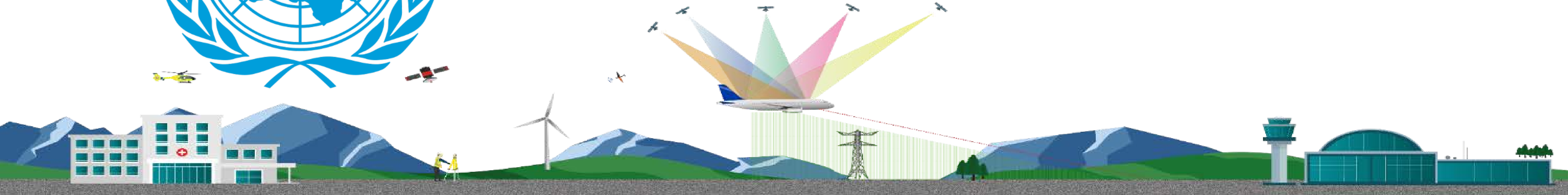
Instrument Flight Procedure data set

CGX Proposal of Coding Guidelines

INTERREGIONAL EUR/MID WORKSHOP ON AERONAUTICAL INFORMATION DATASETS

Cairo,Egypt 21-22 may 2023



(TPL-EN)PPT-4-3_v3-7

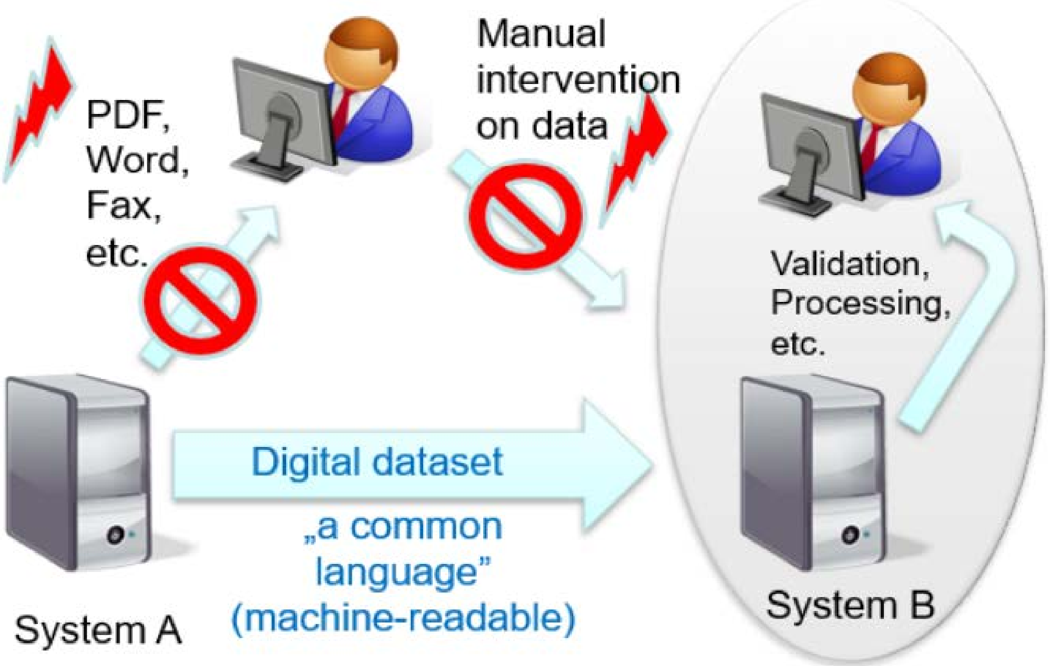
PRESENTATION'S SUMMARY

- Digital data sets introduction
- PANS AIM mapping to AIXM 5.2
- Coding Guidelines
- Coding examples
- Application with CGX solutions

Digital data sets introduction

Context & Goals

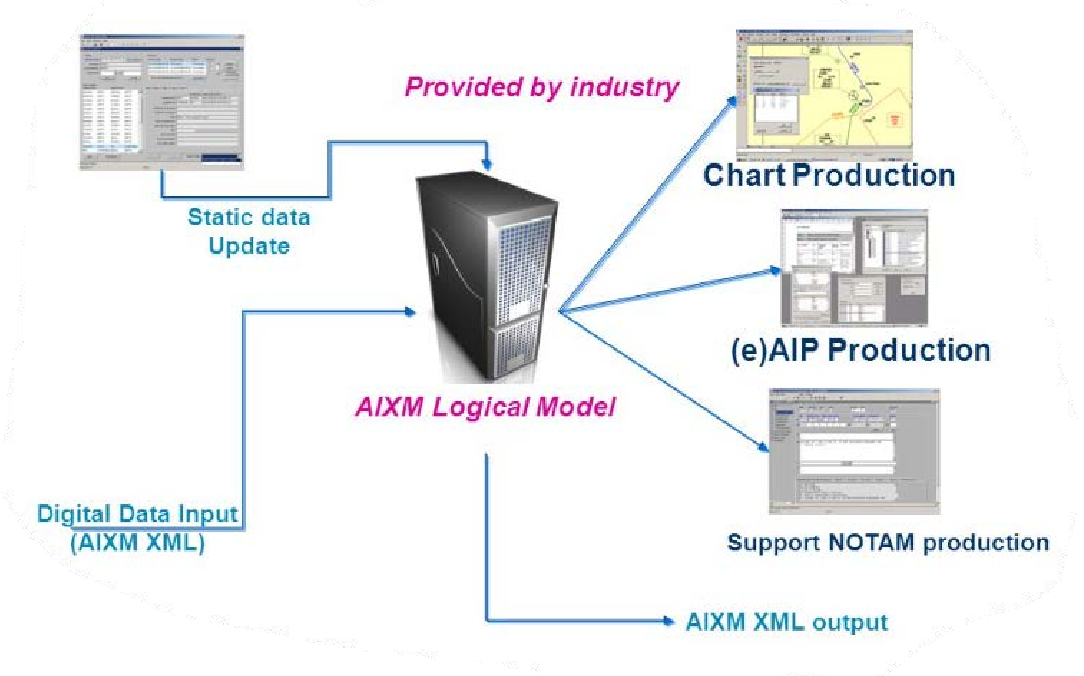
- Digital data sets are one of the pillar of the AIS to AIM transition
- Required to build seamless aeronautical information
- Needed to:
  - Replace gradually the provision of paper documents
  - Standardize format and structure
  - Ensure minimum set of provided information
  - Facilitate communication of information between stakeholders
  - Facilitate the definition of Data Quality Requirements



Digital data sets introduction

Advantages

- Aeronautical information will include **Temporality** concept
- Digital data sets will provide **Meta Data**
- Data verification will be possible thanks to **Business Rules**
- Data integrity will be ensured using the **CRC**
- Digital data sets will help to be **SWIM** ready
- Digital data sets will help to be **Digital NOTAM** ready



Digital data sets introduction

Defaults of current navigation databases

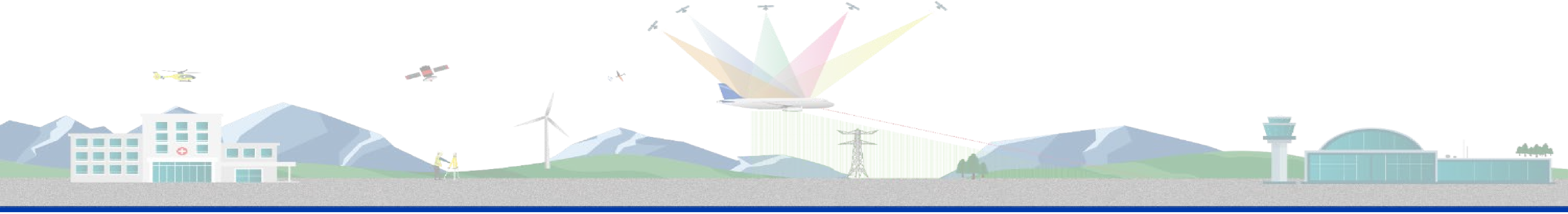
- Different non structured formats are used
  - Navigation databases are mainly derived from a copy of the AIP, providing rounded and/or truncated data compared to the source data available in the various technical departments of civil aviation
- Data Quality Requirements are not respected
  - The limitations of certain FMS lead to the need for data alteration to allow to fly the procedures
  - Loss of precision between the initial design and what goes on board the planes
- Different data bases are used
- Aeronautical information are not centralized
- No harmonization between civilians and military
- No dedicated workflows

Digital data sets : Context & Goals

IFP Dataset added value

- Part of the AIM chain
  - required for charting and Navigation Databases
  - Increase the integrity of the chain, in particular **AIS ➔ navDB provider**.
- The AIS could monetize their data more easily vs Today business is concentrated = the navDB provider level
- A real time saving and quality improvement of procedure designer daily work:
  - Procedure maintenance
  - Procedure update against new obstacles
  - Technical report automation
  - Automatic generation of ARINC 424 coding
- Automatic Charting, in direct connection with central database
- Procedure digital dataset could bring new uses of the data (provision of protection areas for obstacles creators)
- Possibility to implement Ground Validation tools

PANS AIM mapping to AIXM 5.2



PANS AIM mapping to AIXM 5.2

IFP Dataset – PANS AIM minimum data items

The instrument flight procedure data set **shall** include data as a **minimum :**

a) procedure
b) procedure segment
c) final approach segment
d) procedure fix
e) procedure holding
f) helicopter procedure

