



AICM-AIXM History and Overview (Dakar, Senegal, 3-5 October 2016)

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RO/AIM

Agenda Items 6a





AICM – the beginning

- 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 conceptual model
 - Data model for the European AIS Database (EAD)
 - Basis for eAIP
 - Basis for aeronautical data exchange specification
 - Contribution to ICAO (AIS/MAP Divisional Meeting of 1998)
 - etc.



AICM – the beginning

- **Aeronautical Information Conceptual Model (AICM)**
 - October 1996 - drafting group established
 - Based on
 - ICAO Annexes
 - “real” AIP
 - ARINC 424
 - Entity-Relationship methodology
- **October 1997, AICM Edition 1.0**
 - Aerodromes, heliports, runways, ...
 - Navaids, significant points, navigation systems, ...
 - Routes, usage restrictions, traffic flow restrictions (RAD), ...
 - SID/STAR/IAP/HOLDING, ...
 - Airspace, Services and Organisations, ...
 - AIS Documents - AIP, AIC, SUP, NOTAM, ...

View diagrams

View: Entities definition

- ILS_LLZ
- MKR
- MLS
- MLS_AZIMUTH
- MLS_ELEVATION
- MSA
- MSA_GROUP
- NAVAID_LIMITATION
- NAV_SYS_CHECKPOINT
- NDB
- OBSTACLE
- OCA_OCH
- OIL
- ORG_AUTH
- ORG_AUTH_ADDRESS
- ORG_AUTH_ASSOC
- PASSENGER_FACILITY
- PREDEFINED_LVL
- PREDEFINED_LVL_COLUMN
- PREDEFINED_LVL_TABLE
- PROCEDURE_LEG
- RTE_PORTION
- RTE_SEG
- RTE_SEG_USE
- RTE_SEG_USE_LVL
- RWY
- RWY_CLINE_POINT

The local angular difference between the true North and the magnetic North.

Rules:

- If VAL_MAG_VAR is specified, then DATE_MAG_VAR is mandatory.

Domain: VAL_ANGLE_MAG_VAR

DATE_MAG_VAR [Magnetic variation date] *optional*

The year the magnetic variation was measured.

Domain: DATE_YEAR

CODE_EM [Emission] *optional*

A code indicating the type of emission, as defined at the 1979 ITU World Administrative Radio Conference. E.g. A3E, NONA2a, G1D, etc..

Domain: CODE_EM_RDO

CODE_DATUM [Datum] *mandatory*

A code indicating the geodetic datum in which the geographical co-ordinates are expressed.

Rules:

- All geographical coordinates should be expressed in the WGS 84 system.

Domain: CODE_DATUM

VAL_GEO_ACCURACY [Geographical accuracy] *optional*

The horizontal distance from the stated geographical position position falling.

Rules:

- If VAL_GEO_ACCURACY is specified, then UOM_GEO

Domain: VAL_DIST_HORZ

CODE_DATUM Format: ALPHA(1,3)

A code indicating the geodetic datum in which the geographical co-ordinate WGS-84 Manual; abbreviations based on ARINC 424, Attachment 2).

Allowable values:

- WGE** [WGS-84 (GRS-80)]
- WGC** [WGS-72]
- EUS** [European 1950 (ED 50)]
- EUT** [European 1979 (ED 79)]
- ANS** [Austria NS]
- BEL** [Belgium 50]

Diagram: [029_NAV_AID] Zoom: 100%

```

    graph TD
      VOR[VOR] -- co-located with --> SIGNIFICANT_POINT[SIGNIFICANT_POINT]
      DME[DME] -- co-located with --> SIGNIFICANT_POINT
      VOR -- used as --> SIGNIFICANT_POINT
      DME -- used as --> SIGNIFICANT_POINT
      SIGNIFICANT_POINT -- considered as --> SIGNIFICANT_POINT
  
```

VOR Entity Attributes:

- CODE_ID
- GEO_LAT
- GEO_LONG
- TEXT_NAME
- CODE_TYPE
- VAL_FREQ
- UOM_FREQ
- CODE_TYPE_NORTH
- VAL_DESIGNATION
- VAL_MAG_VAR
- DATE_MAG_VAR
- CODE_EM
- CODE_DATUM
- VAL_GEO_ACCURACY
- UOM_GEO_ACCURACY
- VAL_ELEV
- VAL_ELEV_ACCURACY
- VAL_GEOE_LONGITUDE
- UOM_DIST_HORZ
- VAL_CIC
- TEXT_VER_DATUM
- TEXT_RMK

DME Entity Attributes:

