



Aeronautical Information Exchange Model (AIXM) – Lessons learned

railML.org conference, Paris

Speaker: Eduard Porosnicu
EUROCONTROL, Senior AIM Specialist
18 Sep 2013

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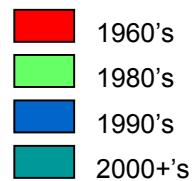
About EUROCONTROL - European Organisation for the Safety of Air Navigation

Europe – air traffic at a glance



EUROCONTROL – European Organisation for the Safety of Air Navigation

40 member states
& the European
Community



Complementary Partners



- Political direction
- Community method
- Regulatory authority
- Finance
- Technical expertise
- Facilitation skills
- Civil-military

“ Technical Agency of the Single European Sky ”

You typically hear about us hen things go wrong...



FLIGHT	DESTINATION	GATE #	STATUS
1	LOS ANGELES	A23	DELAYED
2	LONDON	C72	DELAYED
3	MADRID	B34	DELAYED
4	PARIS	A14	DELAYED
5	TOKYO	C89	DELAYED
6	HONG KONG	G12	DELAYED
7	MIAMI	C5	DELAYED
8	NEW YORK	D13	DELAYED
9	RIO DE JANEIRO	A4	DELAYED
10	SYDNEY	B22	DELAYED
11		A22	DELAYED



Sign Up

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EUROCONTROL Like

Government organisation · Brussels, Belgium



Join us on



Wall

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Links

Photos (12)

Events

Discussions

RSS/Blog



EUROCONTROL

We're welcoming more than 200 students from 14 European Schools from 21-23 March for the "European Schools Science Symposium" - curious to meet the youngsters and get their impressions on EUROCONTROL (and feed them back to you :-))

11 hours ago · Like · Comment

Roland Becker likes this.



EUROCONTROL

Situation unchanged: EUROCONTROL still rejecting flight plans for... until further notice #Libya #noflyzone

Friday at 09:16 via HootSuite · Like

www.eurocontrol.int

YouTube

EUROCONTROL TV

The CATS project: collaboration, 854 views · 1 year ago

EUROCONTROL - Building the Single EUROCONTR... - 5,221 views

sesar introductory video - 1,156 views

EUROCONTROL - Building the Single EUROCONTR... - 5,221 views

EUROCONTROL TV

Subscriptions (7)

SESAR

Parliament

ESA

EUROCONTROL

ATFCM Network Situation

Last update: 22/03/2011 19:45

ATFCM Situation Data

Last update: 22/03/2011 19:51:00

Flights	Total
Landed	26054
Airborne	20640 (77 %)

Network: Headline News

21/03/2011 Civil-military airspace co-ordination, regarding Libya's no-fly zone

Please see the following attachments regarding Libyan situation update:

NOTAM A0289-11

NOTAM A0290-11

ECHO4AIR

CFMU Network Operations

21/03/2011 Libyan Situation

Following the United Nations Security Council resolution 1973 to apply a "No - Fly" zone over Libya, and the ban on flights in the airspace of Libyan Arab Jamahiriya. All flights for traffic planned to operate into this airspace will be suspended. Therefore only those flights which are exempted from the ban, in accordance with the resolution, will be permitted to operate. Further information will be issued as the situation evolves and is clarified.

21/03/2011 Japan update

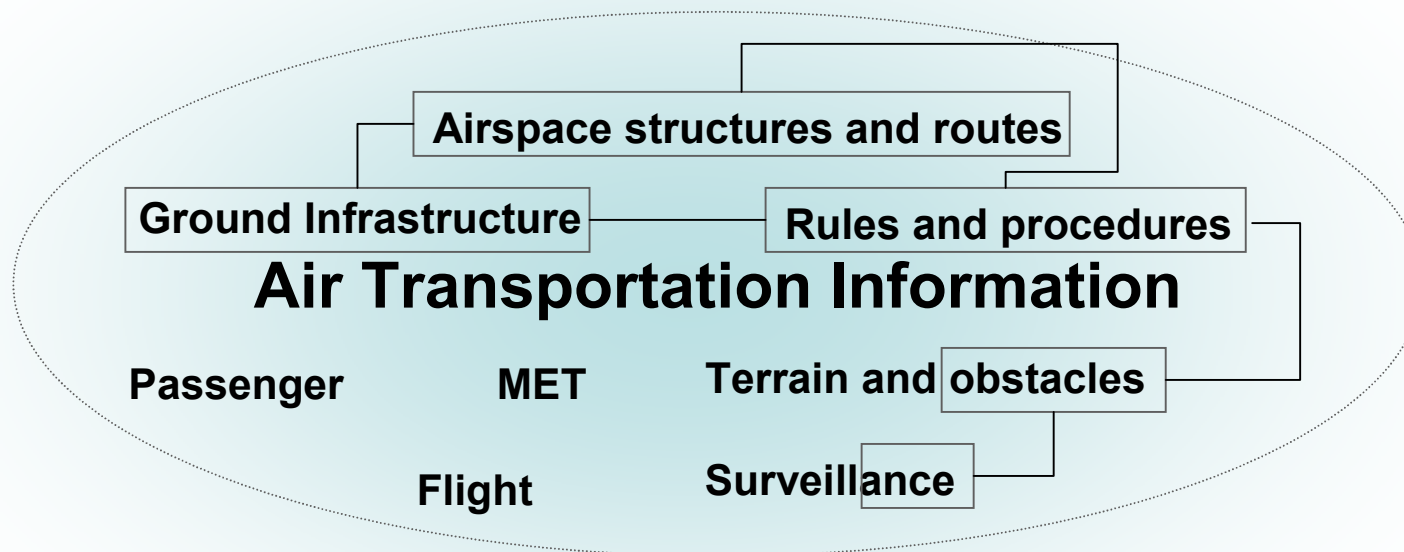
About AIXM

AIXM – why necessary

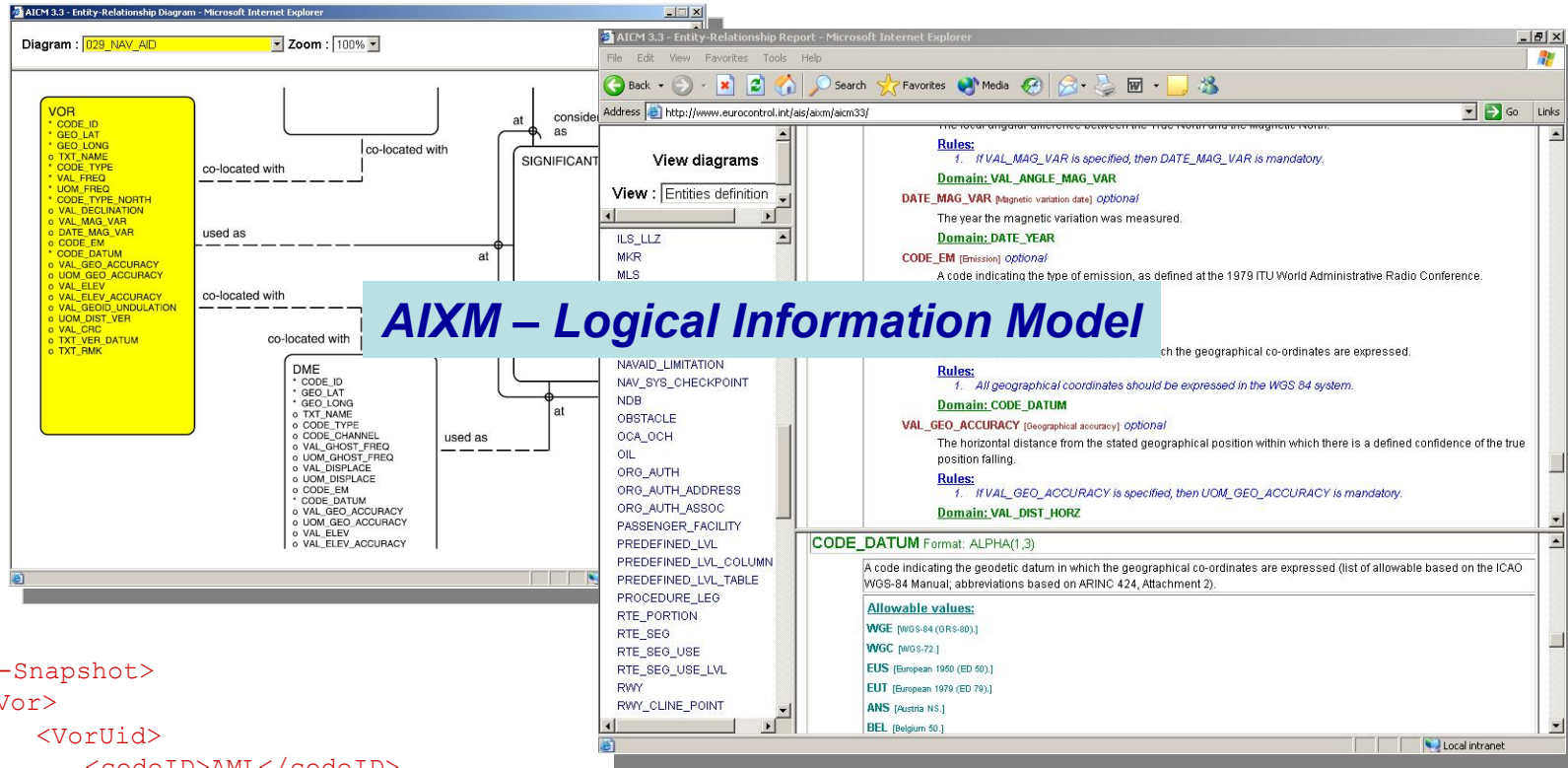
- European Aeronautical Information Services Database (EAD) Feasibility Study (by “CAPdebis”) - 1993
 - *“The exchange of static data in an electronic format is rare for ground based systems. Other than ARINC 424 format, which was developed according to the demands of FMS, a state of the art, commonly 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 “electronic AIP”
 - Proposal for global standard (International Civil Aviation Organisation)
 - For industry implementations
 - etc.