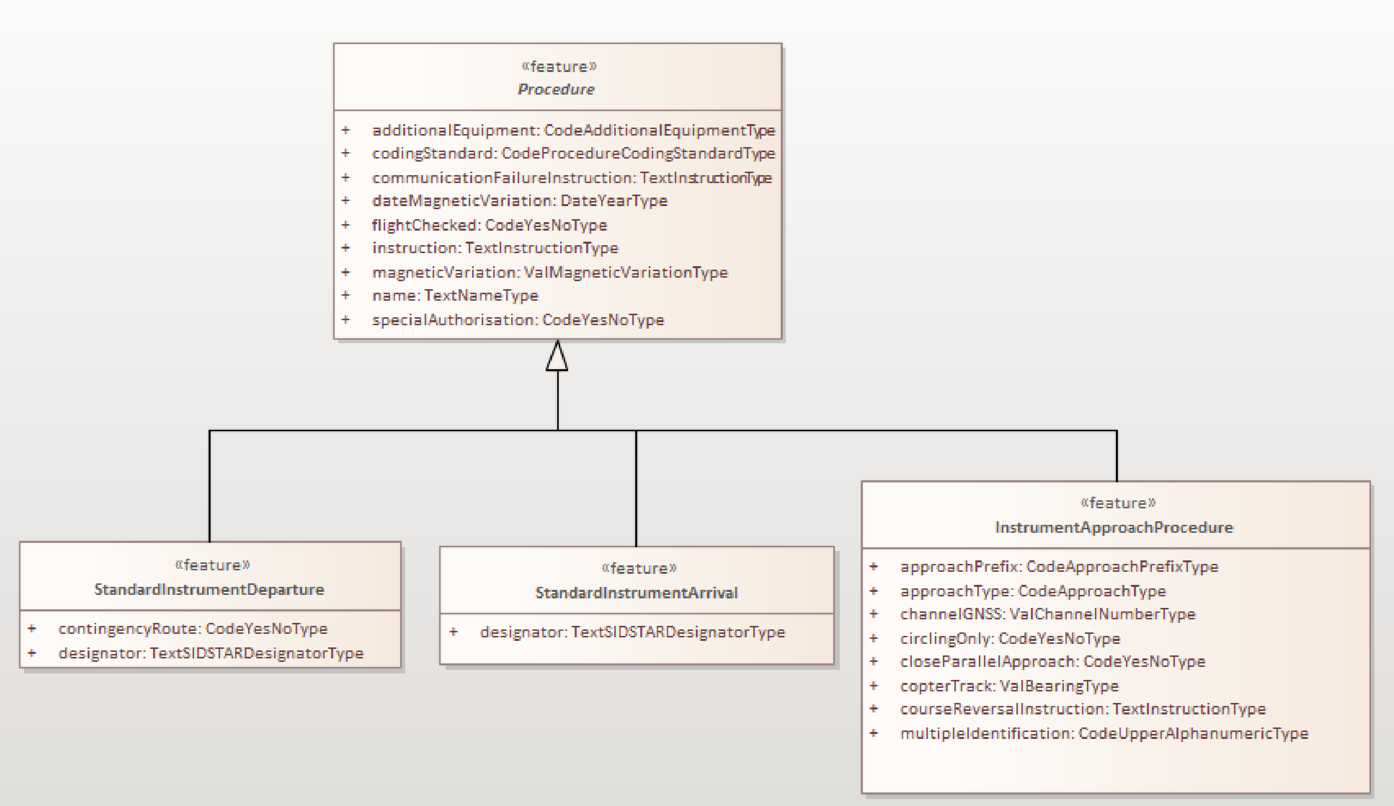
The IFP data set **should** include the requirements for data publication contained in PANS-OPS, Doc. 8168, Volume II

PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 - Procedure

PANS AIM	AIXM 5.2

Subject	Propoerty	Sub-Property
Procedure		
	Identification	
		FAS Guidance
		Runway
		Circling
		Multiple Code
		NS Limiter
		Name
	Plain Language Designation	
		Basic Indicator
		Validity Indicator
		Route Indicator
		Visual Indication
	Coded Designation	
		Significant Point
		Validity Indicator
		Route Indicator
	Procedure Type	
	PBN or Conventional	



PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Procedure : Partial view

PANS AIM	AIXM 5.2
Identification – FAS Guidance	Procedure.GuidanceService.navaid.type
Identification – Runway	Procedure.AirportHeliport.Runway.designator
Identification – Circling	InstrumentApproachProcedure.circlingOnly (AIXM 5.2)
Identification – Multiple Code	InstrumentApproachProcedure.multipleIdentification
Identification – Name	Procedure.name
Procedure Type	StandardInstrumentDeparture |StandardInstrumentArrival| InstrumentApproachProcedure.
PBN or Conventional	Procedure.AircraftCharacteristic.navigationType
Precision Type	InstrumentApproachProcedure.FinalLeg. ApproachCondition.landingPrecisionCategory (AIXM 5.2)
Aircraft Category	Procedure.AircraftCharacteristic.aircraftLandingCategory
Magnetic variation	Procedure.magneticVariation

AIXM 5.2 specific planned : procedures

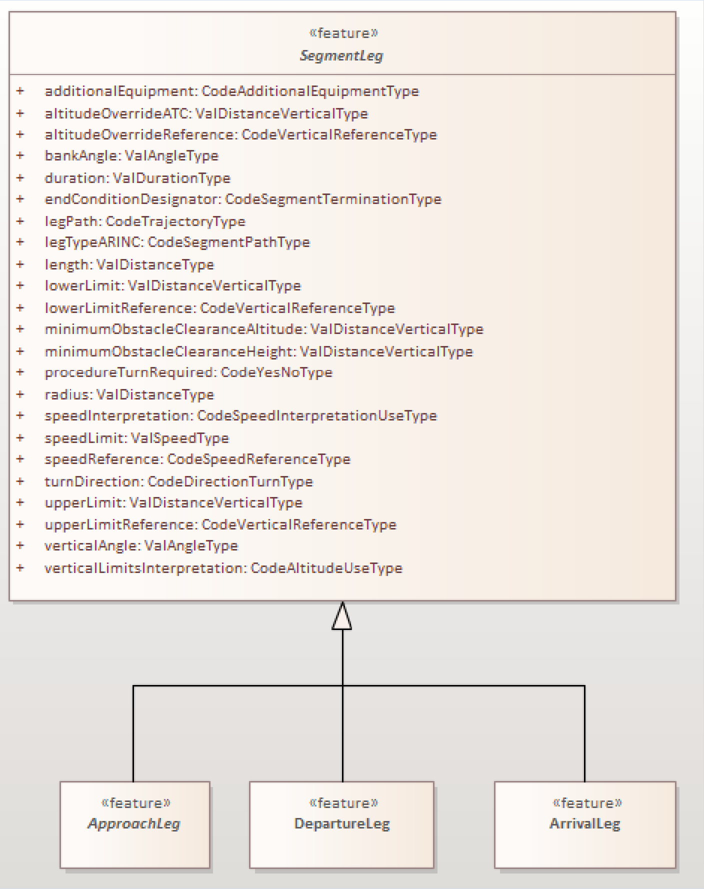
- Identification – Circling
- Approach precision « Precision Type »

PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Procedure Segment

PANS AIM	AIXM 5.2

Subject	Propoerty	Sub-Property
Procedure Segment		
	Start	
	End	
	End fix functionality	
	End fix role	
	Procedure altitude/height	
	MOCA	
	Distance	
	True bearing	
	Magnetic bearing	
	Gradient	
	Speed	
	Controlling obstacle	
		Type
		Position
		Elevation:



PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Procedure Segment : Partial view

PANS AIM	AIXM 5.2
Start	SegmentLeg:startPoint.SegmentPoint.DesignatedPoint.designator Or SegmentLeg:startPoint.SegmentPoint.Navaid.designator Or SegmentLeg:startPoint.SegmentPoint.RunwayCentrelinePoint.designator Or SegmentLeg:startPoint.SegmentPoint.TouchDownLiftOff.designator Or SegmentLeg:startPoint.SegmentPoint.AirportHeliport.designator
End	SegmentLeg:endPoint.SegmentPoint.DesignatedPoint.designator Or SegmentLeg:endPoint.SegmentPoint.Navaid.designator Or SegmentLeg:endPoint.SegmentPoint.RunwayCentrelinePoint.designator Or SegmentLeg:endPoint.SegmentPoint.TouchDownLiftOff.designator Or SegmentLeg:endPoint.SegmentPoint.AirportHeliport.designator
End fix functionality	SegmentLeg:endPoint.SegmentPoint.flyOver
End fix role	SegmentLeg:endPoint.TerminalSegmentPoint.role
Procedure altitude/height	SegmentLeg.lowerLimit
MOCA	SegmentLeg.minimumObstacleClearanceAltitude (AIXM 5.2)
Distance	SegmentLeg.length
True bearing /Magnetic bearing	SegmentLeg.CourseGroup.course and SegmentLeg.CourseGroup.courseType (AIXM 5.2)
Speed	SegmentLeg.SpeedLimit
Controlling obstacle	SegmentLeg.ObstacleAssessmentArea.Obstruction.VerticalStructure

AIXM 5.2 specific planned : Procedure Segment

- MOCA
- True bearing /Magnetic bearing

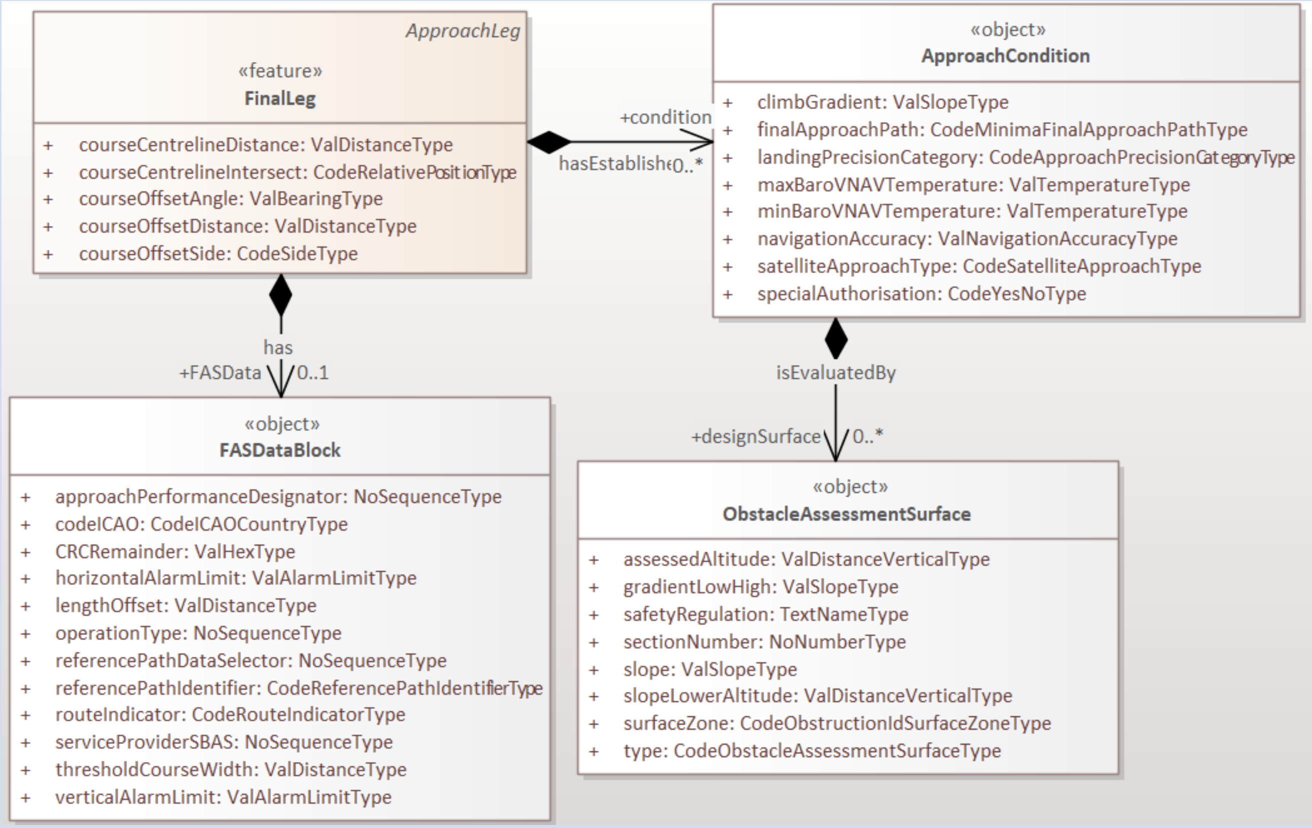
PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Final Approach Segment

