AIXM Status

ATIEC 2017

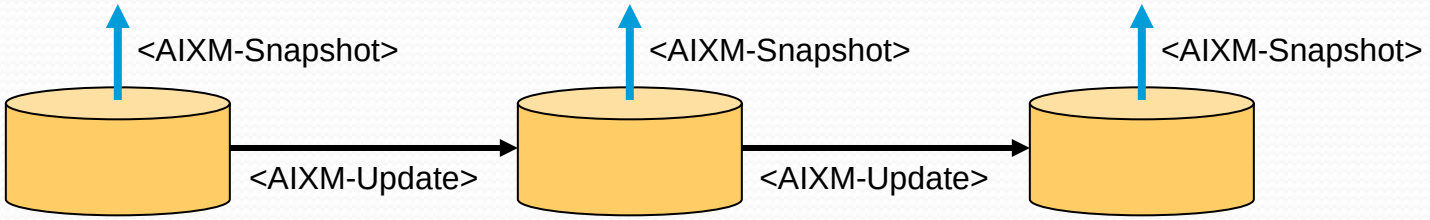
Presented by: D. Cowell (FAA) & E. Porosnicu (EUROCONTROL)

Content

- AIXM usage - current and future
- Interoperability
- Digital NOTAM

AIXM intended use

- **AIXM 2.1/3.3/4.5** - developed for the EAD (European AIS Database)



- **AIXM 5** – wider range of applications
  - See "White Paper" (public consultation in 2006)
    - http://www.aixm.aero/sites/aixm.aero/files/imce/AIXM50/aixm_5_proposal_20060620_whitepaper_.pdf
  - ground-ground data exchange
  - UML/XML + usage rules for specific use cases

AIXM use – current (October 2017)

- Data exchange in the European AIS Databased (EAD)context
  - National system to/from Regional system
- AIS data publication
  - Obstacles (growing number of States)
  - Airspace, Route, Airport, etc. data sets
    - … mostly as side-effect of AIS automation, no ICAO requirements!
- Data exchange between AIS tools
  - Database to charting, AIP production, NOTAM, etc. tools
- Data origination
  - Procedure designer to AIS, etc.
- Local data provision to ATM systems
  - airspace, routes, points, etc.

AIXM use – new ICAO data sets

- Revised Annex 15
  - Digital data sets
    - AIP
    - Obstacles
    - Terrain
    - Airport Mapping
    - Instrument Procedures
- New PANS-AIM
  - More detailed requirements
  - Based on data catalogue
    - Subjects
    - Properties
    - Sub-properties
    - Types
    - Description, data quality…

Incentive : if the data set is provided,
no longer necessary to include the same data in the printed AIP!

Use of AIXM

- AIP Data Set
  - AIXM 5.1 Coding guidelines in development
  - Including data verification/validation rules
  - Including sample data set(s)
- Airport Mapping Data Set
  - ED-99A/DO-272A Mapping Guidelines for AIXM 5.1 available (http://www.aixm.aero/sites/aixm.aero/files/imce/library/ed99atoaixm5.1mappingv0.6.doc)
- Obstacle Data Set
  - AIXM 5.1 coding guidelines / data verification guidelines to be further developed (see eTOD Manual from EUROCONTROL)
- Instrument Flight Procedures Data Set
  - Will probably need AIXM 5.2 for complete coverage

AIP Data Set – harmonised coding rules

www.aixm.aero/confluence

Pages

Overview

Created by EDUARD POROSNICU, last modified on 28 Jul 2017

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AIXM Data Sources

Presented as:

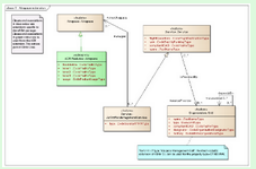
- map of the World
- list of sources

AIXM Coding Guidelines

Including:

- AIXM 5.1(.1) Model Overview
- (ICAO) AIP Data Set
- Digital NOTAM

AIXM Extensions



Will be added progressively!

