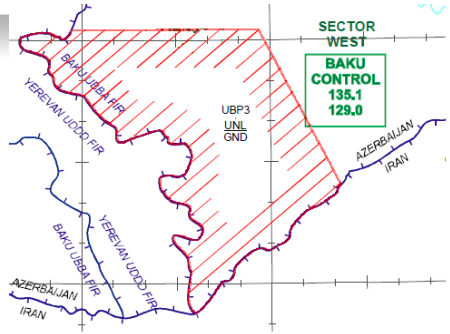
Discussion: ***Can the start of life and the end of life properties of a feature vary in time?***

At first sight, probably not. A feature is created at a moment in time and will cease to exist at another moment in time. But this is true only when considering the already known history of a feature. When exchanging data about the future, there might be situations where the start/end of life is planned to happen at a certain date/time and this date might change.

Therefore, we have to include the start/end of life of a feature in the time varying properties list.

Implementation Guidance

- GML Guidelines for aviation data
  - Encoding rules / conventions
  - Profile
- OGC Aviation Domain WG
  - See OGC Portal



8.2 GML encoding

The encoding of GeoBorder references can be done in two ways:

- either using the "annotation" property of an aixm:Curve, for applications where a simple text remark is sufficient;
- or using the xlink:href attribute of a gml:curveMember, for applications where a true reference needs to be preserved.

```
<aixm:Airspace gml:id="urn.uuid.1965dd58-6898-4065-8f21-b1774c959bbb">
    ...
        <aixm:horizontalProjection>
          <aixm:Surface gml:id="S001" srsName="urn:ogc:def:crs:EPSG::4326">
            <gml:polygonPatches>
              <gml:PolygonPatch>
                <gml:exterior>
                  <gml:Ring>
                    <gml:curveMember>
                      <gml:Curve gml:id="CUR001">
                        <gml:segments>
                          <gml:LineStringSegment interpolation="linear">
                            <!-- because the two consecutive points have the same latitude, the first segment is
encoded as a parallel (linear interpolation in EPSG:4326) -->
                            <gml:posList> 40.05 45.88972222 40.05 46.93333333</gml:posList>
                          </gml:LineStringSegment>
                          <gml:GeodesicString interpolation="geodesic">
                            <gml:posList>40.05 46.93333333 39.42916667 47.36333334</gml:posList>
                          </gml:GeodesicString>
```

Implementation Guidance

Use of xlink:href and UUID


```
<aixm:clientAirspace xlink:href="urn:uuid:a82b3fc9-4aa4-4e67-8def-aaea1ac595j"/>
```

Implementation Guidance

- Metadata Profile
  - Requirements for Aviation Metadata
  - Guidance on the Aviation Metadata Profile
- Business Rules
- CRC
- Etc.

Requirement/Source	Annex 15	ADQ	INSPIRE IR	OWS-6
5.1.1 Resource Title				
5.1.2 Resource Abstract				
5.1.3 Resource Language				
5.2.1 Topic Category				
5.3.1 Geographic Bounding Box				
5.3.2 Spatial Reference System				
5.4.1 Temporal Extent				
5.4.2 Date of Publication				
5.4.3 Date of Last Revision				
5.4.4 Date of Creation				
5.4.5 Temporal Reference System				
5.5.1 Lineage				
5.5.2 Accuracy of Numerical Data				
5.6.1 Conditions Applying to Access and Use				
5.6.2 Limitations on Public Access				
5.7.1 Responsible Party				
5.7.2 Responsible Party Role				
5.8.1 Metadata Point of Contact				
5.8.2 Metadata Date				
5.8.3 Metadata Language				

Global AIM Congress c 6

- Recommendation 1
  - *"ICAO adopt the AICM/AIXM as the standard aeronautical information conceptual model and the standard aeronautical information exchange model, and*
    - *develop appropriate means of compliance, and*
    - *global mechanisms to manage and develop the AICM/AIXM"*

