Doc 10003
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Manual on the Digital Exchange of Aeronautical Meteorological Information

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AMENDMENTS

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RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by

CORRIGENDA		
No.	Date	Entered by

FOREWORD

This first edition of the *Manual on the Digital Exchange of Aeronautical Meteorological Information* is published in response to the introduction of the exchange of aeronautical meteorological information in a digital form as part of Amendment 76 to Annex 3 — *Meteorological Service for International Air Navigation*, applicable 14 November 2013. As of this date, aerodrome routine and special meteorological reports (METAR and SPECI, including trend forecasts (TREND)), aerodrome forecasts (TAF) and information concerning en-route weather phenomena which may affect the safety of aircraft operations (SIGMET), may be exchanged in a digital form by States that are in a position to do so.

In the case of METAR, SPECI and TAF, their digital exchange is in addition to their current required exchange in the METAR, SPECI and TAF code forms, respectively, prescribed by the World Meteorological Organization. In the case of SIGMET, their digital exchange is in addition to their current required exchange in abbreviated plain language.

Where States are in a position to exchange METAR, SPECI, TAF and SIGMET in a digital form, Annex 3 requires that the information be formatted in accordance with a globally interoperable information exchange model, use extensible markup language (XML)/geography markup language (GML), and be accompanied by the appropriate metadata. This manual is intended to assist States in each of these three respects.

The availability of aeronautical meteorological information in a globally interoperable digital format is seen as a key enabler for future global air traffic management within a system-wide information management (SWIM) environment. Consequently, the enabling of the digital exchange of METAR, SPECI, TAF and SIGMET can be viewed as the first step towards the transition of all required aeronautical meteorological information to a digital form and its integration into a SWIM environment. Future amendments to Annex 3 are therefore expected to enhance and expand the digital exchange provisions introduced as part of Amendment 76. This manual will, consequently, be subject to periodic review and amendment to ensure necessary alignment with the evolving Annex 3 provisions in this regard.

The content of the manual was developed over a period of two years primarily through the input of the ICAO Meteorological Aeronautical Requirements and Information Exchange Project Team (MARIE-PT). Expertise from airline and pilot representative organizations and regional programmes for air transport modernization, and detailed technical expertise from the World Meteorological Organization and elsewhere was utilized. The manual was peer reviewed by various domain experts.

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LIST OF ABBREVIATIONS AND ACRONYMS

AIM*	Aeronautical information management
AIXM*	Aeronautical information exchange model
ANSP*	Air navigation service provider
ATM	Air traffic management
CDM*	Collaborative decision making
FIXM*	Flight information exchange model
GML*	Geography markup language
ISO*	International Organization for Standardization
IWXXM*	ICAO meteorological information exchange model
METAR	Aerodrome routine meteorological report (in meteorological code)
METCE*	Modèle pour l'Échange des informations sur le Temps, le Climat et l'Eau (of the World Meteorological Organization, WMO)
NOP*	Network operations plan
OGC*	Open Geospatial Consortium
OPM*	Observable property model
SAF*	Simple aeronautical features
SIGMET	Information concerning en-route weather phenomena which may affect the safety of aircraft operations
SPECI	Aerodrome special meteorological report (in meteorological code)
SWIM*	System-wide information management
TAF	Aerodrome forecast (in meteorological code)
TREND	Trend forecast
UML*	Unified modelling language
W3C*	World Wide Web Consortium
WMO*	World Meteorological Organization
WXXM*	Weather information exchange model
XML*	Extensible markup language
XSD*	XML schema definitions

* Abbreviations not included in the *Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400)

Chapter 1

BACKGROUND

1.1 THE EVOLVING GLOBAL AIR TRANSPORT SYSTEM

1.1.1 The *Global Air Traffic Management Operational Concept* (Doc 9854) describes the manner in which the air traffic management (ATM) system will deliver services and benefits to airspace users by 2025-2030 and is in line with the recommendations of the Twelfth Air Navigation Conference (Montreal, 19–30 November 2012). It also details how ATM will act directly on the flight trajectory of a manned or an unmanned vehicle during all phases of flight, and the interaction of that flight trajectory with any hazard. Its scope describes the services that will be required to operate the global ATM system up to and beyond 2028.

