AIXM - current and future evolution

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AIXM/UML/XML/GMLWorkshop
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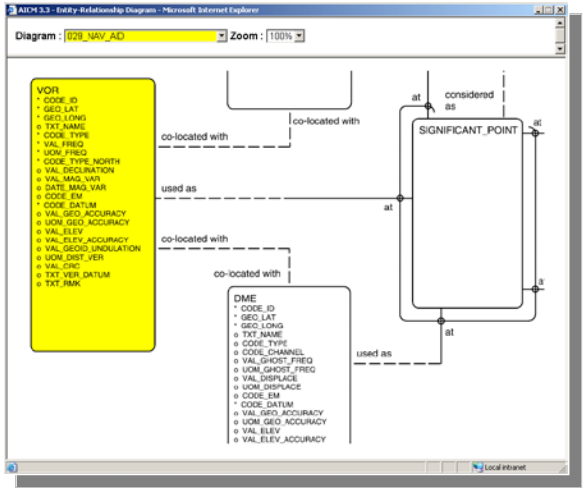
Content

- Current status
- Implementation
- Related specifications
- Future evolution

AIXM 4.5

- Published: 2005
  - Entity/Relationship
  - Custom XML schema
  - Core AIP data
- Usage:
  - European AIS Database (EAD) and European national systems
  - Around 20 other AIS national systems world-wide

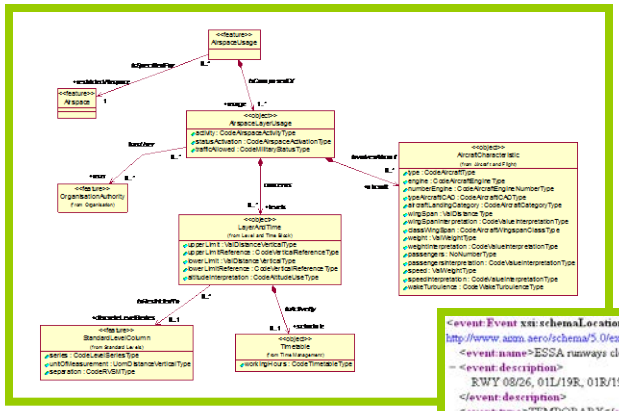



```
<AIXM-Snapshot>
    <Vor>
        <VorUid>
            <codeID>AML</codeID>
            <geoLat>34.3928N</geoLat>
            <geoLon>123.4333W</geoLon>
        </VorUid>
    …
</AIXM-Snapshot>
```

AIXM 5.0

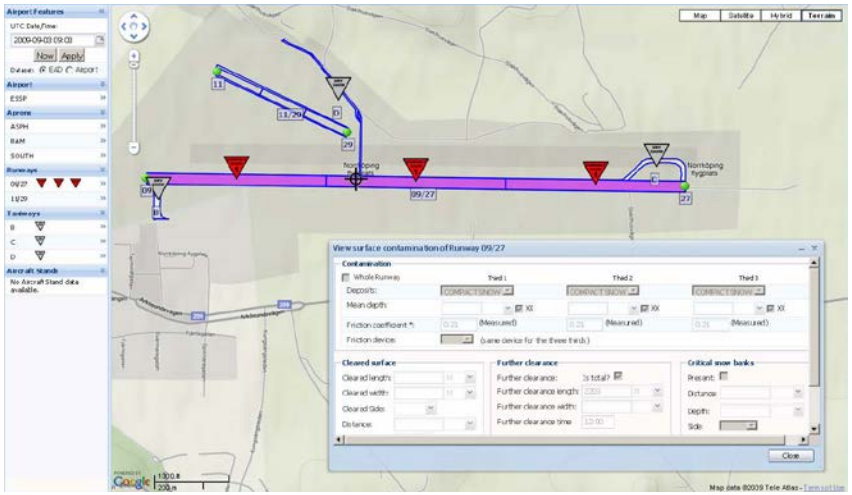
- Published: MAR 2008
- UML Model
- GML Schema
- Full AIP/NOTAM data
  - Including obstacle, airport mapping, etc.
- Metadata
- Extensibility
- Usage:
  - Partially, by FAA and NGA