PANS AIM

Subject	Propoerty	Sub-Property
Final Approach Segment		
	Operation type	
	Approach performance designator	
	SBAS provider	
	RPDS	
	RPI	
	LTP/FTP	
		Position
		Ellipsoid height
		Orthometric height
	FPAP	
		Position
		Orthometric height

AIXM 5.2

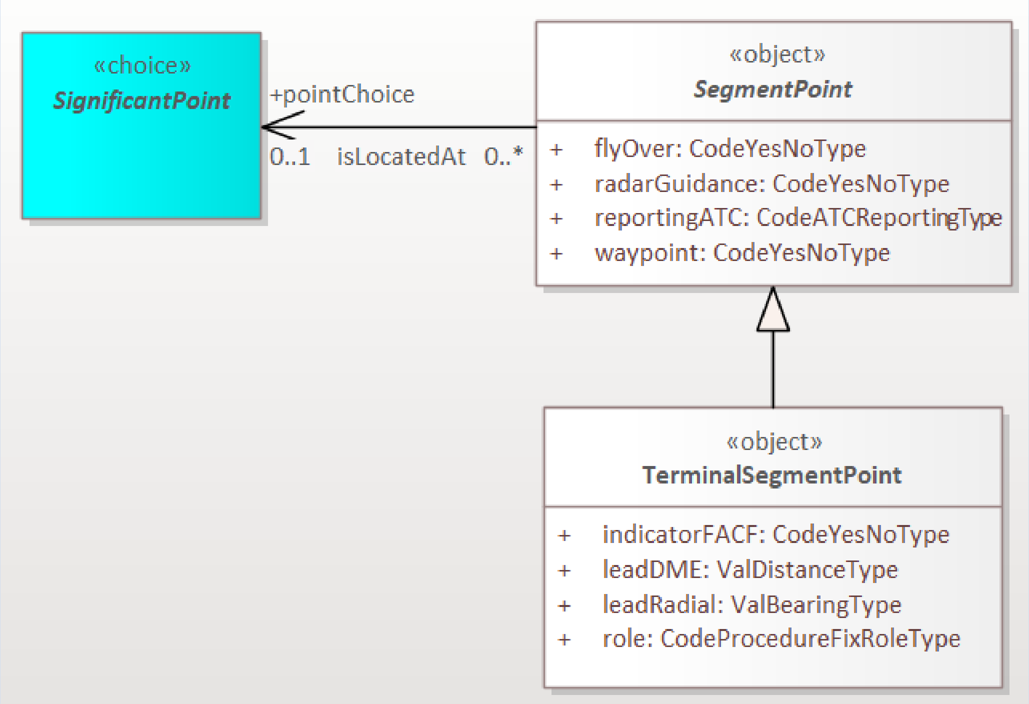


PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Procedure Fix

PANS AIM	AIXM 5.2

Subject	Property	Sub-Property
Procedure Fix		
	Identification	
	ATC Reporting requirements	
	VFR Reporting point	
	Position	
	Type	
	Formations	
		Navaid
		Bearing
		Distance

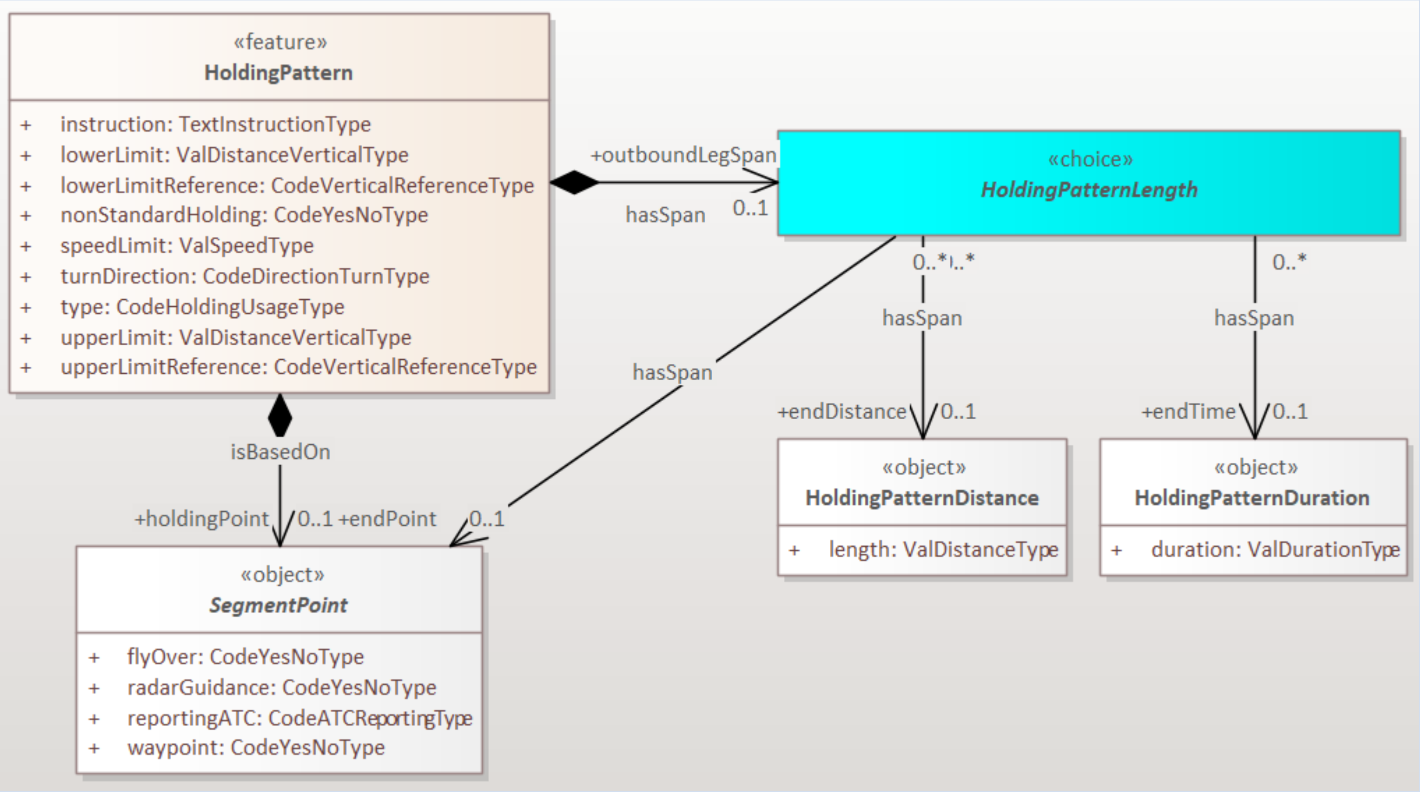


PANS AIM mapping to AIXM 5.2

Mapping PANS AIM to AIXM 5.2 – Procedure Holding

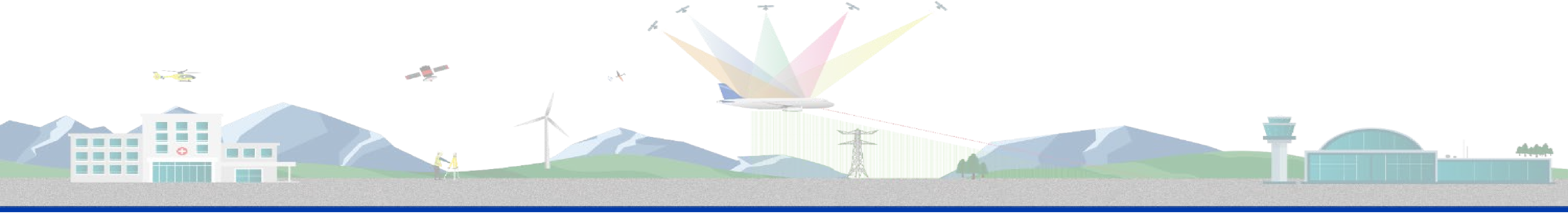
PANS AIM	AIXM 5.2

Subject	Propoerty	Sub-Property
Procedure Holding		
	Identification	
	Fix	
	Inbound course	
	Outboundcourse	
	Leg distance	
	Leg time	
	Limiting radial	
	Turn direction	
	Minimum altitude	
	Maximum altitude	



