Global Information Management

AIXM Business Rules in a wider XM context

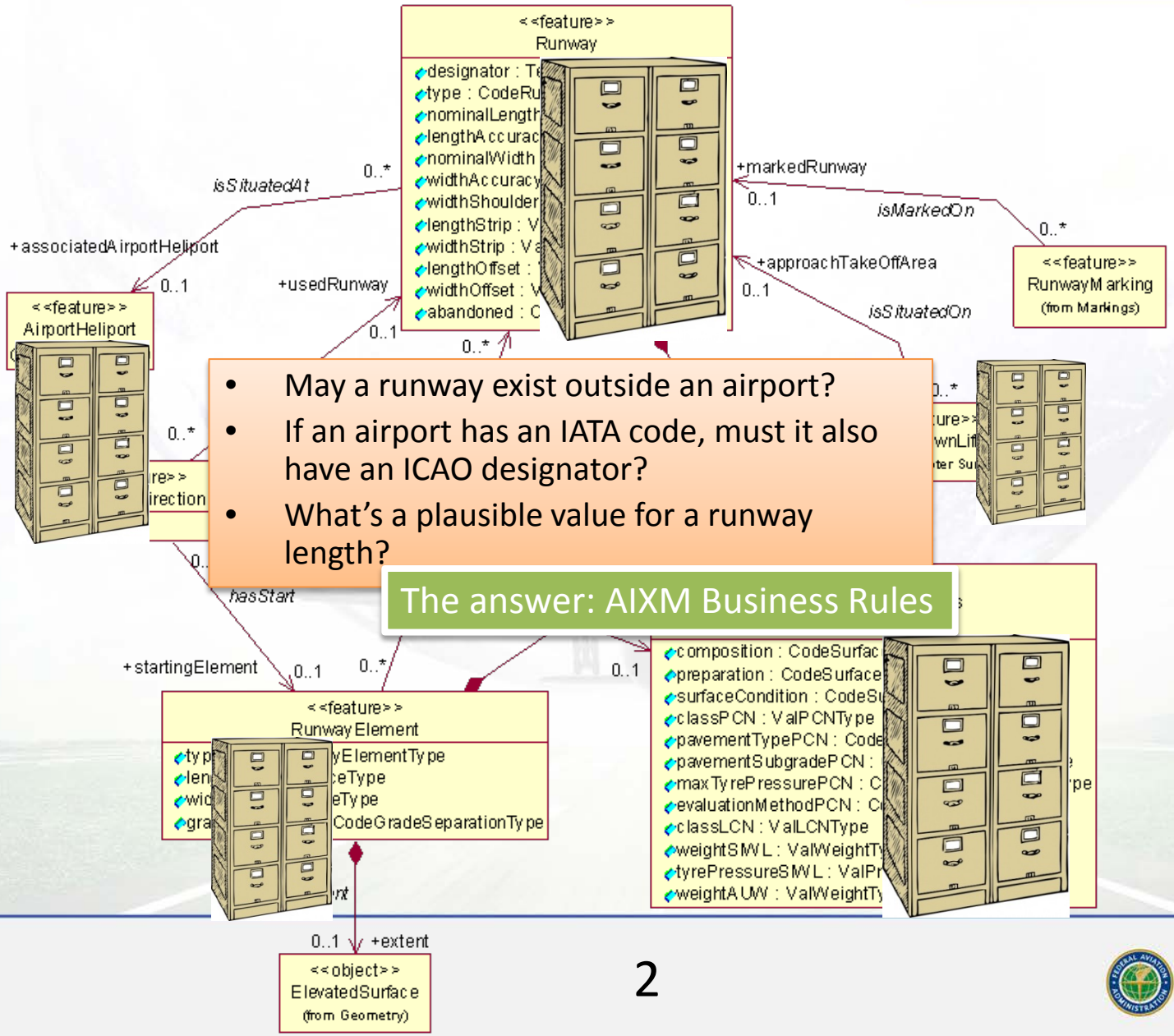
Presented By: *Eduard Porosnicu, Eurocontrol*

Date: *August 25, 2015*

Content

- The AIXM Business Rules project
- Business rules in a wider XM context
  - Flight Restrictions seen as business rules

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

  Coding specification rule

  - "*[RWY.CLS] Event must have CLOSED operationalStatus*"

