



SAM/AIM/9

**INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN REGIONAL OFFICE**

**NINTH MULTILATERAL MEETING OF THE SAM
REGION FOR THE TRANSITION OF AIS TO AIM
(SAM/AIM/9)**

PRELIMINARY REPORT

Lima, Peru, 24 to 28 October 2016

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HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Ninth Multilateral Meeting of the SAM Region for the transition of AIS to AIM (SAM/AIM/9) was held at the ICAO South American Regional Office, Lima, Peru, from 24 to 28 October 2016.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Oscar Quesada, Deputy Regional Director of the ICAO South American Office, greeted the participants and highlighted the importance of the objectives of the Meeting, as regards consolidation of Phase 1 of the Roadmap for the transition from AIS to AIM, and the continuation and follow-up of the tasks of AIM Projects for the provision of Electronic Terrain and Obstacle Data (e-TOD), aeronautical information/data management, the preparation of quality specifications applicable to the digital AIM environment, emphasizing the importance and connection of these implementations with the Declaration of Bogota, as well as the adoption of Amendment 39 to Annex 15 - *Aeronautical Information Services*.

Mr. Quesada also highlighted the participation of the delegates of Suriname and Guyana, stating that improved connectivity with these States would facilitate their participation at the meetings held in the Office. Moreover he underlined the importance of implementing and certifying quality management systems and maintaining their certification, since this contributed to the execution of implementation plans and AIS-AIM personnel training. He considered important the preparatory work to introduce States in the implementation of the System-wide Information Management as *SWIM*.

Two presentations were made by Brazil and Argentina on e-TOD data availability and GIS, respectively. Furthermore the technical committee of the Regional Safety Oversight Cooperation System (SRVSOP) made a presentation on the drafting of the AIM-LAR (LAR 215) intended to serve as a tool for civil aviation authorities for regulating aeronautical information service providers.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Meeting agreed to hold its sessions from 0830 to 1530 hours, with appropriate breaks. The work was done with the Meeting as a Single Committee and Working Groups.

Mrs. Ivette Iturrado González, Chief of the Aeronautical Information Department of the Civil Aviation Authority (CAA) of Panama, was unanimously elected as Chairperson of the Meeting. Mr. Oscar Dioses, Aeronautical Information Specialist from the Corporación Peruana de Aeropuertos y Aviación Comercial (CORPAC S.A.) of Peru, was elected as Vice-Chairman.

Mr Jorge Armoa Cañete, AIM/MET Regional Officer from the South American Regional Office, acted as Secretary.

ii-4 WORKING LANGUAGES

The working language of the Meeting was Spanish, with simultaneous interpretation into English, and its relevant documentation was presented in both languages.

ii-5 AGENDA

The following agenda was adopted:

Agenda

Item 1: Implementation of provision of Electronic Terrain and Obstacle Data (e-TOD)

Agenda

Item 2: Implementation of Aeronautical Information and Aeronautical Data Exchange Systems

Agenda

Item 3: Implementation of the Quality Management System in AIM units

Agenda

Item 4: NOTAM Contingency Plan, AIM deficiencies and ICARD system

Agenda

Item 5: Update on information concerning progress in the implementation of automated systems and other requirements according to Annex 15

Agenda

Item 6: Analysis of objectives, metrics and dates for the implementation of elements regarding second phase of the plan for the transition of AIS to AIM: digital

Agenda

Item 7: Amendment 39 to Annex 15 – Aeronautical Information Services

Agenda

Item 8: Other business

ii-6 ATTENDANCE

The Meeting was attended by 24 participants from 8 States of the SAM Region, (Argentina, Brazil, Chile, Guyana, Panama, Peru, Suriname and Uruguay), and 1 State of the CAR Region (Guatemala).

The list of participants is presents in page iii-1.

LIST OF PARTICIPANTS**ARGENTINA**

1. Ricardo Daniel Sykes
2. Jorge Osmar Rivero
3. María Inés Villalba
4. Lucas Aidar Rosa
5. Jorge Roberto Cornelio

BRAZIL

6. Rinaldo Ferreira Marinho
7. Felipe de Almeida Souza
8. Leonardo Coelho de Almeida

CHILE

9. Sergio M. García Jorquera

GUATEMALA

10. Marco Antonio Archila Gozalvo

GUYANA

11. Trevor Mahase

PANAMA

12. Ivette M. Iturrado González
13. Dalys Rodríguez

PERU

14. Jorge Taramona Perea
15. Roger Soca Gómez
16. Federico Vásquez Cáceres
17. Sara Siles La Rosa
18. Karina Calderón Yactayo
19. Juan Vargas Gavancho
20. Oscar Dioses García
21. Blanca Sánchez Guerrero

SURINAME

22. Regina Gefferie
23. Karamantana Henna

URUGUAY

24. Graciela Monzillo
25. Mario Dávila

ICAO

26. Jorge Armoa

Agenda Item 1: Implementation of provision of Electronic Terrain and Obstacle Data (e-TOD)

1.1 Under this Agenda Item, the Meeting reviewed the following papers:

- WP/02 – *GREPECAS Project G1* (Presented by the Secretariat)
- WP/03 – *GREPECAS Project G3* (Presented by the Secretariat)
- WP/04 - *Service Level Agreement (SLA)* (Presented by the Secretariat)
- WP/16 - *Electronic terrain and obstacle data (e-TOD) in Area 2* (Presented by Ecuador)
- WP/18 – *Availability of eTOD data using free software* (Presented by Brazil)
- WP/19 - *Type A Charts* (Presented by IATA)
- IP/03 – *Implementation of provision of Electronic Terrain and Obstacle Data (e-TOD)* (Presented by Argentina)

GREPECAS Proyecto G1 - Implementation of the provision of electronic terrain and obstacle data (e-TOD)

1.2 During the review of this agenda item, the Meeting analyzed the progress made in the various terrain and obstacle surveys related to the different areas listed in Annex 15:

AREA 1 - Terrain

1.3 Information was compiled in relation to compliance with terrain surveying requirements in Area 1, with the following results:

- a) Regarding implementation, **Argentina, Brazil, Chile, Colombia, French Guiana, Panama, Peru, and Venezuela** had a terrain and/or elevation or surface digital model for the development of Area 1. **Panama** informed that surveying was being conducted at national level, currently reaching 90%. They expected to complete it in December 2016. Fifty-six percent (56%) of States in the Region had digital models, **with 44% pending completion before November 2016.** **The progress made since March 2015 was 7%.**
- b) Regarding compliance with terrain requirements for Area 1, according to Annex 15 Table 8-1, **Argentina, Brazil, Chile, French Guiana, Panama, Peru, and Venezuela** were in compliance. The current implementation percentage is 57%, with **43% pending implementation before November 2016.** **The progress made since March 2015 was 14%.**
- c) Regarding the ISO 19110 Digital Model Methodology, **Argentina, Brazil, Chile, Colombia, French Guiana, Panama, Peru, and Venezuela** reported compliance, reaching 56% implementation in the SAM Region, with **44% pending compliance before November 2016.** **The progress made since March 2015 was 14%.**

AREA 1 - Obstacles

1.4 Information was compiled on compliance with obstacle surveying requirements for Area 1, with the following results:

- a) Regarding the availability of an obstacle database covering Area 1, **Argentina, Brazil, Colombia, French Guiana and Peru** reported compliance, thus reaching 42% implementation in the Region. Chile complied only partially, so it is considered as not completed. **Pending completion by November 2016 reached 58%. The progress made since March 2015 was 7%.**
- b) **Argentina, Brazil, Chile, Panama, Peru, Uruguay, and Venezuela** reported compliance with the obstacle requirements of Table 8-1 for Area 1. The implementation level in the Region went to 42%, with **58% pending completion by November 2016.** The progress made since March 2015 was 28%.

AREA 2 - Terrain

1.5 Regarding Action Plans for obtaining electronic terrain data in Area 2a, **Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Panama, Paraguay, Peru, and Uruguay** accounted for 56% compliance, with **44% pending implementation in 2015.** No improvement was registered since **August 2015.**

1.6 Regarding compliance with the provision of terrain data for the take-off path, States that reported the development of an Action Plan were **Argentina, Brazil, Chile, Ecuador, Panama, Paraguay, Peru, and Uruguay**, reaching 57% compliance in the Region, with **43% pending completion in 2015.** Progress made in this area since August 2015 was 8%.

1.7 Regarding the provision of electronic terrain data corresponding to the area defined by the lateral extension of the aerodrome obstacle limitation surfaces, **Argentina, Brazil, Chile, Ecuador, Panama, Paraguay, and Peru** accounted for 50% implementation, **50% pending completion in 2015.** Progress made in this area since August 2015 was 15%.

AREA 2 - Obstacles

1.8 **Argentina, Bolivia, Brazil, Chile, Ecuador, Panama, Paraguay, and Peru** developed Action Plans for the compilation of Area 2a data, concerning obstacles that penetrated the obstacle limitation surface, in accordance with Appendix 8 to Annex 15, reaching 57% compliance, with **43% pending completion in 2015.** Progress made in this area since August 2015 was 8%.

1.9 Likewise, **Argentina, Brazil, Chile, Ecuador, Panama, Paraguay, and Peru** reported progress in their Action Plans for the provision of electronic data on objects protruding from the flat slope of 1.2% with respect to the take-off path, thus increasing implementation in the Region from 42% to 57%, with **43% pending implementation in 2015.** Progress made in this area since August 2015 was 15%.

1.10 Regarding the provision of electronic data on the penetration of obstacle limitation surfaces at aerodromes, **Argentina, Bolivia, Brasil, Chile, Ecuador, Panama, Paraguay, and Peru** had developed Action Plans to comply with the requirement. Compliance reached 64%, with **36% pending completion in 2016.** Progress made in this area since March 2015 was 15%.

1.11 Likewise, **Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Panama, Paraguay, Peru, Suriname, and Uruguay** had produced a Manual on technical specifications for e-TOD implementation, with **16% pending completion in 2016**. **No progress had been made since August 2015.**

1.12 With regard to obstacle surveying for Area 2, Argentina informed that obstacle surveying had been completed in four airports, Chile, in two airports, Panama was in a bidding process for two airports, Peru had awarded the job for the Cuzco airport, and Uruguay expected to complete the survey by the end of 2017.

1.13 Regarding e-TOD implementation, Suriname informed the Meeting that they were in the planning stage, and could not give any dates yet nor define an Action Plan for either terrain or obstacles.

1.14 Guyana informed that it would take some time for the project to be implemented. Regarding Area 2, it was informed that the main runway was currently being extended and, if obstacle surveying started now, efforts would be duplicated. The runway was foreseen to be completed in 2017 and, after that, they would prepare the obstacle survey plan for Area 2.

e-TOD Training in the SAM Region

1.15 The Meeting took note that regarding e-TOD training, there had been no change in the Region. **Argentina, Brazil, Chile, Colombia, Ecuador, French Guiana, Panama, and Uruguay** continued with e-TOD training plans, **accounting for 56% of the States, with 44% pending completion in 2016**. **No progress had been made since August 2015.**

1.16 Regarding the inclusion of operational concepts in training, **implementation reached 72% in the Region, with 28% pending completion in 2016**. **No progress had been made since August 2015.**

1.17 Regarding equipment and programmes required for e-TOD information management, the Region had reached 56% compliance, with **44% pending completion in 2016**. **Progress made in this area since March 2015 was 7%.**

Service Level Agreement (SLA) and Geographic Information Systems (GIS)

1.18 Regarding Service Level Agreements (SLA) between AIM units and data providers, Argentina informed that the SLA had been included in its plans for 2016/17. Panama informed that it had prepared an SLA only with one provider, but still has not been signed. Suriname was preparing the SLAs with the providers, and was in the signing phase. Likewise, the Secretariat informed that Colombia had prepared the SLAs for all data providers, but had not been signed yet due to internal regulatory restrictions. Chile had providers within the Administration's quality system, as well as external providers; the Quality Department was studying the best procedure for including external providers within the scope of its internal regulations.

1.19 The Secretariat emphasized the importance of publishing an AIC with the numerical requirements for keeping in pace with the changes made to the Amendments to Annex 15 in this respect. **The level of implementation of SLAs was 43%. Progress made in this area since March 2015 was 8%.**

2015		
State	% of States with Automated or GIS systems = 56%	% of States that have established SLA agreements = 43%
ARG	YES	YES
BOL		
BRA	YES	YES (Standard)
CHI	YES	YES within the Quality Integrated System
COL	YES	
ECU		
FGY	YES	
GUY		
PAN	YES	YES
PAR		
PER	YES	YES
SUR		
URU	YES	YES
VEN		

1.20 The Meeting updated the information of **Appendix A** to this part of the Report, and the Secretariat would make any required changes in **Appendix B**, corresponding to the description of GREPECAS Project G1.

e-TOD Corrective Action Plan

1.21 The Meeting took note that non-compliance with the provision of terrain and obstacle data in electronic format as of 12 November 2015 becomes a deficiency type “A”. In this regard, the Secretariat informed that the responses to the State Letter requesting the Corrective Action Plan did not contain significant details.

1.22 In view of the above, the Secretariat informed that a Corrective Action Plan Model containing detailed information, subject to monitoring, had been prepared. The Meeting agreed with the model, but deemed it important to review it. To this end, it designated a study group to review and adjust the model to the Region. This study group was composed by Argentina, Brazil, Panama, Peru, and Uruguay. The group submitted to the Meeting the changes to be made to the model. Finally, the Meeting felt that it should maintain the original format and present it as a Guide for the development of an Action Plan on e-TOD implementation. The final model approved by the Meeting is contained in **Appendix C** to this part of the report, available in Spanish only.

Availability of e-TOD data through the Internet

1.23 Brazil presented a proposal on e-TOD data availability through the Internet using free software and a geoportal. The Meeting took note of the presentation and noted that it contained a very important methodology for the user to access the data, provided the corresponding permissions were obtained.

Important websites to assist AIM experts

1.24 The delegation of Brazil provided some important websites to assist AIM experts in tasks related to spatial data geo-technology, using free software. The sites were as follows:

- 1) **Geonetwork:** <http://geonetwork-opensource.org/>
 - a) Catalogue for registering metadata in accordance with ISO 19115 and 19139 Methodology.
 - b) Catalogue for registering objects in accordance with ISO 19110 Methodology.
- 2) **QGIS:** <http://www.qgis.org/en/site/>
Geographic Information System (GIS).
- 3) **Geoserver:** <http://geoserver.org/>
Map application for configuring map services (WMS, WFS, WCS, etc.) and developing *webmapping* solutions.
- 4) **Openlayers:** <http://openlayers.org/>
JavaScript open source library to be used for offering/displaying geographic data on the Internet.
- 5) **Postgres:** <http://www.postgresql.org/download/>
Databank management system.
- 6) **Postgis:** <http://postgis.net/>
Special Postgres databank extension for managing spatial data.

Websites presented:

- 1) **National Spatial Data Infrastructure** (*Infraestrutura Nacional de Dados Espaciales - INDE*): <http://www.inde.gov.br/>
Spatial Data Infrastructure of Brazil that offers data and metadata produced by Brazilian mapping bodies, including the Aeronautical Mapping Institute.
- 2) **OGC (Open Geospatial Consortium):** <http://www.opengeospatial.org/domain/aviation>
OGC technical committee for the establishment of system requirements to promote the interoperability of aeronautical information.
- 3) Latin America and Caribbean Geospatial Network (*Red Geoespacial de América Latina y del Caribe - GeoSUR*): <http://www.geosur.info/geosur/index.php/es/noticias>.

TYPE “A” chart

1.25 The Meeting took note of IATA’s request on the need to have obstacle information available for contingency procedures related to engine failure after takeoff. IATA noted that knowledge of the obstacles in the vicinity of the airport was required for safety reasons, and that charts provided in Annex 4 (Type A chart) had to be properly updated.

1.26 The Meeting recognized that several States had not updated these charts for the last 5 years, but they noted that they were working in the updates. Argentina and Chile, for example, noted that their charts were up-to-date. States undertook to update the information, and to monitor and correct this deficiency.

APÉNDICE A / APPENDIX A

SEGUIMIENTO NIVEL DE IMPLANTACIÓN DE LA NORMA PARA LA PROVISIÓN DE
DATOS ELECTRÓNICOS SOBRE EL TERRENO (E-TOD) PARA EL ÁREA 1 (Ref.: Anexo 15, 10.1.3)FOLLOW-UP LEVEL OF IMPLEMENTATION OF THE STANDARD FOR THE PROVISION OF
ELECTRONIC TERRAIN OBSTACLE DATA (E-TOD) FOR THE AREA 1 (Ref.: Annex 15, 10.1.3)

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
Modelo digital – DIGITAL MODEL														
¿Dispone la Oficina de un Modelo Digital del Terreno (MDT) o de un Modelo Digital de Elevación (MDE) u otro? (Especifique) / Does the Office have a Model for Digital Terrain (MDT) or a Model for Digital Elevation (MDE) or other? (Specify).	Y	N ¹	Y ¹	Y	Y ¹	N	N	Y ¹	N	N	Y	N	N	Y
¿De dónde los obtuvo? (¿de la propia organización, de organización externa? - ¿cuál?) Where did you obtain it? (from your organization, an external organization? - which?).	Y ⁸	-	Y ²	N	Y ²	N	-	Y ²	N	N	Y ⁴	N	N	* ₁
¿La precisión de este modelo está de acuerdo con requerimientos? / The accurateness of this model is according to the requirements?	Y		Y/P						Y					
¿Cumple con Tabla A8-1; requisitos de los datos sobre el terreno para el Área 1 del Anexo 15? / Does it comply with Table A8-1; data requirements for Annex 15, Area 1?	Y	N	Y ⁴	Y	N	N	N/A	Y ⁴	Y/P	N	N	N	N	Y
¿Dicho modelo cumple con la Norma ISO 19110? (Si/No) / Does such model comply with the ISO standard 19110? (Yes/No)	Y	N ⁴	Y ⁵	Y	Y ⁴	N	N/A	Y ⁵	Y	N	Y	-	N	Y

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
Obstáculos – OBSTACLES														
¿Dispone de una base de datos de obstáculos que abarque todo el territorio de su país? (Si/No) / Is there an obstacle data base covering all territory in your country? (Yes/No).	Y ¹	N	Y ⁶	N	Y ⁵	N	N	Y ⁶	P	N	N ¹	N	N	N ⁴
¿Cómo los obtuvo? (¿de la propia organización, de organización externa? -¿cuál?) / How did you get them (from your organization, from an external organization? – which?	Y ²	N	Y ⁷	N	Y ⁶	N	N/A	Y ⁷	Y ³	N	N	-	Y	* ⁵
¿Dichos datos cumplen con la Norma ISO 19110? (Si/No) / Does the data comply with the ISO 19110 standard? (Yes/No).	Y ³	N	Y ⁸	N	N	N	N/A	N ⁸	Y	N	N	-	N ³	Y
¿Cumple con Tabla A8-2; requisitos de los datos sobre obstáculos para el Área 1 del Anexo 15? / Does it comply with Table A8-1; data requirements on terrain for Annex 15 Area 1?	N	N	Y	N	N	N	N/A	N ⁹	P ³	N	N	N	Y	Y
Planificación – PLANNING														
¿Ha establecido la Oficina un plan detallado con las tareas, plazos, análisis de riesgos, aspectos económicos y demás para la ejecución del proyecto de implantación del e-TOD para el Área 1? (Si/No). (Si la respuesta es Si, indicar plan y fechas de cumplimiento). / Has your office established a detailed plan with tasks, risk analysis, economical aspects, etc. for the execution of the e-TOD implementation project for Area 1 (Yes/No). (If answer is Yes, indicate plan and dates of compliance).	N	N	Y ¹⁰	Y ¹	N	Y ¹	N	Y ¹⁰	P	N	N	N	Y ⁴	N

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
<p>¿Ha definido la Oficina un manual de especificaciones técnicas para dicha implantación? (Si/No). (Consultar si se puede acceder al mismo). / Has the office defined a manual with technical specifications for such implementation? (Yes/No). (Ask if there is easy access to the same).</p>	Y ⁵	Y	Y ¹¹	Y	Y	Y	N	Y ¹¹	Y	Y	Y	Y	Y ⁵	N
<p>¿Ha definido y firmado Acuerdos de Nivel de Servicio (SLA) con los proveedores de datos? (Si/No). (Consultar si se puede obtener una copia modelo de los mismos). / Has your office defined and signed Service Level Agreements (SLA) with data providers? (Yes/No). (Ask if there is an available copy of the same).</p>	Y ⁶	N	Y ¹⁵	N	N	N	N	N ¹²	Y	N	Y	N	Y ⁶	N
<p>¿Dispone de un programa de capacitación para aquellas personas que tengan que operar con los datos del e-TOD en la dependencia AIS? (Si/No). (Consultar si se puede acceder al mismo). / Is there a training programme for those persons that have to operate with e-TOD data in AIS unit? (Yes/No). (Ask if the same may be accessed).</p>	Y	N	Y ¹²	Y	Y	Y ²	N	Y ¹³	N	Y ⁴	N	N	Y	N
<p>¿Se han tenido en cuenta los conceptos operacionales en este proyecto? (Si/No). (Comentar el plan). / Have operational concepts been taken into account? (Yes/No). (Comments on the plan).</p>	Y	Y	Y	Y	Y	Y ³	N	N ¹⁴	-	Y	Y	N	N	-

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
<p>¿La Oficina dispone de equipamiento y programas para la gestión de la información referida a e-TOD? (Si/No). (En caso de respuesta Si, indicar característica de los equipos y programas). / Does the office have equipment and programmes for information management referred to e-TOD? (Yes/No). (In case answer is Yes, indicate the characteristic of equipment and programmes).</p>	N	N	Y ¹³	Y	Y ⁷	Y ⁴	N	N ¹⁵	Y	N	Y ³	N	Y ⁷	N
<p>¿Se han definido cronogramas y especificaciones para la carga y verificación de los datos referidos al e-TOD? (Si/No). (En caso de respuesta Si, indicar tiempos y formas de la verificación). / Have schedules and specifications been defined for the load and data verification referred to e-TOD? (Yes/No). (In case answer is Yes, indicate times and ways to check).</p>	N ⁷	N	Y ¹⁴	Y	N	Y ⁵	N	N ¹⁶	N	N	N	N	Y ⁸	N

Y = Si / Yes
^{1, 2, ...} = Ver comentarios / See comments
N = No
P = Parcialmente / Partially
N/A = No aplicable / Not applicable
S/R = Sin respuesta / Without answer

COMENTARIOS DE LOS ESTADOS / COMMENTS BY STATES

ESTADOS/ STATES	COMENTARIOS / COMMENTS
ARG	<p>¹ Se dispone de datos de obstáculos que se han incorporado a una base de datos. / Obstacle data available, which has been incorporated in a data base.</p> <p>² El proveedor es el departamento de aeródromos. / Aerodrome Department is the provider.</p> <p>³ Se está evaluando. / Under assessment.</p> <p>⁴ Está en proceso de elaboración. / In process of preparation.</p> <p>⁵ Está en proceso de elaboración. / In process of preparation.</p> <p>⁶ Está en proceso de elaboración. / In process of preparation.</p> <p>⁷ En proceso de realización con el proveedor. / Under process of implementation by the provider.</p> <p>⁸ Carta digital obtenida del ING / Digital chart obtained from ING</p>
BOL	<p>¹ Las elevaciones de los obstáculos están en base a las elevaciones proporcionadas por el Estado Plurinacional de Bolivia. / Obstacles are in base to elevations provided by Plurinational State of Bolivia.</p> <p>² Del Instituto Geográfico Militar/IGM. / From the IGM.</p> <p>³ Las elevaciones del IGM tiene una precisión de 1×10^{-4}. / IGM elevations have a precision of 1×10^{-4}.</p> <p>⁴ No se tiene implantado el Sistema de Gestión de la Calidad. / Quality assurance system is not implemented.</p>
BRA	<p>¹ Brasil tiene un Modelo Digital de Terreno (MDT) para el Área e-TOD 1 (todo el territorio nacional). Para las otras áreas Brasil adoptará Modelo Digital de Superficie (MDS). / Brazil has the Digital Terrain Model (DTM) for the e-TOD Area 1 (all national territory). For the other areas, Brazil will adopt the Digital Surface Model (DSM).</p> <p>² El Modelo Digital de Terreno para el Área 1 e-TOD comprende líneas de contorno y puntos ploteados en 3D obtenidos de las cartas aeronáuticas con una escala de 1:250,000 y cartas topográficas con escalas de 1:100,000 y 1:50,000. Las Cartas Aeronáuticas se producen por el ICA y las cartas topográficas se producen por agencias federales encargadas de la cartografía del territorio nacional. Para áreas del territorio nacional en que no existen los productos mencionados, se usa el Modelo Digital de Terreno derivado del SRTM y disponible libre de cargo por el gobierno de EEUU. El Modelo Digital de Superficie para las otras áreas se encuentra en preparación por parte de ICA (Instituto de la Cartografía Aeronáutica, la agencia brasileña responsable de la preparación de cartas aeronáuticas, publicaciones AIS y e-TOD), y se obtiene por medio de fotografías aéreas. / The Digital Terrain Model for the e-TOD Area 1 comprises contour lines and points plotted in 3D obtained from the aeronautical charts with a scale of 1:250,000 and topographical charts with scales of 1:100,000 and 1:50,000. Aeronautical charts are produced in the Air Force Institute of Cartography (ICA) and topographical charts are produced by federal agencies that have the allocation of mapping the national territory. For areas of national territory where the mentioned products do not exist, it is used the Digital Terrain Model derived from the Shuttle Radar Topography Mission (SRTM) and available free of charge by the U.S. Government. The Digital Surface Model for the other e-TOD areas is being made by ICA (Aeronautical Cartography Institute, the Brazilian agency responsible for the aeronautical charts, AIS publications and e-TOD) through aerophotogrammetry.</p> <p>³ La precisión del Modelo Digital de Terreno para un área particular geográfica dependerá de la información utilizada, de acuerdo a los siguientes valores: / The accurateness of the model digital terrain for a particular geographic area will depend on the input used, according to the following values:</p> <ul style="list-style-type: none"> • Cartas aeronáuticas a escala / aeronautical charts at scale of 1:250,000 = altimetry (± 50 m to 70 m) and planimetry (± 125m to 250 m); • Cartas topográficas a escala / topographical charts at scale of 1:100,000 = altimetry (± 25 m to 37.5 m) and planimetry (± 50m to 100 m); • Cartas topográficas a escala / topographical charts at scale of 1:50,000 = altimetry (± 10 m to 15 m) and planimetry (± 25m to 50 m);

ESTADOS/ STATES	COMENTARIOS / COMMENTS
	<ul style="list-style-type: none"> • SRTM = ±20m en altimetría, pero hay discrepancias en áreas que presentan valores de altitud / SRTM = ±20m in altimetry, but there are discrepancies in areas that present altitude values. Se obtendrá la precisión del Modelo Digital de Superficie con el fin de cumplir con las recomendaciones de la OACI. / The accurateness of the Digital Surface Model will be obtained in order to comply with the recommendations of the ICAO. ⁴ Todos los ítems cumplen con los requerimientos, con la excepción de la precisión vertical y precisión horizontal, cuando el Modelo Digital de Terreno se obtiene por la carta a escala 1:250,000, carta a escala 1:100,000 y por SRTM debido a que dichos datos comprenden valores menos exactos que aquellos definidos en la Tabla A8-1. / All items comply with the requirements with the exception of vertical accuracy and horizontal accuracy, when the Digital Terrain Model is obtained by aeronautical chart at scale of 1:250,000, topographical chart at scale of 1:100,000 and by SRTM because such data comprises values less accurate than those defined in Table A8-1. ⁵ Las series de la norma ISO 19110 todavía serán estudiadas e implantadas. / The series of ISO Standard 19110 will still be studied and implemented. ⁶ Hay una base de datos nacional, pero no se asegura que el 100% de obstáculos de más de 100 metros sean registrados en la base de datos, tal como se requiere en el Anexo 15 para el Área 1 e-TOD, debido a regulaciones recientes que son efectivas desde el 2011 (Orden No.256/GM5). / There is a national database, but it is not assured that 100% of obstacles of more than 100 meters are registered in the database, as required by Annex 15 for the e-TOD Area 1, due to the recent regulations that are effective as of 2011 (order N.256/GM5). ⁷ Los obstáculos se obtienen a través de estudios topográficos llevados a cabo por el ICA o a través de diversas organizaciones nacionales responsables del control regional de los obstáculos y la navegación. / Obstacles are obtained through topographic survey conducted by the Air Force Institute of Cartography (ICA) or through the other organizations that are responsible for the regional control of obstacles and air navigation. ⁸ Las series ISO 19110 aún serán estudiadas e implantadas. / The series of ISO standard 19110 will still be studied and implemented. ⁹ Los datos obtenidos por el ICA cumplen con la Tabla A8-2. Los datos procedentes de fuentes externas sólo se incluirán en la base de datos de obstáculos si cumplen con los requisitos de la Tabla A8-2, debido a la nueva legislación (CIRCEA 53-2), que entró en vigor en 2013. Sin embargo, no es posible garantizar el cumplimiento de estos requisitos para los datos existentes en la base de datos antes de que la legislación citada. / Data from external sources will only be included in the database of obstacles if they comply with the requirements of Table A8-2, due to new legislation (CIRCEA 53-2), which entered into force in 2013. However, it is not possible to ensure compliance with these requirements for existing data in the database before the cited legislation. ¹⁰ El plan de Acción está implantado. / Action Plan implemented. ¹¹ Brasil estableció un manual de especificaciones técnicas que definen el proceso de recolección, procesamiento, distribución y almacenamiento de los datos recogidos por fotogrametría. Sin embargo, se está evaluando la posibilidad de adoptar otros métodos de recolección de datos, así como la adición de mejoras en el proceso que se utiliza en la actualidad, por lo que este manual está en proceso de revisión. / Brazil established a technical specification manual defining the process of collecting, processing, distribution and storage of the data collected through photogrammetry. However, other methods of data collection are being considered, as well as adding improvements to the process that is used today, so this manual is under revision. ¹² Los técnicos que trabajan con la adquisición y tratamiento de datos Aerofotogramétricos tenían formación adecuada, sin embargo, no existe un plan formal para el mantenimiento de la capacitación. El establecimiento de este plan es parte del Proyecto AIM-BR, creado para gestionar la transición del AIS al AIM. / Technicians working with the acquisition and processing of photogrammetric data has proper training, however, there is no formal plan for continuous training. The establishment of this plan is part of AIM-BR Project, created to manage the transition from AIS to AIM. ¹³ El sector responsable de e-TOD está equipado con 4 estaciones de trabajo con ajuste apropiado para la actividad, incluidos los monitores y ratones 3D y almacenamiento de datos de alta capacidad. Los programas más utilizados son ArcGIS, ERDAS LPS y Global Mapper. /

ESTADOS/ STATES	COMENTARIOS / COMMENTS
	<p>The sector responsible for e-TOD is equipped with 4 workstations appropriate for the activity, including monitors and mice 3D and high data storage capacity. The most used programs are ArcGIS, ERDAS LPS and Global Mapper.</p> <p>¹⁴ Se establecieron las especificaciones de carga y verificación de datos e-TOD, formalizado en una guía de instrucciones para los operadores. El cronograma establecido se está revisando, y será parte del plan del proyecto e-TOD (véase la respuesta 10). / Load and e-TOD data verification specifications were established, formalized in an instruction guide for operators. The schedules are being revised, and will be part of the e-TOD project plan (see item 10).</p> <p>¹⁵ Brasil tiene una normativa con relación a la provisión de los datos e informaciones de los proveedores a la sección AIS. La misma contempla todos los puntos observados en los SLA.</p>
CHI	<p>¹ Hay establecido un grupo de trabajo que ha definido un Proyecto de Plan con tareas, plazos, análisis de riesgos y aspectos económicos para la implantación de las Áreas 1, 2, 3 y 4. El citado Proyecto de Plan está en una etapa de evaluación, por lo cual aún no se ha definido un calendario de ejecución. / There is a work group which has defined a Plan Project with tasks, deadlines, risk analysis and economical aspects for the implementation of Areas 1, 2, 3 and 4. The mentioned Plan Project is under assessment, and for this reason an implementation calendar has not been defined yet.</p>
COL	<p>¹ Se dispone de un DTM. / There is a DTM.</p> <p>² Instituto Geográfico Agustín Codazzi. IGAC.</p> <p>³ 30 metros. / 30 mts.</p> <p>⁴ Es producido con estándares IPGH. / Produced with IPGH standards.</p> <p>⁵ Base de datos Programa FEAMAN, GFEAMAN, ARGIS, MICROESTATION / Data Base Programme FEAMAN, GFEAMAN, ARGIS, MICROESTATION.</p> <p>⁶ Diversas fuentes externas / Different external sources</p> <p>⁷ Programas FEAMAN, GFEAMAN, ARGIS, MICROESTATION / Programmes FEAMAN, GFEAMAN, ARGIS, MICROESTATION.</p>
ECU	<p>¹ El Plan de implementación e-TOD – SIG está planificado realizarlos desde el 2014 al 2016. / e-TOD - SIG implementation plan is planned to be carried out starting in 2014 to 2016.</p> <p>² Dentro del proyecto de implantación del SIG y e-TOD, se contempla la capacitación del personal AIM responsable del mismo. / Training of AIM personnel responsible for the SIG and e-TOD Project is contemplated within its implementation.</p> <p>³ El plan contempla los nuevos requisitos que emanan del concepto operacional de ATM mundial; los servicios de información aeronáutica deben integrarse en un concepto más amplio de gestión de la Información Aeronáutica centrada en los datos y también se tiene en cuenta lo establecido en la Hoja de Ruta de transición del AIS al AIM de Ecuador. / The plan contemplates new requirements which emanate from the global ATM operational concept; the aeronautical information services must be integrated within an ample concept of aeronautical information management centered in data and also what is established in the Roadmap for transition from AIS to AIM of Ecuador.</p> <p>⁴ Personal AIS/MAP con experiencia y conocimientos básicos de GIS. / AIS/MAP personnel with experience and basic knowledge of GIS. Software Microstation 95, ArcGIS 9 (En proceso de compra de licencias). / Microstation 95, ArcGIS 9 software (under process of licenses acquisition).</p> <p>⁵ El cronograma estará basado en tiempo establecido para el desarrollo del proyecto, seguimiento a través de Indicadores de cumplimiento de cada etapa./The Schedule is based in time established for the development of the project, follow-up through indicators of compliance in each stage.</p>
GUY	<p>Estamos en el proceso de entrenar al personal para establecer una dependencia MAP para el AIS. / We are in the process of of training personnel to establish a MAP unit for the AIS.</p>

ESTADOS/ STATES	COMENTARIOS / COMMENTS
FGU	<p>¹ Modelo Terreno Digital (DTM). / Digital Terrain Model (DTM).</p> <p>² Organización externa: Institut Geographique National (the French National Geodetic and Mapping Agency) – ver AIC A 2008_31 (https://www.sia.aviation-civile.gouv.fr/dossier%5Caicfrancea%5CAIC_A_2008_31_EN.pdf). Las condiciones para adquirir estos datos (licencias) se encuentran en el catálogo IGN. / External organization: Institut Geographique National (the French National Geodetic and Mapping Agency) – see AIC A 2008_31 (https://www.sia.aviation-civile.gouv.fr/dossier%5Caicfrancea%5CAIC_A_2008_31_EN.pdf). The conditions relating to acquisition of these datasets (licensing) are provided in the IGN catalogue.</p> <p>³ El producto IGN BD ALTI® es una descripción de referencia terrestre del territorio Francés. Los Modelos DTM (Modelos Terrestres Digital) y contornos describiendo el terreno a diferentes escalas (de 1:50 000 a 1:1 000 000) se derivan del BD ALTI®. El BD ALTI® consiste en archivos de vector estructurados del escaneo de contornos del terreno francés. El intervalo de contorno puede variar de 5 a 40 m. Los datos se ingresan en mapas IGN a 1:25 000 a 1:50 000 y de fotografías adicionales a 1:20 000; 1:30.000 y 1:60 000. / IGN BD ALTI® product is a terrain reference description of French territory. DTM (Digital Terrain Models) and contours describing the terrain at different scales (from 1:50 000 to 1:1 000 000) are derived from the BD ALTI®. The BD ALTI® consists of structured vector files from scanning all the contours of French terrain. The contour interval can range from 5 to 40 m. Data is entered on IGN maps at 1:25 000 at 1:50 000 and from additional aerial photographs at 1:20 000; 1:30.000 and 1:60 000.</p> <p>⁴ Excepto en áreas escarpadas donde el IGN-F recolecta datos adicionales para mejorar la precisión. / Except in very steep areas where IGN-F is collecting additional data to improve accuracy.</p> <p>⁵ Los metadatos se pueden obtener gratuitamente en el website de IGN-F, en francés. / Metadata is provided free on IGN-F website, in French.</p> <p>⁶ La recolección y evaluación de los datos existentes está en proceso. Nuevos estudios se realizan cada año (por ejemplo en Guyana Francesa en 2011 y en el Caribe en 2012). / Gathering and assessments of existing data are on-going. New surveys are scheduled every year (e.g. in French Guiana in 2011 and the Caribbean in 2012).</p> <p>Obstrucciones aisladas artificiales aparecen en el AIP francés. / Artificial Isolated Obstructions are listed in French AIP; (see / ver: https://www.sia.aviation-civile.gouv.fr/aip/enligne/uk/..%5CPDF_AIPparSSection%5CAIP%20FRANCE%5CENR%5C5%5C1201_ENR--5.4.pdf).</p> <p>⁷ De nuestra organización con apoyo de IGN-F. / From our organization with IGN-F support.</p> <p>⁸ En proceso, con apoyo de IGN-F. / On-going with IGN-F support.</p> <p>⁹ La evaluación de datos existentes está en proceso, con apoyo de IGN-F. Los datos nuevos serán compatibles de conformidad con los acuerdos de nivel servicios (SLA) con los proveedores de datos. / Assessments of existing data are on going with IGN-F support. New data will be compliant according to service level agreements (SLA) with data providers.</p> <p>¹⁰ En proceso, con apoyo de IGN-F. / On-going with IGN-F support.</p> <p>¹¹ EUROCONTROL está escribiendo un Manual de Datos de Obstáculos del Terreno, un material de guía de datos de obstáculo en el terreno, de acuerdo al Anexo 15 de la OACI. La primera edición del Manual de Datos de Obstáculos del Terreno ha sido evaluado por un Estudio de Pilotos Suizo-Francés para poner el e-TOD en práctica. / EUROCONTROL (European organisation for the safety of air navigation) is writing a “Terrain and Obstacle Data Manual”, a guidance material on the provision of Terrain and Obstacle Data (TOD) in accordance with ICAO Annex 15. First release of “Terrain and Obstacle Data Manual” has been evaluated through a Swiss-French Pilot Study in view of putting eTOD into practice.</p> <p>¹² En proceso. / On-going.</p> <p>¹³ El entrenamiento en todas las ediciones geodéticas y de cartas. / The training is global on all the geodetic and charting issues.</p> <p>¹⁴ En proceso. / On-going.</p> <p>¹⁵ Varios Sistemas de Información Geográfica (GIS) como ESRI ArcGIS. / Various Geographic Information Systems (GIS) such as ESRI ArcGIS.</p> <p>¹⁶ En proceso. / On-going.</p>

ESTADOS/ STATES	COMENTARIOS / COMMENTS
PAN	<p>¹ Sólo se dispone de algunos obstáculos dentro del territorio nacional, sin embargo el Instituto Geográfico Nacional Tommy Guardia, desarrolló un proyecto de levantamiento en todo el territorio nacional, llevando un avance del 90%, por lo que culminando este proyecto estaremos en capacidad de contar con los datos del terreno área 1, de acuerdo a convenio de cooperación que existe entre las dos instituciones del estado. / There are only some obstacles within the territory, however, the National Geographic Instituto Tommy Guardia developed a surveying project in the entire national territory, with 90% increase, therefore, when completing this project Panama will be able to have área 1 terrain data, in accordance with the cooperation agreement between the two State entities.</p> <p>² Panamá obtuvo el software de base de datos AIXM junto con el ArcGis para la confección de las cartas electrónicas de acuerdo con una inversión que realizó el estado para el mejoramiento de los Servicios de Navegación Aérea. / Panama obtained the AIXM database software with ArGis for the preparation of electronic charts with an investment of the State for the improvement of Air Navigatio Services.</p> <p>³ Los obstáculos en el área de los aeródromos se tienen parcialmente en cada aeródromo, sin embargo se hacen las coordinaciones para el levantamiento de nuevos obstáculos construidos en las inmediaciones de los aeródromos. Tocumen, S.A. junto con AAC harán los esfuerzos para el levantamiento de los obstáculos para los aeródromos dentro del área terminal. / Obstacles in the aerodromes área are partially in each aerodrome, however coordinations are being made for the surveying of new obstacles built in the aerodromes surroundings. Tocumen S.A. with the CAA will make efforts for obstacle surveying for the aerodromes within the terminal area.</p> <p>⁴ Panamá dispone de un Programa de Capacitación anual en donde están incluidoS todos los aspectos relacionados a cursos y seminarios e-TOD. / Panama has an annual Training Programme where all the issues related to e-TOD courses and seminars are included</p>
PER	<p>¹ Sólo se dispone de información gráfica aislada de obstáculos de algunos aeródromos y que aparecen en algunas cartas aeronáuticas, no se encuentra en una base de datos. / Only isolated obstacle graphical information available of some aerodromes and shown in some aeronautical charts, not found in a data base.</p> <p>² De levantamientos topográficos realizados por la propia organización. / Topographical surveying by same organization.</p> <p>³ Se cuenta con equipos de medición GPS R8 diferencial y estación total TOPOCON 7500, 02 estaciones de trabajo HP Z800, software de diseño CAD. / GPS R8 differential measuring equipment available and total station TOPOCON 7500, 02 workstations HP Z800, CAD design software.</p> <p>⁴ Carta digital obtenida del ING. / Digital chart obtained from ING.</p>
URU	<p>¹ En proceso. / On-going.</p> <p>² En proceso. De la propia Organización y externa. IGM – Instituto Geográfico Militar. / On-going. From the organisation and outsided source. IGM.</p> <p>³ En proceso. / On-going.</p> <p>⁴ 2011 - 2015</p> <p>⁵ En proceso. / On-going.</p> <p>⁶ En proceso. / On-going.</p> <p>⁷ Sistema de Información Geográfica ARC-GIS ESRI. / Geographical Information System ARC-GIS ESRI.</p> <p>⁸ 2011 – 2015.</p>

ESTADOS/ STATES	COMENTARIOS / COMMENTS
VEN	<p>*¹ De organización externa. / Outside sources. Souttle Radar Topography Mission-National Geospatial Intelligence Agency (NGA) y/and National Aeronautics and Space Administration (NASA). *² 90 metros. / 90 mts. *³ 90 metros. / 90 mts. *⁴ Se tiene archivos de trabajos geodésicos para los Aeropuertos Internacionales de Venezuela, donde hay obstáculos en el alrededor y aprox del aeropuerto. / There are geodetic work files for International Airports in Venezuela, where there are obstacles around and approx to the airport. ⁵ Los archivos mencionados anteriormente se obtuvieron por trabajos de la propia organización. / The files previously mentioned were obtained by works of the same organisation. El Servicio AIS de Venezuela a fines de 2013 adquirió un GIS que está en Fase 1 de ejecución (completar Base de datos estructurados y no estructurados) para generar un AIP electrónico. En la Fase 2 se adquirirá el Módulo e-TOD para gestionar la base de datos e-TOD de Obstáculos y Terreno que afectan las Áreas 1, 2 y 3 de los aeropuertos internacionales y espacios aéreos adyacentes en Venezuela. / By end 2013 AIS Service in Venezuela acquired a GIS which is in execution phase 1 (complete structured and no structured database) to generate electronic AIP. In phase 2 e-TOD module will be acquired to manage e-TOD Obstacle and Terrain database affecting Areas 1, 2 and 3 of international airports and adjacent airspace in Venezuela.</p>

APPENDIX B

SAM Region	PROJECT DESCRIPTION (DP)	DP N° G1	
<i>Programme</i>	Title of the Project	Start	End
<p><i>AIM</i></p> <p>(ICAO Programme Coordinator: Jorge Armoa)</p>	<p>Implementation of the provision of electronic terrain and obstacle data (e-TOD) (SAM)</p> <p>Project coordinator: Juan González (Uruguay)</p> <p>Experts contributing to the project: SAM/AIM IG</p>	<p>26/09/11</p>	<p>31/12/17</p>
<p>Objective</p>	<p>Support the implementation of the provision of e-TOD by SAM States, and provide guidance to States on GIS acquisition and management.</p>		
<p>Scope</p>	<p>The scope of the project contemplates the assessment and identification of implementation levels associated to the provision of electronic terrain and obstacle data. It contemplates the drafting of an Action plan and guides for the implementation of e-TOD to support developments in the provision of electronic terrain and obstacle data for the evolution of digital terrain models (DTM) to gradually improve electronic aeronautical charts and other similar products, with the support of tools such as the geographical information systems (GIS).</p>		
<p>Metrics</p>	<ul style="list-style-type: none"> • Number of States that have implemented GIS or automated systems. • Guide-document with action plan approved. • Number of States that establish SLAs. • Main Airports with Area 2 (eTOD) Surveyed 		
<p>Strategy</p>	<p>The conduction of project activities will be coordinated among project members, the project coordinator, and the programme coordinator, mainly through teleconferences (GoToMeeting application) and meetings that may be held within other scheduled events, based on the activities of the work programme. The project coordinator will coordinate with the programme coordinator for the inclusion of additional experts, if warranted by the tasks and works to be executed.</p> <p>The results of the work done will be submitted to the consideration and review of State experts in the form of a final consolidated document for analysis, review, and approval, and for presentation to the GREPECAS PPRC by the programme coordinator.</p>		

Goals	Draft the Guide-document containing the objectives of the e-TOD project. 2012. Define the technical and e-TOD project specifications. 2012. Prepare the document containing the e-TOD technical specifications. 2012. Guide on the acquisition of a geographical information system (GIS). 2012. GIS implementation Manual. 2012. Available Methodology and tools for surveying Area 2. 2013 Main International Airports with Area 2 surveyed. 2017
Rationale	Compliance with the SARPs of Annexes 15 and 4 to facilitate the execution of performance-based air operations and to advance with the AIS-AIM Transition Roadmap. A close relationship with other projects is needed in order to obtain the operational requirements of the aforementioned applications and their respective tentative dates of implementation.
Related projects	This project is related to Project G3 “Implementation of the Quality Management System in the AIM units” in the CAR/SAM States.