Coding Guidelines

CGX proposal



Coding Guidelines

CGX Approach

State of the art

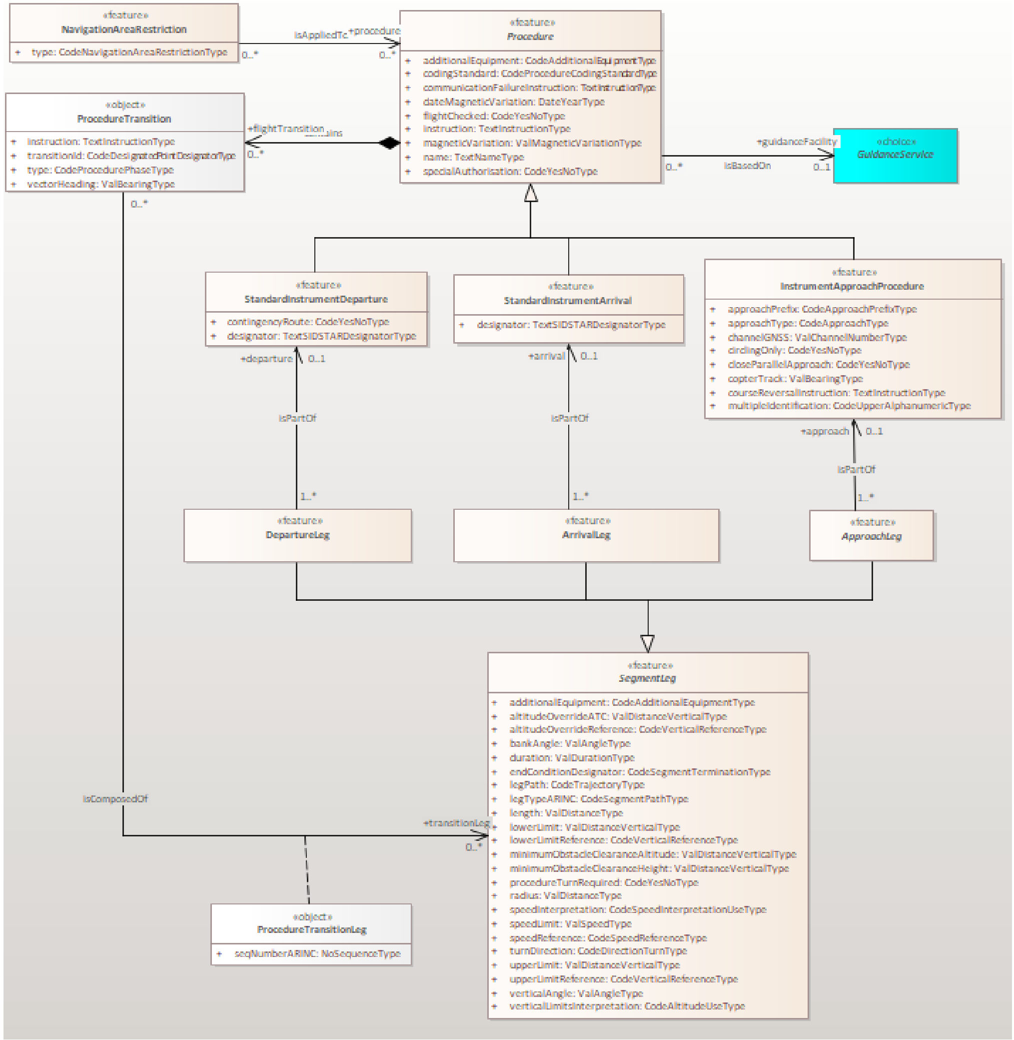
- EUROCONTROL provides a proposition of coding specifications for various aeronautical information products and services.
- AIXM Coding Guidelines are proposed for the following specific products:
  - **(ICAO) AIP Data Set**
  - **(ICAO) Obstacle Data Sets**
  - **(ICAO) Airport Mapping Data Sets**
  - **Digital NOTAM**
- The coding guidelines for IFP data sets are being developed in parallel with the finalization of AIXM 5.2 → Not yet available on EUROCONTROL AIXM Confluence

CGX Approach

- Similar work to the available Data Set Coding Specifications in the products
- Proposal of some coding guidelines
- Proposal of examples for IFP data sets.

Coding Guidelines

- Procedure Coding Guidelines – AIXM Model overview



Coding Guidelines

Procedure Coding Guidelines – CGX AERO proposal

1. The main class in IFP AIXM model is the Procedure class containing the basic data, such as the name of the procedure.
2. In AIXM 5, the Procedure is defined as "**A series of predetermined manoeuvres with specified protection from obstacles**."
3. The Procedure may serve one or more AirportHeliport.
4. The standard design rules and criteria for the procedure are defined in DesignStandard, with the attributes Name and Version.
5. The Procedure may be limited to one or more AircraftCharacteristic, which defines the Classification, properties, and equipment capabilities of aircraft, such as airplane, balloon, helicopter, etc.
6. The Procedure may be based on one or more GuidanceService as a guidance facility, which may be a Navaid, a SpecialNavigationSystem, a GBAS, a SatelliteSystem or a RadarSystem.

Coding Guidelines

Procedure Coding Guidelines

7. The Procedure may be applied to one or more NavigationAreaRestriction, Areas that are restricted from use for a procedure.
8. The Procedure may be protected by one or more MinimumAltitudeArea.
9. The availability of the Procedure, such as the status for flight planning/operations, may be provided via the ProcedureAvailability and its related classes.
10. The Procedure class is specialized into: StandardInstrumentDeparture, StandardInstrumentArrival and InstrumentApproachProcedure.
11. The StandardInstrumentDeparture and StandardInstrumentArrival are used to code departure and arrival procedures, which are identified by their designator (e.g 'KOGAL1A').

Coding Guidelines

Procedure Coding Guidelines

12. The InstrumentApproachProcedure is used to code approach procedure, it contains specific attributes such as approachPrefix, approachType and multipleIdentification.
13. The LandingTakeoffAreaCollection groups Landing Areas or Takeoff Areas serviced by the procedure, Arrival for STAR, Take off for SID and Landing for IAP procedures. It may be located on one or more RunwayDirection, or TouchDownLiftOff for helicopters.
14. When an approach cannot be continued, missed instructions may be defined in MissedApproachGroup associated to the InstrumentApproachProcedure.
15. The FinalProfile defines the profile view of an InstrumentApproachProcedure. Altitudes and distances to be depicted in the profile view may be defined using ApproachAltitudeTable and ApproachDistanceTable. In addition, timings between final approach fix and the missed approach point may be defined using ApproachTimingTable.

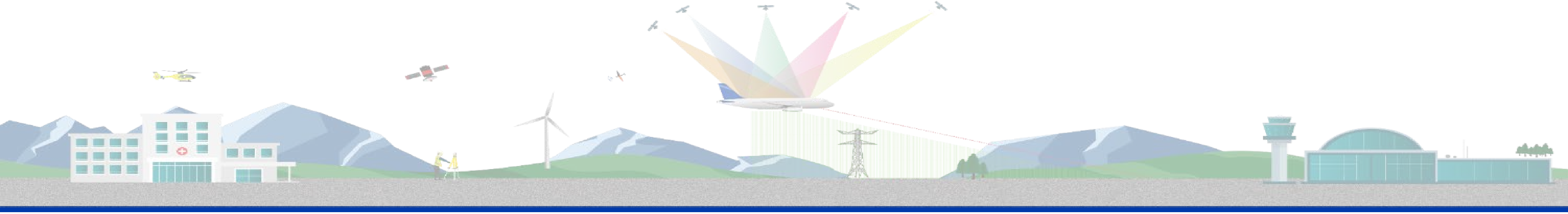
Coding Guidelines

Procedure Coding Guidelines

16. One or more **CirclingArea** may be used for an **InstrumentApproachProcedure**, allowing to land under visual conditions after completing an instrument landing approach.
17. The lowest altitudes providing the minimum clearances may be defined in one or more **TerminalArrivalArea** associated to the **InstrumentApproachProcedure.**
18. The **Procedure** contains one or more **ProcedureTransition,** which is a group of consecutive segments that are part of a branch on an approach procedure, SID or STAR.

Coding Examples

CGX Proposition



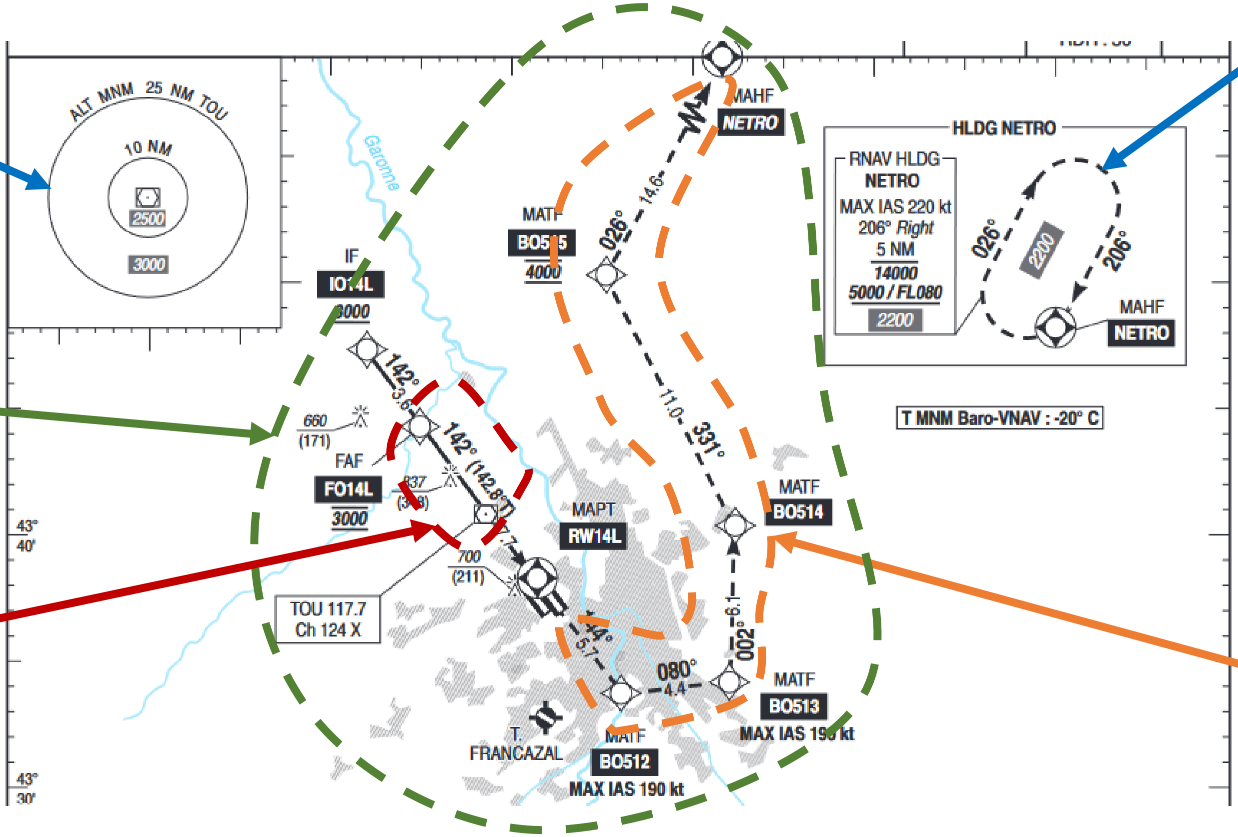
Coding Example

Procedure Coding Example

MinimumAltitudeArea
Defines the minimum altitudes for specific flight operations

InstrumentApproachProcedure
Defines the manoeuvres for the approach flight procedure from the initial approach fix or an arrival route