1.1.2 This operational concept and the *Global Air Navigation Plan* (Doc 9750) address what is needed to increase user flexibility and maximize operating efficiencies in order to increase system capacity and improve safety levels in the future ATM system.

1.1.3 The guiding principle is that the ATM system is based on the provision of services. The service-based framework described in the operational concept considers all resources (including airspace, aerodromes, aircraft and humans) to be part of the ATM system. The primary functions of the ATM system will enable flight from an aerodrome into airspace and its subsequent landing, safely separated from hazards, within capacity limits, making optimum use of all system resources. The description of the operational concept components is based on realistic expectations of human capabilities and the ATM infrastructure at any particular time in the evolution of the ATM system described by this operational concept. It is independent of reference to any specific technology.

1.1.4 It is clearly evident that the future ATM system will be founded on knowledge based collaborative decision making (CDM). Effective CDM requires the intelligent use of the characteristics of uncertainty that are associated with the meteorological information provided. This form of risk management will enable decision makers to make executive choices according to their own objectively determined thresholds for action.

1.1.5 The system will be a network-based operation formed by four main components:

a) a robustly networked ATM system which improves information sharing;

b) a sharing of information which will enhance the quality of information and provide shared situational awareness;

c) collaboration and self-synchronization enabled by shared situational awareness; and

. d) enhanced sustainability and speed of decision making.

Collectively these will dramatically increase the efficiency of the ATM system.

1.2 NET-CENTRIC OPERATIONS

1.2.1 The concept of common (collaborative) information sharing has been under development for a decade or more. It was borne from a clear recognition that future ATM will be managed on a “network-centric” (net-centric) basis, with each aerodrome and each aircraft being considered as a node interlinked with all others within the system. Considerable investment is being made to develop the means to implement CDM at aerodromes and from a flow management perspective, as first steps towards system-wide efficiency. Substantial progress has been made with the individual stakeholders at an aerodrome identified and the information needs and flows mapped. Site-specific trials are yielding positive results and CDM is being progressively rolled-out on a global basis.

1.2.2 Nevertheless, it is clearly recognized that individual (national) airspaces and aerodromes cannot continue to be regarded as singular and isolated components of ATM. Each will serve as a node interlinked with all others within the system. A transition to a service-centric approach within a global business framework is clearly required. ATM must be managed on a net-centric basis, and aerodrome and network CDM and the transition to a “time-ordered” system will be practical representations of this concept.

1.3 CONSEQUENCES FOR METEOROLOGICAL SERVICES

1.3.1 The global ATM system will continue to be subject to the same vagaries of weather phenomena that affect air transport today. The additional and significant volume of air traffic predicted for the coming years will render the system significantly more sensitive to disruption and the consequential increased costs associated with it. Historically, aeronautical meteorological services have mainly addressed safety issues. Now, within the context of the evolving ATM system, the considerable impact of weather on capacity and efficiency and the potential to mitigate some of the environment impacts of aviation must be given greater consideration while maintaining to operate safely.

1.3.2 The importance of timely, accurate and easily available meteorological information for decision support is emphasized in Doc 9854. As such it is recognized that the success of the ATM system will be reliant on effective planning and management to deliver to the airspace user the (near as possible) optimum business trajectory while ensuring flexibility. Flow and capacity management enabled by high precision time-based metering (e.g. consistently achieving the required time of arrival, four-dimensional (4D)-trajectory management and short/medium term conflict detection and resolution) will be significant means of ensuring flight punctuality, efficiency and maintaining system throughput. This will be a key component in the effective management of congested airspace and aerodromes.

1.3.3 Furthermore, based on forecast traffic volumes and their orientations, and weather forecasts, air traffic flow management will originate and control the daily plan (e.g. network operations plan (NOP), story book) and will apply any refinements to accommodate real-time events. The need to adapt the original plan may also result from forecast significant weather phenomena that are monitored on a continuous basis.