Project deliverables	Relationship with the performance-based regional plan (PFF)	Responsible party	Status of implementation*	Delivery date	Comments
Survey on the status of eTOD implementation.	PFF: SAM AIM/02	Juan González Uruguay		30/11/2011	Finalised on schedule.
Generate follow-up report.	PFF: SAM AIM/02	Juan González Uruguay		30/04/2012	Finalised on schedule.
Develop Guide-Documents with the objectives of the eTOD project.	PFF: SAM AIM/02	Juan González Uruguay		30/09/2012	Finalised on schedule. Delivered 30/09/2012
Define the technical specification of the eTOD project.	PFF: SAM AIM/02	Juan González Uruguay		30/09/2012	Finalised on schedule. Delivered 30/09/2012
Develop the document with the eTOD technical specifications.	PFF: SAM AIM/02	Juan González Uruguay		30/09/2012	Finalised on schedule. Delivered 30/09/2012

Guide for the acquisition of a geographical information system (GIS).	PFF: SAM AIM/01	Juan González Uruguay		09/03/2012	Finalised on schedule.
GIS implementation manual.	PFF: SAM AIM/01	Juan González Uruguay		09/03/2012	Finalised on schedule.
Present to States the different options available for surveying Area 2	ASBU:BO30 DATM	ICAO Coordinator		26/07/2013	Finalised on schedule.
Guide to develop a Digital Terrain Model (DTM) or a Digital Elevation Model (DEM)	PFF: SAM AIM/02 ASBU:BO30 DATM	Ad Hoc Group SAM/AIM/7 Meeting		30/03/2015	Finalised on schedule
Complete 50% States with DTM and/or DEM implementation before SAM/AIM/7 Meeting	PFF: SAM AIM/02 ASBU:BO30 DATM	States		12/11/2016	49% finalised on schedule.
Availability of programmes to manage e-TOD information	PFF: SAM AIM/02 ASBU:BO30 DATM	States		12/11/2016	49% States finalised on schedule.
Action Plan for electronic terrain data in Area 2	PFF: SAM AIM/02 ASBU:BO30 DATM	States		12/11/2017	49% States finalised on schedule.
Action Plan for electronic obstacle data in Area 2	PFF: SAM AIM/02 ASBU:BO30 DATM	States		12/11/2017	42% States finalised on schedule.
Resources required	Designation of experts in the execution of some of the deliverables. More commitment by States to support the designated Coordinators and experts.				

*Grey

Task not started

Green

Activity underway as scheduled

Yellow

Activity started with some delay but expected to be completed on time

Red

It has not been possible to implement this activity as scheduled; mitigating measures are required

Agenda Item 2: Implementation of Aeronautical Information and Aeronautical Data Exchange Systems

2.1 Under this agenda item, the Meeting reviewed the following paper:

- WP/05 - *GREPECAS Project G2* (Presented by the Secretariat)
- WP/06 - *Implementation of SWIM* (Presented by the Secretariat)

GREPECAS Project G2

2.2 The Coordinator of *Project G2 - "Implementation of Aeronautical Information Exchange Systems (AIXM)"*, in coordination with the Secretariat, presented several activities, which were reviewed by the Meeting. The activities are presented in **Appendix A** to this part of the report. The Meeting deemed it important to update the dates of the activities and change their status. These changes are reflected in Appendix A.

2.3 The Secretariat reminded the Meeting that the four EUROCONTROL documents selected as a starting base to analyse the operation of AIXM systems--the *Temporality Model (Appendix B)*, *AIXM Conceptual Model (Appendix C)*, *AIXM Application Schema Generation (Appendix D)* and *Feature Identification and Reference (Appendix E)*--had been circulated at the SAM/AIM/8 meeting to gather comments and suggestions from the States in order to prepare the final document for the AIXM Implementation Guide.

2.4 The Meeting felt that, although there was software available in the market that offered all the technical features described in the document, it was important to have this document available to assist in the drafting of the technical specifications of the software to be required and to be aware of the technical aspects related to information technology.

2.5 The Project Coordinator explained the technical contents of the document and emphasized the need for IT experts to work together with AIS/AIM experts in AIXM implementation, in order to supplement their knowledge and the systems to be used.

2.6 The Meeting approved the aforementioned documents. Consequently, the Project Coordinator will have to prepare the final document based on them.

2.7 Furthermore, the Meeting agreed to conduct AIXM tests between Argentina and Panama on 30 March 2017, and between Brazil and Peru on 27 April 2017.

Implementation of SWIM

2.8 The Meeting took note of the implementation of the future aviation Intranet called "SWIM". The Secretariat informed that the implementation of system-wide information management (SWIM) was necessary because the existing information exchange model prevented prospective implementation of future operational performance improvements.

2.9 The Meeting was informed that implementation required a multidisciplinary approach involving several ATM areas, a communication infrastructure and information technology. It was recognized that it consisted of standards, infrastructure, and governance for managing information

concerning air traffic management and the exchange of data and information between authorised individuals through interoperable services.

2.10 The Meeting noted that, in addition to communication and IT infrastructure, the States should consider implementing standard information exchange models (AIXM, WXXM, FIXM, AIDX) to facilitate SWIM implementation.

2.11 The Secretariat reminded the States that they should be aware that the implementation of ASBU Block 1, which included SWIM, started in 2018.

APPENDIX A

SAM Region	PROJECT DESCRIPTION (DP)	DP N° G2	
<i>Programme</i>	Title of the Project	Start	End
<i>AIM</i> (ICAO Programme Coordinator: Jorge Armoa Cañete)	G2: Implementation of Aeronautical Information Exchange Systems (AIXM) (SAM) Project coordinator: Eng. Karina Calderón Experts contributing to the project: SAM/AIM/IG	01/03/12	01/12/17
Objective	Prepare an action plan to be implemented by States for the application of the aeronautical information/data exchange model.		
Scope	The scope of the project contemplates the evaluation and identification of automation levels associated to the integration of the aeronautical information and data exchange model in the Region, through surveys, the identification of database providers, and the follow-up on the development of SARPs on this matter.		
Metrics	Number of States that have implemented an Action Plan for data exchange systems.		
Goals	Complete all the documentation needed by States before 31/12/16.		

Strategy	Project activities will be coordinated among project members, the Project Coordinator, and the Programme Coordinator, mainly through teleconferences (GoToMeeting application). Seminars/meetings are scheduled in accordance with work programme activities. The Project Coordinator will coordinate with the Programme Coordinator for the inclusion of additional experts, if warranted by the tasks and work to be performed. Coordination will take place between the CAR and SAM Regions. The results of the work done will be submitted to the consideration and review of State experts in the form of a final consolidated document for analysis, review, and approval, and for presentation to the GREPECAS PPRC by the Programme Coordinator.				
Rationale	Integrate aeronautical information so as to permit the interoperability of ATM systems while preserving safety, applying the information exchange models.				
Related projects	This project is related to Project G3 “ <i>Implementation of the Quality Management Systems in the AIM units in SAM States</i> ”.				
Project deliverables	Relationship with the performance-based regional plan (PFF)	Responsible party	*Status of Implementation	Delivery date	Comments
Survey of the provision of IAIP, using a table.	D-ATM	ICAO coordinator		16/03/12	Finalised on schedule at the SAM/AIM meeting.
Circulation of IAIP survey to States	D-ATM	ICAO coordinator		16/03/12	Finalised on schedule at the SAM/AIM meeting.
Collection and updating	D-ATM	ICAO coordinator		16/03/12	Finalised on schedule at the SAM/AIM meeting.
Collection of experiences in SAM States with the electronic AIP	D-ATM	ICAO coordinator		16/03/12	Finalised on schedule at the SAM/AIM meeting.

Develop AIXM action plan	D-ATM	ICAO coordinator		24/04/15	Finalised on schedule.
AIXM documentation collection	D-ATM	ICAO coordinator		22/05/15	Finalised on schedule.
AIXM documentation translation	D-ATM	ICAO		10/07/15	Finalised on schedule.
AIXM documentation revision	D-ATM	ICAO coordinator		21/08/15	Finalised on schedule.
Documentation validation	D-ATM	ICAO coordinator		30/11/16	
Develop document describing AIXM tests steps	D-ATM	ICAO coordinator		28/02/17	
AIXM tests	D-ATM	ICAO coordinator		30/03/17 and 27/04/17	
Transmission and reception of tests results data	D-ATM	ICAO coordinator		31/05/17	
AIXM seminar	D-ATM	ICAO coordinator		02/10/15	Finalised on schedule.
AIXM management concept guidance material	D-ATM	ICAO coordinator		27/12/16	
Resources required	Designation of experts in the execution of some of the deliverables. Commitment by States to support the coordinators and experts.				

**Grey Task not started.*

Green Activity underway as scheduled.

Yellow Activity started with some delay but would be completed as scheduled.

Red This activity has not been implemented as scheduled and mitigation measures are required.

APPENDIX B

AIXM 5

TEMPORALITY MODEL

AIXM 5

Temporality Model

Aeronautical Information Exchange Model (AIXM)

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Part Edition No.	Part Edition	Part Issue Date	Part Author	Reason for Change
0.1	Draft	24 APR 2007	Design Team	Initial Draft
0.2	Draft	04 JUN 2007	Design Team	Updated after discussions in St. Louis and Frankfurt.
0.3	Draft	10 JUN 2007	Design Team	Updated after comments from AIXM FG #8 Meeting and from Edna.
0.4	Proposed	15 JUL 2007	Design Team	Removed "Static" Time Slices from the model. Re-organised the presentation of the different kinds of Time Slices.
0.5	Proposed	12 NOV 2007	Design Team	Clean-up for first public version.
0.6	Proposed	01 FEB 2010	Design Team	Describe PropertiesWithSchedule concept introduced in AIXM 5.1 (see chapter 2.8) Include UML diagrams from AIXM 5.1 model
1.0	Released	15 SEP 2010	Design Team	Released version, to be used as baseline for AIXM 5.1 implementations.

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1. The need for a temporality model

Time is an essential aspect on the aeronautical information world, where change notifications are usually made well in advance of their effective dates. Aeronautical information systems are usually requested to store and to provide both the current situation and the future changes. The expired information needs to be archived for legal investigation purposes.

For operational¹ reasons, a distinction is usually made between:

- **permanent changes** (the effect of which will last until the next permanent change or until the end of the lifetime of the feature) and
- **temporary status** (changes of a limited duration that are considered to be overlaid on the permanent state of the feature).

A temporary change includes the concepts of overlay and reversion. The temporary change is overlaid on the permanent feature state. When the temporary change ends, the temporary changes no longer apply and we revert back to the permanent feature state.

Note that, from an operational point of view, “temporary status” also includes the concept of “temporary features”. However, from the AIXM point of view, temporary features are in no way different from normal features. The feature is created and withdrawn, just that the life span is shorter than usual.

In order to satisfy the temporal requirements of aeronautical information systems, AIXM must include an exhaustive temporality model, which enables a precise representation of the states and events of aeronautical features. In particular, this shall enable the development and the implementation of **digital NOTAM**. By digital NOTAM we mean replacing the free text contained in a NOTAM message with structured facts, which enable the automated processing of the information.

A general temporal model should be uniformly applied to all aeronautical feature types and the temporality concept should be abstracted from the task of modeling object properties. At the conceptual level, the model should describe the temporal evolution of the features, as they occur in the real world. This shall be done in compliance with the following rules:

- Completeness - all temporal states must be representable;
- Minimalism - use of minimal number of elements;
- Consistency - no reuse of elements with different meaning;
- Context-free - meaning of (atomic) elements independent of context; no functional dependency of (atomic) elements at the data encoding level;

The data exchange specification shall support the conceptual model. In addition, convenience elements (“views”) may be introduced in the data exchange specification in order to facilitate the operations. This means that the data exchange specification may deviate from the “minimalism” rule.

¹ For example, systems that produce printed aeronautical documentation (AIP, charts) tend to ignore temporary status information; only the static data is represented on such printed products.

2. Building the Temporality Model

In order to explain the AIXM Temporality Model, this chapter follows a step-by-step approach, in which the elements that compose this model are added progressively in order to satisfy the operational needs.

2.1 (step 1) Time varying properties

There are two levels at which aeronautical feature instances are affected by time:

- Every feature has a start of life and an end of life;
- The properties of a feature can change within the lifetime of the feature; this includes the possibility for a property to not be defined over a time period.

The start of life and the end of life may also be considered as feature properties (attributes). This gives the following high-level list of properties for any AIXM feature:

- a global unique identifier;
- the start of life (date and time);
- the end of life (date and time);
- attributes and associations that qualify, quantify or relate in some form that feature.

It is considered that any feature property may change in time, except for the global unique identifier. This is a key assumption of the AIXM Temporality model.

The first step in the construction of the AIXM temporality model is represented by the diagram below, which shows the values of a feature's properties (P1, P2, ... P5) along a timeline.

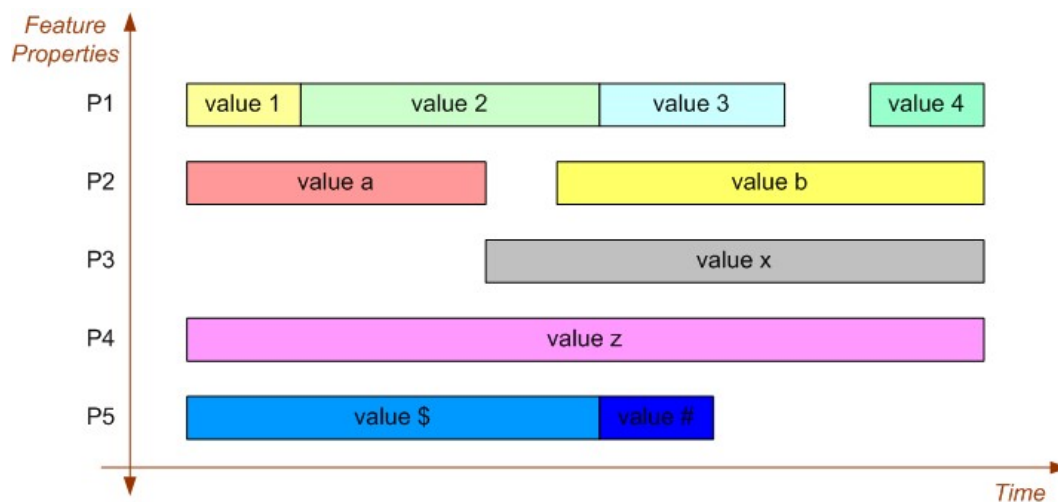


Figure 1 – Time varying properties

Discussion: *Can the start of life and the end of life properties of a feature vary in time?*

At first sight, probably not. A feature is created at a moment in time and will cease to exist at another moment in time. But this is true only when considering the already known history of a feature. When exchanging data about the future, there might be situations where the start/end of life is planned to happen at a certain date/time and this date might change.

Therefore, we have to include the start/end of life of a feature in the time varying properties list.

2.2 (step 2) The Time Slice model

The temporality model adopted² by AIXM describes feature events and states. An event is a change of one or more feature properties. A state is the feature property set valid over a time period. An event occurs at the transition between states. In the diagram below events are located at the vertical cuts while states are represented as the feature property set between events.

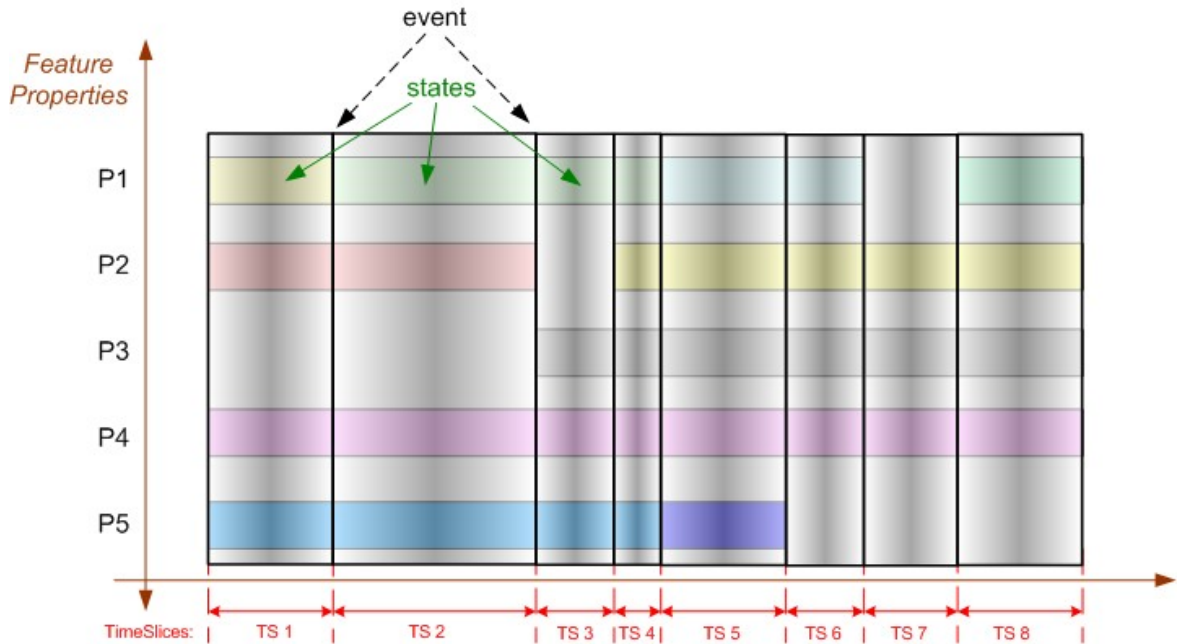


Figure 2 – Events and States

In order to describe the feature properties during states and events, the time varying properties of every feature are encapsulated in a container called “Time Slice”. The history of the feature is described with “state” Time Slices, each containing the values of the time varying properties between two consecutive changes (events). Each Time Slice has maximum one value for each property and one specified validity period. In an UML diagram, the basic Time Slice concept is represented as below:

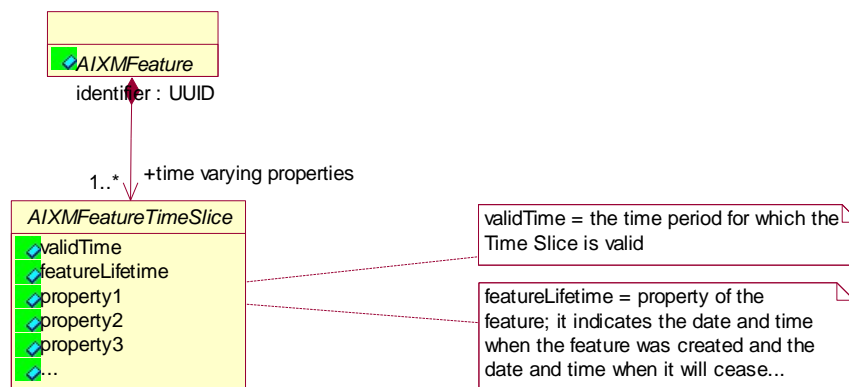


Figure 3 – AIXMFeatureTimeSlice

² The AIXM Time Slice model is based on the ISO 19136 (GML) timeslice concept.

Discussion: Why not a validity period for each property?

Instead of grouping property values in Time Slices, another approach could be a temporal model where every property gets its own validity period.

The first argument against this approach is that, in general, the properties of a feature do not change independently from each other. There exist operational constraints that link the values of some properties with the values of other properties. Therefore, several properties would have anyhow to be grouped together, with a common validity period.

The second reason is that changes in the aeronautical world are regulated by the AIRAC cycle. This imposes that significant operational changes occur at predefined dates, in order to ensure the predictability of the aeronautical environment and to allow time for the users to accommodate with the changes. In general, aeronautical features have stable property values between AIRAC cycle dates. Therefore, grouping together the properties in Time Slice with a unique validity period is a simplified temporal model, which supports well the operational requirements.

2.3 (step 3) Temporary events – digital NOTAM

Aeronautical features may be affected by temporary events, such as a navaid being out of service, a runway being closed, a restricted area becoming active, etc. All such events generate temporary changes in the values of one or more feature properties. At the end of the temporary event, the values of these properties are reversed to their static values.

In order to model temporary events, we need to specialise the basic temporality model defined at step 2 by differentiating between two kinds of Time Slices:

- **Baseline** = a kind of Time Slice that describes the feature state (the set of all feature's properties) as result of a permanent change.
- **Temporary** = a kind of Time Slice that describes the transitory overlay of a feature state during a temporary event.

From a “payload” point of view, there exists an essential difference between Baseline and Temporary Time Slices:

- A Baseline Time Slice includes the values of all time varying feature properties that are defined for the time of validity of the Time Slice; for example, in the diagram below, TS2 will include the values of p1, p2, p4 and p5;
- A Temporary Time Slice includes just the values of the properties that are temporarily changed; for example, in the diagram below, TS “temp” will include just p4=“value w”. For this reason, temporary Time Slices are called “Temporary Delta” Time Slices.

Note: a temporary change could also consist in a feature property becoming temporarily undefined (no value). For this purpose, feature properties can also get a ‘nil’ value.

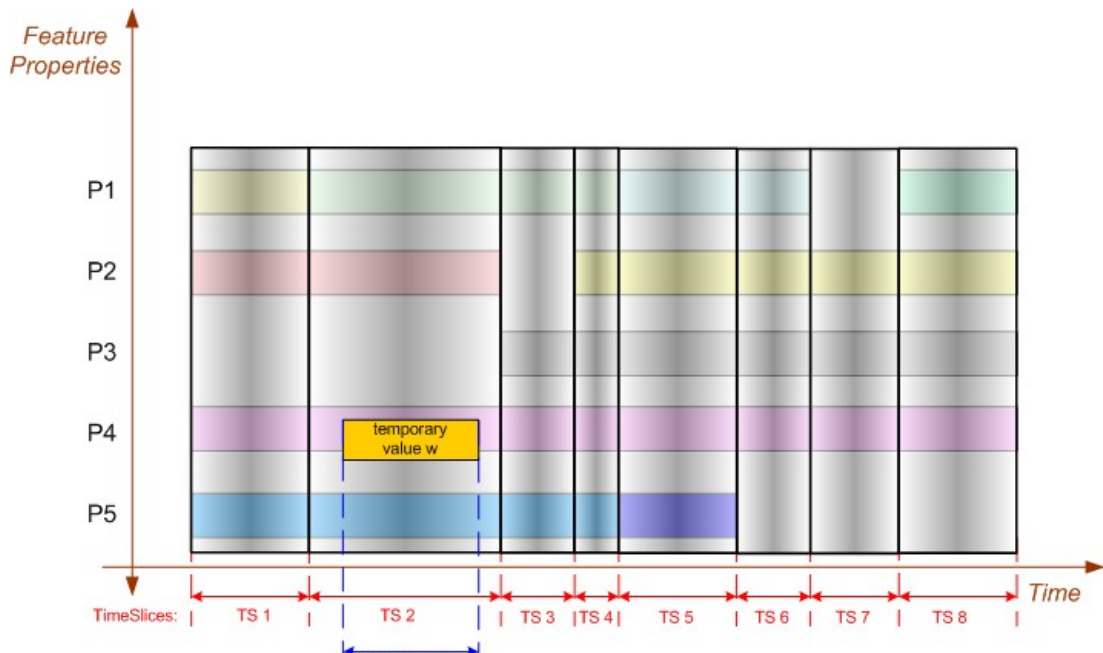


Figure 4 - BASELINE and TEMPDELTA TimeSlices

One reason for temporary Time Slices to contain strictly the modified properties is to avoid confusions that could result from overlapping temporary events. When several temporary delta overlap in time, complicated rules would be necessary in order to decide which values to include for not affected properties. Should the values of the baseline Time Slice be included? Or should the other temporary changes be considered? Therefore, the model is clearer if only the affected properties are included in Temporary Delta Time Slices.

With regard to the UML model, as the Temporary Delta Time Slices need to be distinguished from the baseline ones, an additional attribute is necessary in the AIXMFeatureTimeSlice class. This is named “interpretation” and indicates the type of Time Slice - BASELINE or TEMPDELTA, as shown in the figure below.

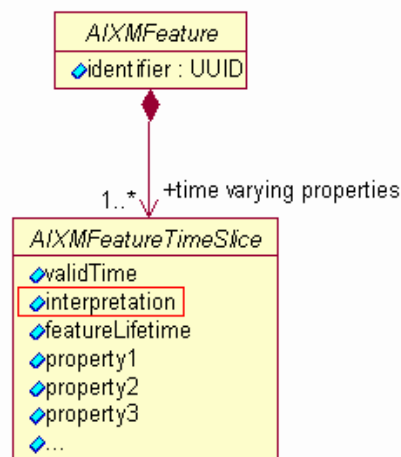


Figure 5 – FeatureTimeSlice with “interpretation” property

The essential benefit brought by TEMPDELTA Time Slices is that they enable the encoding of “digital NOTAM”. A TEMPDELTA Time Slice will contain the values of all feature properties that are overlaying for a limited time period the baseline values.

Discussion: Why not considering the temporary change as a sequence of two permanent changes?

Using a Time Slice model with BASELINEs only, the interval TS2 would have to be split into 3 new Time Slices, for example TS2a, TS2b and TS2c. In this approach, the temporary situation would be modeled as a sequence of two permanent changes. The disadvantage of this solution is that the information about the temporary nature of the value “w” would be lost. There exist aeronautical applications, such as charting and AIP production, which normally ignore the temporary changes. Such applications need to know if a value is temporary or part of the baseline.

Also, temporary events, such as the activation of a restricted area, have a life of their own: first the activation is requested, than planned for a time interval maybe different from what was requested, than active for maybe a shorter time than planned, etc. In order to correctly model the life of temporary events, they need to be modeled as such and not hidden behind fictitious permanent changes.

2.4 (step 4) Current Status - SNAPSHOT Time Slices

The temporality model described up to this point complies with the rules for completeness, minimalism, consistency and context-free mentioned at the end of section 1. Using BASELINE and TEMPDELTA Time Slices it is possible to describe the temporal evolution of the time varying properties of aeronautical features, covering both permanent states and temporary events.

However, the model is slightly inconvenient for a real life implementation, because it lacks the possibility to communicate the current status of a feature, which results when merging the baseline data with any temporary data that is effective at that moment in time. For convenience, we need an additional kind of Time Slice to be included in the model. This will be named “SNAPSHOT” and will carry the result of merging the effective BASELINE information with all overlaying TEMPDELTA that are effective at a that moment in time. Typically, a SNAPSHOT Time Slice will have a Time Instant as validTime.

- SNAPSHOT = A kind of Time Slice that describes the state of a feature at a time instant, as result of combining the actual BASELINE Time Slice effective at that time instant with all TEMPDELTA Time Slices that are effective at that time instant.

Note that for a SNAPSHOT, the correctionNumber and the sequenceNumber properties shall not be populated.

2.5 (step 5) Data exchange – need for PERMDELTA Time Slices

Another kind of Time Slice that will be introduced for convenience is in support to systems that need to notify the clients about data updates. There exist two types of applications:

1. “Pull” Systems - provide an interface by which a client can query the aeronautical information and extract the results of the query;
2. “Push” Systems - generate and transmit to the client notifications about aeronautical information changes.

For “push” systems, it is difficult to use only these three kinds of Time Slice for communicating (generating and transmitting) information about the future. For example, how to communicate information about the end of life (decommissioning) of a feature?

Using BASELINE Time Slices for this purpose would require communicating an ‘update’ of at least the last sent Time Slice, with an updated value of the ‘endOfLife’ property (encoded as featureLifetime/endPosition). This would also require interpretation rules such as “if the endOfLife

is equal with the end of validity of the Time Slice, then this means that the feature is permanently withdrawn”. The postponement of a withdrawn, which is operationally possible, would require a second update of the endOfLife, which might become complicated to interpret.

A more convenient solution is to include in the temporality model a Time Slice that represents permanent change events. This will be called Permanent Delta (PERMDELTA).

- PERMDELTA = A kind of Time Slice that describes the difference in a feature state as result of a permanent change.

The end of life can now be communicated with a PERMDELTA Time Slice in which the featureLifetime/endPosition gets a value.,. Symmetrically, the start of life can also be communicated with a PERMDELTA Time Slice, in which the featureLifetime/startPosition property and the other feature properties get their initial values. Being modeled as formal events, the start of life and the end of life can relatively simply be postponed or advanced (this requires a mechanism for updating an ‘event’ Time Slice, which will be discussed later in this paper).

A second advantage of PERMDELTA Time Slices is that client systems no longer need to compare the previously received BASELINE Time Slice with the new one in order to detect the changed attributes. This process may be time consuming and even error prone. The data originator is the best positioned to know the list of changed properties and the PERMDELTA Time Slice gives the possibility to communicate this information to interested clients. This facilitates the implementation of systems that are not interested in changes of certain feature properties. For example, charting applications - a PERMDELTA affecting properties that do not appear on the chart will easily be ignored.

From a conceptual point of view, a PERMDELTA Time Slice occurs at the edge between any two consecutive BASELINE Time Slices and it contains values strictly for the changed properties.

All these kinds of Time Slices are described in Figure 6.

Conceptually, there exists a direct dependence between PERMDELTA and BASELINE Time Slices. However, this does not mean that the BASELINE Time Slice needs to be effectively instantiated after each PERMDELTA. In an implementation, it is possible, for example, to “accumulate” PERMDELTA Time Slices. The instantiation of a new BASELINE might occur, for example, after each third PERMDELTA affecting a feature.

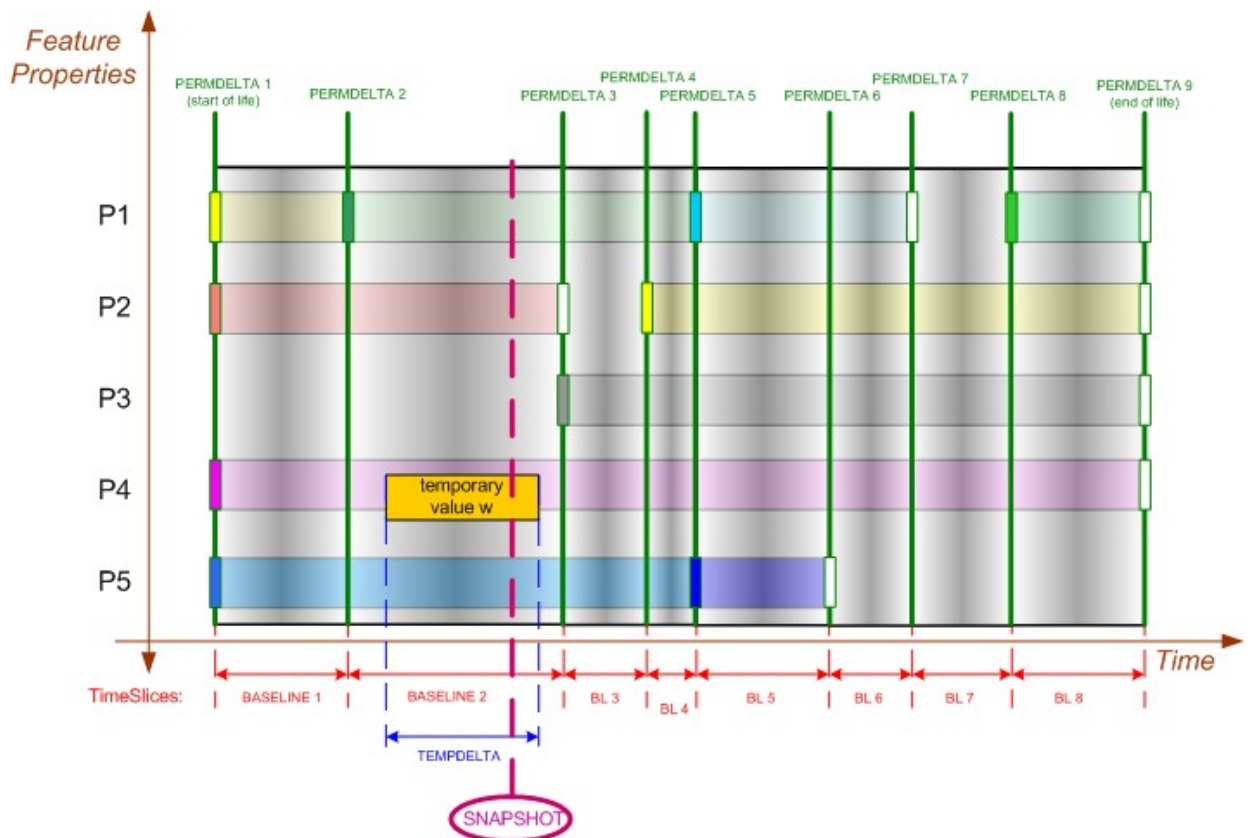


Figure 6 – Four types of TimeSlices

2.6 (step 6) Data exchange – corrections

In the aeronautical world we need to communicate information about events that are planned to take place in future. Inevitably, the reality might be different from the initial planning and it might be necessary to update the already communicated information.

As in AIXM the properties of a feature are encapsulated in Time Slices, this means that we need a mechanism for updating/correcting a previously communicated feature Time Slice. First, a key is necessary for the identification of the Time Slice concerned. For this purpose, a **“sequence number” attribute is introduced in the model, playing the role of unique identifier for each Time Slice** inside a feature.

If necessary to correct a previously communicated Time Slice, an update of the Time Slice will be provided, having the same sequence number but a higher correction number. As a consequence, if there exist more than one Time Slice with the same sequence number related to a given feature, the one with the higher correction number will be considered valid.

The UML representation of the final AIXM 5 Feature Time Slice model is provided below:

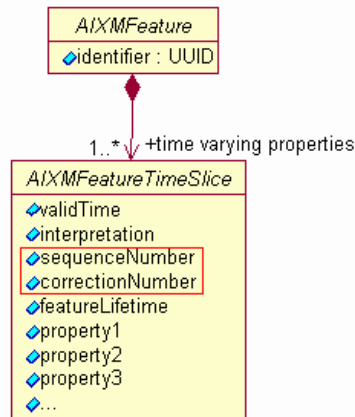


Figure 7 – Complete AIXMFeatureTimeSlice model

To summarise, the following Time Slice types are used in the AIXM:

- **BASELINE** = a kind of Time Slice that describes the feature state (the set of all feature’s properties) as result of a permanent change.
- **PERMDELTA** = A kind of Time Slice that describes the difference in a feature state as result of a permanent change.
- **TEMPDELTA** = a kind of Time Slice that describes the overlay of a feature state during a temporary event.
- **SNAPSHOT** = A kind of Time Slice that describes the state of a feature at a time instant, as result of combining the actual BASELINE Time Slice (valid at that time instant) with all eventual TEMPDELTA Time Slices that are effective at that time instant.

Discussion: What was the temporality model of past AIXM versions?

AIXM 3.x and 4.x provide limited temporality support. It is possible to encode the feature state at a point in time (AIXM-Snapshot message) and to communicate baselines (AIXM-Update). AIXM 3.x and 4.x do not support the direct encoding of the temporary status information; it would have to be done as a sequence of two baselines, one changing the properties and the second one reverting to the previous situation. But this does not allow distinguishing between real permanent changes and temporary status information.

In addition, AIXM 3.x and 4.x embed temporality in the exchange message rather than in the feature itself. Consequently, temporality was a property of the message rather than a property of the aeronautical feature. The message properties describe how receiving systems should interpret the message content.

The limited capabilities to transmit temporal information using Update and Snapshot messages in AIXM 3.x and 4.x have led to the development of this more complete AIXM 5 Temporality Concept, at feature level.

2.7 Properties with schedule

The Temporality Model described up to this point works well for features that have properties with constant values during their time of validity. In some cases, one or more properties of a feature may have their own cyclic variation in time according to an established schedule. For example, a navaid can be operational during day time and unserviceable during night time; a restricted airspace could be active every day from 09:00 till 17:00; etc.

To model such situations, the concept of “properties with schedule” has been introduced in AIXM 5.1. The idea is to associate the properties that have cyclic varying values with a “Timesheet” that describes the times when each value is applicable for those attributes. The concept of Timetable/Timesheet already existed in AIXM 3.x and 4.x. It was inherited as such in AIXM 5.0, where it was found to sometimes overlap with the TimeSlice concept. Therefore, a re-thinking of the role of Timesheets was necessary in AIXM 5.1 (see [Change Proposal 5.1-35](#), which provides a more detailed analysis of the need for schedules in AIXM).

Discussion: Does the model really need to support schedules?

It is obvious that schedules exist in the aeronautical data domain. The question is whether the TimeSlice concept is sufficient or not for also coverings such situations.

Theoretically, the TimeSlice model without schedules can be used for a feature (such as a navaid) that has a property (such as operational hours) that changes cyclically (such as operational every day from 06:00 – 22:00). But this means that either a dedicated BASELINE or a TEMPDELTA is encoded each time when the operationalStatus changes from operational to unserviceable. This would generate either 730 BASELINE TimeSlices or one BASELINE Timeslice and 365 TEMPDELTA TimeSlices in a year, which is a significant inconvenience. In addition, the “cyclical” aspect would not be immediately visible.

Therefore, the TimeSlice model needs to be complemented with a “schedules” concept, which enables to model directly the cyclic variation of the values of one or more feature properties.

At the feature level, all the properties that change according to an established schedule must be isolated in a separate class, as illustrated below with class NavaidOperationalStatus. This class inherits from an abstract class called “PropertiesWithSchedule”.

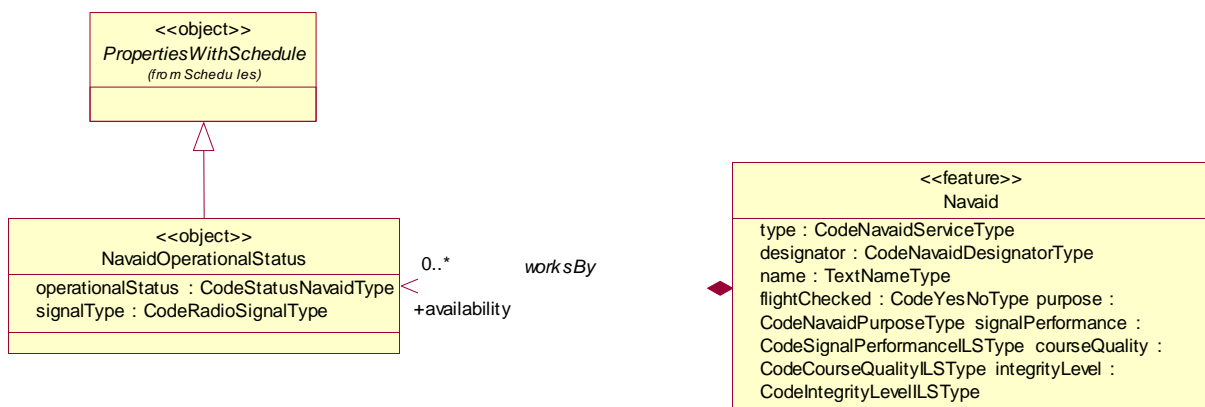


Figure 8 - Properties with schedule model

The abstract class PropertiesWithSchedule is then associated with Timesheet(s).

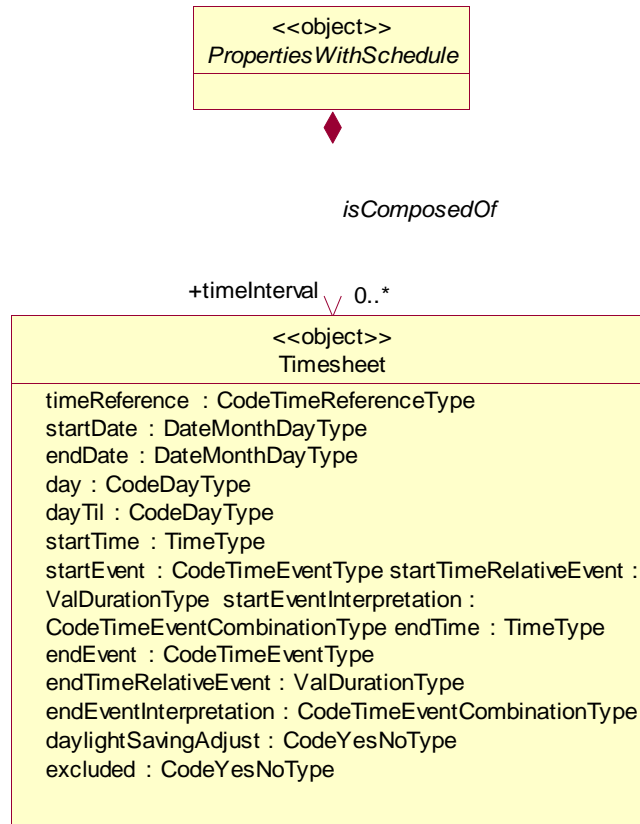


Figure 9 - Timesheet class

The Timesheet class contains the time reference system (UTC-12 to UTC +14), daylight saving indicator and provides the possibility to include/exclude specified dates and 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...

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 hide this important aspect.

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

The introduction of the PropertiesWithSchedule requires clear rules for interpreting the various combinations that can occur between TimeSlice types, their validity and property schedules. The risk is that the value of a property may be undefined if the schedules associated with a BASELINE leaves “holes”. In the AIS operations of today, for properties that change values according to a schedule, it is quite common to specify only the “main” value, such as “operational”, “active”, etc.. For example, it is indicated that the “navaid operates every day from 06:00 – 22:00”, but it is not explicitly indicated what is the status of the navaid between 22:00 – 06:00. Operational people will assume that the navaid is not operating between 22:00 – 06:00.

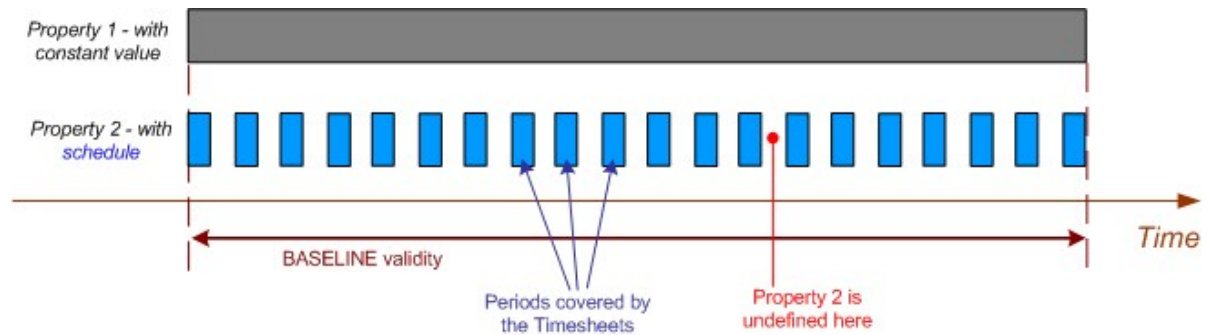


Figure 10 - Schedule with holes

As machines cannot make “assumptions”, for digital data processing, it is safer if the “non-operating” times are also stated explicitly, so that schedules associated with the values of the property do not leave any holes. Therefore, it is recommended that BASELINE Timeslices contain only fully defined properties with schedule, which indicate explicitly what the property value is at every moment within the validity time of the TimeSlice. If one or more Timesheets are associated with a property with schedule, than the value of the property shall be considered as undefined at any moment not covered by a Timesheet.

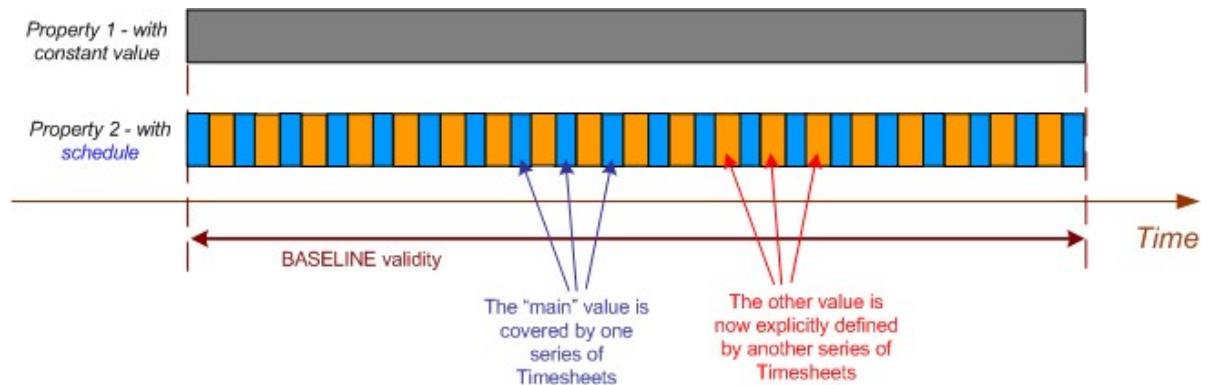


Figure 11 - Fully defined property with schedule

Timesheets that leave gaps can also occur for TEMPDELTA TimeSlices. By definition, any property contained in a TEMPDELTA overrides the value of the equivalent BASELINE property, for the duration of validity of the TEMPDELTA. Therefore, as a general principle, the times encoded in Timesheets contained in TEMPDELTA TimeSlices also replace in full the times encoded in the equivalent BASELINE Timesheets.

The situation is simple and clear if the TEMPDELTA does not have Timesheets or if these Timesheets cover the whole period of applicability of the TEMPDELTA, as presented in the following diagrams:

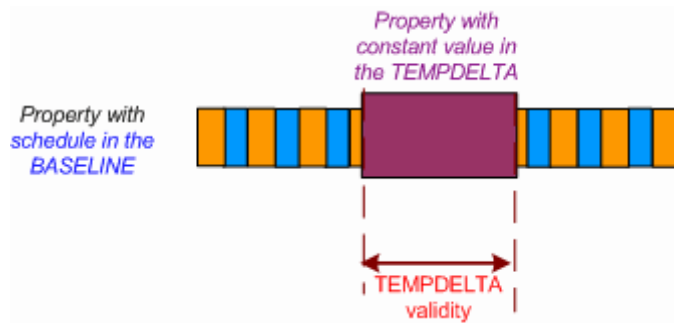


Figure 12 - TEMPDELTA constant value overrides the BASELINE schedule

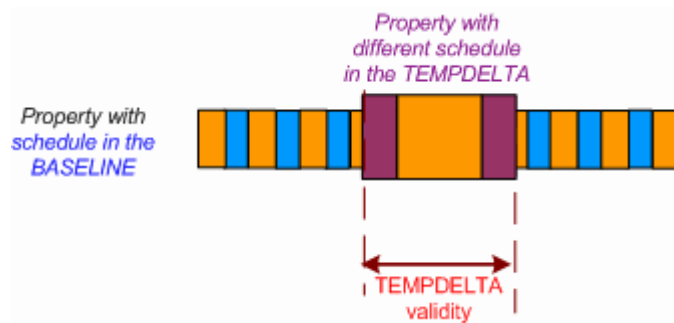


Figure 13 - TEMPDELTA schedule overrides the BASELINE schedule

A situation that can lead to difficulties in interpretation is when the Timesheets associated with the TEMPDELTA leave gaps (times where the value of the property is not explicitly specified), as in the following diagram:

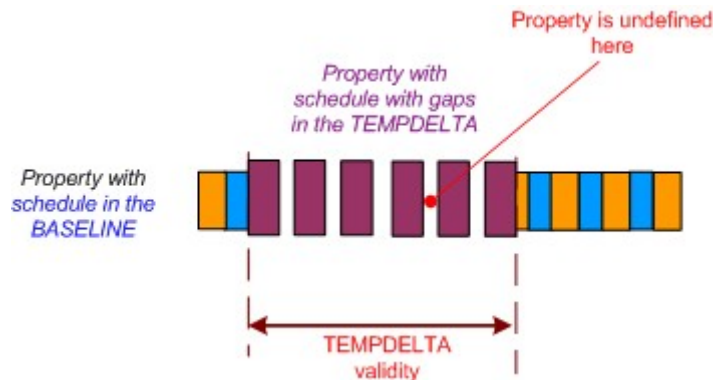


Figure 14 - TEMPDELTA schedule gaps leave the property undefined

The temptation could be to consider that the BASELINE situation applies in the gaps left by the Timesheets associated with the TEMPDELTA. But this would be in conflict with the general principle that the TEMPDELTA values replace the BASELINE values in full. Therefore, if a TEMPDELTA schedule leaves gaps (periods for which the value is not explicitly provided), then it shall be considered that the property has an unspecified value at those time periods.