  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

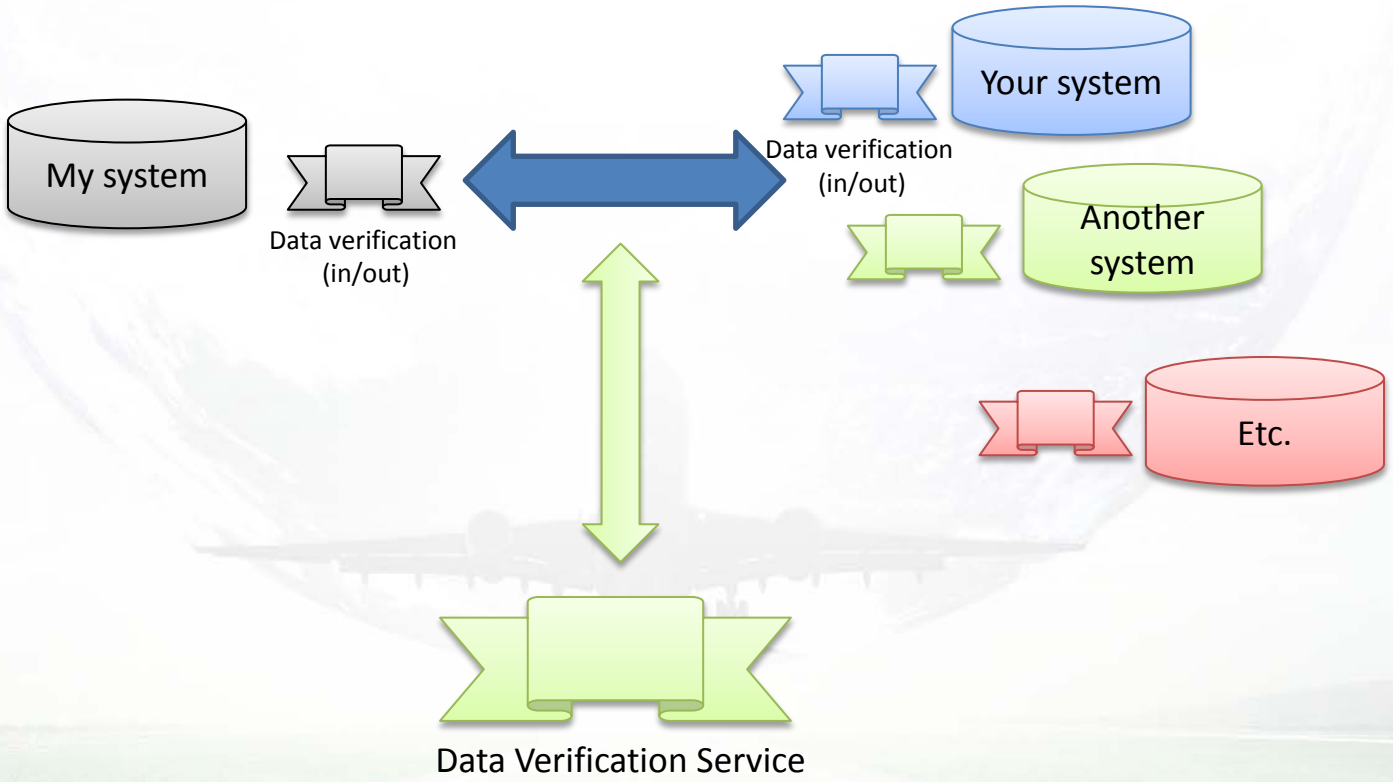
Each Airspace with type equal-to ('CTA','UTA', 'OCA') shall have exactly one geometryComponent.AirspaceGeometryComponent.operation equal-to 'BASE'

