



**Network Manager**  
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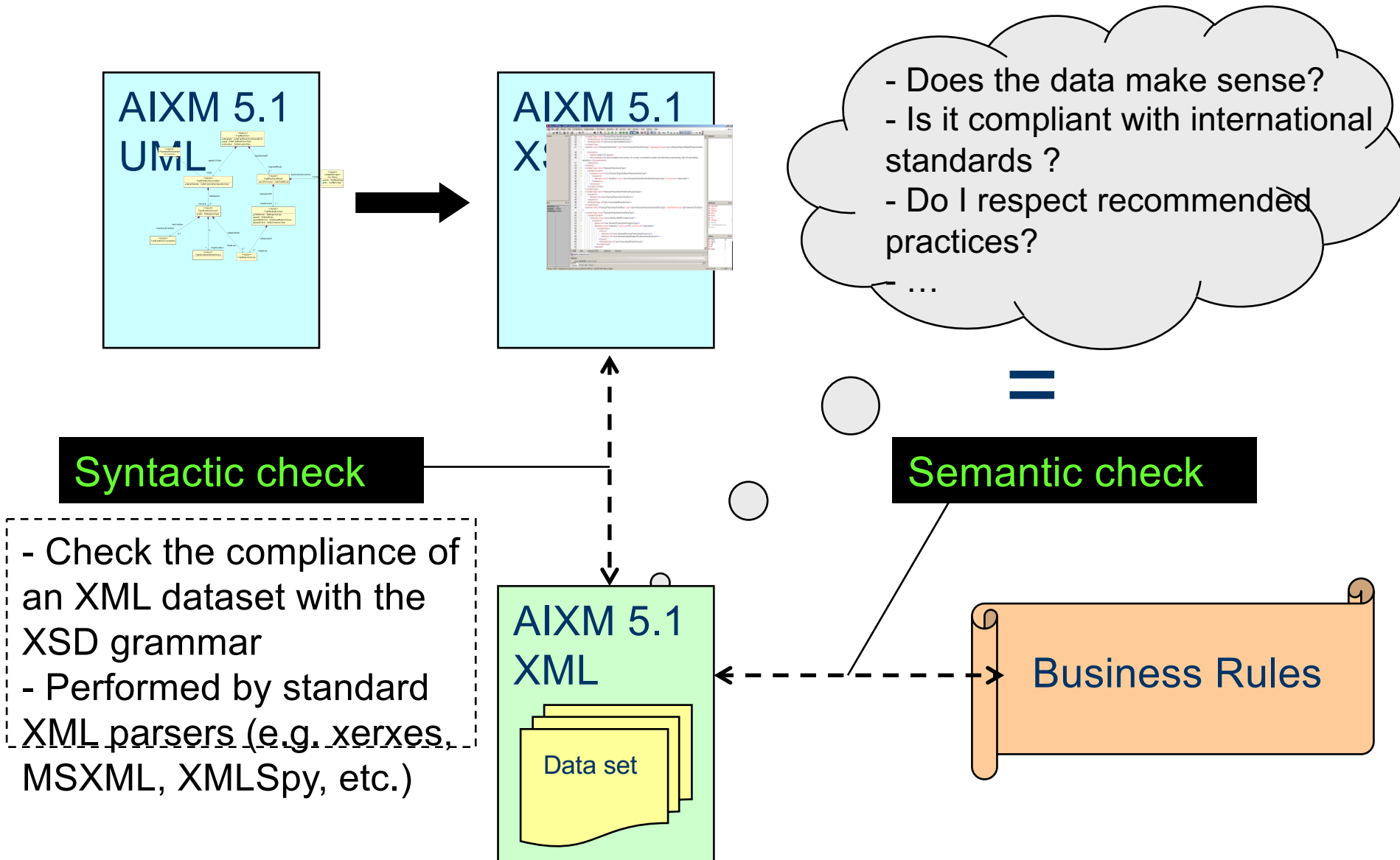


# AFI Region AIXM e-AIP Implementation Workshop Dakar, Senegal, 3-5 October 2016

AIXM 5.1 Business Rules

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# Validation of AIXM 5.1 data