From the examples above, it is therefore recommended that TEMPDELTA schedules do not leave unspecified periods (gaps) within the time of applicability of the TEMPDELTA.

2.8 Temporality applied to the Abstract Model

The AIXM UML model contains a set of abstract classes that are used as templates for the features and objects defined in AIXM. When applying the Time Slice concept, as described in this document, this would trigger the split of every UML class that represents a feature into a main class and a “FeatureTimeSlice” class, as shown in the following diagram.

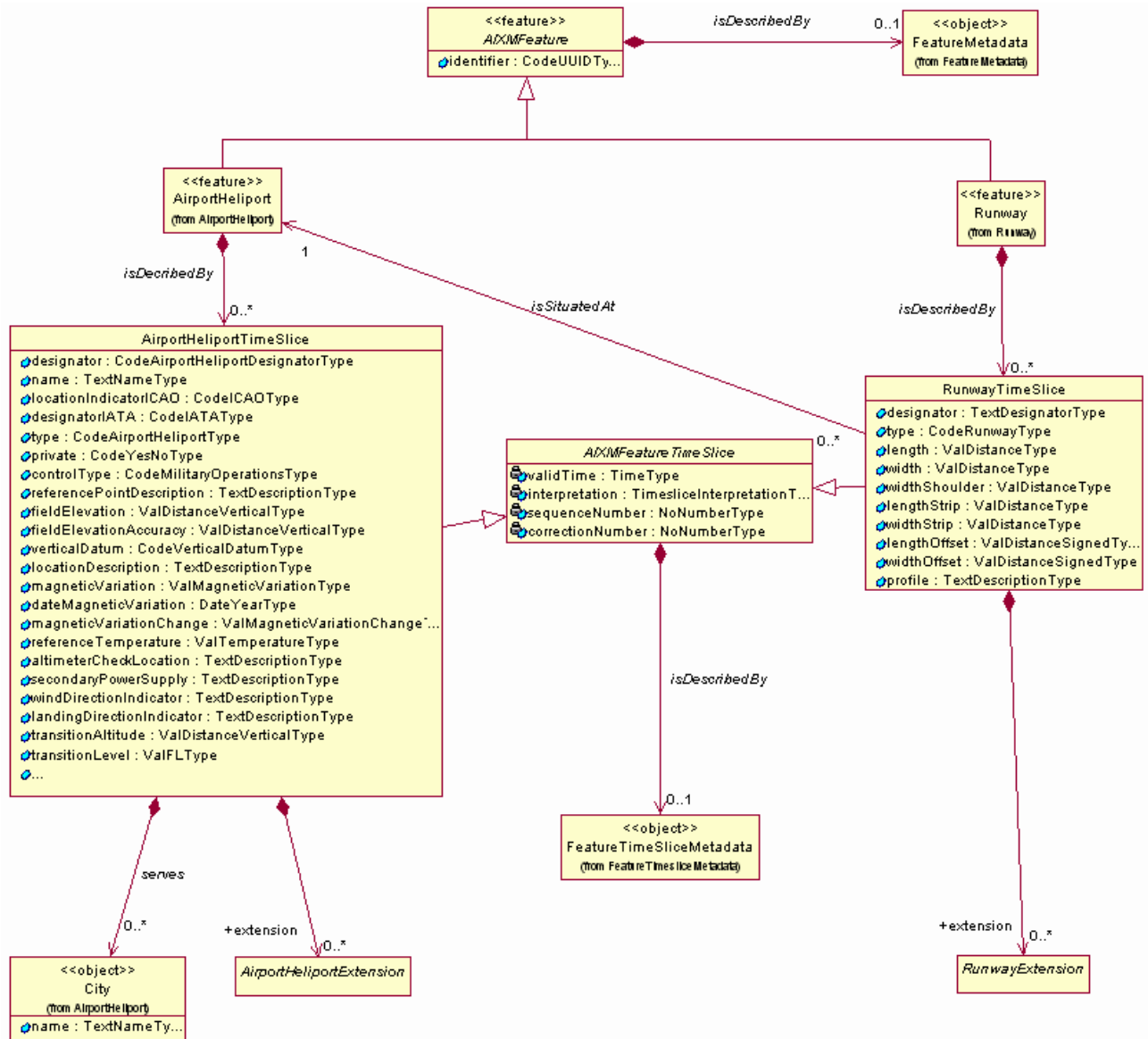


Figure 15 - Model expanded with explicit TimeSlice classes

The UML diagram shows how each and every <<feature>> inherits from the abstract AIXMFeature class. The concrete features are described by TimeSlices which have properties. The TimeSlice inherits from the abstract AIXMFeatureTimeSlice class.

The diagram also shows that each AIXM Feature may have FeatureMetadata and each TimeSlice may have FeatureTimeSliceMetadata. Finally, each TimeSlice may contain an Extension. The 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 undermine the readability of the UML diagrams, as a separate “TimeSlice” class and the necessary associations would have to be added for each <<feature>> class. **Therefore, the Design Team has decided to provide a simplified AIXM 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.

3. Application aspects

3.1 BASELINE Time Slices with undetermined end of validity

The operationally significant changes in the aeronautical information domain are regulated by the AIRAC cycle. Usually, when a permanent change is communicated, it is unknown when the next permanent change will take place. Therefore, it triggers the encoding of a BASELINE with an unknown end of validity. This is expressed in GML as “<gml:endPosition indeterminatePosition="unknown"/>”. This BASELINE will cover the period until the next permanent change. Implicitly, when the next change occurs, the previous BASELINE gets an end of validity and needs to be updated/corrected.

The situation may be represented as in the diagram below. The first BASELINE, created at the start of life of the feature, initially has an unknown end of validity. It is represented on this diagram as “BASELINE 1”, assuming that it has sequenceNumber=1.

When the permanent change “PERMDelta 2” occurs, the validity of the initial BASELINE ends and a new BASELINE takes over. To completely represent the history of the feature, a corrected version of the first BASELINE is instantiated (having the same sequenceNumber=1 and also a correctionNumber=1), this time with a known end of validity. The newly created BASELINE has sequenceNumber=2 and no correction yet.

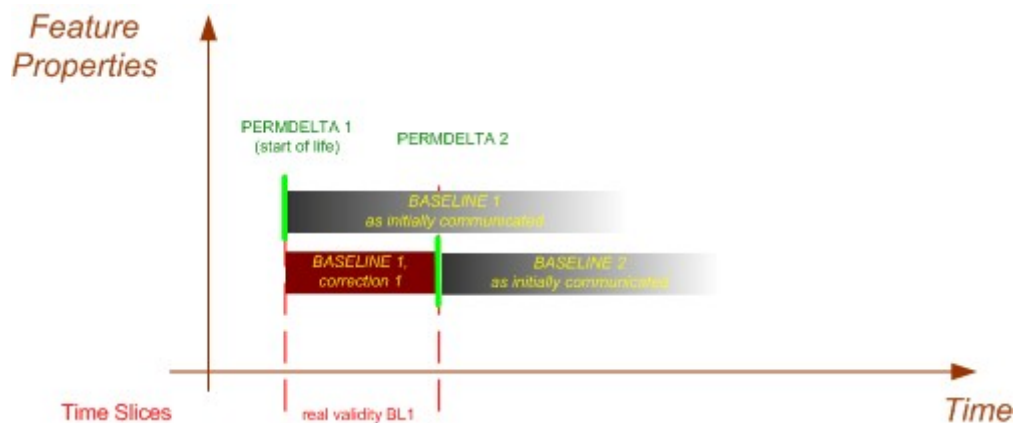


Figure 16 – Previous BASELINE correction as result of a PERMDelta

3.2 SequenceNumber values

As explained in 2.6, the sequenceNumber is primarily used as an identifier of the TimeSlice, in order to apply a correction. Therefore, the sequenceNumber shall be unique per type of TimeSlice and should be persistent. It is not allowed to change the sequenceNumber of a TimeSlice because this could break the link with a correction TimeSlice and there is no mechanism in AIXM that would enable notifying the change of a sequenceNumber.

A secondary aspect is that sequenceNumbers can also be used to give some chronological information about the time when that TimeSlice was issued (not in which order it becomes valid!).

Therefore, it is recommended that sequenceNumbers are allocated starting from “1” and are incremented by 1 unit (“2”, “3”, “4”, etc.) each time that a new TimeSlice of that kind is encoded:

- The initial PERMDELTA that creates the feature to have sequenceNumber=1 and the first BASELINE that results to also have sequenceNumber=1;
- The second PERMDELTA (the first change of the feature after its creation) to have sequenceNumber=2 and the resulting BASELINE to also have sequenceNumber=2, etc.
- Then, the first TEMPDELTA that occurs to have sequenceNumber=1, the next one sequenceNumber=2, etc.

The result of this recommendation is visible in Figure 17 – Complete history of a feature.

3.3 Feature end of life

As explained in 2.5, the PERMDELTA TimeSlices have been introduced in order to facilitate the notification of the end of life / decommissioning / withdraw of a feature. This shall be encoded as a PERMDELTA that changes the featureLifetime/./endPosition property (of the BASELINE TimeSlice valid at the withdraw time) from "undetermined" into a precise date and time value. The effective date of the PERMDELTA shall be equal to the end of life value. No other property of the feature is included in the PERMDELTA in this case, as this PERMDELTA will not result into the establishment of a new BASELINE, just in a correction of the last active BASELINE. Extended to the complete history of the feature, the correction of the initially communicated BASELINES up to the end of life of the feature can be represented as in the following diagram.

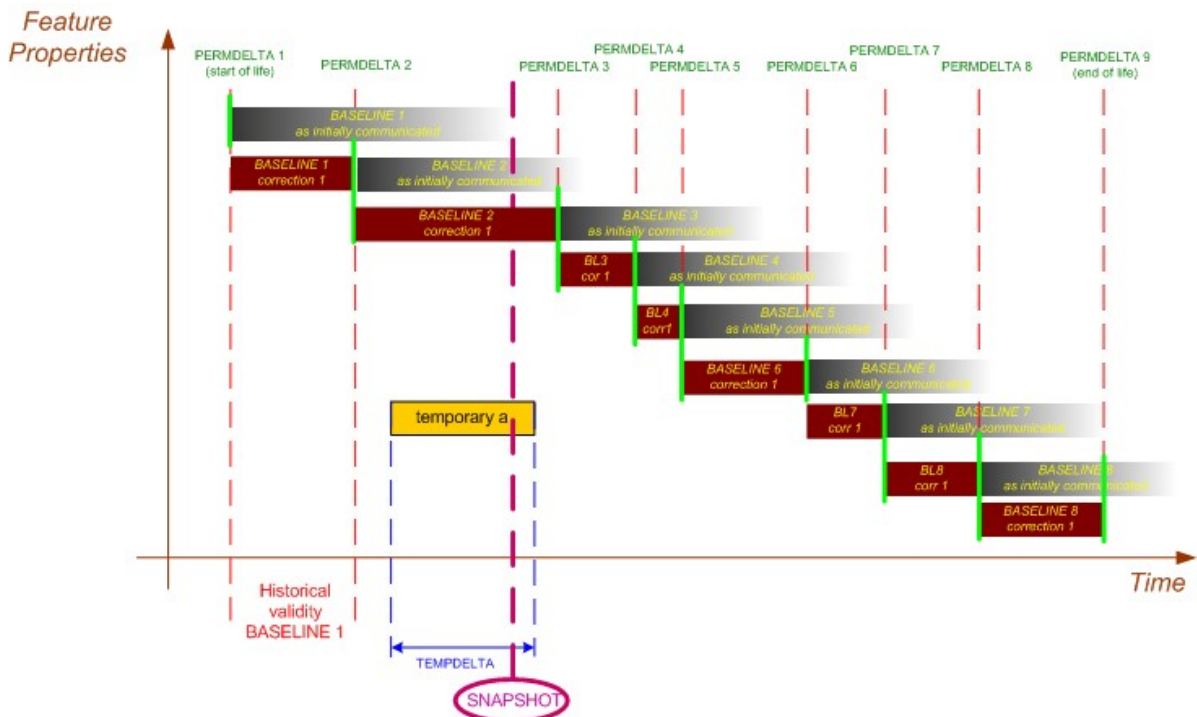


Figure 17 – Complete history of a feature

3.4 “Delta” for complex properties

Many AIXM features have complex properties that are made of zero or more component classes (represented as aggregated classes in the UML model, 0..*). For example, an AirportHeliport has an associated AirportHeliportAvailability which is “composedOf” zero or more AirportHeliportUsage.

```

<<feature>>
AirportHeliport
designator : CodeAirportHeliportDesignatorType
name : TextNameType
locationIndicatorCAO : CodeCAOType
designatorIATA : CodeIATAType
type : CodeAirportHeliportType
certifiedCAO : CodeYesNoType
privateUse : CodeYesNoType
controlType : CodeMilitaryOperationsType
fieldElevation : ValDistanceVerticalType
fieldElevationAccuracy : ValDistanceVerticalType
verticalDatum : CodeVerticalDatumType
magneticVariation : ValMagneticVariationType
magneticVariationAccuracy : ValAngleType
dateMagneticVariation : DateYearType
magneticVariationChange : ValMagneticVariationChangeType
referenceTemperature : ValTemperatureType
altimeterCheckLocation : CodeYesNoType
secondaryPowerSupply : CodeYesNoType
windDirectionIndicator : CodeYesNoType
landingDirectionIndicator : CodeYesNoType
transitionAltitude : ValDistanceVerticalType
transitionLevel : ValFLType
lowestTemperature : ValTemperatureType
abandoned : CodeYesNoType
certificationDate : DateType
certificationExpirationDate : DateType
    
```

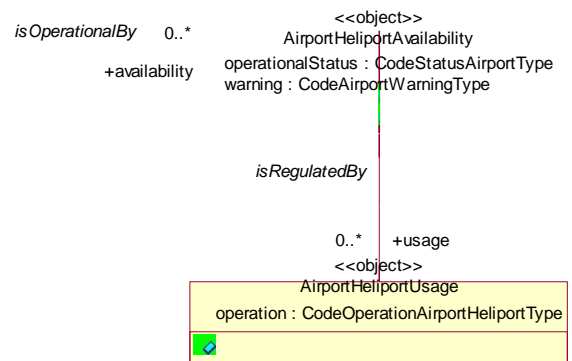


Figure 18

The question is: what should PERMDELTA or TEMPDELTA Time Slices contain for such situations?

By definition, “delta” Time Slices shall contain strictly the values of the affected feature properties and this rule applies only to features. Objects are considered complex types of a feature property and have to be included in full in a “delta” Time Slice, if the encapsulating feature property is changed. This will be explained further down with an example.

Feature properties are all the feature attributes and all the associations for which the feature has the navigability (indicated as an arrow pointing from the feature class towards another class). For example, in the previous class diagram, the properties of the AirportHeliport feature are all attributes (designator, name, ..., certificationExpirationDate) and also the “availability” property, given by the role played by class AirportHeliportAvailability in the association isOperationalBy. The “availability” property of the Airspace is a complex one, composed of several AirportHeliportUsage. If a temporary or permanent change occurs inside the AirportHeliportAvailability (for example, a modification of one of its composing AirportHeliportUsage), then the modified AirportHeliportAvailability shall be included in full in the TEMPDELTA or PERMDELTA Time Slice.

3.5 “Delta” for multi-occurring properties

An equivalent rule applies for feature properties that can occur multiple times. In UML, such properties are encapsulated in an Object, which is related with the feature class by a 0..* association. For example, an AirportHeliport may serve 0..* Cities, as indicated in the following diagram. This means that the property “serves” of the AirportHeliport feature is potentially multi-occurring.

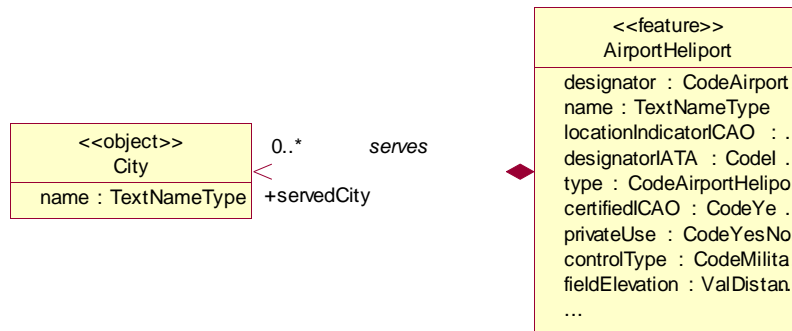


Figure 19

The rule is that, in a PERMDELTA or TEMPDELTA Time Slice, multi-occurring properties shall be provided with all occurrences included. Therefore, if an AirportHeliport had, for example, two served cities and this needs to be permanently changed to three cities, all the three “servedCity” properties have to be included in a PERMDELTA.

3.6 Identifying the feature affected by a DELTA Time Slice

A Time Slice is always encoded as child element of a feature. As every AIXM feature has ‘gml:identifier’ property, this should be sufficient for this purpose. This is supposed to be a global unique identifier (of type UUID), which provides an unambiguous key for every AIXM Feature.

However, the global unique identifiers are likely to not exist for some time. In this situation, there are two possibilities:

- Either use the gml:identifier property for encoding a local unique identifier (an artificial key), specific to the data originator. In this case, the PERMDELTA and TEMPDELTA Time Slices can be operationally received only from the same originator who has provided the BASELINE data. Using PERMDELTA/TEMPDELTA from another data source would inevitably break the chain, as different identifiers would be used.
- Or, in addition to the PERMDELTA or TEMPDELTA Time Slice, include in the AIXM file a SNAPSHOT Time Slice, which contains some properties (a “natural key”) that are sufficient for identifying the feature. The fact that the SNAPSHOT contains just some natural key properties and does not contain all properties is not in conflict with the definition of a SNAPSHOT TimeSlice, because a SNAPSHOT represents the view that a particular system has on that feature, which might be an incomplete view. The recipient of the data will have to query his local system and identify the feature that has the same values at that moment in time, thus being identified as the target for the update.

3.7 Canceling a Time Slice (abandoned changes)

For aeronautical information systems that work in “push” mode, the primary means for generating and providing information about a change is by PERMDELTA and TEMPDELTA Time Slices. The question is what procedures shall be applied in the case of a change in the planning, such as:

- Abandoning the commissioning/decommissioning of a feature (before its effective date)
- Abandoning a permanent change (before its effective date)
- Abandoning a temporary change (before its effective date)

It was already discussed (see 2.6) that the postponement/advancement of an event requires a correction to a TimeSlice, using the sequenceNumber property as key for identifying the Time Slice concerned. The sequenceNumber will also be used for identifying the PERMDELTA or TEMPDELTA that needs to be abandoned. To clearly indicate that the change contained in the TimeSlice has been canceled, the gml:validTime property will be empty and it will have the nilReason attribute set to “inapplicable”. For example, if a PERMDELTA for SomeFeature has been provided, with sequenceNumber “23”, in order to cancel it, a second PERMDELTA with the same sequenceNumber and a higher correctionNumber has to be issued, as below

<p><i>TimeSlice (initial)</i></p> <ul style="list-style-type: none"> - validTime = timeInstant... - <i>interpretation = PERMDELTA</i> - sequenceNumber = 23 - featureLifetime/beginPosition = same timeInstant... - property 1 - property 2 - property 3 - property 4 5 	<p><i>TimeSlice (correction)</i></p> <ul style="list-style-type: none"> - validTime : nilReason="inapplicable" - <i>interpretation = PERMDELTA</i> - sequenceNumber = 23 - correctionNumber = 1 - featureLifetime/beginPosition: nilReason="inapplicable"
---	--

Note that this Time Slice cancellation does not affect ‘pull’ systems, such as Web Services or WFS, where the system provides the most current information, following an on-line request by the client. The client is not supposed to refer to or compare the results with the results of a previous query.

3.8 Overlapping TimeSlices and corrections

The sequenceNumber and correctionNumber are used to resolve and interpret overlapping timeSlices. Consider the scenario shown in the figure below where a Feature’s Status property is changed repeatedly over several overlapping time intervals. Each temporary change receives a sequenceNumber. In the example, one of the Time Slices is corrected, leading to a duplicated sequenceNumber and different correctionNumber.

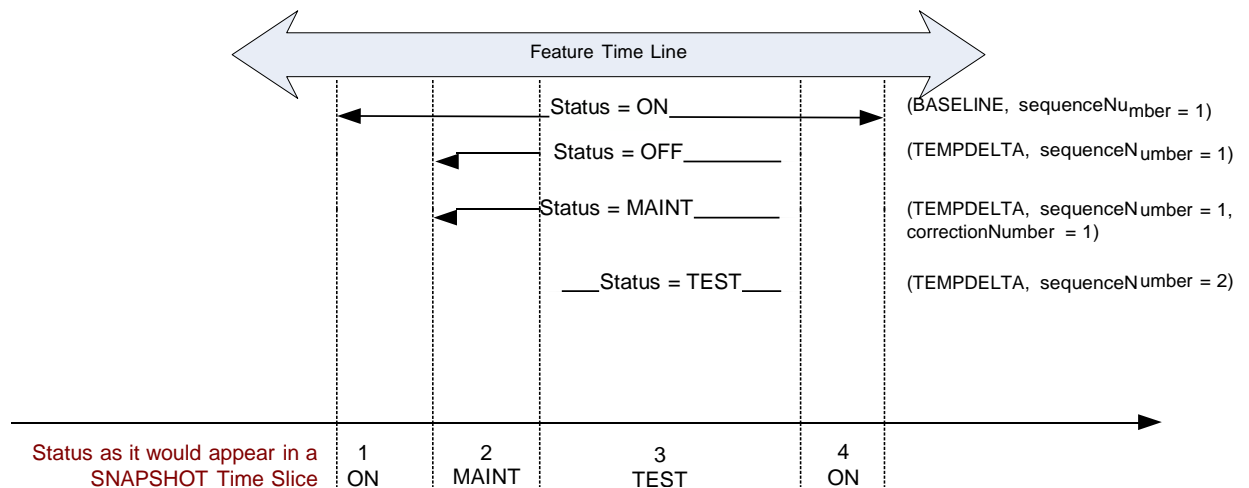


Figure 20 Example of TimeSlice corrections and overlapping

At the edges of each temporal event we can identify transitions to different feature versions. The combination of Time Slice type and sequenceNumber can be used to unambiguously identify the value of the Feature’s Status property at each moment in time.

To determine the value of a property at a given time or over a given time interval the following rules should be used:

1. Identify the BASELINE that is valid at that moment in time, by looking at it’s validTime. If several exist, they should all have the same sequenceNumber and different correctionNumbers. Take the one with the highest correctionNumber;
2. Identify all TEMPDELTAS that are effective at the specified time ;
3. Sort the TEMPDELTAS by increasing sequenceNumber;
4. Apply the TEMPDELTAS to the feature from low sequenceNumber to high sequenceNumber.
 - a. When two or more deltas have the same sequenceNumber apply the delta with the highest correctionNumber.

The possibility to resolve overlapping TEMPDELTAS using the sequenceNumber and correctionNumber shows how cancellations and corrections can be communicated. In this example, TEMPDELTA sequenceNumber = 1 is initially used to communicate that the feature Status = OFF. Later, a Time Slice correction is transmitted using the same sequenceNumber = 1 but with a correctionNumber = 1; it corrects the feature state to Status = MAINT. However, the final status is later given by the TEMPDELTA with sequence number 2 which indicates the feature Status = TEST.

3.9 Other implementation considerations

The conceptual temporal model described in the previous section provides considerable flexibility for systems that implement temporality. A system that tried to fully implement the AIXM temporality model would be very complex. However there is no requirement for systems implementing AIXM to support all kinds of Time Slices. For example:

- Some systems may only store BASELINE Time Slice data and disregard any temporary changes. Examples include AIP publication, paper chart publishers and ARINC 424 based systems.
- Some systems may only transmit and store temporary changes. Examples include the NOTAM systems. However, such systems need to refer to source of BASELINE data.
- Some systems may only require periodic snapshots providing the current state of the system. An example is a passive monitoring system designed to report system status at selected time intervals.
- Some systems may want a new “snapshot” after every change without making a distinction between a temporary and a permanent change. Examples include traffic management and flight plan processing systems.
- Some systems may be developed that can process and interpret all of the temporal components and provide users with Baseline, Deltas and Snapshot Time Slices at any given moment in time.

AIXM contains a complete temporal model; however, as the examples illustrate it is the responsibility of interacting systems to negotiate specific temporal data exchange requirements as well as to integrate temporality into their internal subsystems.

4. Usage examples

4.1 Navaid example

Figure 21 illustrates the temporal model by showing a transmission frequency change for a navigation aid (VOR AML, from 112.0 MHz to 113.2 MHz). Normally, this change should occur at an AIRAC cycle date. Usually, the change requires the navaid to be out of service for a certain time, then to be on test on the new frequency. The temporary status is communicated at present through NOTAM messages.

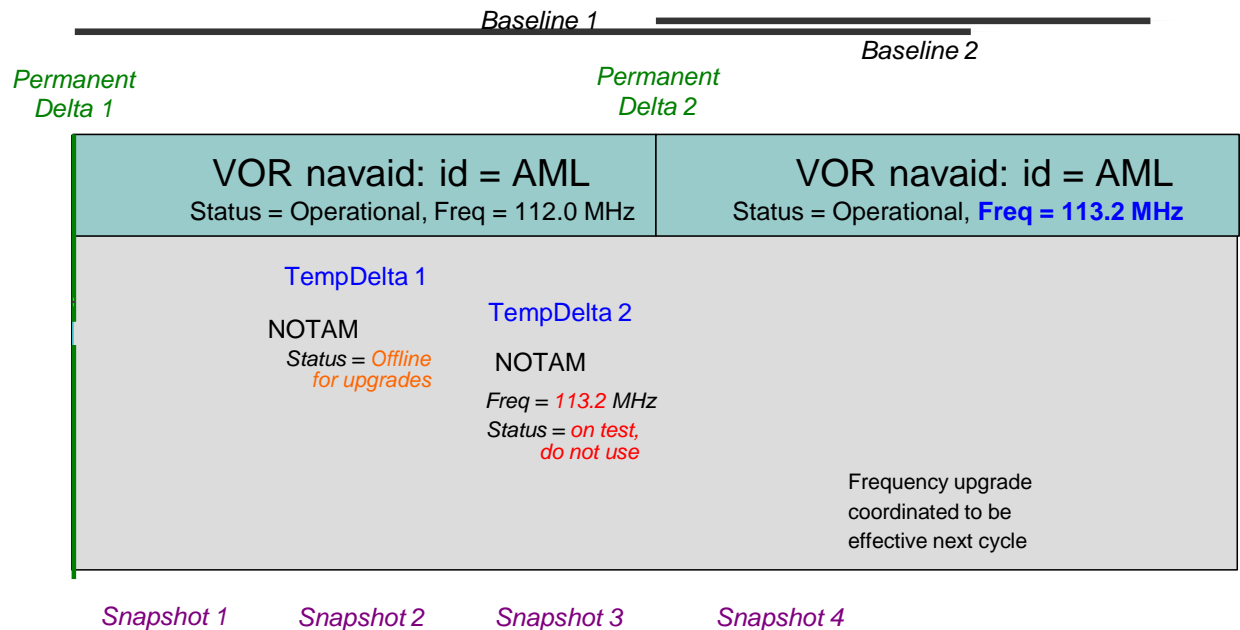


Figure 21

Based on this diagram we can identify the following temporal components:

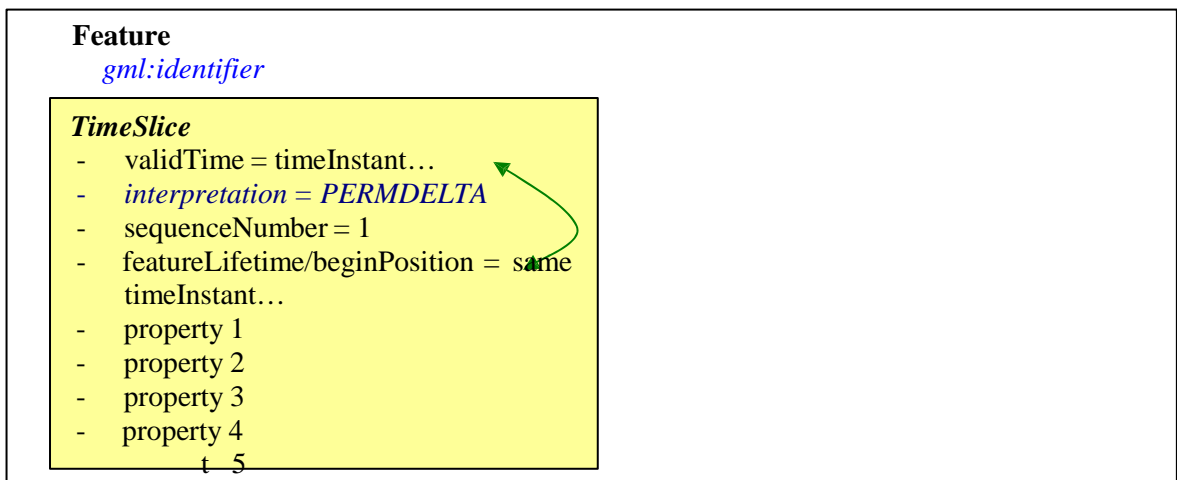
- The diagram shows two BASELINE Time Slices. The first baseline has a NAVAID frequency of 112.0 MHz and is valid since some time in the past; the second baseline has the new frequency of 113.2 MHz and is valid starting from the AIRAC cycle date.
- A PERMDELTA can be used to describe the permanent state change, which is the AML VOR frequency change. For completeness sake, the previous PERMDELTA that has preceded the first BASELINE (1) is also shown.
- Each transitory event can be expressed as a TEMPDELTA that changes the Operational Status of the navaid and eventually the frequency.
- Based on the PERMDELTA and the TEMPDELTA delta Time Slices shown in the diagram, four different versions for the “current status of the feature” may exist. Each “current status” version begins and ends at the boundary of a Permanent or Temporary Delta and may be presented as a Time Slice of type SNAPSHOT.

Depending on the temporal implementation employed by the exchanging systems, different methods can be used to communicate feature changes. In the interest of global standardization, the rest of this

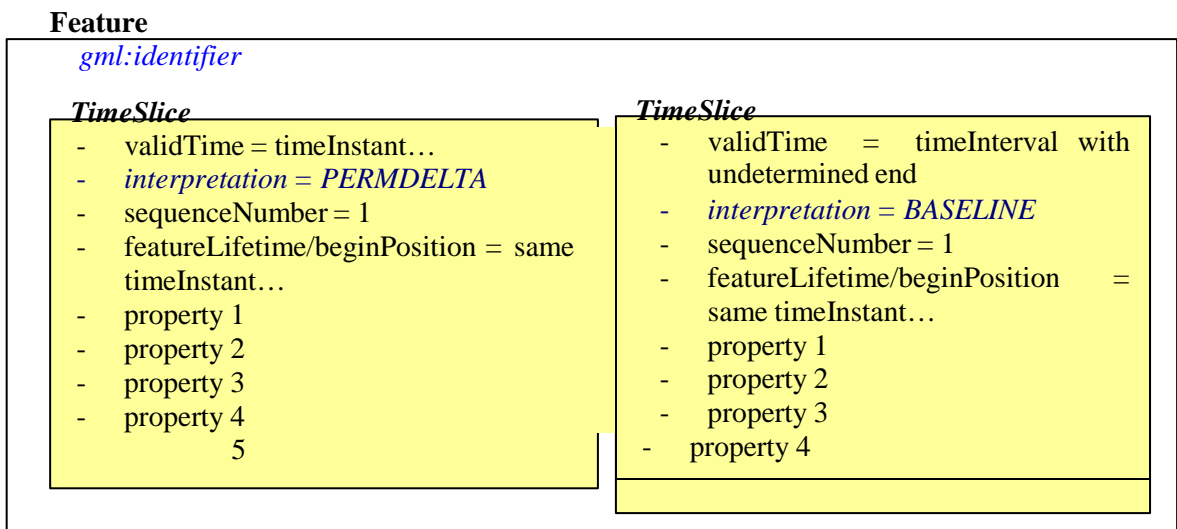
section provides some recommendations. They are relevant especially for “push” type applications, which generate and provide notifications in the form of TEMPDELTA and PERMDELTA Time Slices.

4.2 Feature creation (commissioning)

The start of life of a feature (also known as “commissioning”) is modelled as a PERMDELTA which gives an initial value to the startOfLife property and to all other feature properties that are defined. The validTime of the PERMDELTA shall be the effective date and time when the feature is commissioned.



Optionally, if this has been requested by the user, a BASELINE Time Slice, containing the same property values as the PERMDELTA (as they are the result of the PERMDELTA) may also be included. The validTime of the BASELINE shall be a timeInterval with the end “undetermined”.



4.3 Permanent change

A permanent change is modeled as a PERMDELTA Time Slice, containing all properties that change their values. The validTime of the PERMDELTA shall be the effective date and time of the change.

Optionally, a BASELINE Time Slice can be included, containing all the properties that have a value as they result after the PERMDELTA. The validTime of the new BASELINE shall be a timeInterval with the end “undetermined”.

Feature

gml:identifier

TimeSlice

- validTime = timeInstant...
- *interpretation = PERMDELTA*
- sequenceNumber = 2
- property 3 (new value)
- property 5 (new value)

TimeSlice

- validTime = timeInterval with undetermined end ...
- *interpretation = BASELINE*
- sequenceNumber = 2
- featureLifetime/beginPosition = timeInstant...
- property 1
- property 2
- property 3 (new value)
- property 4

4.4 Digital NOTAM

A temporary state of a feature is encoded as a TEMPDELTA Time Slice, containing all properties that temporarily change their values. The validTime of the PERMDELTA shall indicate the start and the end of effectivity for the temporary state. The end can be undetermined.

Feature

gml:identifier

TimeSlice

- validTime = timeInterval...
- *interpretation = TEMPDELTA*
- sequenceNumber = 1
- property 4 (temporary value)

Optionally, a SNAPSHOT Time Slice can be included in the data set (used as “natural key”).

Feature <i>gml:identifier</i>	
TimeSlice <ul style="list-style-type: none"> - validTime = timeInterval... - interpretation = <i>TEMPDELTA</i> - sequenceNumber = 1 - property 4 (temporary value) 	TimeSlice <ul style="list-style-type: none"> - validTime = timeInstance - interpretation = <i>SNAPSHOT</i> - property 1 (part of natural key) - property 2 (part of natural key)

4.5 End of life (decommissioning)

The end of life of a feature (also known as “permanent withdrawn” or “decommissioning”) is modelled as a PERMDELTA which gives a value to the featureLifetime/endPosition.

Feature <i>gml:identifier</i>	
TimeSlice <ul style="list-style-type: none"> - validTime = timeInstant... - interpretation = <i>PERMDELTA</i> - sequenceNumber = 3 - featureLifetime/endPosition = same timeInstant... 	

Optionally, the correction of the latest BASELINE can be included (if requested by the client).

Feature <i>gml:identifier</i>	
TimeSlice <ul style="list-style-type: none"> - validTime = timeInstant... - interpretation = <i>PERMDELTA</i> - sequenceNumber = 3 - featureLifetime/endPosition = same timeInstant... 	TimeSlice <ul style="list-style-type: none"> - validTime = timeInterval with the end as specified by the PERMDELTA - interpretation = <i>BASELINE</i> - sequenceNumber = 2 - correctionNumber = 1 - featureLifetime/beginPosition = timeInstant... - featureLifetime/endPosition = timeInstant, as specified by the PERMDELTA - property 1 - property 2 - property 3 - property 4 - property 5

4.6 Complete feature histories

The Timeslice model can be used to transmit history of a feature by transmitting the sequence of changes that occur to the feature’s property. The feature history can be the past history or future history.

Figure 22 shows an example history of a fictional VOR navigation aid. The navigation aid has the following events:

- Jan 7, 2006: Commissioned
- Jan 23 – Feb 18, 2006: Temporary frequency change
- Feb 11 – Mar 9, 2006: Temporary offline
- Feb 22, 2006: Change in magnetic variation
- Mar 27, 2006: Change in frequency

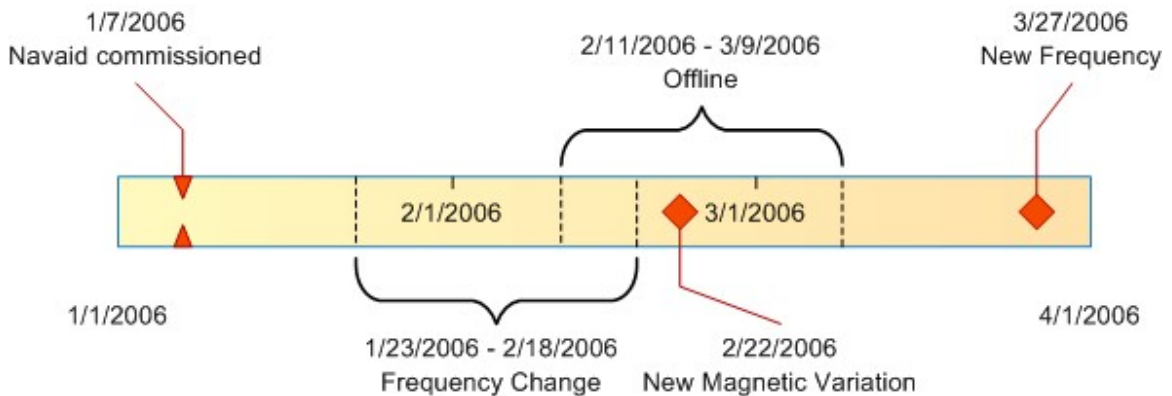


Figure 22: Fictitious example - history of a VOR navigation aid.

Using the Time Slice model we could represent the history of the VOR navigation aid as a series of five Time Slices, as shown in Figure 23. Three Time Slices are used to represent states and two are used to represent temporary events. Notice that overlapping events are encoded as separate Time Slices. The PERMDELTA Time Slices are not shown in this example.

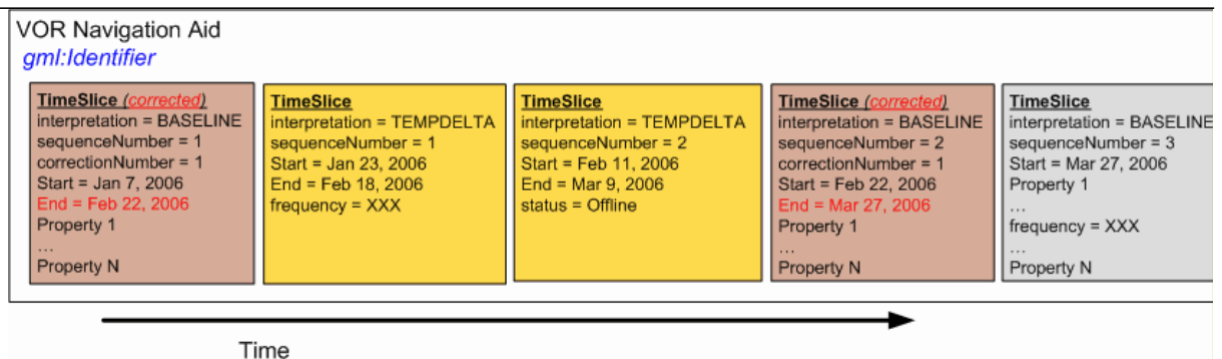


Figure 23: TimeSlices for the VOR navigation aid history

This approach to modeling history is equivalent to the recommended approach for GML 3.2 [4]. In actual implementations of the AIXM Timeslice mode, communicating histories can lead to very large messages. These large messages might be a problem for some resource constrained system. Although implementation issues are outside the scope of this design document we want to point out that the disadvantage of message size should be weighed against the value of standardization and compliance with GML. In most situations, the value of standardization may outweigh the loss of message efficiency.

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APPENDIX C

AIXM

UML TO XML SCHEMA MAPPING

AIXM

UML to XML Schema Mapping

Aeronautical Information Exchange Model (AIXM)

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	2006/08/25	Barb Cordell	Incorporate data modelling section
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	2007/01/30	Barb Cordell	Update for Release Candidate 1
0.2	2007/07/31	Scott Wilson	Update for Release Candidate 2
0.3	2007/09/20	Eddy Porosnicu	Modified model for units of measurement
0.4	2008/01/15	Eddy Porosnicu	Modified rules for associations, from now on based on role names.
1.0	2008/03/15	Eddy Porosnicu	Editorial changes for first public version.
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1 Scope

1.1 Introduction

The AIXM Conceptual Model is maintained as a UML class model. The AIXM exchange format is codified as a series of XML schemas. There is a direct link between the AIXM Conceptual Model and the AIXM XML Schema.

This document describes how the AIXM Conceptual Model is converted into the AIXM XML Schema. The conversion process is illustrated using a series of examples from the AIXM 5 XML schema.

1.2 References

1. Geographic Information – Spatial Schema. ISO 19107. First Edition, 2003-05-01
2. ISO 19136:2007 - Geographic information -- Geography Markup Language (GML)
3. UML 2.0 In a Nutshell. Dan Pilone. O'Reilly Media Inc. 2005.
4. AIXM Temporality Model, www.aixm.aero (see Downloads)

2 AIXM UML Modelling Conventions

2.1 Diagram types

Two types of diagrams are used in the model:

Class diagrams – Used to represent the features, properties, relationships and inheritance between features;

Package diagrams – Used to split the model into modules and identify dependencies among sets of classes.

2.2 Stereotypes

The classes are distinguished by their stereotypes. Stereotypes are used to further define and extend standard UML concepts. The main stereotype are <<feature>>, <<object>>, <<choice>>, <<datatype>> and <<odelist>>.

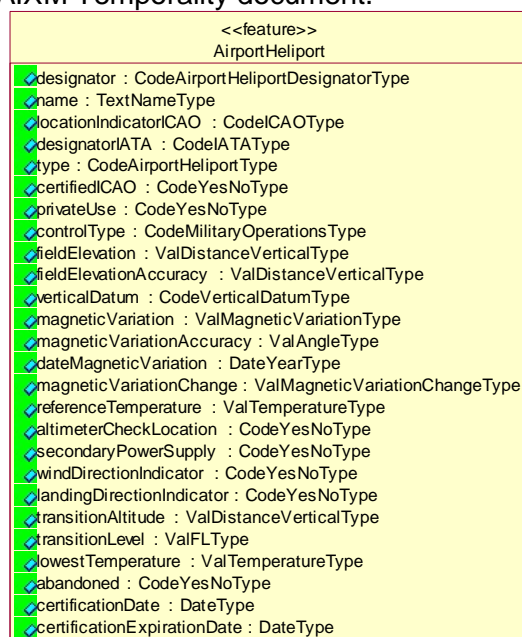
2.3 Abstract Classes

In addition, some classes are abstract. Abstract classes are designated by putting the class name in *italics*. An abstract class cannot be realised in an implementation such as an XML document. Instead, abstract classes are used as base classes in an inheritance hierarchy. For example, the AIXMFeature abstract class describes the basic properties of an AIXM Feature. Every specific AIXM Feature, such as Runway, inherits¹ from the abstract AIXMFeature class.

2.4 Features

Features describe real world entities and are fundamental in AIXM. AIXM features can be concrete and tangible, or abstract and conceptual and can change in time. Features are represented as classes with a stereotype <<feature>>. Examples include Runway and AirportHeliport.

AIXM features are dynamic features. Timeslice objects are used to describe the changes that affect the AIXM feature over time. Timeslice objects and temporality are discussed extensively in a separate AIXM Temporality document.