- 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

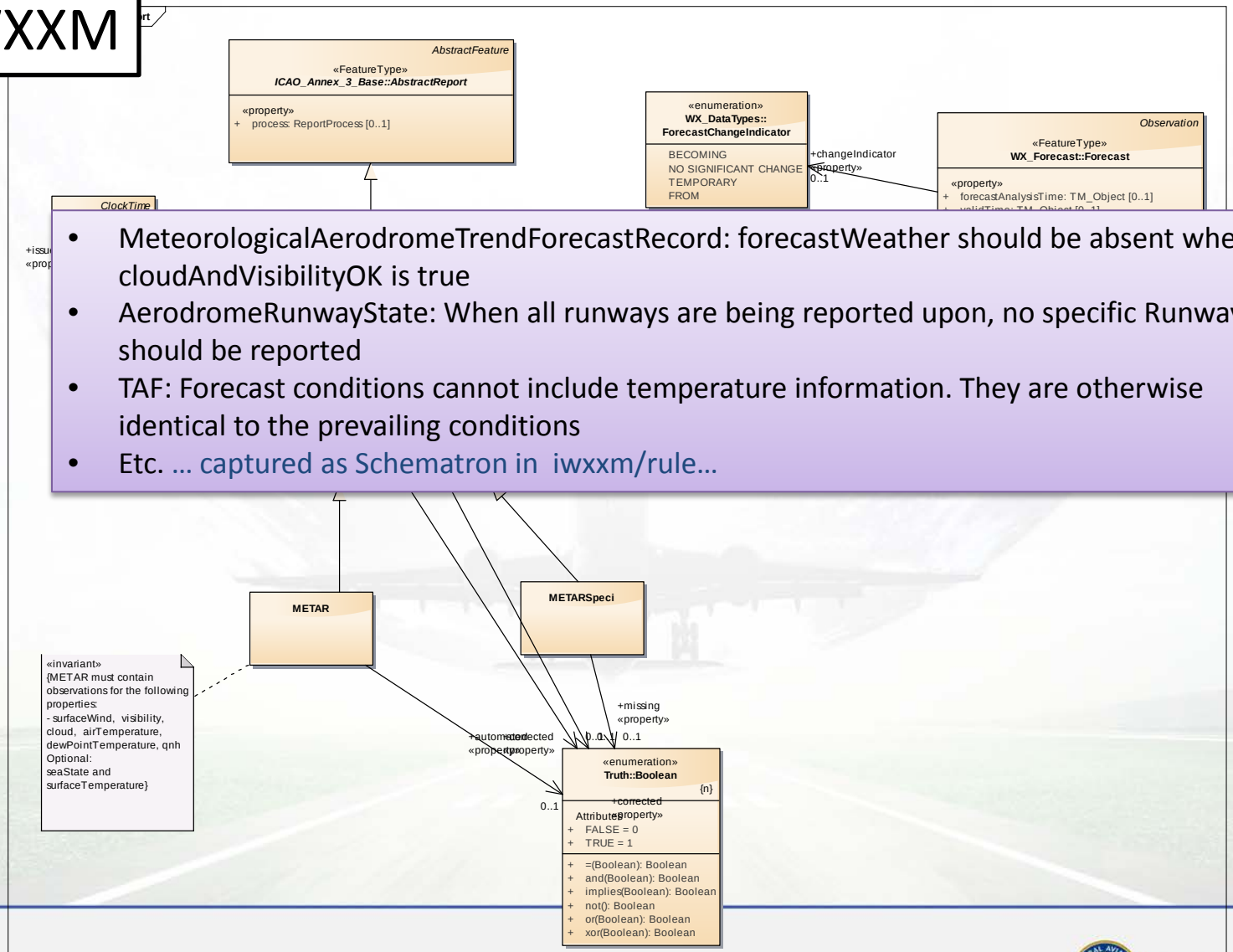
- See www.aixm.aero/wiki -> Business Rules
  - Conceptual document "*AIXM 5.1 - Business Rules - using SBVR and Schematron*"
  - AIXM 5.1 Business Rules (work in progress, version 0.4) available in the form of an Excel file (1250+ rules)
  - Includes Schematron code, where possible
    - Estimated feasible 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 – Data verification