Aeronautical Information Exchange Model

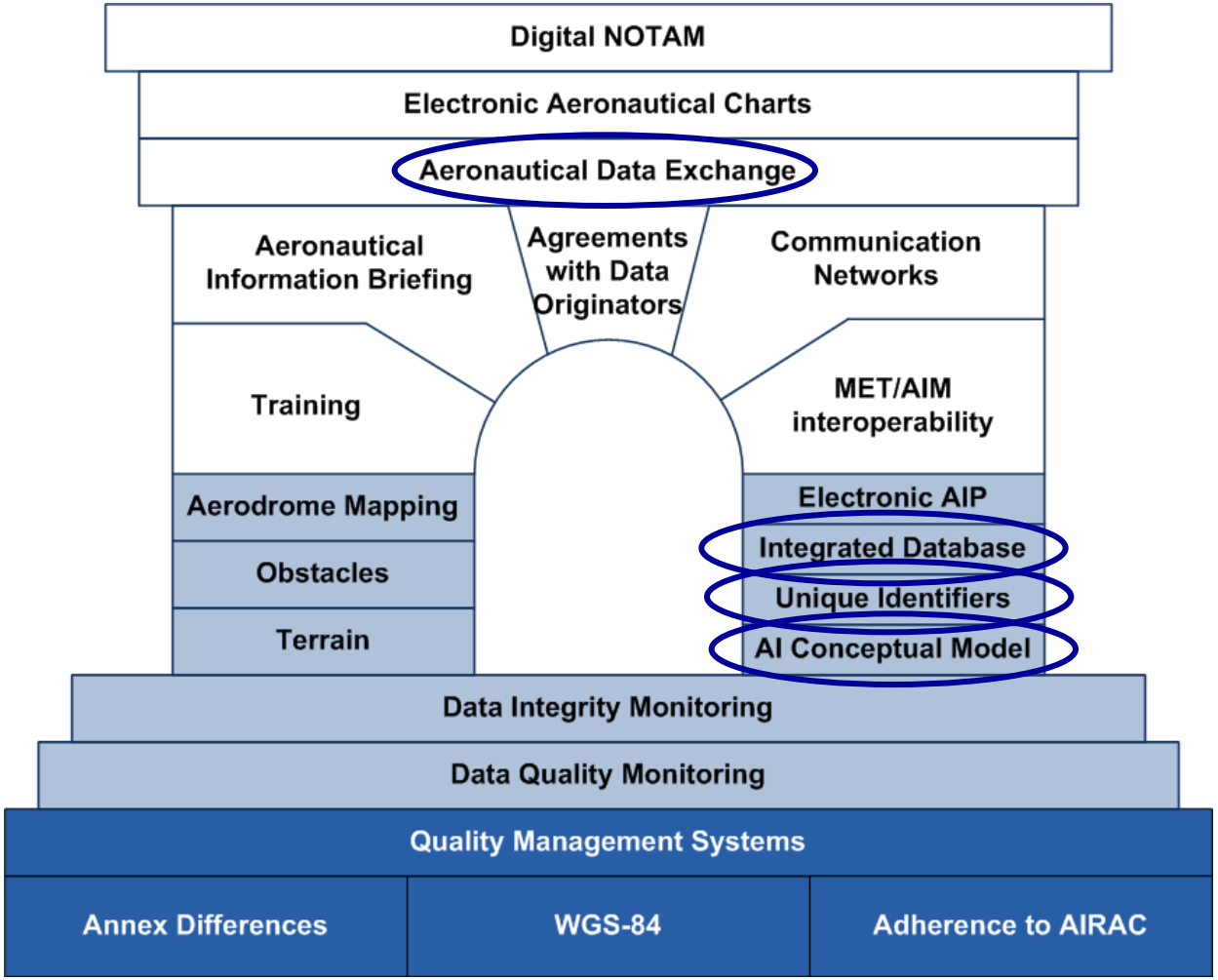


AIXM 5.1 (current)