How to use

Structure

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Style and format aspects

Mark-up

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AIP Data Set – harmonised coding rules

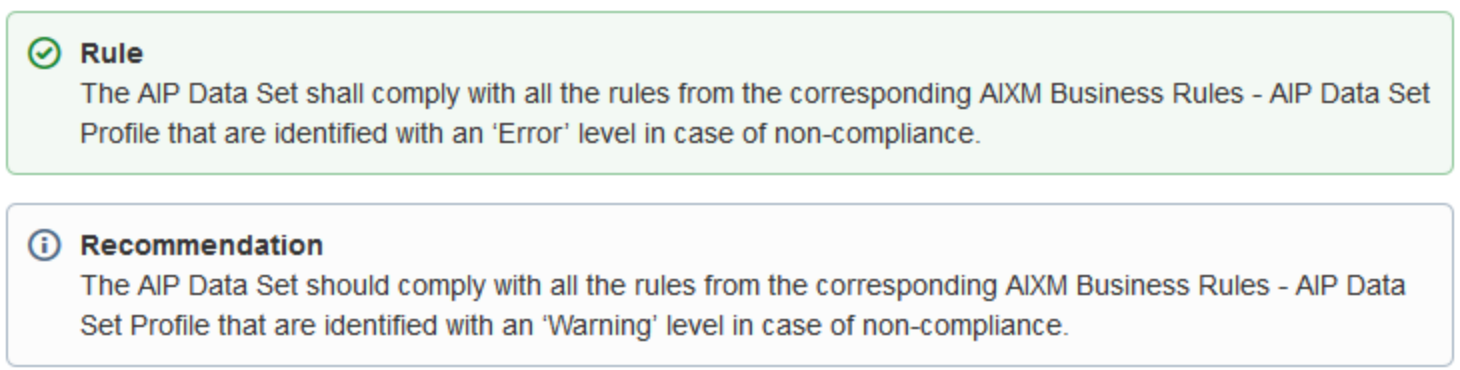
- Mapping of the ICAO PANS-AIM AIP Data Set to AIXM 5.1(.1)
- AIXM 5.1(.1) coding rules for the AIP Data Set
- Interoperability rules for the AIP Data Set (including conformance testing)
- AIXM 5.1(.1) verification rules for the AIP Data Set
- Reference implementation - sample AIXM 5.1(.1) AIP Data Set (DONLON)

AIP Data Set verification rules

Identifier	Data Encoding Rule	Justification	Data Verification Rule (UID)	Remarks
DPN-107	If **DesignatedPoint.type** equal-to ('ICAO' , 'COORD' , 'OTHER') then there should not exists any other designated point with **type** of ('ICAO' , 'COORD' , 'OTHER') located within 1NM.	Data consistency	TBD	
DPN-108	If **DesignatedPoint.type** equal-to 'ICAO', then **DesignatedPoint.designator** should be unique world-wide.	ICAO Annex 11 [1]	AIXM-5.1_RULE-2CEC0	
DPN-109	The **DesignatedPoint.location** property is mandatory.	Minimum AIP data set	AIXM-5.1_RULE-1A3384	
DPN-110	The **Point.horizontalAccuracy** (or **ElevatedPoint.horizontalAccuracy**) attribute is mandatory.	Minimum AIP data set	TBD	
DPN-111	If coded, the value of the **horizontalAccuracy** for the **DesignatedPoint** used in the enroute environment (i.e is used as **EnRouteSegmentPoint)** shall be 100 M or less.	PANS-AIM	AIXM-5.1_RULE-EC542 (rule does not check the DesignatedPoint but the EnRouteSegmentPoint feature), AIXM-5.1_RULE-EC543 (rule checks 300FT which is not defined in PANS-AIM)	
DPN-112	Coordinates of **DesignatedPoint** used in the enroute environment (i.e is used as **EnRouteSegmentPoint)** shall be published with at least 4 decimals resolution.	PANS-AIM	AIXM-5.1_RULE-639C1, AIXM-5.1_RULE-EB1B9	PANS-AIM requires a publication resolution of 1 second, which can be achieved by minimum 4 decimal of a degree.
DPN-113	Coordinates of **DesignatedPoint** used in the terminal environment (i.e is used as **TerminalSegmentPoint)** shall be published with at least 5 decimals resolution.	PANS-AIM	AIXM-5.1_RULE-639C2, AIXM-5.1_RULE-1A8CE1	PANS-AIM requires a publication resolution of 1/10 second, which can be achieved by minimum 4 decimal of a degree.