ICAO SARPS

36 (Thirteenth Edition)	The Secretariat with the assistance of the Aviation Use of the Public Internet Study Group (AUPISG) and the Aeronautical Information Services-Aeronautical Information Management Study Group (AIS-AIMSG); recommendations of the fourth meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/4)	New provisions relating to the operational use of the public Internet; the reporting of volcanic ash deposition; quality management systems; the use of automation enabling digital data exchange; electronic aeronautical information publications; the NOTAM Format; and electronic terrain and obstacle data.	22 February 2010 12 July 2010 18 November 2010; 12 November 2015

3.6.5 Use of automation

Recommendation.— *Automation enabling digital data exchange should be introduced with the objective of improving the speed, quality, efficiency and cost-effectiveness of aeronautical information services.*

Note.— Guidance material on an aeronautical conceptual and data exchange model for the development of databases and the establishment of data exchange services is contained in Doc 8126.

AMDT 37 expected to make this a mandatory requirement and provide more details

Draft AMDT 37 to Annex 15

3.6 ~~3.6.5~~ Use of automation

3.6.1 **~~Recommendation.~~** ~~—~~Automation ~~*enabling digital data exchange should*~~ shall be introduced with the objective of improving the timeliness speed, quality, efficiency and cost-effectiveness of aeronautical information services for all users in the ATM system.

3.6.4 In order to meet the data quality requirements ~~as provided in Tables A7-1 to A7-5 of Appendix 7~~ automation shall:

a) enable digital aeronautical data exchange between the parties involved in the data processing chain; and

b) use globaly interoperable aeronautical information and data exchange models.

Note.— Guidance on the aeronautical information and data exchange models is included in Doc. 8126.

See: http://www2.icao.int/en/ais-aimsg/AISAIM%20Meeting%20MetaData/SN%202%20complete.pdf

Draft AMDT 37 to Annex 15

3.6.5 The globaly interoperable aeronautical information model used shall meet the following minimum performance requirements:

a) use the Unified Modeling Language (UML) to describe the aeronautical information features and their properties, associations, and data types;

b) include data value constraints and data verification rules;

c) cover the aeronautical information contained in AIS products and data sets provided by the AIS;

d) include provisions for metadata as specified in section 3.4.2; and

e) include a temporality model to enable capturing the evolution of the properties of an aeronautical information feature during its life cycle.

3.6.6 The globaly interoperable aeronautical data exchange model used shall meet the following minimum performance requirements:

a) apply a commonly used data encoding format;

b) cover all the classes, attributes, data types and associations of the UML information model mentioned in 3.6.5; and

c) provide an extension mechanism, by which groups of users can extend the properties of existing features and add new features which are not relevant for global standardization.

Note.—The Extensible Markup Language (XML) and Geography Markup Language (GML) are commonly used data encoding formats.

ICAO SARPS

36 (Thirteenth Edition)	The Secretariat with the assistance of the Aviation Use of the Public Internet Study Group (AUPISG) and the Aeronautical Information Services-Aeronautical Information Management Study Group (AIS-AIMSG); recommendations of the fourth meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/4)	New provisions relating to the operational use of the public Internet; the reporting of volcanic ash deposition; quality management systems; the use of automation enabling digital data exchange; electronic aeronautical information publications; the NOTAM Format; and electronic terrain and obstacle data.	22 February 2010 12 July 2010 18 November 2010; 12 November 2015