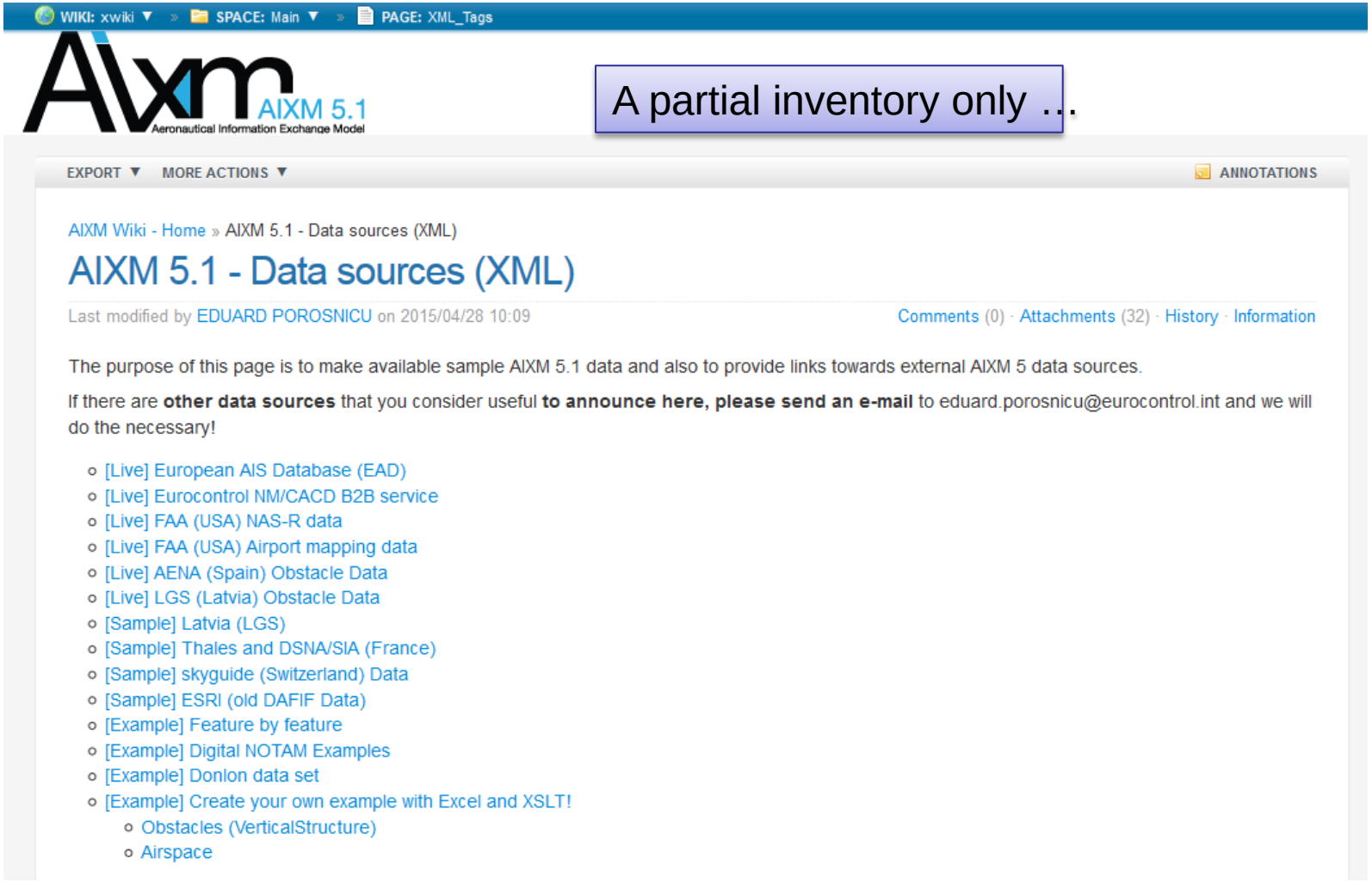
- Published: FEB 2010
- Update of AIXM 5.0
  - Usage/availability model
  - Notes vs. descriptions
  - Other adjustments to facilitate Digital NOTAM encoding
- Usage
  - *see AIXM Wiki (www.aixm.aero/wiki)*
    - *Data Sources*



ICAO AIS to AIM Roadmap



AIXM 5.1 Implementations



- www.aixm.aero
  - Downloads
  - AIXM Wiki (www.aixm.aero/wiki)
  - AIXM Forum (around 2000 members)
  - Training resources
  - Industry implementations/support

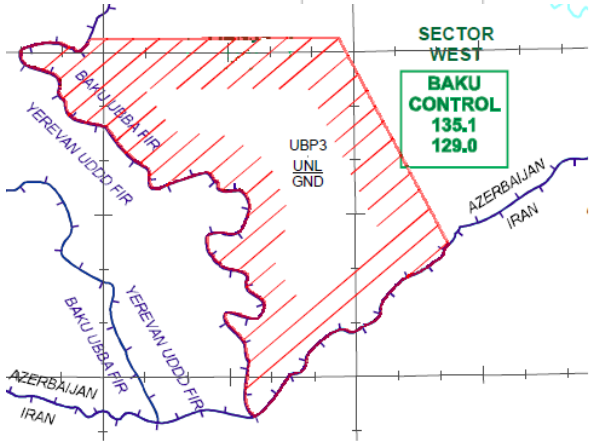
Implementation Guidance

- Use of xlink:href and UUID


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

Implementation Guidance

- GML Guidelines for aviation data
  - Encoding rules / conventions
  - Profile
- OGC Aviation Domain WG
  - https://portal.opengeospatial.org/files/?artifact_id=62852