FinalLeg
Defines the properties of final approach segment



HoldingPattern
Defines the properties of manoeuvre keeping aircraft awaiting further clearance

ProcedureTransition
Missed approach branch, defined by transition id and type

Coding Example

Procedure Coding Example

FNA RNP RWY 32L												
RMK								MAG VAR 2020 01.0°E			REF NAVAID :	
Leg sequence	Path Terminator	Waypoint Identification	Fly Over	Direction MAG (°)	Direction True (°)	Distance (NM)	Turn direction	MNM Altitude (FL or AMSL ft)	MAX Altitude (FL or AMSL ft)	MAX IAS (kt)	Vertical angle (°) / TCH (m)	NAV Spec
HLDG	-	SULIT	Yes	007	007.9	5.0	R	FL080 /5000	FL140	220	-	RNAV1 / RNP APCH
APCH	IF	IO32L	-	-	-	-	-	3000	-	-	-	RNP APCH
	TF	FO32L	-	322	323.0	3.6	-	3000	3000	-	-	RNP APCH
	TF	RW32L	Yes	322	323.0	7.7	-	-	-	-	-3.0 / 15	RNP APCH
	TF	TOU	Yes	323	323.8	4.6	-	-	-	-	-	RNP APCH
	TF	BO614	-	303	304.0	10.0	L	-	4000	-	-	RNP APCH
	TF	BO616	-	250	251.0	10.1	L	-	-	-	-	RNP APCH
	TF	BO618	-	165	166.4	13.9	L	-	-	-	-	RNP APCH
	TF	SULIT	Yes	118	118.5	13.8	-	-	-	-	-	RNP APCH

«feature»
SegmentLeg

- + additionalEquipment: CodeAdditionalEquipmentType
- + altitudeOverrideATC: ValDistanceVerticalType
- + altitudeOverrideReference: CodeVerticalReferenceType
- + bankAngle: ValAngleType
- + duration: ValDurationType
- + endConditionDesignator: CodeSegmentTerminationType
- + legPath: CodeTrajectoryType
- + legTypeARINC: CodeSegmentPathType
- + length: ValDistanceType
- + lowerLimit: ValDistanceVerticalType
- + lowerLimitReference: CodeVerticalReferenceType
- + minimumObstacleClearanceAltitude: ValDistanceVerticalType
- + minimumObstacleClearanceHeight: ValDistanceVerticalType
- + procedureTurnRequired: CodeYesNoType
- + radius: ValDistanceType
- + speedInterpretation: CodeSpeedInterpretationUseType
- + speedLimit: ValSpeedType
- + speedReference: CodeSpeedReferenceType
- + turnDirection: CodeDirectionTurnType
- + upperLimit: ValDistanceVerticalType
- + upperLimitReference: CodeVerticalReferenceType
- + verticalAngle: ValAngleType
- + verticalLimitsInterpretation: CodeAltitudeUseType

CGX Aero

Coding Example

Procedure Coding Example

FNA RNP RWY 32L												
RMK								MAG VAR 2020 01.0°E			REF NAVAID :	
Leg sequence	Path Terminator	Waypoint Identification	Fly Over	Direction MAG (°)	Direction True (°)	Distance (NM)	Turn direction	MNM Altitude (FL or AMSL ft)	MAX Altitude (FL or AMSL ft)	MAX IAS (kt)	Vertical angle (°) / TCH (m)	NAV Spec
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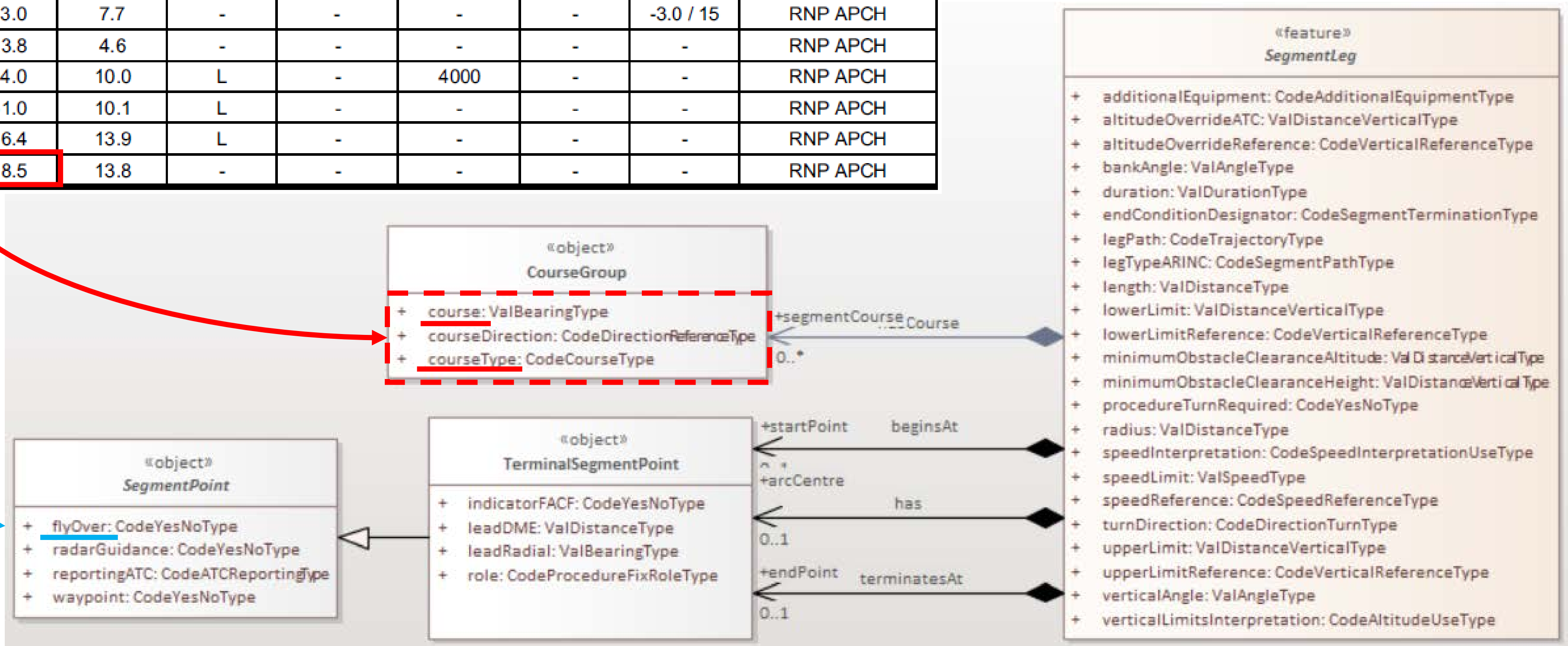
	TF	BO618	-	165	166.4	13.9	L	-	-	-	-	RNP APCH
	TF	SULIT	Yes	118	118.5	13.8	-	-	-	-	-	RNP APCH