AIXM Scope



AIXM 4.5: two main components

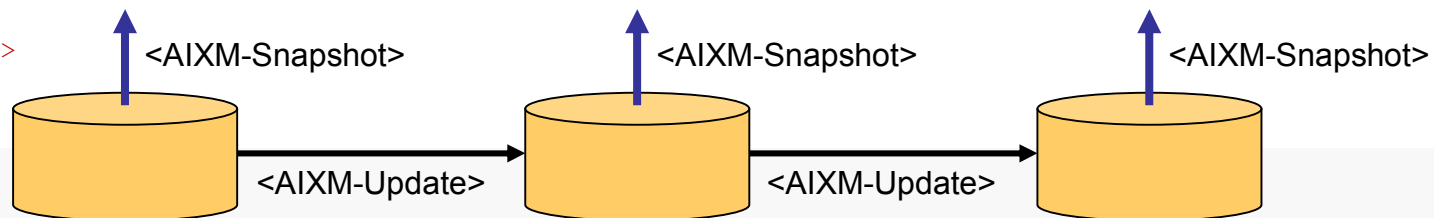


The screenshot shows two browser windows. The left window displays an Entity-Relationship Diagram for '029_NAV_AID'. It features a list of entities on the left, including VOR and DME, with their attributes. Relationships like 'co-located with', 'used as', and 'at' are shown between entities. A central text box reads 'AIXM – Logical Information Model'. The right window shows an 'Entity-Relationship Report' for 'AIXM 3.3'. It lists various entities such as ILS_LLZ, MKR, and MLS, along with their rules and domains. For example, the 'DATE_MAG_VAR' entity has a rule: 'If VAL_MAG_VAR is specified, then DATE_MAG_VAR is mandatory.' and a domain of 'VAL_ANGLE_MAG_VAR'.