1.3.4 A key change needed is the evolution of the interfaces between the airlines, flight crews and ATM network in determining the optimum profiles for a flight. The airline operations centres will examine the requirements for a flight and the current and predicted environment in which to operate (e.g. as meteorological conditions, airspace structure, en-route capacity, aerodrome capacity and environmental considerations) so as to select the optimum flight trajectory. Meteorological information will be collated and analysed in order to assess, in conjunction with aircraft performance data and user charges, the cost benefit of modified flight profiles or alternative routes, and aircraft may be re-planned while in flight.

1.3.5 The development of air and ground-based automated systems, in association with new procedures and working arrangements in ATM (e.g. 4D trajectory management[1]), is required to support future operations. It is expected that these will permit the dynamic management of airspace allowing the tactical routing of aircraft to provide significant operational benefits (safety, economy, flexibility, improved regularity and environmental impact mitigation) to users.

1.3.6 It is recognized that certain meteorological conditions (e.g. low visibility, strong winds, thunderstorms) and weather-induced runway contamination (e.g. snow, volcanic ash) can and do restrict aerodrome and airspace capacity. Each aerodrome, and to some extent, each sector of airspace is affected by local meteorological conditions which impact on their individual actual capacity at any moment in time. New equipment to support aircraft operations during hazardous meteorological conditions (e.g. advanced surface movement guidance and control systems, synthetic vision), are becoming increasingly available. Nevertheless, the key to mitigation and minimization of disruption will remain primarily in the intelligent use of increasingly accurate forecasting of meteorological conditions. This will be especially important for large, congested hub aerodromes and their associated airspace.

1.3.7 Improvements are also foreseen in terminal area short-term forecasting (e.g. departure and approach wind profiles) to maximize runway throughput. This will be achieved by the incorporation of such data into algorithms to provide tools for use by controllers to improve aerodrome throughput by delivering time-based separation rather than the inefficient distance-based separation of today, and a reduction of wake-vortex separation when conditions so exist. Furthermore, terminal area short-term forecasting will support continuous descent operations in general.

1.3.8 Figure 1-1 provides a graphical representation of the different stages in the 4D-trajectory evolution linked to the various stages of planning and where the integration of meteorological information could be envisaged.

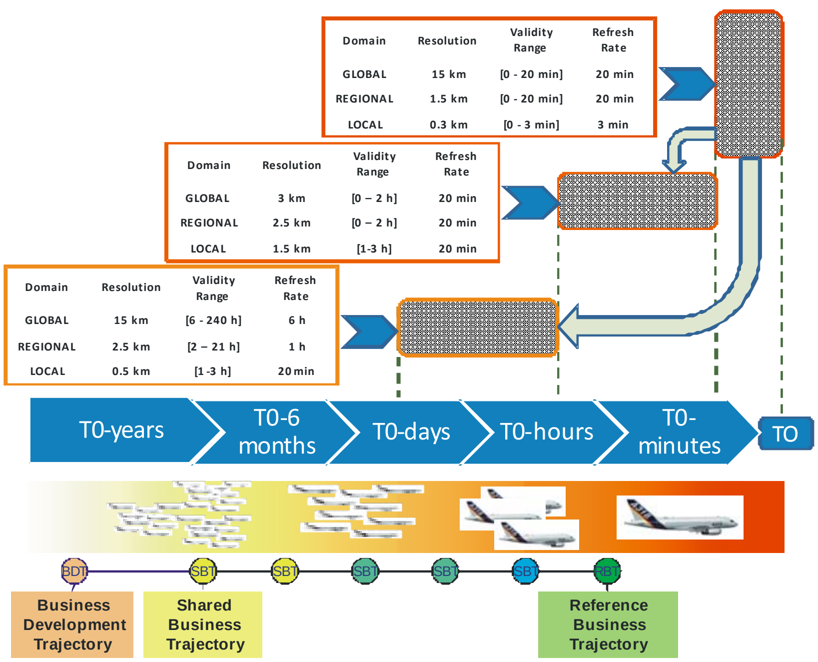

Figure 1-1. MET-ATM perspective

[1] 4-D trajectory management is the process that captures the overall traffic situation in the NOP and controls the development of the business or mission trajectories in four dimensions (latitude, longitude, flight level and time). Specifically, 4-D trajectory management is the process by which the business trajectory of the aircraft is established, agreed, updated and revised. This is achieved through collaborative decision making processes between the operator, ATM, and other stakeholders where applicable, except in time-critical situations when only the flight crew and controller are involved.