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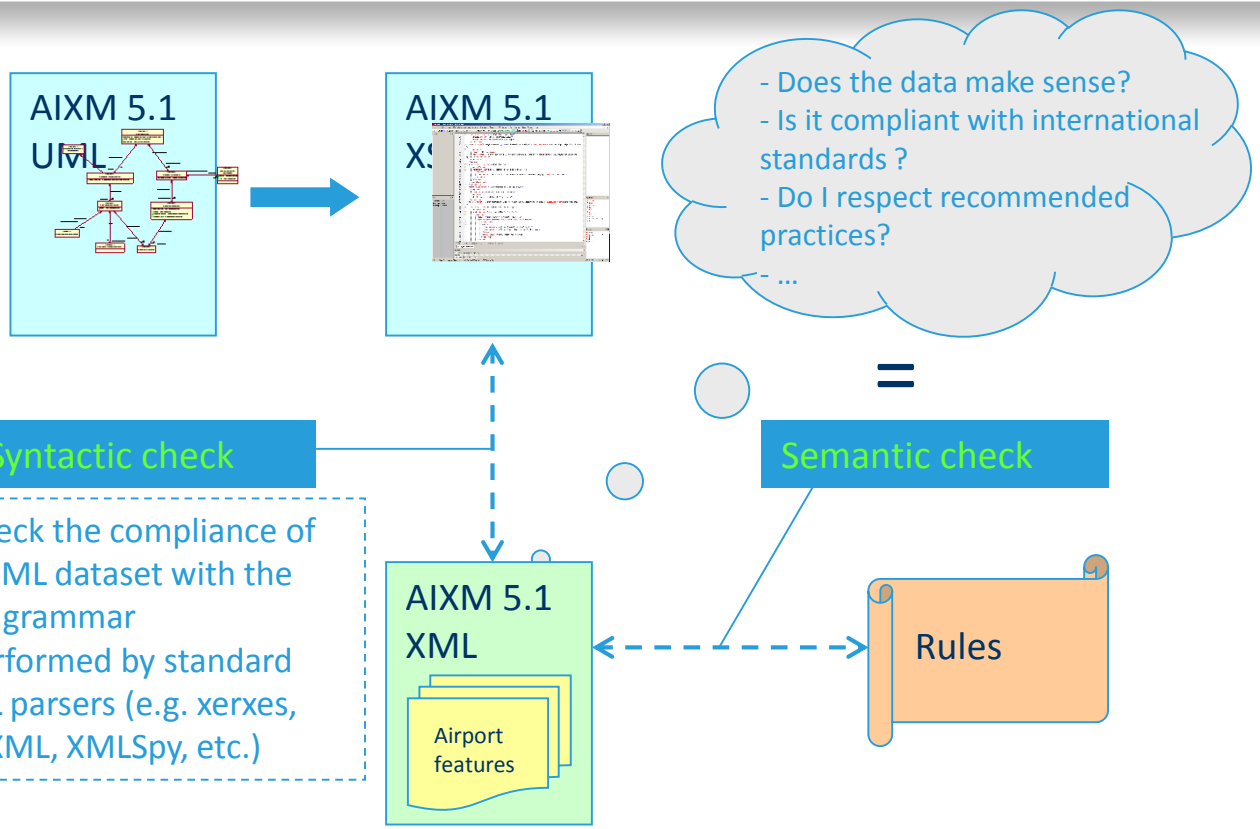
Validation of AIXM 5.1



SBVR specification

- SBVR = (OMG) Semantics of Business Vocabulary and Business Rules
  - defines the vocabulary and rules for documenting the semantics of business vocabularies, business facts, and business rules.

- It identifies two types of business rules
  - **Structural rules**
  - **Operative rules**

- AIXM 5 has adopted this terminology and identifies the following business rules:
  - **AIXM Structural rules**: the enumerations of values (datatypes)
  - **AIXM Operative rules**: rules extracted from official documents (ICAO Annexes), minimum data rules, consistency rules, recommended practices, coding rules…

1st AIXM 5.1 Business Rules Report

- Currently, an **Excel report**
  - Containing **textual rules** classified by type etc…
  - Providing **Schematron** code
  - Working Draft status
- AIXM Users are able to pick-up the rules they need for their systems

	A	B	C	D	E
307		**Source**	**§**	**Rule expressed in SVBR**	**Comments** ***(usually contains the original wording of the rule)***
308	0	ICAO Annex 15	section 3.7.1.1	Each […] that has an srsName must have srsName = 'urn:ogc:def:crs:OGC:1.3:CRS84'	All geographical coordinates should be expressed in the WGS 84 sys [Standard - Source: ICAO Annex 15, item 3.7.1.1]
309	1	AIXM 4.5 Business Rules	generic rule 02	Each ElevatedCurve that has a verticalAccuracy must have an elevation	VAL_ELEV_ACCURACY may be specified only if VAL_ELEV has bee
310	2	AIXM 4.5 Business Rules	generic rule 03	Each ElevatedPoint that has a verticalAccuracy must have an elevation	VAL_ELEV_ACCURACY may be specified only if VAL_ELEV has bee
311	3	AIXM 4.5 Business Rules	generic rule 05	Each ElevatedCurve that has a geoidUndulation must have an elevation	VAL_GEOID_UNDULATION may be specified only if VAL_ELEV has l specified
312	4	AIXM 4.5 Business Rules	generic rule 06	Each ElevatedPoint that has a geoidUndulation must have an elevation	VAL_GEOID_UNDULATION may be specified only if VAL_ELEV has l specified