AIP Data Set verification rules

- Conformance testing



… work in progress

- 2018 –> Eurocontrol verification service for the AIP data set (proof of concept)

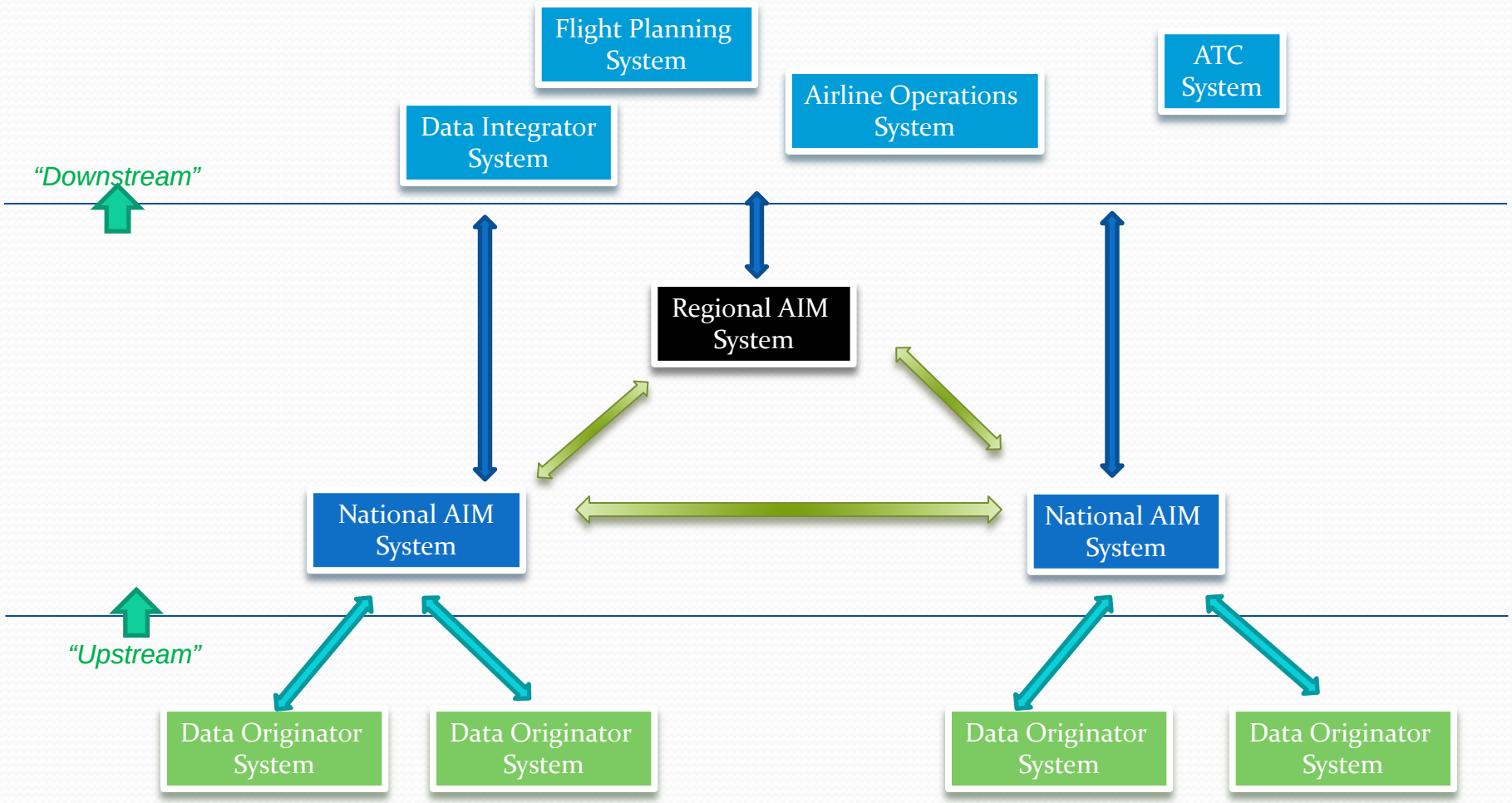
AIXM and interoperability

- "AIXM interoperability" issues
  - Raised initially by CANSO,
  - Also in the IFAIMA Congress 2017
  - Examples
    - Use of GML for aviation data - difficulties
    - Limited set of TimeSlices supported by different systems
    - Use of UUID not formally required
    - Lack of "mandatory attributes"
    - Lack of "mandatory business rules"
    - Lack of metadata profile
    - Etc.
- Action taken by the AIXM CCB
  - Set-up a dedicated working group (started in July 2016)
  - Document the issues & propose solutions

AIXM and Interoperability

- ***Interoperability***
  - *"a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, at present or future, in either implementation or access, without any restrictions"*
    - *Source: Wikipedia*
  - *"the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge.*
    - *Source: (Draft) ICAO IMP SWIM Controlled Vocabulary*