- CODE_ID
- GEO_LAT
- GEO_LONG
- TEXT_NAME
- CODE_CHANNEL
- VAL_GHOST_FREQ
- UOM_GHOST_FREQ
- VAL_DISPLACE
- UOM_DISPLACE
- CODE_EM
- CODE_DATUM
- VAL_GEO_ACCURACY
- UOM_GEO_ACCURACY
- VAL_ELEV
- VAL_ELEV_ACCURACY

AIXM – based on AICM

- Aeronautical Information Exchange Model (AIXM)
 - Requirements
 - AIP database update specification
 - Update/snapshot messages
 - Based on AICM
 - Non-proprietary format
 - Possibilities
 - Position based (example: ARINC 424)
 - Keyword based (example: ADEXP), etc.
- March 1998, first draft (MITRE support)
 - Initial approach 'SQL like' messages
- 1999 - discovered the Extensible Markup Language (XML)
 - Early adoption





AIXM – XML

- XML advantages
 - Industry standard
 - Non-proprietary format
 - Main stream in IT
 - Largely supported by COTS software
 - Set of schema languages
 - XML Schema has limitations? use Schematron!
 - Human and machine readable
 - Typical for the aviation domain
 - Examples: NOTAM, flight plan, MET messages ...
 - Emerging standards such as GML, SVG, etc.



AIXM – XML language for AIM

- **XML Schema**
- **Vocabulary – based on AICM**
 - AIXM data types
 - Example: fire fighting category for aerodrome/heliport `<codeCatFireAd> = {1, 2, 3, ... 9}`
 - AIXM Features
 - Example: VOR `<Vor>`
 - AIXM Feature attributes
 - Example: VOR Frequency `<valFreq>`, working hours `<Vtt>` - complex structure
- **Grammar (database update mechanism)**
 - AIXM-Update message type
 - “On ... at ..., the following VOR, RWY, ... will be introduced/changed/withdrawn as follows ...”
 - AIXM-Snapshot message type
 - “I have the following information about these VOR, AD, RWY ...”



ICA

U:\EAIP\EDGR\AIXM\XML\Work\2002_01_25 by Umesb\Example_update.xml

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit Real.com

Address U:\EAIP\EDGR\AIXM\XML\Work\2002_01_25 by Umesb\Example_update.xml Links

```
<?xml version="1.0" encoding="UTF-8" ?>
- <AIXM-update xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="AIXM-Update.xsd"
  Effective="2001-10-23T00:00:00" Origin="EAD" Created="2001-06-01T15:25:34">
- <Group Reason="Vor 'BXL' has been re-located and complemented with a Dme facility">
- <Changed>
- <!-- -->
- <VorUid>
  <codeId>BXL</codeId>
  <geoLat>514333.34N</geoLat>
  <geoLong>0032301.21E</geoLong>
</VorUid>
- <Vor>
- <VorUid>
  <codeId>BXL</codeId>
  <geoLat>514326.67N</geoLat>
  <geoLong>0032345.37E</geoLong>
</VorUid>
- <OrgUid>
  <txtName>BELGIUM</txtName>
</OrgUid>
  <txtName chg="1">BRUSSELS VOR</txtName>
  <codeType>DVOR</codeType>
  <valFreq>119.00</valFreq>
  <uomFreq>MHZ</uomFreq>
  <codeTypeNorth>MAG</codeTypeNorth>
  <codeDatum>WGE</codeDatum>
  <codeWorkHr>H24</codeWorkHr>
</Vor>
</Changed>
- <New>
- <Dme>
- <DmeUid>
  <codeId>BXL</codeId>
  <geoLat>514327.45N</geoLat>
  <geoLong>0032346.21E</geoLong>
```

Local intranet

Start Inbox ... NATO ... Slides ... WinZip ... [2001-0... Microso... marketing Index P... [2002-... U:\E...

16:34



AICM/AIXM - documentation

- Main resource: www.eurocontrol.int/ais/aixm
- AICM
 - Entity-relationship model reports and diagrams
 - AICM Manual (0.9) – work in progress for AICM 4.0
 - Tutorials
 - EUROCONTROL (Web Based Training module in development)
 - Commercial companies
 - Mappings
 - ARINC 424 <-> AICM 3.3 (see EAD Web site)
 - AIP <-> AICM (not yet publicly available)
 - ...
 - FAA site: www.faa.gov/aixm



AICM/AIXM - documentation

- AIXM
 - XML Schema files
 - AIXM Primer
 - Tutorials
 - Sample files
 - Real examples from EAD
- AIXM Change Descriptions
 - 25 changes between versions 3.3 and 4.0