What about other XMs

WXXM

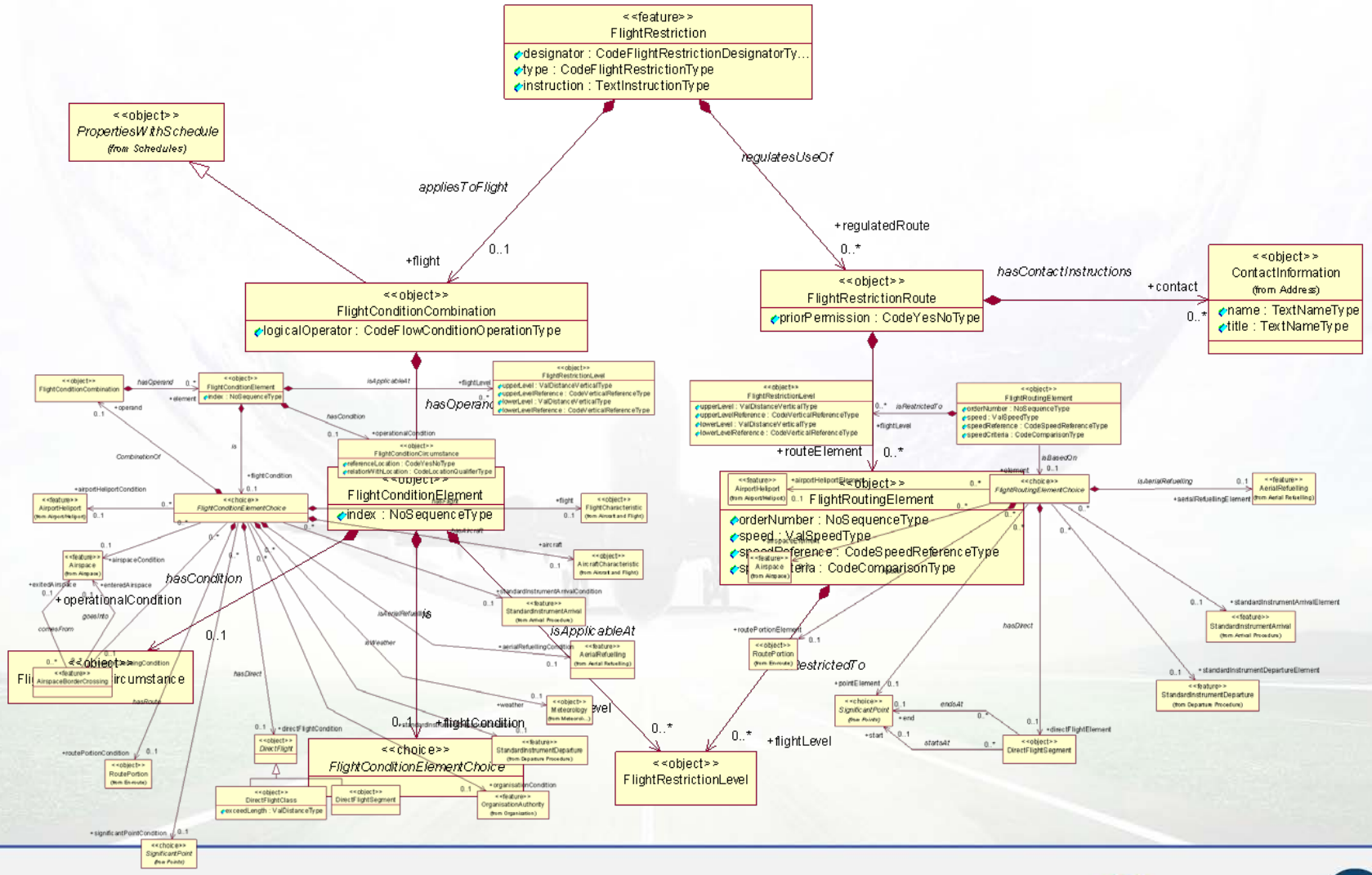


- MeteorologicalAerodromeTrendForecastRecord: forecastWeather should be absent when cloudAndVisibilityOK is true
- AerodromeRunwayState: When all runways are being reported upon, no specific Runway should be reported
- TAF: Forecast conditions cannot include temperature information. They are otherwise identical to the prevailing conditions
- Etc. … captured as Schematron in iwxxm/rule…

A research idea…

- Flight restrictions seen as business rules?

Flight restrictions in AIXM



Flight restrictions in AIXM


```
<?xml version="1.0" encoding="utf-8" ?>
- <adrmsg:ADRMessage gml:id="ID_10181_1436407595634_1"
    xmlns:adrmsg="http://www.eurocontrol.int/cfmu/b2b/ADRMessage"
    xmlns:adrext="http://www.aixm.aero/schema/5.1/extensions/EUR/ADR"
    xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:aixm="http://www.aixm.aero/sche
    xmlns:xlink="http://www.w3.org/1999/xlink">
  - <adrmsg:hasMember>
    - <aixm:FlightRestriction gml:id="ID_10181_1436407595634_520384">
        <gml:identifier codeSpace="urn:uuid:">4f2dfa97-52e0-4f96-9f23-9ff3fef7b07c</gml:ide
      - <aixm:timeSlice>
        - <aixm:FlightRestrictionTimeSlice gml:id="ID_10181_1436407595634_520385">
          - <gml:validTime>
            + <gml:TimePeriod gml:id="ID_10181_1436407595634_520386">
              </gml:validTime>
              <aixm:interpretation>BASELINE</aixm:interpretation>
            + <aixm:featureLifetime>
              <aixm:designator>YX4000A</aixm:designator>
              <aixm:type>FORBID</aixm:type>
              <aixm:instruction>APP3 EKCH TO EDDV NOT ABOVE FL295$</aixm:instruction>
          - <aixm:flight>
            - <aixm:FlightConditionCombination gml:id="ID_10181_1436407595634_520388">
              - <aixm:timeInterval>
                + <aixm:Timesheet gml:id="ID_10181_1436407595634_520389">
                </aixm:timeInterval>
                <aixm:logicalOperator>OR</aixm:logicalOperator>
              - <aixm:element>
                - <aixm:FlightConditionElement gml:id="ID_10181_1436407595634_520392">
                  - <aixm:flightCondition_operand>
                    - <aixm:FlightConditionCombination
                        gml:id="ID_10181_1436407595634_520393">
                        <aixm:logicalOperator>SEQ</aixm:logicalOperator>
```

verbose, complex - trying to express logical combination of conditions as a tree…

Missing the key element – the flight itself…

However, allowing to provide the European Restrictions to the Network Manager stakeholders!

Flight restrictions seen as business rules

- Thus the idea…
  - FIXM is maybe a more appropriate place for flight restrictions
  - Flight restrictions should better be seen as “business rules”
    - Apply the AIXM SBVR methodology
  - FIXM&AIXM (AIRM!) can maybe offer the complete reference model for flight restrictions in SBVR