1.3.9 The key to efficient operation of the ATM system is interoperability within the ATM environment. This will be enabled by advanced communications systems, standard interfaces and by standard information exchange models that support the required seamless, transparent and open digital exchange of meteorological information.

1.3.10 An important consideration in this respect is to ensure global interoperability not only from a meteorological information perspective but also on interlinks with other identified relevant data domains. ATM systems, such as controller decision support tools, will not only use meteorological information but will fuse this information with other relevant information, such as aeronautical information and flight Information, to support knowledge based decision making. Figure 1-2 provides a graphical representation of the different identified data domains and user communities.

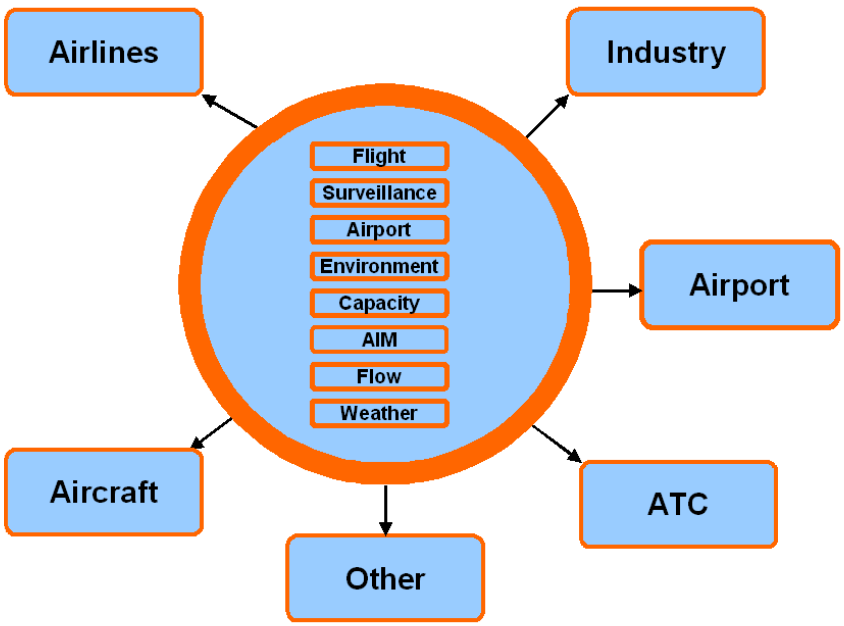

Figure 1-2. ATM information

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Chapter 2

DIGITAL INFORMATION EXCHANGE PRINCIPLES

2.1 GLOBAL INTEROPERABILITY

2.1.1 To achieve global interoperability within the ATM system (1.3 refers), it is crucial that the exchanged data shares the same meaning at both its origin and its destination. This enables systems to combine and process received data from different identified domains and from (multiple) sources. This so-called global semantic interoperability is vital for international air navigation. It is a true strategic air transport industry asset and resource.

2.1.2 A simplified, non-exhaustive overview of the aggregation of the different information components one could identify in the wider context of aeronautical meteorological information exchange only is the following:

a) ICAO global aeronautical meteorological constructs (the globally defined aeronautical meteorological information constructs that are uniquely required by the provisions of Annex 3 and to be globally shared);

b) ICAO regional aeronautical meteorological constructs (the regional aeronautical meteorological information constructs that are uniquely required by the provisions of ICAO regional air navigation plans based on Annex 3 and to be regionally shared); and

c) user, State or multi-State specific aeronautical meteorological constructs (the aeronautical meteorological information constructs that are not specifically required by the provisions of Annex 3, or are additions to Annex 3 but identified as important to be shared in a specific user context with a specific user benefit).