Coding Example

Procedure Coding Example

FNA RNP RWY 32L												
RMK								MAG VAR 2020 01.0°E			REF NAVAID :	
Leg sequence	Path Terminator	Waypoint Identification	Fly Over	Direction MAG (°)	Direction True (°)	Distance (NM)	Turn direction	MNM Altitude (FL or AMSL ft)	MAX Altitude (FL or AMSL ft)	MAX IAS (kt)	Vertical angle (°) / TCH (m)	NAV Spec
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APCH	IF	IO32L	-	-	-	-	-	3000	-	-	-	RNP APCH
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	TF	BO616	-	250	251.0	10.1	L	-	-	-	-	RNP APCH
	TF	BO618	-	165	166.4	13.9	L	-	-	-	-	RNP APCH
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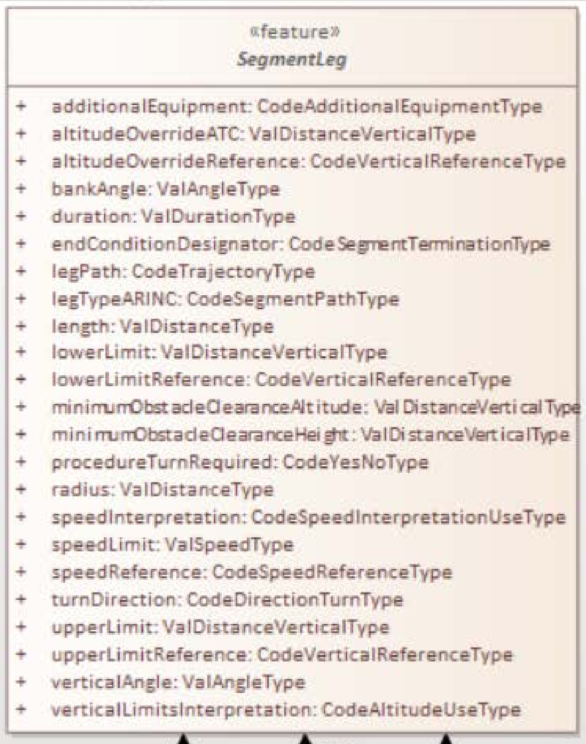
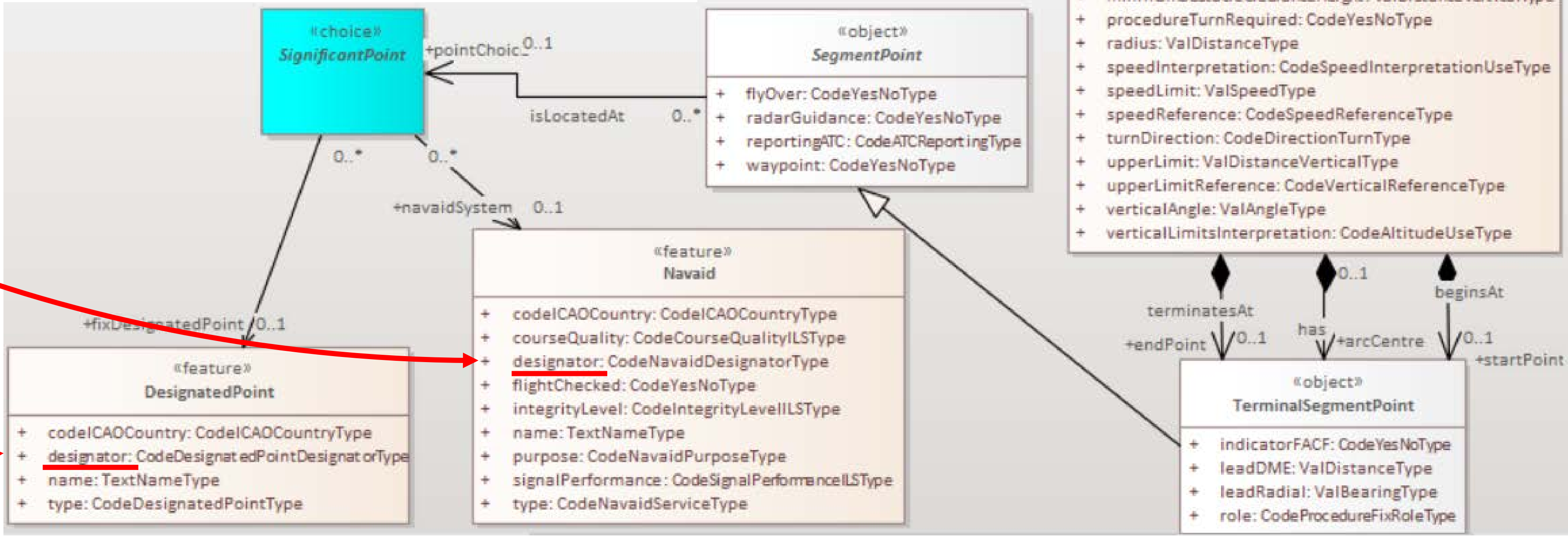
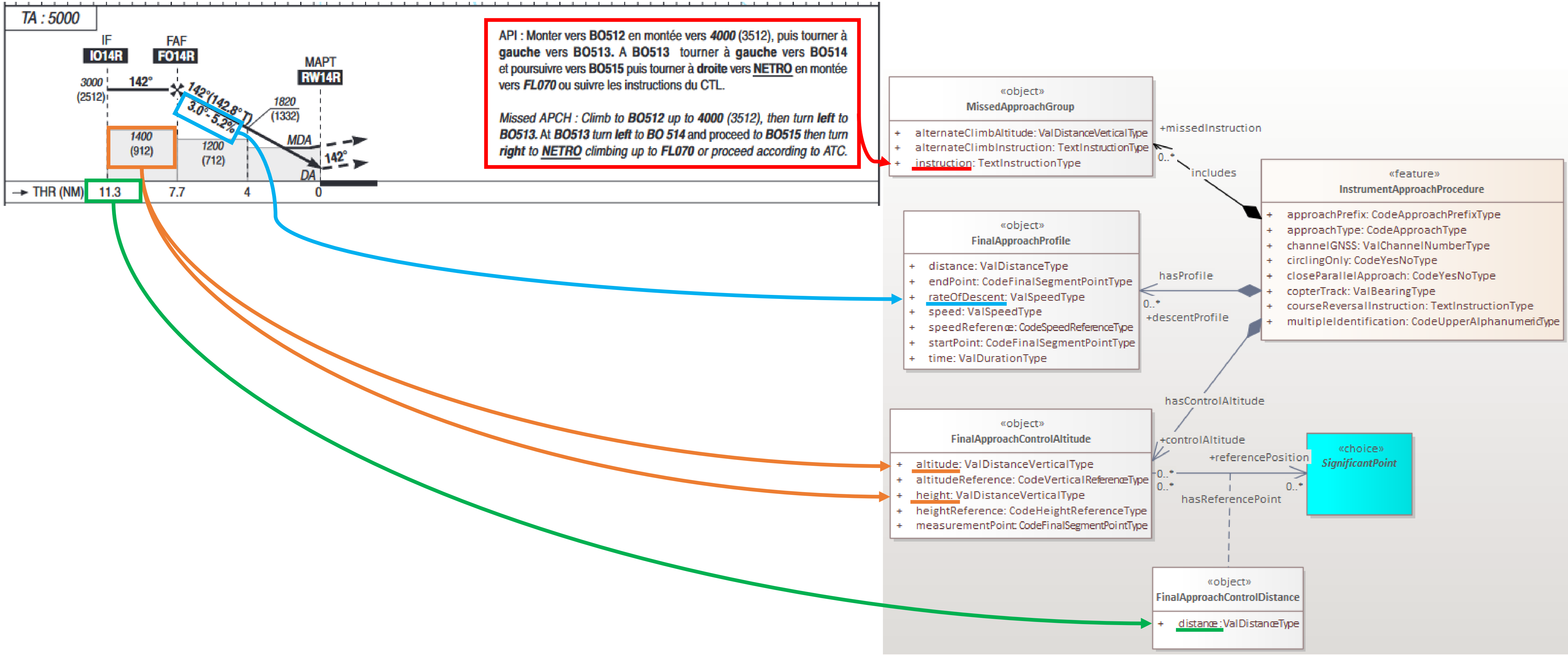




