EUROCONTROL’s Efforts with AIXM

AIXM 5.1 XML Developers' Seminar #3 – Jan 2010

EUROCONTROL

Overview

- **Current work on AIXM 5.1**
  - Update of AIXM 5.1 Documentation
  - Mapping AICM 4.5 -> AIXM 5.1
  - Mapping AIXM 5.0 <-> AIXM 5.1 + xslt scripts
  - AIXM 5.1 Business rules
  - eASM extension

- **AIXM 5 Implementations**
  - Digital NOTAM
  - Digital NOTAM / SNOWTAM trials
  - EAD

Current work on AIXM 5.1

- Update of AIXM 5.1 Documentation
- Mapping AICM 4.5 -> AIXM 5.1
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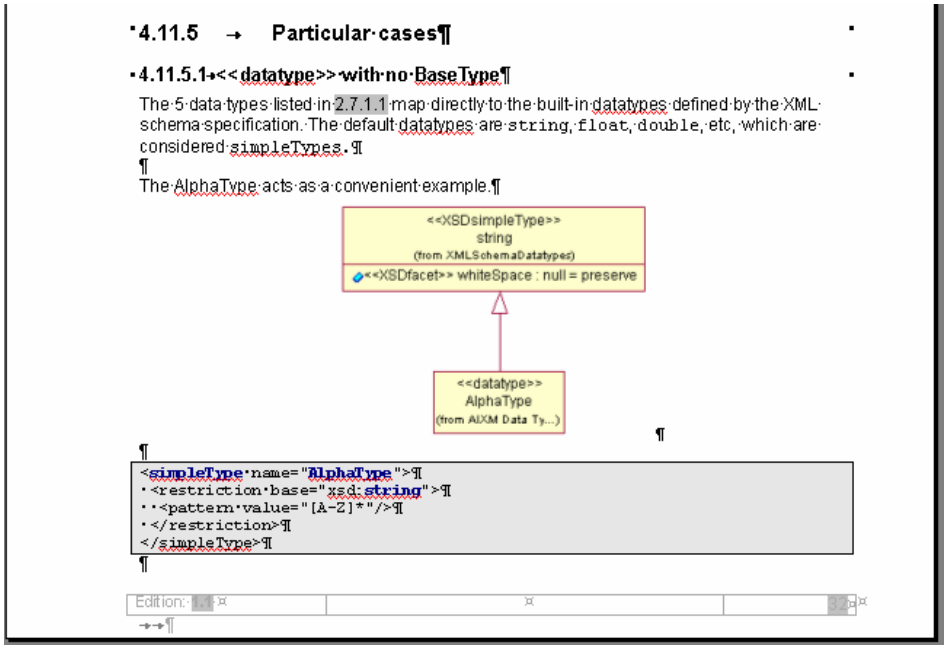
- AIXM 5.1 Business rules
- eASM extension

Update of AIXM 5.1 Documentation

- **AIXM UML to AIXM XSD Mapping v1.1**
  - nilReason attribute
  - Up to date examples
  - Particular cases



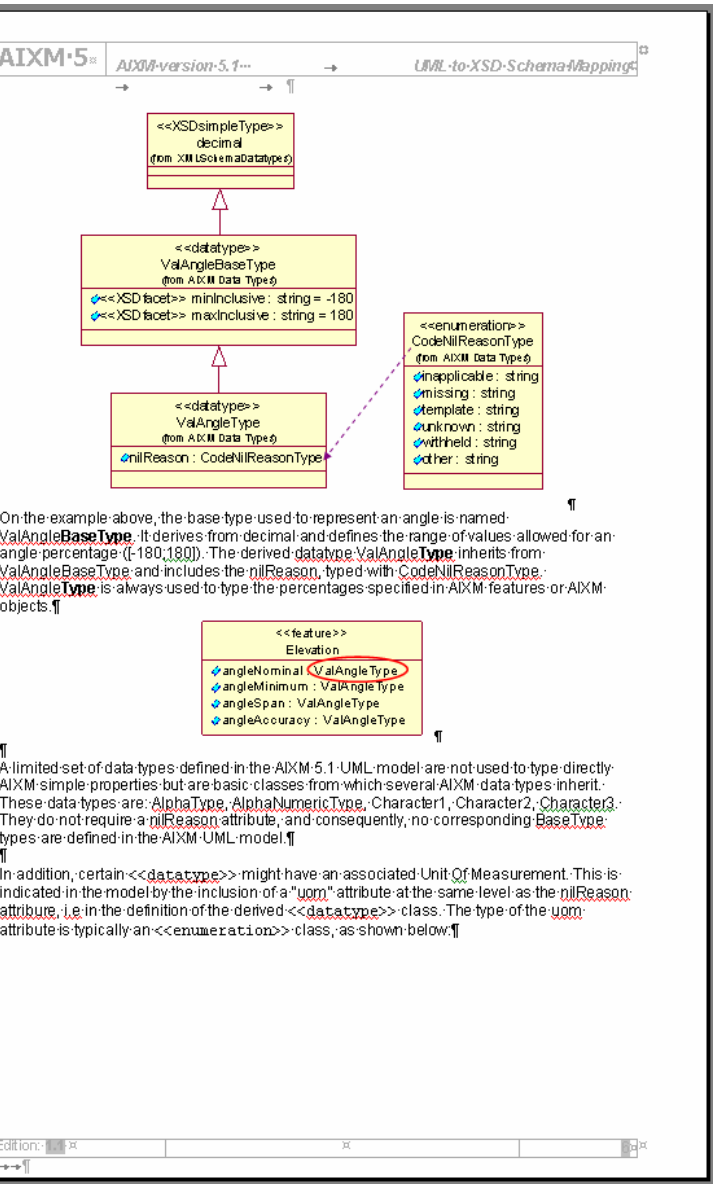
4.11.5 → Particular cases

4.11.5.1 <<datatype>> with no BaseType

The 5 data types listed in 2.7.1.1 map directly to the built-in datatypes defined by the XML schema specification. The default datatypes are `string`, `float`, `double`, etc, which are considered `simpleTypes`.

The AlphaType acts as a convenient example.


```
<simpleType name="AlphaType">
 <restriction base="xsd:string">
  <pattern value="[A-Z]*"/>
 </restriction>
</simpleType>
```



AIXM 5 | AIXM version 5.1 → UML to XSD Schema Mapping

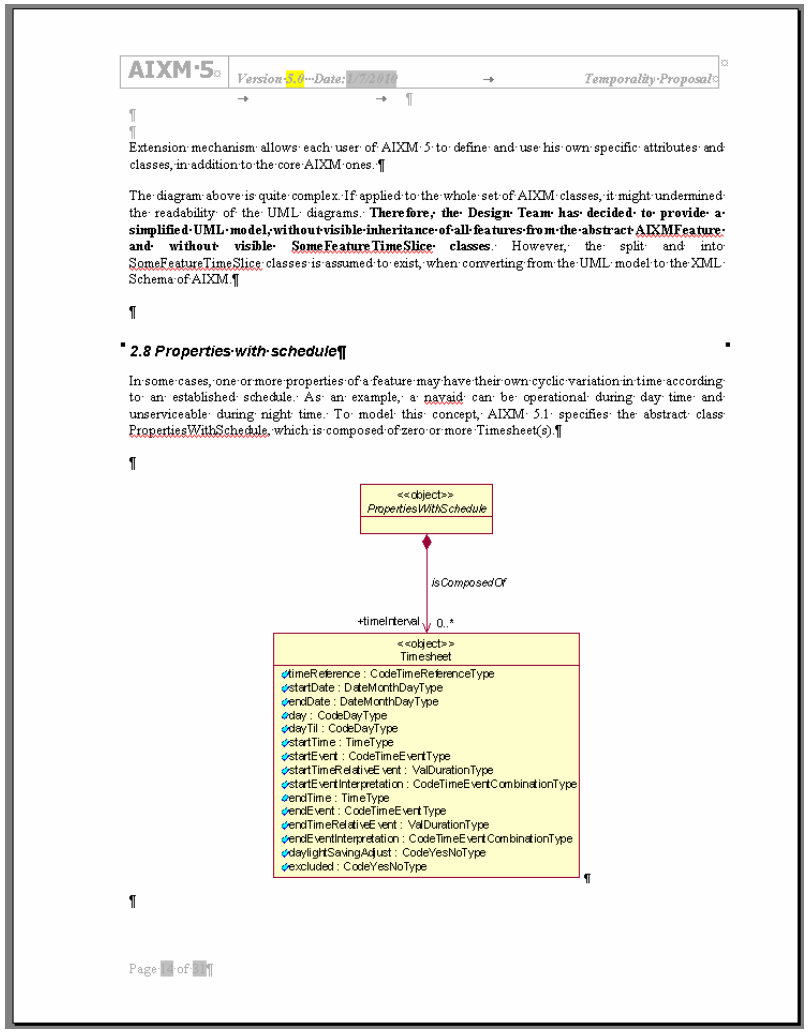
On the example above, the base type used to represent an angle is named ValAngle**BaseType**. It derives from decimal and defines the range of values allowed for an angle percentage ([-180;180]). The derived datatype ValAngle**Type** inherits from ValAngleBaseType and includes the nilReason, typed with CodeNilReasonType. ValAngle**Type** is always used to type the percentages specified in AIXM features or AIXM objects.

A limited set of data types defined in the AIXM 5.1 UML model are not used to type directly AIXM simple properties but are basic classes from which several AIXM data types inherit. These data types are: AlphaType, AlphaNumericType, Character1, Character2, Character3. They do not require a nilReason attribute, and consequently, no corresponding BaseType types are defined in the AIXM UML model.

In addition, certain <<datatype>> might have an associated Unit Of Measurement. This is indicated in the model by the inclusion of a "uom" attribute at the same level as the nilReason attribute, i.e in the definition of the derived <<datatype>> class. The type of the uom attribute is typically an <<enumeration>> class, as shown below:

Update of AIXM 5.1 Documentation

- **AIXM Temporality**



AIXM 5 Version 5.0 Date: 1/7/2010 Temporality Proposal

Extension mechanism allows each user of AIXM 5 to define and use his own specific attributes and classes, in addition to the core AIXM ones.

The diagram above is quite complex. If applied to the whole set of AIXM classes, it might undermined the readability of the UML diagrams. **Therefore, the Design Team has decided to provide a simplified UML model, without visible inheritance of all features from the abstract AIXMFeature and without visible SomeFeatureTimeSlice classes.** However, the split and into SomeFeatureTimeSlice classes is assumed to exist, when converting from the UML model to the XML Schema of AIXM.