2.1.3 These three identified categories are a high level decomposition of aeronautical meteorological information exchange recognizing that this could be decomposed further. From a meteorological information provision perspective, each component includes elements that are not unique to aeronautical meteorology but are common to meteorology in general; or elements could be identified that are not unique to aeronautical meteorology but are common to aviation.

2.1.4 When establishing true global semantic interoperability, the efforts to standardize or specify meteorological information exchange should not be limited to the high-level perspective on aeronautical meteorological information only, but should be inclusive of establishing the same meaning at both their origin and their destination of these common meteorological and common aeronautical information elements. For example, the notion “runway” in a meteorological information exchange environment cannot have a different meaning than a “runway” used in aeronautical information exchange. Alternatively the meaning of “temperature” could not be modified in an aeronautical context and still be called “temperature”.

2.1.5 The decomposition of the broad domain of aeronautical meteorological information exchange in distinct elements such as the global aeronautical meteorological component, generic meteorological element and generic aeronautical element is the prerequisite for a truly data centric environment to support international air navigation. By this decomposition, information is unbundled to potentially be re-bundled and integrated in an information service that contributes to the overall air transport safety and performance targets.

2.1.6 Meteorological information exchange then becomes an integral component of the system-wide information management concept, where information management solutions will be defined at the overall system level, rather than individually at each major subsystem (programme/project/process/function) and interface level, as has happened in the past (Doc 9854).

2.2 SYSTEM-WIDE INFORMATION MANAGEMENT

2.2.1 The scope of global system-wide information management (SWIM) includes all the information exchanged globally between applications and the infrastructure that makes it possible; by using a common methodology for information elements of interest and by the use of appropriate technology and standards. Conceptually, the following five loosely coupled, bidirectional layers are identified (see Figure 2-1):

a) applications of global service providers and service consumers that publish and/or use information;

b) services for information exchange, defined for each ATM information domain following governance specifications, and agreed upon by SWIM stakeholders;

c) standards for information exchange which provide the subject-specific standards for sharing information for the above information exchange services;

d) SWIM messaging infrastructure which provides the infrastructure and governance for sharing information and sometimes referred to as the "SWIM Infrastructure"; and

e) global information technology infrastructures, providing consolidated telecommunications services, including hardware.