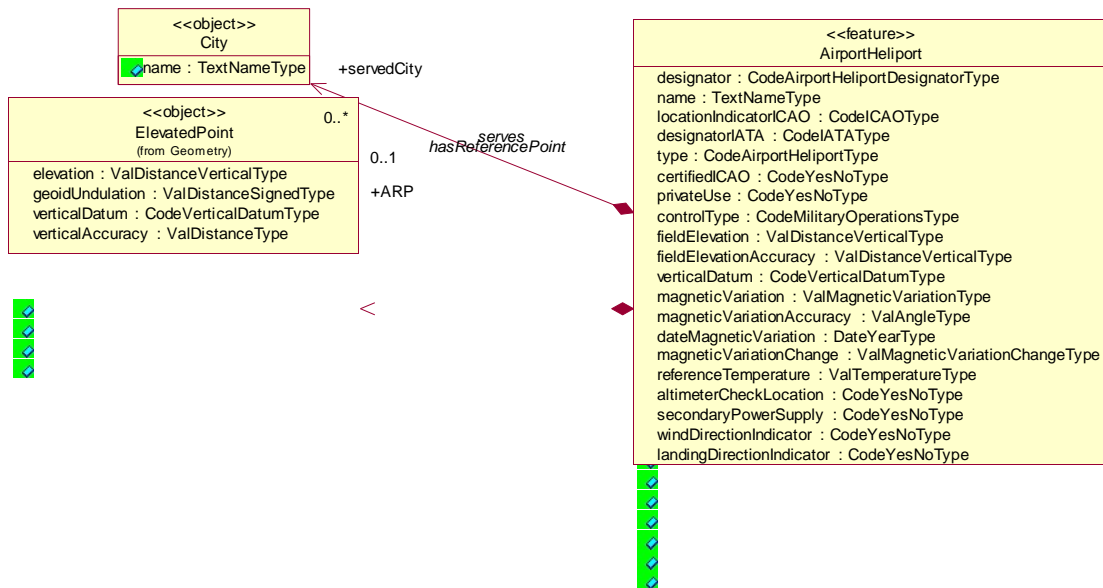
¹ Please see section 3.1 The Abstract Model, which explains why this inheritance is not visible in UML

2.5 Objects

Objects are abstractions of real world entities or, more frequently, of properties of these entities, which do not exist outside of a feature. An object is created for two reasons in AIXM:

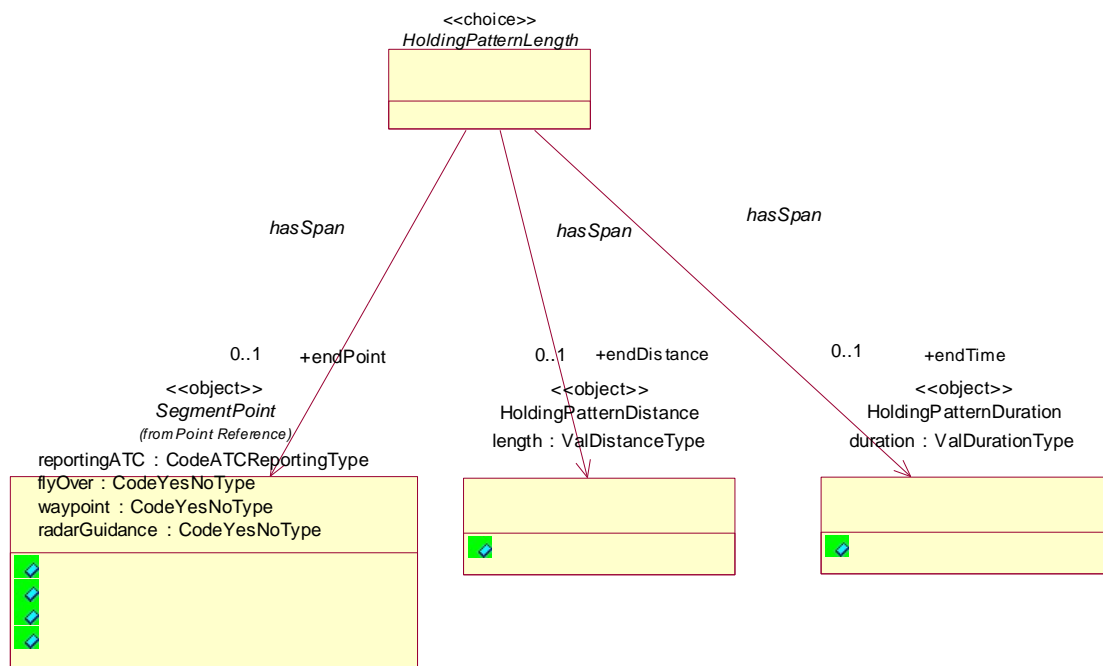
- When a property has a multiplicity greater than one (such as the city served by an AirportHeliport), or
- The object has its own attributes that are reused throughout the model, such as ElevatedPoint.

In both cases, the property is represented as an object with the proper UML composition relationship as shown below.



2.6 Choice

Some classes are marked as <<choice>>. These are used to model XOR relationships. For example, the length of a Holding Pattern can be expressed using a HoldingPatternDistance, a HoldingPatternDuration or a SegmentPoint defining the end of the outbound leg.



2.7 Properties

Properties are the attributes and relationships that characterise a feature or object. In the UML:

- Attributes are used to describe simple properties of a feature or object;
- Relationships are used to describe associations to features or objects. Whenever a property has a multiplicity greater than one, it is described using a UML relationship with cardinality.

2.7.1 Attributes

Simple properties of cardinality one are shown as attributes in the UML diagram.

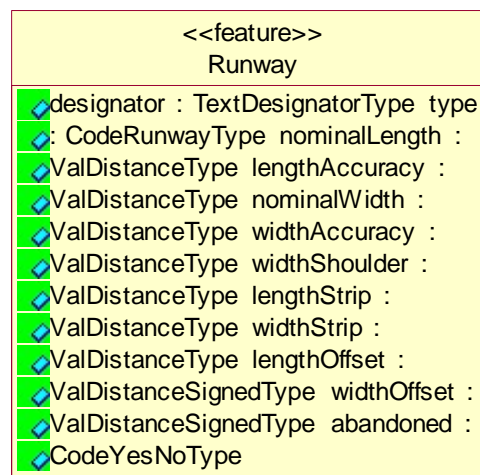
An attribute has the following format:

Visibility / stereotype name : type multiplicity

For AIXM 5 the following values are used:

- Visibility – Public
- / – not used
- Stereotype – not used
- Name – name of the property
- Type – property type
- Multiplicity – usually not specified; for reasons related to the AIXM Temporality model, an implementation should assume that all properties are optional, [0..1]

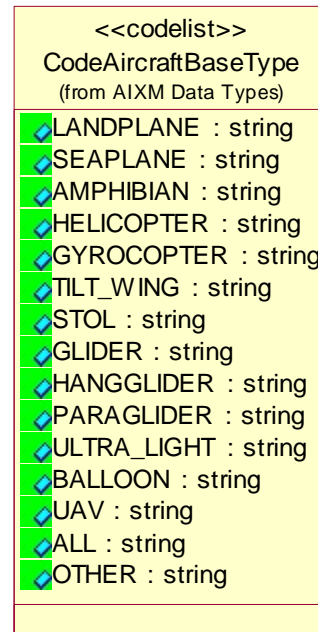
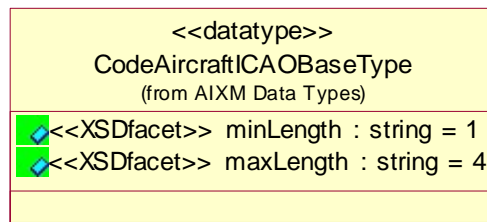
To illustrate, the Runway feature has several simple properties e.g. designator and type. These properties are assigned a datatype; for example, the designator attribute is of type TextDesignatorType.



2.7.1.1 DataTypes

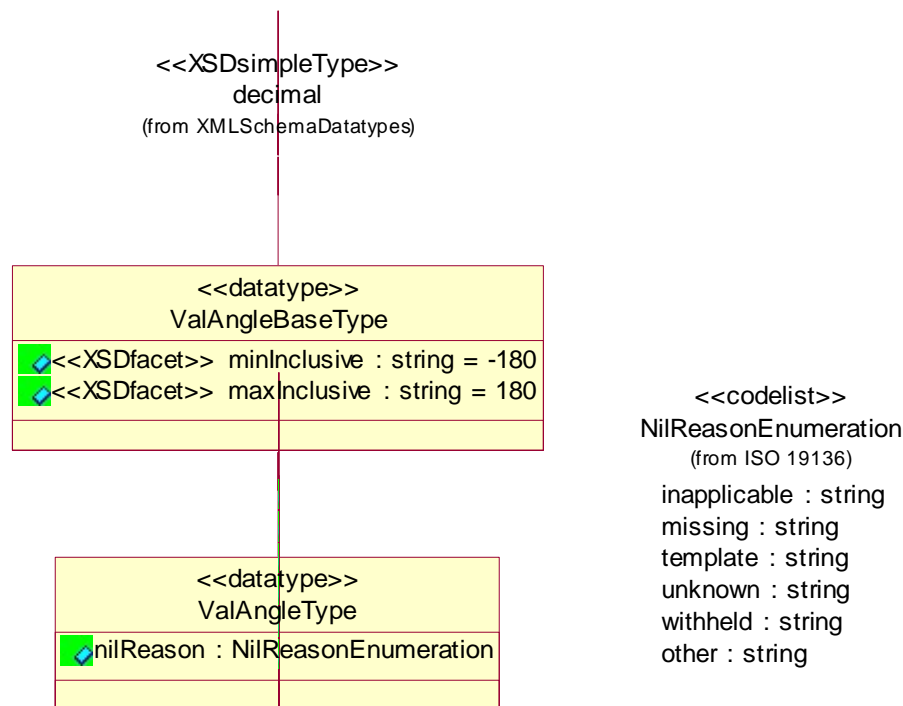
The UML model lists the datatypes that are used throughout the AIXM. These are given one of the two following stereotypes:

- <<datatype>> - This is basic data type that specifies a pattern to use.
- <<codelist>> - This is a data type which codes a predefined list of values. The <<codelist>> includes the value OTHER which can be expanded with some free text in uppercase ("OTHER:MY_VALUE") to support un-supported values.

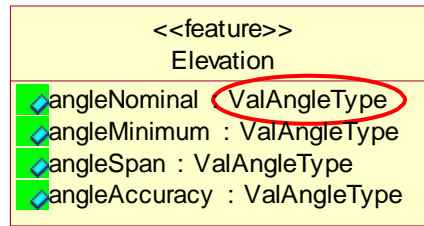


All the data types used to type AIXM simple properties define a nilReason, which is used to indicate the reason for a null value. This is realized in AIXM 5.1 by introducing

- A base type, which contains the core “business” information, such as a range of value for <<datatype>>, or the list of string values for <<codelist>>
- A derived data type, which explicitly declares the nilReason attribute, and which is used to type the corresponding AIXM simple properties.

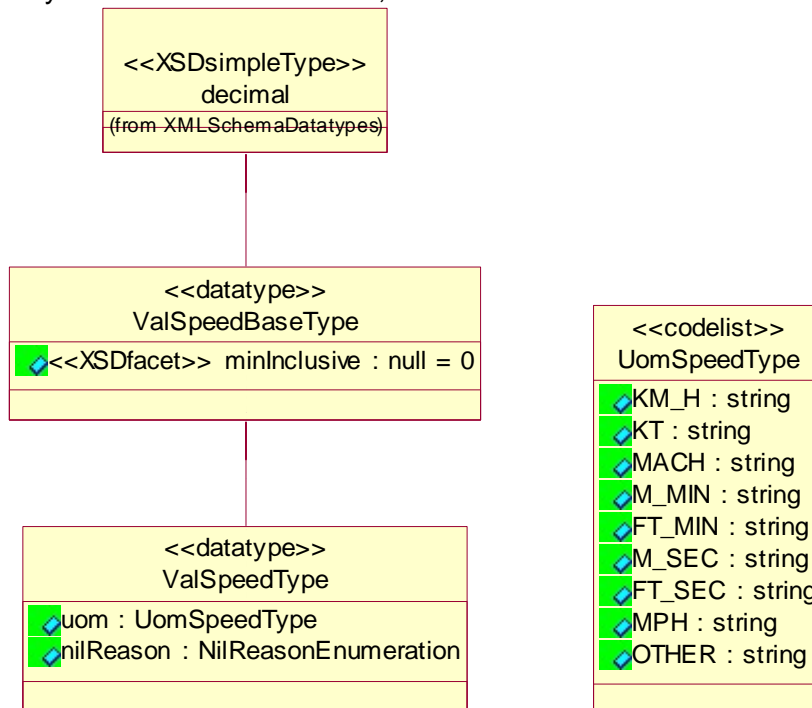


On the example above, the base type used to represent an angle is named **ValAngleBaseType**. It derives from decimal and defines the range of values allowed for an angle percentage ([-180;180]). The derived datatype **ValAngleType** inherits from **ValAngleBaseType** and includes the nilReason, typed with NilReasonEnumeration. **ValAngleType** 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 a <<codelist>> class, as shown below:



Note that the <<codelist>> types representing Units of Measurement do not require a nilReason. As a consequence, no base type is created for uom.

2.7.2 Relationships

Whenever a property has a multiplicity greater than one, it can not be described in UML with an attribute. In that case, the property is described using a UML relationship which specifies the cardinality and which is always navigable in one and only one direction. The name of the complex property is given by the name of the role played by the targeted class.

2.7.2.1 Relationships to Objects

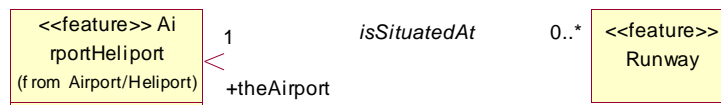
Relationships to objects are depicted by the standard UML composition (*aggregation by value*) association. Composition is a form of aggregation with strong ownership and coincident lifetime of the parts by the whole. The part is removed when the whole is removed.



The example above shows that the <<feature>> Runway has a property named *theSurface*. This property is modelled in UML using a composition association between the <<feature>> Runway and an object representing the characteristics of a geometric surface.

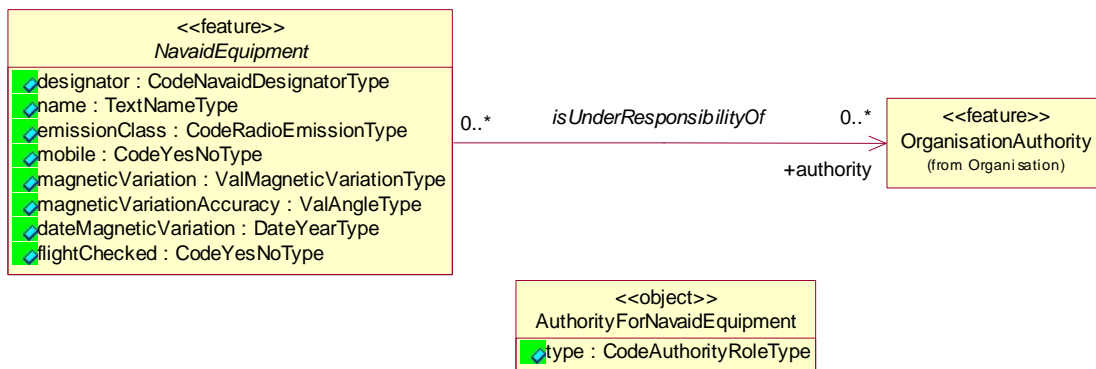
2.7.2.2 Relationships to Features

Relationships to features are described with a standard UML association. All of the associations are navigable in only one direction. This shows that the two classes are related but only one class knows that the relationship exists. In the example below the Runway feature knows about the AirportHeliport but the AirportHeliport does not know about the Runway.



2.7.2.3 Association Classes

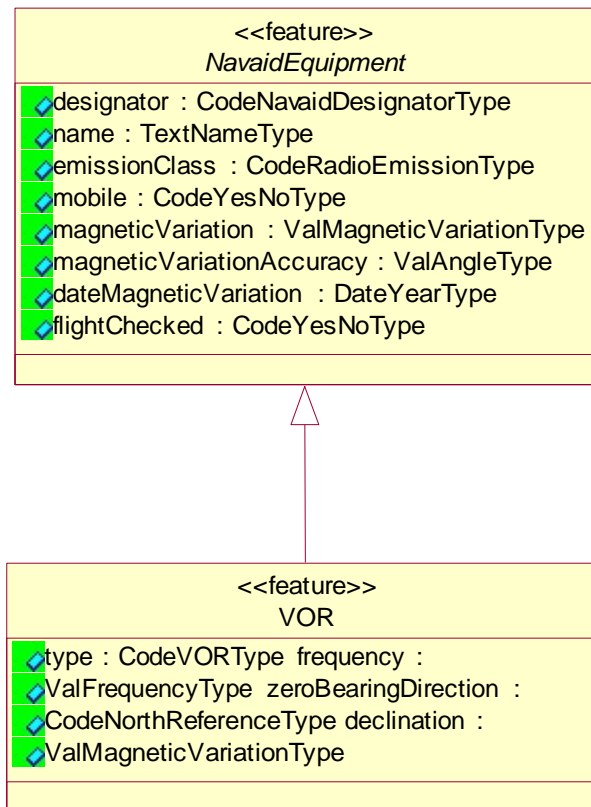
When information about a relationship is required, a UML association class is used. The association class is attached to the relationship with a dotted line.



2.8 Inheritance

Inheritance refers to the ability of one class (the specialized or child class) to inherit the properties of another class (the generalized or parent class), and then add new properties of its own. In AIXM, Features must only inherit from other Features and Objects must only inherit from other Objects. Multiple inheritance is not allowed.

In the example below the VOR is a kind of NavaidEquipment.



2.9 Naming

Feature, Object and Choice names are written in UpperCamelCase e.g. NavaidEquipment.

Simple property names (i.e. attributes) are written in lowerCamelCase e.g. widthShoulder. Relationship names are written in lowerCamelCase but as present tense verbs e.g. isSituatingAt. Relationship Role names are also written in lowerCamelCase and they are nouns that express the role played by the class in the association.

Datatype names are written in UpperCamelCase and end with 'Type' e.g. CodeAircraftType.

3 Other Aspects of the Model

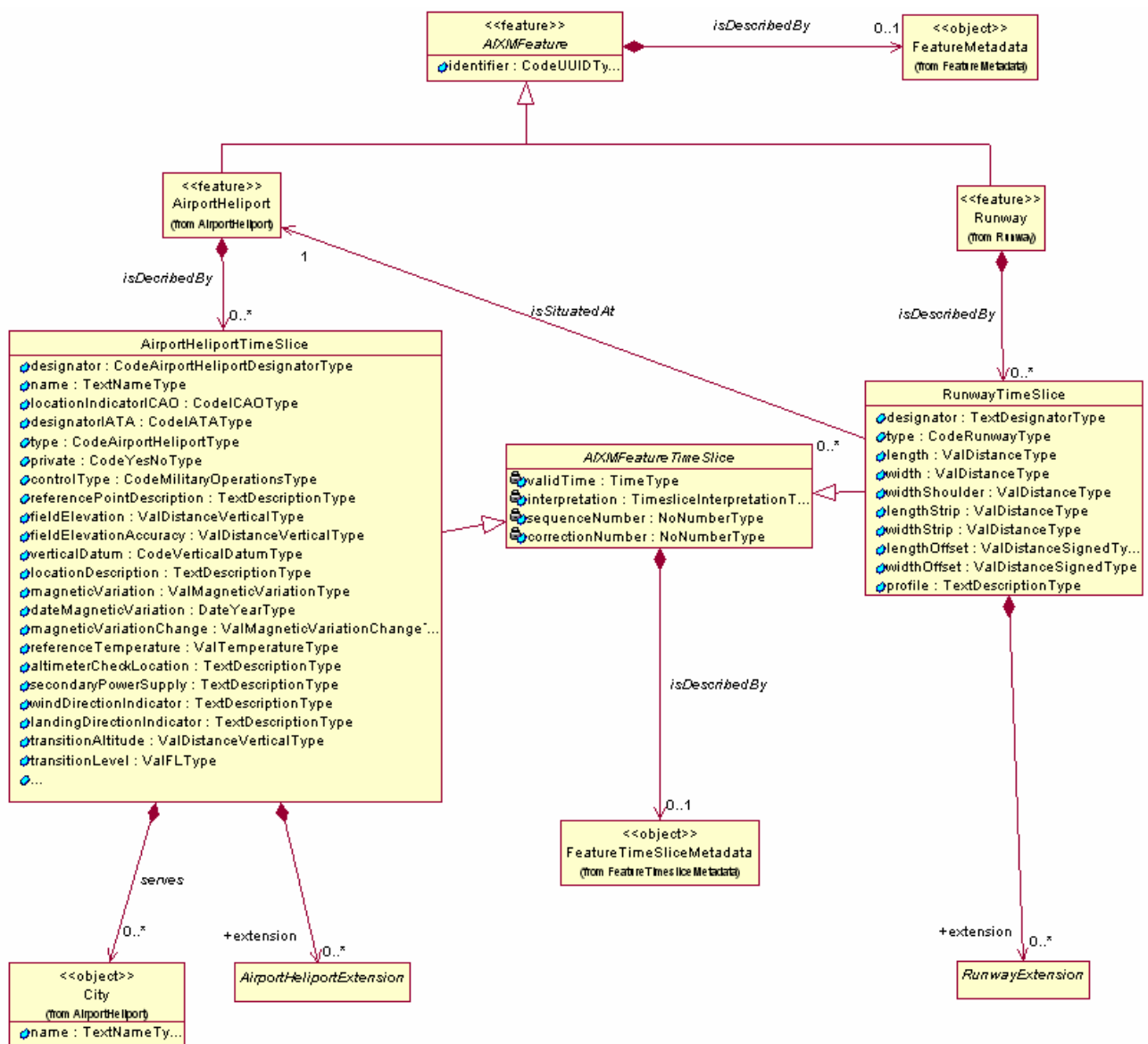
To simplify the UML model some convenience steps have been taken. Some elements are not shown on every diagram and some relationships are 'assumed'.

3.1 The Abstract Model

The model should contain a set of abstract AIXM classes that are used as the building blocks for the AIXM XML Schema. However, for simplicity, these relationships are not shown on any diagram and do not really exist in the UML. They are just assumed to exist, when converting from the UML model to the XML Schema of AIXM.

3.1.1 AIXMFeature and AIXMFeatureTimeSlice Class

The UML below shows how each and every <<feature>> inherits from the abstract AIXMFeature class. The concrete features are described by TimeSlices which are composed of properties. The TimeSlice inherits from the abstract AIXMFeatureTimeSlice class.



The diagram above is quite complex. If applied to the whole set of AIXM classes, it might undermine 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, all of these relationships and classes must be mapped in the AIXM XML Schema.

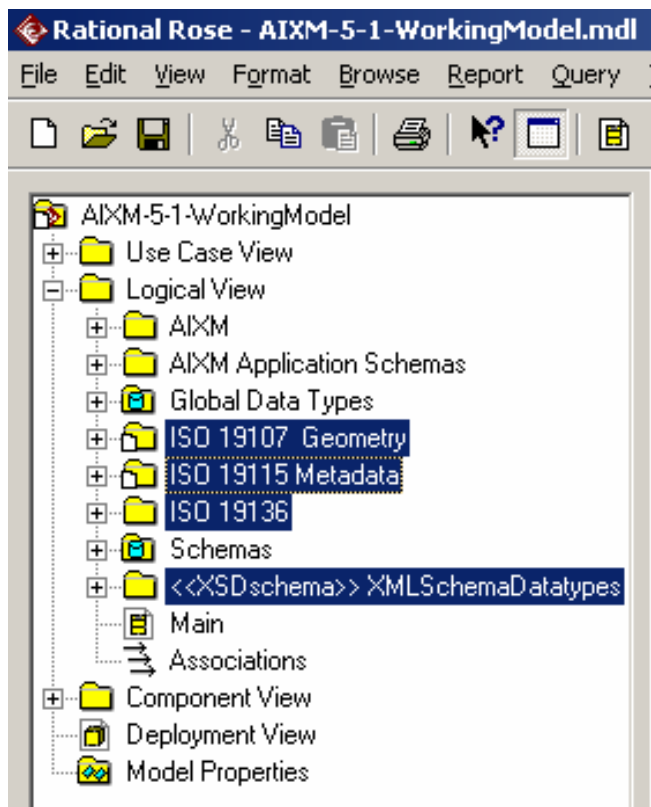
3.1.2 Metadata

The diagram also shows that each AIXM Feature and each TimeSlice is described by metadata. The AIXM XML schema incorporates the ISO 19139 metadata elements - see 3.2.2.

3.1.3 Extension

Finally, each TimeSlice may contain an Extension. The Extension mechanism allows each user of AIXM5 to define and use his own specific attributes and classes.

3.2 External packages



3.2.1 <<XSDschema>> XMLSchemaDatatypes

The XSD Schema Datatypes package declares XSD specific data types that are referenced by AIXM data types, when generating the AIXM XML (XSD) Schema. However, these XSD bindings do not mean that AIXM is "dependent" on the XML Schema specification. The pre-defined XSD simple types (such as string, decimal, unsignedInt, etc.) referenced by AIXM are sufficiently generic and mappable to the simple data types of many other data encoding standards.

3.2.2 ISO 19115 Metadata

This package contains some basic connections from the AIXM model to the ISO 19115 Metadata elements (MD_Metadata, MD_Constraints ...).

3.2.3 ISO 19107 Geometry

This package contains some basic connections from the AIXM model to the ISO 19107 geometry elements (GM_Point, GM_Surface ...).

3.2.4 ISO 19136

This package contains some basic connections from the AIXM model to GML specific elements, which are not part of the ISO 19107. Practically, the package contains only the data type NilReasonEnumeration, used to indicate the reason for a null value.

4 Mapping to the AIXM XML Schema

4.1 AIXM - core XSD files

The core AIXM exchange format is composed of three main files:

AIXM_AbstractGML_ObjectTypes.xsd: the file references the ISO19139 Metadata Schema and defines the base AIXM Feature/Object constructs

- AbstractAIXMFeatureType / AbstractAIXMFeature
- AbstractAIXMTimesliceType / AbstractAIXMTimeslice
- AbstractAIXMObjectType
- AbstractAIXMPropertyType, which defines the nilReason for all the AIXM complex properties

AIXM_Datatypes.xsd: this file contains the XML representation of all the data types defined in the AIXM UML model.

AIXM_Features.xsd: this file contains the XML representation of all the AIXM features with all their properties (simple and complex).

The chapters here after specify the rules that govern the mapping between the AIXM UML model and the AIXM XML Schema.

4.2 AIXM is GML

The AIXM exchange model is an XML exchange standard based on a subset of the Geography Markup Language (GML). Essentially:

- AIXM Features are GML features;
- AIXM Objects are GML objects;
- AIXM follows the GML object-property concept.

4.3 The GML Object-Property Model

The GML object-property model explains some of the complexity of the AIXM UML to XSD mapping. It means that no GML object may appear as the immediate child of a GML object. Consequently, no element may be both a GML object and a GML property.

The object-property model prohibits the encoding of an object directly inside a feature, e.g.

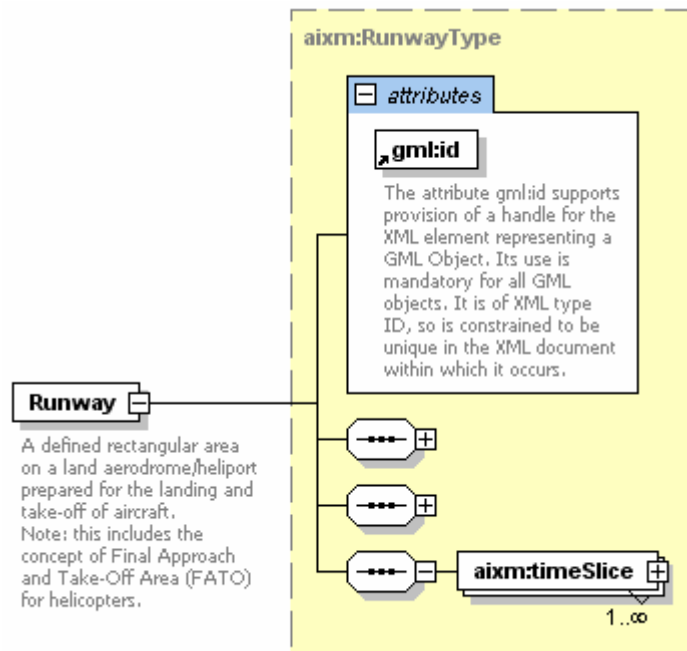
```
<AirportHeliport> <!-- feature -->
  <ElevatedPoint> <!-- object -->
```

Instead, in a compliant GML application schema, an association between two features (or a feature and an object) is implemented over a property of the feature, e.g.

```
<AirportHeliport> <!-- feature -->
  <hasReferencePoint> <!-- property -->
    <ElevatedPoint> <!-- object -->
```

The direction of the association arrow from the UML diagrams (the navigability) dictates which of the two association partners has the property that associates the other.

In the AIXM XML Schema, the object-property model is encoded by declaring a type and then assigning properties (attributes and relationships) to that type. The type defines the object.



4.4 Mapping Inheritance

Within the AIXM XML Schema, inheritance implies two characteristics:

1. Substitutability. The more general feature or object can be substituted by a specialization. In the XML schema this is supported using substitution groups.
2. Property inheritance. The specialized feature inherits all of the properties of the more general feature. In the XML schema including the properties of the general class into the specialized class supports this.

4.5 Mapping Name of Classes

The UML class name is used for the element names in the XML Schema.

4.6 Mapping Features

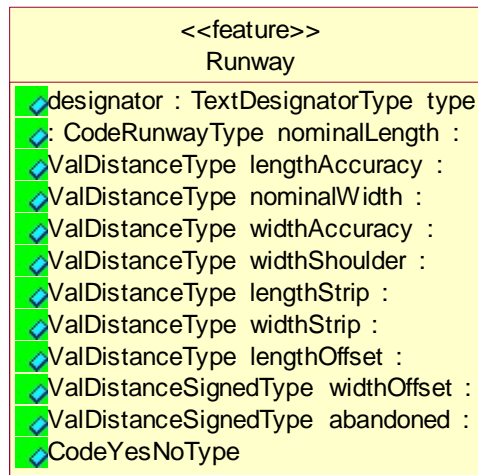
For each AIXM Feature in the UML, the following XML schema entities are created:

- FeaturePropertyType*
- Feature FeatureType*
- FeatureTimeSlicePropertyType*
- FeatureTimeSlice.*
- FeatureTimeSliceType*
- FeaturePropertyGroup*
- AbstractFeatureExtension*

↑
The direction in which the different types and elements are used in the schema definition (e.g. Feature uses FeatureType)

4.6.1 An Example Mapping

The Runway feature (shown below) will be used to illustrate the mapping. The example will concentrate on the properties (shown as attributes).



4.6.1.1 RunwayPropertyGroup

An XML Schema (XSD) group is generated for each feature containing all of the properties (attributes and relationships) of the feature.

The order in which the chilled elements of the group are declared is the following:

1. (if applicable) in the case of derived classes only, the property group of the super class is inserted first;
2. then, all the elements that correspond to class attributes, in the order that they appear in the UML class diagram
3. then, all the elements that correspond to association role names, in random order;
4. last the “annotation” property – note that for derived classes this property is only defined in the super class, therefore it will appear in the property group of the super class.

Below is an example of the RunwayPropertyGroup in graphic form and as an extract from the XSD. It shows clearly how the attributes are mapped from the UML to the XSD and how the relationship ‘associatedAirportHeliport’ is created.



- aixm:designator**

The full textual designator of the runway, used to uniquely identify it at an aerodrome/heliport which has more than one.
E.g. 09/27, 02R/20L, RWY 1.
- aixm:type**

The type can be either runway for airplanes or final approach and take off area (FATO) for helicopters.
- aixm:nominalLength**

The declared longitudinal extent of the runway for operational (performance) calculations.
- aixm:lengthAccuracy**

Accuracy of the value of the physical length of the runway.
- aixm:nominalWidth**

The declared transversal extent of the runway for operational (performance) calculations.
- aixm:widthAccuracy**

Accuracy of the value of the physical width of the runway.
- aixm:widthShoulder**

The value of the runway shoulder width.
- aixm:lengthStrip**

The value of the physical length of the strip. The runway strip is a defined area including the runway and, if applicable, the stopway. It is intended (a) to reduce the risk of damage to aircraft running off the runway and (b) to protect aircraft flying over the runway during take-off or landing operations.
- aixm:widthStrip**

The value of the physical width of the strip.
- aixm:lengthOffset**

A value specifying the longitudinal offset of the strip, when it is not symmetrically extended beyond the two runway ends.

Notes: The longitudinal offset defines the distance along the centreline from the middle of the runway centreline towards the middle of the strip centreline. An offset in the direction defined from the threshold with the lower runway direction designation number towards the opposite runway threshold is indicated by a positive value. An offset in the opposite sense is indicated by a negative value.

Example: a runway oriented 09/27 has a strip that is extending 120 m before the threshold of the runway direction 09 and only 100 m before the threshold of the runway direction 27. The value of the longitudinal offset will be -10 m.
- aixm:widthOffset**

A value specifying the lateral offset of the strip, when it is not symmetrically extended beyond the two runway edges.

Note: The lateral offset defines the distance from the runway centreline to the strip centreline in direction perpendicular to the runway centreline. An offset to the right, based on the direction defined from the threshold with the lower runway direction designation number towards the opposite runway threshold, is indicated by a positive value. An offset to the left is indicated by a negative value.

Example: a runway oriented 09/27 has a strip that is extending 150 m to the right of the runway direction 09 and 300 m to the left of the same runway direction. The value of the lateral offset will be -75 m.
- aixm:abandoned**

Indicating that the surface is no longer in operational use, but it is still physically present and visible, although usually in a degraded state.
- aixm:surfaceProperties**

Identifies the surface characteristics of the runway.
- aixm:associatedAirportHeliport**

Identifies the Airport where the Runway is situated.
- aixm:overallContaminant**

0..∞

Identifies the contaminant of the runway.
- aixm:areaContaminant**

0..∞
- aixm:annotation**

0..∞

```

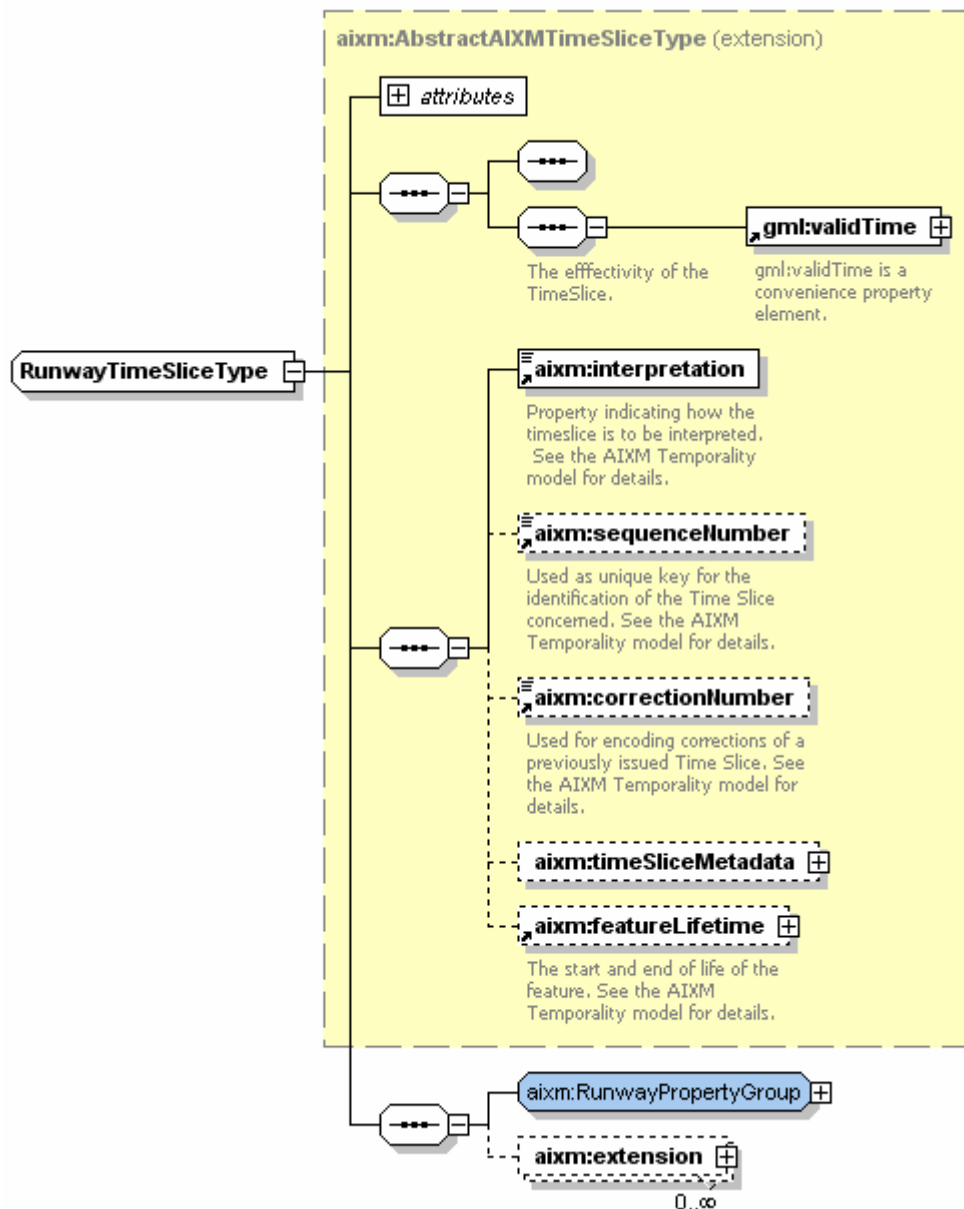
<group name="RunwayPropertyGroup">
  <sequence>
    <element name="designator" type="aixm:TextDesignatorType"
nillable="true" minOccurs="0"/>
    <element name="type" type="aixm:CodeRunwayType" nillable="true"
minOccurs="0"/>
    <element name="nominalLength" type="aixm:ValDistanceType"
nillable="true" minOccurs="0"/>
    <element name="lengthAccuracy" type="aixm:ValDistanceType"
nillable="true" minOccurs="0"/>
    ...
    <element name="associatedAirportHeliport"
type="aixm:AirportHeliportPropertyType" nillable="true" minOccurs="0"/>
    ...
    <element name="areaContaminant" type="aixm:
RunwayContaminationPropertyType" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
    <element name="annotation" type="aixm:NotePropertyType" nillable="true"
minOccurs="0" maxOccurs="unbounded"/>
  </sequence>
</group>

```

4.6.1.2 RunwayTimeSliceType

The properties of a feature or the target of any feature relationship can change within the lifetime of the feature. This temporality can be expressed in GML by using dynamic features and feature collections. The TimeSlice property of a dynamic feature contains one or more Feature TimeSlices that capture the evolution of the feature over time. A gml:TimeSlice object contains the dynamic properties of the feature.

For each feature a TimeSlice property is created that contains an array of feature TimeSlice objects. This example shows the RunwayTimeSliceType encapsulating all of the Runway properties (RunwayPropertyGroup created above) that change over time.



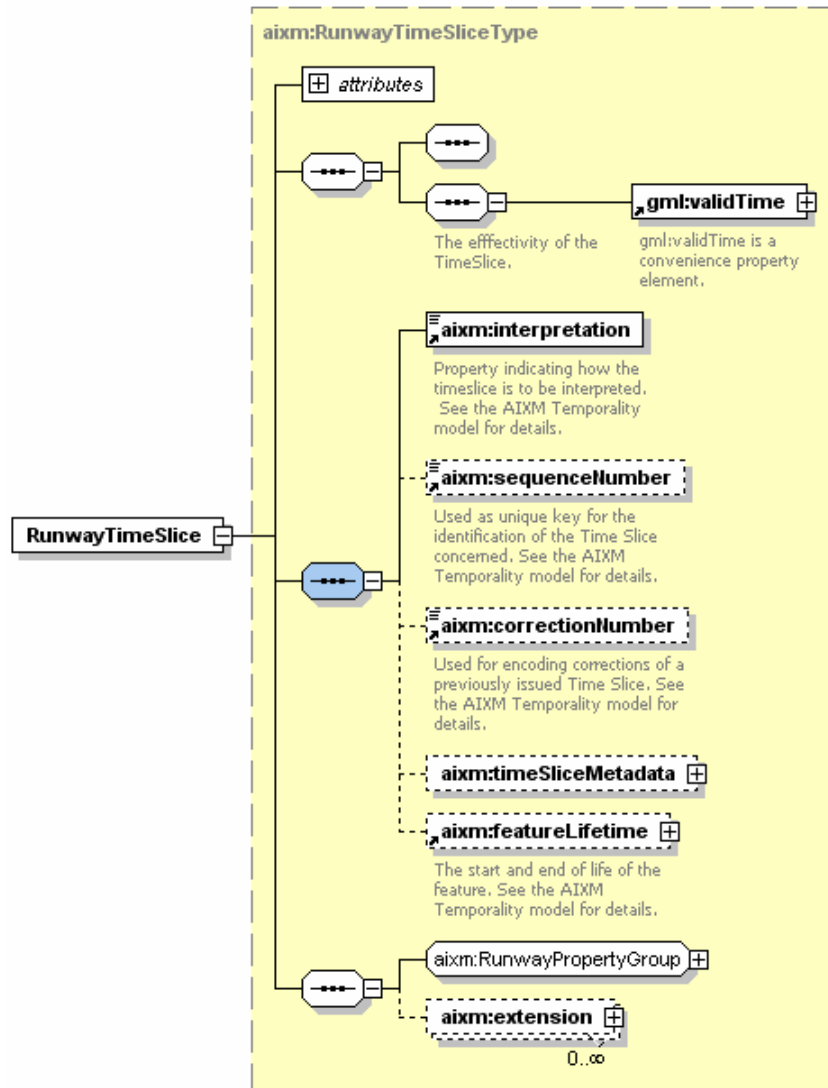
```

<complexType name="RunwayTimeSliceType" >
  <complexContent>
    <extension base="aixm:AbstractAIXMTimeSliceType">
      <sequence>
        <group ref="aixm:RunwayPropertyGroup" />
        <element name="extension" minOccurs="0" maxOccurs="unbounded">
          <complexType>
            <sequence>
              <element ref="aixm:AbstractRunwayExtension" />
            </sequence>
            <attributeGroup ref="gml:OwnershipAttributeGroup" />
          </complexType>
        </element>
      </sequence>
    </extension>
  </complexContent>
</complexType>

```

4.6.1.3 RunwayTimeSlice

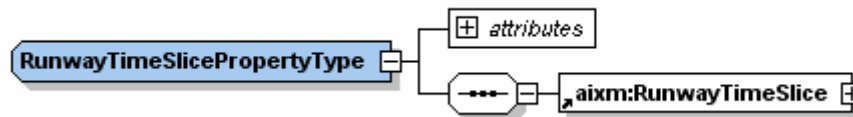
The *FeatureTimeSlice* object is of type *FeatureTimeSliceType*. Continuing the example, the *RunwayTimeSlice* element is of type *RunwayTimeSliceType*.



```
<element name="RunwayTimeSlice" type="aixm:RunwayTimeSliceType"
substitutionGroup="gml:AbstractTimeSlice"/>
```

4.6.1.4 RunwayTimeSlicePropertyType

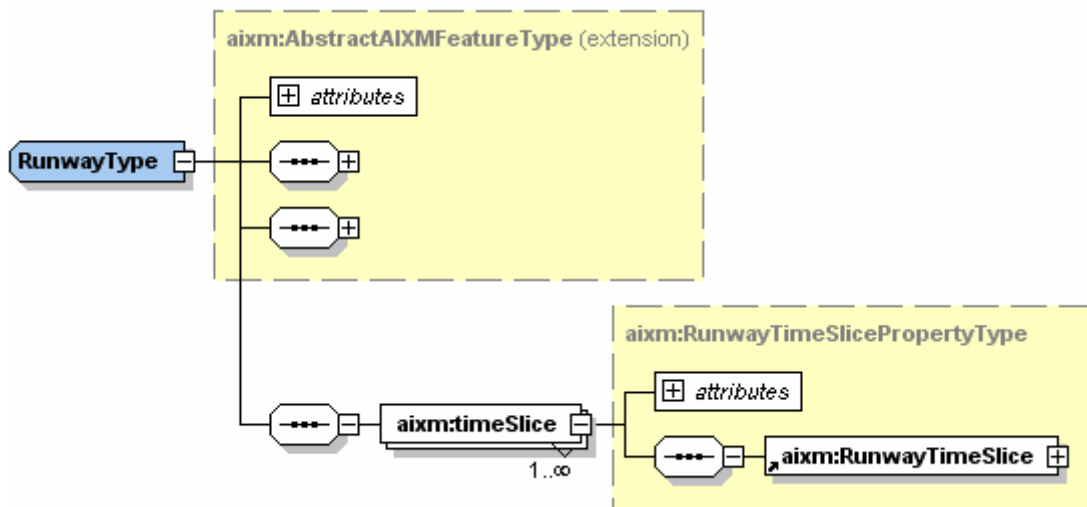
A GML property type containing a *FeatureTimeSlice* objects is created.



```
<complexType name="RunwayTimeSlicePropertyType" >
  <sequence>
    <element ref="aixm:RunwayTimeSlice" />
  </sequence>
  <attributeGroup ref="gml:OwnershipAttributeGroup" />
</complexType>
```

4.6.1.5 RunwayType

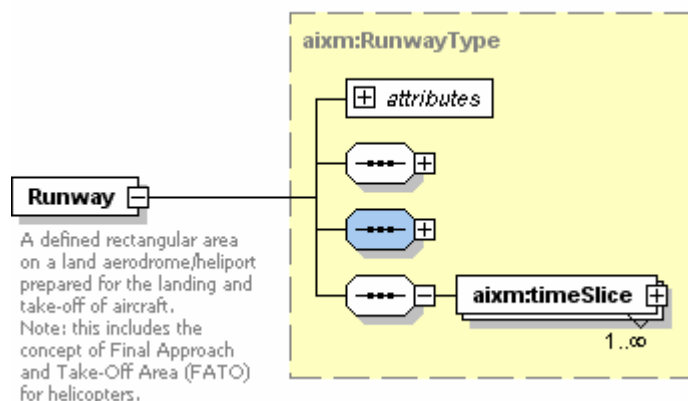
Continuing with the object-property model, the Runway feature type is created extending the AbstractAIXMFeatureType with the RunwayTimeSlice object created above.



```
<complexType name="RunwayType" >
  <complexContent>
    <extension base="aixm:AbstractAIXMFeatureType">
      <sequence>
        <element name="timeSlice" type="aixm:RunwayTimeSlicePropertyType"
maxOccurs="unbounded"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
```

4.6.1.6 Runway

The Runway feature is then defined by the RunwayType.

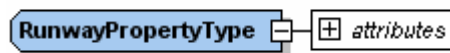


```
<element name="Runway" type="aixm:RunwayType"
substitutionGroup="aixm:AbstractAIXMFeature">
  <annotation>
    <appinfo>RWY</appinfo>
    <appinfo><gml:description>A defined rectangular area on a land
aerodrome/heliport prepared for the landing and take-off of aircraft. Note:
this includes the concept of Final Approach and Take-Off Area (FATO) for
helicopters.</gml:description></appinfo>
  </annotation>
</element>
```

4.6.1.6.1 RunwayPropertyType

When a property of a feature is a relationship, the relationship must be associated to another feature or object. This is done through the creation of the *FeaturePropertyType*, in this case, the *RunwayPropertyType*.