2.8 Properties with schedule

In some cases, one or more properties of a feature may have their own cyclic variation in time according to an established schedule. As an example, a navaid can be operational during day time and unserviceable during night time. To model this concept, AIXM 5.1 specifies the abstract class PropertiesWithSchedule, which is composed of zero or more Timesheet(s).

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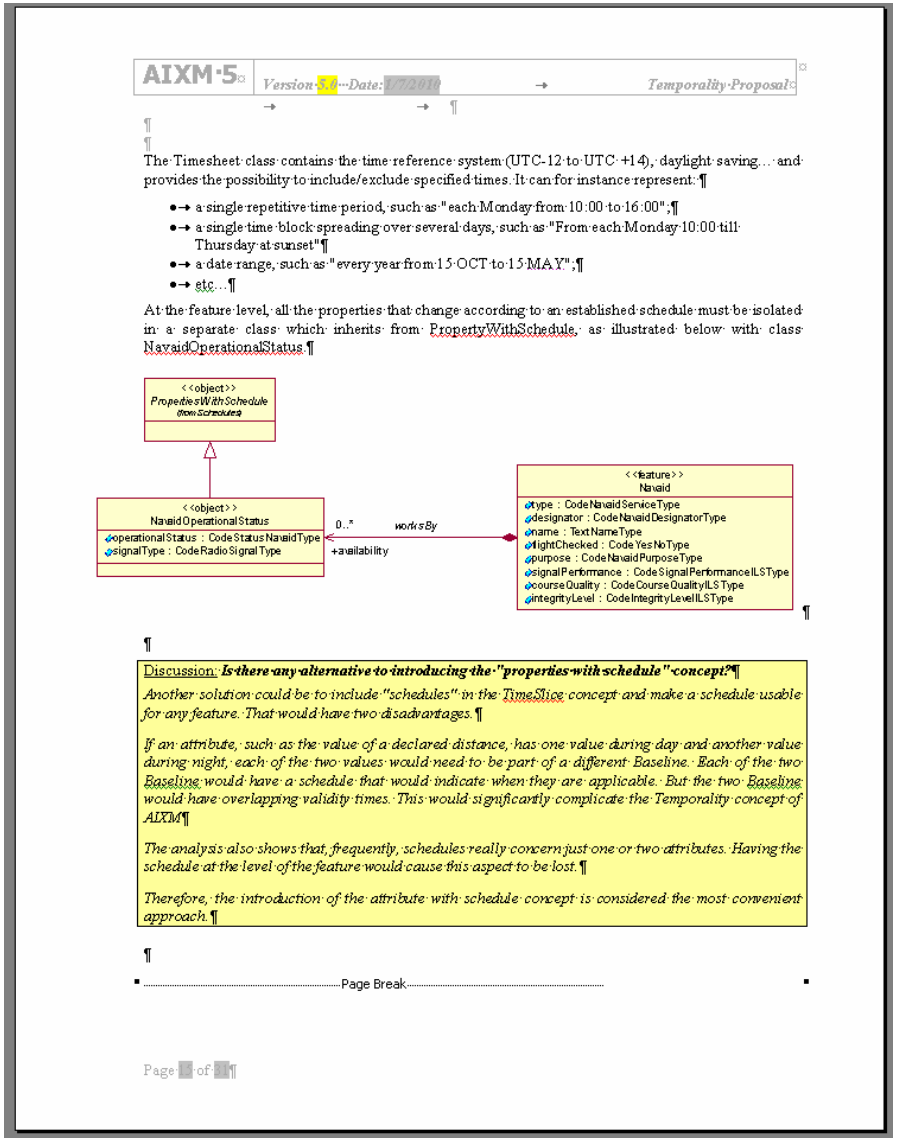

AIXM 5 Version 5.0 Date: 1/7/2010 Temporality Proposal

The Timesheet class contains the time reference system (UTC-12 to UTC +14), daylight saving… and provides the possibility to include/exclude specified times. It can for instance represent:

- a single repetitive time period, such as "each Monday from 10:00 to 16:00";
- a single time block spreading over several days, such as "From each Monday 10:00 till Thursday at sunset"
- a date range, such as "every year from 15 OCT to 15 MAY";
- etc…

At the feature level, all the properties that change according to an established schedule must be isolated in a separate class which inherits from PropertyWithSchedule, as illustrated below with class NavaidOperationalStatus.

Discussion: ***Is there any alternative to introducing the "properties with schedule" concept?***

Another solution could be to include "schedules" in the TimeSlice concept and make a schedule usable for any feature. That would have two disadvantages.

If an attribute, such as the value of a declared distance, has one value during day and another value during night, each of the two values would need to be part of a different Baseline. Each of the two Baseline would have a schedule that would indicate when they are applicable. But the two Baseline would have overlapping validity times. This would significantly complicate the Temporality concept of AIXM

The analysis also shows that, frequently, schedules really concern just one or two attributes. Having the schedule at the level of the feature would cause this aspect to be lost.

Therefore, the introduction of the attribute with schedule concept is considered the most convenient approach.

Page Break

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Update of AIXM 5.1 Documentation

- **AIXM Application Schema Generation 1.1**
  - Update examples to reflect 5.1 changes
  - …

- Once finalised, all these documents:
  - Will be posted on the AIXM forum
  - Will be available for download on www.aixm.aero

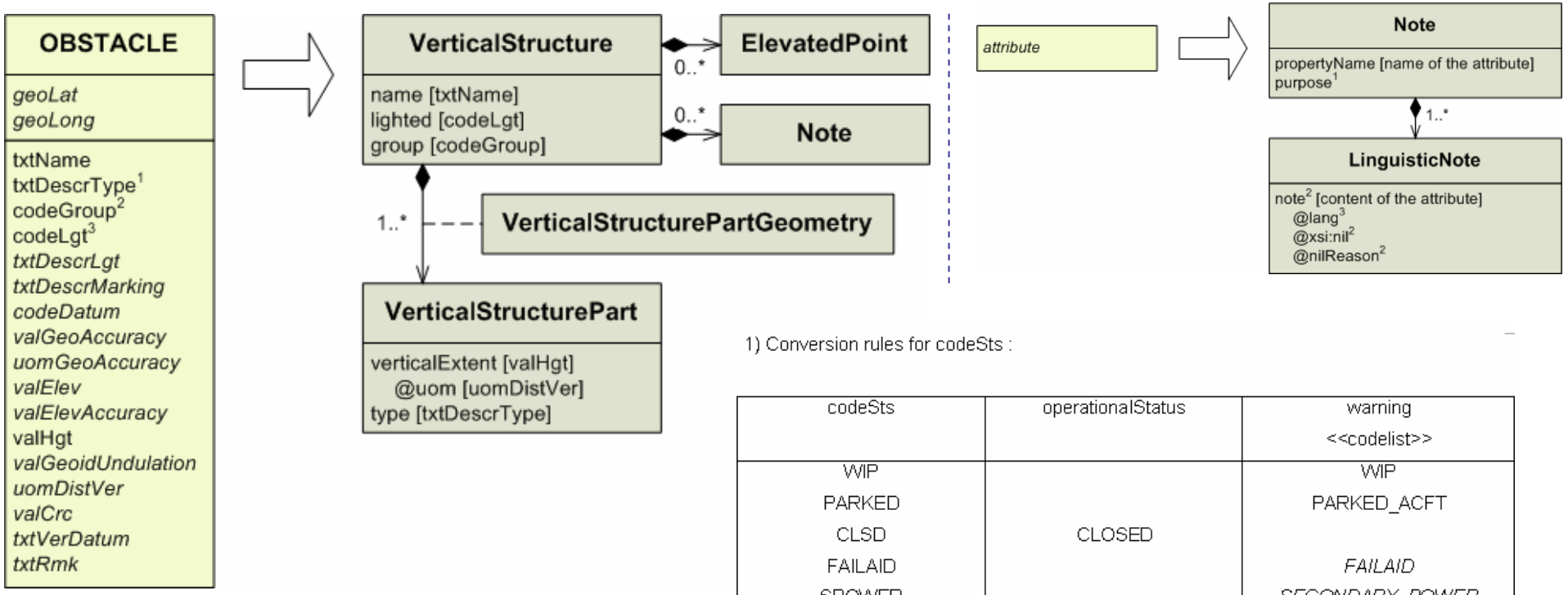
Mapping AICM 4.5 -> AIXM 5.1

- The **need** for such a conversion:
  - Today, much aeronautical data is structured according to **AIXM 4.5**
  - It is expected that implementers will progressively move towards **AIXM 5**

- A contract was awarded in **November 2009**. Objectives:
  - **Entity** to **class** mapping
  - **Attribute** to **property** mapping
  - **Attribute value** to **property values**
  - Processes involved in the mapping (**merge** of values…)
  - Mapping of AICM 4.5 **geographical** elements to **GML**

Mapping AICM 4.5 -> AIXM 5.1

- The deliverable is almost finalised.



1) Conversion rules for codeSts :

codeSts	operationalStatus	warning <<codelist>>
WIP		WIP
PARKED		PARKED_ACFT
CLSD	CLOSED	
FAILAID		*FAILAID*
SPOWER		*SECONDARY_POWER*
OTHER	OTHER	

- It will be posted for review on the AIXM forum.

Mapping AIXM 5.0 <-> AIXM 5.1 + xslt scripts

- Part of the same contract

- Objectives:
  - Provide a **5.0->5.1** mapping and a **5.1->5.0** mapping
  - Use a **technique similar** to the one employed for the 4.5-> 5.1 mapping
  - **Limited** to the list of **differences** between AIXM 5.0 and 5.1
  - Develop **XSLT scripts** implementing these rules

- For the 5.1->5.0 mapping, an **AIXM 5.0 extension** will be created to gather the new AIXM 5.1 elements.