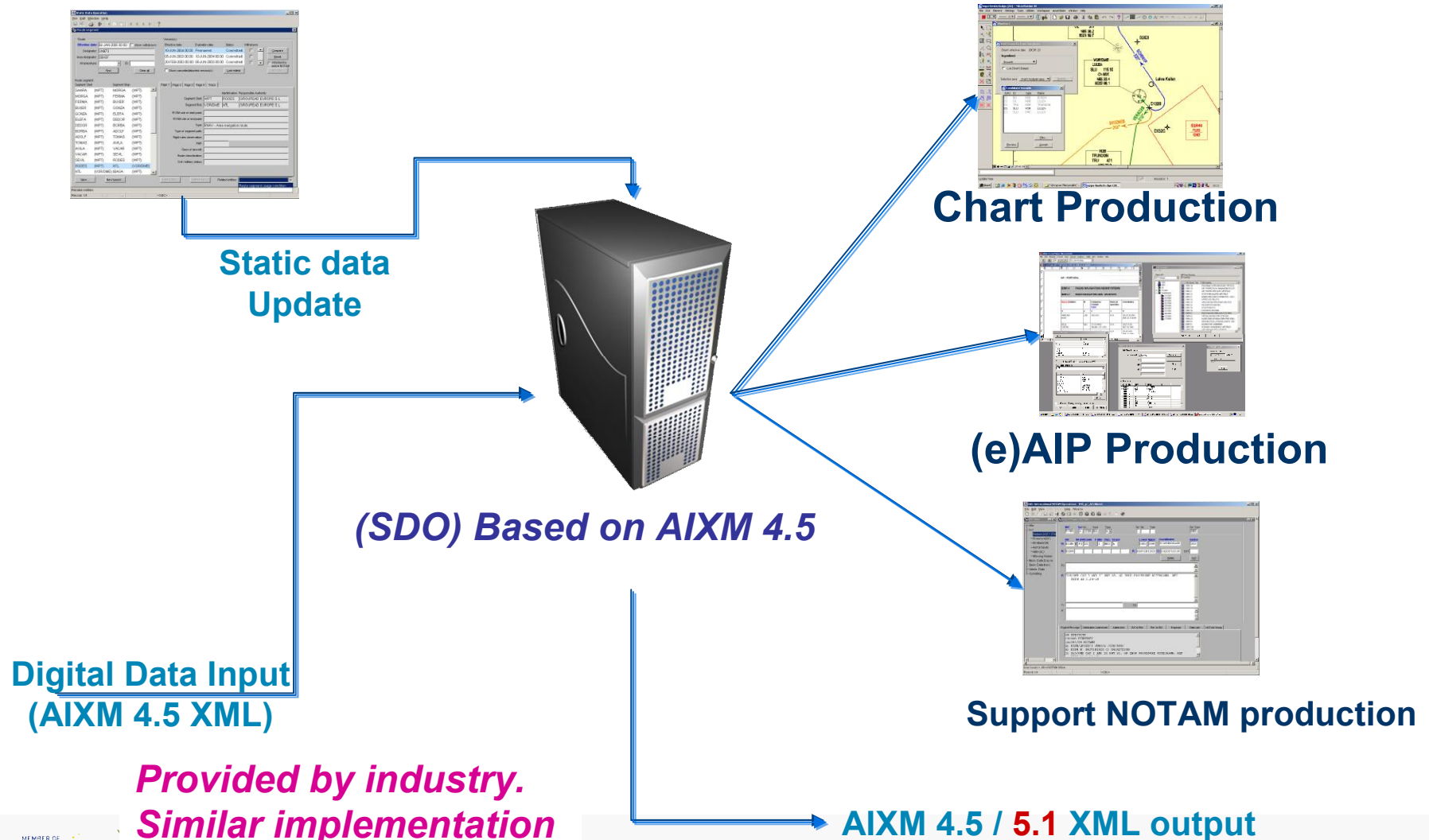
```

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

AIXM – Data Exchange Format



AIXM in EAD (today)

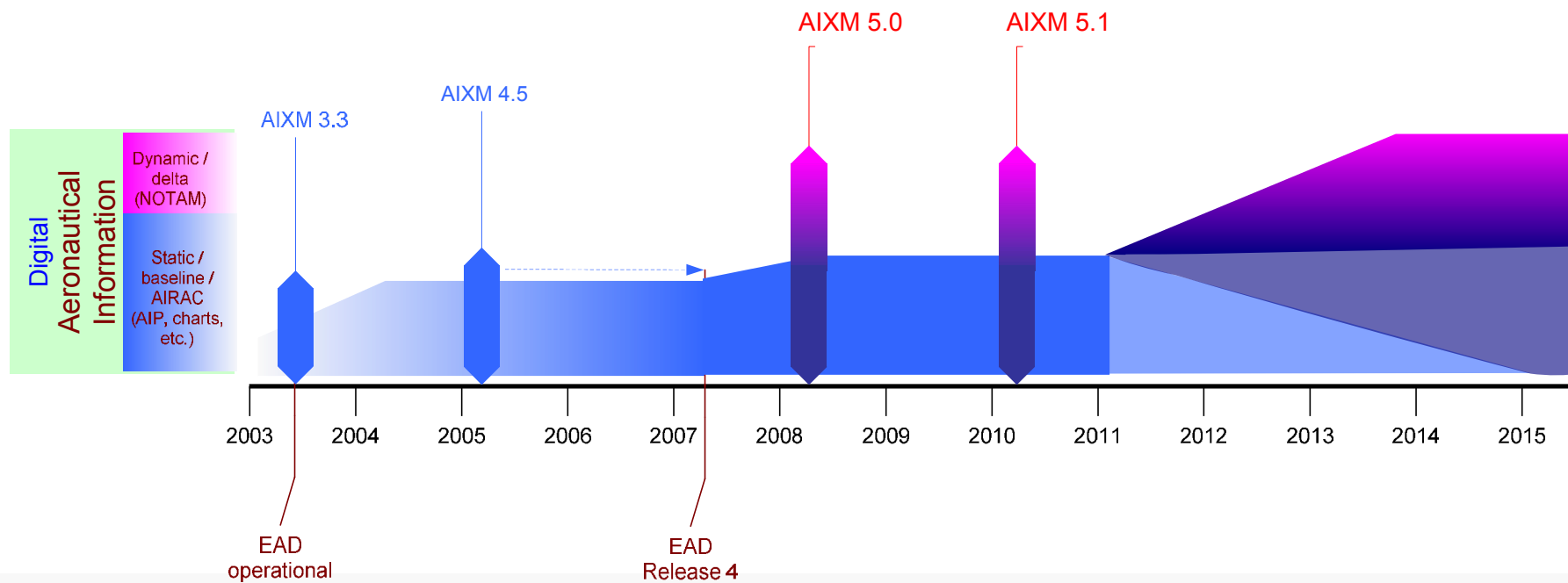


*Provided by industry.
Similar implementation
in local AIS systems*

AIXM version 5 – key aspects

AIXM version 5

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

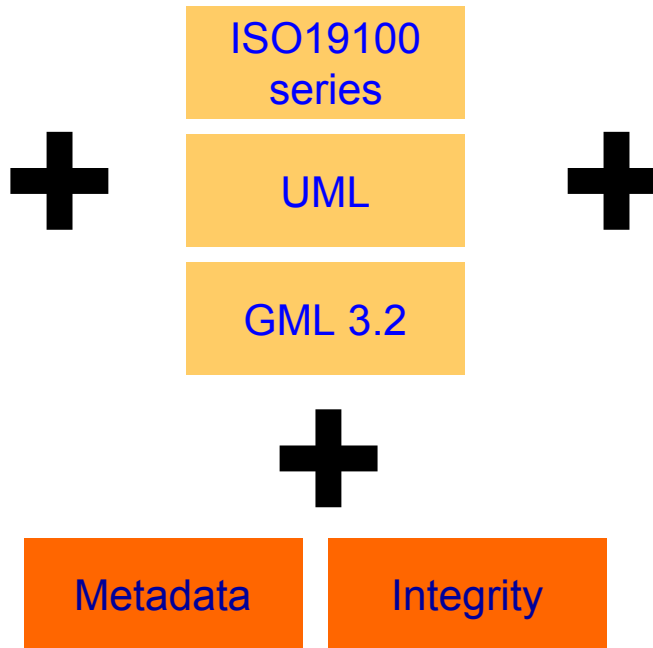


AIXM 5 Design Objectives

New capabilities

- Modularity
- Extensibility
- Flexible Exchange
- Flexible Messages
- Static and Dynamic

Technical Design Decisions

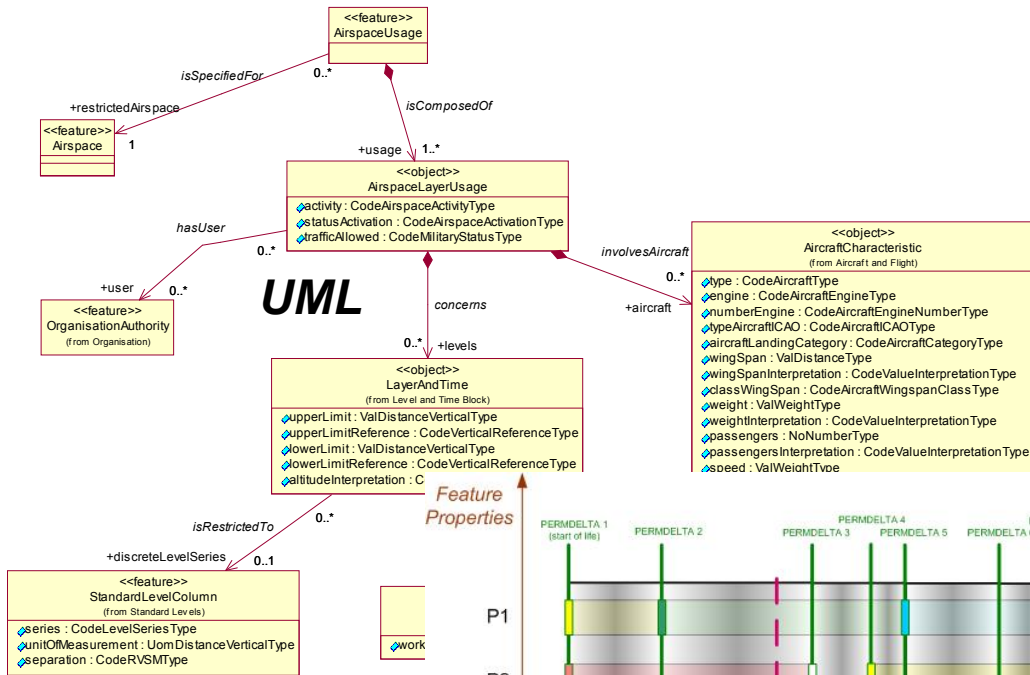


Expand/Refresh Domain Model

- Aerodrome Mapping
- Terminal Procedures
- Obstacles

External Constraints

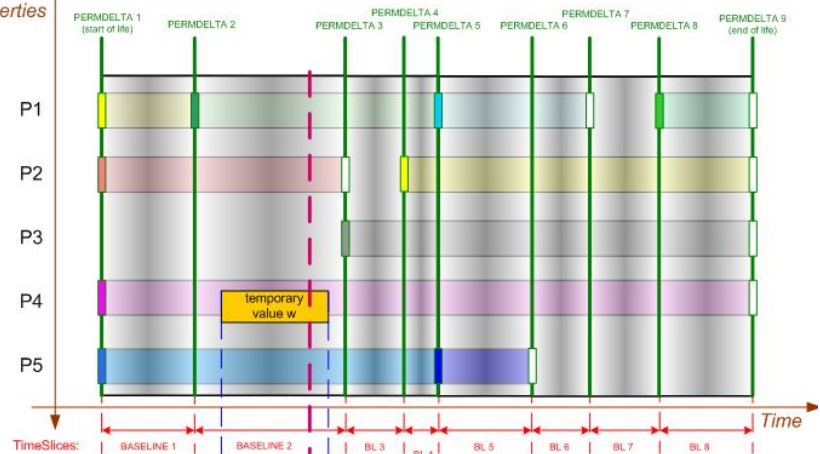
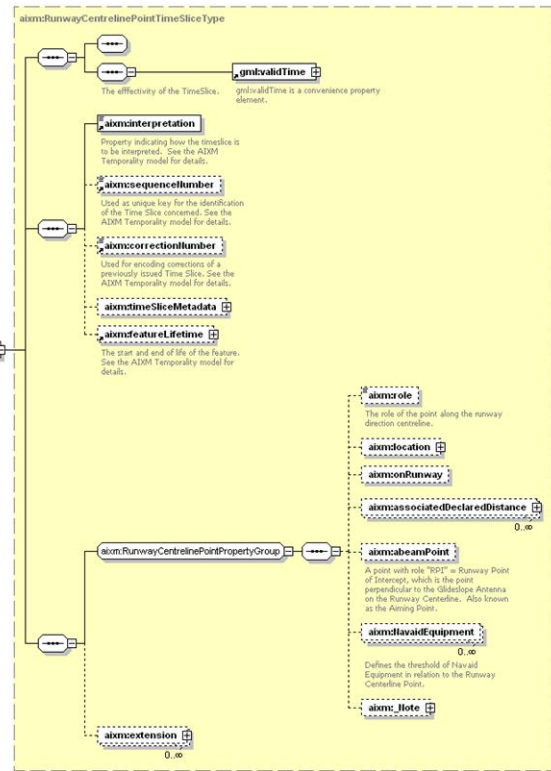