## 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

Business Rules

# Status of AIXM 5.1 Business Rules in June 2013



Excel file on [www.aixm.aero/wiki](http://www.aixm.aero/wiki) -> Business Rules

UID	Profile:EAD	Profile:Event	Profile:Event_FAA	Source	Â§	Rule textual description	Rule tagged description	C
AIXM-5.1_RULE-16B49	Warning			ICAO Annex	Table A7-1	It is prohibited that a <b>NavaidEquipment specialisation VOR</b> has <b>location.ElevatedPoint</b> coordinates expressed with less than 4 decimals	<keyword>It is prohibited that a</keyword> <NounConcept>NavaidEquipment</NounConcept> <Verb-concept>specialisation</Verb-concept> <NounConcept>VOR</NounConcept> <Verb-concept>has</Verb-concept> <NounConcept>location.ElevatedPoint</NounConcept> coordinates expressed with less than 4 decimals	L (
AIXM-5.1_RULE-16B52	Warning			ICAO Annex	Table A7-1	It is prohibited that a <b>NavaidEquipment specialisation DME</b> has <b>location.ElevatedPoint</b> coordinates expressed with less than 4 decimals	<keyword>It is prohibited that a</keyword> <NounConcept>NavaidEquipment</NounConcept> <Verb-concept>specialisation</Verb-concept> <NounConcept>DME</NounConcept> <Verb-concept>has</Verb-concept> <NounConcept>location.ElevatedPoint</NounConcept> coordinates expressed with less than 4 decimals	L (
AIXM-5.1_RULE-16B53	Warning			ICAO Annex	Table A7-1	It is prohibited that a <b>NavaidEquipment specialisation MarkerBeacon</b> has <b>location.ElevatedPoint</b> coordinates expressed with less than 4 decimals	<keyword>It is prohibited that a</keyword> <NounConcept>NavaidEquipment</NounConcept> <Verb-concept>specialisation</Verb-concept> <NounConcept>MarkerBeacon</NounConcept> <Verb-concept>has</Verb-concept> <NounConcept>location.ElevatedPoint</NounConcept> coordinates expressed with less than 4 decimals	L rt

1390 rules

Sources: AIXM 4.5, ARINC 424, AIXM 5.1 design  
(work done in 2009-2010 by Pulsar Consulting for Eurocontrol)

# Current work in progress

- “Community Project”
  - Review, clean, update...
  - Small stakeholder group, mostly industry
  - Started in June 2013
  - Baseline of over 1300 rules
    - Using the BRM repository from which the Excel file was extracted
    - Initial SBVR formulated
    - Draft Schematron included
  - First phase – Airspace, minimal data and SBVR profile
  - Second phase – EAD minimum data set and obstacles
  - Third phase – the rest of the rules; rule profiles added
  