AIXM 5.1 Business rules

- Definition of “business rules” has been standardized by OMG since Jan 2008

rule

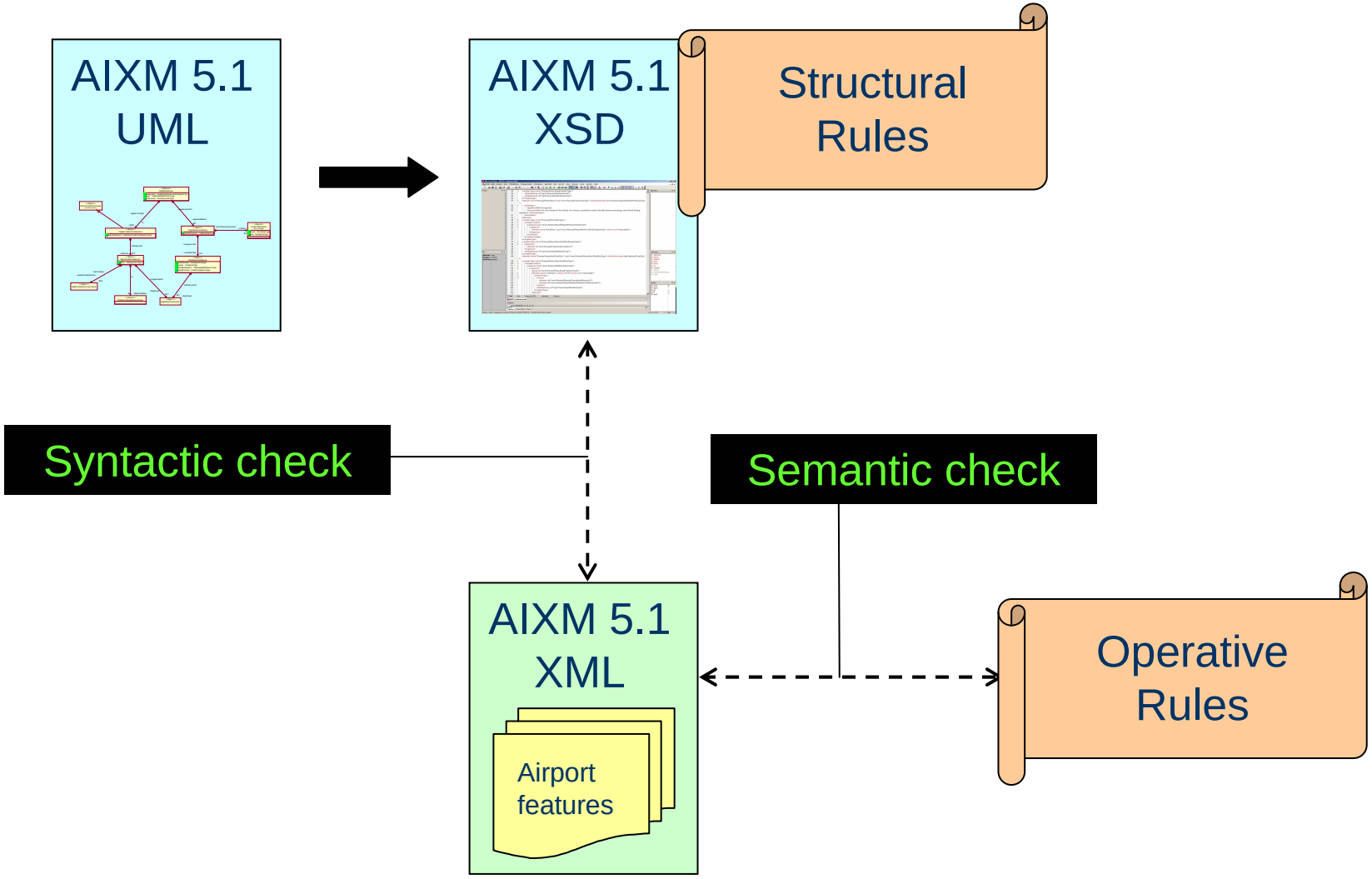
Definition:	proposition that is a claim of obligation or of necessity
Dictionary Basis:	one of a set of explicit or understood regulations or principles governing conduct or procedure within a particular area of activity ... a law or principle that operates within a particular sphere of knowledge, describing, or prescribing what is possible or allowable. [ODE]

business rule

Definition:	rule that *is* under business jurisdiction
General Concept:	rule, element of guidance
Note:	A rule’s being “under business jurisdiction” means that it is under the jurisdiction of the semantic community that it governs or guides - that the semantic community can opt to change or discard the rule. Laws of physics may be relevant to a company (or other semantic community); legislation and regulations may be imposed on it; external standards and best practices may be adopted. These things are not business rules from the company’s perspective, since it does not have the authority to change them. The company will decide how to react to laws and regulations, and will create business rules to ensure compliance with them. Similarly, it will create business rules to ensure that standards or best practices are implemented as intended. See subclause A.2.3

- See *Semantics of Business Vocabulary and Business Rules (SBVR), v1.0*
  - Chapter 12.1.2
  - Annex A.2.3

AIXM 5.1 Business rules



AIXM 5.1 Business rules

- The need for AIXM 5.1 Business Rules:
  - Business rules for **AIXM 4.5** must be **adapted to AIXM 5.1** as data provider systems will gradually move towards AIXM 5
  - AIXM 5 does **no** longer specify **mandatory properties or associations for a feature.**

- A contract was awarded in December 2009.

AIXM 5.1 Business rules

- **Objectives**:
  - Define a **set of AIXM 5.1 business rules** based on:
    - AIXM **4.5** business rules
    - **ICAO Annex 10, 11, 14** and **15** and the **ICAO PANS-OPS**
    - **Temporality** Concept document (including PropertiesWithSchedule)
    - **Activation/Usage** concept
    - draft **AIXM GML** profile
    - (Optional) Arinc424-A specification
  - Provide as a proof-of-concept an i**mplementation** of these rules in **Schematron** language
  - Upgrade Eurocontrol's tool **ARC** which performs Schematron validation of AIXM data

AIXM 5.1 Business rules

- The result of this work will be an **Excel report**
  - Containing **textual rules** classified by type etc…
  - Providing **Schematron** code

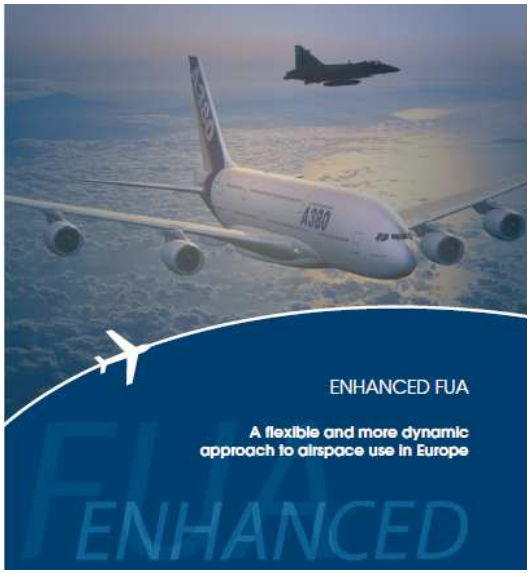
- AIXM Users will be able to pick-up the rules they need for their systems

Source	$	Rule textual description	Comments	AIXM Class	AIXM Attribute	AIXM Association	Category	Level	Name	AIXM Rule Type	AIXM Rule Ident	AIXM - Schematron Rule Context	AIXM - Test Ident (assert ident) ?	AIXM - Schematron rules - full description
Activation /Usage		An airport that is under military control cannot forbid military flights.		AirportAvailability	...	...	Consistency rule	Error						

eASM extension

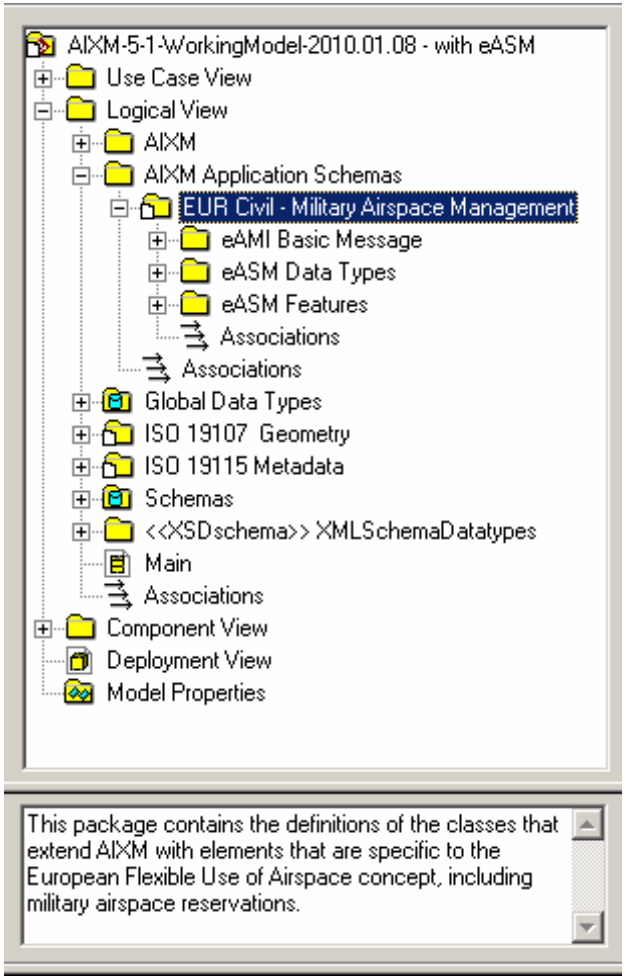
- European "**Flexible Use of Airspace**" concept:
  - Airspace is no longer designated as purely "civil" or "military" airspace
  - Any necessary airspace segregation is temporary, based on real-time usage within a specific time period.
  - Contiguous volumes of airspace are not constrained by national boundaries.