Flight restrictions seen as business rules

- Example - EKCH to EDDV

  (FPL-UFO1667-IS

  -AT76/M-DFGRSY/LB1

  -EKCH1250

  -N0270F220 KOPEX T504 LOMPU/N0270F210 T504 MIC/N0270F220 Z990 DIRBO

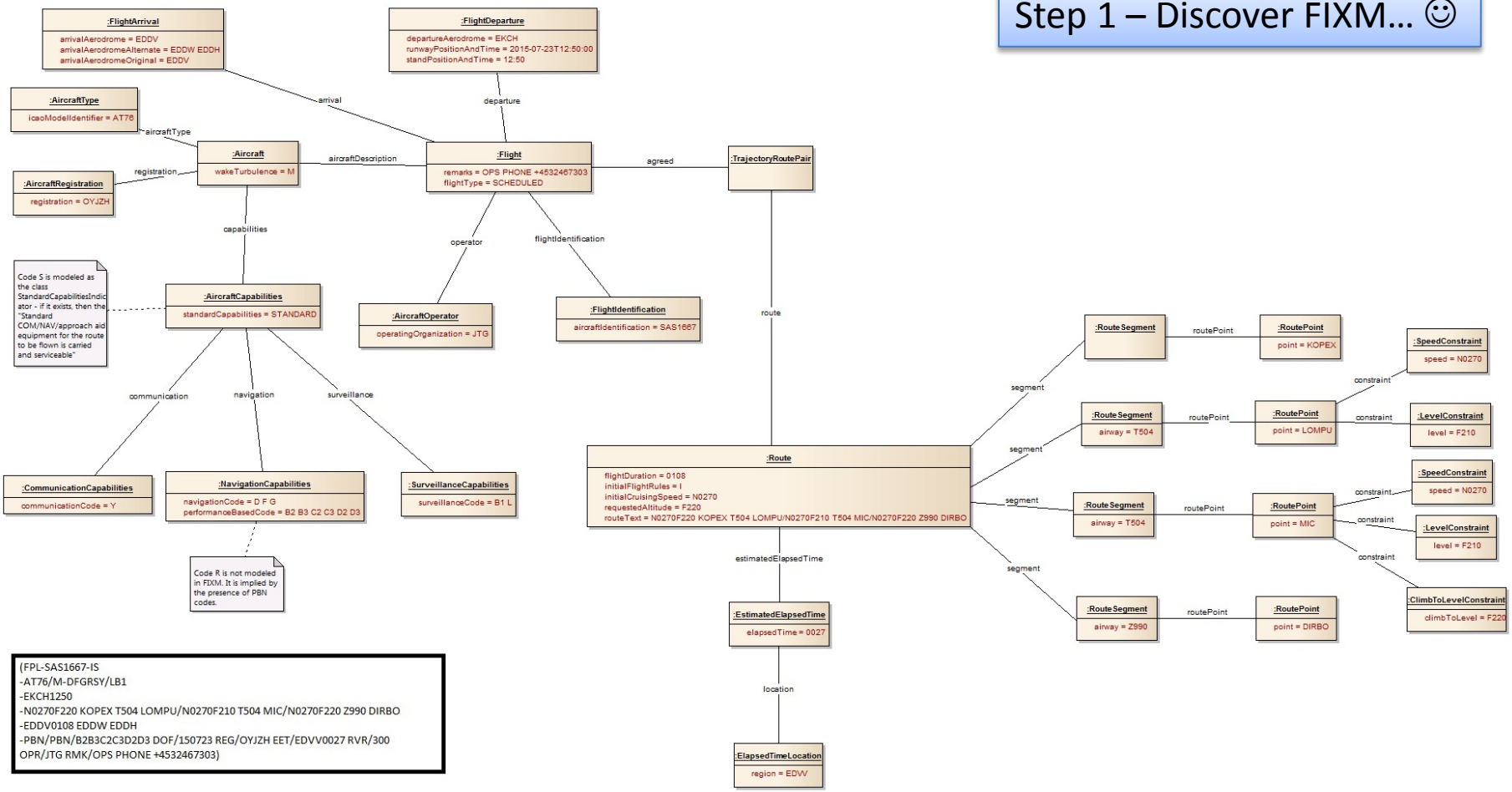
  -EDDV0108 EDDW EDDH

  -PBN/PBN/B2B3C2C3D2D3 DOF/150723 REG/UFOZH EET/EDVV0027 RVR/300

  OPR/JTG RMK/OPS PHONE +123456789)