AICM/AIXM – Evolution

- Original goals
 - initially developed for EAD
 - requirement: fully compliant with ICAO
 - few European specific constructs (ex: FUA)
 - “globally applicable aeronautical data exchange specification, compliant with ICAO SARPS (Standards and Recommended Practices) and satisfying the needs for international aeronautical information dissemination of the ECAC States”



AICM/AIXM – Evolution

- **Current situation**
 - operational systems using AIXM and systems in the final development stage
 - Change requests
 - Need for stability
 - “AIP database update specification”
 - potential AIXM users
 - (aggressive) changes requests
 - “AIXM should be extended to support aeronautical information services in general”
 - xNOTAM – major improvement for AIXM
 - Merge static and dynamic data in a single format
 - Requests for compliance with GIS standards
 - ISO 19100 series
 - GML, WFS



AICM/AIXM – Evolution

- World-wide adoption of a common aeronautical data exchange specification
 - AIXM has a high potential
- Current objective
 - globally applicable aeronautical data exchange specification
 - compliant with ICAO SARPS
 - satisfying the needs for international aeronautical information dissemination of the stakeholder States
 - including temporary changes (NOTAM)
 - existing investments shall be protected by a full backwards compatibility model
 - a standard extension mechanism shall enable the use of AIXM for a wider spectrum of aeronautical information services applications.



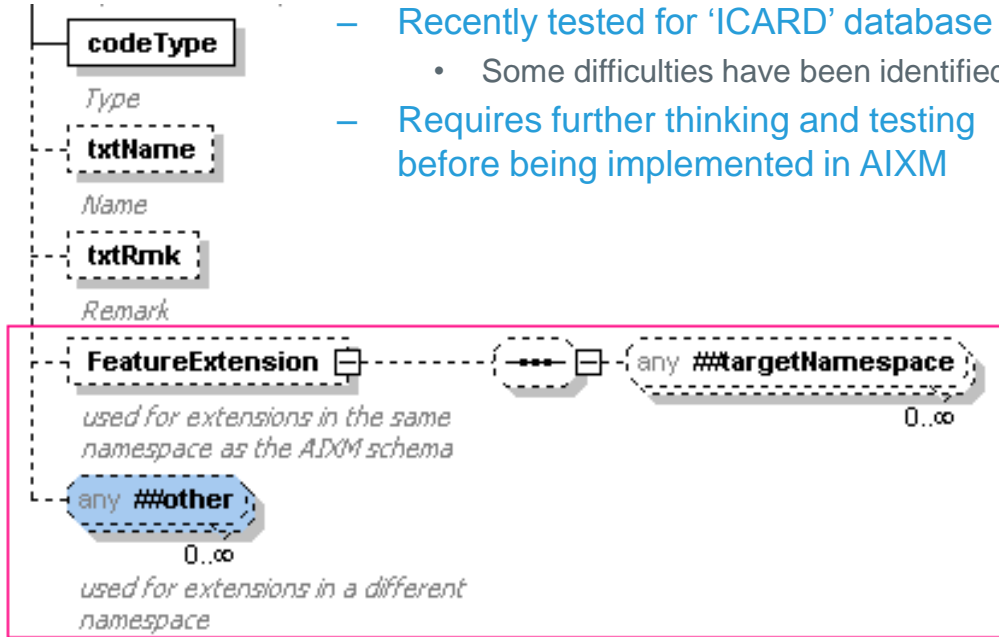
Extensibility

- Enable additions to the format by stakeholders other than the designers
 - “Changing an XML format by creating subsequent versions is usually done by the entity that controls the format, while extensions are typically added by third parties”
- Increasingly necessary
 - have more data in the XML instances than is described by the AIXM schema and still have a valid document
 - advantages
 - increased adoption of AIXM, through applications for which it was not primarily designed
 - reduce pressure on the ACCB to include in the model data local constructs



Extensibility

- One possible mechanism
 - Recently tested for 'ICARD' database
 - Some difficulties have been identified
 - Requires further thinking and testing before being implemented in AIXM





AIXM and GML

- AIXM does not have a defined geometrical model
 - Descriptive approach "how the shape was built/defined"
 - For example, the shape of an airspace may be defined:
 - using a series of vertex or
 - using a series of vertex in which we intercalate references to pre-defined open polylines called 'geographical borders', such as State political borders or
 - using airspace aggregations: rather than defining a border for it, the airspace is declared as being the result of unions, subtractions and intersections of other airspace or
 - using 'same horizontal shape as other airspace' associations.
 - Other features have a simple point by point description, as it is the case for 'centrelines'
- Inside a database/application, such descriptions are usually converted into geometrical representations specific to that system (Oracle Spatial, ESRI, etc.)