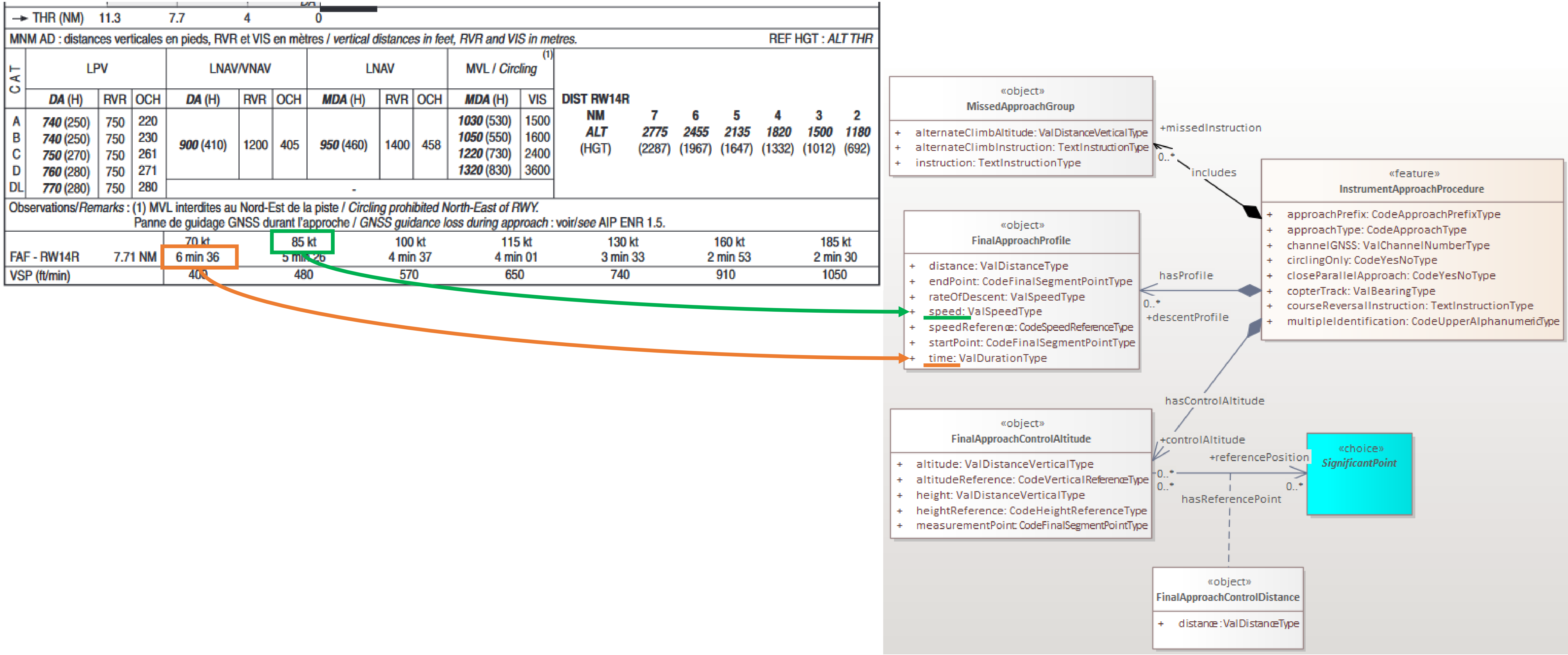
Coding Example

Procedure Coding Example



Coding Example

Procedure Coding Example



Coding Example

Procedure Coding Example


```xml
<aixm:InstrumentApproachProcedureTimeSlice gml:id="SKDB_AIXM51_ENTITY_01">
  <gml:validTime>
    <gml:TimePeriod gml:id="SKDB_AIXM51_ENTITY_02_VALIDTIME">
      <gml:beginPosition>2023-05-18T00:00:00Z</gml:beginPosition>
      <gml:endPosition indeterminatePosition="unknown" />
    </gml:TimePeriod>
  </gml:validTime>
  <aixm:interpretation>BASELINE</aixm:interpretation>
  <aixm:sequenceNumber>1</aixm:sequenceNumber>
  <aixm:designCriteria>PANS_OPS</aixm:designCriteria>
  <aixm:codingStandard>ARINC_424_18</aixm:codingStandard>
  <aixm:name>MEXRNAV</aixm:name>
  <aixm:RNAV>YES</aixm:RNAV>
  <aixm:aircraftCharacteristic>
    <aixm:AircraftCharacteristic gml:id="SKDB_AIXM51_ENTITY_03">
      <aixm:aircraftLandingCategory>A</aixm:aircraftLandingCategory>
    </aixm:AircraftCharacteristic>
  </aixm:aircraftCharacteristic>
  <aixm:aircraftCharacteristic>
    <aixm:AircraftCharacteristic gml:id="SKDB_AIXM51_ENTITY_04">
      <aixm:aircraftLandingCategory>B</aixm:aircraftLandingCategory>
    </aixm:AircraftCharacteristic>
  </aixm:aircraftCharacteristic>
  <aixm:aircraftCharacteristic>
    <aixm:AircraftCharacteristic gml:id="SKDB_AIXM51_ENTITY_05">
      <aixm:aircraftLandingCategory>C</aixm:aircraftLandingCategory>
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  <aixm:aircraftCharacteristic>
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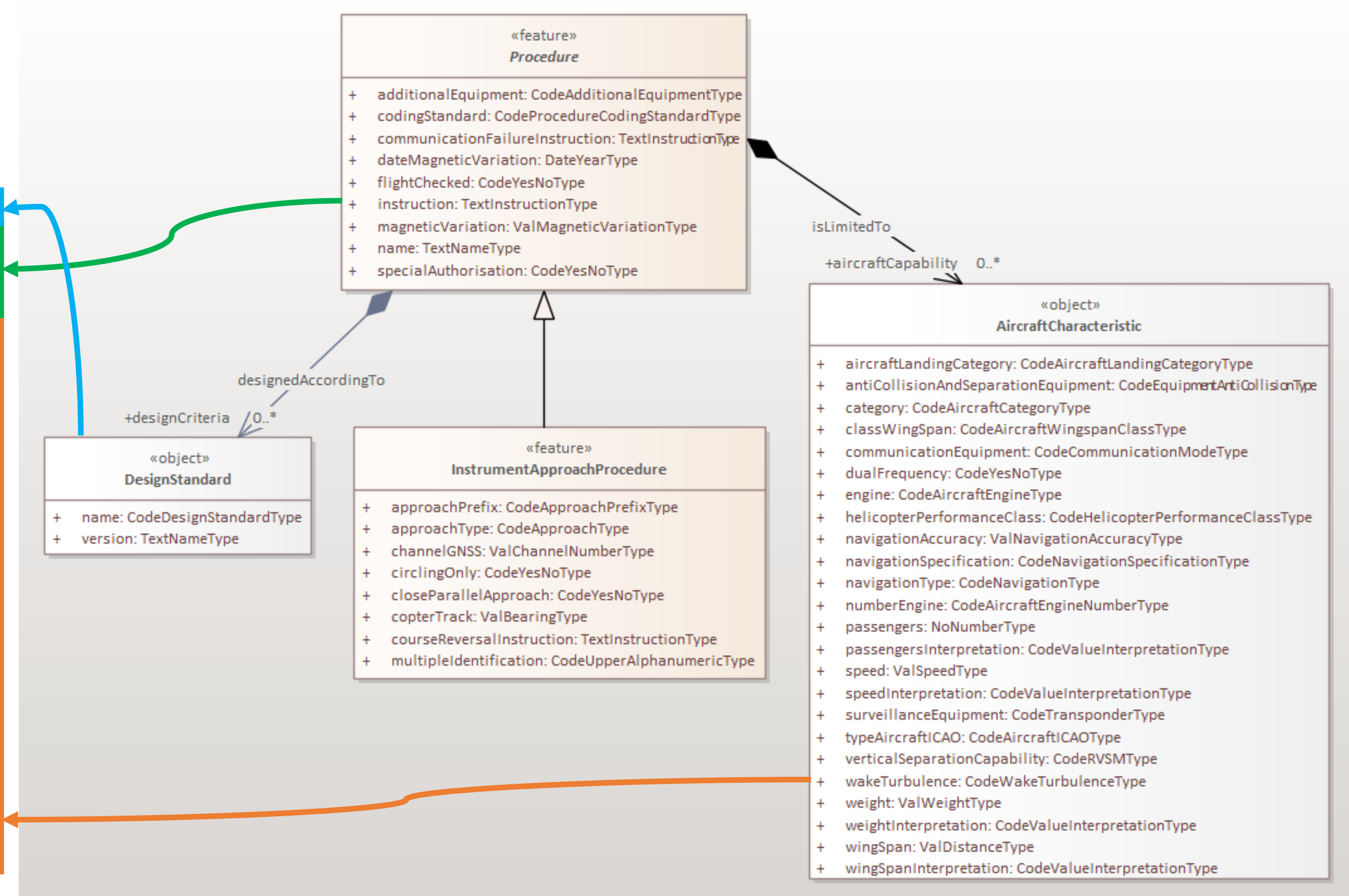
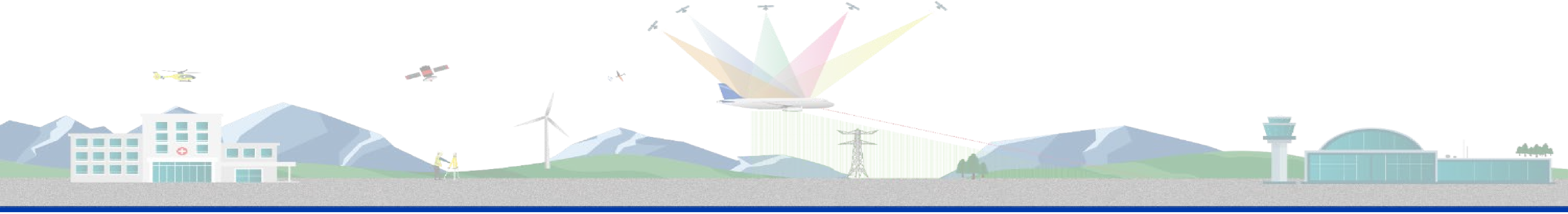


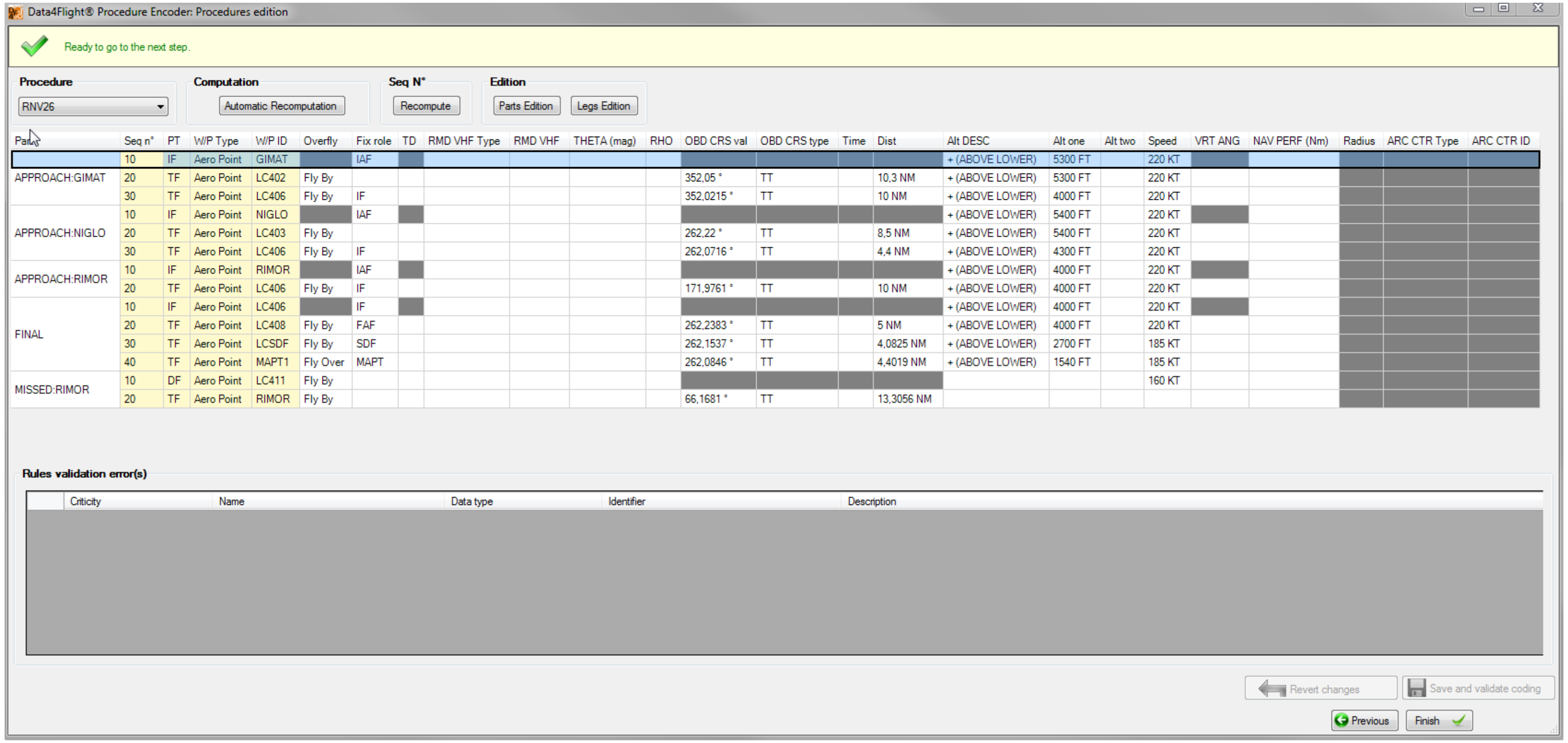
Application with CGX solutions



Application with CGX solutions

Procedure ARINC 424 Coding

- The AIM Chain of CGX is based on an AIXM 5 centralized database.
- Data4Flight®, a software that manages aeronautical data, takes advantage of digital data sets to store data according to the specified coding guidelines.
- Thanks to the stored properties of an **Instrument Flight Procedure**, Data4Flight® generates automatically the associated **ARINC 424 procedure coding**:

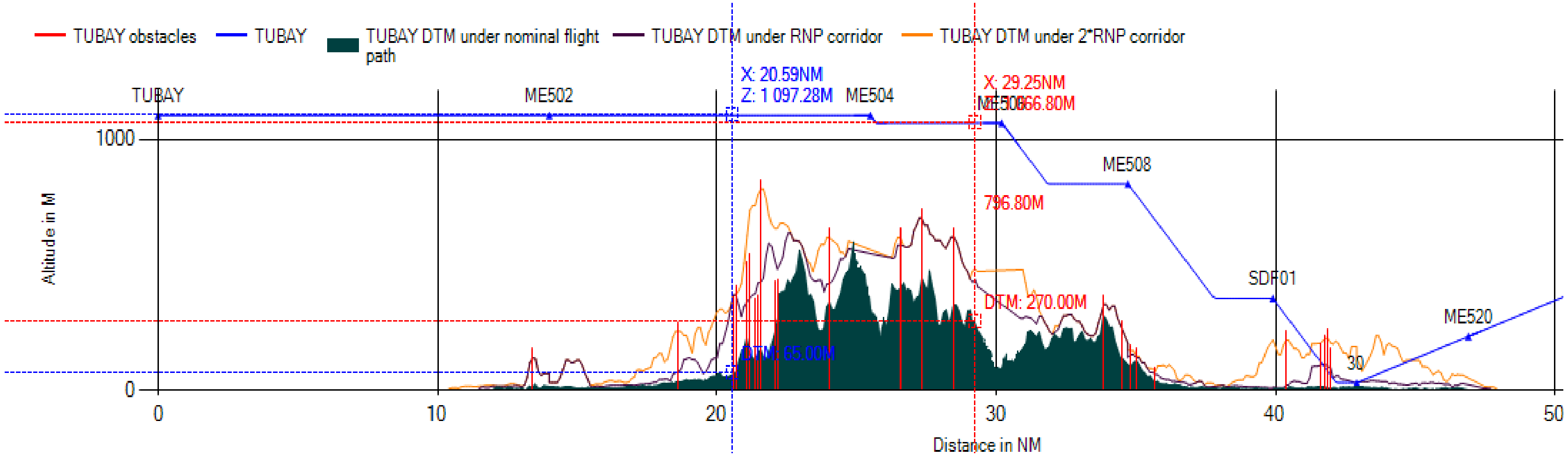


Part	Seq n°	PT	W/P Type	W/P ID	Overfly	Fix role	TD	RMD VHF Type	RMD VHF	THETA (mag)	RHO	OBD CRS val	OBD CRS type	Time	Dist	Alt DESC	Alt one	Alt two	Speed	VRT ANG	NAV PERF (Nm)	Radius	ARC CTR Type	ARC CTR ID
	10	IF	Aero Point	GIMAT		IAF										+ (ABOVE LOWER)	5300 FT		220 KT					
APPROACH:GIMAT	20	TF	Aero Point	LC402	Fly By							352,05 °	TT		10,3 NM	+ (ABOVE LOWER)	5300 FT		220 KT					
	30	TF	Aero Point	LC406	Fly By	IF						352,0215 °	TT		10 NM	+ (ABOVE LOWER)	4000 FT		220 KT					
	10	IF	Aero Point	NIGLO		IAF										+ (ABOVE LOWER)	5400 FT		220 KT					
APPROACH:NIGLO	20	TF	Aero Point	LC403	Fly By							262,22 °	TT		8,5 NM	+ (ABOVE LOWER)	5400 FT		220 KT					
	30	TF	Aero Point	LC406	Fly By	IF						262,0716 °	TT		4,4 NM	+ (ABOVE LOWER)	4300 FT		220 KT					