Flight restrictions seen as business rules

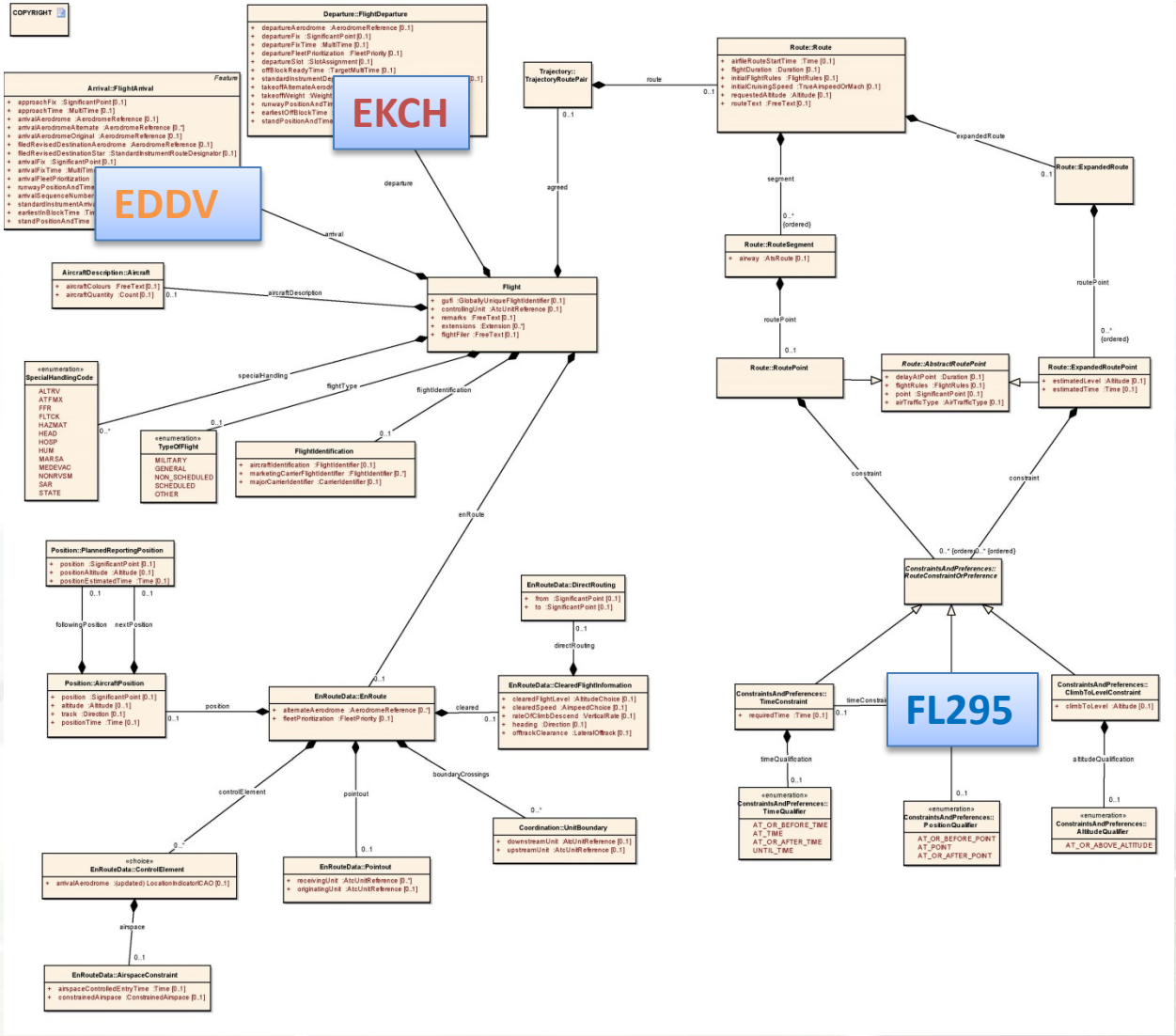
Step 1 – Discover FIXM… ☺



(FPL-SAS1667-IS
-AT76/M-DFGRSY/LB1
-EKCH1250
-N0270F220 KOPEX T504 LOMPU/N0270F210 T504 MIC/N0270F220 Z990 DIRBO
-EDDV0108 EDDW EDDH
-PBN/PBN/B2B3C2C3D2D3 DOF/150723 REG/OYJZH EET/EDVV0027 RVR/300
OPR/JTG RMK/OPS PHONE +4532467303)