AIXM version 5.1



UML

Feature Properties

XSD



Temporality Concept

SNAPSHOT

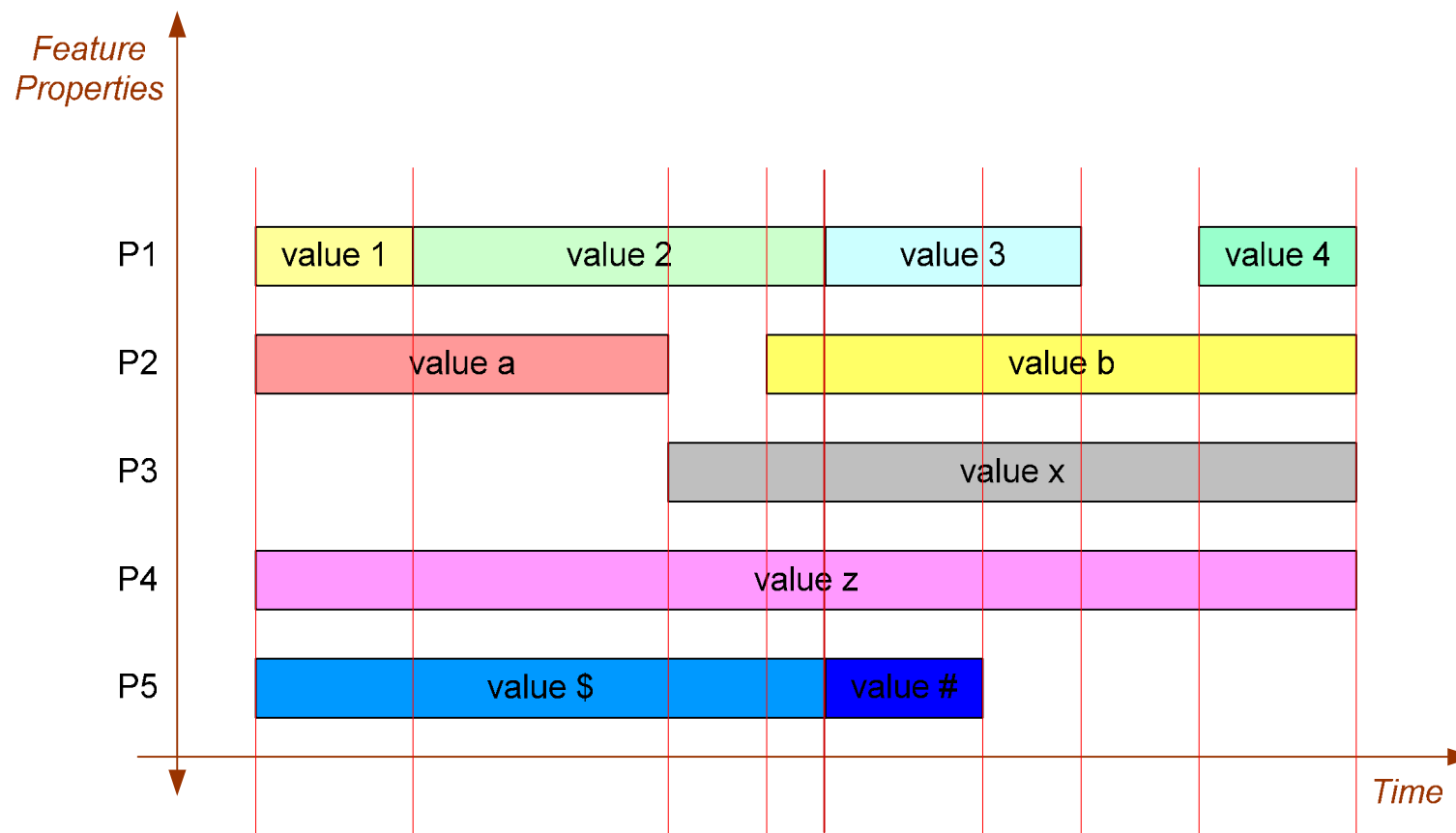
Generated by XmlSpY www.altova.com

www.aixm.aero

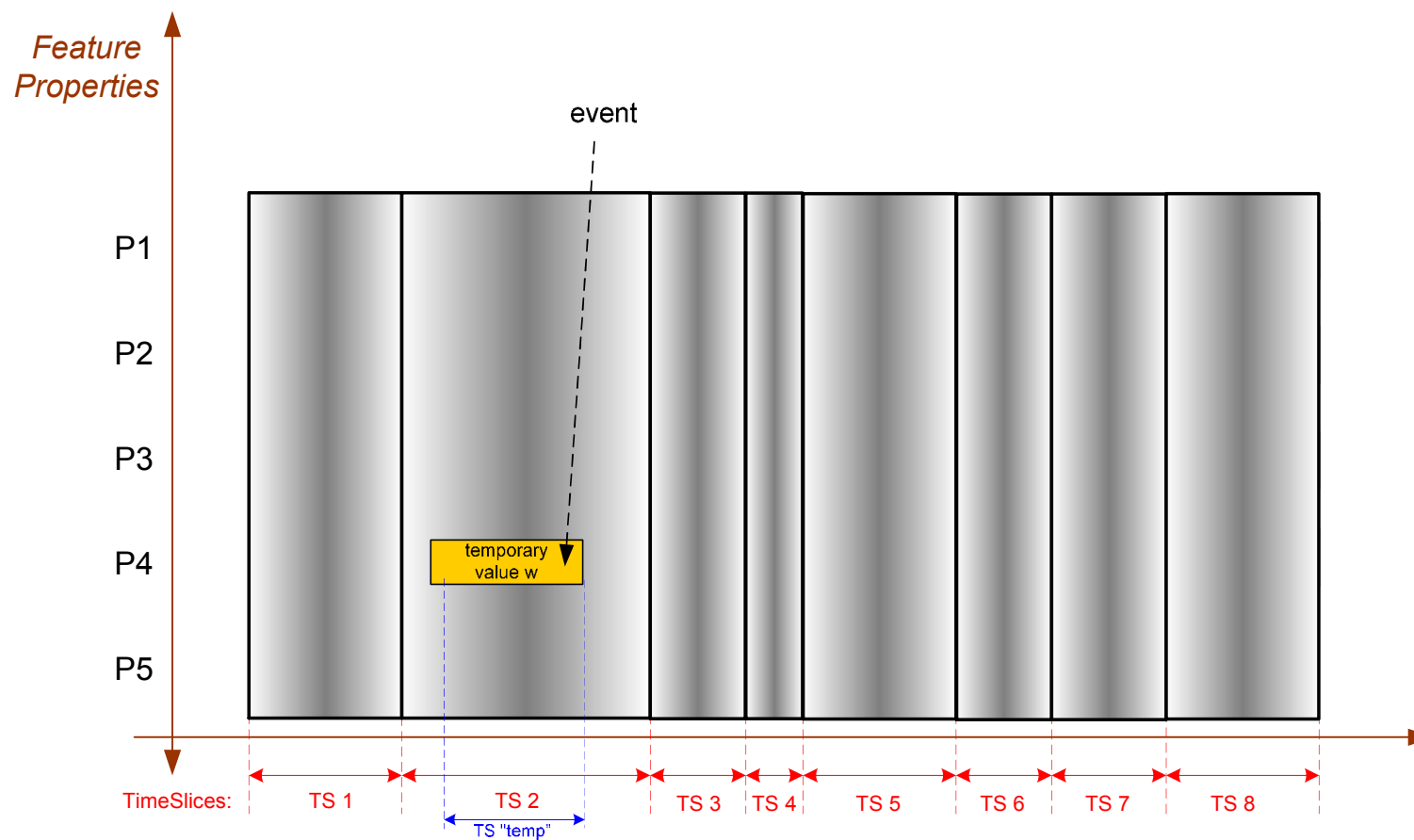
Temporality Model

- Definition
 - A model that incorporates the concept of time at feature level!
- Key assertions
 - All features are temporal with start of life and end of life
 - Example - a new air traffic control sector
 - All features can change over time
 - Example - a navigation aid changes frequency
 - Additional issue – feature properties can have different values according to a repetitive schedule
- AIXM Temporality Model
 - Relates feature properties to the time extent in which they are valid
 - Provides various means to describe the time extent