- Pan-European implementation has not been feasible in the past
  - Main problem: **Data diversity**
  - **Terminology** was **different** between **civil** and **military** stakeholders

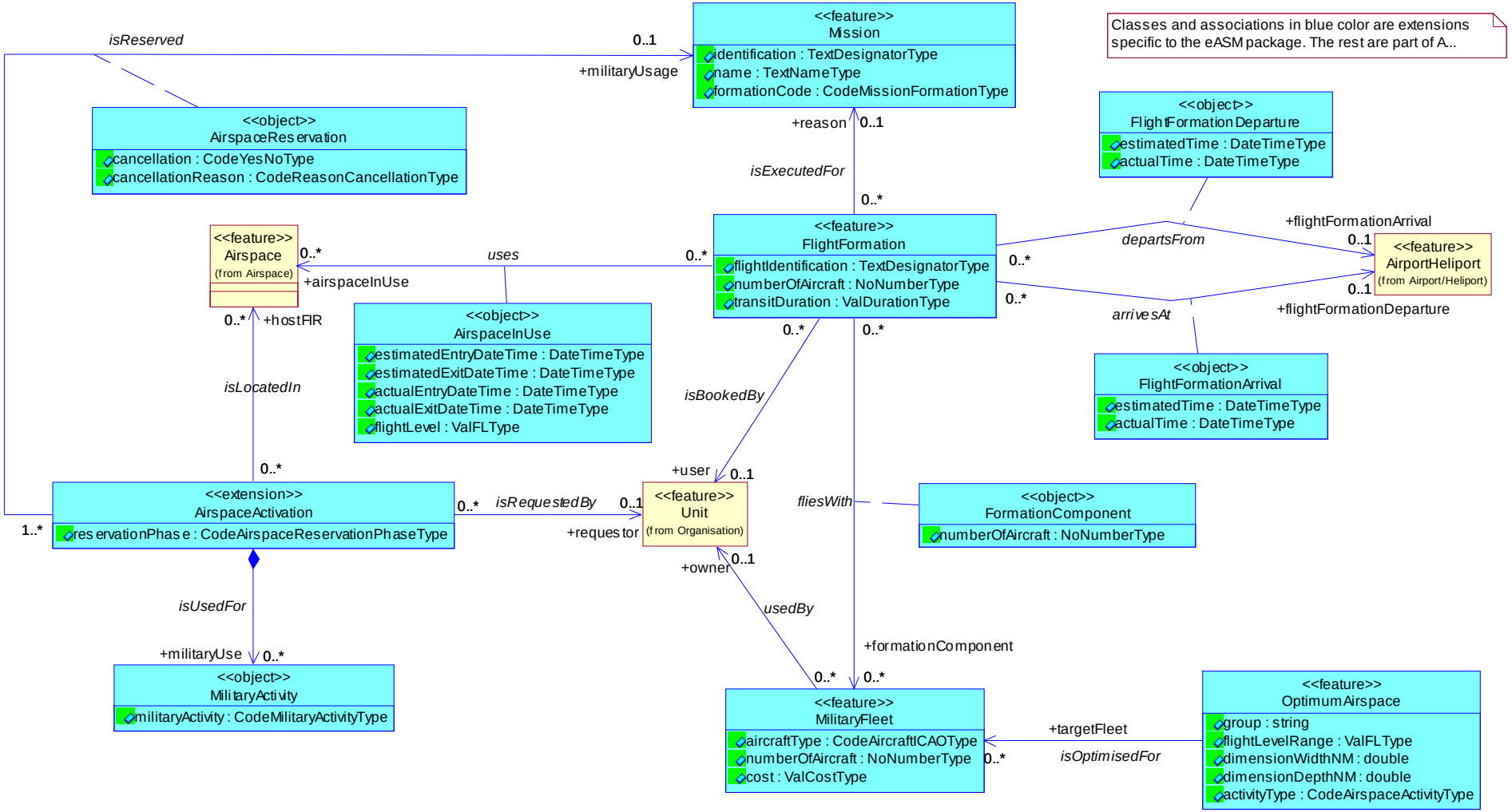


eASM extension

- The eASM **extends AIXM 5.1** to support the FUA concept
- The eASM **Conceptual** Model defines:
  - **Airspace activation**
  - **Conditional route closure/activation**
  - **Military missions**
- The eASM **XSD schemas** are generated in compliance with the **AIXM 5.1 UML to XSD mapping guidelines**



eASM extension



AIXM 5 Implementations

- Digital NOTAM
- Digital NOTAM / SNOWTAM trials
- EAD: European Aeronautical Database

Digital NOTAM

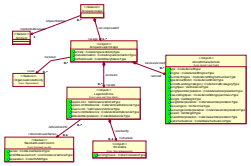
Current NOTAM

(A2018/07 NOTAMN
Q) EGPX/QMRLC/IV/NBO/A /000/999/5439N00613W005
A) EGAA B) 0709011344 C) 0709011344
E) RWY 07/25 WITHDRAWN FM SER DUE TO ESSENTIAL MAINT.
BOTH RWY CAN BE MADE AVBL TO FULL OPR CRITERIA WITH 30MIN PPR.
WIP WILL BE SUSPENDED WHEN THE CLOUD CEILING FALLS TO OR BLW 600FT
OR VIS FALLS TO OR BLW 5000M.)

*"A **notice** distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations."*

Digital NOTAM

*"A **data set** made available through digital services containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to systems and automated equipment used by personnel concerned with flight operations."*



Requires data models!

Digital NOTAM Sample

```
<event:Event xsi:schemaLocation="http://www.aixm.aero/schema/5.0/event/0.1 http://www.ai
http://www.aixm.aero/schema/5.0/extensions/eur/fua/FUA_Features.xsd" gml:id="Event-0003">
  <event:name>ESSA runways closed</event:name>
- <event:description>
    RWY 08/26, 01L/19R, 01R/19L closed temporarily due to snow contamination and bad we
  </event:description>
  <event:type>TEMPORARY</event:type>
- <event:hasMember>
  - <aixm:AirportHeliportUsage gml:id="VID2678448">
      <gml:identifier codeSpace="http://www.eurocontrol.int/xnotam">0cfbd1ea-bf3
    - <aixm:timeSlice>
      - <aixm:AirportHeliportUsageTimeSlice gml:id="VID2678449">
        - <gml:validTime>
          - <gml:TimeInstant gml:id="VID000002">
              <gml:timePosition>2009-02-127T07:00:00</gml:timePosition>
            </gml:TimeInstant>
          </gml:validTime>
          <aixm:interpretation>PERMDELTA</aixm:interpretation>
          <aixm:sequenceNumber>1</aixm:sequenceNumber>
          <aixm:correctionNumber>0</aixm:correctionNumber>
        - <aixm:featureLifetime>
          - <gml:TimePeriod gml:id="VID000001">
              <gml:beginPosition>2009-02-127T07:00:00</gml:beginPosition>
              <gml:endPosition indeterminatePosition="unknown"/>
            </gml:TimePeriod>
          </aixm:featureLifetime>
        - <aixm:limitation>
          - <aixm:AirportHeliportUsageLimitation>
              <aixm:type>FORBID</aixm:type>
            - <aixm:condition>
              - <aixm:AirportHeliportUsageCondition>
                - <aixm:flight>
                  - <aixm:FlightCharacteristic>
                      <aixm:rule>ALL</aixm:rule>
                    </aixm:FlightCharacteristic>
                  </aixm:flight>
                - <aixm:operation>
                  - <aixm:AirportHeliportOperation>
                      <aixm:type>TAKEOFF</aixm:type>
                    </aixm:AirportHeliportOperation>
                - <aixm:operation>
                  - <aixm:AirportHeliportOperation>
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                    </aixm:AirportHeliportOperation>
                  </aixm:operation>
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              </aixm:condition>
            </aixm:AirportHeliportUsageLimitation>
          </aixm:limitation>
          <aixm:affectedRunwayDirection xlink:href="http://www.eurocontrol.int
          /xnotam#xpointer(//aixm:RunwayDirection[gml:identifier='75a95f14-bc8c-4335-9851-6f7a7e766d1a'])"
          xlink:title="//aixm:RunwayDirection//aixm:designator='08' and //aixm:AirportHeliport
          //aixm:designator='ESSA'"/>
          <aixm:affectedRunwayDirection xlink:href="http://www.eurocontrol.int
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          xlink:title="//aixm:RunwayDirection//aixm:designator='26' and //aixm:AirportHeliport
          //aixm:designator='ESSA'"/>
          <aixm:affectedRunwayDirection xlink:href="http://www.eurocontrol.int
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          //aixm:designator='ESSA'"/>
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          //aixm:designator='ESSA'"/>
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          /xnotam#xpointer(//aixm:RunwayDirection[gml:identifier='f91cc17a-45cb-4b4c-aae0-2215945bab2c '])"
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          //aixm:designator='ESSA'"/>
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      </aixm:timeSlice>
```
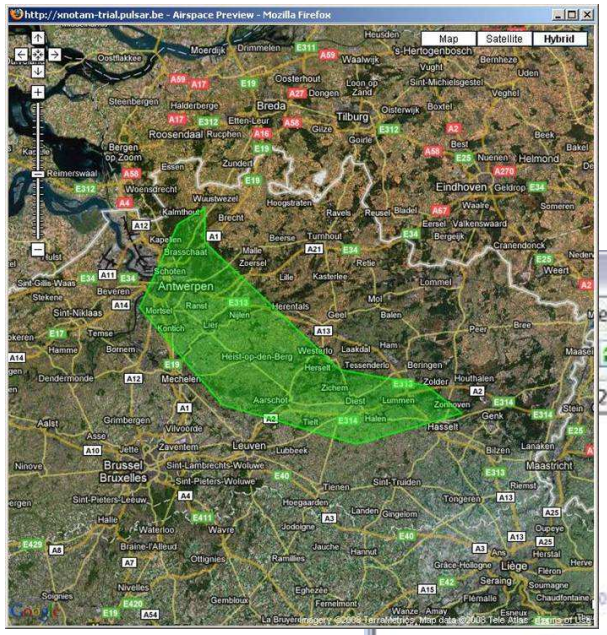
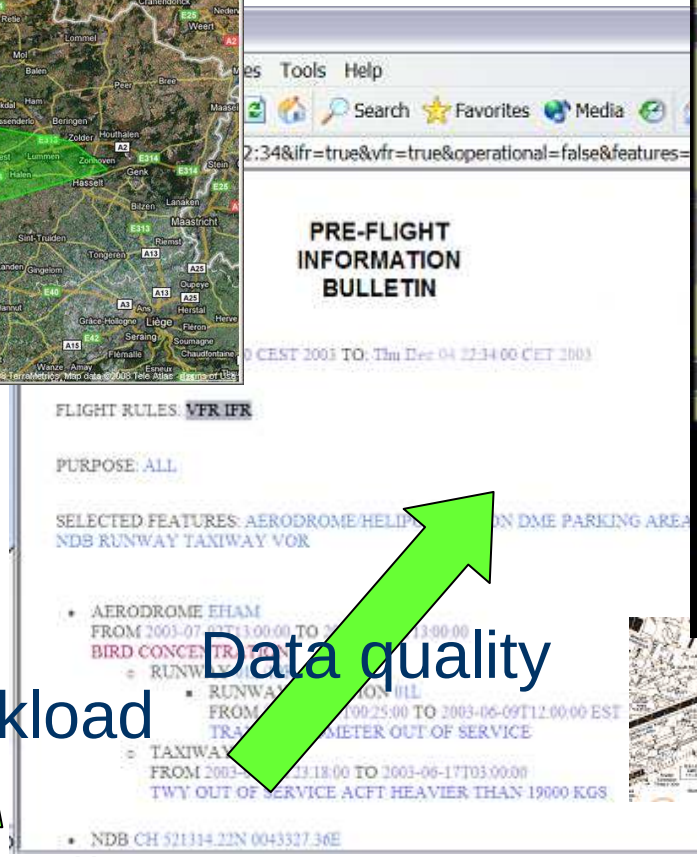