AIM Systems Interoperability



AIXM and interoperability

- AIXM
  - Data coding format (XML Schema)
    - UML model – AIRM mapping (semantic interoperability)
  - Usage rules (temporality, feature identification and reference, coding guidelines, use of GML, etc.)
    - By design (explicit requirement for flexibility!), AIXM 5.x allows options on certain points (such as use of UUID)
  - **AIXM alone cannot ensure the interoperability!**
  - Partial implementations and non-coordinated use of the AIXM 5.x options can harm interoperability!
    - Solution: **Business Rules (SBVR)** & data set verification services

AIXM and interoperability

- Proposed SOLUTION : **Interoperability scenarios (AIXM use cases)**

ICAO Data Sets (downstream interoperability)

AIM to Data Originator (upstream interoperability)

Hub scenario (where applicable)

AIP Data Set – coding rules

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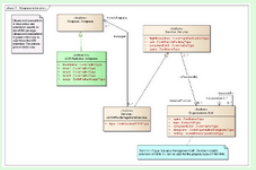

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Interoperability rules (proposed)

- AIXM version for AIP Data Set

> **Rule**
> An AIP Data Set shall be valid against the AIXM 5.1.1 BasicMessage XMLSchema (http://www.aixm.aero/schema/5.1.1/message/AIXM_BasicMessage.xsd).

- GML Profile

> **Rule**
> The Data Set shall comply with the GML limitations and usage rules stated in the OGC 12-028r1 [1] document.

> **Rule**
> The GML pointProperty element shall not be used, except when necessary:
>
> - in order to encode references to places, as stated in chapter Chapter 10 of the OGC 12-028r1 [1] document;
> - in order to provide an accuracy value for a Curve point that is different from the accuracy of the whole Curve;
> - in order to provide an srsName for a Curve point that is different from the srsName of the whole Curve;

> **Recommendation**
> Sequences of more than two consecutive GML pos elements should not be used in the Data Set. The GML posList should be used instead.

Interoperability rules (proposed)

- Feature identification and reference

Rule
Each AIXM feature included in an AIP Data Sets shall have a non-empty gml:identifier.

Rule
The gml:identifier shall be a UUID value, as defined in the AIXM Feature Identification and Reference [1] document.

Rule
The UUID values shall be generated with a compliant Version 4 UUID.

Rule
Abstract references (by gml:identifier), as defined in the [1] document, shall be used whenever the target record is not contained in the same data set.

Rule
Either abstract references (by gml:identifier) or internal references (by gml:id), as defined in the [1] document, shall be used whenever the target record is contained in the same data set.

Interoperability rules (proposed)

- Use of extensions

Permission
An AIP Data Set may include extension of the core model, on condition that:

Rule
The Data Set shall remain valid against one of the AIXM BasicMessage schema mentioned.

Rule
The extension schema shall be made available through a public URL.

Rule
A document explaining the purpose of the extension and the usage of each extension element shall be made available to all recipients of the data set.

Recommendation
The UML representation of the extension should be made available to all the recipients of the data set.

Interoperability rules (proposed)

- Common ICAO data subset

Rule

An AIP Data Set shall not re-define locally the data features declared in the Common ICAO AIP Data Subset, available at:

http://www.aixm.aero/dataset/5.1.1/aixm_5_1_1_icao_common_data_subset.xml

Open issue

What should be the validTime.BeginPosition and the featureLifetime.BeginPosition for the features included in the common ICAO AIP data set?

One proposal is to omit the featureLifetime for all the features included in the data set.

validTime.BeginPosition could be Nov 2018, as no AIP Data Sets would not be published before. Alternatively, the individual features could have a start of validity long time in the past as the data subset itself would be valid from the date of publication. That would ensure that references from legacy data are also covered in the past.

Rule

An AIP Data Set shall use abstract references (as defined in section 3.4 of the AIXM Feature Identification and Reference [1]) in order to encode associations with features contained in the Common ICAO AIP Data Subset.