- Finalisation intended – December 2016

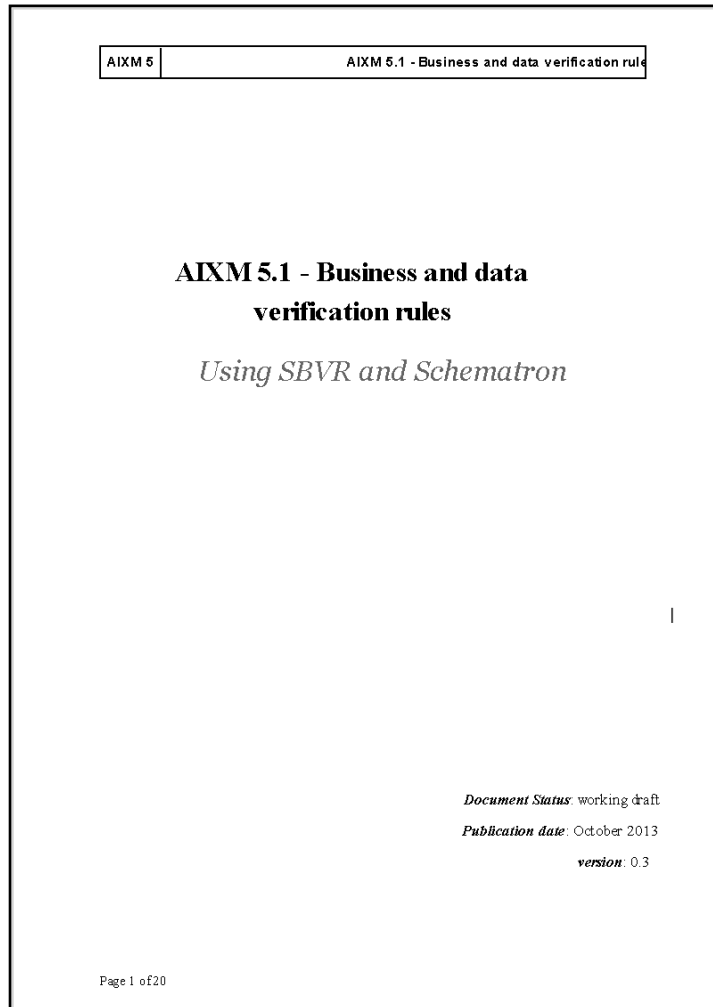
# Use of SBVR

- 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**
- Applied to AIXM 5:
  - **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, industry coding rules, etc
    - **These are the rules that we try to capture as part of the current BR project**

# Examples of AIXM Business Rules

- Structural rules examples (that are not captured as data types):
  - *“Each [...].lowerLevel that has an uom equal to 'FL' should have 2 or 3 digits.”*
  
- Operative rules examples:
  - *“Each AirportHeliport.ARP must have horizontalAccuracy and AirportHeliport.ARP.horizontalAccuracy should be at most 1sec”*
  - *“Each DepartureLeg that has a speedLimit must have a speedReference”*
  - *“Each ElevatedCurve that has a verticalAccuracy must have an elevation”*

# AIXM 5.1 – Business Rules document in preparation



- The need for Business Rules
- Rules definition using SBVR
  - SBVR Profile for AIXM
    - SBVR concepts
    - Logical Operations
    - Quantification
    - Modality
    - Additional SBVR keywords
    - Additional Fact-types
  - Methodology
- Schematron reference implementation
  - Schematron code availability
  - Practical verification of AIXM data sets
- Annex B - Examples
- Annex C - AIXM Business Rules Profiles
  - Minimum air navigation data set profile
  - Full air navigation data set profile
  - Flight planning environment data profile

# SBVR Profile for AIXM

- **NounConcept**

- Represented by AIXM UML Classes and Properties, meaning that AIXM Class Name, Role Name or Attribute Name may appear as NounConcept

- ***Verb-concept*** (also known as “fact-type”)

- Represented by Name of AIXM UML association. Some frequently used fact types such as “*is property of*” or “*has*” do not appear explicitly in the model, they are implicit associations between a class and one of its attributes.

- **Name**

- Represents UML Instances, Slots, Enumeration literals, and their assigned Properties. Also CodeList values

- **Keyword**

- the words that can be combined with other designations to form statements and definitions: [Logical Operations](#), [Quantification](#), [Modality](#) and [Additional SBVR keywords](#)



# SBVR Profile for AIXM - Example

1. Candidate rule: “*Every airport must have a name*”
2. Identify the fact-type in the model
  - “name is-property-of AirportHeliport”
3. Build the rule text around that fact type:
  - add quantification to each noun concept involved;
  - add logical operations, if more conditions are involved;
  - add modality for the fact type.
  - “It is obligatory that exactly one name is-property-of each AirportHeliport”
4. Simplify the text using alternative keywords (if necessary)
  - For example, use “shall” instead of “it is obligatory that”
  - “Each AirportHeliport shall *have* exactly one name”

# SBVR Profile for AIXM



- Examples of other rules
  - Each Runway shall *be situated at exactly one* AirportHeliport
  - A Runway shall *not be situated at* AirportHeliport with type= 'HP'
  - Each StandardInstrumentArrival shall have assigned designator
  - Each TACAN shall have assigned channel
  - Each Timesheet shall *have* endTime *greater-than* startTime



- 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.