The basic Time Slice model



Temporary events (digital NOTAM)

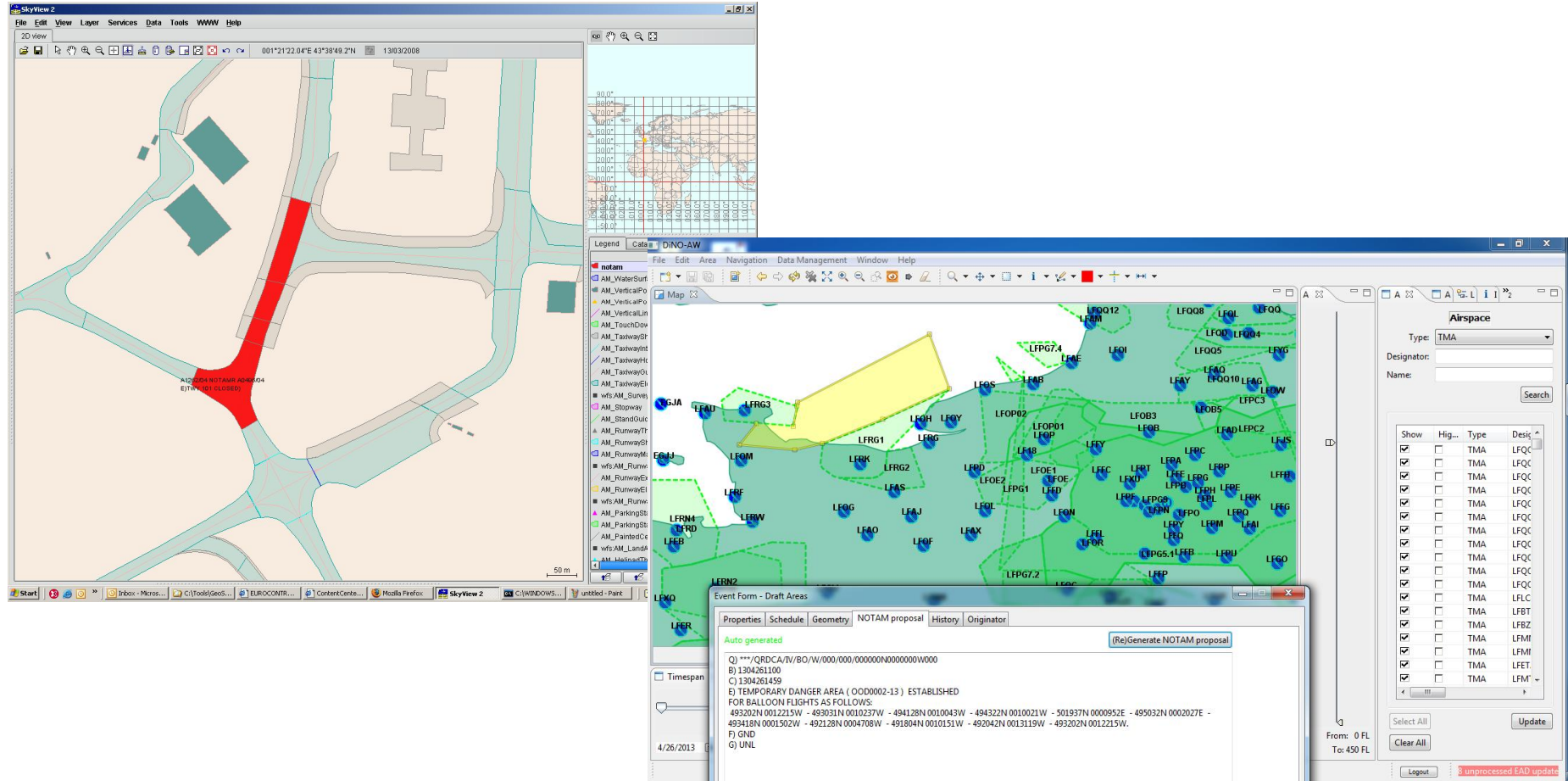


Many years ago...

- NOTAM = **NO**tice **T**o **A**ir**M**en
- When not more than 10-20 NOTAM were on the list for one flight 😊
- With 25000 NOTAM in force world-wide at every moment 😞
 - only digital data processing can help...



Digital NOTAM = visual NOTAM



The screenshot displays the SkyView 2 interface. The main map shows a 2D view of a geographical area with a red highlighted region. A legend on the left lists various map layers such as 'notam', 'AM_WaterSurf', and 'AM_VerticAln'. An inset map in the top right shows the current location on a world map. A detailed NOTAM proposal form is open in the foreground, showing the following text:

```

Q) ****/QRDCA/IV/BO/W/000/000/000000N000000W000
B) 1304261100
C) 1304261459
E) TEMPORARY DANGER AREA (ODD0002-13) ESTABLISHED
FOR BALLOON FLIGHTS AS FOLLOWS:
493202N 0012215W - 493031N 0010237W - 494128N 0010043W - 494322N 0010021W - 501937N 0000952E - 495032N 0002027E -
493418N 0001502W - 492128N 0004708W - 491804N 0010151W - 492042N 0013119W - 493202N 0012215W.
F) GND
G) UNL
  
```

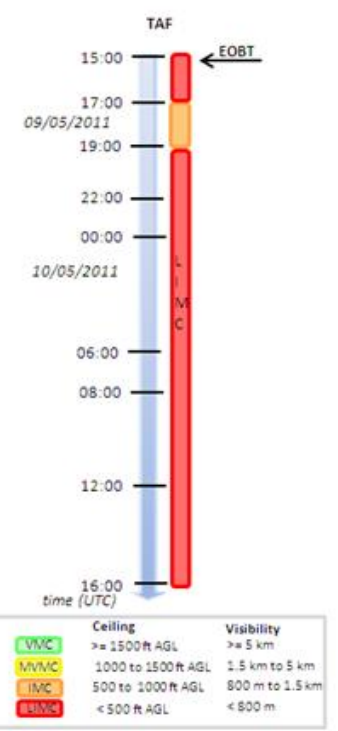
The form also includes a 'Properties' tab, a '(Re)Generate NOTAM proposal' button, and a 'Timespan' section showing the date '4/26/2013'. On the right side, an 'Airspace' panel is visible, showing a list of airspace types and designators with checkboxes for selection.

Enhanced Pre-flight Information Bulletin (mockup)

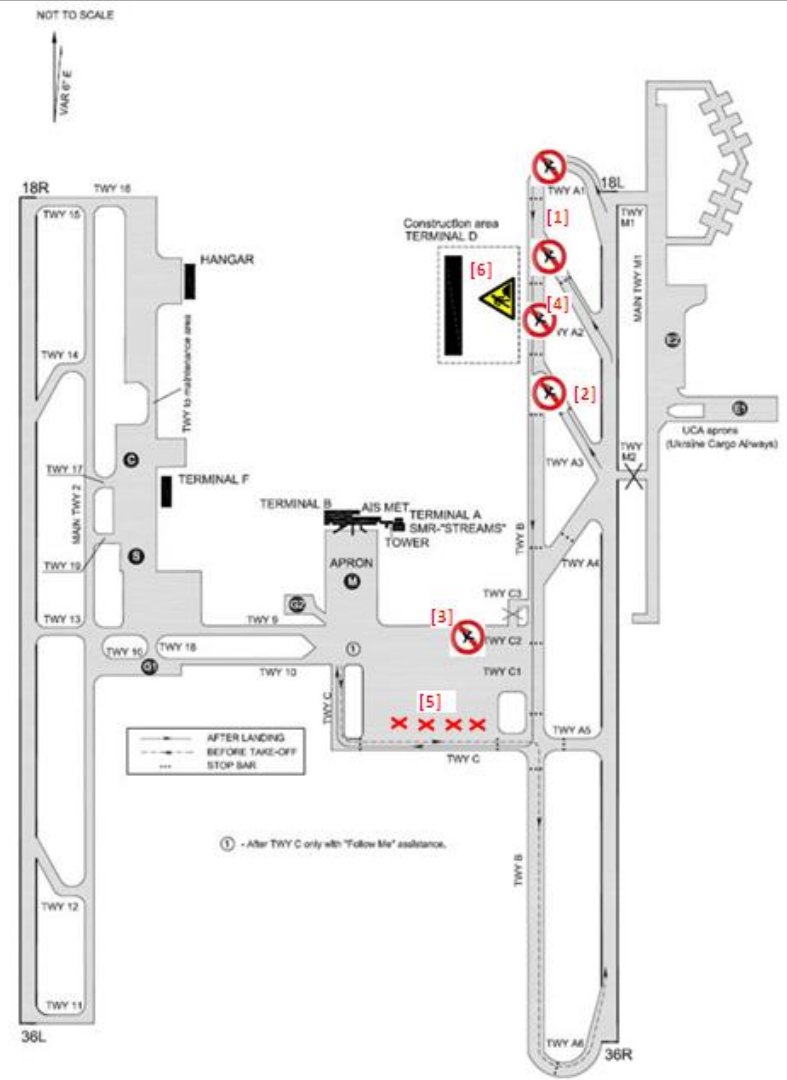
Departure Aerodrome: UKBB stand/push-back/taxiing/take-off

METAR:
 UKBB 091455Z 13509KT 090V165 9999 BKN500 20/12
 Q1015 CAVOK NSW

TAF:
 UKBB 091432Z 0915/1016 1001G21KT 6000 OVC007
 TEMPO 0915/0917 1000 SHSN BR BKN003 SCT008CB
 BECMG 0917/0919 1001G25KT 4000 -SN BLSN OVC005
 TEMPO 0919/1016 0600 +SHSN BLSN OVC003 BKN008CB
 BECMG 1006/1008 14014G23KT TNM04/1003Z TXM00/1012Z



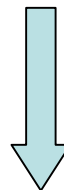
AFR1953 – 09 May 2011 15:15
 UTC – UKBB-LFPG



AIXM 5 - Use of Geography Markup Language (GML)

```
<geoLat>52.2889</geoLat>  
<geoLong>-32.0350</geoLong>  
<codeDatum>WGE</codeDatum>
```

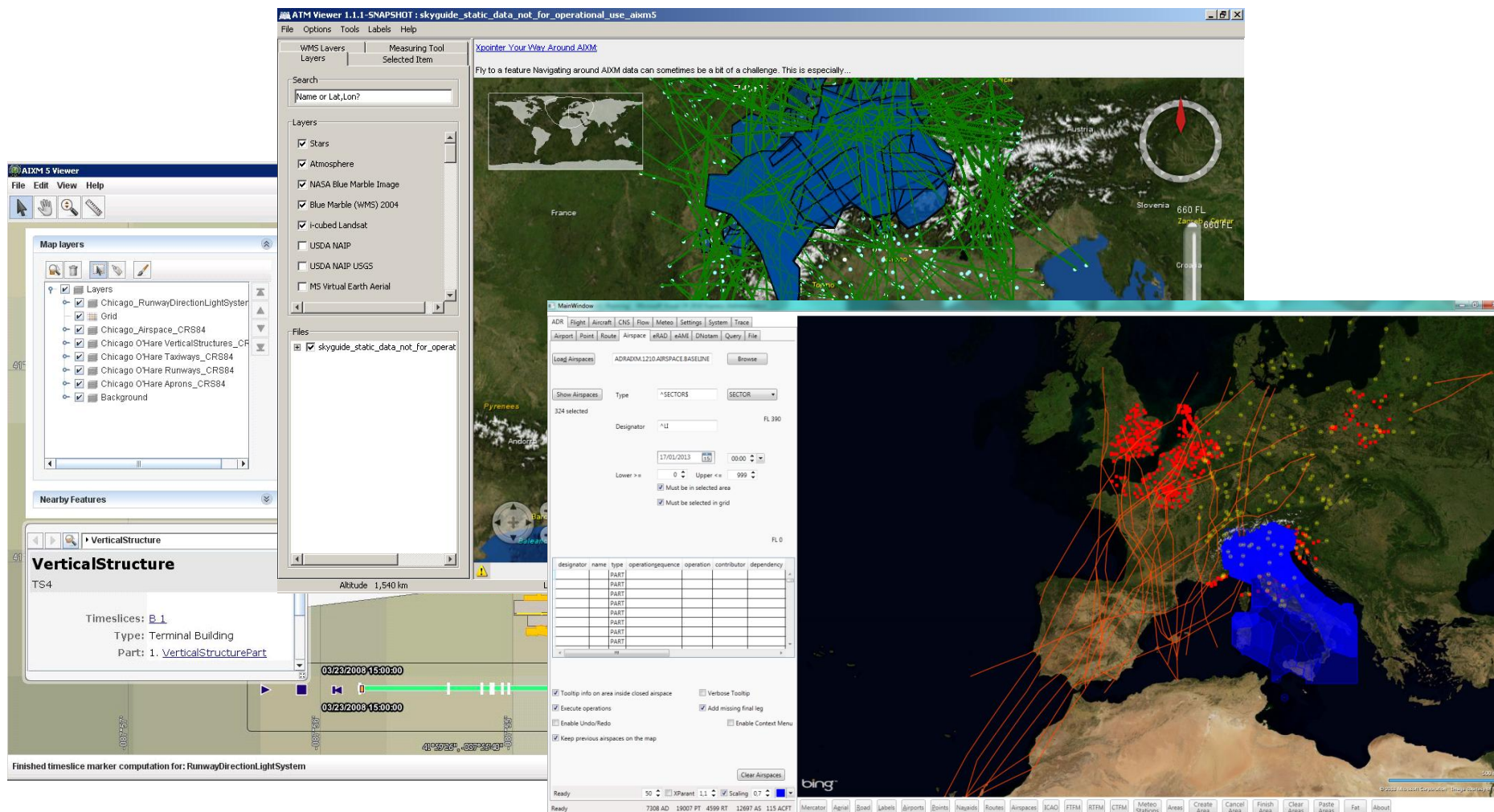
AIXM 4.5 – non GML