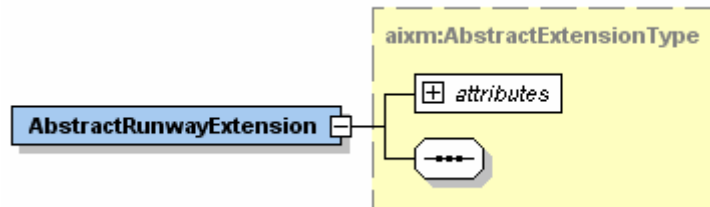
In AIXM, when the relationship or association points to another feature, the feature is referenced using the `xlink:href` attribute (it's always a "remote" encoding). When the relationship points to an object, the object is included inside the parent. (Objects cannot exist without the parent.) Since a Runway is a feature the *RunwayPropertyType* is created with the attribute `xlink:href`.



```
<complexType name="RunwayPropertyType" >
  <attributeGroup ref="gml:OwnershipAttributeGroup" />
  <attributeGroup ref="gml:AssociationAttributeGroup" />
</complexType>
```

4.6.1.7 RunwayExtension

All Features and Objects can be extended. A relationship is created with an abstract XML element that acts as the root for all extensions. Below is an example of the extension for the Runway feature. The *AbstractRunwayExtension* element uses the *AbstractExtensionType* as shown below.



```
<element name="AbstractRunwayExtension" type="aixm:AbstractExtensionType"
  abstract="true" substitutionGroup="aixm:AbstractExtensionType" />
```

4.7 Mapping Objects

AIXM objects are encoded as GML objects. For the most part, the XML schema entities are created in the same way as for Features, following the object-property model. However it is important to remember that AIXM objects do not exist outside of a feature and are therefore part of the feature timeslice. TimeSlice types and elements are not created for objects.

For each AIXM Object the following XML schema entities are created:

- ObjectPropertyGroup*
- Object ObjectType*
- ObjectPropertyType*
- AbstractObjectExtension*

ObjectType is complex type which extends *AbstracAIXMObjectType*.

```

<complexType name="NavaidEquipmentDistanceType">
  <complexContent>
    <extension base="aixm:AbstractAIXMObjectType">
      <sequence>
        <group ref="aixm:NavaidEquipmentDistancePropertyGroup"/>
        <element name="extension" minOccurs="0" maxOccurs="unbounded">
          <complexType>
            <sequence>
              <element ref="aixm:AbstractNavaidEquipmentDistanceExtension"/>
            </sequence>
            <attributeGroup ref="gml:OwnershipAttributeGroup"/>
          </complexType>
        </element>
      </sequence>
    </extension>
  </complexContent>
</complexType>

```

ObjectPropertyType type is a complex type which extends *aixm:AbstractAIXMPropertyType*.

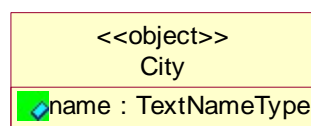
```

<complexType name="NavaidEquipmentDistancePropertyType">
  <complexContent>
    <extension base="aixm:AbstractAIXMPropertyType">
      <sequence>
        <element ref="aixm:NavaidEquipmentDistance"/>
      </sequence>
      <attributeGroup ref="gml:OwnershipAttributeGroup"/>
    </extension>
  </complexContent>
</complexType>

```

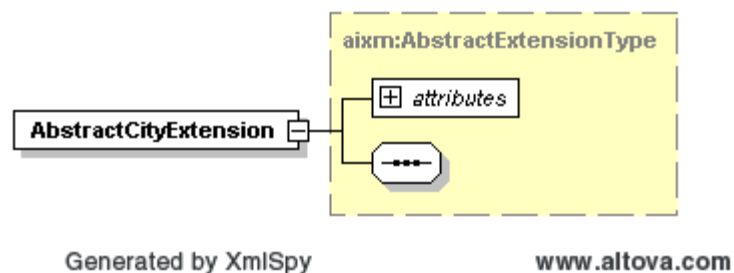
4.7.1 An Example Mapping

The example will use the City object illustrated below. The object represents the town that is served by an AirportHeliport.



4.7.1.1 AbstractCityExtension

An abstract XML element acts as the root for all extension to the City object. Object extensions are defined in the same way as Feature extensions.



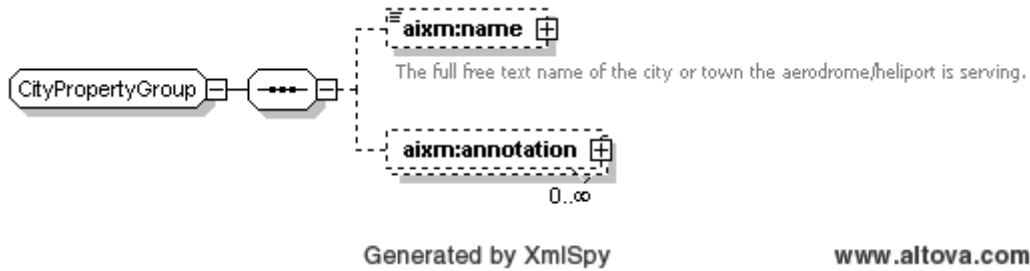
```

<element name="AbstractCityExtension" type="aixm:AbstractExtensionType"
  abstract="true" substitutionGroup="aixm:AbstractExtension"/>

```

4.7.1.2 CityPropertyGroup

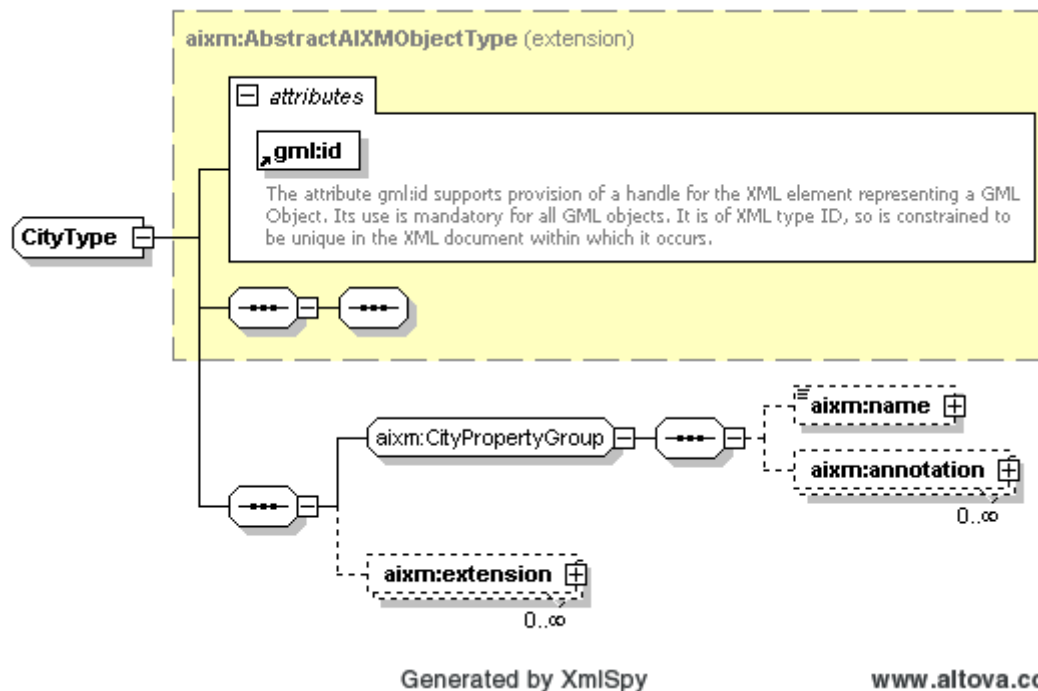
An XSD group containing the properties of the City object is created, again similar to Features.



```
<group name="CityPropertyGroup" >
  <sequence>
    <element name="name" type="aixm:TextNameType" nillable="true"
minOccurs="0">
      <annotation>
        <appinfo>AIXM 4.5</appinfo>
        <appinfo><gml:description>The full free text name of the city or town
the aerodrome/heliport is serving.
        </gml:description></appinfo>
      </annotation>
    </element>
    <element name="annotation" type="aixm:NotePropertyType" nillable="true"
minOccurs="0" maxOccurs="unbounded">
      </element>
    </sequence>
  </group>
```

4.7.1.3 CityType

The CityType definition uses the CityPropertyGroup and the extension. It extends AbstractAIXMObjectType



```
<complexType name="CityType" >
  <complexContent>
    <extension base="aixm:AbstractAIXMObjectType">
      <sequence>
```

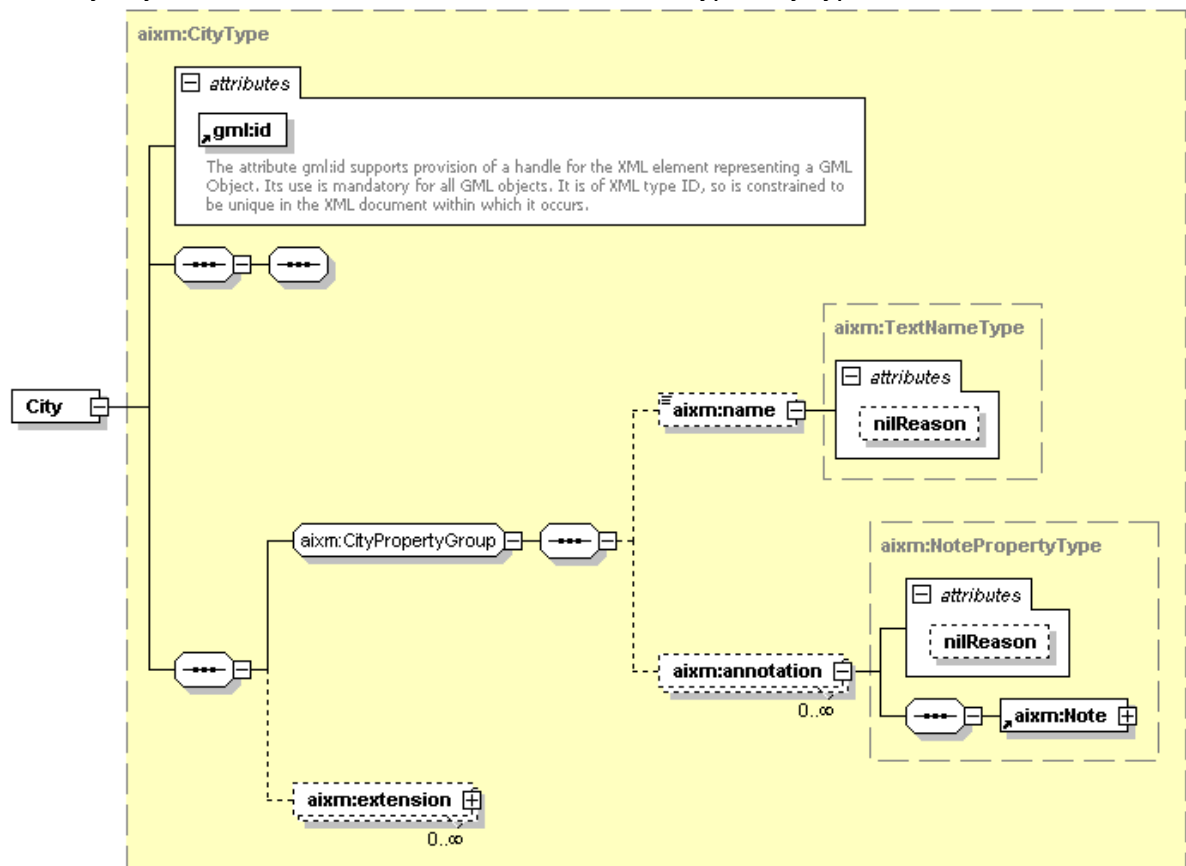
```

<group ref="aixm:CityPropertyGroup"/>
<element name="extension" minOccurs="0" maxOccurs="unbounded">
  <complexType>
    <sequence>
      <element ref="aixm:AbstractCityExtension"/>
    </sequence>
    <attributeGroup ref="gml:OwnershipAttributeGroup"/>
  </complexType>
</element>
</sequence>
</extension>
</complexContent>
</complexType>

```

4.7.1.4 City

The City object is then defined as an XSD element of type CityType.



Generated by XmlSpy

www.altova.com

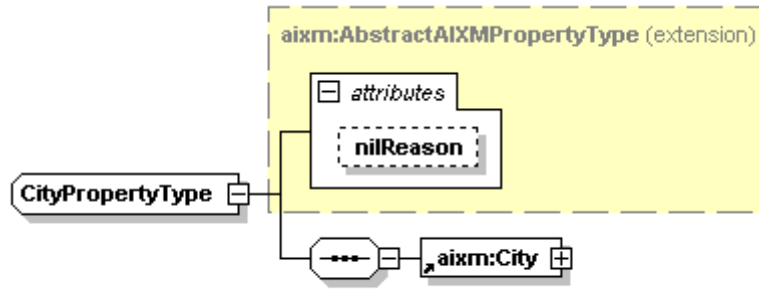
```

<element name="City" type="aixm:CityType">
  <annotation>
    <appinfo><gml:description>A city or location that may be served by an
airport/heliport.</gml:description></appinfo>
  </annotation>
</element>

```

4.7.1.5 CityPropertyType

An XSD complex type representing a GML property type is created. A Feature uses this element to include the City object rather than reference it (using `xlink:href`) because object does not exist without the parent.



Generated by XmlSpy

www.altova.com

```
<complexType name="CityPropertyType">
```

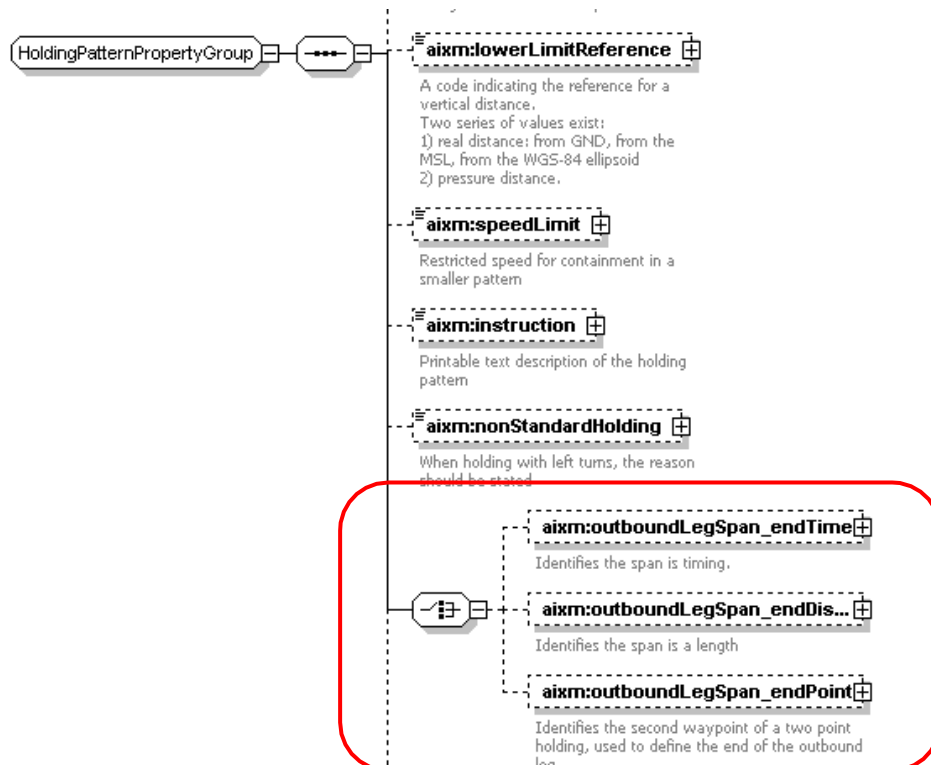
```

  <complexContent>
    <extension base="aixm:AbstractAIXMObjectType">
      <sequence>
        <element ref="aixm:City"/>
      </sequence>
      <attributeGroup ref="gml:OwnershipAttributeGroup"/>
    </extension>
  </complexContent>
</complexType>

```

4.8 Mapping Choices

Classes marked with the stereotype <<choice>> do not appear in the XML Schema. Instead, the choice of elements is created.



The name of the element is the concatenation of the role of the <<choice>> class with the role of the target class of each choice branch, separated by “_”.

```
<group name="HoldingPatternPropertyGroup">
```

```

  <sequence>
    .....
    <element name="nonStandardHolding" type="aixm:CodeYesNoType"
      nillable="true" minOccurs="0">

```

```

<annotation>
  <appinfo>
    <gml:description>ndicates whether the HoldingPattern is non-
standard, for example because it uses left-hand turns.</gml:description>
  </appinfo>
</annotation>
</element>
<choice>
  <element name="outboundLegSpan_endTime"
type="aixm:HoldingPatternDurationPropertyType" nillable="true"
minOccurs="0">
    <annotation>
      <appinfo>
        <gml:description>Span is timing</gml:description>
      </appinfo>
    </annotation>
  </element>
  <element name="outboundLegSpan_endDistance"
type="aixm:HoldingPatternDistancePropertyType" nillable="true"
minOccurs="0">
    <annotation>
      <appinfo>
        <gml:description>span is length</gml:description>
      </appinfo>
    </annotation>
  </element>
  <element name="outboundLegSpan_endPoint"
type="aixm:SegmentPointPropertyType" nillable="true" minOccurs="0">
    <annotation>
      <appinfo>
        <gml:description>The second waypoint of a two point holding, used
to define the end of the outbound leg.</gml:description>
      </appinfo>
    </annotation>
  </element>
</choice>
.....
</sequence>
</group>

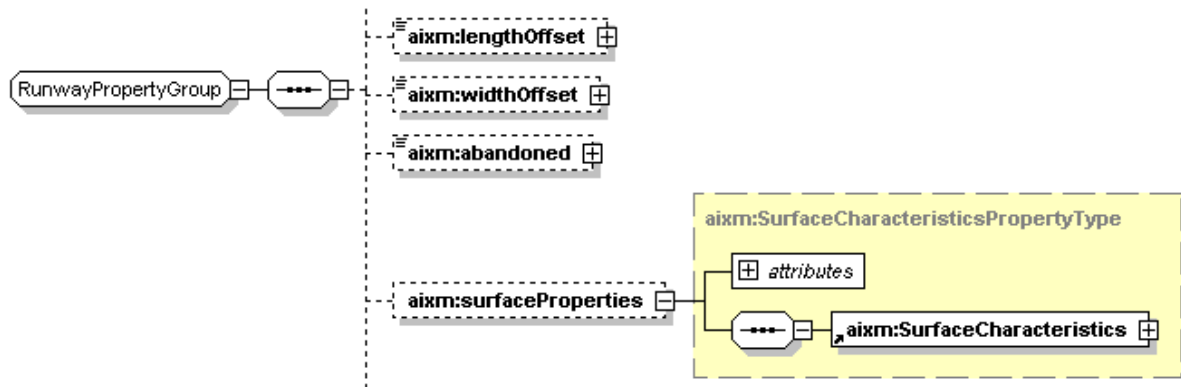
```

4.9 Mapping Relationships to Objects

Relationships are encoded by creating an XML element with the same name as the role name on the UML model. It is of type *ObjectPropertyType*.



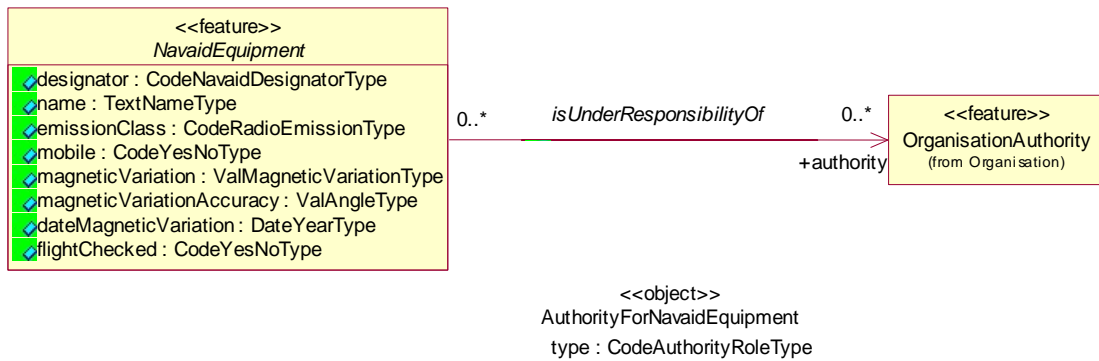
In this example, the SurfaceCharacteristics object is a property of the Runway. The "surfaceProperties" property of the Runway is defined as being of type SurfaceCharacteristicsPropertyType.



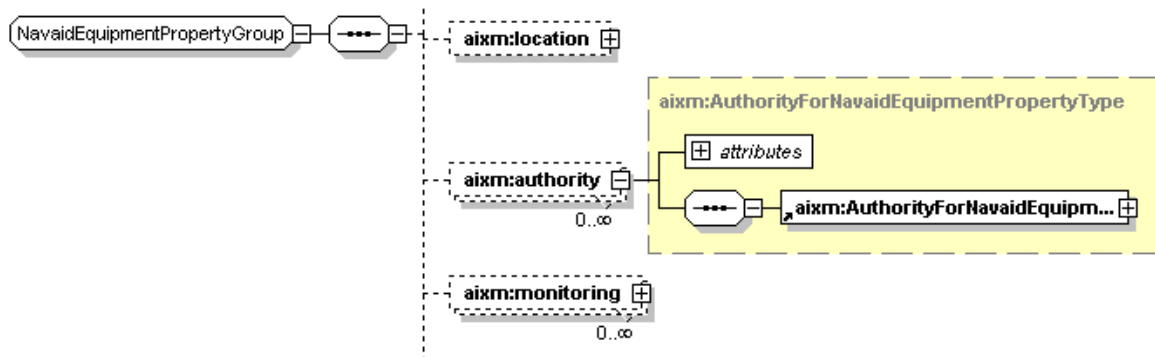
```
<element name="surfaceProperties"
type="aixm:SurfaceCharacteristicsPropertyType" minOccurs="0" />
```

4.9.1 Mapping Associations with Association Classes

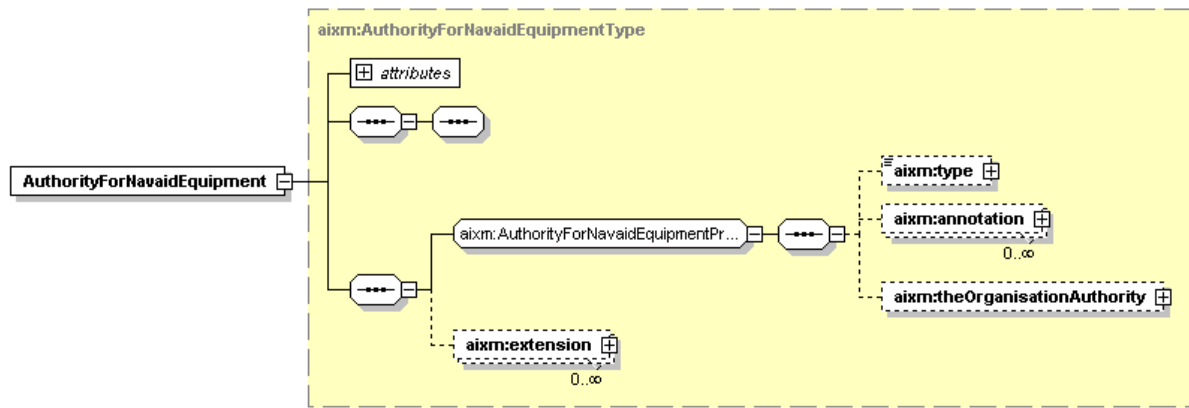
In the UML below, the NavaidEquipment feature has a relationship to the OrganisationAuthority feature. This relationship contains properties defined in the AuthorityForNavaidEquipment class.



When mapping this in XSD, an 'authorityForNavaidEquipment' property is created in the NavaidEquipment feature as shown below. The name of this property is automatically derived from the name of the association class, by conversion to lowerCamelCase style. The direction of the arrow is important. If the direction would have been to the NavaidEquipment, the property would have been created in the OrganisationAuthority feature.

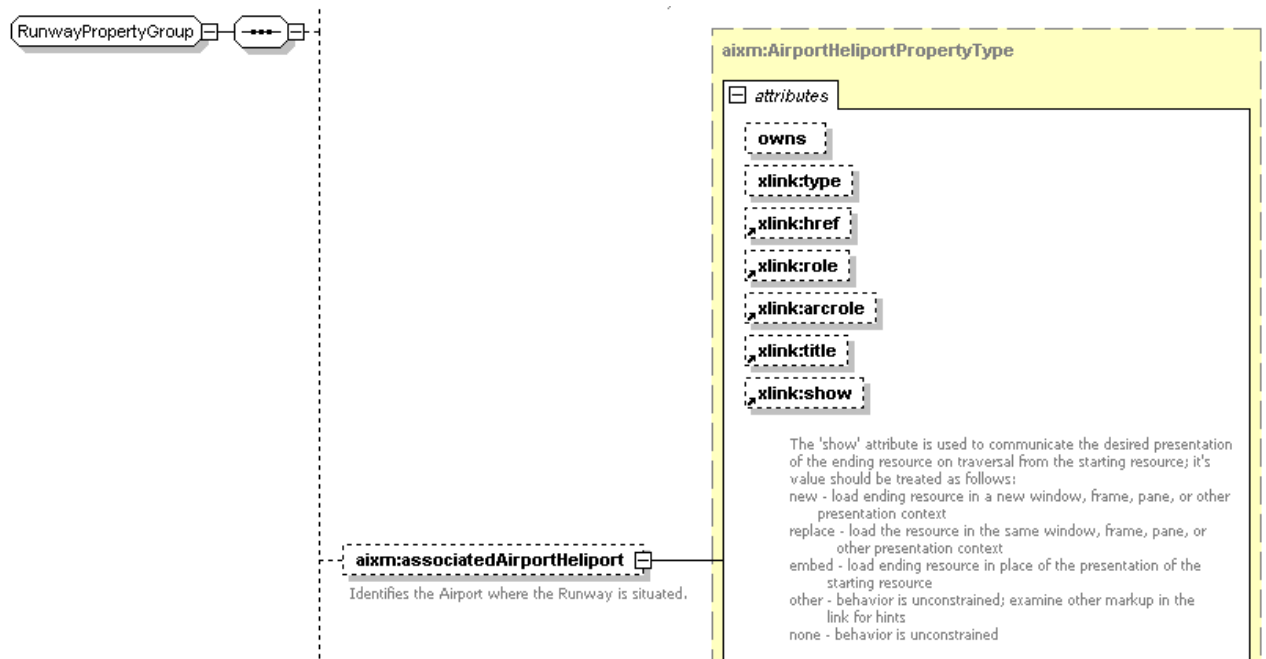


A second step is then required to complete the XSD. In this case an element named 'theOrganisationAuthority' is added in the definition of the AuthorityForNavaidEquipmentPropertyGroup, based on the role of the OrganisationAuthority class in this association.



4.10 Mapping Relationships to Features

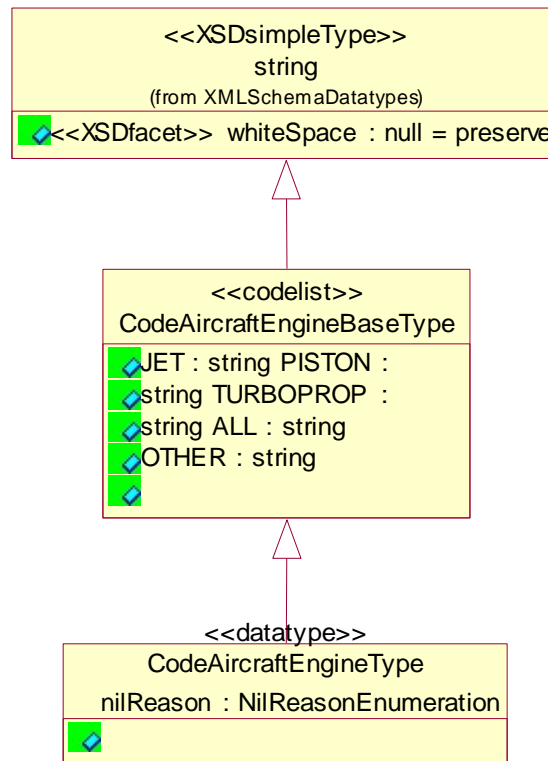
In AIXM, Relationships to features are described by reference using `xlink:href`. The UML role name is used for the XML element name and the XML element is of type `FeaturePropertyType`.



4.11 Mapping Data Types

4.11.1 <<codelist>>

Codelists are given by the stereotype <<codelist>>. As it can be seen from the diagram below, for each <<codelist>> type, there also is a <<datatype>> class, which defines the nilReason attribute.



First, the <<codelist>> class is converted into a simpleType in the XSD:

```

<simpleType name="CodeAircraftEngineBaseType">
  <annotation>
    <appinfo><gml:description>A code indicating the type of aircraft engine
    (for example, jet, piston, turbo).</gml:description></appinfo>
  </annotation>
  <union>
    <simpleType>
      <restriction base="xsd:string">
        <enumeration value="JET">
          <annotation>
            <appinfo><gml:description>Jet Engine</gml:description></appinfo>
          </annotation>
        </enumeration>
        <enumeration value="PISTON">
          <annotation>
            <appinfo><gml:description>Piston
            Engine</gml:description></appinfo>
          </annotation>
        </enumeration>
        <enumeration value="TURBOPROP">
          <annotation>
            <appinfo><gml:description>Turbo Propeller
            Engine</gml:description></appinfo>
          </annotation>
        </enumeration>
      </restriction>
    </simpleType>
  </union>
</simpleType>
  
```

```

<enumeration value="ALL">
  <annotation>
    <appinfo><gml:description>All aircraft engine
types.</gml:description></appinfo>
  </annotation>
</enumeration>
</restriction>
</simpleType>
<simpleType>
  <restriction base="string">
    <pattern value="OTHER:(\w|_){1,58}?" />
  </restriction>
</simpleType>
</union>
</simpleType>

```

Note that the simple data types is declared as a union between the enumerated values declared in the UML model (with the exception of the value “OTHER”) and a string with the pattern “OTHER:(\w|_){1,58}?”. This enables <<codelist>> data types to include values that are not supported by the enumeration list. For example, an electric engine type could be encoded as “OTHER:ELECTRIC”.

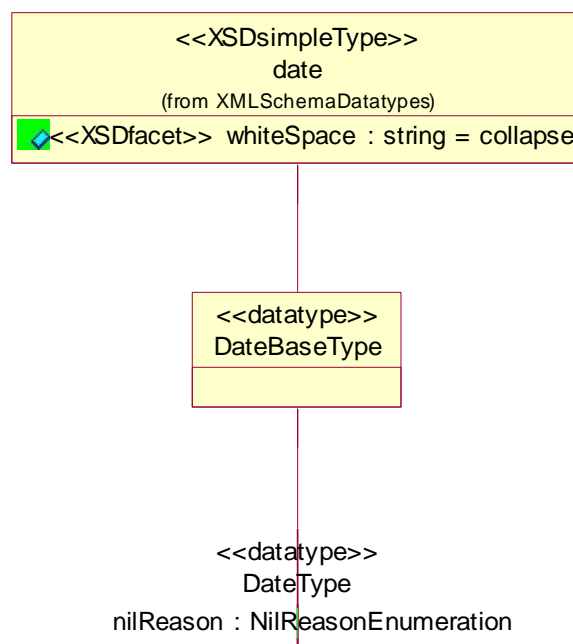
In addition, a complex type is defined, including the declaration of the nilReason attribute:

```

<complexType name="CodeAircraftEngineType">
  <simpleContent>
    <extension base="aixm:CodeAircraftEngineBaseType">
      <attribute name="nilReason" type="gml:NilReasonEnumeration"/>
    </extension>
  </simpleContent>
</complexType>

```

4.11.2 <<datatype>> - default case



As for <<codeList>>, the mapping of <<datatype>> used to type simple properties (see 2.7.1.1) consists of two steps.

The first step is the creation of the simpleType corresponding to the BaseType.

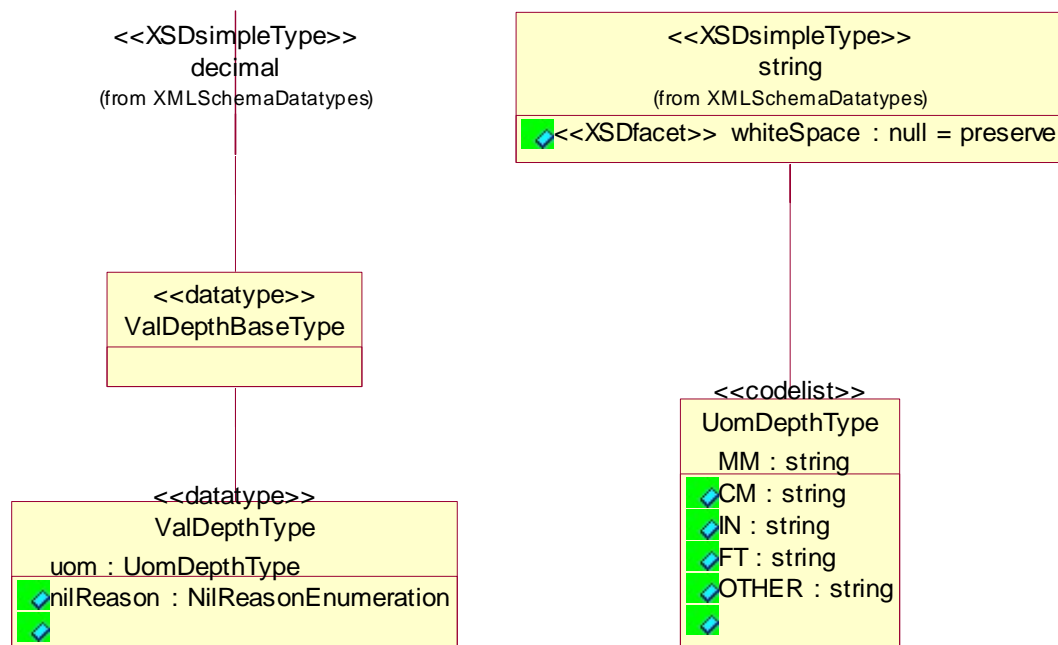
```
<simpleType name="DateBaseType">
  <restriction base="xsd:date">
  </restriction>
</simpleType>
```

The second step is the creation of the complexType which defines the attribute nilReason.

```
<complexType name="DateType">
  <simpleContent>
    <extension base="aixm:DateBaseType">
      <attribute name="nilReason" type="gml:NilReasonEnumeration"/>
    </extension>
  </simpleContent>
</complexType>
```

4.11.3 <<datatype>> with Unit of Measurement

A Unit of measurement (UOM) exists for many data types that take numerical values. This has been modelled as a uom attribute in the <<datatype>> class.



The XSD mapping of uom types follows the same rules as for any other <<codelist>>, except that no complex type is required with the nilReason.

```
<simpleType name="UomDepthType">
  <union>
    <simpleType>
      <restriction base="xsd:string">
        <enumeration value="MM">
        </enumeration>
        <enumeration value="CM">
        </enumeration>
        <enumeration value="IN">
        </enumeration>
        <enumeration value="FT">
        </enumeration>
      </restriction>
    </simpleType>
  </union>
</simpleType>
```

```

<restriction base="string">
  <pattern value="OTHER:\w{2,58}"/>
</restriction>
</simpleType>
</union>
</simpleType>

```

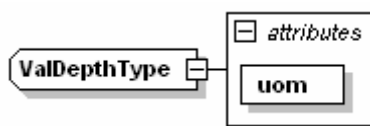
In a second step, the class ValDepthBaseType is generated as a simple type, as described in 4.11.2.

```

<simpleType name="ValDepthBaseType">
  <restriction base="xsd:decimal"/>
</simpleType>

```

Then, the uom attribute is added to the complexType ValDepthType, after the definition of nilReason attribute.



```

<complexType name="ValDepthType">
  <simpleContent>
    <extension base="aixm:ValDepthBaseType">
      <attribute name="nilReason" type="gml:NilReasonEnumeration"/>
      <attribute name="uom" type="aixm:UomDepthType" use="required"/>
    </extension>
  </simpleContent>
</complexType>

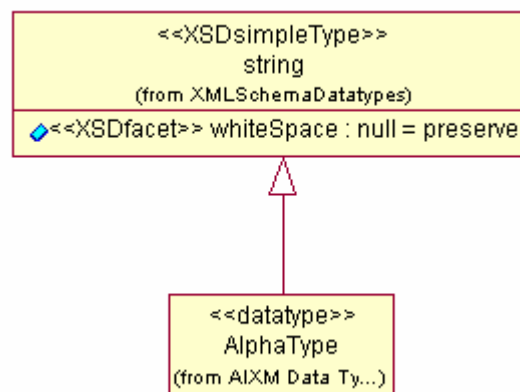
```

4.11.4 Particular cases

4.11.4.1 <<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>

```

4.11.4.2 <<datatype>> XHTMLBaseType

<<datatype>> XHTMLBaseType represents a structured XHTML document compliant with <http://www.w3.org/1999/xhtml>. It should be mapped as follows in XML:

```
<complexType name="XHTMLBaseType" >
  <sequence>
    <any namespace="http://www.w3.org/1999/xhtml" minOccurs="1"
maxOccurs="unbounded" processContents="skip"/>
  </sequence>
</complexType>
```

APPENDIX D

AIXM

AIXM APPLICATION SCHEMA GENERATION

AIXM

AIXM Application Schema Generation

Aeronautical Information Exchange Model (AIXM)

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1 Scope

1.1 Introduction

The purpose of this document is to describe how the AIXM UML model can be extended to support the needs of a particular Community of Interest (COI):

- Define messages that are necessary and eventually restrict the content of these messages to a sub-set of the AIXM features;

- Extend existing AIXM features with new attributes or associations or define new features, which are only relevant for that community.

The UML to XML Schema conversion for extensions is illustrated using a series of examples from the AIXM 5 Application Schema extensions.

1.2 Background

The AIXM conceptual model and data standard are maintained as a UML model. AIXM was developed to be extendable allowing greater flexibility for international use. Each feature and codelist may be extended to meet individual needs of the AIXM Community of Interest (COI).

If you are not familiar with the AIXM UML to AIXM XSD mapping document please review before reading this document. A good understanding of the mapping document will help to understand AIXM extensions.

Features describe real world entities and are fundamental in AIXM. AIXM features can be concrete and tangible, or abstract and conceptual and can change in time [7]. Features are represented as classes with a stereotype `<<feature>>`. Examples include Runway and AirportHeliport.

AIXM features are dynamic features. Timeslice objects are used to describe the changes that affect the AIXM feature over time. Timeslice objects and temporality are discussed extensively in a separate AIXM Temporality document.

Objects are abstractions of real world entities or, more frequently, of properties of these entities, which do not exist outside of a feature. An object is created for two reasons in AIXM:

- When a property has a multiplicity greater than one (such as the city served by an AirportHeliport), or

- The object has its own attributes that are reused throughout the model, such as ElevatedPoint.

Some classes are marked as `<<choice>>`. These are used to model XOR relationships. For example, an AirspaceVolume's horizontal projection can be a Surface, an AirspaceCorridor or the same shape as for another Airspace.

Properties are the attributes and relationships that characterise a feature or object. In the UML:

- Attributes are used to describe simple properties of a feature or object;

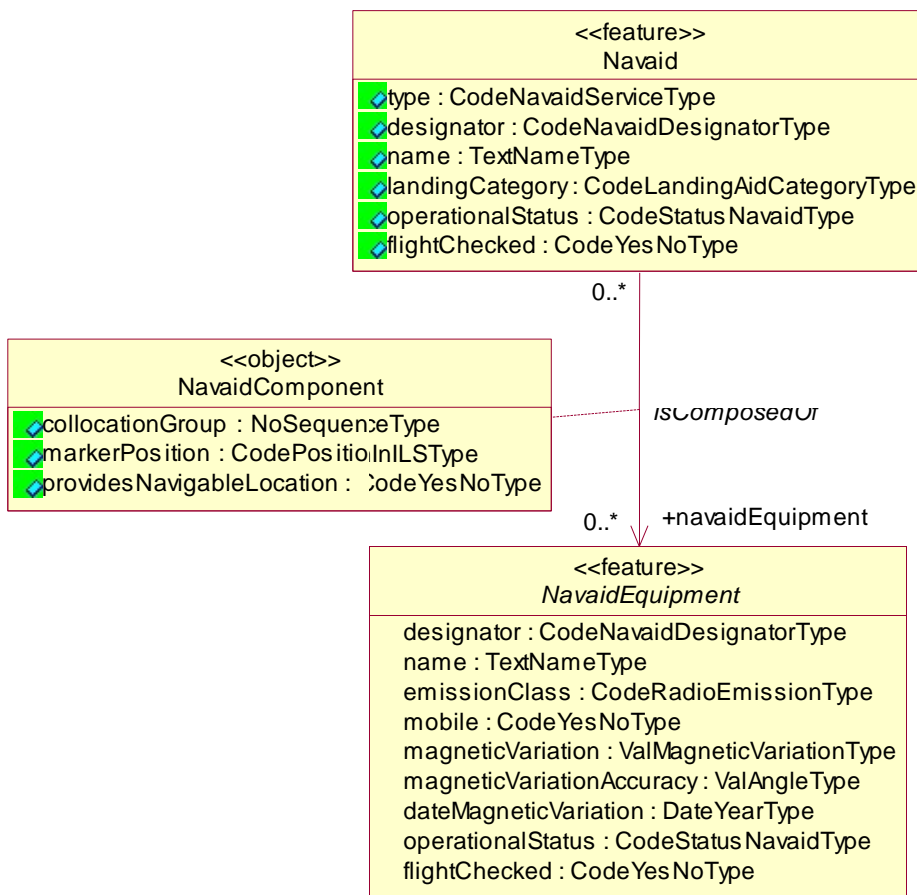
- Relationships are used to describe associations to features or objects. Whenever a property has a multiplicity greater than one, it is described using a UML relationship with cardinality.

- Relationships to objects are depicted by the standard UML composition (*aggregation by value*) association. Composition is a form of aggregation with strong ownership and coincident lifetime of the parts by the whole. The part is removed when the whole is removed
- Relationships to features are described with a standard UML association. All of the associations are navigable in only one direction. This shows that the two classes are related but only one class knows that the relationship exists

The UML model lists the datatypes that are used throughout the AIXM. These are given one of the two following stereotypes:

- <<datatype>> - This is basic data type that specifies a pattern to use.
- <<codelist>> - This is a data type which codes a predefined list of values. The <<codelist>> includes the value OTHER which can be expanded with some free text in uppercase (“OTHER:MY_VALUE”).to support un-supported values.

When information about a relationship is required, a UML association class is used. The association class is attached to the relationship with an Association Class line.



Inheritance refers to the ability of one class (the specialized or child class) to inherit the properties of another class (the generalized or parent class), and then add new properties of its own. In AIXM, Features must only inherit from other Features and Objects must only inherit from other Objects. Multiple inheritance is not allowed.

Important Note: Inheritance is supported only from “Abstract” classes. The UML to XSD scripts do not support the inheritance from non-Abstract classes. The “extension”

mechanism, explained in this document, gives the possibility to extend an existing AIXM class with new properties, with the advantage that the extended class remains valid against the core AIXM schema.

1.3 Objective

The core AIXM model provides the definition of standardised aeronautical information features. In order to use AIXM for a specific application, a Community of Interest (COI) will have to agree upon how instances of AIXM features are to be exchanged and communicated in the community. This can be accomplished by either using a pre-defined Web Service (such as WFS), which enables the direct provision of individual AIXM features or collections of AIXM features or by defining custom AIXM messages with specific properties and encompassing a selected list of AIXM features.

In the definition of the AIXM Application Schema, the COI might also want to extend the core AIXM with additional properties and features. Some principles that regulate such extensions include:

An extension of an existing AIXM feature should remain valid against the definition of the core AIXM XSD element with the same name (for that purpose, the AbstractSomeFeatureExtension element is provided in the core AIXM XSD). A consequence is that it is not possible to extend <<datatype>> classes. Only <<codelist>> may be extended.

An additional feature and objects shall follow the core AIXM modelling conventions (stereotypes, naming, data types, etc.)

Important Note: It is under the responsibility of the COI to ensure that the extensions do not duplicate features and properties that already exist in the core model. When such extensions are defined, the COI might want to share it with the global AIXM community. For this purpose, the application schema can be made available through www.aixm.aero.

1.4 References

1. Geographic Information – Spatial Schema. ISO 19107. First Edition, 2003-05-01
2. ISO 19136:2007 - Geographic information -- Geography Markup Language (GML)
3. UML 2.0 In a Nutshell. Dan Pilone. O'Reilly Media Inc. 2005.
4. AIXM UML to XML Schema Mapping, www.aixm.aero (see Downloads)
5. AIXM Temporality Model, www.aixm.aero (see Downloads)

2 Extending AIXM Features / Objects

2.1 UML Package for Extensions

To extend AIXM, a new package must be created under the AIXM Application Schemas package. This package will contain all the information you need for your extension.

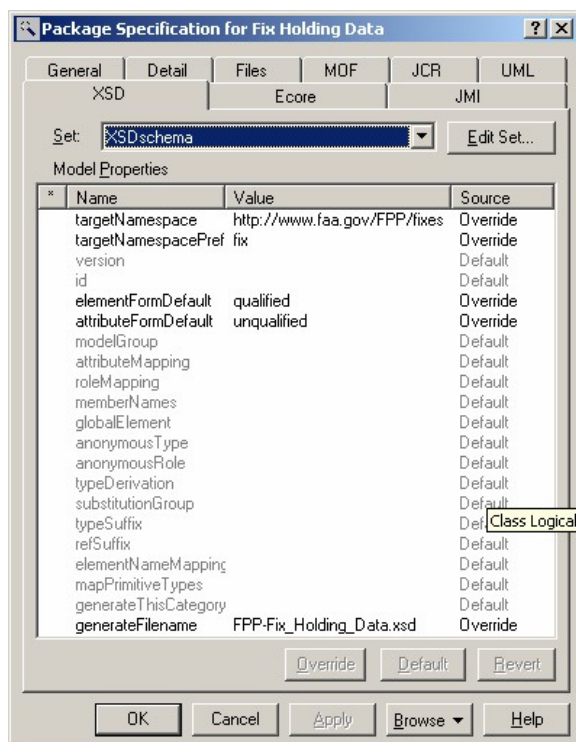
2.1.1 Package Structure

Different types of sub-packages are used to control the generation of appropriate XML schemas (XSD). The Extension sub-package contains the extensions to AIXM Core features and objects. If the extension requires new data types, then a second sub-package, the Extension Data Types, is created containing any new data types and codelists needed. The final sub-packages that are needed are the message packages. Multiple packages may be required based on the number of different message schemas needed. Most Application Schema Packages will have at least one request package and one response package.



2.1.2 Package Specifications and Namespaces

The extension package must have the appropriate XSD tool attributes set so the script can generate the namespaces correctly. Below is an example of how these attributes are set for the Fix Holding Data sub-package.



There are five properties that are needed for each new Application Schema package being used to generate XML Schemas. These properties are highlighted below with the Source as 'Override'.

To modify the value of these properties, open the Package Specification and navigate to the XSD tab. The targetNamespace and targetNamespacePrefix property values are determined by the COI and used in accordance with other related schemas and will determine if an external import is included or imported.

Additionally, denote the generateFilename property as applicable so the schema is named consistently each time it is generated with the UML to XSD scripts.

The following was generated for the Fix Holding Data Application Schema package.