# Encoding Business Rules - ISO Schematron

- **<assert>** and **<report>** elements
  - Test attribute
  - Simple declarative sentences in natural language
  - *<assert>* used to tag assertions positively

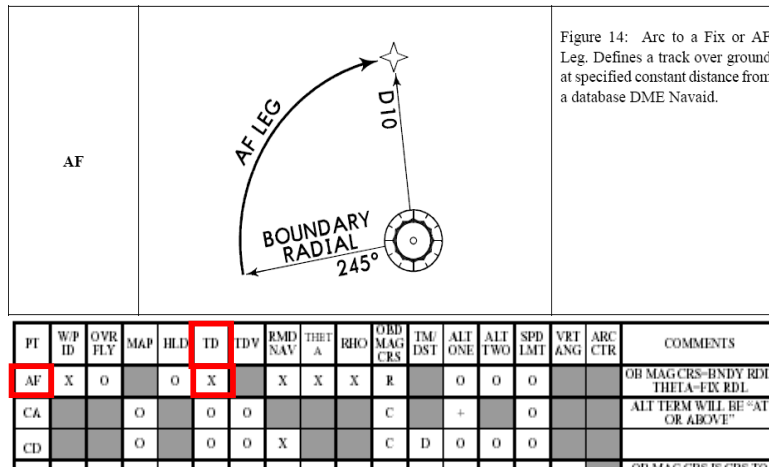
```
<!-- The assert element matches if test is false -->  
<assert test="//designator">  
An AirportHeliport shall have a designator.  
</assert>
```

- **<rule>** element
  - Used to group assertions
  - Has a context: if the context matches, the assertions are tested
- **<pattern>**, **<phase>**, **<schema>**: used to logically group rules

# Encoding Business Rules - ISO Schematron

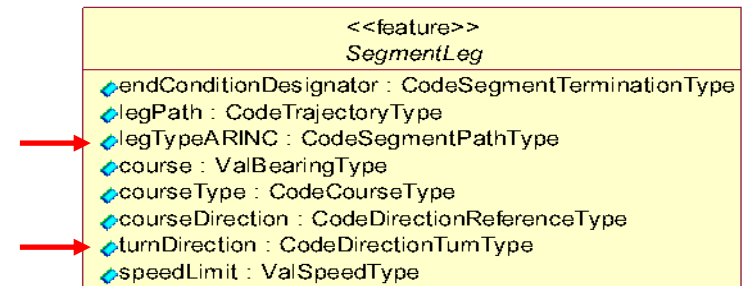


## Operational Rule



## Translation in SBVR

*Each ProcedureTransitionLeg.theSegmentleg that has legTypeARINC equal to AF must have a turnDirection.*



```

<SegmentLeg>
  <legTypeARINC>AF</legTypeARINC>
  <turnDirection>L</turnDirection>
</SegmentLeg>
  
```

## Simplified ISO Schematron example

```

<rule id="1"
  context="//SegmentLeg[@legTypeARINC='AF'] ">
  <assert id="1_1"
    test="boolean(@turnDirection)">
  </assert>
</rule>
  
```

**<rule id="1"**  
 -> unique identifier of the rule

**context="// SegmentLeg[@legTypeARINC='AF'] "**  
 -> Defines the conditions of the rule (If attribute SegmentLeg.legTypeARINC= "AF").  
 ->The rule will be tested if the context is true.

**<assert id="1\_1"**  
 -> unique identifier of the assertion

**test="boolean(@turnDirection)"**  
 -> the logical test to be performed. The "assert" element matches if the logical test returns false (in this case, if the turnDirection is not provided).

# Summary - AIXM 5.1 Business Rules

- Available since 2010 in the form of an Excel file with around 1250 'candidate rules'
  
- Current work in progress
  - Review and clean this initial set
  - Refine SBVR expression of the rules
  - Add Schematron code
  - Define profiles
    - Minimum air navigation data set profile ?
    - Full air navigation data set profile ?
    - Flight planning environment data profile ?



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# Questions?