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>
```

AIXM 5.1 Mappings

- Airport Mapping Requirements
  - See www.aixm.aero/wiki -> Mappings
  - ED 99/DO 272 (A/B/C) into AIXM 5.1
  - Status: Proposed Release

1.1 AM_RUNWAYELEMENT

ED-99A Definition: Part of a runway.

AIXM 5.1 Definition: Runway element may consist of one ore more polygons not defined as other portions of the runway class.

ED-99A	AIXM 5.1
AM_RunwayElement	**RunwayElement[type='NORMAL']**
idarpt	associatedRunway.Runway.associatedAirportHeliport.AirportHeliport.locationIndicatorICAO
idrwy	associatedRunway.Runway.designator
pcn	surfaceProperties.SurfaceCharacteristics.classPCN
width	width
	Note: there is also nominalWidth on Runway
length	length
	Note: there is also nominalLength on Runway
surftype	surfaceProperties.SurfaceCharacteristics.composition
	AND
	surfaceProperties.SurfaceCharacteristics.preparation
geopoly	extent.ElevatedSurface
feattype	*Note: Can be implied*
vacc	extent.ElevatedSurface.verticalAccuracy
vres	extent.ElevatedSurface.*verticalResolution*
hacc	extent.ElevatedSurface.horizontalAccuracy
hres	extent.ElevatedSurface.*horizontalResolution*