ARC Tool

Validate business's rules

Page 1 of 9

Profile: 4.5_fat.xml- Date: 2007-06-21 / Time: 11:25:00+00:00 AIXM
Version: 4.5/ Source File: _Baseline.xml

AERO_GND_LGT - SIBY ABN

CODE_TYPE

Error

If CODE_TYPE = 'HBCN', 'IBN', 'SIG' or 'ABN then TXT_NAME and TXT_NAME of the related AD_HP must match
[Consistency rule - Source AIXM]

AD_HP_COLLOCATION - EADD EADH

TXT_DESCR

Error

If the value of the CODE_TYPE is anything else than 'F' (i.e. full collocation), a textual description of the shared parts has to be given. Therefore the TXT_DESCR is mandatory in this case
[Consistency rule - Source AIXM]

AD_HP - EADH

ADDRESS relationship

Warning

For every aerodrome/heliport there must be at least one postal address and one telephone number defined
[Minimal data rule - Source AIXM]

AD_HP_NAV_AID - EADD BOR 522206N 0322230W

COORDINATES

Error Parameter: 20000

The position of the related SIGNIFICANT_POINT must be plausibly close to the position of the ARP (within 20 KM/20000m)
[Data plausibility rule - Source AIXM]

AIRSPACE - FIR AMSWELL

CODE_TYPE

Error

If CODE_TYPE has the value 'FIR' or 'UIR', than CODE_LOC_IND is mandatory
[Consistency rule - Source AIXM]

AIRSPACE - TMA DONLON

UOM_DIST_VER_UPPER

Error

If the unit of measurement has the value 'FL' or 'SM', then the attribute CODE_DIST_VER_UPPER must have the value 'STD' (standard pressure).
[Technical rule - Source AIXM]

AIRSPACE - TMA NIBORD

UOM_DIST_VER_UPPER

Error

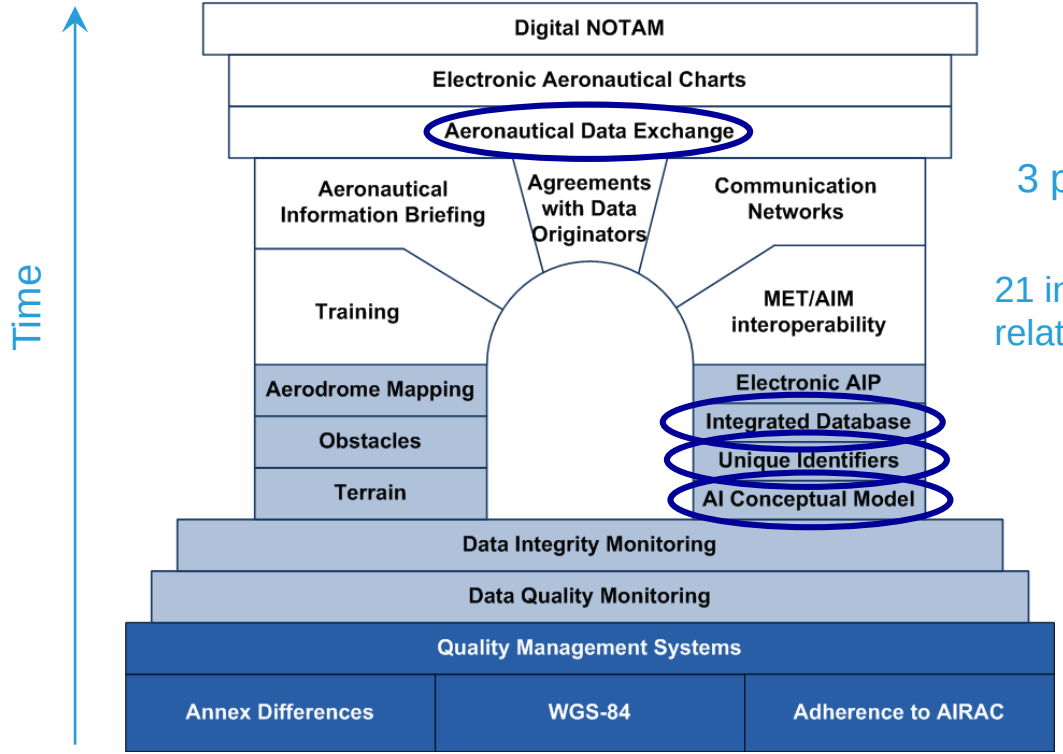
If the unit of measurement has the value 'FL' or 'SM', then the attribute CODE_DIST_VER_UPPER must have the value 'STD' (standard pressure).
[Technical rule - Source AIXM]