APPROACH:RIMOR	10	IF	Aero Point	RIMOR		IAF										+ (ABOVE LOWER)	4000 FT		220 KT					
	20	TF	Aero Point	LC406	Fly By	IF						171,9761 °	TT		10 NM	+ (ABOVE LOWER)	4000 FT		220 KT					
	10	IF	Aero Point	LC406		IF										+ (ABOVE LOWER)	4000 FT		220 KT					
	20	TF	Aero Point	LC408	Fly By	FAF						262,2383 °	TT		5 NM	+ (ABOVE LOWER)	4000 FT		220 KT					
FINAL	30	TF	Aero Point	LCSDF	Fly By	SDF						262,1537 °	TT		4,0825 NM	+ (ABOVE LOWER)	2700 FT		185 KT					
	40	TF	Aero Point	MAPT1	Fly Over	MAPT						262,0846 °	TT		4,4019 NM	+ (ABOVE LOWER)	1540 FT		185 KT					
MISSED:RIMOR	10	DF	Aero Point	LC411	Fly By														160 KT					
	20	TF	Aero Point	RIMOR	Fly By							66,1681 °	TT		13,3056 NM									

Application with CGX solutions

Procedure Profile

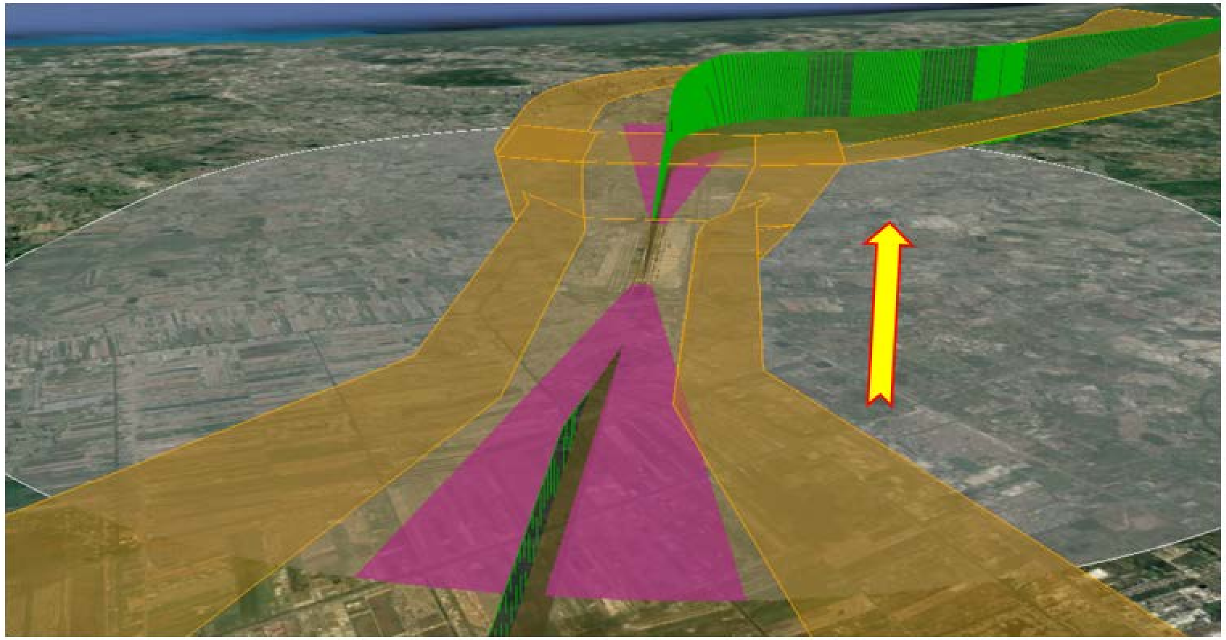
- Data4Flight® uses stored data of **Instrument Flight Procedure** to visualize the associated vertical profile.
- Profiles under the procedure protection areas and RNP corridors are also computed and visualized.

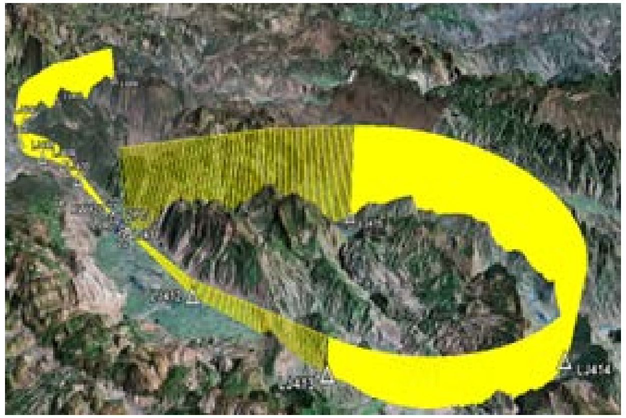


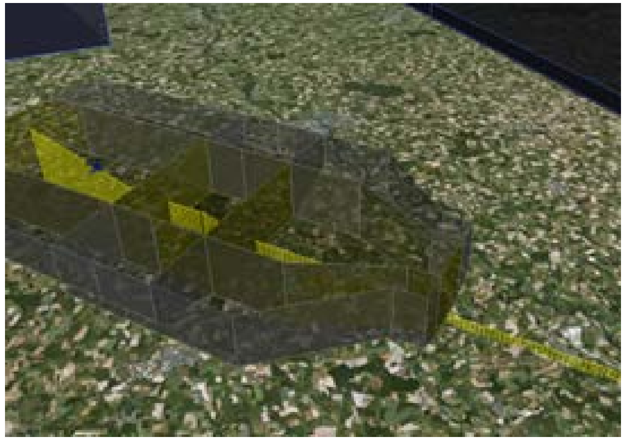
Application with CGX solutions

3D Visualization

- Having a total support of the advanced **AIXM-GML** profile, CGX tools store and computes the geometric properties of aeronautical information items and provide a 3D visualization of procedure data.







Application with CGX solutions

Automatic reports

- CGX solutions provide tools allowing to generate automatically the **technical report** of an **Instrument Flight Procedure.** The more the required properties are filled, the more complete the report will be, hence the advantage of using IFP digital data sets.

- A well-informed database will benefit from CGX tools capabilities of assessment and validation against **Business Rules.** Validation results are generated in automatic reports.

Show 10 entries Search:

Name	Status	Integrity
1541239404 : AIXM-5.1_RULE-D8D6B -The Unit of measurement shall be specified if a value is specified for a property with uom attribute .		
C :: LDDU || Taxiway:width	Success	Routine
G :: LDDU || Taxiway:width	Success	Routine
W :: LDDU || Taxiway:width	Success	Routine
D :: LDDU || Taxiway:width	Success	Routine
F :: LDDU || Taxiway:width	Success	Routine
E :: LDDU || Taxiway:width	Success	Routine
B :: LDDU || Taxiway:width	Success	Routine
157383666 : AIXM-5.1_RULE-1A8520 -The feature instance actually targeted by an association (through its role name value) shall exist and correspond to the feature type defined by the model .		
APRON :: LDDU ||	Success	Routine
1646186266 : ICAO Annex 14 AIXM-5.1_RULE-58DE0 - Runway threshold elevation for non-precision approaches shall be published with 0.5 m accuracy .		
THR :: 29 :: RWY-11/29 :: LDDU || Point:horizontalAccuracy	Warning	Routine
THR :: 11 :: RWY-11/29 :: LDDU || Point:horizontalAccuracy	Warning	Routine
Name	Status	

Showing 51 to 60 of 232 entries Previous Next

THANK YOU FOR YOUR ATTENTION

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