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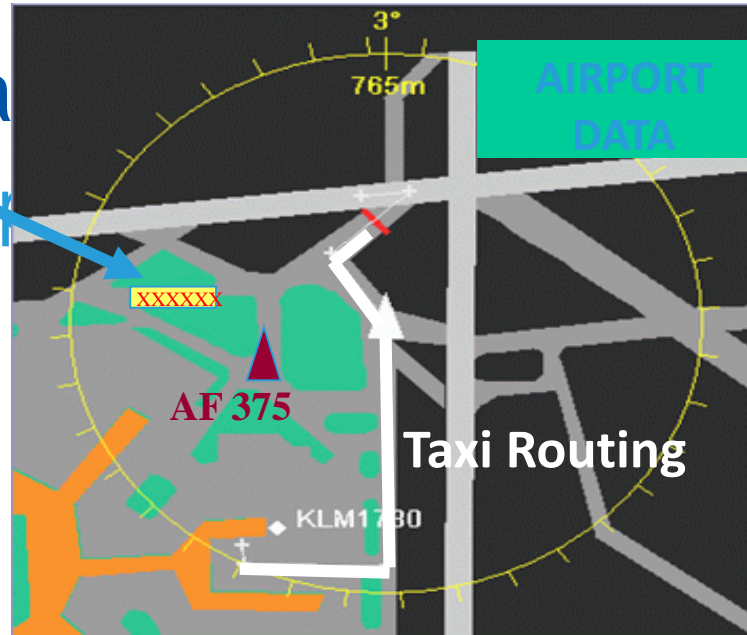
AICM/AIXM 4.5

- Main intended changes
 - New model for obstacles
 - point, line polygon
 - compliant ICAO AMDT 33 to Annex 15
 - Revised model for SID/STAR/IAP procedures
 - RNAV procedures
 - TAA model
 - Other changes
 - Oxygen services, APU units, etc.
 - Full application of the approved principles
 - Extensibility
- Intended publication date – summer 2005

AIXM 5.0

- Main intended change
– Notification of temporary (NOTAM (TWY closed))

Urgent need for fully computer interpretable real-time updates





Te

ons

TFR List TFR Map Map Airports TFR Help PilotWeb

Zoom In Zoom Out Pan Get Info Print Map Zoom US Zoom AK Zoom HI Zoom PR Zoom CB

Select Center to zoom
Select a center [v]
GO

Select State to zoom
Select a state [v]
GO

Map Layers

- NOTAM
- Lat/Long Grid
- SUA's
- City
- Metropolitan Statistical Areas (MSA) *
- Highways *
- apt Airports *
- Centers

Update Map



xNOTAM – example

- **Danger area activation – current NOTAM**

(A1905/04 NOTAMN

Q) LGGG/QRDCA/IV/BO/W/000/150/3648N02342E028

A) LGGG

B) 0411010600 C) 0412311300

D) NOV 01 TIL DEC 31 DAILY 1600-1930

E) LGD76 KARAVIA ISLANDS ACTIVATED RAC 5-1-9 REF.

F) AMSL G) FL150)



```

<AIXM-update effective="2004-11-01T06:00:00" (message type)
origin="GREECE NOF" created="2004-10-15T10:18:34">
  <Group><Changed> (update type)
    <Ase> (affected facility)
      <AseUid><!--Airspace Identifier -->
        <codeType>D</codeType> <codeId>LGD76</codeId> (vertical limits)
      </AseUid>
      <codeDistVerUpper>STD</codeDistVerUpper>
      <valDistVerUpper>150</valDistVerUpper>
      <uomDistVerUpper>FL</uomDistVerUpper>
      <codeDistVerLower>ALT</codeDistVerLower>
      <valDistVerLower>0</valDistVerLower>
      <uomDistVerLower>FT</uomDistVerLower>
      <codeOpsStatus>ACTIVE</codeOpsStatus> (condition)
      <Att> (activation time)
        <codeWorkHr>TIMSH</codeWorkHr>
        <Timsh><codeTimeRef>UTC</codeTimeRef>
        <dateValidWef>01-11</dateValidWef>
        <dateValidTil>31-12</dateValidTil>
        <codeDay>WD</codeDay>
        <timeWef>16:00</timeWef><timeTil>19:30</timeTil>
      </Timsh></Att></Ase>
      <TEMP until="2004-12-31T11:30:00" /> (is temporary)
    </Changed></Group></AIXM-update>
  
```




ICAO DAKAR UNITING AVIATION



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Central American
and Caribbean
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Mexico City

South American
(SAM) Office
Lima

ICAO
Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
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(MID) Office
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Asia and Pacific
(APAC) Sub-office
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(APAC) Office
Bangkok



THANK YOU