AIRSPACE - POLITICAL DONLON

Aeronautical Data Quality (ADQ)

- ADQ 1
  - COMMISSION REGULATION (EU) No 73/2010
    - "*laying down requirements on the quality of aeronautical data and aeronautical information for the single European sky*"
    - Basically; Turning Annex 15 into European Law
    - Compliance dates: 2013-2017
  - Means of Compliance
    - Electronic AIP (eAIP) — Published
    - *Aeronautical Information Exchange (AIX)* — *Final Draft*
      - ***AIXM 5.1 is proposed as compliant model***
    - Data Quality Requirements (DQR) — Under development
    - Data Assurance Levels (DAL) — Under development
    - Data Origination (DO) — Under development

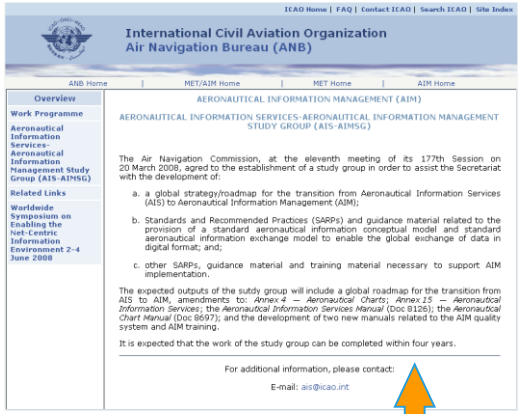
ICAO AIS to AIM Roadmap



3 phases

21 inter-related steps

AIXM 5.1 proposed to ICAO



AIXM Change Control Board - mandate

- Transparency
- Stakeholder representation
  - States, Military
  - ANSP, Service Providers
  - Airlines, Airports
  - Manufacturing industry
- Decisions by consensus!
  - Change proposals developed collectively
  - If no serious disagreement with a change proposal is notified (silent process) -> adopted
  - A widely acceptable solution needs to be found for any issue!

Roles

- CCB Member
  - Any AIXM stakeholder (organisation)
    - Raise/comment issues
    - Develop/review change proposals
- CCB Secretariat - Eurocontrol and FAA
  - JIRA maintenance
  - Drives the change proposal process
    - but does not take decisions in isolation!
  - Implements the model changes
  - Maintains www.aixm.aero and related Web sites
- CCB Advisory Board
  - Maximum 20 members - Representatives of stakeholder groups
  - Maintain the “AIXM CCB Charter”
  - Witness the correctness of the CCB process
  - Receive regular reports from Secretariat
  - Not requested to approve individual changes!

Future versions policy

- Major Version (v.5, v.6, etc.)
  - None foreseen for the moment
- Intermediate Version (v.5.x, v.6.x, etc.)
  - Every 3-4 years
  - Include bi-directional mapping rules
  - AIXM 5.2 not earlier than end 2013
    - CCB process to start in Q2 2012
- Minor Version (v.5.1.x, v.5.2.x, etc.)
  - Probably AIXM 5.1.1 in 2012
    - Editorial bugs – corrections
    - Enable gml:identifier for “objects”

ICAO

THANK YOU