Flight restrictions seen as business rules

Step 2 – Map our sample "level capping" restriction onto FIXM

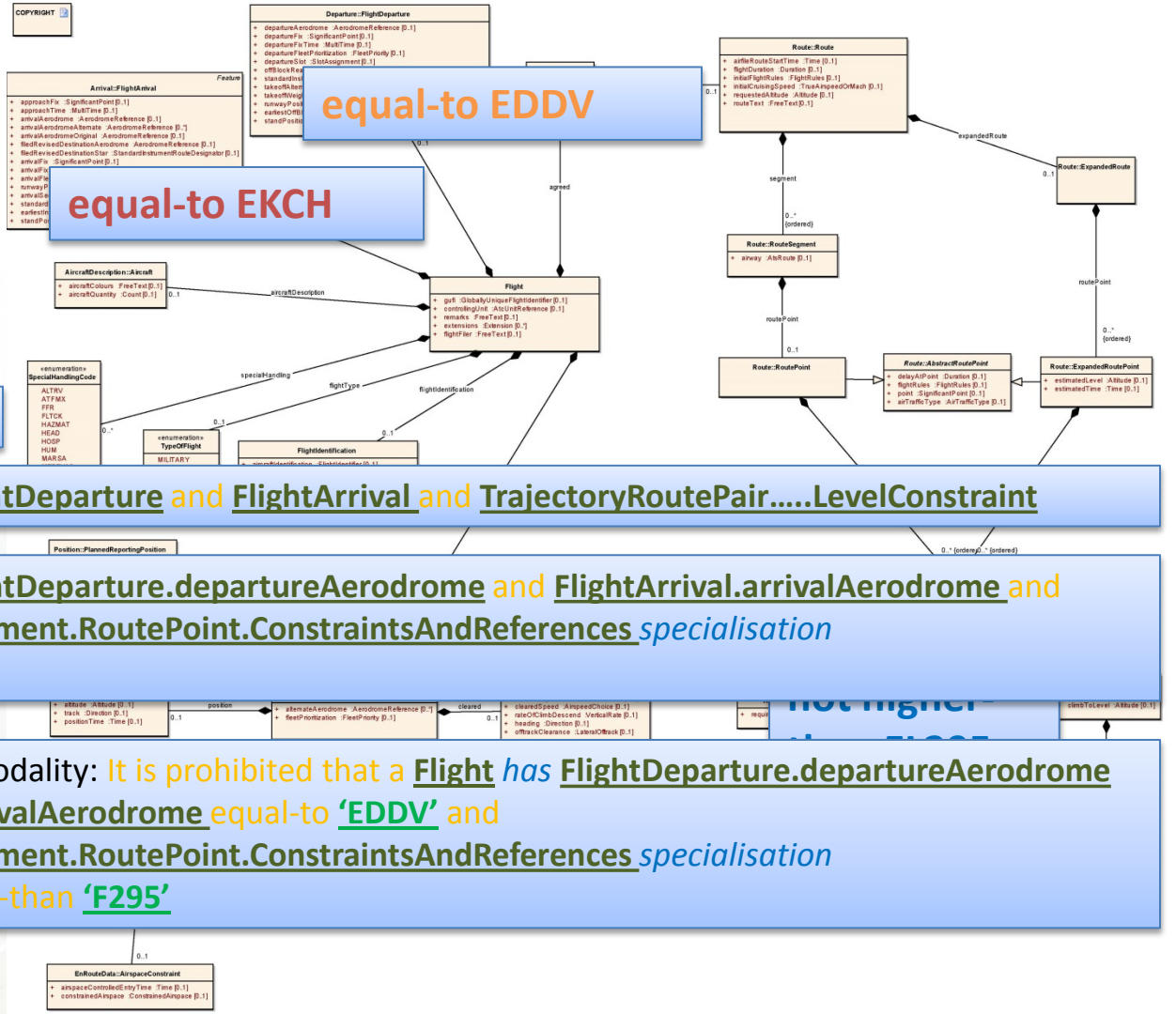


Federal Aviation Administration

EUROCONTROL

Flight restrictions seen as business rules

Step 3 – Express the restriction applying the (AIXM) SBVR Profile



"EKCH TO EDDV NOT ABOVE FL295"

Start from model fact: **Flight** *has* **FlightDeparture** and **FlightArrival** and **TrajectoryRoutePair…..LevelConstraint**

Refine the model fact: **Flight** *has* **FlightDeparture.departureAerodrome** and **FlightArrival.arrivalAerodrome** and **TrajectoryRoutePair.Route.RouteSegment.RoutePoint.ConstraintsAndReferences** *specialisation* **LevelConstraint.level**

Add conditions, quantification and modality: It is prohibited that a **Flight** *has* **FlightDeparture.departureAerodrome** equal-to **'EKCH'** and **FlightArrival.arrivalAerodrome** equal-to **'EDDV'** and **TrajectoryRoutePair.Route.RouteSegment.RoutePoint.ConstraintsAndReferences** *specialisation* **LevelConstraint.level** equal-or-higher-than **'F295'**

Flight restrictions seen as business rules

- More complex restrictions
  - *"Z601 ZUE KPT not available for traffic ARR EDDM, EDJAType JetExcept DEP EDNY, LSZR"*
  - *"T715 SUNEG KRH only available for traffic ARR LFGA/GB/SB/SM/ST, EDTD/TF/TO"*
  - *"BKY LAM MEA 660 compulsory for trafficDEP EGSHVia MID/LYD/KAPEX/KUMIL*
    - *EG5270 To enforce standard departure routing to de-conflict traffic DEP EGSH from London TMA traffic*
  - *Etc.*

… at first sight, the SBVR approach seems feasible for all of them!