What you can do with Digital NOTAM





Manual workload

Data quality

Digital NOTAM – Europe Roadmap

- **2012 – 2014**
  - ECAC States provide Digital NOTAM increment 1
  - Service providers and end users gradually use digital NOTAM on the ground
- **2015 – 2018**
  - ECAC States provide Digital NOTAM increment 2
  - Service providers and end users use digital NOTAM on the ground and gradually in the air

- The AI Team supports 2012 as start date
- Proposed date (2014) for full operational capability for Increment 1 in ECAC is still **TBC**

Digital NOTAM Trial - 2008

Digital NOTAM Trial - 2008

- Organised between February and June 2008 to demonstrate the **maturity** of the "**digital NOTAM**" concept
- Based on **AIXM 5 Release Candidate 2**

- Objectives:
  - Validate AIXM 5
  - Provide a proof of concept for a "digital NOTAM encoding application"
  - Provide a significant amount of test xNOTAM data

http://xnotam-trial.pulsar.be - Airspace Permanent Change - Mozilla Firefox

Airspace Permanent Cha

Effective Time Instant

Start date and time: 2008/02/07 13:1

Airspace | Geometry | Time Table

Shape:

Latitude
510251N
510057N
505731N
505342N
505830N
511032N

Vertical limits:

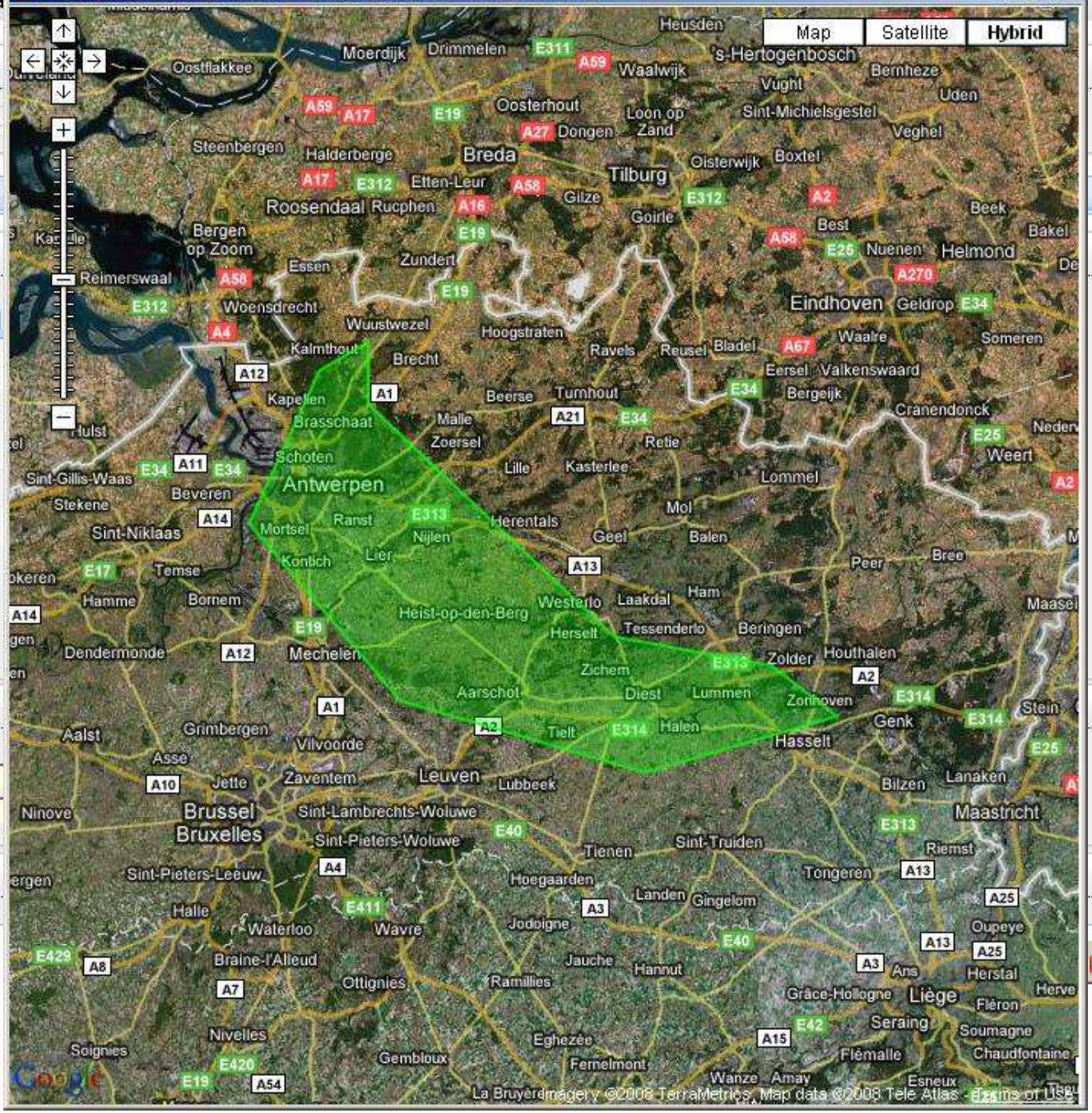
Upper Limit: UNL

Lower Limit: 195

Aggregate:

Cancel

http://xnotam-trial.pulsar.be - Airspace Preview - Mozilla Firefox


Map
Satellite
Hybrid
Antwerpen
Brussel
Bruxelles
Leuven
Eindhoven
Tilburg
Breda
Roosendaal
Hasselt
Maastricht
Liège
Genk
Mechelen
Aarschot
Heist-op-den-Berg
Turnhout
Geel
Mol
Lommel
Sint-Niklaas
Dendermonde
Aalst
Ninove
Halle
Waterloo
Wavre
Tienen
Sint-Truiden
Tongeren
Zichem
Diest
Lummen
Zonhoven
Houthalen
Peer
Bree
Weert
Helmond
's-Hertogenbosch
Oosterhout
Dongen
Oisterwijk
Boxtel
Veghel
Uden
Vught
Waalwijk
Drimmelen
Moerdijk
Oostflakkee
Steenbergen
Halderberge
Etten-Leur
Rucphen
Bergen op Zoom
Reimerswaal
Woensdrecht
Essen
Zundert
Goirle
Best
Nuenen
Geldrop
Someren
Waalre
Eersel
Valkenswaard
Bergeijk
Cranendonck
Ravels
Reusel
Bladel
Hoogstraten
Wuustwezel
Kalmthout
Brecht
Kapellen
Brasschaat
Malle
Zoersel
Retie
Beerse
Lille
Kasterlee
Schoten
Sint-Gillis-Waas
Stekene
Beveren
Mortsel
Ranst
Nijlen
Lier
Kontich
Herentals
Balen
Laakdal
Westerlo
Herselt
Tessenderlo
Beringen
Ham
Hamme
Bornem
Temse
Grimbergen
Vilvoorde
Zaventem
Jette
Asse
Ternat
Sint-Lambrechts-Woluwe
Sint-Pieters-Woluwe
Sint-Pieters-Leeuw
Hoegaarden
Landen
Gingelom
Jodoigne
Jauche
Hannut
Ramillies
Ottignies
Braine-l'Alleud
Nivelles
Soignies
Gembloux
Eghezée
Fernelmont
Flémalle
Seraing
Herstal
Oupeye
Visé
Fléron
Herve
Soumagne
Chaudfontaine
Esneux
Amay
Wanze
Lubbeek
Bilzen
Lanaken
Riemst
Stein
Zolder
Halen
Tielt
Zonhoven
Gräce-Hollogne
Ans
Jupille-sur-Meuse
Visé
Aubel
Plombières
Dalhem
Blégny
Trembleur
Oupeye
Herstal
Herve
Fléron
Soumagne
Chaudfontaine
Esneux
Amay
Wanze
Flémalle
Seraing
Liège
Maasmechelen
Genk
Hasselt
Tongeren
Riemst
Lanaken
Maastricht
Visé
Aubel
Plombières
Dalhem
Blégny
Trembleur
Oupeye
Herstal
Herve
Fléron
Soumagne
Chaudfontaine
Esneux
Amay
Wanze
Flémalle
Seraing
Liège
Gräce-Hollogne
Ans
Jupille-sur-Meuse

Digital NOTAM Trial - 2008

- Lessons learned:
  - **AIXM 5.0** model was sufficiently **mature** to support the Digital NOTAM concept.
  - Identified some **modelling deficiencies**, **corrected in AIXM 5.1** (e.g. the “Usage” concept)
  - Demonstrated that with a **relatively small investment** (200 k€) it is possible to develop a basic HMI that can be successfully used by today’s NOTAM operators to provide the desired Digital NOTAM output