integr	*integrity*
source	*source*
	OR
	gmd:MD_Metadata.gmd:dataQualityInfo.gmd:lineage.gmd:LI_Lineage.gmd:processStep.gmd:LI_ProcessStep
	Note: Needs processor with a role set to "originator".
revdate	*revisionDate*

ED-99B	AIXM 5.1
idnumber	identifier
restacn	availability.ManoeuvringAreaAvailability.usage.ManoeuvringAreaUsage[type="FORBID"].selection.ConditionCombination.aircraft.AircraftCharacteristics.typeAircraftICAO

ED-99C	AIXM 5.1
stfeat	featureLifetime.gml:TimePeriod.gml:beginPosition
endfeat	featureLifetime.gml:TimePeriod.gml:endPosition
stvalid	validTime.gml:TimePeriod.gml:beginPosition
endvalid	validTime.gml:TimePeriod.gml:endPosition
interp	interpretation
restacft [= restacn]	*Note: See restacn above*

AIXM 5.1 Mappings

- Aeronautical Information Publication (AIP) into AIXM 5.1
  - See www.aixm.aero/wiki -> Mappings
  - Status: review in progress

A.1.1 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

1. **`Item to be mapped`** "obstacle position, represented by geographical coordinates in degrees, minutes and seconds;"

AIXM 5.1 Mapping:

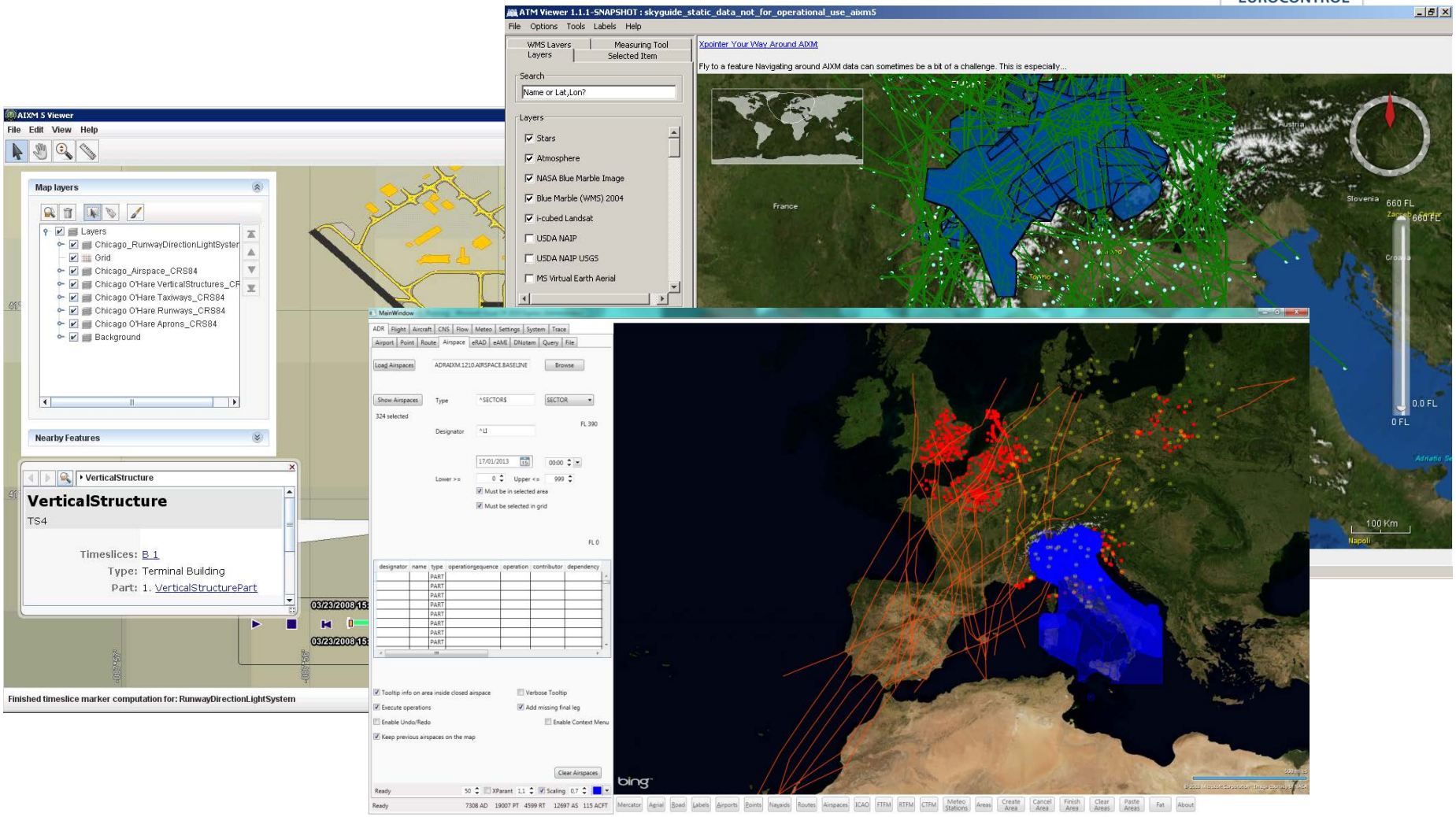
Figure 297. Short Mapping Description