Permission

An AIP Data Set may include the Common ICAO AIP Data Subset using the following XML include statement:

```
<xi:include href="http://www.aixm.aero/dataset/5.1.1/aixm_5_1_1_icao_common_data_subset.xml" parse="xml" xmlns:xi="
```

Additional issues

- For example, FIR/UIR boundaries…

BRUSSELS FIR

Lateral limits	510521N 0023244E - 510700N 0020000E - 513000N 0020000E - 512223N 0032147E - along the Belgian-Dutch border - 504515N 0060116E - along the Belgian-German border - 500748N 0060816E - along the German-Luxembourg border - 492810N 0062202E - along the French-Luxembourg border - 493247N 0054907E - along the Belgian-French border - 510521N 0023244E.
Vertical limits	

AIP

Revised ICAO Annex 15 and PANS-AIM

AIP Data Set

```
<?xml version="1.0" encoding="UTF-8"?><message:AIXMBasicMessage xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:messa
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:html="http://www.w3.org/1999/xhtml" gml:id="uniqueId" xsi:s
http://www.aixm.aero/schema/5.1/extensions/EUR/ADR http://www.aixm.aero/schema/5.1/extensions/EUR/ADR18.5/AD
gml:id="uuid.d6ae921c-9daf-4475-8853-f083be9a8a1a"><gml:identifier codeSpace="urn:uuid:">d6ae921c-9daf-4475-
gml:id="uuid.fbc8c2d5-8577-40fb-a761-32ae22612ce5"><gml:validTime xlink:type="simple"><gml:TimePeriod gml:id
indeterminatePosition="unknown"/></gml:TimePeriod></gml:validTime><aixm:interpretation>BASELINE</aixm:interp
xlink:type="simple"><gml:TimePeriod gml:id="uuid.b306d310-6581-4c56-96d3-8a735d697189"><gml:beginPosition>20
indeterminatePosition="unknown"/></gml:TimePeriod></aixm:featureLifetime><aixm:type>R</aixm:type><aixm:desig
ryComponent gml:id="uuid.20964f31-505c-4e2e-a6e7-6f0efc4fea73"><aixm:theAirspaceVolume><aixm:AirspaceVolume
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xlink:type="simple"><gml:Point xsi:type="aixm:PointType" srsName="urn:ogc:def:crs:EPSG::4326" gml:id="uuid.2
xlink:type="simple"><gml:Point xsi:type="aixm:PointType" srsName="urn:ogc:def:crs:EPSG::4326" gml:id="uuid.5
interpolation="geodesic"><gml:pointProperty xlink:type="simple"><gml:Point xsi:type="aixm:PointType" srsName
137.18389</gml:pos></gml:Point></gml:pointProperty><gml:pointProperty xlink:type="simple"><gml:Point xsi:typ
137.29944</gml:pos></gml:Point></gml:pointProperty></gml:Geodesic><gml:Geodesic interpolation="geodesic"><gm
```

Up to 10 000 points for some FIR! …Unusable for downstream operations

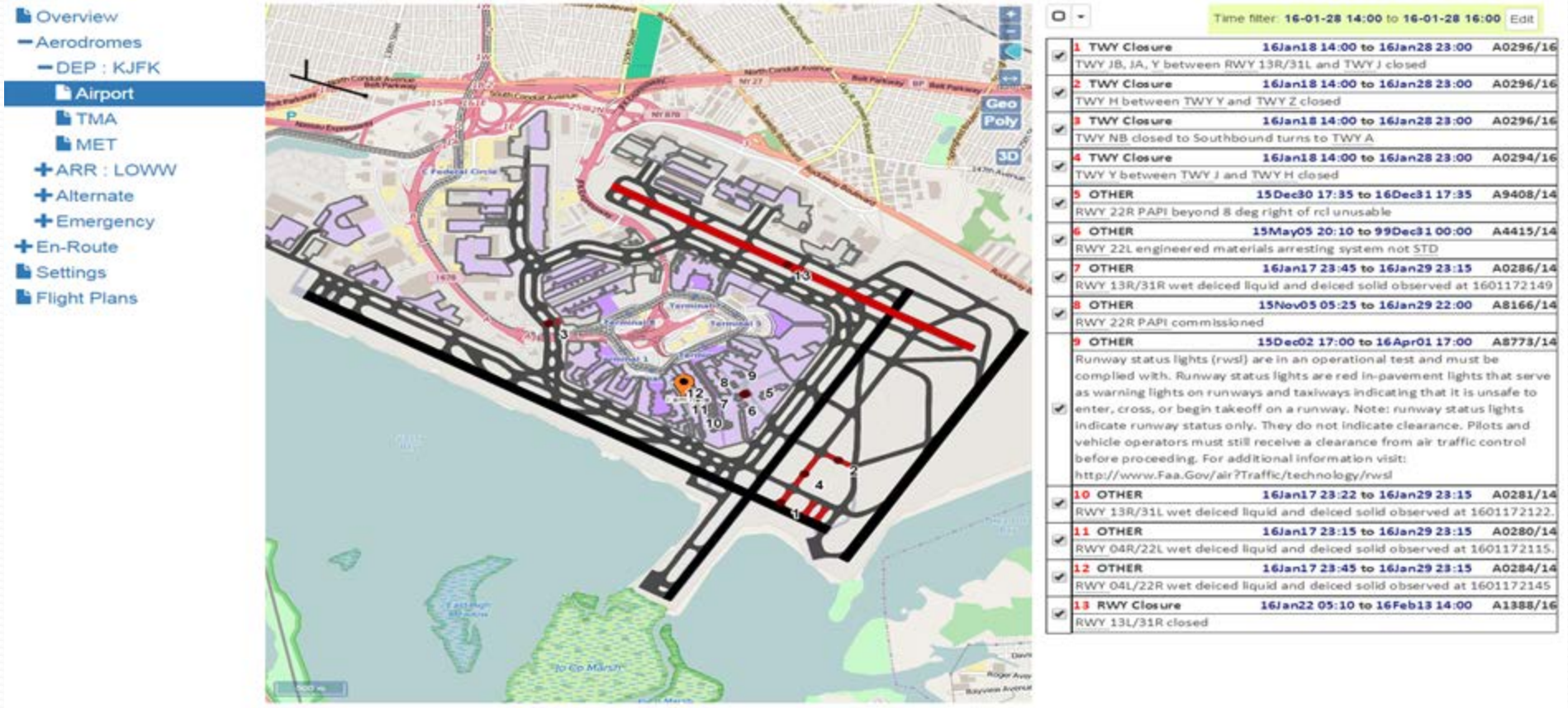
… no reference to State boundary
… degree/minute resolution