```
<aixm:ElevatedPoint srsName="urn:ogc:def:crs:EPSG::4326" gml:id="ID55">  
  <gml:pos>52.2889 -32.0350</gml:pos>  
</aixm:ElevatedPoint>
```

AIXM 5.1– GML

GML-based tools for AIXM data visualisation



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

Files:
 skyguide_static_data_not_for_operat

AIXM 5 Viewer
File Edit View Help

Map layers:
 Layers
 Chicago_RunwayDirectionLightSystem
 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
 TS4
 Altitude: 1,540 km
 Timeslices: B_1
 Type: Terminal Building
 Part: 1. VerticalStructurePart

Finished timeslice marker computation for: RunwayDirectionLightSystem

MainWindow
 ADR | Flight | Aircraft | CNS | Flow | Meteo | Settings | System | Trace
 Airport | Point | Route | Airspace | eRAD | eAME | DNotam | Query | File

Load Airspaces: ADRADM.1210.AIRSPACE.BASELINE Browse

Show Airspaces: Type: *SECTORS SECTOR
 324 selected
 Designator: *LI FL 390
 17/01/2013 15:00:00
 Lower >= 0 Upper <= 999
 Must be in selected area
 Must be selected in grid

designator	name	type	operationsequence	operation	contributor	dependency
		PART				
		PART				
		PART				
		PART				
		PART				
		PART				
		PART				

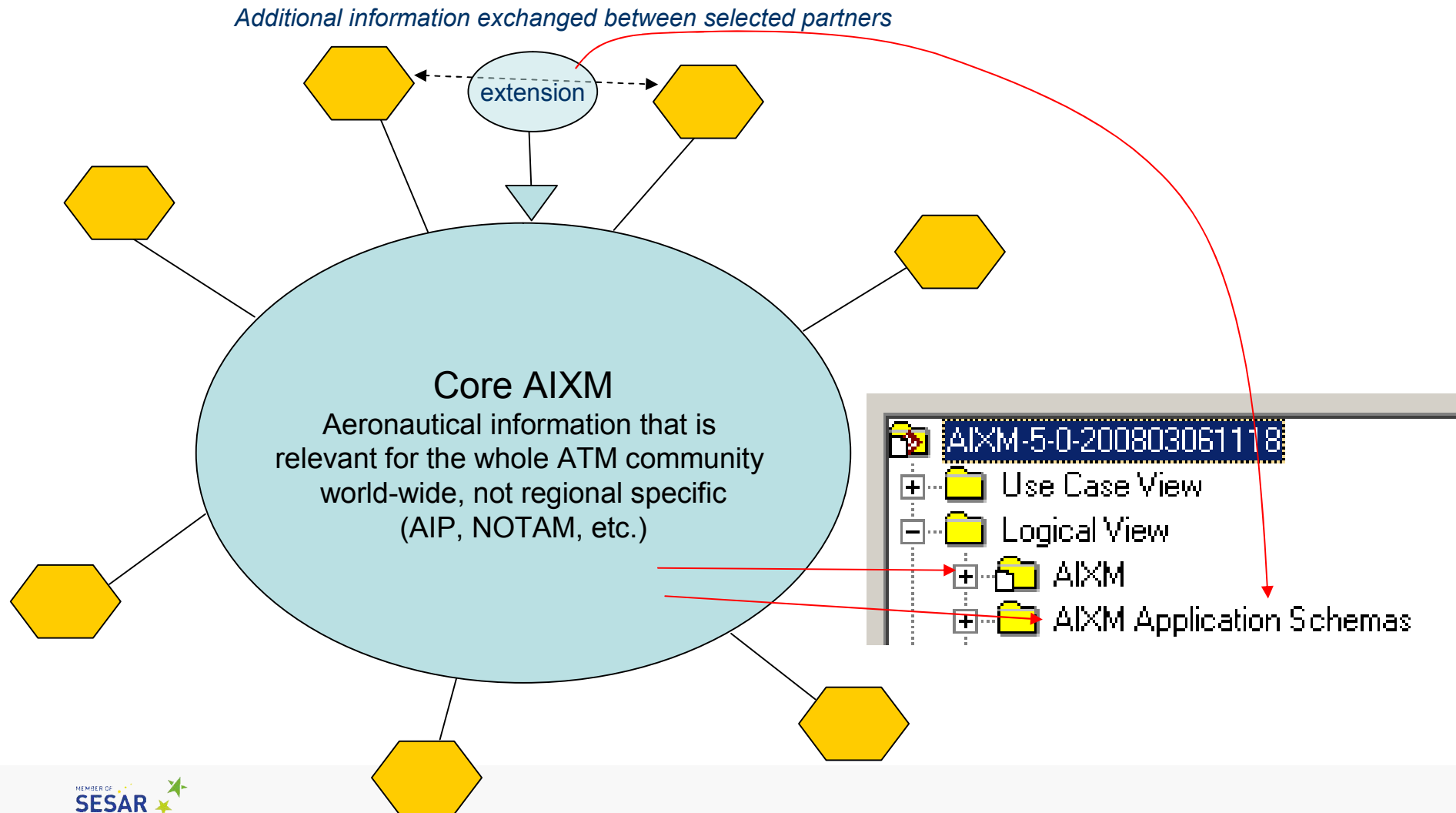
Tooltip info on area inside closed airspace
 Verbose Tooltip
 Execute operations
 Add missing final leg
 Enable Undo/Redo
 Enable Context Menu
 Keep previous airspaces on the map
 Clear Airspaces

Ready 50 XParent: L1 Scaling: 0.7
 Ready 7308 AD 19007 PT 4599 RT 12697 AS 115 ACFT
 Mercator Agnal Board Labels Airports Points Nav aids Routes Airspaces ICAO FIRM RTM CTM Meteo Stations Areas Create Area Cancel Finish Area Clear Areas Paste Areas Fat About

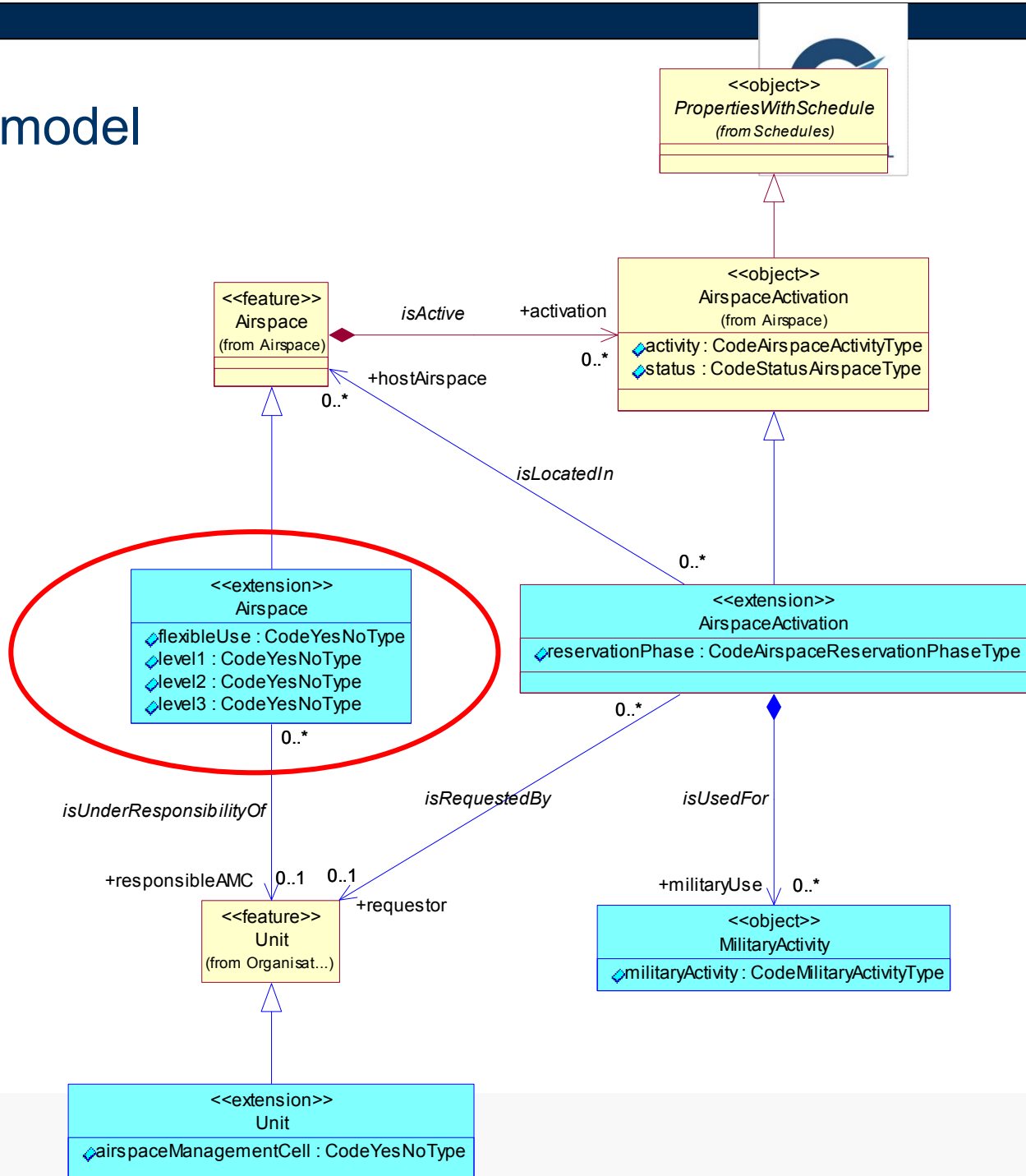
Guidance and Profile of GML for use with Aviation Data

- Published: MAY 2012 by OGC (produced by the Aviation Domain WG)
- Status: OGC Discussion Paper (https://portal.opengeospatial.org/files/?artifact_id=47859)
- 1st part - Encoding guidelines for aviation specific data
 - srsName (WGS 84 is imposed in aviation)
 - Surface and lines - specials
 - Parallels
 - Arcs
 - Embedded curves/points
 - Geographical borders re-used in Surface definitions
 - In relation with the use of AIXM for aeronautical data encoding
- 2nd part - GML Profile

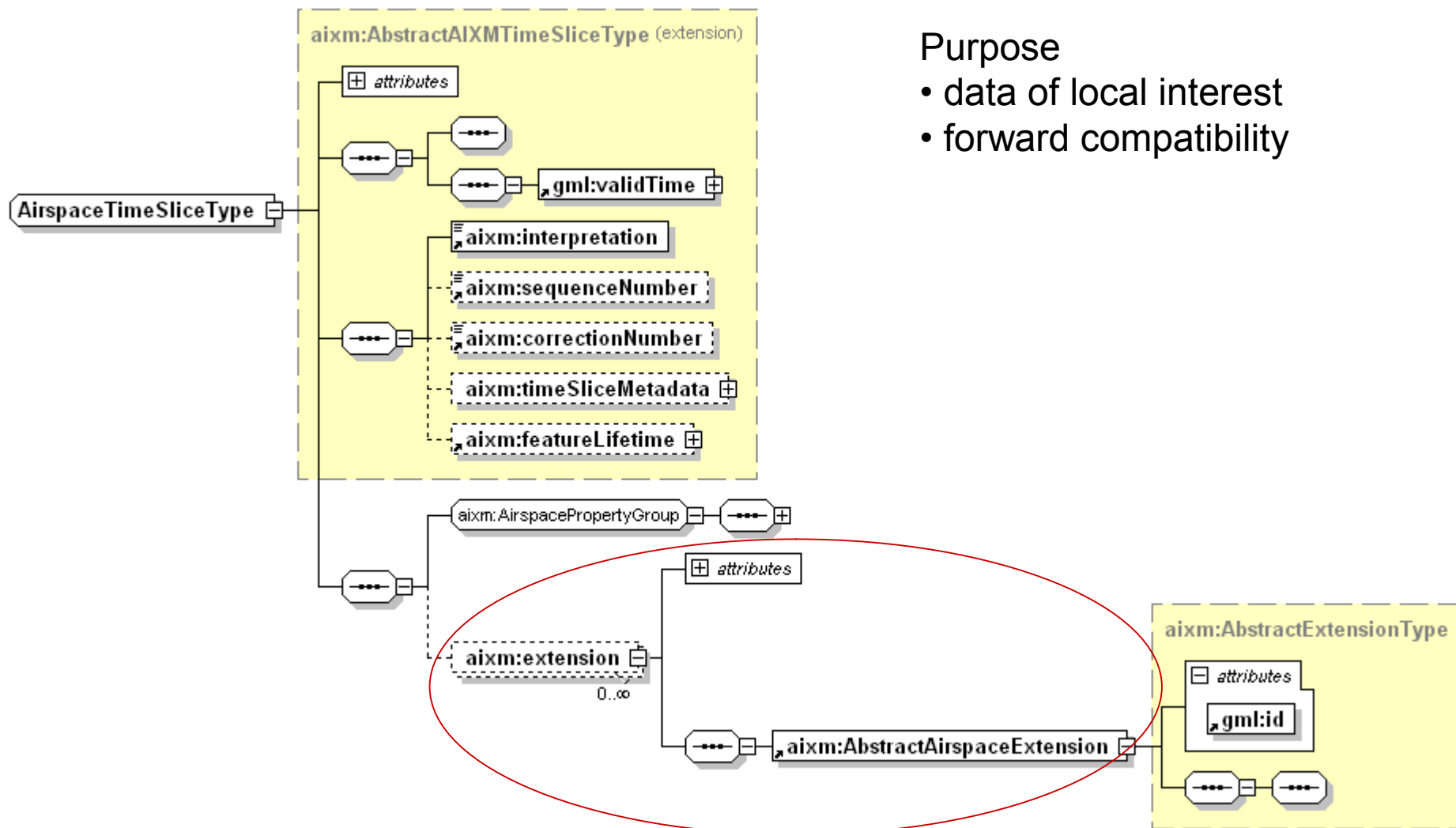
AIXM 5.1 extensions



Extensions – UML model



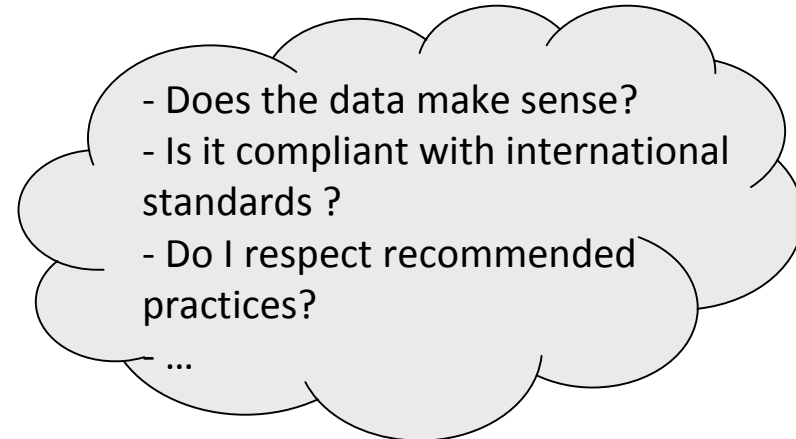
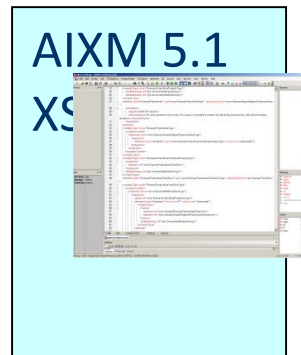
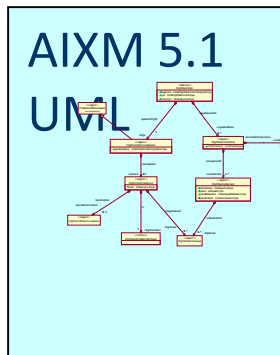
Extensions – feature/object



Purpose

- data of local interest
- forward compatibility

Validation of AIXM data sets

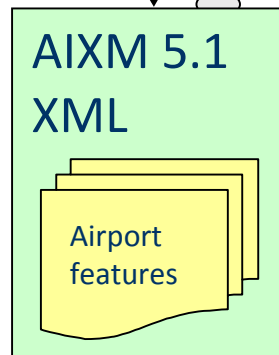


=

Syntactic check

- Check the compliance of an XML dataset with the XSD grammar
- Performed by standard XML parsers (e.g. xerxes, MSXML, XMLSpy, etc.)

Semantic check



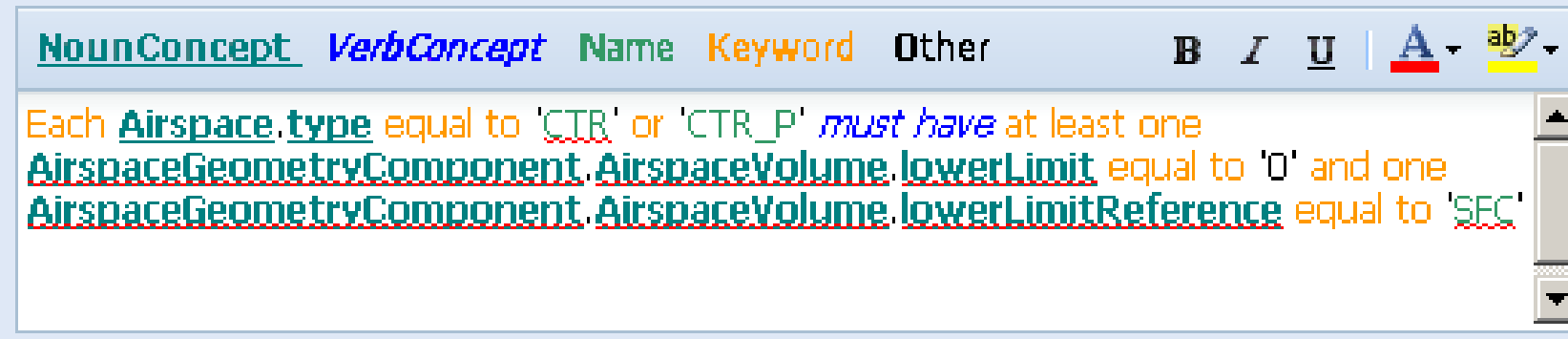
Use of SBVR

- 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)
 - (Most) coded already in the AIXM schema
 - **AIXM Operative rules:** rules extracted from official documents (ICAO Annexes), minimum data rules, consistency rules, recommended practices, coding rules...

SBVR in AIXM - example

- ICAO Annex 11: “*If a control zone is located within the lateral limits of a control area, it shall extend upwards from the surface of the earth to at least the lower limit of the control area.*”
- SBVR equivalent:

SBVR Text:



The screenshot shows a text editor window with a toolbar at the top. The toolbar includes buttons for Bold (B), Italic (I), Underline (U), a color selection tool (A), and a spell checker (ab). The text in the editor is color-coded: 'NounConcept' in green, 'VerbConcept' in blue, 'Name' in green, 'Keyword' in orange, and 'Other' in black. The text content is: "Each Airspace.type equal to 'CTR' or 'CTR_P' *must have* at least one AirspaceGeometryComponent.AirspaceVolume.lowerLimit equal to '0' and one AirspaceGeometryComponent.AirspaceVolume.lowerLimitReference equal to 'SEC'".