```
VerticalStructure
  .part
    .VerticalStructurePart
      .horizontalProjection
        .VerticalStructurePartGeometry
          .location
            .ElevatedPoint[coordinates=""]
```

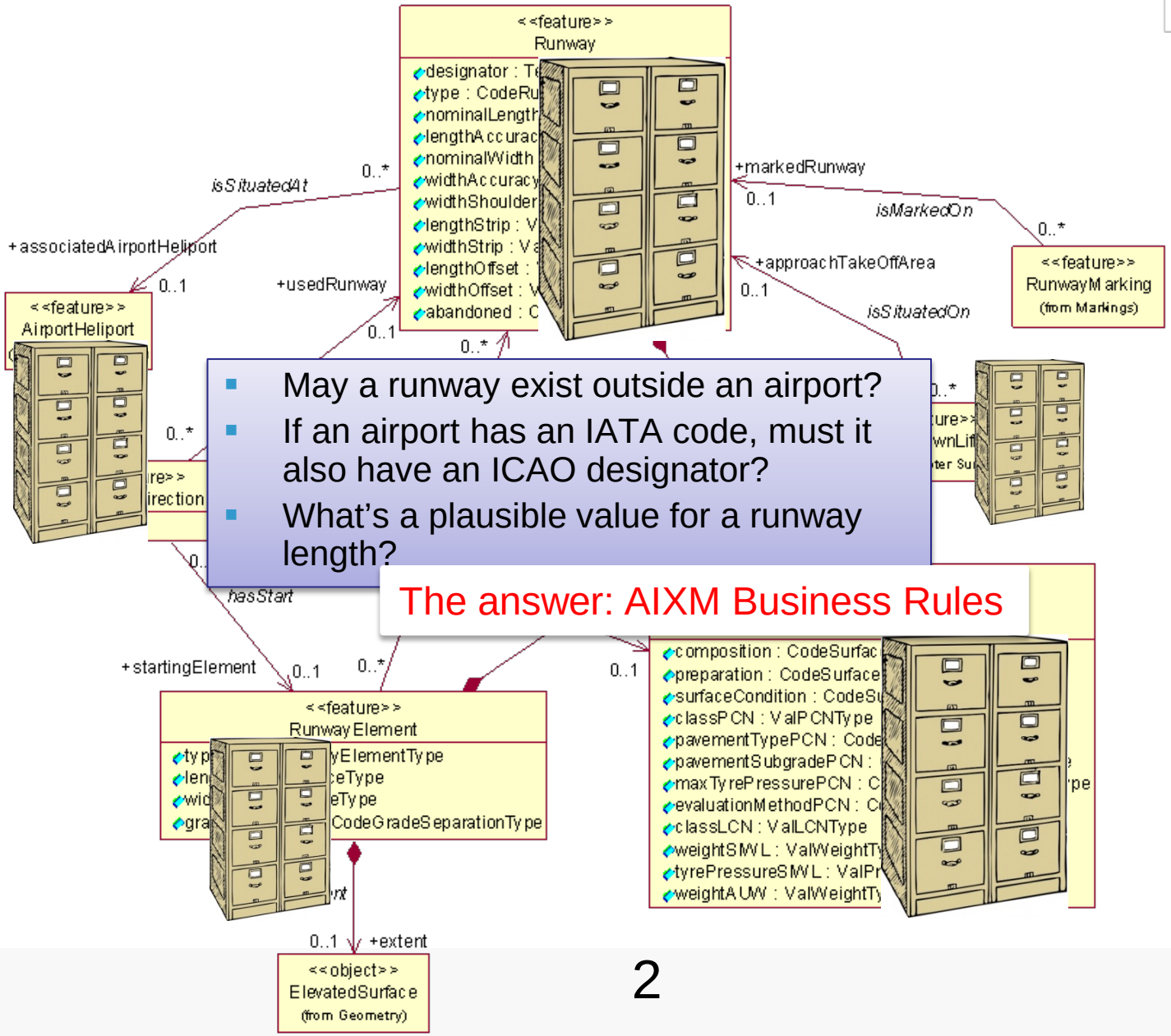
. AIXM 5.1 Mapping of AIP-TS-ENR-5.4/3

Class	`VerticalStructure`		
Association	`part(isMadeOf)`		
	Class	`VerticalStructurePart`	
	Association	`horizontalProjection(isRepresentedAs)`	
		Class	`VerticalStructurePartGeometry`
		Association	`location(hasPointShape)`
			Class `ElevatedPoint`
			Attribute (name and value) `coordinates = ""`

Free Tools


AIXM 5 Viewer
File Edit View Help
Map layers
Layers
Chicago_RunwayDirectionLightSyster
Grid
Chicago_Airspace_CRS84
Chicago O'Hare VerticalStructures_CR
Chicago O'Hare Taxiways_CRS84
Chicago O'Hare Runways_CRS84
Chicago O'Hare Aprons_CRS84
Background
Nearby Features
VerticalStructure
VerticalStructure
TS4
Timeslices: B 1
Type: Terminal Building
Part: 1. VerticalStructurePart
Finished timeslice marker computation for: RunwayDirectionLightSystem
ATM Viewer 1.1.1-SNAPSHOT : skyguide_static_data_not_for_operational_use_aixm5
File Options Tools Labels Help
WMS Layers
Measuring Tool
Layers
Selected Item
Search
Name or Lat,Lon?
Layers
Stars
Atmosphere
NASA Blue Marble Image
Blue Marble (WMS) 2004
i-cubed Landsat
USDA NAIP
USDA NAIP USGS
MS Virtual Earth Aerial
Xpointer Your Way Around AIXM:
Fly to a feature Navigating around AIXM data can sometimes be a bit of challenge. This is especially...
France
Austria
Slovenia
660 FL
0.0 FL
100 Km
Napoli
bing

AIXM = AI structure and content



- May a runway exist outside an airport?
- If an airport has an IATA code, must it also have an ICAO designator?
- What's a plausible value for a runway length?

The answer: AIXM Business Rules

AIXM – Business Rules

- Example – Digital NOTAM coding
  - "*[RWY.CLS] Event must have CLOSED operationalStatus*"

Coding specification rule

AIXM - SBVR rule

It is prohibited that a **RunwayDirectionTimeSlice** with **availability.ManoeuvringAreaAvailability.operationalStatus** not equal-to 'CLOSED' belongsTo **Event** with **scenario** equal-to 'RWY.CLS' and with **version** equal-to '2.0'

Executable computer code