```
<schema xmlns:fix="http://www.faa.gov/FPP/fixes"
xmlns="http://www.w3.org/2001/XMLSchema"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:aixm="http://www.aixm.aero/schema/5.1"
xmlns:dpshare="http://www.faa.gov/avnis/shared"
targetNamespace="http://www.faa.gov/avnis/fixes"
elementFormDefault="qualified"
attributeFormDefault="unqualified">
```

2.2 UML Extension Package

2.2.1 Overview

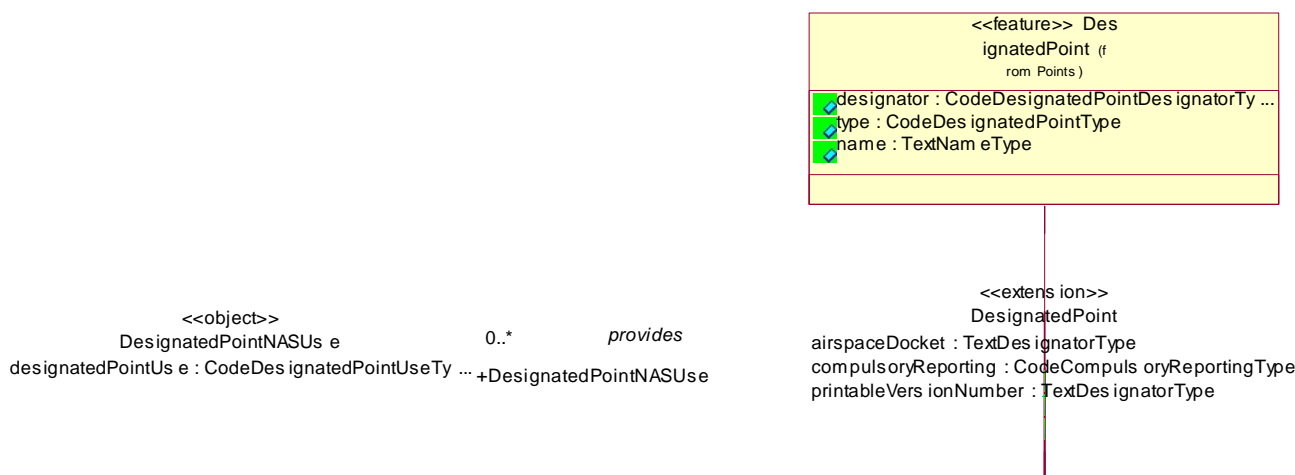
A feature or object may be extended by creating a class with the same name as the core AIXM feature and giving it a stereotype <<extension>>. This new class can contain:

- New attributes

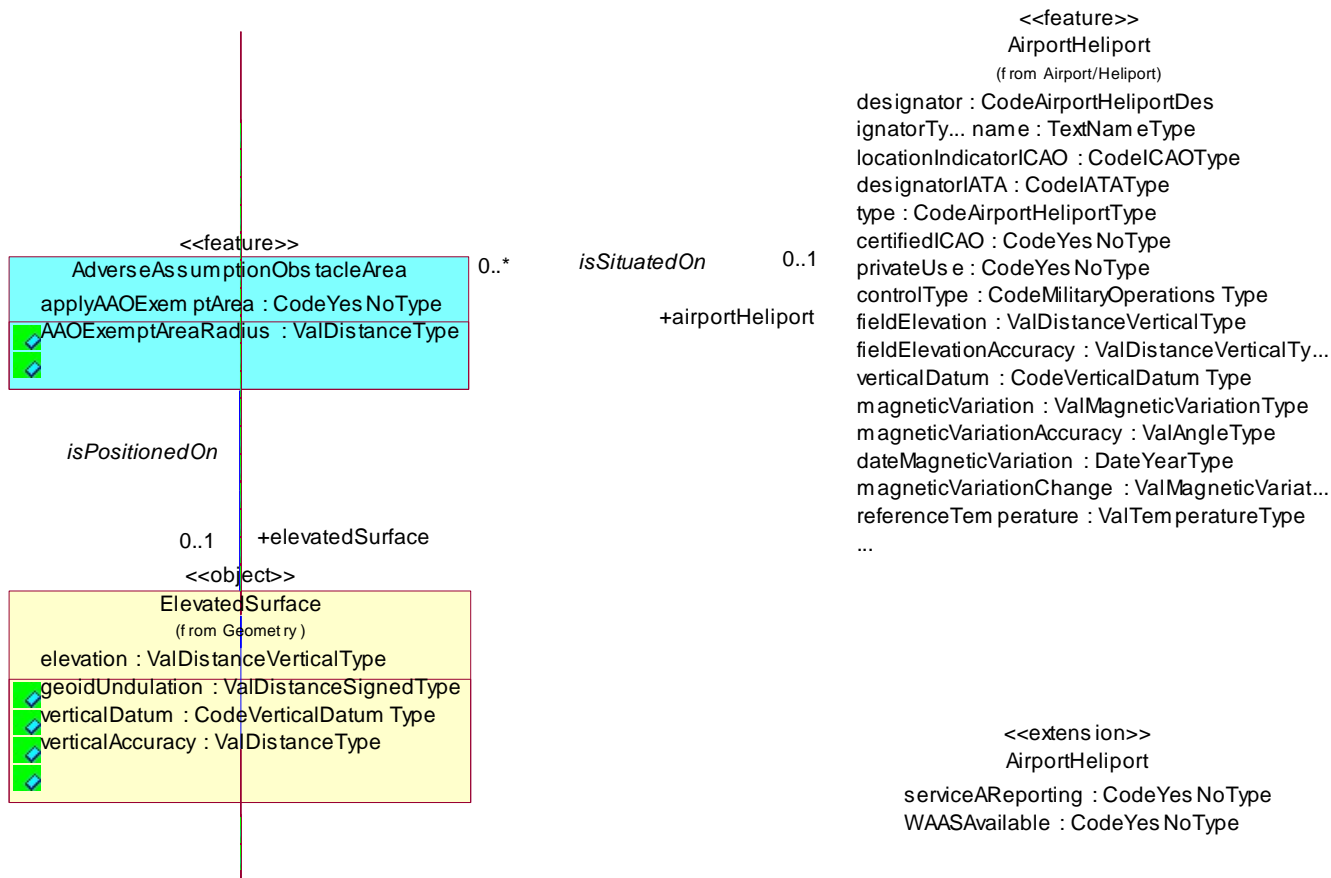
- New associations. **Important Note:** if a core AIXM class is involved, the navigability of the association should always be from the <<extension>> class towards the core AIXM class.

In addition, it is possible in extensions to create declare totally new classes (features and objects), that do not extend existing AIXM Core classes. The only rule is to follow the AIXM UML modelling conventions described at the beginning of the document. This will enable the script AIXM-FeatureGenerator.ebs to correctly generate the XML elements for these new classes. This situation is not described in detail in this document because it does not require any special action. Just follow the UML modeling conventions.

The example below shows the modelling convention used to extend the DesignatedPoint feature. The example adds a new attribute to DesignatedPoint and a new relationship to a new object called DesignatedPointNASUse.



Associations can also be created between new features or objects and AIXM Core features or objects as depicted below in the association between AdverseAssumptionObstacle and AirportHeliport. The new association should be created in the Application Schema package and towards the AIXM Core Feature rather than an extension (if present). This action ensures the relationship is represented properly in the XML Schema



Use the approved rules for AIXM Core elements to produce new features or objects. Some rules that apply to new *extension* classes are:

- The extension class stereotype must be <<extension>>.
- The extension class name for the extension must match the class you are extending. (When using Rational Rose, it is possible to do that if you create a new class in the navigation menu at the left and change the name of that class; only afterwards drag and drop the class on the diagram.)
- The extension class must be a specialized class extending the matching base class.
- The extension class attributes are added to the extension class the same as they would a regular AIXM class (Data Types are discussed later in this document).

2.2.2 XML Schema Generation

Use the AIXM-FeatureGenerator.ebs script to generate the extension XML Schema in which the script triggers the generation of an extension element by recognizing the <<extension>> stereotype. Generation of the extension follows the AIXM generation rules.

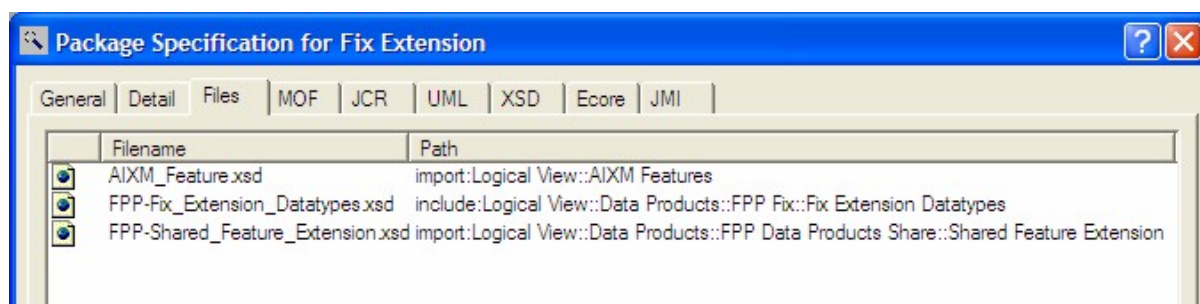
If new data types or codelists are introduced the script, AIXM-DataTypeGenerator.ebs, must be executed first on the associated Data Type Package.

2.2.2.1 Imported and Included Schemas

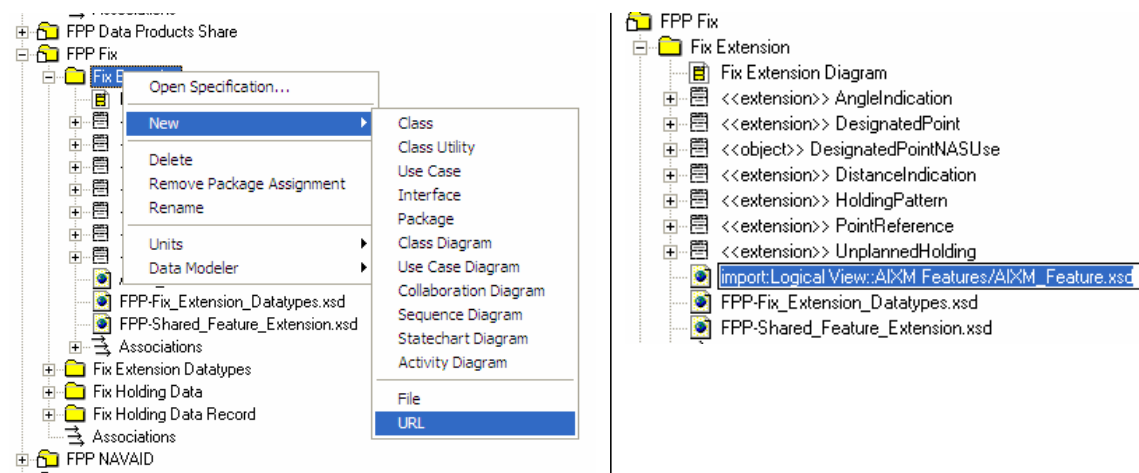
Every application schema sub-package must incorporate imported XML Schemas from the AIXM Core Schemas. Additionally, if new data types or codelists are introduced, the schema from that sub-package must be included. It is sometimes required to utilize common objects from a 'shared' package to increase object re-use. These elements should be incorporated as well by importing the schema.

It is not required for these schemas to be generated for the script to run in Rational Rose, but if they are not created and in the folder structure when the schema is opened it will have errors. The script, AIXM-DataTypeGenerator.ebs, is used to create the schema on the associated Data Type sub-package.

These linked schemas, essentially URL's, can be incorporated by entering them on the Files tab of the Package Specification.



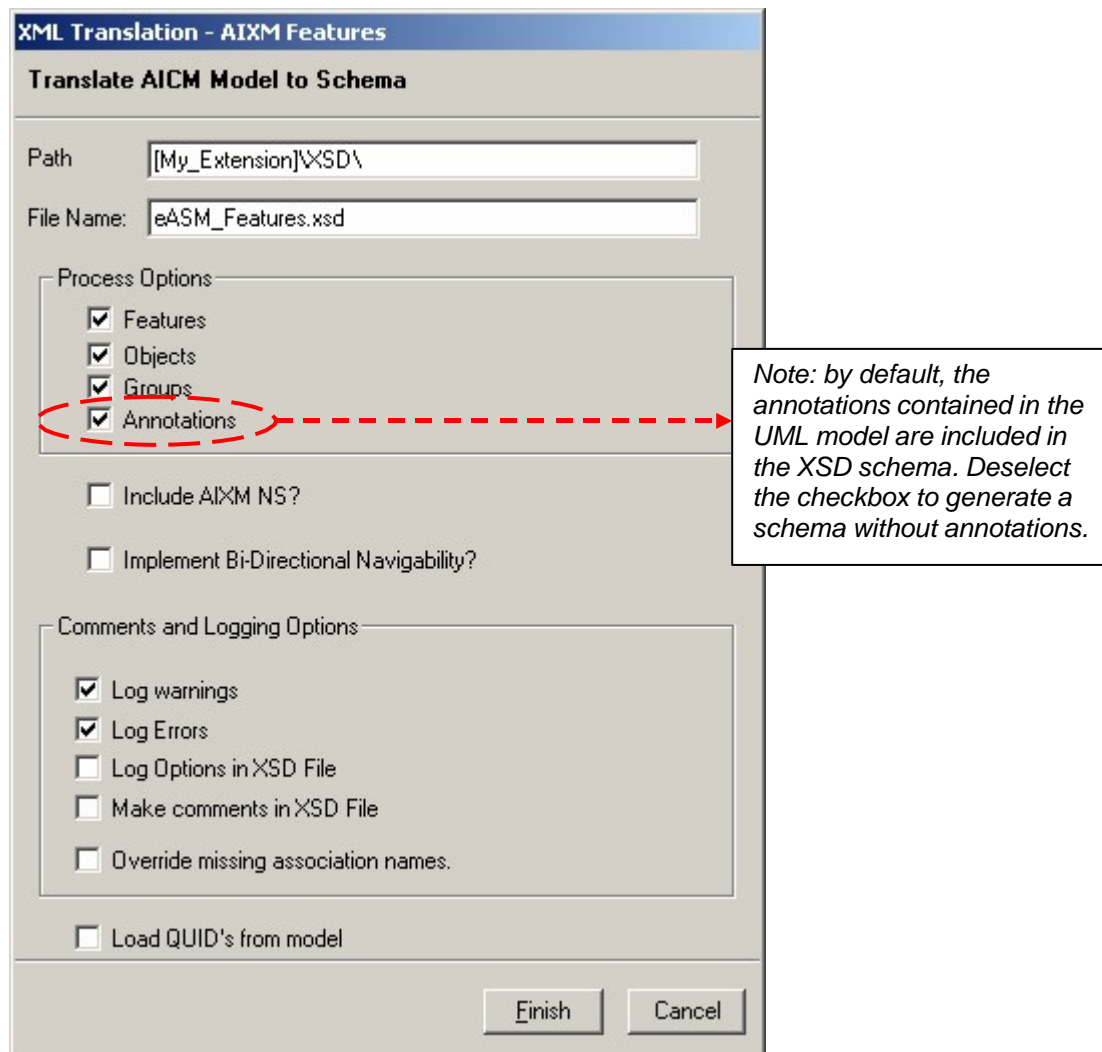
They can be added also be added in the navigation window by entering the full path of the schema location within the model.



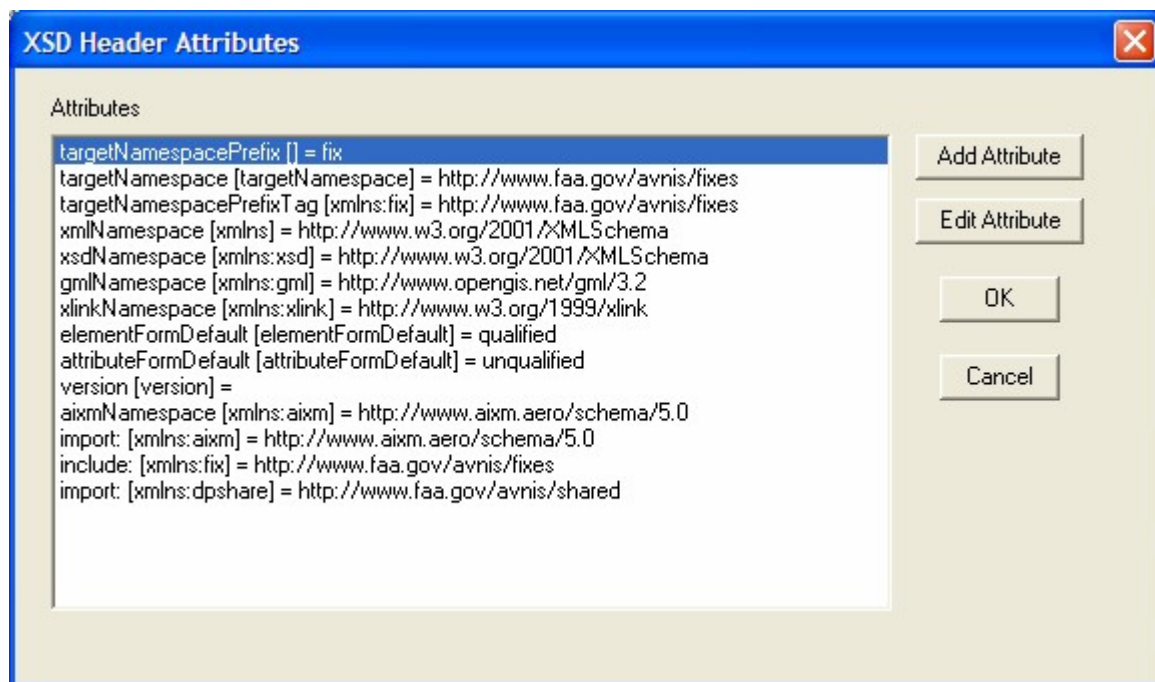
2.2.2.2 Executing the Script

There are some specific options that need to be set when executing the script in Rational Rose, but most of the options will be defaulted. In the image below, notice the File Name is pulled from the generateFilename property set in the package specification earlier.

The schema generation scripts are used for both AIXM Core and Application Schemas. The checkbox for 'Include AIXM NS' is selected when executing scripts for packages that are not part of the AIXM Core set since the AIXM Namespace is automatically included for those schemas. Furthermore, select the checkbox for 'Load QUID's from model' when new classes have been added to the model since the script was last run, which ensures the element identifiers are correctly recognized.



After selecting 'Finish' and regenerating the QUID's (if needed), a dialogue will open to allow the addition or editing of the XSD Header attributes. It should not be necessary to make any changes, but notice the targetNamespace attributes generated from the package specifications set earlier. After selecting 'OK', the XML schema file will be generated and can be found in the directory in which the script was run.

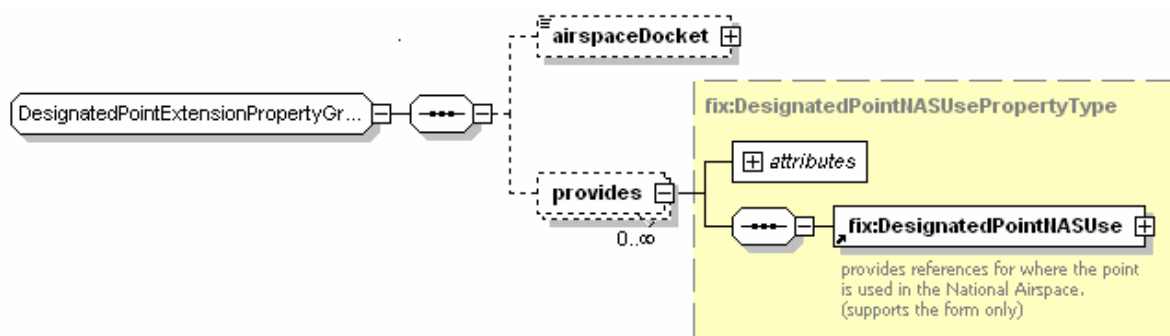


2.2.2.3 XML Schema Output

Classes with the stereotype of <<extension>> generate three related elements for that class.

- <classname>ExtensionPropertyGroup
- <classname>ExtensionType
- <classname>Extension

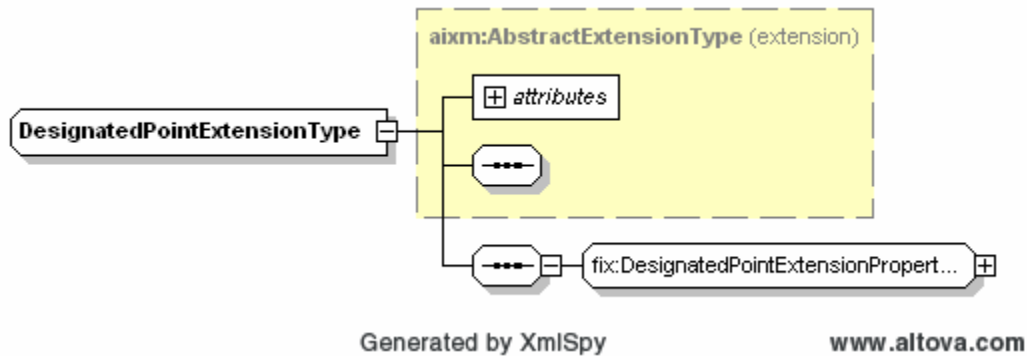
The <classname>ExtensionPropertyGroup contains the properties (elements and relationships) of the Extension.



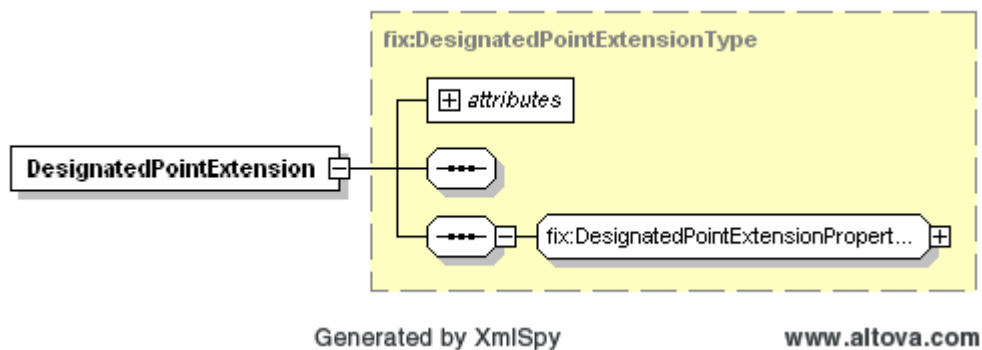
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The <classname>ExtensionType element is generated as a XMLSchema <complexType.> and extends base type aixm:AbstractExtensionType.



The <classname>Extension element is generated as a XMLSchema <element>. The Extension element cannot stand alone, it may only exist as an extension to an AIXM base element. The Extension element does not have a timeslice. The Extension element attribute substitutionGroup is the substitutionGroup of the base type extension. Extension elements are not extensible.

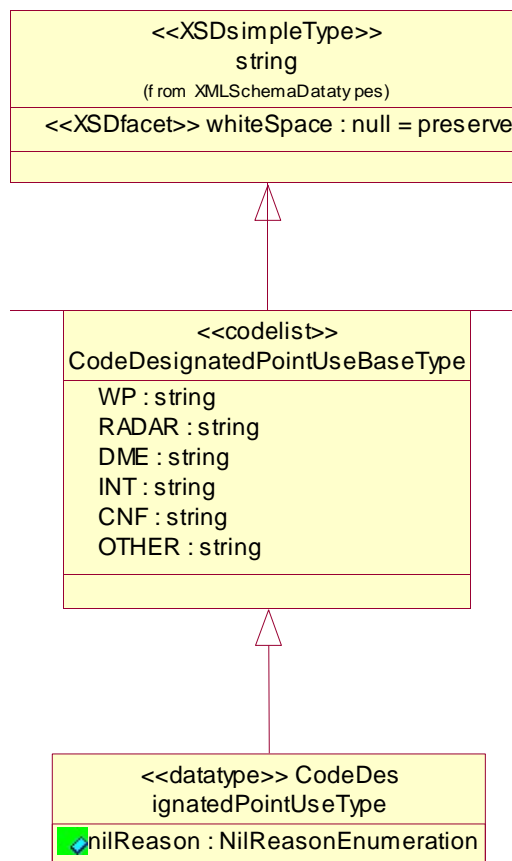


2.3 Data Type Extension Package

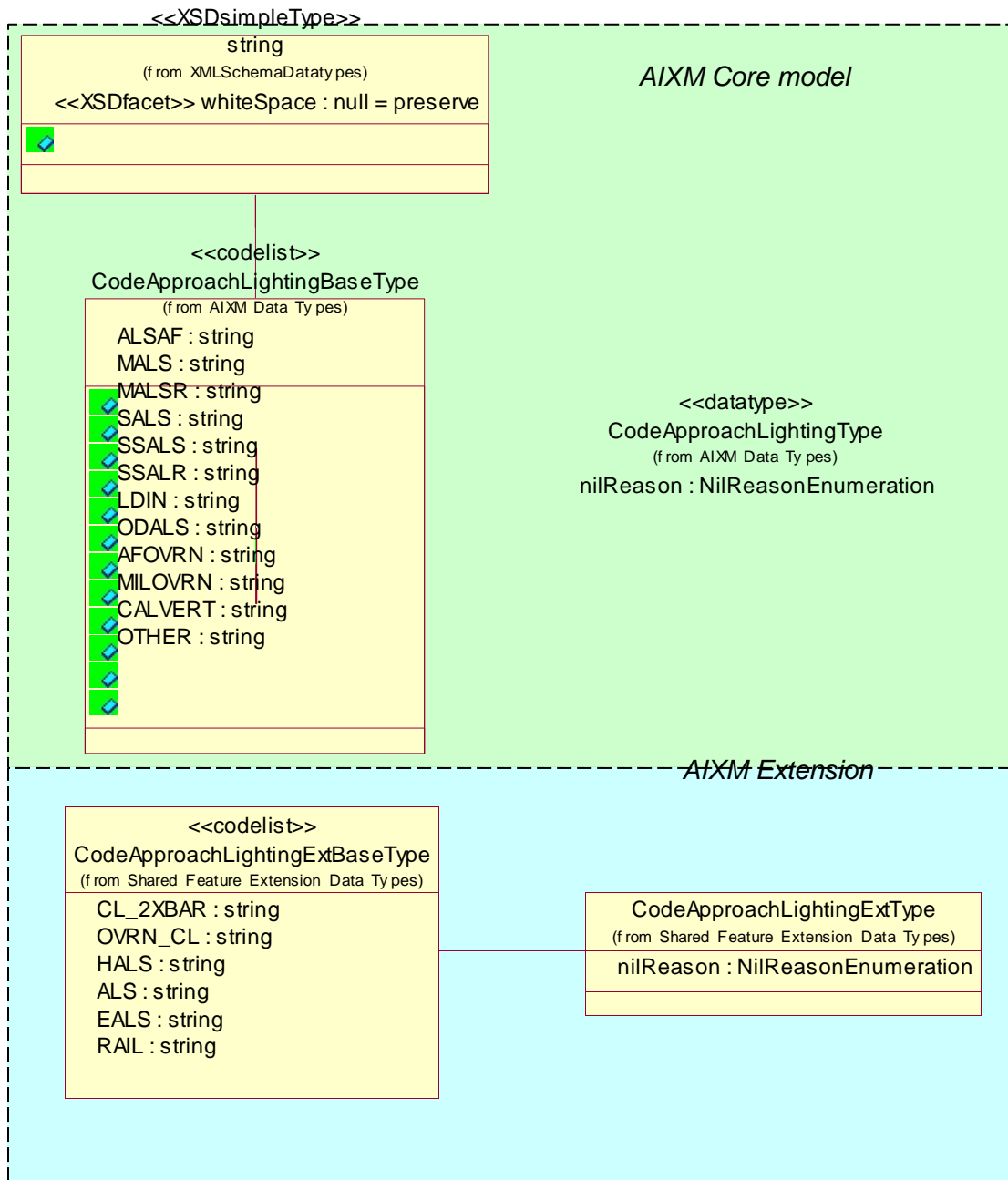
2.3.1 Overview

An extension, new feature or object class may require additional data types or codelists to capture the valid values for new attributes added to the class. To add new data types or codelists create a Data Type sub-package containing any new data types needed.

In the example below, an <<codelist>> is defined in an extension package. It is called CodeDesignatedPointUseBaseType, it has a generalization to the 'string' class and inherits the basic attributes of an XSD string variable. The <<datatype>> CodeDesignatedPointBaseType is created with the nilReason property, as specified in [4]. This is the most common configuration for codelists.



AIXM Core <<codelists>> can also be extended in the Data Type sub-package. Extend a codelist by creating a class with the same name as the codelist and giving it a stereotype <<codelist>>.



Careful analysis must be done to ensure that the extended list of values remains normalised. It shall not duplicate values that already exist in the core <<codelist>> (including the OTHER value), but with other names/abbreviations.

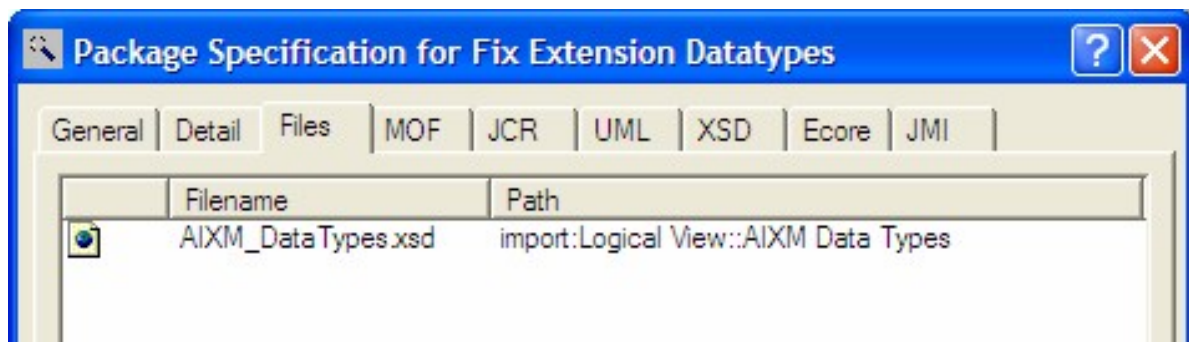
If additional values are required for an AIXM Core codelist for international data exchange, then AIXM Core model will need to be updated.

2.3.2 XML Schema Generation

Use the AIXM-DataTypeGenerator.ebs script to generate the data type extension XML Schema. Data Types are generated as a XMLSchema <simpleType> with the appropriate facets, Patterns and/or codelists defined.

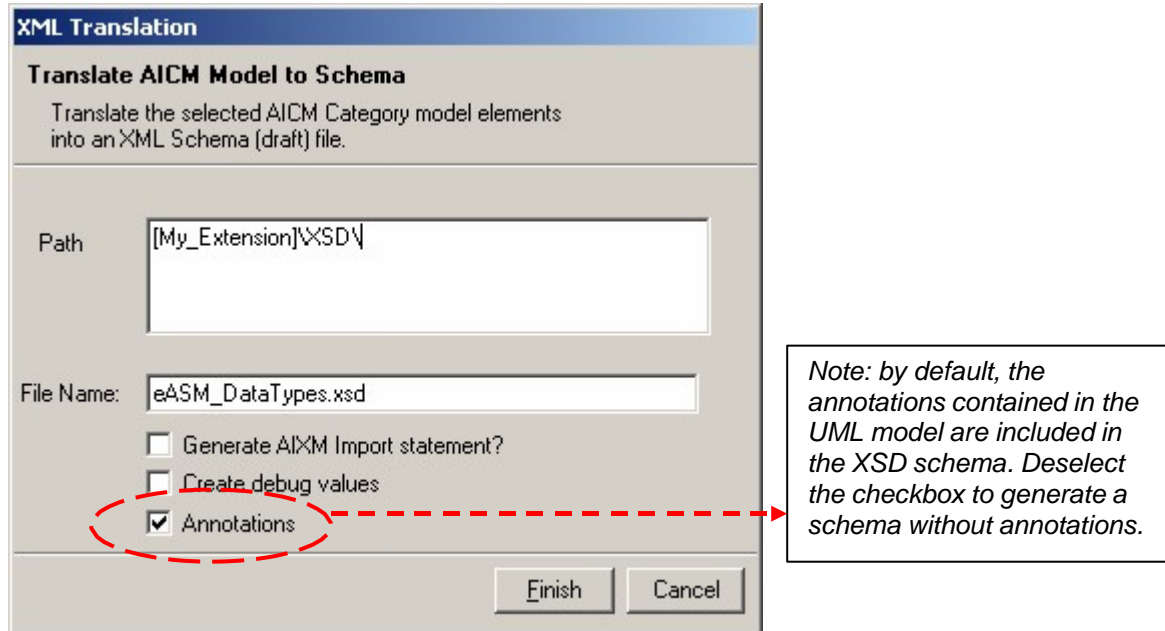
2.3.2.1 Imported and Included Schemas

Each data type sub-package must incorporate the AIXM Core Data Type schema. It is not required for this schema to be generated for the script to run in Rational Rose, but if the AIXM Core Data Type schema is not created and in the folder structure when the schema is opened it will have errors.



2.3.2.2 Executing the Script

In the image below, notice the File Name is pulled from the generateFilename property set in the package specification earlier. However the Path denotes the location of the UML model file, which should be changed appropriately. The checkbox for 'Include AIXM NS' is selected when executing scripts for packages that are not part of the AIXM Core set since the AIXM Namespace is automatically included for those schemas.

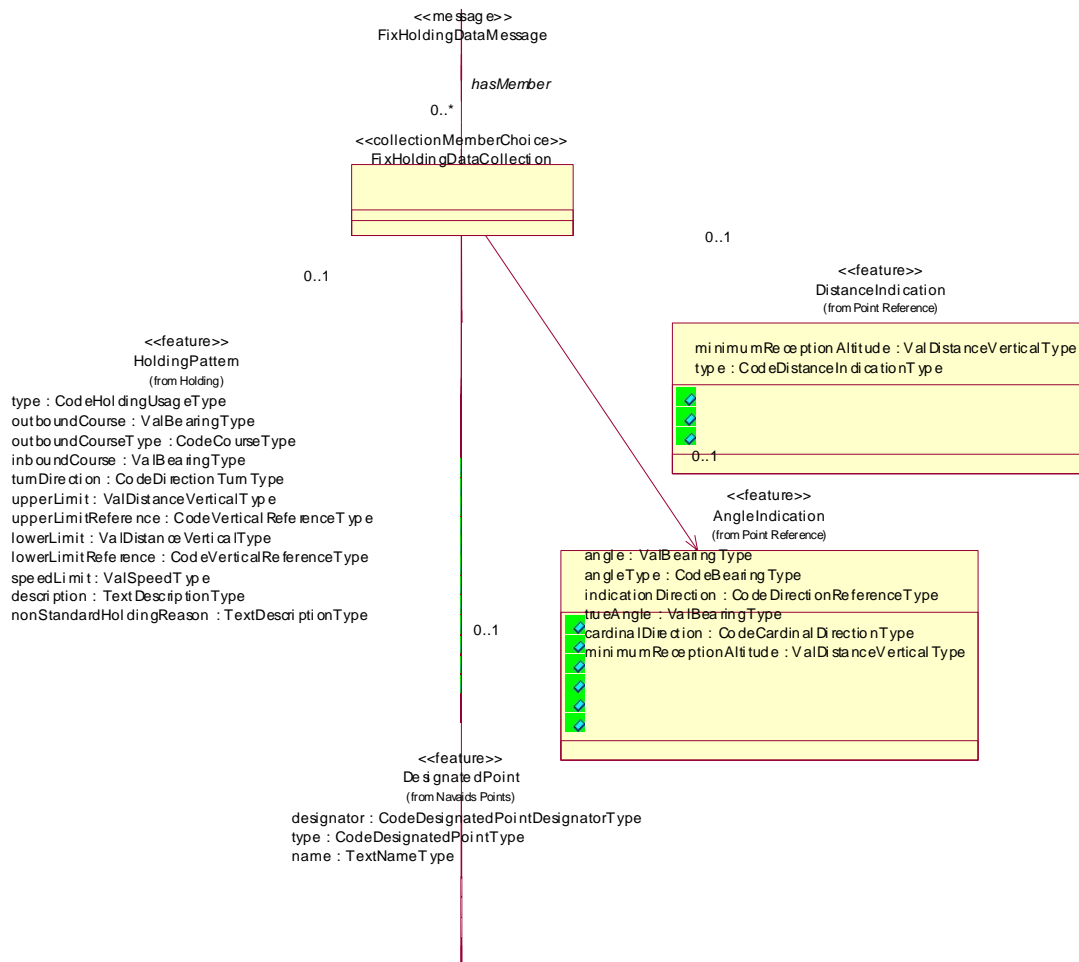


2.4 UML Message Package

2.4.1 Overview

The message package is used to generate an XML Schema for request and response messages. Below is an example of the FixHoldingData Response Message. This message includes the extensions described previously even though they do not appear in the diagram.

A Message is modelled in UML using the class object with a stereotype <<message>>. In this example the message is a limited collection of AIXM features with extensions. This is modelled by relating the collection of features; <<collectionMemberChoice>> to the message through the relationship “hasMember”.

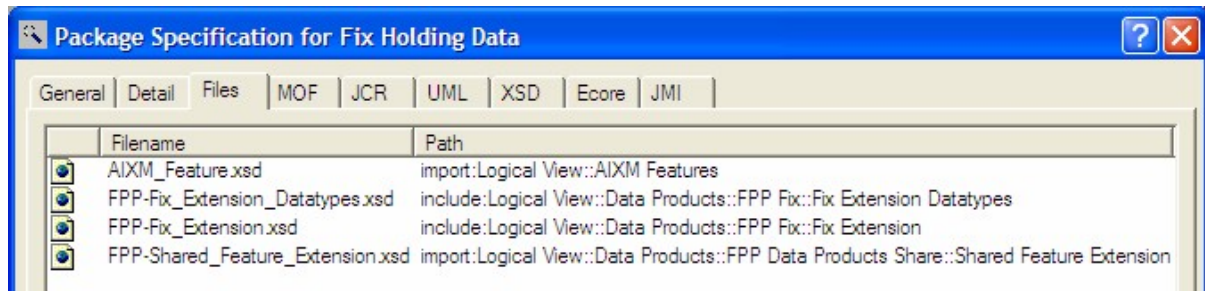


2.4.2 XML Schema Generation

Use the AIXM-ApplicationSchemaGenerator.ebs script to generate the message XSD. The script triggers the generation of the message element by recognizing the <<message>> stereotype.

2.4.2.1 Imported and Included Schemas

The UML Message sub-package brings together all of the related elements created in earlier processes such as extensions and data types. As before, the AIXM Core schema must be included as well as any other referenced schemas (i.e. shared or common objects that are to be used in multiple application schemas).



The accumulation of the imported and included XML Schemas is displayed below.

```
<import namespace="http://www.opengis.net/gml/3.2"
  schemaLocation="./ISO_19136_Schemas/gml.xsd"/>
<import namespace="http://www.aixm.aero/schema/5.1"
  schemaLocation="./AIXM_Feature.xsd"/>
<import namespace="http://www.w3.org/1999/xlink" schemaLocation="./xlink/xlinks.xsd"/>
<import namespace="http://www.faa.gov/avis/shared" schemaLocation="./FPP-
  Shared_Feature_Extension.xsd"/>
<include schemaLocation="FPP-Fix_Extension_Data_Types.xsd"/>
<include schemaLocation="FPP-Fix_Extension.xsd"/>
```

2.4.2.2 Executing the Script

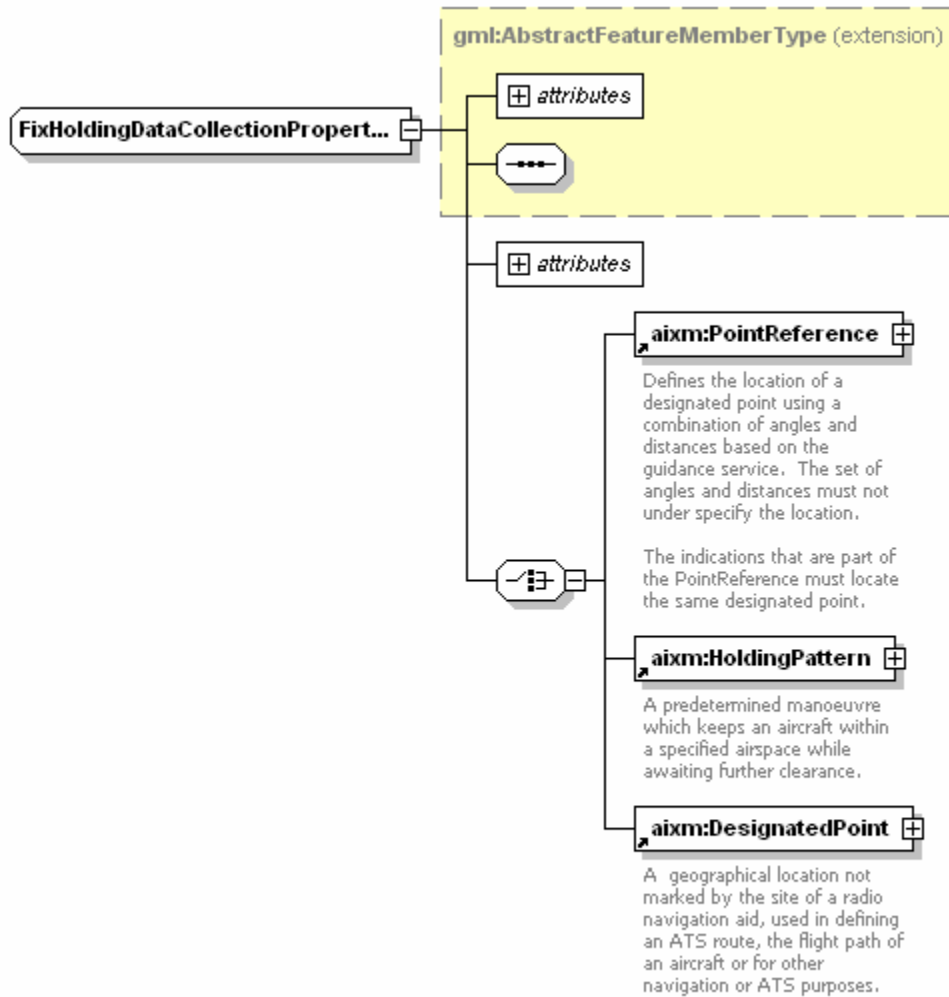
Follow the procedures outlined in section 2.2.2.2.

2.4.2.3 XML Schema Output

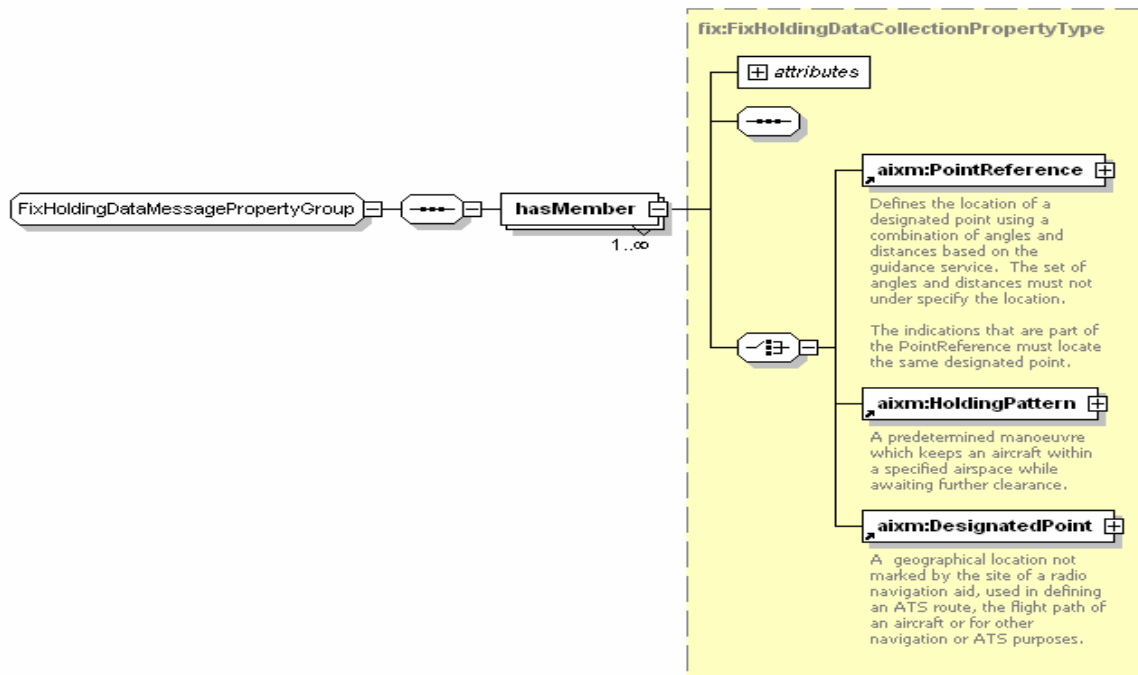
Classes with the stereotype of <<message>> following the AIXM feature collection response generates four related elements for that class.