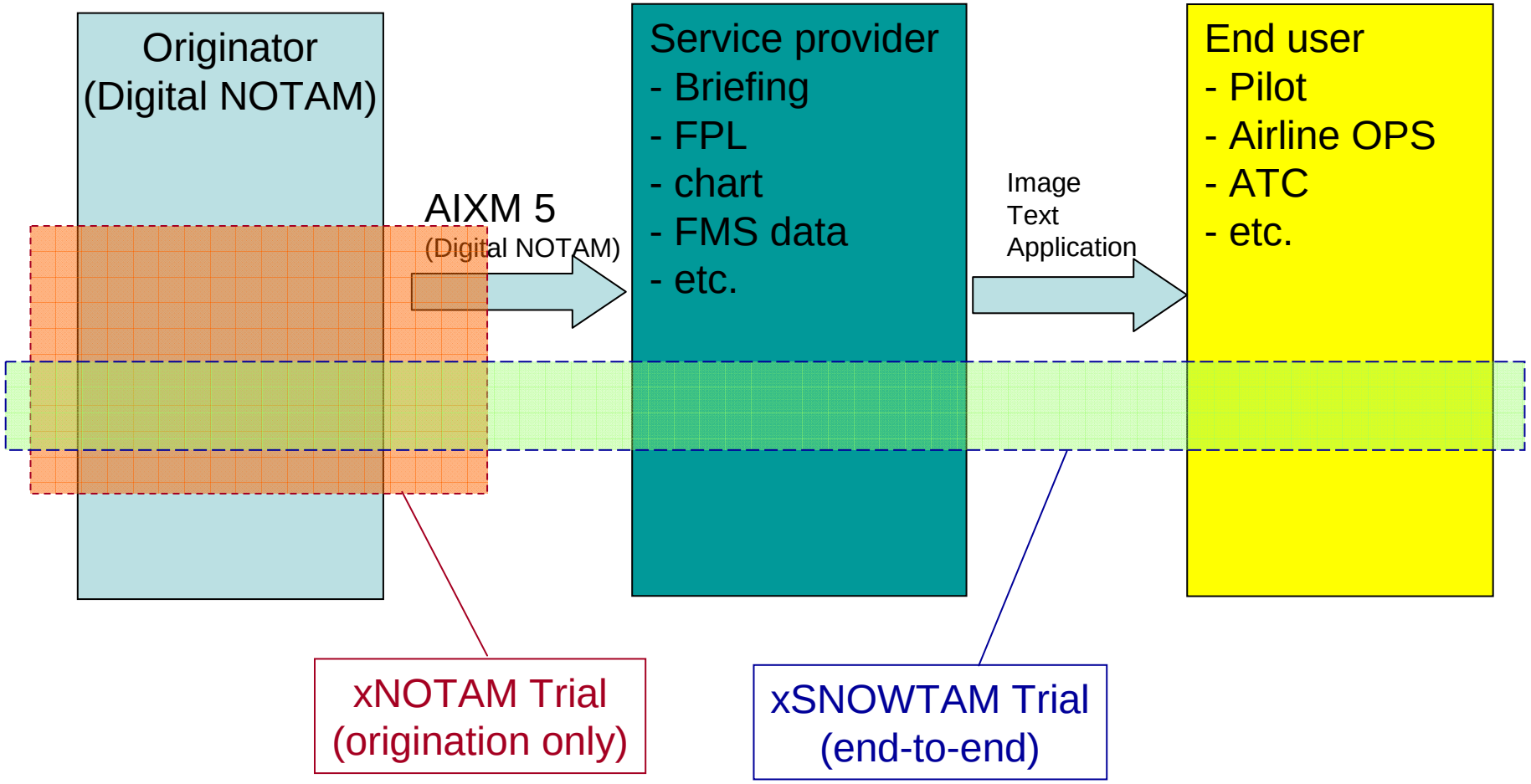
Digital SNOWTAM Trial 2009-2010

Digital SNOWTAM Trial 2009-2010

- The **Digital SNOWTAM Trial** was launched in November 2009 and will run until March 2010.

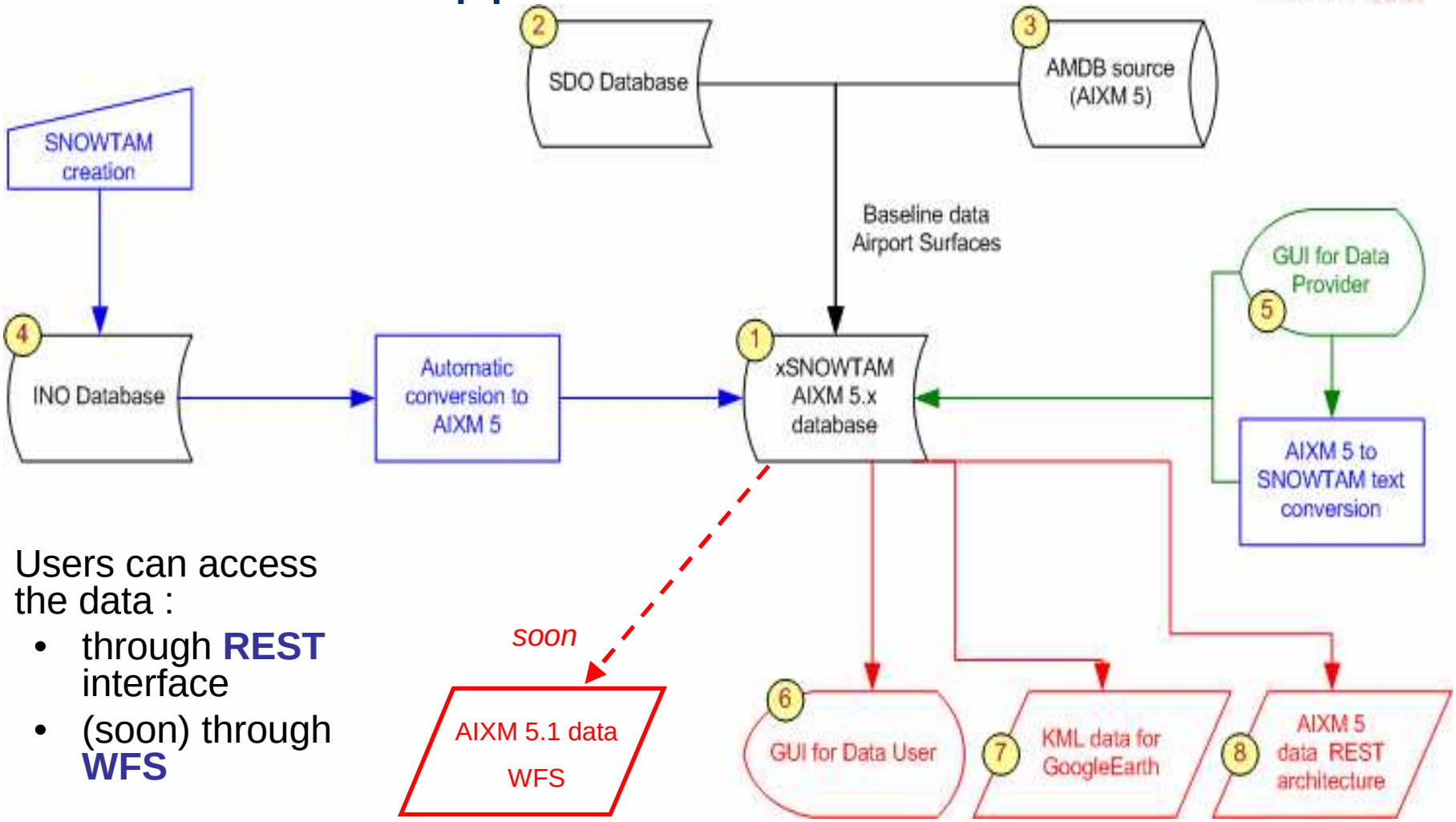
- Objectives
  - Demonstrate xNOTAM benefits to end users -> Airlines
  - Verification of the AIXM 5.1 Surface Contamination model
  - Continue the testing of Web service standards
    - REST architecture
  - Start work on algorithms and open source code
    - structured SNOWTAM text to AIXM 5.1
    - AIXM 5.1 to SNOWTAM text

Digital SNOWTAM Trial - Scope



Participants: 10 NOTAM offices, Airlines, Airports, System developers

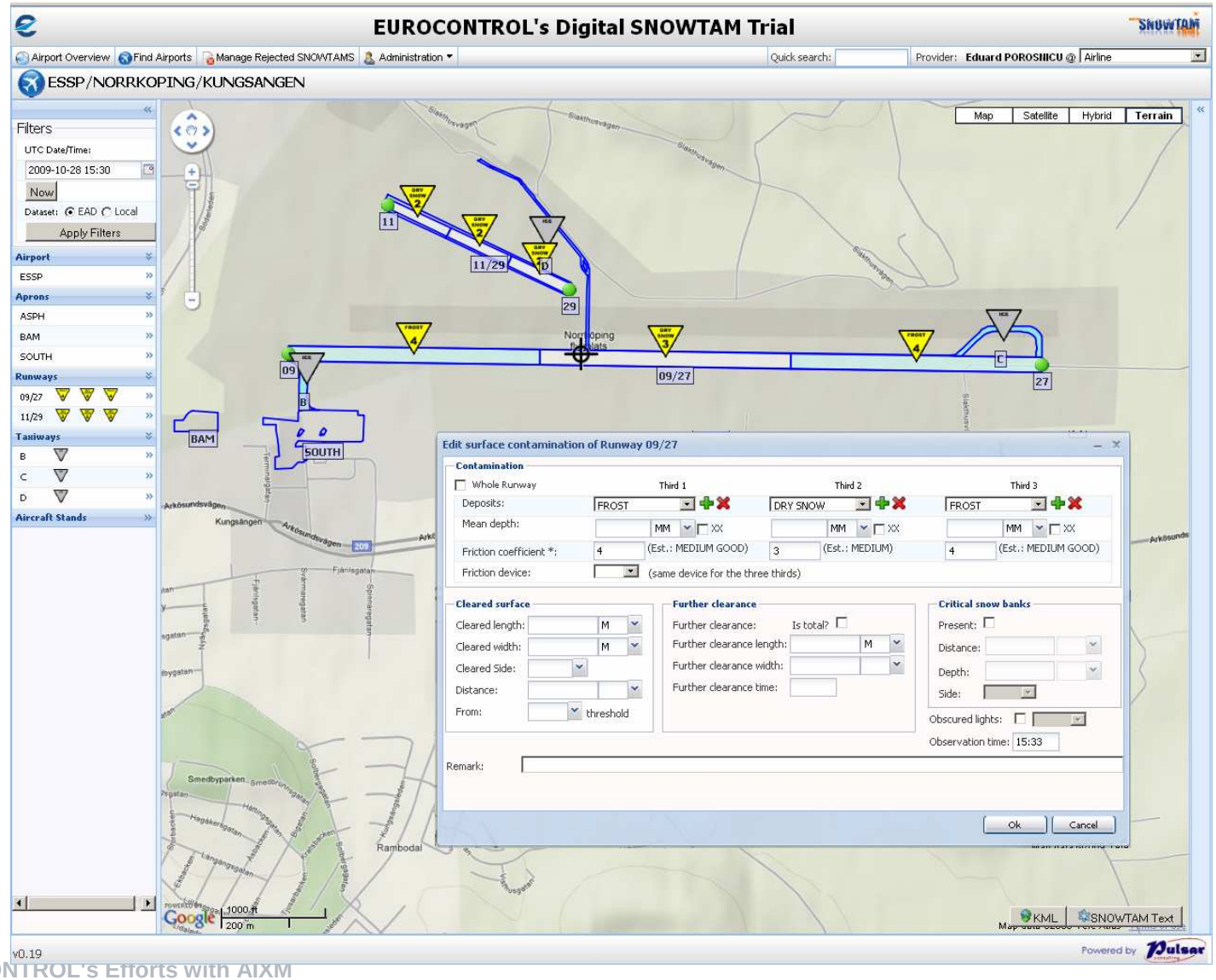
Trial – Application architecture



- Users can access the data :
  - through **REST** interface
  - (soon) through **WFS**