- **SBVR might get a bit more complex (the profile might need to be enhanced)**

Flight restrictions seen as business rules

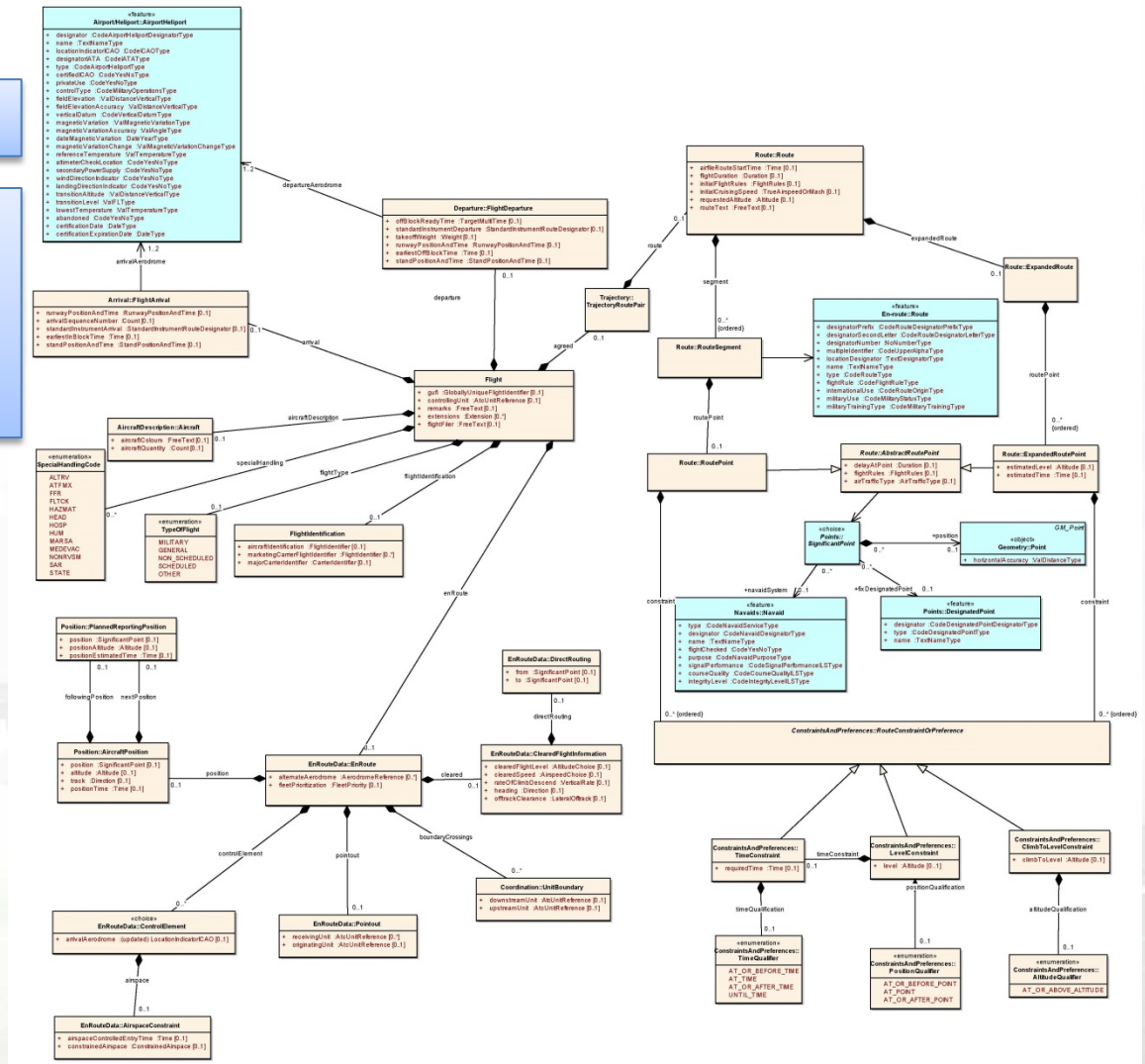
- Even more – “cross-domain” restrictions
  - Aircraft of type XYZ cannot land on airport with all runway LDA lower-than 6000 FT
  - Airport KXXX can be used as alternate for Trans-Atlantic flights when temporarily closed during the night
  - Warning – destination airport requires PPR 30 minutes due to work in progress
  - Etc.

Feasible when using an integrated FIXM+AIXM model (the AIRM idea!)

Flight restrictions seen as business rules

FIXM + AIXM elements (example)

"Airport KXXX can be used as alternate for Trans-Atlantic flights when temporarily closed during the night"



Conclusions

- Business Rules
  - the necessary complement to XMs (UML)
  - Expressed in SBVR, possibly encoded in Schematron
  - Data verification as a service

- An idea (to be further researched)
  - Flight Restrictions can be efficiently modelled as business rules
  - FIXM&AIXM (AIRM!) can offer the complete reference model for flight restrictions in SBVR

This presentation is the result of joint effort by:

- Eduard Porosnicu
  (AIXM, SBVR)
  eduard.porosnicu@eurocontrol.int
- Andrei Ghencea
  (EUROCONTROL Trainee - AIXM, SBVR, FIXM)
  andrei.ghencea@eurocontrol.int
- Hubert Lepori
  (FIXM, AIXM)
  hubert.lepori@eurocontrol.int
- Francisco Graciani Higuero
  (FIXM)
  francisco.graciani-higuero@eurocontrol.int