```
<classname>CollectionPropertyGroup
<classname>MessagePropertyGroup
<classname>MessageType
<classname>Message
```

The <classname>CollectionPropertyGroup is generated as a XMLSchema <complexType>, which extends gml:AbstractFeatureMemberType, and includes a <choice> between the all the features it is pointing to.



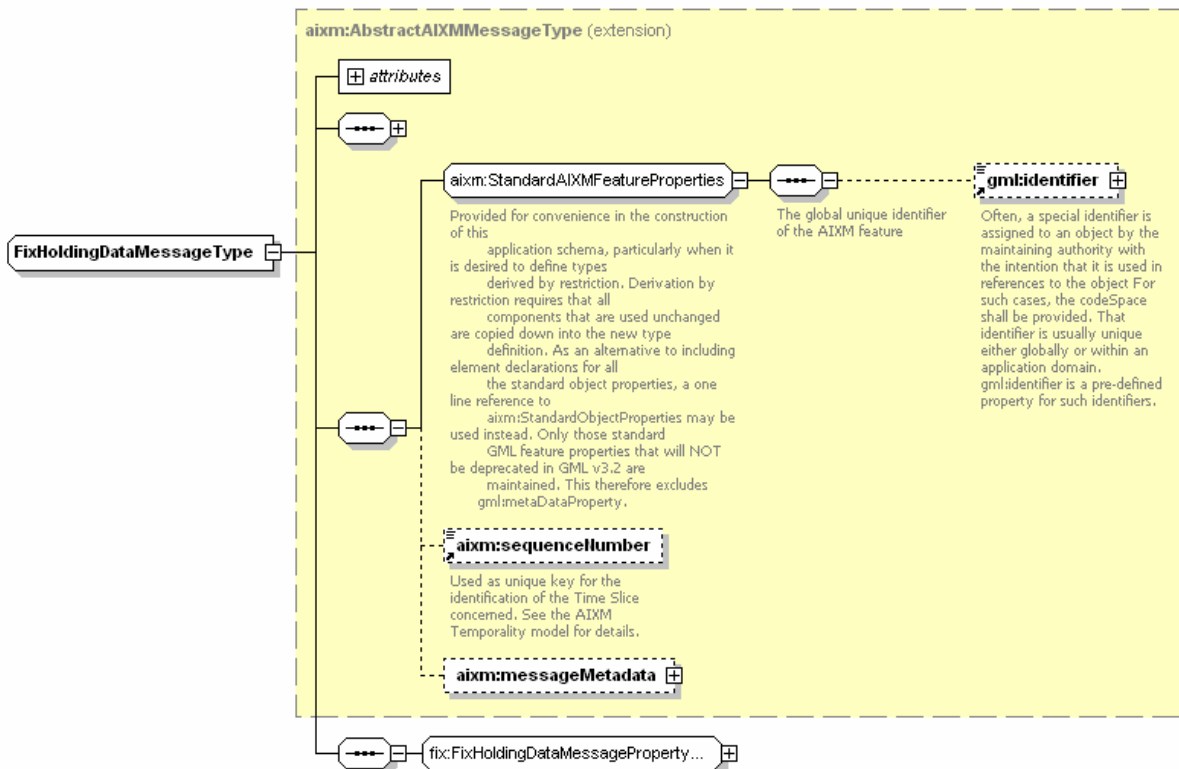
The <classname>MessagePropertyGroup is generated as a XMLSchema <group>, which contains the properties (elements and relationships) of the Message.



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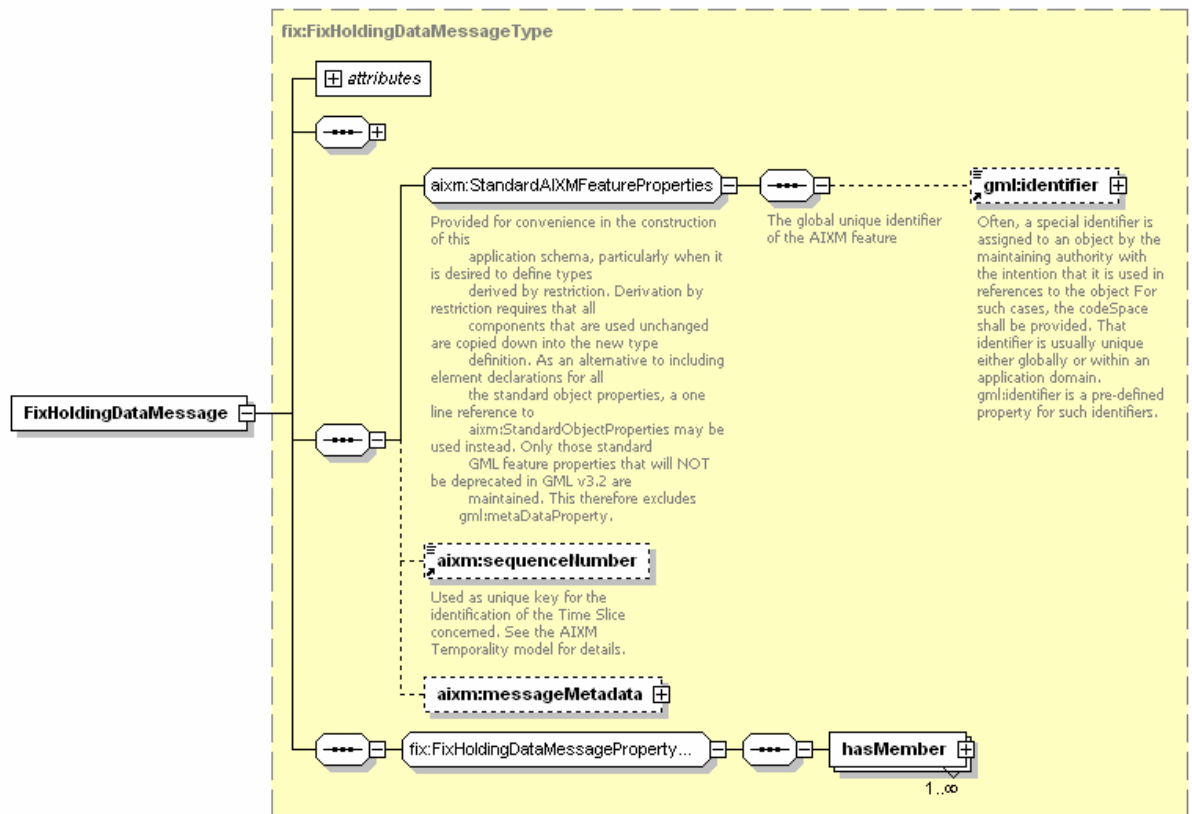
The <classname>MessageType element is generated as a XMLSchema <complexType> and extends base type `aixm:AbstractAIXMMessageType`.



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The <classname>Message element is generated as a XMLSchema <element>. The associations are treated as objects. They are included in the schema.



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APPENDIX E

AIXM 5

FEATURE IDENTIFICATION AND REFERENCE

Use of xlink:href and UUID

AIXM 5

Feature Identification and Reference

- use of xlink:href and UUID -

Aeronautical Information Exchange Model (AIXM)

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Edition No.	Edition Issue Date	Author	Reason for Change	
0.1	First	2009	Design Team	First Edition
0.2	Proposed	2010	Design Team	Update
0.3	Proposed	06 Oct 2010	Design Team	Update Abstract references
0.4	Updated proposal	22 Nov 2010	Eurocontrol-FAA AIXM Design Team with the contribution of AIXM Forum members	Included guidelines for UUID generation. Updated based on comments and recommendations received from the AIXM Forum members and during the AIXM-XML Seminars of 2010.
0.5	Updated Proposal	21 Dec 2010		Updated following latest comments on the AIXM Forum. Use of "uuid" URN. Use of URN only for abstract references.
0.6	Updated	21 FEB 2011		Updated following discussions off-line with the most active (on this subject) AIXM Forum members
1.0	Released	29 APR 2011		Final release. Added a sentence in section 2.2 stressing the importance for UUID to be allocated by the real authoritative source for a feature's data.

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1 Scope

1.1 Introduction

The Aeronautical Information Exchange Model (AIXM) is a GML 3.2 application schema meant to allow for the machine-to-machine exchange of aeronautical information in a structured format. As services that disseminate information in AIXM 5.1 to consumers are developed, the ability to manage the linkages between aeronautical features is key. This encompasses the concepts of feature identification and feature reference.

The AIXM 5.1 schema uses the XLink schema bundled with GML 3.2 for representing a reference between two features. In concert with the XLink standard, the XPointer standard may be used to address individual XML elements of messages. This document defines a number of standard cases for how XLinks should be used within an AIXM 5.1 message and how those XLinks should be resolved by applications.

The AIXM 5.1 schema also relies on the use of universal unique identifiers (UUID) as artificial identifiers for AIXM features. In fact, they do not identify the feature itself, but the data that represents that feature in digital aeronautical information management systems. This document provides guidance with regard to the algorithms that can be used for the generation of these UUID values.

1.2 References

[XLINK]	XLink v1.0 Specification http://www.w3.org/TR/xlink
[XPTR]	XPointer Specification http://www.w3.org/TR/xptr
[XPTH]	XPath Specification http://www.w3.org/TR/xpath
[UUID]	Universally unique identifier (theory) http://en.wikipedia.org/wiki/Universally_unique_identifier
[UUID-AIXM]	Universally Unique Identifier (UUID) Analysis, by Robert DeBlanc, MITRE, in support to FAA
[UUID-ISO]	ISO/IEC 9834-8, which is also ITU-T Rec x.667 http://www.itu.int/ITU-T/studygroups/com17/oid.html

1.3 Assumptions and Dependencies

This document assumes that the systems in question are communicating using messages or data sets that comply with the AIXM 5.0, 5.1 or later schema version.

2 Feature identification (UUID)

2.1 The *gml:identifier* property

Each AIXM Feature is identified through the use of the *identifier* property, which is inherited from the abstract AIXMFeature. In the AIXM XML Schema, this is mapped to the *gml:identifier* property, which all AIXM features inherit from the *gml:DynamicFeatureType*.

According to the AIXM Temporality Concept, the *identifier* property is the only time-invariant property; therefore it is situated outside the TimeSlice complex object, which encapsulates all the feature properties that can change in time. The *gml:identifier* property can be transmitted along with any Feature TimeSlice, allowing to identify the feature to which the TimeSlice belongs.

There are two essential requirements for the identifier property:

1. **to be unique** – there should exist a reasonable confidence that an identifier will never be unintentionally used by anyone for anything else;
2. **to be universal** – the same identifier should be used in all systems to identify a given AIXM Feature.

2.2 Use of UUID

The first requirement can be satisfied through the use of Universal Unique Identifiers (UUID). UUID generation algorithms can guarantee that the risk for the same UUID value to be generated by another system, for another feature, is extremely low. Information about such algorithms is provided in Appendix 1 of this document.

Concerning the second requirement, it is important to note that the identifier does not identify a feature. It identifies the data that someone has about a feature! In order to get maximum benefit from UUID, they should be generated by the primary originator (authoritative source) for that feature data.

Ideally, all stakeholders should have the same data about a given feature. However, as multiple “pseudo-primary” information sources may exist for the same data item or because the digital data transmission chain may be broken or duplicated, this cannot be guaranteed, at least on short term. Ensuring that the same *gml:identifier* is used in all systems for a given AIXM feature is a requirement for the information management process; therefore, it needs to be taken care through the process rules. From this point of view, UUIDs can indicate the continuity and the coherence of the data chain. If two systems use the same UUID for a feature, this indicates that either:

- they have the data from the same source (could be one of the two system, or a third one), or
- there are processes in place that ensure the consistency of the data between the two systems.

It is therefore possible that two or more information sets (list of TimeSlices) exists for the same AIXM feature, in two different systems, with different *gml:identifier* values. When data from different sources is merged in a single system, the owner of that system might be confronted with the need to identify and merge duplicate feature data, based on actual properties of the feature, not on the *gml:identifier*.

Overall, the most important advantage of using UUID as *gml:identifier* in AIXM is for software development. It is much simpler and less error prone to write code that relies on

UUID for feature identification and reference, as compared the use any kind of “natural key” combination.

2.3 UUID version and codeSpace

On the basis of the analysis presented in Appendix 1, **the use of version 4 UUID based on random number generation, is recommended for AIXM**. An example of a gml:identifier using a UUID value is provided below.

```
<gml:identifier
  codeSpace="urn:uuid:">a82b3fc9-4aa4-4e67-8def-
  aaealac595j</gml:identifier>
```

Information about UUID generation capabilities in common software is provided in Appendix 1, section A.1.9.

Note that a Uniform Resource Name (URN) is used as codeSpace for the gml:identifier. The ISO/IEC 9834-8 or RFC 4122 (<http://www.ietf.org/rfc/rfc4122.txt>) provide the UUID codeSpace value “urn:uuid:”.

2.4 The gml:id property

Every GML object is required to have a gml:id value, which is intended as a local unique identifier, within the XML data set. AIXM features also being GML objects, they must have a gml:id value as well. In addition, all other GML objects inside the feature (TimeSlice, gml:TimePeriod, gml:Point, aixm:SurfaceCharacteristics, aixm:AirspaceVolume, etc.) are also required to have a gml:id values, as shown in the example below:

```
<aixm:Airspace gml:id="...">
  <gml:identifier
    codeSpace="urn:uuid:">a82b3fc9-4aa4-4e67-8def-
    aaealac595j</gml:identifier>
  <aixm:timeSlice>
    <aixm:AirspaceTimeSlice gml:id="...">
      <gml:validTime>
        <gml:TimePeriod gml:id="...">
          <gml:beginPosition>2010-06-29T17:31:00</gml:beginPosition>
          <gml:endPosition>2010-06-29T19:00:00</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <aixm:interpretation>BASELINE</aixm:interpretation>
      <aixm:sequenceNumber>1</aixm:sequenceNumber>
      <aixm:type>D</aixm:type>
      <aixm:geometryComponent>
        <aixm:AirspaceGeometryComponent gml:id="...">
          <aixm:theAirspaceVolume>
            <aixm:AirspaceVolume gml:id="...">
              <aixm:upperLimit uom="FT">500</aixm:upperLimit>
              <aixm:upperLimitReference>MSL</aixm:upperLimitReference>
              <aixm:lowerLimit uom="FT">GND</aixm:lowerLimit>
              <aixm:lowerLimitReference>MSL</aixm:lowerLimitReference>
              <aixm:horizontalProjection>
                <aixm:Surface gml:id="...">
                  <gml:patches>
                    <gml:PolygonPatch>
                      <gml:exterior>
                        ...
                      </gml:exterior>
                    </gml:PolygonPatch>
                  </gml:patches>
                </aixm:Surface>
              </aixm:horizontalProjection>
            </aixm:AirspaceVolume>
          </aixm:theAirspaceVolume>
        </aixm:AirspaceGeometryComponent>
      </aixm:geometryComponent>
    </aixm:AirspaceTimeSlice>
  </aixm:timeSlice>
</aixm:Airspace>
```

```
</aixm:Airspace>
```

The gml:id value has to comply with the same rules as any other XML ID attribute: to be unique within the XML file, to start with a letter, etc.

It is recommended that the gml:id of the AIXM features (such as aixm:Airspace, aixm:Runway, etc.) also make use of the UUID value, prefixed with "uuid.". Since UUID are globally unique, they are also locally unique and thus perfect candidates for gml:id. Attention, this recommendation concerns only the AIXM Feature level, not the lower levels, such as aixm:AirspaceTimeSlice, etc. The use of the feature UUID as gml:id will facilitate the implementation of concrete xlink:href references using the direct '#ID' syntax, as explained in 3.1.

Applied to the previous example, these recommendations give the following gml:id values:

```
<aixm:Airspace gml:id="uuid.a82b3fc9-4aa4-4e67-8def-aaea1ac595j">
  <gml:identifier
    codeSpace="urn:uuid:">a82b3fc9-4aa4-4e67-8def-
aaea1ac595j</gml:identifier>
  <aixm:timeSlice>
    <aixm:AirspaceTimeSlice gml:id="ID00001">
      <gml:validTime>
        <gml:TimePeriod gml:id="ID00002">
          <gml:beginPosition>2010-06-29T17:31:00</gml:beginPosition>
          <gml:endPosition>2010-06-29T19:00:00</gml:endPosition>
        </gml:TimePeriod>
      </gml:validTime>
      <aixm:interpretation>BASELINE</aixm:interpretation>
      <aixm:sequenceNumber>1</aixm:sequenceNumber>
      <aixm:type>D</aixm:type>
      <aixm:geometryComponent>
        <aixm:AirspaceGeometryComponent gml:id="ID00003">
          <aixm:theAirspaceVolume>
            <aixm:AirspaceVolume gml:id="ID00004">
              <aixm:upperLimit uom="FT">500</aixm:upperLimit>
              <aixm:upperLimitReference>MSL</aixm:upperLimitReference>
              <aixm:lowerLimit uom="FT">GND</aixm:lowerLimit>
              <aixm:lowerLimitReference>MSL</aixm:lowerLimitReference>
              <aixm:horizontalProjection>
                <aixm:Surface gml:id="ID00005">
                  <gml:patches>
                    <gml:PolygonPatch>
                      <gml:exterior>
                        ...
                    </gml:PolygonPatch>
                  </gml:patches>
                </aixm:Surface>
              </aixm:horizontalProjection>
            </aixm:AirspaceVolume>
          </aixm:theAirspaceVolume>
        </aixm:AirspaceGeometryComponent>
      </aixm:geometryComponent>
    </aixm:AirspaceTimeSlice>
  </aixm:timeSlice>
</aixm:Airspace>
```

3 Feature Reference (xlink:href)

3.1 Introduction

Associations between AIXM Features are implemented in the AIXM XML Schema through the use of XLinks [XLINK].

The general recommendation is to use the gml:identifier (UUID) of the referenced AIXM Feature. This supports many commercial solutions out-of-the-box, as it relies entirely on the XLink, XPointer and XPath standards. It is critical that every XLink value points to the correct feature of interest. For example, that an xlink value identifying an Airspace holds the identifier of an Airspace feature, not the one of a Runway or another feature, message, etc. However, this cannot be ensured by the XML Schema and it needs to be dealt with as part of the data validation rules.

If the UUID is not available, a natural key search can be used. In general, the verbosity of such a request may increase as finding the key will require querying into a TimeSlice of the AIXM Feature.

From the point of view of the Xlink target, there exist three cases of interest:

1. Concrete local references within a data set;
2. Concrete external references resolved via web services;
3. Abstract references to be resolved by the consuming application.

These are described in more detail in the following sub-sections.

3.2 Concrete local references within a message

In some cases, services producing AIXM 5.1 data will provide data sets in which all the referenced features are included. Instead of a reference by gml:identifier, a simpler local reference to the gml:id attribute could be used in this case. The gml:id is, by definition, unique within an XML file. Therefore, when used for local references, it is unambiguous. The gml:id attributes are defined as identifiers in the schema and can be indexed during parsing.

An example is provided below. Note that the recommendation made in 2.4 is applied here, which means the gml:id of the Airspace feature is actually based on the UUID value of the gml:Identifier.

```
<aixm:Airspace gml:id="uuid.:a82b3fc9-4aa4-4e67-8def-aaealac595j">
  <gml:identifier
    codeSpace="urn:uuid:">a82b3fc9-4aa4-4e67-8def-
    aaealac595j</gml:identifier>
  ...
</aixm:Airspace>
...
<aixm:AirTrafficControlService gml:id="uuid.d4d33081-54ad-4c1a-9519-
b5b67de561ae">
  <aixm:timeSlice>
    <aixm:AirTrafficControlServiceTimeSlice
gml:id="AirTrafficControlService01_TS1">
      <gml:validTime>
        <gml:TimePeriod gml:id="AirTrafficControlService01_TS1_TP1">
          <gml:beginPosition>2008-01-01T00:00:00</gml:beginPosition>
          <gml:endPosition indeterminatePosition="unknown"/>
        </gml:TimePeriod>
      </gml:validTime>
    </aixm:AirTrafficControlServiceTimeSlice>
  </aixm:timeSlice>
</aixm:AirTrafficControlService>
...
</message>
```

```

    </gml:TimePeriod>
  </gml:validTime>
  <aixm:interpretation>BASELINE</aixm:interpretation>
  <aixm:type>ACS</aixm:type>
  <aixm:clientAirspace xlink:href="#uuid.a82b3fc9-4aa4-4e67-8def-
aaealac595j" />
</aixm:AirTrafficControlServiceTimeSlice>
</aixm:timeSlice>
</aixm:AirTrafficControlService>

```

3.3 Concrete external references

When information about features is exposed via web services, a method by which XLinks can be resolved is via a Universal Resource Locator (URL).

In this case, the expectation is that the consumer of the message can follow the URL provided in the XLink directly and the hashtag will identify the feature within the resultant resource to which this reference resolves. If the recommendation made in 2.4 was applied and the target feature has a UUID based gml:id, then the concrete reference may be encoded using simply the '#ID' reference syntax, as in the example below:

```

<aixm:clientAirspace
xlink:href="http://aim.faa.gov/services/AirspaceService#uuid.a82b3fc9-
4aa4-4e67-8def-aaealac595j" />

```

A more general, but also much more complex solution is to use xpointer. Again, the combination of the URL and the XPointer should result in the tag which resolves to the feature which is referenced.

```

<aixm:clientAirspace
xlink:href="http://aim.faa.gov/services/AirspaceService?get=a82b3fc9-4aa4-
4e67-8def-
aaealac595j#xmlns(ns1=http://www.opengis.net/gml/3.2)xmlns(ns2=http://www.
aixm.aero/schema/5.1)xpointer(//ns2:Airspace[ns1:identifier='a82b3fc9-
4aa4-4e67-8def-aaealac595j'])" />

```

Note that the above URL is independent of implementation. It may identify a (Web Feature Server) WFS server, but it could also be an implementation of a simple web service which returns a particular set of features based on the user's query. As long as the resolution of the URL produces an XML document which contains the AIXM Feature, the above is a valid reference.

The approach for the first two cases (concrete local or external references) is based purely on the XLink and XPointer standard: there is no application-specific logic required to resolve the reference. However, implementers should take care to take advantage of caching strategies to avoid continually resolving features for which they already have definitions.

3.4 Abstract references

Xlink assumes a "resource centered approach", in which the XML document or fragment is a resource which can be referenced from anywhere. It assumes that the resource is available on the web in a single, definitive copy. In the aeronautical information domain, the feature is an entity which can be globally referenced but there are many representations of that feature in circulation. Many of those representations are in AIXM messages; others are in databases or applications. This is why the use of concrete references is rare and the use of abstract references needs to be considered as well.

Abstract references fit very well to the GML paradigm since they provide a reference to the abstract idea of the feature, rather than one of its representations. Resolving the abstract

reference to a physical one is the problem of the application and it can deal with issues of multiple copies in all the messages, databases etc. that it knows about.

Leaving the resolution with the application also allows the application to adapt to its context. For example, if the application is off-line it could choose to use a locally cached copy of the feature. An on-line application could go to the definitive web-service for the feature.

In those cases, the `xlink:href` should use a universal resource name (URN) rather than a URL; note that URNs, unlike URLs, cannot be directly used to find a resource. In the case where a URN is presented to the consumer, it is the responsibility of the consuming application to resolve the reference.

Nothing in the use of a URN implies the availability of the referenced feature or its location; it may be that the feature is defined locally within the message, accessible remotely by a web service, or directly through a database access.

In general, the following three steps will be followed:

1. The recipient of the data will use the identifier of the referenced feature to search its local database.
2. If no such feature exists in its local data set, the incoming data set would be searched for the referenced feature.
3. If the above does not find the feature, the system would search known data sources to resolve the reference.

This type of reference is limiting in its openness, as it requires application logic to be resolved. As such, its use is expected to be reduced over time, as the aeronautical information domain moves towards Web service solutions. By using the concrete standards mentioned above, any standards-complete system can resolve AIXM references without additional application logic.

3.4.1 Using UUID

It is recommended that the URN is based on the UUID of the referenced feature, as in the following example

```
<aixm:clientAirspace xlink:href="urn:uuid:a82b3fc9-4aa4-4e67-8def-aaea1ac595j" />
```

In this case, the application will consume the URN-based locator and internally discover the definition of the referenced airspace through data registries, manual coding, or other methods specific to the systems involved. The beginning of the URN should match the codeSpace used for `gml:identifier`.

3.4.2 Using natural keys

When the UUIDs are not available, an AIXM specific URN composed with natural keys could be used, as in the example below:

```
<aixm:clientAirspace xlink:href="urn:aixm:Airspace(gml:timePosition=2010-04-07T09:00;aixm:type=D;aixm:designator=EBD25A) " />
```

Apart from being much more complex than those based on UUID, the disadvantage of the URN based on natural keys is that they requires specific code for decoding and identifying the target feature. Therefore, URN with natural keys should be used only during transition periods and on a limited scale. For example, it might be a solution to use natural key based URN between systems that store the data in legacy formats and which do not have the possibility to work with UUID values..

The following rule shall be applied in the composition of the “aixm” URN:

urn:aixm:**Feature**(timePosition=**time_value**;**property_name**=**property_value**;...)

where:

- **Feature** is the name of an AIXM Feature as defined in the AIXM XML Schema; for example: AirportHeliport, Airspace, Runway, etc.
- **time_value** is a UTC date and time value in the format yyyy-mm-ddThh:mm and it indicates the moment in time at which the BASELINE TimeSlice of the AIXM Feature referred had the **property_value(s)** that appear in the URN composition;
- **property_name** is the name of property of an AIXM Feature that composes a natural key for that feature; the property name shall be spelled according to the AIXM XML Schema, exactly as it appears as child element of the AIXM Feature TimeSlice.

It is assumed that all natural key properties are either direct child elements of the Feature TimeSlice or that they exist only once in the XML tree (such as the gml:pos of a Navaid).

- **property_value** is the value of the of the property identified by **property_name** as defined in the BASELINE TimeSlice of that feature that is valid at the date and time specific by the **time_value**;

In some situations, this includes properties that do not directly have a value, but have an xlink:href attribute that points to another Feature. In this case, the URN of the referenced feature shall be used as property_value. A typical example is the Runway feature, for which the natural key includes the AirportHeliport where it is located. The URN will look like in the example below:

```
urn:aixm:Runway(gml:timePosition=2010-12-20T16:32;aixm:designator=02%2F20;aixm:associatedAirportHeliport=urn:aixm:AirportHeliport(gml:timePosition=2010-12-20T16:32;aixm:designator=EBBR))
```

Note that the value of an AIXM feature natural key property could contain characters that are not allowed in the composition of the URN, as explained in the URN Syntax (RFC 2141) and have to be replaced with their hex code, prefixed by the character “%”. This is the case for the “/” character, which is typically used in runway designators. Therefore, in the example above, the runway designator “02/20” was encoded as “02%2F20”, where “%2F” is the hex representation of “/”.

In order to be valid URN in terms of the RFC 2141 (URN Syntax), the “aixm” URN would have to be registered with the Internet Assigned Numbers Authority. Until then, it shall be considered as a non-standard (experimental) URN.

3.5 Use of xlink:title

The value of the attribute xlink:title on a xlink is a human-readable description of the referenced value. In this case, it would be a human-friendly description of the referenced aeronautical feature.

It is suggested that the xlink:title be used, especially in cases in which the referenced feature is defined remotely. The title should be a human-friendly name of the feature which can be used internally by applications for display purposes. It is discouraged to use the xlink:title for automatic feature identification.

```
<aixm:clientAirspace xlink:href="urn:uuid:a82b3fc9-4aa4-4e67-8def-  
aaealac595j" xlink:title="Gabbs North MOA"/>
```

A.1. UUID algorithms

A.1.1 Introduction

This Appendix examines the four main versions of the UUID; how they are generated, their efficiency and their computational overhead. On the basis of this comparison it is found that the version 4 UUID, based on random number generation, is the most efficient. The tendency in the industry is to move toward the use of version 4, with the notable exception of Oracle that remains on version 1. A survey of the UUID/Globally Unique Identifier (GUID) versions supported by the main software products and libraries is summarized in Figure 7.

A.1.2 Definition and Uniqueness

A UUID is a 128-bit number that is encoded either with a random number, the output of a cryptographic hash function or a combination of a random number and the time of generation. UUIDs are conventionally written or displayed in their 'canonical' form, which is a sequence of 32 hexadecimal digits grouped into a sequence of 8, 4, 4, 4 and 12 digits; an example is given below.