If you want to participate in the trial, please contact us !
http://www.eurocontrol.int/aim/public/standard_page/xnotam_trials.html

Digital SNOWTAM Trial 2009-2010



EAD - European AIS Database

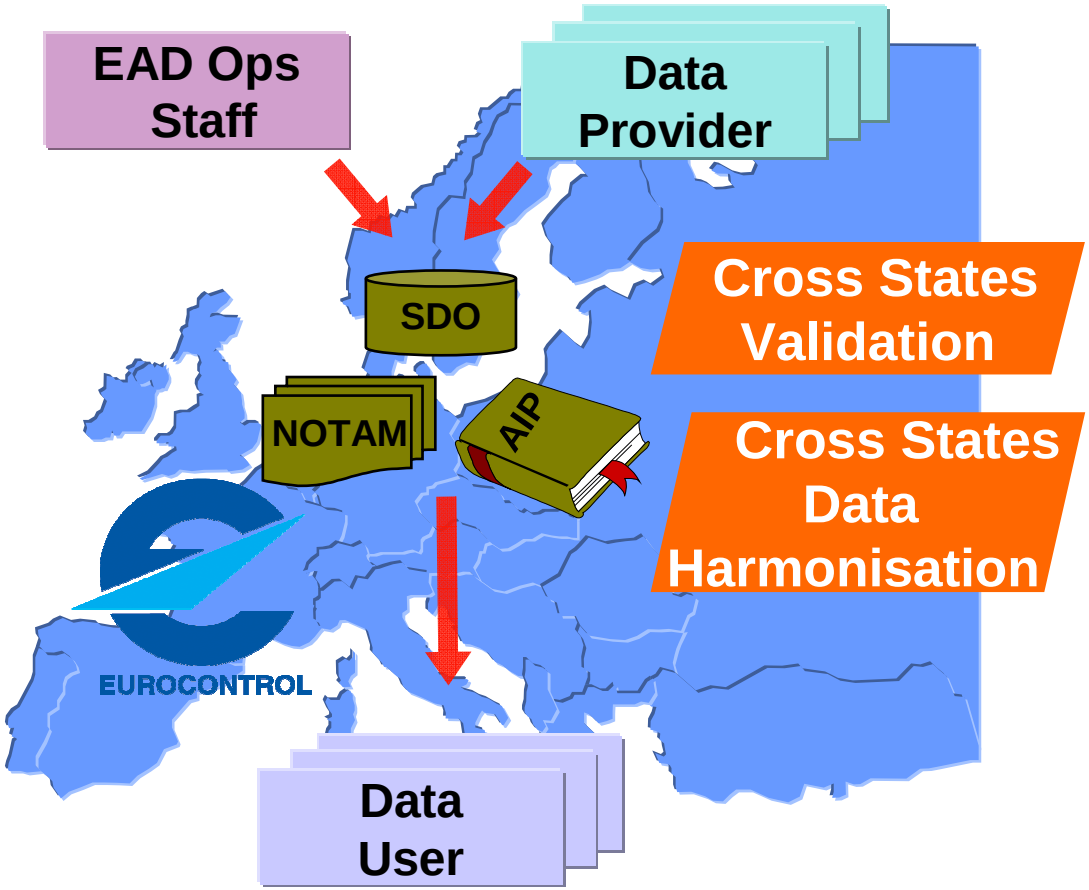
- **EAD** is a service provided and owned by EUROCONTROL on behalf of its Member States.

Data Providers (Civil & Mil)

- Civil Aviation Authorities
- Air Navigation Service Providers
- EUROCONTROL/CFMU

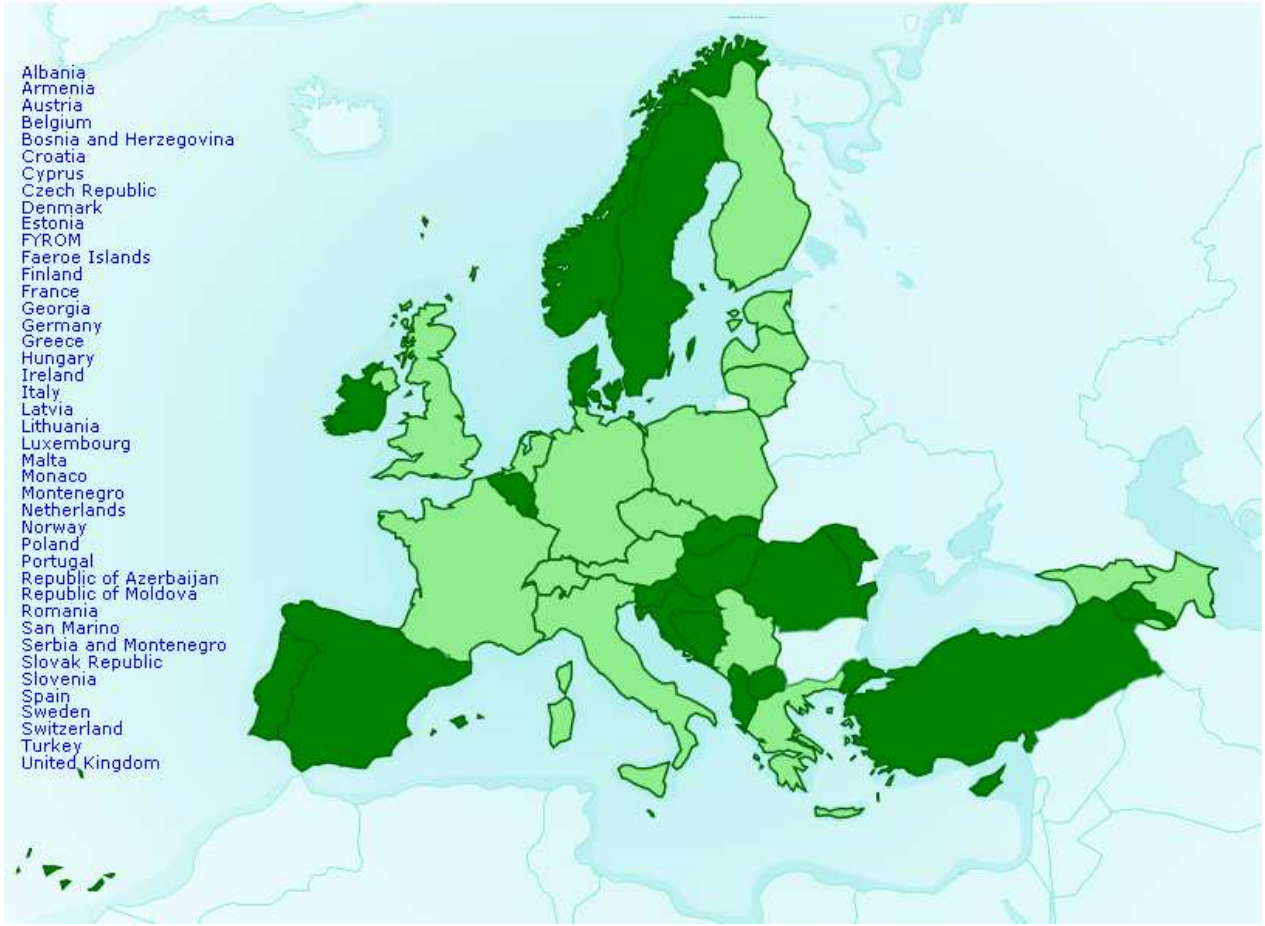
Data Users

- Aircraft Operators
- Commercial Users
- Private Pilots
- ATC
- General Public



EAD - European AIS Database

- **23 Data Providers fully migrated to the EAD**
- **19 Data Providers committed to migrate**



EAD - European AIS Database

- **SDO** - Static Data Operation
  - Central repository of validated specific world wide AIP data and complete ECAC AIP data

- **Coverage**:
  - **ECAC area:** Full set of aeronautical information data published in AIP
  - **Worldwide:** Minimum set of static data required for NOTAM validation and Pre-flight Information Bulletin generation

- **SDO** implements **AIXM 4.5**

- **EAD** will progressively move towards **AIXM 5.1**, mainly to **support Digital NOTAM**