```
(: for each runway direction :)
for $runwayDirection in . return
(
    if
    (
        (: if its operationalStatus is not 'CLOSED' :)
        not($runwayDirection/aixm:availability/aixm:ManoeuvringAreaAvailability/aixm:operationalStatus='CLOSED')
        and
        (: and we find one (or more) event that... :)
     count
     (
         for $event in //event:Event

.....
```

AIXM – Business Rules

- 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.
  - http://www.omg.org/spec/SBVR

- Example

Free text

"*The geometry of operational airspace of type CTA, UTA and OCA shall be encoded as an aggregation of the corresponding operational SECTORS*"

SBVR

Each Airspace with type equal-to ('CTA','UTA', 'OCA') shall have exactly one geometryComponent.AirspaceGeometryComponent.operation equal-to 'BASE'

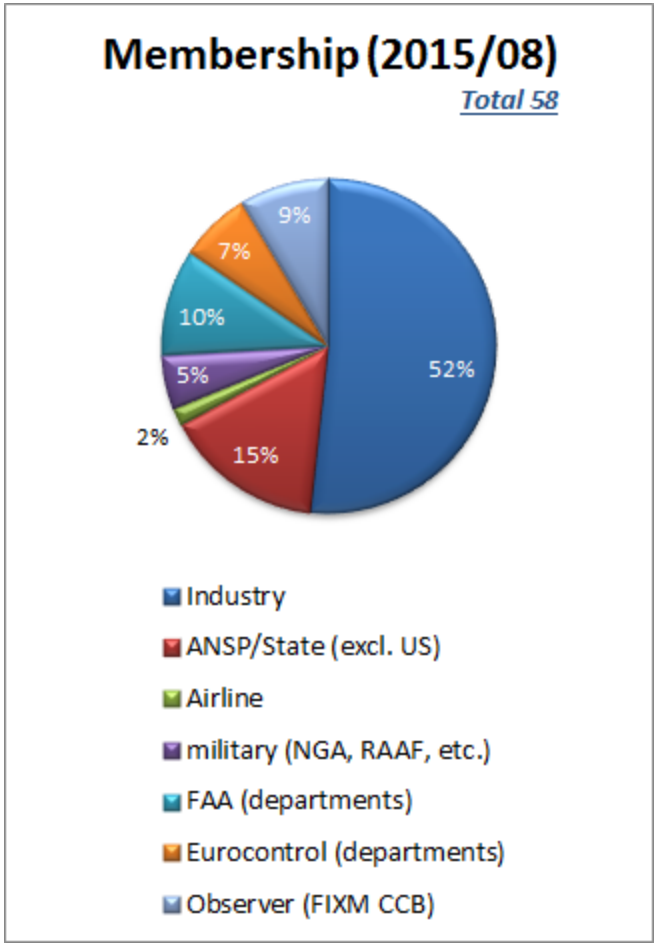
- Each Airspace with type equal-to ('CTA','UTA', 'OCA') shall not have geometryComponent.AirspaceGeometryComponent.operation not equal-to ('UNION')
- It is prohibited that AirspaceVolume is-property-of Airspace with type equal-to ('CTA','UTA', 'OCA') and dependsOn Airspace with type not equal-to 'SECTOR'

AIXM – Business Rules

- See www.aixm.aero/wiki -> Business Rules
  - Conceptual document "*AIXM 5.1 - Business Rules - using SBVR and Schematron*"
  - AIXM 5.1 Business Rules (work in progress, version 0.4) available in the form of an Excel file (1250+ rules)
  - Includes Schematron code, where possible
    - Estimated feasible for 90-95% of the rules
    - Probably not feasible for spatial constraints (such as Airspace of type FIR shall not intersect…)
    - Automatic generation from SBVR is possible!
  - Profiles
    - Allow to identify the rules enforced by a particular community of interest (such as the European AIS Database and its data providers)

AIXM CCB

- AIXM Change Control Board
  - Established based on the ICAO AIS-AIMSG recommendations
  - Membership implies acceptance of the Charter