51.07056 35.27611
51.05417 35.27333
51.05417 35.27333
51.05444 35.25722
51.05444 35.25722
51.06417 35.25278
51.06417 35.25278
51.04583 35.22222
51.04583 35.22222
51.05389 35.21278
51.05389 35.21278
51.05306 35.19056
51.05306 35.19056
51.07889 35.17111
51.07889 35.17111
51.08167 35.15083
51.08167 35.15083
51.08889 35.17222
51.08889 35.17222
51.10167 35.16639
51.10167 35.16639
51.10194 35.16139
51.10194 35.16139
51.11111 35.15861
51.11111 35.15861
51.12278 35.17556
51.12278 35.17556
51.1475 35.13278
51.1475 35.13278
51.18 35.13222
51.18 35.13222
51.22556 35.15389
51.22556 35.15389
51.23194 35.07417
51.23194 35.07417
51.20611 35.04083
51.20611 35.04083
51.22 35.03389
51.22 35.03389
51.23306 34.97694
51.23306 34.97694

Digital NOTAM

Digitally enhanced briefing

- SESAR Project 13.2.2



Key enabler - Digital NOTAM

- Identify types of “events” for which the information is currently provided through NOTAM
  - Example: runway closed, navaid u/s, new obstacle, etc.
- Provide the AIXM encoding rules for each type of event
  - Including data verification
- … also, support the automatic generation of NOTAM messages (as long as necessary)

Digital NOTAM Specification

- Version 2.0 – work in progress

scenarios	*scenarios*
•Published special activity area – activation	•Displaced threshold
•Published ATS airspace - activation or deactivation	•Declared distances changes
•Ad-hoc special activity area – creation	•Runway portion closure
•Ad-hoc ATS airspace – creation	•Airport Usage limitation
•Route portion closure	•Runway usage limitation
•Route portion opening	•Taxiway usage limitation
•Aerodrome closure	•Approach lights unserviceable
•Runway closure	•Approach lights downgraded
•Navaid unserviceable	•Runway lights unserviceable
•New obstacle	•Obstacle lights unserviceable
•Taxiway closure	•Visual Approach slope indicator unserviceable
•Surface contamination (SNOWTAM)	•Taxiway lights unserviceable
•Other Event (any other situation that does not have a dedicated scenario)	

Conclusions

- Revised ICAO Annex 15 and PANS-AIM

  - Digital data sets (AIP, obstacles, IFP, …)
    - AIXM 5.1 as coding format (proposed)
      - Harmonised coding rules in support to interoperability objective
      - AIXM 5.2 will improve the coding, in particular for IFP

  - Digital NOTAM – version 2.0
    - additional scenarios,
    - alignment with the ICAO data sets