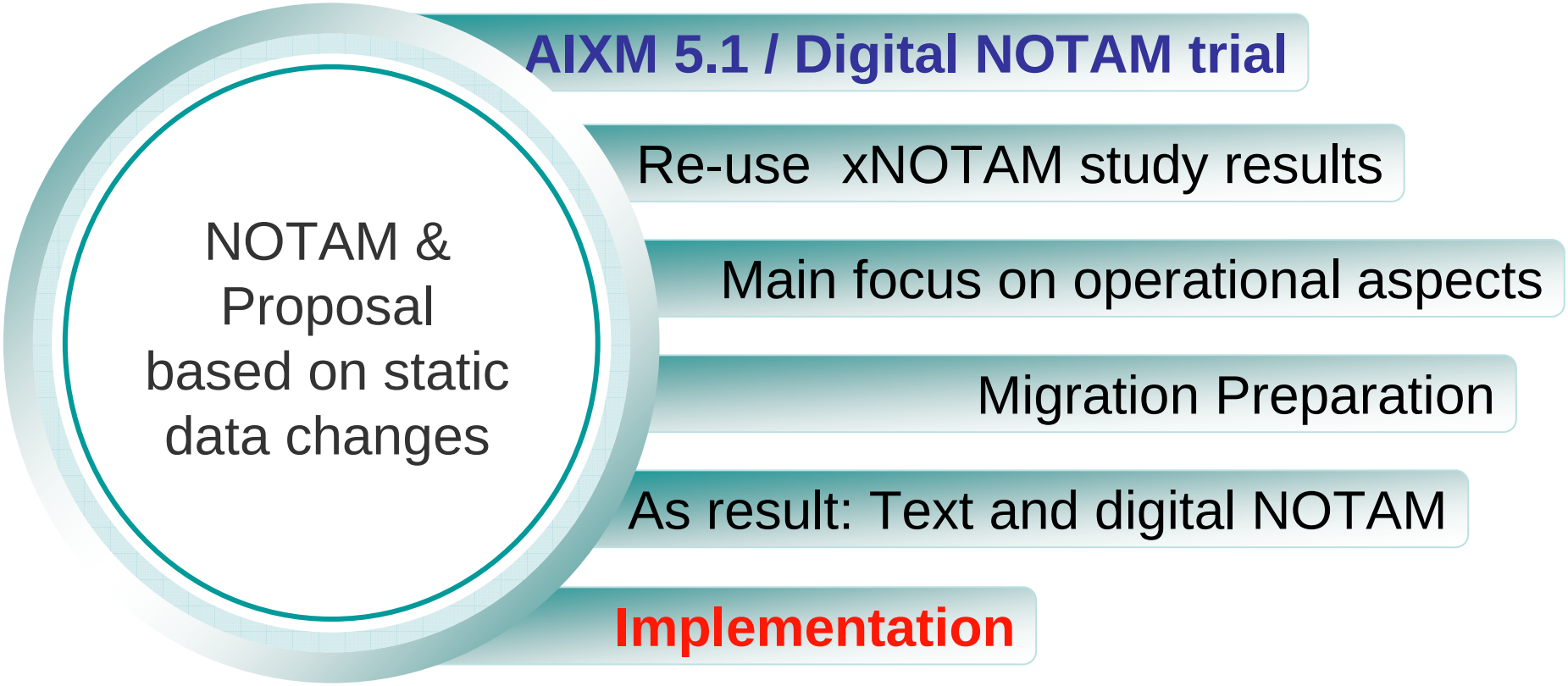
EAD – Implementation of AIXM 5.1

- SDO **Obstacle** concept will be updated to be compliant with **AIXM 5.1**
  - Spring 2010

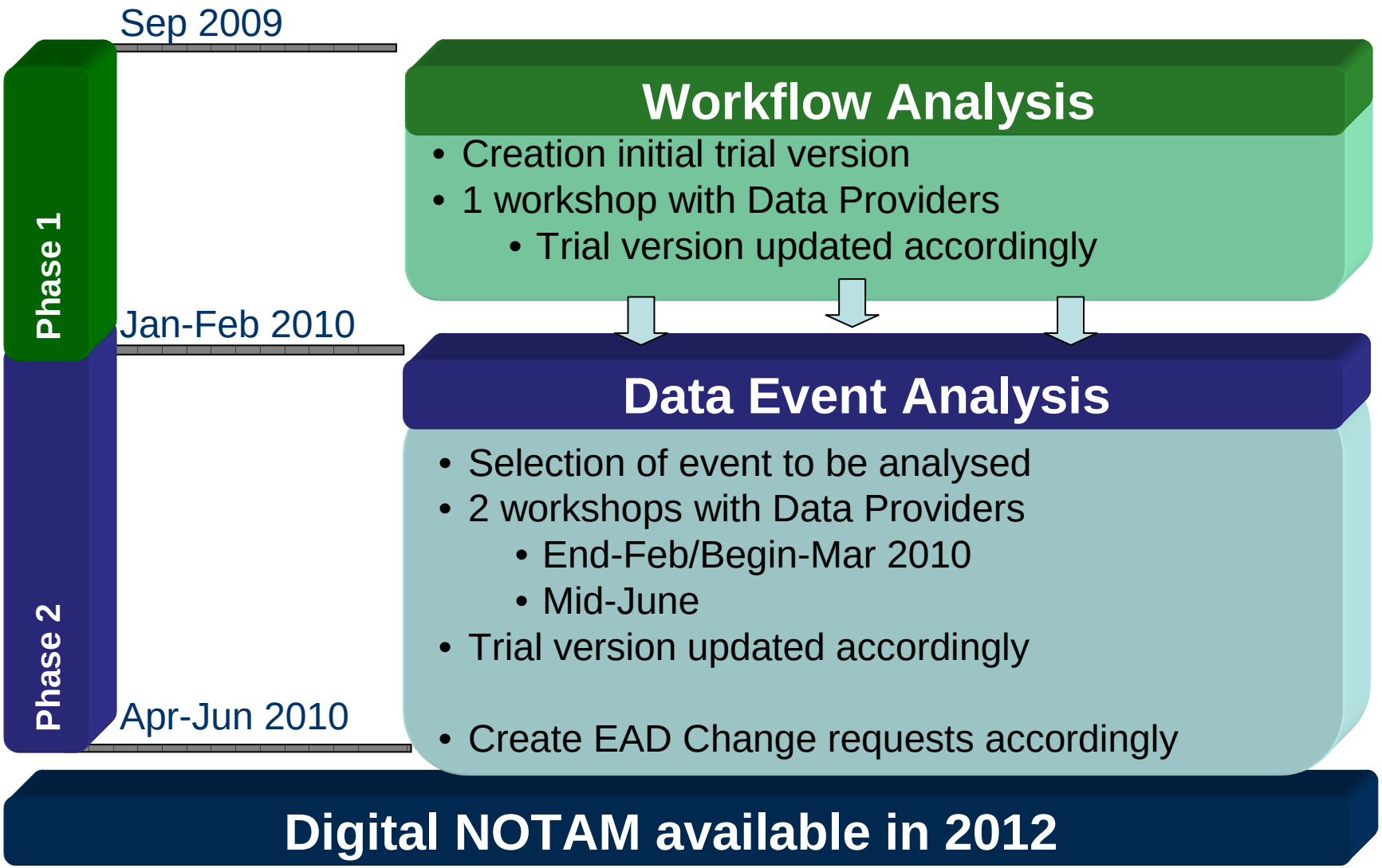
- Full implementation of the AIXM 5.1 **Temporality** model - supports the following timeslice types:
  - BASELINE
  - PERMDELTA
  - SNAPSHOT
  - TEMPDELTA (preparatory work for the future Digital NOTAM).

- Next step: NAVAIDS and Designated Points, based on the ADR requirements and the harmonisation with the CFMU Environment system (**eASM** …)

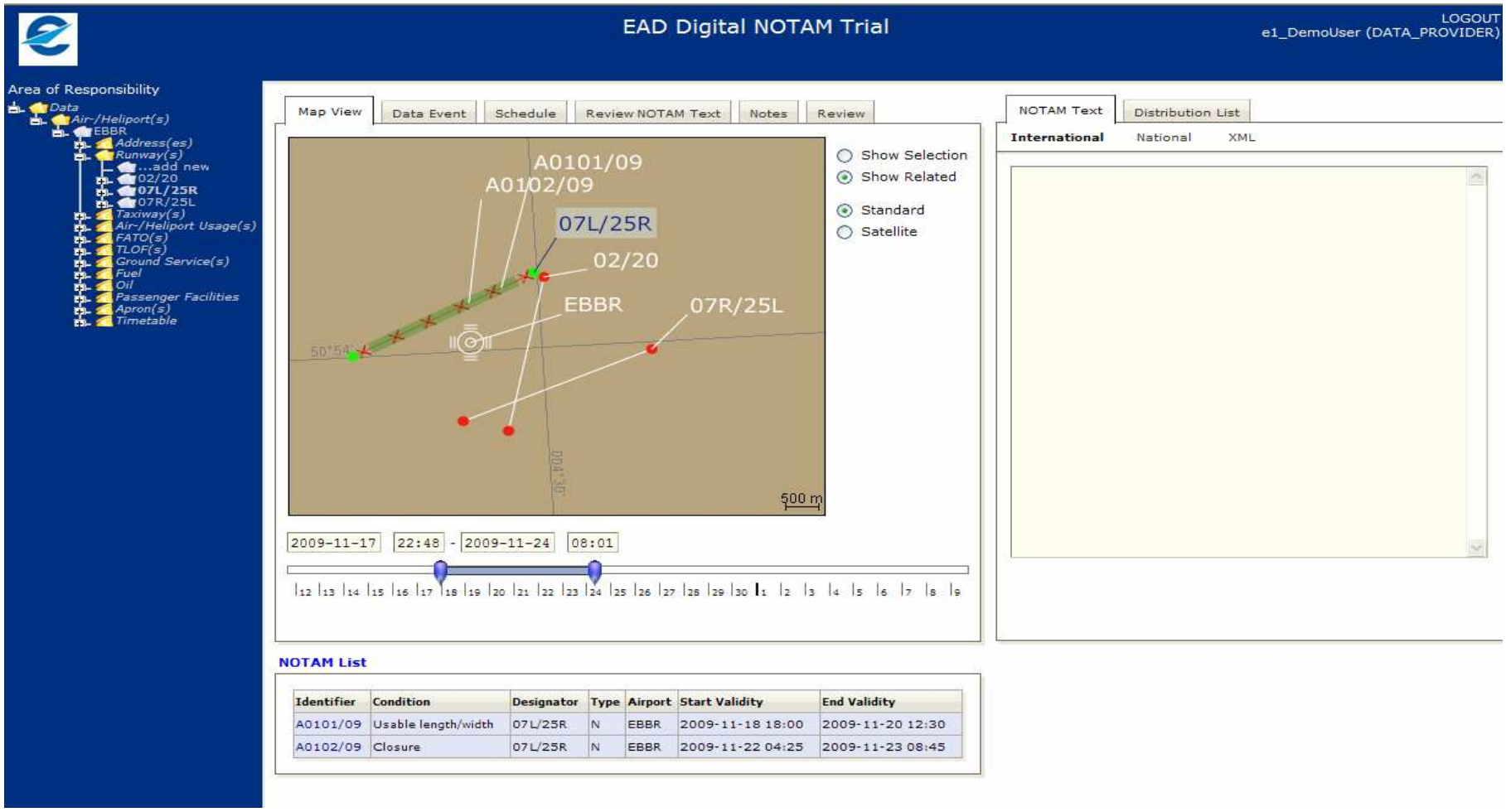
EAD - Digital NOTAM



EAD Digital NOTAM Trial - Timetable



EAD NOTAM Wizard



Questions ?