    - http://www.aixm.aero/public/standard_page/aixm_ccb.html
  - Current situation
    - 58 members
      - including FIXM observers
    - FAA & Eurocontrol ensuring the secretariat and support

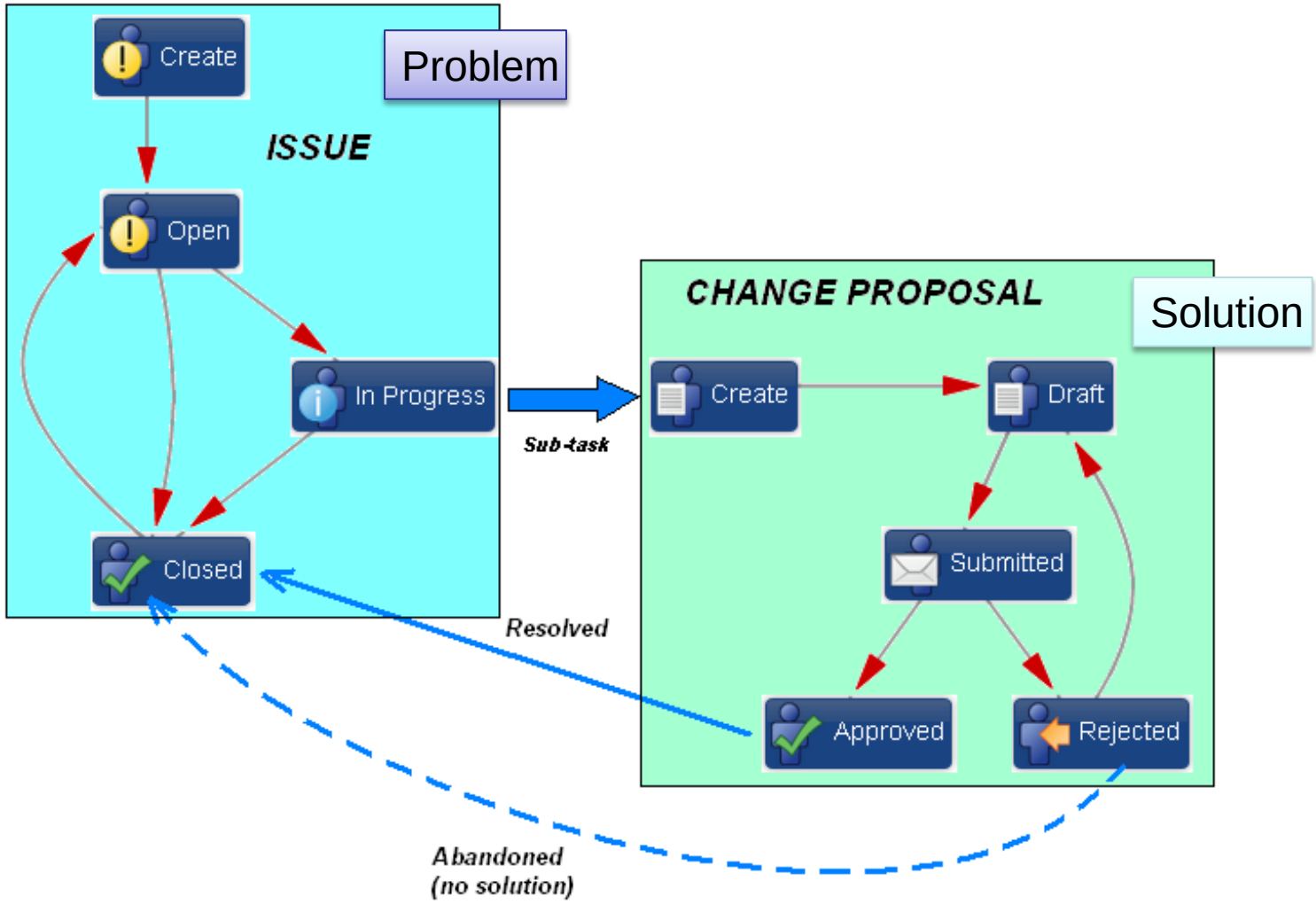


CCB Mandate

Protect investments

Ensure progress

CCB Process



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AIXM Release Plan

- [2015] Minor Release - AIXM 5.1.1
  - “technical release”
    - move to Sparx EA modelling environment
    - test the CCB process
    - re-align with xlink, GML, metadata standards
    - minor corrections
    - definitions
  - fully backwards compatible
    - Bi-directional mapping scripts provided

AIXM Release Plan

- [2015] Minor Release - AIXM 5.1.1
  - Almost finalized
  - 15 changes, solving 21 issues
    - *UML model moved to Sparx EA*
      - *New Schema generation scripts*
    - *Spelling corrections*
    - *definitions adjustments (around 700 proposed by FAA)*
    - *Xlink schema reference*
    - *GML profile reference*
    - *Some additional entries in lists of values*
    - *Work in progress – Temporality Concept clarifications (no real changes!)*

AIXM Release Plan

- [2017] Regular Release - AIXM 5.2
  - Around 40 issues already in JIRA
    - *Temporality Concept related issues*
    - *PBN procedures*
    - *route data*
    - *vertical reference systems*
    - *alignment of definitions*
  - Other work areas
    - *additional items required by ICAO SARPS changes*
    - *support for latest AMDB specs*
    - *AIP mapping gaps*
    - *other SID/STAR/Approach and*
    - *additional data items coming from various regions (US, Europe, etc.) , if relevant for international use*
      - *Otherwise -> regional extension*
    - *support for OCAS (Obstacle Collision Avoidance System)*
    - *development of coding guidelines*
    - *development/revision of mapping guidelines (ARINC 424, AIP, AMDB,…)*

Conclusions

- 3 versions in use (4.5, 5.0, 5.1)
- AIXM 5.1.1 – minor release (2015)
- AIXM 5.2 – regular release (2017)