Encoding Business Rules ISO Schematron

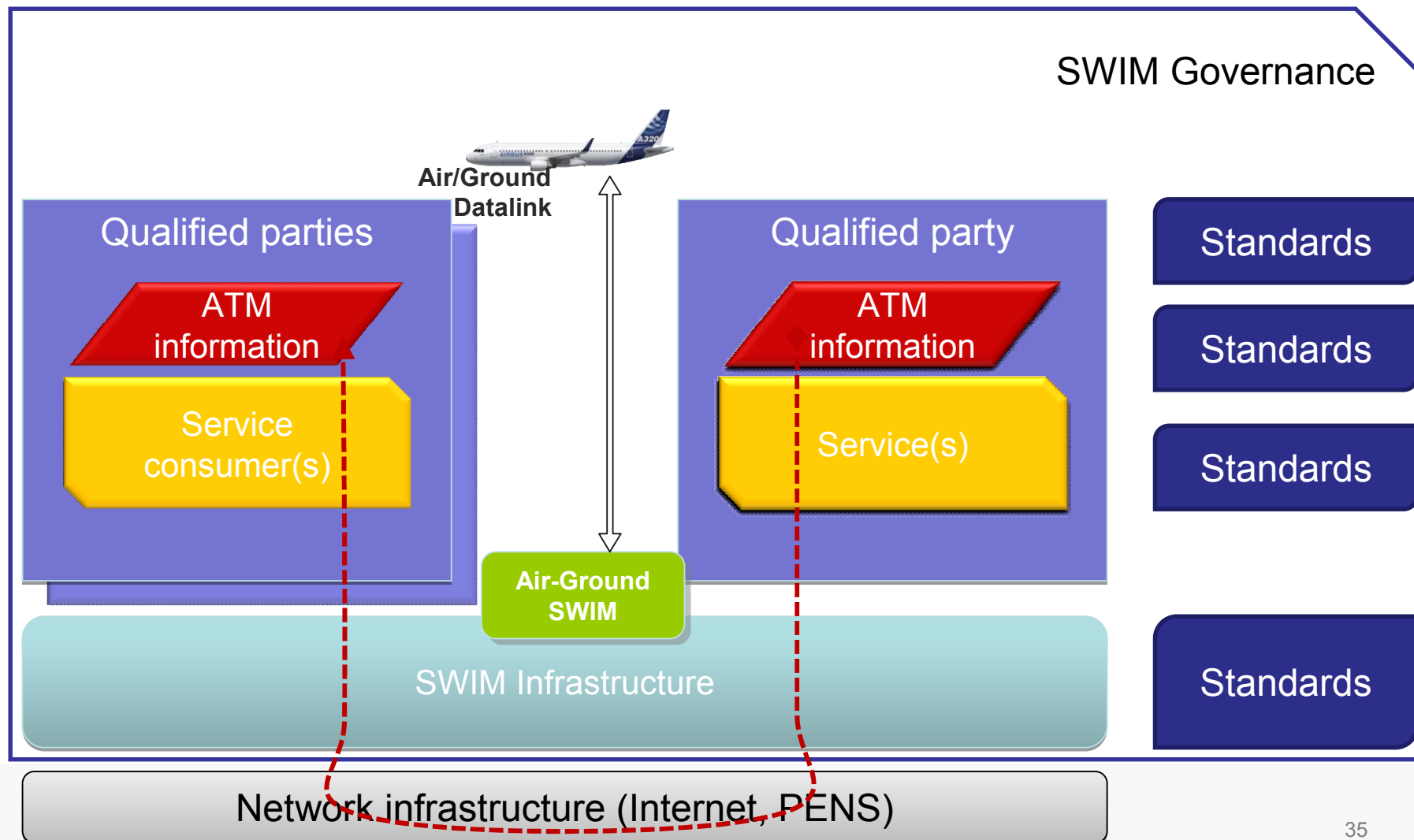
- Schematron (<http://www.schematron.com/>)
 - is an open language for the validation of XML document...
 - ...whose specification is standardized (ISO/IEC 19757)

- There are 6 basic elements in ISO Schematron: assertion, rule, pattern, schema, namespace and phase.

SESAR – System Wide Information Management

SWIM context

SWIM consists of standards, infrastructure and governance enabling the management of ATM information and its exchange between qualified parties via interoperable services.



WE ARE MAKING POWERFUL INFORMATION
FROM OPERATIONAL DATA



2013

Join the SESAR SWIM Master Class 2013

Building on the success of last year's edition, the second SWIM Master Class is planned from June to November 2013.

This year, more ATM data providers are entering the game, offering development teams a wider scope of data and services to exploit in their SWIM-enabled applications or web-services.

Therefore ATM data service providers and developers are invited to participate to the launch of an even more promising challenge.

5 key steps to know about

- Expression of interest by ATM data providers **and** development teams: April - May 2013;
- Selection of ATM data providers covering one or more ATM domains: April - May 2013;
- SWIM Initiation Day/Kick-off: June 2013. An opportunity to enhance your knowledge of SWIM and acquire more information about the SWIM Master Class Platform/Infrastructure/ATM Data Providers;
- Open competition: July to October 2013. Time for creative business and development teams to demonstrate their ability to develop new applications or web services based on SWIM technologies;
- SWIM best-in-class ceremony: November 2013 at EUROCONTROL Headquarters awarding the winners and demonstrating the best prototypes.

Enter the growing SWIM community

"For us, one of the most valuable parts of the Master Class for promoting and furthering SWIM has been in sharing our prototype and findings with the other Master Class participants" (Ian Painter, Managing Director at Snowflake).



Over 100 participants took part to the first SWIM Master Class in 2012, acquiring state-of-the-art expertise and sharing experience amongst top-notch SWIM experts. The Best-in-Class ceremony awarded the prototypes from Snowflake Software, M-Click and Thales Air Systems.

The SWIM Master Class is open on a voluntary basis to all interested parties wishing to demonstrate their SWIM-enabled application built on selected data service providers.

The best-in-class developments will be given the opportunity to demonstrate their results during the awards ceremony in November 2013.

Are you ready to take on the challenge and share experience, raise your profile within the ATM community and create new business opportunities?

Contact us at swim@eurocontrol.int and register before 30 April 2013

Open competition
Raise awareness on SWIM
Increase buy-in
Accelerate uptake

1
More data providers

2
Development of services

3
Development of SWIM enabled applications

4
Key role for Standard Organisations

Conclusions

- AIXM version 5 - key aspects
 - UML model
 - Temporality concept
 - Use of GML/XML Schema
 - Extensibility
 - Status and condition of aeronautical features (digital NOTAM)
 - Business Rules

- We are interested in further cooperation
 - GML?
 - SWIM Master Class?

Contact Information



- www.aixm.aero
- www.aixm.aero/wiki

- Eddy Porosnicu (EUROCONTROL)
 - eduard.porosnicu@eurocontrol.int
 - +32 (2) 729-3326

- Diana Young (FAA)
 - diana.young@faa.gov
 - +1 (202) 385-7445