```
550e8400-e29b-41d4-a716-446655440000
```

The left-most digit of this string represents the most significant four bits of the UUID.

The purpose of the UUID is best described by Wikipedia <http://en.wikipedia.org/wiki/UUID> as: *"The intent of UUIDs is to enable distributed systems to uniquely identify information without significant central coordination. Anyone can create a UUID and use it to identify something with reasonable confidence that the identifier will never be unintentionally used by anyone for anything else."* The UUID is defined in three compatible standards: [ISO/IEC 11578:1996](#), ITU-T Rec. X.667 | [ISO/IEC 9834-8:2005](#) and [IETF RFC 4122](#).

The reason for the use of a number field as large as $[1-2^{122}]$ is that the UUID is **universal**, i.e. the probability of a duplicate UUID being encountered within the IT universe for the foreseeable future must be a very low.

A.1.3 Format and Versions

The UUID format is depicted in Figure 1. Six of the 128 bits are used to specify the type of UUID leaving 122 to carry a random number, the output of a cryptographic hash function or a combination of a Network Interface Card (NIC) MAC address and the time of generation, depending on the Version of the UUID. The six control bits are very awkwardly placed, and are not even contiguous, making the generation and interpretation of UUIDs more complicated than it need have been. The digits are numbered from the left-most digit of the canonical (string) form. The type of UUID is defined first by the value of the Variant field (YY) which occupies the most significant two bits of the 17th hex digit.

Note: *RFC 4122, paragraph 4.1.1 shows the variant field as having three bits. For all standard UUIDs the least significant bit of these three is irrelevant; it is used as the top bit of the clock sequence in version 1 UUIDs, or is part of the random or hash fields in version 3,4 or 5 UUIDs.*

A value of 2 in the variant field indicates that the UUID is one of the standard versions. A zero value of the most significant bit of the variant field indicates that the UUID was generated by a workstation in the Apollo Network Computing System. A value 3 of the

variant field indicates a UUID that was used by .COM in versions of Microsoft Windows before Windows 2000. The *Version* field (VVVV) is coded into the 13th digit allowing up to 15 UUID versions. Five versions, numbered 1 – 5 currently exist.

Hex Digits	1	2	3	4	5	6	7	8
1 to 8	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
9 to 16	XXXX	XXXX	XXXX	XXXX	VVVV	XXXX	XXXX	XXXX
17 to 24	YYXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
25 to 31	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Figure 1 - General Format of UUID

The UUID standards do not require that the UUIDs generated by a given system must all be of the same version. A closed (i.e. not universal) distributed system, could exploit this by allowing any of the four main versions to be generated. The degree of uniqueness of the UUIDs would then be quadrupled, from a field of $[1-2^{122}]$ an effective field of $[1-2^{124}]$.

A.1.4 Version 1 UUID

The version 1 format is the oldest and most complicated, but is still widely used; the encoding is shown in Figure 2. The 60 bits labeled ‘t’ are the time at which the UUID was created, in increments of 100 nano-seconds (1×10^{-7}) seconds. The 48 bits labeled ‘m’ are the (universally unique) MAC address of one of the Network Interface Cards (NIC) on the system; when this is not available a 48-bit random or pseudo-random number is generated. The 14 clock-sequence bits labeled ‘c’ are used to reduce the possibility of a duplicate UUID value being generated following the clock being set backwards (after a power outage) or the NIC card being changed. The field allows for 2^{14} or >16,000 resets in the lifetime of the system. In the unlikely event that the clock sequence just before the event is known, it can be used on recovery and just incremented; otherwise the clock sequence is re-initialized with a random number.

Hex Digits	1	2	3	4	5	6	7	8
1 to 8	tttt	tttt	tttt	tttt	tttt	tttt	tttt	tttt
9 to 16	tttt	tttt	tttt	tttt	0001	tttt	tttt	tttt
17 to 24	10cc	cccc	cccc	cccc	mmmm	mmmm	mmmm	mmmm
25 to 31	mmmm	mmmm	mmmm	mmmm	mmmm	mmmm	mmmm	mmmm

Figure 2 - Format of Version 1 UUID – Time and Address

The time field in a version 1 UUID provides the elapsed time, in 100 nanosecond increments, since the start of the Gregorian calendar in October 1582. The maximum

(unsigned) value of 2^{60} nanoseconds is equal to about 3663 years. Currently the highest order bit set in a version 1 UUID time field is the 57th bit. The 58th and higher bits will not be used until after 2444.

A.1.5 Version 2 UUID

Version 2 UUID is used in the IEEE Portable Operating System Interface POSIX Distributed Computing Environment. The format is very similar to version 1.

A.1.6 Version 4 UUID

The encoding of a version 4 UUID is shown in Figure 3. The 122 bits labeled ‘r’ comprise a pseudo-random number, or preferably a cryptographic quality random number.

Hex Digits	1	2	3	4	5	6	7	8
1 to 8	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr
9 to 16	rrrr	rrrr	rrrr	rrrr	0100	rrrr	rrrr	rrrr
17 to 24	10rr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr
25 to 31	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr	rrrr

Figure 3 - Format of Version 4 UUID – Random Number

After a distributed system starts generating version 4 UUIDs, if a source of cryptographic quality random numbers is used, the probability that it will generate a duplicate UUID of one already generated $p(n;d)$ is given by the expression $1 - e^{-nxn/2^d}$ where the number already generated is 2^n and d is the number of bits occupied by the random number. The probability of a collision will be higher if pseudo-random numbers generated by the system are used.

As an example, after 243 (≈8.8 trillion) UUIDs have been generated, the probability of the next UUID being a duplicate of one already generated is $\approx 7.276 \times 10^{-12}$. Figure 4 gives $p(n;d)$ for values of n : 36, 41, 43 and 46 and values of d : 90, 106 and 122. {calculated with R Statistical Language}. The fourth column of the table shows that taking 4 octets of the random number field for another use would introduce a significant probability of collisions occurring.

	$d = 122$	$d = 106$	$d = 90$
$n = 36$	4.44×10^{-16}	2.91×10^{-11}	1.19×10^{-6}
$n = 41$	4.55×10^{-13}	2.98×10^{-8}	1.95×10^{-3}
$n = 43$	7.28×10^{-12}	4.77×10^{-7}	3.08×10^{-2}
$n = 46$	4.66×10^{-10}	3.05×10^{-5}	8.65×10^{-1}

Figure 4 - Probability of Collision for Version 4 (Random Number) UUIDs

A.1.7 Versions 3 and 5 UUID

The encoding of a version 3 or version 5 UUID is shown in Figure 5. The bits labeled 'h' are the output of an MD5 cryptographic hash function in version 3 UUIDs and are the output of a SHA-1 cryptographic hash function in version 5 UUIDs. The hash function values of 128 bits (MD5) and 160 bits (SHA-1) are truncated to the 122 bits available in the UUID.

Hex Digits	1	2	3	4	5	6	7	8
1 to 8	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh
9 to 16	hhhh	hhhh	hhhh	hhhh	0011/0101	hhhh	hhhh	hhhh
17 to 24	10rr	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh
25 to 31	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh	hhhh

Figure 5 - Format of Version 3 or Version 5 UUID

Information about the MD5 algorithm can be found at http://www.w3.org/TR/1998/REC-DSig-label/MD5-1_0, and about the SHA-1 algorithm at <http://www.itl.nist.gov/fipspubs/fip180-1.htm>. Both of these algorithms have been 'broken' by systematic attacks; in the case of MD5 within 2^{43} hash operations and in the case of SHA-1 within 2^{63} hash operations. These are well below the number of operation that can be guaranteed to produce a collision, 2^{64} and 2^{80} respectively. However this has no implications for the use of hash numbers in UUIDs, where they are used more for convenience than for security, other than to suggest that the uniqueness of a UUID formed with either of these algorithms will be less than that of a version 4 UUID formed with a random number of cryptographic quality.

A.1.8 Comparisons of UUID Versions

Efficiency of bit usage

The time algorithm used in version 1 UUIDs is inefficient in its granularity of 100 nanoseconds. The 56th bit of the 60-bit time field was not used until some time in 1986, and the 57th bit will not be used until 2444. This means that the top 4 bits are effectively not being used. Also, the 14 bit clock sequence field in version 1 UUIDs is only used each time the system is powered up, allowing for 2^{14} or >16,000 resets in the lifetime of the system. A lower number of bits would provide for a sufficient number of resets, given that a recycling of this field would not produce UUIDs with an ambiguous time of generation.

In contrast to version 1 UUIDs, in versions 3, 4 and 5 UUIDs all 122 available bits are used to hold either a random number or the output of a hash function.

Computational overhead

An April 2007 test to compare the times taken to generate version 1, version 3 and version 4 UUIDs { <http://johannburkard.de/blog/programming/java/Java-UUID-generators-compared.html> } showed the following average times to generate 1 million UUIDs with standard Java software:

Version 1 Time based	5,432 milliseconds
Version 3 MD5 based	40,788 milliseconds
Version 4 Random number based	48,900 milliseconds

Figure 6 - Average times for UUID generation

These results show that versions 3 and 4 UUIDs incur substantially higher processing overhead than version 1 UUIDs: by a factor of about 7.5 for version 4 and a factor of about 9 for version 3.

The SHA-1 algorithm generates a 160 bit hash compared to the 128 bits generated by the MD5 algorithm. When used in a UUID, both hashes are truncated to 122 bits, so any advantage in security or randomness that the SHA-1 might have over MD5 is obviated when it is used in a UUID.

Uniqueness

The timestamp field in the version 1 UUID is not a random number. Each bit changes with half the frequency of the preceding, less significant bit; the 48th and higher bits change less than once a year. More significant is the devotion of 14 bits to the clock sequence field, which is only incremented each time a system is switched back on. The Version 1 UUIDs are therefore substantially less unique than either Version 3 or Version 4 UUIDs.

The uniqueness of version 3 or 5 UUIDs can not be greater than the uniqueness of version 4 UUIDs and may be less, given the fact that they can both be compromised after a number of uses that is well below the number at which duplication could be expected (“brute force attack”): 2^{43} instead of 2^{64} in the case of MD5 and 2^{63} instead of 2^{80} in the case of SHA-1.

A.1.9 Support by Common Software

It is sometimes difficult to establish what versions of UUID are supported by a particular software application, as many users and even product announcements do not seem to be aware that five distinct versions exist. Typically the output of a UUID generator is only described as several groups of hexadecimal digits. Oracle is notable in this respect, simply defining its UUID as a 16 byte raw value. In the case of Microsoft, it was difficult to untangle because UUIDs are used extensively within Microsoft packages; only one of many interfaces in the Microsoft Component Object Model (COM), and now in the .NET framework, use the type of UUIDs included in this study. Microsoft switched from using version 1 to version 4 with the introduction of .NET and Windows 2000.

Although a particular application package may not support a given version of a UUID, in many cases an extension to support that version can be added from libraries such as the UNIX-based Open Source Software Project (OSSP).

	Version 1	Version 3	Version 4	Version 5	Variant
Microsoft .COM					3
Microsoft Windows 2000			X		
Oracle	X				
Java (JUG)	X	X	X	X	
Java J2SE5		X	X		

JavaScript uuid.js	X				
Linux (oss)	X	X	X	X	
MySQL Version 1	X				
MySQL current			X		
PostgreSQL			<u>X</u>		
Apache (Jakarta project)	X	X	X	X	
OpenPKG	X	X	X		
Python	X	X	X	X	
Ruby	X	X	X	X	
C++ (oss)	X	X	X	X	

Figure 7 - UUID Versions Supported by Common Software

Agenda Item 3: Implementation of the Quality Management System in AIM units

3.1 Under this agenda item, the Meeting reviewed the following papers:

- WP/07 - *GREPECAS Project G3* (Presented by the Secretariat)
- WP/08 – *New requirements of Standard ISO 9001* (Presented by the Secretariat)

GREPECAS Project G3 – Implementation of the Quality Management System in AIM units

3.2 The Meeting took note of the progress made in the implementation of the Quality Management System for processes managed by AIM units. In this regard, **Uruguay** obtained its certification in September 2015, and **Peru** in December 2015. **Argentina completed the audit certification process and is waiting for its certification.**

3.3 The Meeting expressed its concern for the situation of **Colombia** and **Venezuela**, which were still unable to certify their AIM systems, and for the delays in quality implementation in **Bolivia**, **Guyana** and **Suriname**. In this regard, Guyana and Suriname presented their Corrective Action Plans for the implementation of the quality management system by the end of 2017 or first half of 2018.

3.4 The situation that had driven back implementation was the one facing Ecuador, which had not been able to re-certify its AIM/QMS, certified in 2012, due to administrative problems.

3.5 The main factor that contributed to expedite certification of quality management systems in the States was top management. Top management, when involved in the quality certification of systems and processes, helped to unblock management barriers that delayed implementation.

3.6 The Declaration of Bogota obtained the commitment of top management to quality certification of AIM processes in the Region. This commitment should be replicated at national level in order to obtain the certification as scheduled.

3.7 Based on the above, it was felt advisable for the Project Description to include the task of those States that had not reached 80% certification, in order to send that information to the corresponding authorities and obtain top management support.

3.8 The last update on the progress made in quality implementation is shown in the following table:

STATE	% IMPLEMENTATION OCTOBER 2016	IMPLEMENTATION DATE	% PROGRESS	REMARKS
Argentina	100%	FEB/2016	30%	Internal and external audits have been performed. They are waiting for the certificates.

STATE	% IMPLEMENTATION OCTOBER 2016	IMPLEMENTATION DATE	% PROGRESS	REMARKS
Bolivia	30%	TBD	0%	The provider, AASANA, has trained two experts for quality implementation. One DGCA official attended the Lead auditor course held in October 2015.
Brazil	CERTIFIED	-----	-----	
Chile	CERTIFIED	-----	-----	
Colombia	90%	SEP/2014	25%	A consulting firm has been engaged for AIS/QMS and MET/QMS certification.
Ecuador	Re-certification has not been achieved	-----	-----	There is no information on re-certification plans.
French Guiana	CERTIFIED	-----	-----	
Guyana	60%	DEC/2017	35%	Presented implementation and certification plan. Implementation foreseen for July 2018.
Panama	100%	DEC/2017	10%	Administrative restrictions did not permit certification. The date proposed is December 2017, with ICAO 9001:2015.
Paraguay	CERTIFIED	-----	-----	
Peru	CERTIFIED	-----	-----	
Suriname	50%	AUG/2014	5%	Presented Action Plan
Uruguay	CERTIFIED	-----	-----	
Venezuela	85%	NOV/2014	15%	No progress.

3.9 The Secretariat will update the Project Description presented in **Appendix A** to this part of the report as approved by the Meeting.

Changes in Standard ISO 9001

3.10 The Secretariat informed that Standard ISO 9001 had changed its requirements in September 2015 and that the transition period to adjust the quality management systems already implemented and certified was three years (September 2018).

3.11 The Meeting noted that these changes in Standard ISO 9001 affected all the States that had already been certified as well as those that had not yet implemented the AIM/QMS.

3.12 The Meeting considered that planning was necessary in order to adjust to the new standards within the transition period of three years after publication.

3.13 Furthermore, the Meeting requested that the Guide to support AIM/QMS Implementation in the SAM Region be reviewed, and assigned an expert from Peru to work with the Secretariat in the updating of the Guide.

3.14 The Meeting deemed it important to send a State Letter informing of the changes made in Standard ISO 9001 and requesting delivery of plans for adjusting the quality management systems already implemented to the new requirements of the standard.

APPENDIX A

SAM Region	PROJECT DESCRIPTION (DP)	DP N° G3	
<i>Programme</i>	Title of the Project	Start	End
<i>AIM</i> (ICAO Programme Coordinator: Jorge Armoa Cañete)	Assessment and development of QMS applied to AIM in SAM States Project coordinator: Oscar Dioses (Peru) Experts contributing to the Project: SAM/AIM IG Eng. David Díaz (Peru)	03/10/11	01/11/18
Objective	Implement guides applicable to the quality management system in a digital/electronic AIM environment in the SAM Region, based on the regional performance objectives of the SAM performance-based implementation plan.		
Scope	The scope of the project contemplates the assessment and identification of implementation levels associated to quality management in AIM services in the Region. Drafting of an action plan and guides for the implementation of QMS in a digital/electronic AIM environment.		
Metrics	Percentage of States with ISO 9001:2008 QMS certification.		
Goals	50% of States with the ISO standard 9001:2008 implemented by 2013, and certified by 2014.		
Strategy	Project activities will be coordinated among project members, the project coordinator, and the programme coordinator, mainly through teleconferences (GoToMeeting application) and meetings that may be held within other scheduled events, based on the activities of the work programme. The project coordinator will coordinate with the programme coordinator for the inclusion of additional experts, if warranted by the tasks and work to be performed. The results of the work done will be submitted to the consideration and review of State experts in the form of a final consolidated document for analysis, review, and approval, and for presentation to the GREPECAS PPRC by the programme coordinator.		
Rationale	The quality management system in AIM services must provide users the required guarantee and assurance that the aeronautical information/data distributed meets quality requirements in terms of accuracy, resolution and integrity. There needs to be a close relationship with other projects in order to collect the operational requirements of the aforementioned applications and their respective tentative dates of implementation.		

Related projects	This project is related to Projects G1 “Implementation of the provision of electronic terrain and obstacle data e-TOD” and G2 “Implementation of Aeronautical Information Exchange Systems (AIXM)”.				
Project deliverables	Relationship with the performance-based regional plan (PFF)	Responsible party	Status of implementation*	Delivery date	Comments
Prepare surveys to establish the levels of compliance and implementation of AIM-QMS based on ICAO guides	PFF: SAM AIM/01	ICAO coordinator		25/11/11	Finalised as scheduled.
Circulate surveys to the States	PFF: SAM AIM/01	ICAO coordinator		17/02/12	Finalised as scheduled.
Collect and tabulate the information of the States	PFF: SAM AIM/01	ICAO coordinator		13/04/12	Finalised on 30/03/12.
Description of steps for QMS implementation.	PFF: SAM AIM/01	SAM/AIM/WG		30/03/12	Finalised as scheduled.
QMS self-assessment questionnaire	PFF: SAM AIM/01	David Diaz RLA/06/901		30/03/12	Finalised as scheduled.
Template with QMS assessment results	PFF: SAM AIM/01	David Diaz RLA/06/901		30/03/12	Finalised as scheduled.
QMS implementation plan	PFF: SAM AIM/01	David Diaz RLA/06/901		19/10/12	Finalised as scheduled.

QMS procedures and preventive actions.	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
QMS internal audit procedure.	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
Procedure for controlling AIS service management system records	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
Procedure for drafting QMS documents.	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
Service control procedure – QMS non-conforming products.	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
Procedures for controlling the documents of the AIS service management system.	PFF: SAM AIM/01	Oscar Dioses Peru		19/10/12	Finalised as scheduled.
Model SLA with service providers to ensure the quality of the information and data exchange.	PFF: SAM AIM/01	Juan J. González Uruguay		19/10/12	Finalised as scheduled.
CRC Cyclic Redundancy Check Set of 32 bit.	B0 DATM	Juan J. González Uruguay		30/03/2015	Finalised as scheduled.
AIM Training Programmes	B0 DATM	Juan J. González Uruguay		30/03/2015	Finalised as scheduled.
Collect certifications and produce report on the status of ISO 9001:2008 certifications in the SAM Region	PFF: SAM AIM/01	ICAO coordinator		01/11/18	Brazil, Chile, French Guiana, Paraguay, Peru and Uruguay Certified ISO 9001:2008

Resources required	Designation of experts in the execution of some of the deliverables. More commitment by States to support the designated coordinators and experts.
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**Grey*

Task not started

Green

Activity underway as scheduled

Yellow

Activity started with some delay but expected to be completed on time

Red

It has not been possible to implement this activity as scheduled; mitigating measures are required

Agenda Item 4: NOTAM Contingency Plan, AIM deficiencies and ICARD system

4.1 Under this agenda item the Meeting reviewed the following papers:

- WP/09 - *NOTAM Contingency Plans, deficiencies in the AIM area and ICARD System* (Presented by the Secretariat);

Updates to NOTAM Contingency Plans

4.2 The Meeting was informed that Guyana and Suriname had signed an agreement on the NOTAM Contingency Plan, which was already included in the Regional Catalogue.

4.3 The delegation of Chile noted that no progress had been made in the plans of Paraguay and Chile to implement a NOTAM Contingency Plan.

NOTAM Contingency

4.4 SAM States that already have their corresponding NOTAM Contingency Plans are listed in **Appendix A** to this part of the report.

4.5 It was noted that the NOTAM Contingency Plan was subject to periodic revisions. The modifications required would be made prior coordination between the parties. It was agreed that modifications would be effective not before 30 days after the date of approval.

AIM deficiencies

4.6 Regarding deficiencies reported in the AIM area, it was noted that States had made progress with respect to the last meeting, although some States had had recurrent deficiencies for various years without taking any corrective action, which created great concern in GREPECAS and HQ and was subsequently reflected in the safety audits.

4.7 AIM deficiencies for SAM States are presented in **Appendix B**, and will be subsequently updated in the GANDD based on the information provided during this Meeting. A special topic for discussion is the deficiency concerning e-TOD implementation.

4.8 The Meeting took note of the recommendation made by the Fourth Meeting of the Programmes and Projects Review Committee (PPRC/4) with regard to communicating ICAO of any e-TOD implementation difference through EFOD, and its publication in GEN 1.7, and the drafting of an Action Plan to correct such deficiency.

4.9 The States of Chile and Panama informed that they did publish this difference in GEN 1.7 and that they had prepared action plans to correct the deficiency.

ICARD System

4.10 The Meeting was informed that the SAM/AIM/7 and SAM/AIM/8 meetings had discussed the extent of the required changes to the ICARD system to avoid duplication of codes, as well as the processes to be taken into account, and had concluded that the most appropriate target date for publishing an **AIP Supplement** or an **Amendment to the AIP** would be **23 July 2015**.

4.11 The Meeting recalled that, based on the above, SAM/AIM/8 meeting had proposed **17 September 2015 as the effective date for these changes**. Thus, there would be enough time for data providers to make the necessary corrections and for users to load the database on their aircraft.

4.12 Regarding compliance with this commitment, States reported the following:

- ✓ Argentina: Implemented the amendment on 13 October 2016.
- ✓ Brazil: The SAM/IG is informally addressing this issue.
- ✓ Chile: Had not generated the amendment. Will be reviewed.
- ✓ Paraguay: Had not made the amendment.
- ✓ Uruguay: Implemented the amendment on 10 December 2015.
- ✓ Guyana: Requested the list provided by IATA at the SAM/AIM/6 to work on the amendment, in case there were duplicate points or phonetic similarities within the Georgetown FIR.
- ✓ Suriname: Requested the list provided by IATA at the SAM/AIM/6 to work on the amendment, in case there were duplicate points or phonetic similarities within the Paramaribo FIR.
- ✓ The other States did not report any action taken, except for Bolivia that reported at the SAM/AIM/8 meeting that the corresponding amendment had already been made, but would still be working to verify if there were other points repeated or with similar phonetics within the La Paz FIR.

4.13 Argentina informed that they had reviewed, deleted and replaced duplicate 5LNC codes in the ICARD system. The following table shows the duplicate 5LNC codes of the ICARD system in Argentina that had been replaced in the amendment effective 13 October 2016.

5LNC CODES OF THE ICARD SYSTEM DUPLICATED IN ARGENTINA

DATE: 10/2016

Duplicate ICAO 5LNC code <small>RELEASED on 13/10/16 crossed out - Effective 13/10/16</small>	Replaced 5LNC code <small>Effective 13/10/16</small>	Pending 5LNC code <small>Future AMDT</small>	REMARKS
AKVUL	ORABO	---	T658-UT658
ATABA	MUDNO	---	W59
BISUL	---	CONSULT ICAO	CONTINGENCY ROUTE /AORRA/RVSM/SRR/ FIR EZEIZA OCEANIC SECTOR
BUVIM	SISAX	---	UT655
EDRON	ARVOV	---	T654-UT654 – W32-UW32
ESED	EGEGU	---	W39-UW39
ESPIN	ROMAX	---	W18- UA570
GAVOS	PABEV	---	T655 - W61
KETUL	PAGAR	---	W5- UW5
KILEV	SEBMU	---	UW34
LUCIA	DOKBA	---	B687-UB687-UL324-UT667

Duplicate ICAO 5LNC code RELEASED on 13/10/16 crossed out - Effective 13/10/16	Replaced 5LNC code Effective 13/10/16	Pending 5LNC code Future AMDT	REMARKS
MARIA	---	CONSULT ICAO	LOA BOLIVIA – ARGENTINA (UL404)
NEDAX	NIDBA	---	T655
OPRIX	OPNIN	---	UN775
OSUSO	KOTOL	---	W10
POTRO	ISUGU	---	T657-T661
TEGOL	TEGAV	---	W4
UDIMA	DAKSA	---	UT106-UT657

Crossed-out DESIGNATORS have been released.

4.14 Regarding the above, the Secretariat informed the Meeting that the codes belonged to the ICAO database and, thus, the States were obliged to follow ICAO instructions to avoid duplication of codes. The Secretariat would follow up to verify the action taken on such a safety-sensitive matter.

APÉNDICE / APPENDIX A

Catálogo de los Planes de Contingencia NOTAM de la Región SAM
Catalogue of NOTAM Contingency Plans in the SAM RegionFecha: 07 de agosto de 2015
Date: 07 August 2015

Estado/ State	Estado de respaldo/ Backup State	Situación / Status		Punto de Contacto/ Contact Point	Descripción general de facilidades y servicios que garantizan la continuidad / General description of facilities and services available which ensure continuity	Banco NOTAM NOTAM Bank
		Borrador/ Draft	Final			
1	2	3	4	5	6	7
Argentina	Uruguay		X	NOF Ezeiza Tel: 541 4480 2294 Fax: 541 4480 2260 Email: nofezeiza@anac.gob.ar NOF Montevideo Tel: 5982 6040067 Email: ais@adinet.com.uy	AFS, Tel/Fax, REDDIG, Internet	AMHS
Bolivia	Perú		X	NOF La Paz Tel: 5912 2316686 Email: ais@asana.bo NOF Lima Tel: 511 2301288 –2301172 Email: fvasquez@corpac.gob.pe nofperu@corpac.gob.pe	AFS, Tel, REDDIG, Internet	
Brasil/Brazil				NOF Brasil Tel/Fax: 5561 33648353 Email: nofbrazil@cindacta1.aer.mil.br		SISNOTAM

Estado/ State	Estado de respaldo/ Backup State	Situación / Status		Punto de Contacto/ Contact Point	Descripción general de facilidades y servicios que garantizan la continuidad / General description of facilities and services available which ensure continuity	Banco NOTAM NOTAM Bank
		Borrador/ Draft	Final			
1	2	3	4	5	6	7
Chile	Ecuador		X	NOF Chile Tel: 562 28404033 Email: nofchile@dgac.gob.cl NOF Guayaquil Tel: 5934 2285661 – 5934 2282017 Email: nof_ecuador@dgac.gob.ec	AFS, Tel/Fax, REDDIG, Internet	IAT-WIN
Colombia				NOF Bogotá Tel: 571 2962991 Email: ais@aerocivil.gov.co ; solicitudes.notam@aerocivil.gov.co		Actual Banco Web / Current Web Bank AMHS
Ecuador	Chile		X	NOF Guayaquil Tel: 5934 2285661 – 5934 2282017 Email: nof_ecuador@dgac.gob.ec NOF Chile Tel: 562 28404033 Email: nofchile@dgac.gob.cl	AFS, Tel/Fax, REDDIG, Internet	IAT-WIN
Guyana	Suriname		X	NOF Guyana Telefax: 592 2612279 Tel: 592 2612269 AFS: SYCJYNYX Cable: TIMAIRPORT GUYANA Email: ais@gcaa-gy.org NOF Suriname Tel: 597 0325103 Email: ais.sur@hotmail.com ais@cadsur.sr	AFS, Tel/Fax, REDDIG, Internet	AMHS

Estado/ State	Estado de respaldo/ Backup State	Situación / Status		Punto de Contacto/ Contact Point	Descripción general de facilidades y servicios que garantizan la continuidad / General description of facilities and services available which ensure continuity	Banco NOTAM NOTAM Bank
		Borrador/ Draft	Final			
1	2	3	4	5	6	7
Suriname	Guyana		X	NOF Suriname Tel: 597 0325103 Email: ais.sur@hotmail.com ais@cadsur.sr NOF Guyana Telefax: 592 2612279 Tel: 592 2612269 AFS: SYCJYNYX Cable: TIMAIRPORT GUYANA Email: ais@gcaa-gy.org	AFS, Tel/Fax, REDDIG, Internet	AMHS
Uruguay	Argentina		X	NOF Montevideo Tel: 5982 6040067 Email: ais@adinet.com.uy NOF Ezeiza Tel 5414 480 2294 Fax 5414 480 2260 Email: nofezeiza@anac.gob.ar	AFS, Tel/Fax, REDDIG, Internet	AMHS
Venezuela						

Nota/Note:

- Columna 1: Indicar Estado, Territorio u Organismo Internacional / *Indicate State, Territory or International Organization.*
- Columna 2: Indicar Estado, Territorio u Organismo Internacional con quien debe coordinarse el Plan de Contingencia del Estado citado en la Columna 1 / *Indicate State, Territory or International Organization with whom the Contingency Plan of the State mentioned in Column 1 should be coordinated.*
- Columna 3: Marcar con X en el caso que el Plan de Contingencia se encuentre en proceso para su armonización con el Estado en cuestión / *Mark with an X in case the Contingency Plan is in process for its harmonization with the referred State.*

-
- Columna 4: Marcar con X en el caso que el Plan de Contingencia se encuentre armonizado con el Estado en cuestión / *Mark with an X in case the Contingency Plan is in process for its harmonization with the referred State.*
- Columna 5: Indicar cargo del Punto de Contacto y medio de comunicación a utilizar en caso de ser necesario / *Indicate position of the Point of Contact and communications means to be used, if necessary.*
- Columna 6: Indicar cuáles son, en general, las facilidades y los servicios disponibles mientras el Plan de Contingencia se encuentra activado / *Indicate which are, in general, the facilities available services while the Contingency Plan is activated.*
- Columna 7: Banco NOTAM / *NOTAM Bank.*

APÉNDICE / APPENDIX B

ESTADO DE IMPLANTACIÓN DE PLANES DE CONTINGENCIA NOTAM EN LA REGIÓN SAM STATUS OF IMPLEMENTATION OF CONTINGENCY NOTAM PLANS IN THE SAM REGION			
PLANES EN GESTIÓN ONGOING PLANS	PLANES VIGENTES VALID PLANS	ESTADOS NO INICIADOS STATES WHICH HAVE NOT INITIATED	BANCO NOTAM NOTAM BANK
	ARGENTINA/URUGUAY		AMHS
		BRASIL/BRAZIL	SISNOTAM
	BOLIVIA/PERU		AMHS
	PERU/PANAMA		AMHS
		COLOMBIA	ACTUAL BANCO WEB CURRENT WEB BANK AMHS Sep/2010
	CHILE/ECUADOR		IAT-WIN
	ECUADOR/CHILE		AMHS
	GUYANA/SURINAME		AMHS
	SURINAME/GUYANA		AMHS
PARAGUAY			AMHS
	PANAMÁ/PERU		AMHS
	PERU/BOLIVIA		AMHS.
	URUGUAY/ARGENTINA		SISNOTAM

Fecha de actualización: 28 octubre 2016
Updating date: 28 October 2016

Agenda Item 5: Update on information concerning progress in the implementation of automated systems and other requirements according to Annex 15

5.1 Under this agenda item, the Meeting reviewed the following papers:

- WP/10 – *States' Automated Systems* (Presented by the Secretariat)
- IP/04 - *Update on information concerning progress in the implementation of automated systems and other requirements according to Annex 15* (Presented by Argentina)

5.2 The Meeting recalled that, in accordance with Annex 15 to the Convention of International Civil Aviation, automation was necessary in order to improve the timeliness, quality, efficiency and profitability of aeronautical information services.

5.3 It was noted that the SAM/AIM/7 meeting had established and recognized the importance of automation both for mapping as well as for metadata management and real-time transmission of information and data, among other functionalities.

5.4 The Meeting recognized the need for automation to ensure non-duplication of efforts and standardization of procedures, products and services for end users.

5.5 The Meeting updated the information on the capability of States to provide automated aeronautical information. The updated data is presented in **Appendix A** to this part of the report.

5.6 The Meeting took note of the information presented by Argentina on the GIS project, which had been planned and implemented at the *Dirección Nacional de Control de Tránsito Aéreo*, and was being applied to air navigation, but also allowed, initially, to automatically generate en-route navigation charts. This planning and acquisition was mainly intended to develop a single centralized aeronautical information database following the AICM/AIXM model (ICAO regulation).

APÉNDICE A / APPENDIX A

SEGUIMIENTO AL NIVEL DE IMPLANTACIÓN DE LA AUTOMATIZACIÓN PARA LA PROVISIÓN DE
INFORMACIÓN AERONÁUTICA (Ref.: Anexo 15, 3.6 y Doc 8126, Capítulo 9)FOLLOW-UP THE LEVEL OF IMPLEMENTATION OF THE AUTOMATION FOR THE PROVISION OF
AERONAUTICAL INFORMATION (Ref.: Annex 15, 3.6 and Doc 8126, Chapter 9)

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
Modelo AIXM, Digital NOTAM, GIS y Metadatos / <i>AIXM Model, Digital NOTAM, GIS and Metadata</i>														
¿Tiene el Estado un Plan de Implantación de Automatización de la provisión de información aeronáutica? / <i>Has the State an Automation Implementation Plan for the provision of aeronautical information?</i>	SI	NO	SI/YES	SI	---	---	NO	---	SI	---	SI/YES	NO	NO	---
¿Dispone el Estado del e-AIP en un formato de lenguaje extensible de acuerdo al modelo AIXM? (Especifique) / <i>Has the State the e-AIP in an extensible language format according to the AIXM model? (Specify)</i>	NO	NO	SI/YES ¹	NO ¹	---	---	NO	---	P ²	---	SI/YES ¹	NO	NO	---
¿Tiene el Estado la capacidad de preparar Digital NOTAM? / <i>Has the State the capacity to prepare Digital NOTAM?</i>	NO	NO	NO ⁽²⁾	NO	---	---	---	---	NO	---	SI/YES	NO	NO	---
¿Cuenta el Estado con capacidad de generar Cartas Aeronáuticas electrónicas? / <i>Has the State the capacity to generate electronic aeronautical charts?</i>	SI/YES	NO	SI/YES ³	SI/YES ²	---	---	---	---	SI ¹	---	SI/YES ²	NO	NO	---

ESTADOS / STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
En caso de que la pregunta anterior sea afirmativa ¿ha considerado la recopilación y aplicación de los metadatos para dar trazabilidad a los datos que son utilizados para generación de las cartas aeronáuticas? <i>/ If the previous question is affirmative, has the compiling and application of metadata to give traceability to the data used for the generation of aeronautical charts be considered?</i>	SI/YES	NO	SI/YES	NO	---	---	NO	---	SI	---	SI/YES	NO	NO	---
¿El modelo de metadato utilizado, está acorde con el presentado en la ISO 19115?/ <i>Is the model of the metadata used in accordance with the one presented in ISO 19115?</i>	SI/YES	NO	SI/YES	NO	---	---	---	---	SI	---	SI/YES	NO	NO	---

Y = Si / Yes
 1, 2, ... = Ver comentarios / *See comments*
 N = No
 P = Parcialmente / *Partially*
 N/A = No aplicable / *Not applicable*
 S/R = Sin respuesta / *Without answer*

COMENTARIOS DE LOS ESTADOS / *COMMENTS BY STATES*

ESTADOS/ STATES	COMENTARIOS / <i>COMMENTS</i>
ARG	
BOL	
BRA	Brasil utiliza el software IDS, y una base de datos llamada AERODATABASE. Los datos se encuentran en procesos de carga y esperan contar con e-AIP para 2017. Con relación al NOTAM Digital, esperan poder implantarlo para el 2017 / <i>Brazil uses IDS software and a database named AERODATABASE. The data is in the loading process and expect to count with e-AIP for 2017. With regard to Digital NOTAM, they expect to implement it in 2017.</i>
CHI	¹ Una empresa ha hecho una propuesta para la preparación del AIP electrónico. / <i>A Company has made a proposal for the preparation of the electronic AIP.</i> ² Chile tiene cartas digitales pero no son interactivos. / <i>Chile has digital charts but they are not interactive.</i>
COL	
ECU	
FGU	

ESTADOS/ STATES	COMENTARIOS / COMMENTS
GUY	
PAN	<p>¹Panamá produce cartas digitales pero no son interactivas. / <i>Panama produces digital charts but they are not interactive.</i></p> <p>²Panamá está preparando el AIP electrónico en un formato de lenguaje extensible, el cual estaría disponible para el 2017. / <i>Panama is preparing the electronic AIP in an extensible language format, which would be available for 2017.</i></p>
PAR	
PER	<p>¹Perú, para las publicaciones utiliza el software GROUPVERVE. Para la cartografía, utiliza el software ACCENT. La base de datos proviene del CADAS-AIMDB. / <i>For publications, Peru uses GROUPVERVE software. For cartography, uses ACCENT software. The database comes from CADAS-AIMDB.</i></p> <p>²Perú elabora cartas digitales pero no son interactivas. / <i>Peru prepares digital charts but they are not interactive.</i></p>
SUR	
URU	
VEN	

Agenda Item 6: Analysis of objectives, metrics and dates for the implementation of elements of the second phase of the plan for the transition of AIS to AIM: Digital

6.1 Under this agenda item, the Meeting reviewed the following paper:

- WP/11 – *Second phase of the transition to AIM: Digital* (Presented by the Secretariat)

Second phase of the transition to AIM: Digital

6.2 The Meeting took note that the strategy established in the Roadmap for the Transition from AIS to AIM was that the implementation of the second digital phase could start after the first phase of consolidation had been implemented.

6.3 The Secretariat informed that Block B0-DATM focused on improving management through digital aeronautical information as its main priority, consistent with the initial introduction of digital processing and information management through the use of the aeronautical information exchange model (AIXM), the migration to the electronic AIP, and improved data quality and availability. Available data must be contained in a database.

6.4 For monitoring and reporting purposes, the Meeting analyzed the goals, indicators, performance metrics, and the assessment of the status of AIM improvements through digital aeronautical information management, proposed by the Secretariat within a timeframe ending in 2019. The result of this assessment is presented in **Appendix A** to this part of the report.

6.5 The Secretariat encouraged States to implement Phase 2 on a regional basis, since benefits derived from working in an electronic environment would be greater as more States adopted the digital exchange of aeronautical data and worked in an interoperable environment.

Methodology to report the status of AIS-to-AIM transition

6.6 The Meeting took note that the first edition of the global air navigation report and the AIM performance table had only taken into account the status of implementation of three systems, corresponding to Phase I of the AIS-to-AIM transition roadmap: the AIRAC system, the QMS system, and the WGS-84 system.

6.7 The Secretariat informed the Meeting that for subsequent global reports, the decision had been made to continue monitoring the systems of the first phase of AIS-to-AIM transition, and to show the status of implementation of the second phase, eventually covering some elements of Phase III as needed. Appendix B to this part of the report shows a methodological proposal for reporting and assessing progress concerning AIS-to-AIM transition, which was analysed and completed by the Meeting.

National AIS-to-AIM migration plan

6.8 There were certain characteristics of regional goals that should be taken into account in the AIS-to-AIM transition process, including some differences in the technology used by the various States of the Region and the level of quality of their results. Some States had not yet been able to certify the quality of their products, while other States had certified their products in accordance with ISO standard 9001 a long time ago.

6.9 Based on the above, a roadmap was developed for monitoring the implementation of the various elements of the AIS-to-AIM transition, as shown in **Appendix C** to this part of the report.

Formal arrangements between the AIS and the information and data originators

6.10 In order to ensure timely distribution of good quality information, formal arrangements were required between the aeronautical information service and the data and information originators. This was a State responsibility that should have been met by 30 November 2015.

Training requirements for Phase 2

6.11 The Meeting took note that the implementation of Phase 2 involved a shift in thinking, a shift in culture. The States were aware that, for the implementation of Phase 2, the AIS/AIM expert profile would need to be modified to bring it closer to that of an AIS/IT expert. For this reason, the Meeting suggested to review the professional profile for the training of new AIM experts.

6.12 The Meeting identified some training needs to be considered for AIM professionals, which are shown in **Appendix D** to this part of the report.

6.13 The Meeting also suggested that training plans should be considered within the AIM/QMS and should be planned and implemented well in advance in order to avoid delays in Phase 2 implementation.

APPENDIX A

STATUS OF IMPLEMENTATION OF B0-DATM ELEMENTS

B0 – DATM: Service improvement through digital aeronautical information				
ELEMENTS	SCOPE	INDICATORS/ METRICS	GOALS: %/ Date	STATUS
1- National AIM plan / Action plan	All States	Indicator: % of States that have developed a National AIM Plan and an Action Plan. Metrics: Number of States that have developed a National AIM Plan and an Action Plan.	50% 2 nd Semester 2015 100% 2 nd Semester 2016	43% (6 States)
2 - AIXM	All States	Indicator: % of States that have implemented AIXM on an AIS database. Metrics: Number of States that have implemented AIXM on an AIS database.	Tests 2017 (4 States: ARG, BRA, PAN, PER) 57% by 2017 86% by 2018 100% by 2019	36% (5 States)
3 – Electronic AIP	All States	Indicator: % of States that have implemented an IAID for managing the production of the electronic AIP (eAIP). Metrics: Number of States that have implemented an IAID for managing the production of the electronic AIP (eAIP).	21% by 2017 43% by 2018 86% by 2019 100% by 2020	XX% (X States)
4 - QMS	All States	Indicator: % of States that have obtained AIM/QMS certification. Metrics: Number of States that have obtained AIM/QMS certification.	50% by 2016 80% by 2017 100% by 2018	43% (6 States)
5 - WGS-84	All States	Indicator: % of States that have implemented WGS-84 on the horizontal plane (ENR, terminal, AD) Metrics: Number of States that have implemented WGS-84 on the horizontal plane (ENR, terminal, AD)	Horizontal: 100% by 2014 Vertical: 100% by 2014	100% (14 States) 100% (14 States)

B0 – DATM: Service improvement through digital aeronautical information				
ELEMENTS	SCOPE	INDICATORS/ METRICS	GOALS: %/ Date	STATUS
Consult States		Indicator: % of States that have implemented WGS-84 geoidal undulation. Metrics: Number of States that have implemented WGS-84 geoidal undulation.	100% by 2017	86% (12 States)
6 – Electronic terrain and obstacle data (e-TOD)	All States Argentina, Brazil, Chile and Peru	Indicator: % of States that have implemented the terrain data set. Metrics: Number of States that have implemented the terrain data set. Indicator: % of States that have implemented the obstacle data set. Metrics: Number of States that have implemented the obstacle data set.	Area 1: Terrain: 70% by 2017 86% by 2018 100% by 2019 Obstacles: 56% by 2017 70% by 2018 86% by 2019 100% by 2020 Area 4: Terrain: 70% by 2017 86% by 2018 100% by 2019 Obstacles: 56% by 2017 70% by 2018 86% by 2019 100% by 2020	Area 1: Terrain: XX% (X States) Obstacles: XX% (X States) Area 4: Terrain: XX% (X States) Obstacles: XX% (X States)
7 - Digital NOTAM	All States	Indicator: % of States that have included the digital NOTAM in their national AIS-to-AIM transition plans. Metrics: Number of States that have included the digital NOTAM in their national AIS-to-AIM transition plans.	28% by 2018 56% by 2019 100% by 2020	XX% (X States)

<i>B0 – DATM: Service improvement through digital aeronautical information</i>				
ELEMENTS	SCOPE	INDICATORS/ METRICS	GOALS: %/ Date	STATUS
8- Integrated aeronautical information databases (IAID)	All States	Indicator: % of States that have developed integrated aeronautical information databases (IAID). Metrics: Number of States that have developed integrated aeronautical information databases (IAID).	28% by 2017 56% by 2018 100% by 2019	XX% (X States)

APÉNDICE B

METODOLOGÍA PARA LA PRESENTACIÓN DE INFORMES Y EVALUACIÓN DE LOS PROGRESOS RELACIONADOS CON LA TRANSICIÓN DEL AIS AL AIM

(Available in Spanish only)

1. Introducción

La transición de servicios de información aeronáutica (AIS) para gestión de información aeronáutica (AIM) es un área de alta prioridad para el progreso de la navegación aérea. Esta es una iniciativa de posicionamiento estratégico para manejar la entrega de información aeronáutica mejorada en términos de calidad, puntualidad y la identificación de nuevos servicios y productos para servir mejor a los usuarios aeronáuticos. Esta metodología tiene como objetivo desarrollar un método y un plan para la presentación de informes por los Estados sobre los progresos realizados para la transición del AIS al AIM, basado en el plan de trabajo de la OACI para la transición del AIS al AIM.

Necesidad de informar y evaluar el progreso relacionado con la transición del AIS al objetivo

El marco de rendimiento de OACI en la planificación e implantación de la navegación aérea exige que el informe, monitoreo, análisis y la revisión de las actividades se lleve a cabo sobre una base cíclica anual (ICAO DOC 9750). Los datos recopilados van a poder ser utilizados entre otros para monitorear funciones y para reflejar el progreso en los Informes Mundiales de Navegación Aérea, así como en los cuadros mundiales de rendimiento que muestra la Sede.

2. Aproximación metodológica

El enfoque principal de esta metodología en la recolección de datos e informes es cuantitativo, basado en la regla SMART. Todos los elementos y métricas e indicadores utilizados para la presentación de informes deben ser específicos, medibles, alcanzables, relevantes y tiempo limitado. Algunos elementos de la Hoja de Ruta del AIS al AIM como por ejemplo: P-02 Monitoreo de la integridad del dato, P-07 Identificadores únicos, P-10 Redes de comunicación, P-16 Entrenamiento y P-19 Interoperabilidad con productos meteorológicos, no se toman en cuenta para la elaboración de informes, considerando que ya son parte de otras medidas o medición que no podría realizarse en términos cuantitativos.

3. Estrategia para la recolecta de los datos

Con el fin de evitar la confusión entre las numerosas formas de presentación de informes de los Estados para la recolección de datos, se ha diseñado una recolección metodológica de los datos a través de herramientas actuales como tablas de eANP, etc. No obstante lo anterior, hojas Excel de apoyo a esta recolección pueden utilizarse, si es necesario.

4. Estructura y Plan metodológico

La estructura del Plan metodológico consta de los siguientes elementos:

1. Elemento (fase/paso N°): se refiere al número de fase (1-3), paso y paso número (1-21) de la Hoja de Ruta de la OACI para la Transición del AIS al AIM. Algunos pasos de la Hoja de Ruta de la OACI para la Transición del AIS al AIM (es decir, P-02, P-07, P-10, P-16 y P-19) no se consideran para la elaboración de informes, considerando que ya son parte de otras medidas o medición que no podrían realizarse en términos cuantitativos.
2. Métricas/indicador: se refiere a la condición de cumplimiento e implementación de paso y podría ser por ejemplo no conformidad (NC), cumplimiento parcial (PC) o cumplimiento total (FC).
3. Fuente de datos (cómo recoger datos): la principal herramienta para la recogida de datos sería eANP tablas. Especiales de hojas Excel de apoyo a la recogida de datos pueden utilizarse, si es necesario.
4. Quién recogerá los datos: los datos se deben recoger por la Oficina Regional de OACI/ICAO HQ.
5. Cuándo se recopilan los datos: los datos para cada reporte se recolectarán en noviembre.
6. Año de publicación del informe: el año, en el que se publicarían los reportes (Informe Mundial de Navegación Aérea & Cuadro de Rendimiento regional).
7. Observaciones: cualquier información adicional, por ejemplo, en caso de estado de la aplicación es PC; lista de elementos secundarios que se han implementado.

5. Plan Metodológico para el informe anual

Elemento (Fase/ Paso No.)		Métrica/ Indicador	Fuente de los datos (cómo colectar los datos)	Quién colecta los datos*	Año del Informe	Observaciones	
1		2	3	4	5	6	
Fase 1							
Adherencia al AIRAC		P-03	FC/NC	eANP	ICAO HQ/RO	2014	
Implantación WGS-84		P-05	FC/PC/NC	eANP	ICAO HQ/RO	2014	
Certificación QMS		P-17	FC/NC	eANP	ICAO HQ/RO	2014	
Fase 2							
Monitoreo calidad del dato		P-01	FI/NI	TBD	TBD	TBD	
Monitoreo Integridad del dato		P-02	N/A	N/A	N/A	N/A	
Base de datos de Información Aeronáutica Integrada	AIXM-con Base de datos AIS	P-06	FI/NI	eANP	ICAO HQ/RO	2017	<i>Base de datos de Información Aeronáutica estructurada con capacidad de intercambio (e.g. AIXM)</i> Iniciada
	Implantación de IAID		FI/PI/NI	TBD	TBD	2018	
Identificadores únicos		P-07	N/A	N/A	N/A	N/A	Relacionado con P-06
Modelo conceptual de Información Aeronáutica		P-08	N/A	N/A	N/A	N/A	Relacionado con P-06
AIP Electrónico		P-11	FI/NI	eANP	ICAO HQ/RO	2015	Iniciada-2015
Terreno	Area 1	P-13	FC/NC	eANP	ICAO HQ/RO	2015	Iniciada-2015
	Area 4	P-13	FC/PC/NC	eANP	ICAO HQ/RO	2015	<i>En caso de PC, listar los nombres de ADs</i> Iniciada-2015

Elemento (Fase/ Paso No.)		Métrica/ Indicador	Fuente de los datos (cómo coleccionar los datos)	Quién colecciona los datos*	Año del Informe	Observaciones	
1		2	3	4	5	6	
	Area 2a	P-13	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
	Area de la trayectoria de despegue	P-13	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
	Area delimitada por la extensión lateral de la superficie limitadora de obstáculos	P-13	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
Obstáculos	Area 1	P-14	FC/NC	eANP	ICAO HQ/RO	2015	Iniciada-2015
	Area 4	P-14	FC/PC/NC	eANP	ICAO HQ/RO	2015	<i>En caso de PC, listar los nombres de ADs</i> Iniciada 2015
	Area 2a	P-14	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
	Objetos situados en área de trayectoria de despegue que pasen la superficie plana de 1.2 % con el mismo origen que el área de la trayectoria de despegue	P-14	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
	Penetración de las superficies limitadoras de obstáculos	P-14	FC/PC/NC	eANP	ICAO HQ/RO	2017	<i>En caso de PC, listar los nombres de ADs</i>
Cartografía de Aeródromos	P-15	FI/PI/NI	TBD	TBD	TBD	<i>En caso de PC, listar los nombres de ADs</i>	

Elemento (Fase/ Paso No.)	Métrica/ Indicador	Fuente de los datos (cómo coleccionar los datos)	Quién colecciona los datos*	Año del Informe	Observaciones
1	2	3	4	5	6
Fase 3					
Intercambio de datos aeronáuticos	P-09 FI/PI/NI	TBD	TBD	TBD	En caso de PC, listar nombres de unidades (Originadores de datos/usuarios)
Redes de comunicaciones	P-10 N/A	N/A	N/A	N/A	N/A
Notificación de información aeronáutica	P-12 FI/PI/NI	TBD	TBD	TBD	En caso de PC, listar los nombres de ADs
Capacitación	P-16 N/A	N/A	N/A	N/A	N/A
Acuerdos con los originadores de datos	P-18 FI/PI/NI	eANP	ICAO HQ/RO	2016	En caso de PC, listar nombres de originadores de datos
Interoperabilidad con productos meteorológicos	P-19 N/A	N/A	N/A	N/A	N/A
Cartas Aeronáuticas electrónicas	P-20 FI/NI	TBD	TBD	2017	
NOTAM Digital	P-21 FI/NI	TBD	TBD	2018	

FC: Cumplimiento total; PC: Cumplimiento parcial; NC: No cumple; FI: Implantación total; PI: Implantación parcial; NI: No implantado, N/A: No aplicable

* La recolección de los datos será llevada a cabo por la Sede de OACI y/o Oficina Regional.

6. Fechas para los Informes

Informe anual	Elemento	Paso No.	Observaciones
2014	Adherencia AIRAC	P-03	Completado
	Implantación WGS-84	P-05	Completado
	Certificación QMS	P-17	Parcialmente completado
2015	AIXM-con base de datos AIS	P-06	Iniciada
	AIP electrónico	P-11	
	Terreno(Área 1 y Área 4)	P-13	
	Obstáculos (Área 1 y Área 4)	P-14	
2016	Terreno (Area 2a)	P-13	Iniciada
	Obstáculos (Area 2a)	P-14	
	Acuerdo con originadores de datos.	P-18	
2017 +	Cartas Eléctricas	P-20	

7. Finalización y Criterio de Cumplimiento

Los criterios por los cuales se pueden observar finalización y cumplimiento de las métricas (paso).

Elemento (Paso)	Criterio de finalización, de implantación o cumplimiento (para Métricas 2015 y 2016)
AIXM con Base de datos AIS	Base de datos nacional e información está y es mantenida en una base de datos AIXM-que tiene una base de datos AIS.
AIP Electrónico	AIP GEN 3.1.3 ' <i>publicaciones Aeronáuticas</i> ' provee información acerca de la disponibilidad del AIP nacional en formato electrónico (eAIP).
Set de datos terreno Area 1	AIP GEN 3.1.6 ' <i>Terreno y obstáculos electrónico</i> ' provee información de cómo ese set de datos puede ser obtenido.

Set de datos terreno Area 4	AIP GEN 3.1.6 ‘Terreno y obstáculos electrónico’ provee información de cómo ese set de datos para especificaciones CAT II/III RWY puede ser obtenido. Estados deberán indicar en Observaciones el número existente de CAT II/III RWY. N/A para Estados que no tienen CAT II/III RWY.
Set de datos terreno Area 2 ¹	AIP GEN 3.1.6 ‘Terreno y obstáculos electrónico’ provee información de cómo ese set de datos puede ser obtenido. Estados deberían indicar en observaciones el número AD elegible para provisión de datos de Area 2. Este número debería ser acorde con la Tabla Regional eANP Tabla AOP II-1 – para aeródromos con la siguiente denominación: — RS: <i>international scheduled air transport, regular use</i> — RNS: <i>international non-scheduled air transport, regular use</i> — RG: <i>international general aviation, regular use.</i>
Set de datos obstáculos Area 1	AIP GEN 3.1.6 ‘Terreno y obstáculos electrónico’ provee información de cómo ese set de datos puede ser obtenido.
Set de datos obstáculos Area 4	AIP GEN 3.1.6 ‘Terreno y obstáculos electrónico’ provee información de cómo ese set de datos para especificaciones CAT II/III RWY puede ser obtenido. Estados deberán indicar en Observaciones el número existente de CAT II/III RWY. N/A para Estados que no tienen CAT II/III RWY.
Set de datos obstáculos Area 2 ²	AIP GEN 3.1.6 ‘Terreno y obstáculos electrónico’ provee información de cómo ese set de datos puede ser obtenido.. Estados deberían indicar en observaciones el número AD elegibles para provisión de datos de Area 2. Este número debería ser acorde con la Tabla Regional eANP Table AOP II-1 – para aeródromos con la siguiente denominación: — RS: <i>international scheduled air transport, regular use</i> — RNS: <i>international non-scheduled air transport, regular use</i> — RG: <i>international general aviation, regular use.</i>
Acuerdos con Originadores de datos	TBD

¹ Set de datos requeridos de acuerdo con Anexo 15 (10.1.5)

² Set de datos requeridos de acuerdo con Anexo 15 (10.1.6)

APPENDIX C / APÉNDICE C

NATIONAL AIM IMPLEMENTATION ROADMAP

HOJA DE RUTA PARA LA IMPLANTACIÓN NACIONAL

Phase/Step Fase/Paso	Step/ paso No.	Timeline/ Línea de tiempo					Start/ Empieza	End/ Fin	Remarks/ Observaciones
		2014	2015	2016	2017	2018			
Phase I									
Adherencia AIRAC AIRAC adherence	P-03								
Implantación WGS-84 84 implementation	P-05								
Certificación QMS/ Certification	P-17								
Phase II									
Monitoreo de la calidad del dato/ Data Quality Monitoring	P-01								
Monitoreo de la integridad del dato/ Data Integrity Monitoring	P-02								
AIXM	P-06								
Identificadores únicos/ Unique identifiers	P-07								
Modelo conceptual de Información Aeronáutica/ Aeronautical information conceptual model	P-08								
AIP electrónico /electronic AIP	P-11								

Phase/Step Fase/Paso	Step/ paso No.	Timeline/ Línea de tiempo					Start/ Empieza	End/ Fin	Remarks/ Observaciones
		2014	2015	2016	2017	2018			
Aeronáutica/ Aeronautical information briefing									
Capacitación/ Training	P-16								
Acuerdo con originadores de datos/ Agreement with data originators	P-18								
Interoperabilidad con productos meteorológicos/ Interoperability with meteorological products	P-19								
Cartas aeronáuticas electrónicas/ Electronic aeronautical charts	P-20								
Digital NOTAM	P-21								

APPENDIX D

Training Needs for Phase 2

- ATM operational concept
- ASBU concept
- PBN implementation and mapping representation
- Quality, integrity, and timely distribution of AIS products
- Standard models for the creation of databases on integrated aeronautical information, terrain and obstacle information, and aerodrome mapping data
- Metadata management across the aeronautical information supply chain
- Data protection systems
- Data packaging for electronic use
- Electronic terrain and obstacle data (eTOD) surveying
- English language in aeronautical publications
- Mapping and geoid undulation to be represented in aerodrome and heliport charts
- Use and application of geographic information systems (GIS)
- Volcanic ash and ASHTAMs (even in cases of no volcanic activity)
- SWIM
- Procedures design (PANS-OPS)

Agenda Item 7: Amendment 39 to Annex 15 – Aeronautical Information Services

7.1 Under this agenda item, the Meeting reviewed the following papers:

- WP/12 - *Approval of Amendment 39 to Annex 15 and implementation date* (Presented by the Secretariat)
- WP/13 - *Procedures for Air Navigation Services for Aeronautical Information Management (PANS–AIM)* (Presented by the Secretariat)
- WP/14 - *Data Catalogue* (Presented by the Secretariat)

Amendment 39 to Annex 15 and implementation date

7.2 The Meeting took note of Amendment 39 to Annex 15. The Meeting noted that the Amendment would be effective in two parts: Amendment 39-A, effective on 10 November 2016 and Amendment 39-B, effective on 5 November 2020.

7.3 The Secretariat underlined the tasks to be performed by States in order to adjust their national rules and regulations to the aforementioned Amendment, as described in Attachment E to the State Letter issued by ICAO Secretary General informing about the adoption of the Amendment.

7.4 The Meeting took note of the tasks and noted that a high percentage of States had not performed them, since they had to collect information from the areas affected by the amendment and then generate the corresponding changes and amendments. The Meeting proposed **31 March 2017** as the deadline for States that had not done it yet, to present the adjustments of their national rules and regulations to the requirements of **Amendment 39-A to Annex 15**, and to publish their differences, if any, in **GEN 1.7 of their AIP**.

7.5 The Meeting took note that the update of Doc 8126 - *Aeronautical Information Services Manual*, was not in accordance with the amendments to Annex 15 and that some information or forms were outdated. In this regard, the Meeting deemed it important to refer this concern to the CAR/SAM Regional Planning and Implementation Group (GREPECAS) for the corresponding purposes.

Procedures for Air Navigation Services - Aeronautical Information Management (PANS–AIM)

7.6 The Secretariat informed of plans to create the Procedures for Air Navigation Services for Aeronautical Information Management (PANS-AIM) within the framework of the ICAO AIS-AIM Study Group (AIS-AIM SG).

7.7 The Meeting took note of the target date of publication of the future PANS-AIM (2018), as well as of its contents. It was noted that the objective of PANS-AIM was to provide a document for standardizing the way something should be presented, AIS/AIM data and publications, such as product specifications, standard procedures and protocols. Another objective of the PANS was to provide a vehicle for expanded and/or new specifications for e-TOD and data exchange, for which a level of standardization would be desirable. However, the guidance material would be much more detailed, so it would not be suitable for inclusion as SARPs in Annex 15.

7.8 The Secretariat recommended that States consider this document (PANS-AIM) in their technical libraries and visit the AIS-AIM SG website to view the draft project.

Data Catalogue

7.9 The Meeting was informed by the Secretariat that the new PANS-AIM document would include the “Data Catalogue” to provide a general description of the scope of AIM data, instead of being an inventory of the data to be collected. The data catalogue was considered as a reference for all the provisions related to the origin and publication of aeronautical data, providing a common language and encouraging formal arrangements between data producers and the aeronautical information service.

7.10 The Meeting noted that the “Data Catalogue” should be the only source of all quality requirements, facilitating long-term maintenance when requirements were modified, to make sure that changes were consistent. For instance, resolution and accuracy together should enable verification of the correctness of the data received and further support electronic processing without any future human intervention.

7.11 The Meeting felt that, although it could be useful for national regulations, there were other tools that could accomplish the same objectives, such as the records used in quality management systems. The Meeting suggested adjusting the records based on the requirements contained in the Data Catalogue template and adding any fields that might be required.

7.12 When analyzing the “Data Catalogue” document, the Meeting considered it could provide important information for generating the “databases” to be subsequently used in automated systems.

Agenda Item 8: Other business

8.1 Under this agenda item, the Meeting reviewed the following papers:

- WP/15 – *Volcanic Ash Contingency Plan and volcanic ash SIGMET exercises* (Presented by the Secretariat)
- WP/17 – *LAR 215 – AIM* (Presented by the Secretariat)
- WP/20 – *Electronic Publication* (Presented by IATA)
- WP/21 – *Safety Bulletins* (Presented by IATA)

Volcanic Ash Contingency Plan and SIGMET exercises on volcanic ash

8.2 The Meeting recalled SAM/AIM/8 recommendations to the States regarding measures to be taken by AIS/AIM units for the implementation of the Volcanic Ash Contingency Plan. In this regard, the following information was provided by the States:

- Argentina: had signed a cooperation agreement with the MET service, the service provider (*Dirección Nacional de Control de Tránsito Aéreo - DNCTA*) and the volcano observatory. This agreement should be extended to include the new service provider (*Empresa Argentina de Navegación Aérea Sociedad del Estado – EANA S.E.*). The volcano catalogue was included in the AIP.
- Brazil: had a regulation concerning measures to be taken in case of volcanic ash clouds in any FIR under the responsibility of Brazil. They did not have a volcano catalogue since Brazil had no active volcanoes.
- Chile: had signed a cooperation agreement with the MET service and the volcano observatory. The volcano catalogue was included in the AIP.
- Panama: had signed a cooperation agreement with the MET service and the volcano observatory. Regarding the volcano catalogue, would later inform the Secretariat on its status.
- Peru: had signed a cooperation agreement with the MET service and the volcano observatory. Regarding the volcano catalogue, would later inform the Secretariat on its status.
- Uruguay: had signed a cooperation agreement with the MET service. They did not have a volcano catalogue since Uruguay had no active volcanoes.
- The other States had not prepared agreements nor had a volcano catalogue.

8.3 The Meeting recommended that Brazil and Uruguay should have a volcano catalogue--with no need to include it in the AIP--specifically of volcanoes located in Argentina and Chile that have erupted in the last ten years and whose volcanic ashes have reached both States.

8.4 The Secretariat informed that during the last SIGMET exercise on volcanic ash, carried out on 11 and 12 December 2015, a very scarce participation of NOFs was observed. According to the exercise assessment, the NOFs of Argentina, Brazil, Chile, Paraguay, and Uruguay had participated. Panama noted that it had participated, but the ASHTAM messages had not reached the other States.

8.5 Nevertheless, the Secretariat acknowledged and congratulated States, because upon occurrence of real volcanic eruptions or ash clouds in the FIR, the NOFs had applied the corresponding measures and the issuance of ASHTAMs had been effective.

LAR - 215

8.6 The Technical Committee of the Regional Safety Oversight Cooperation System (SRVSOP) informed the Meeting on the drafting of LAR 215 (LAR-AIM).

8.7 The Meeting took note that the Regional Safety Oversight Cooperation System (SRVSOP) sought to ensure the sustainability of achievements concerning the adoption of a standard safety oversight regulatory system in the SAM Region and other related issues of common interest to the States.

8.8 The SRVSOP mentioned that a proposal had been made to develop the ANS LAR set and that, within this context, the **LAR 215 – Aeronautical Information Service – DRAFT 1.0** had been developed, based on Annex 15, Aeronautical Information Services, including Amendment 39 and other reference documents that had been included as part of the regulations. The SRVSOP also noted that LAR 215, like the other ANS LAR set, was directly focused on establishing the requirements for ANS providers, specifically focusing on the AIS service provider (AISP), with the purpose of regulating all related activities.

8.9 The Meeting took note that, according to the process of adoption of LAR 215, once DRAFT 1.0 was concluded, together with the Inspector Manual, a copy would be delivered to the States for review and adoption of the proposal. Once these steps were completed, the General Board would proceed to approve LAR 215, after the corresponding analysis by the panel, and then it would be submitted to States for implementation.

Electronic publications

8.10 The Meeting took note of the request from IATA to post aeronautical information publications on the website of the civil aviation authority 42 to 56 days in advance (AIRAC cycles) in order to expedite the publication of procedures and the updating of aeronautical publications.

8.11 The Meeting noted that the States were complying with this procedure by submitting the information of the publications by email and posting it on the website, with two AIRAC cycles in advance in case of important changes, with the exception of some States. Likewise, printed publications were delivered to the users.

Safety Bulletins

8.12 The Meeting took note of the information provided by IATA regarding “Safety Bulletins”.

8.13 The Meeting agreed that IATA considerations regarding the publication of this type of bulletins constituted a violation of the standards and recommended practices (SARPS) and could seriously compromise safety due to the following reasons:

- a) there was no standard distribution of the Safety Bulletin and there was no guarantee that all stakeholders received the information;
- b) there was no standard format for Safety Bulletins, making it difficult for users to interpret them; and

- c) Safety Bulletins did not undergo an information quality assurance process and that could constitute a threat to safety.

8.14 Regarding the example shown in the Appendix to the working paper presented by IATA, Brazil mentioned that the authority did not authorize this type of publication.

8.15 The Meeting requested the Secretariat to ask IATA about other cases in which “Safety Bulletins” had been issued, and to send a letter to the States involved warning them about the use of non-standard publications that were not contained in Annex 15 nor in ICAO Doc 8126.