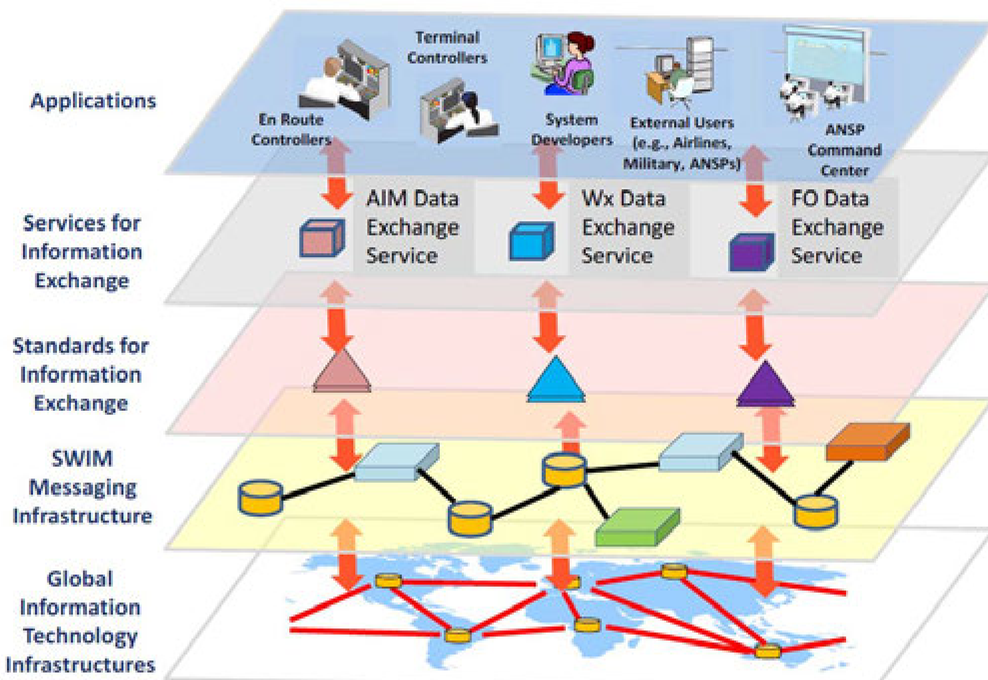

Figure 2-1. SWIM layers

2.2.2 The required provisions and guidance for the digital exchange of aeronautical meteorological information especially operate at level 2 and 3 of this layered SWIM approach. The messaging infrastructure and information technology standards (level 4 and 5) are prerequisites for the Annex 3 provisions on digital information exchange and the scope of this guidance. The applications level (level 1) is considered stakeholder specific so is the concern of the actual provider and consumer and, as such, not included in Annex 3 provisions or in the associated guidance.

2.3 DATA, INFORMATION AND SERVICE MODELLING

2.3.1 One technique to structure the complex and interlinked aspects of global interoperability and the supporting information management framework is by ways of modelling the data, information and services that are required from a systems perspective.

2.3.2 Data and information models are used to represent concepts, relationships, constraints, rules and operations to specify data semantics for a chosen domain of discourse, in this case ATM and its related domain aeronautical meteorology. These data models provide a sharable, stable, and organized structure of information requirements in a domain context and as such provide a key component of the required global (semantic) interoperability. Service models provide a description of (information) services needed to directly support an operational domain and as such build on the data/information captured in these respective models to define the information content of a service.

2.3.3 Different approaches exist in what the required level of abstraction and composition for data, information and services models should be for describing the required level of interoperable information exchange. For the purpose of digital aeronautical meteorological information exchange in support of Annex 3, it is sufficient to specify a so-called foundation and to represent the required models at the logical and physical level only.

2.3.4 Following iterations of the models to support the digital exchange of aeronautical meteorological information could require a separate conceptual view. This view usually provides a high-level description of the meteorological data concepts and the relationships between those concepts which are currently interwoven with the logical models since a specific exchange solution was in mind.

2.3.5 The conceptual view should, in the medium to long term, not be described at the level of the data domain but on the level of all global air transport information exchanges required. When required, specific logical and physical representations of the meteorological exchange required could be derived from that. The recommendations of the AN-Conf/12 on a) globally interoperable system-wide information management and b) to develop a logical architecture to address the global interoperability issues will drive this approach to derive logical and physical information exchange models from one reference. This will have an impact on the digital exchange of aeronautical meteorological information and the supporting models for iterations to come.

Foundation

2.3.6 Certain elementary steps need to be performed to create data models and the desired (semantic) interoperability to ensure that exchanged data from system component to system component share the same meaning at both their origin and their destination. In this elementary phase of modelling data, choices are made on the fit for use and fit for purpose of existing generic principles and standards with respect to information exchange. This so-called “foundation” of generic standards applicable for aeronautical meteorological information is primarily based on the notion that it is a type of geospatial and time referenced information. Furthermore, when discussing the physical exchange of the information in more detail, this should be based on available generic web technology. Moreover, all should fit in the overall context of ATM information exchange also referred to in the draft ICAO SWIM Concept.

2.3.7 The foundation applied to model aeronautical meteorological information is based on the following, mainly International Organization for Standardization (ISO), standards and specifications:

- ISO/TC 19103 *Geographic information — Conceptual schema language*
- ISO 19107 *Geographic information — Spatial schema*
- ISO 19108 *Geographic information — Temporal schema*
- ISO 19115 *Geographic information — Metadata*
- ISO 19123 *Geographic information — Schema for coverage geometry and functions*
- ISO 19136 *Geographic information — GML*
- ISO/TS 19139 *Geographic information — Metadata - XML schema implementation*
- ISO 19156 *Geographic information — Observations and measurements*
- ISO 639-2 *Codes for the representation of names of languages* (Part 2)
- World Wide Web Consortium (W3C) *XML Schema Specification*

Logical data model

2.3.8 The level of abstraction required for a model that represents the aeronautical meteorological data exchange needs varies from system environment to system environment and is strongly related to the level of restrictions imposed by the choice of foundation.

2.3.9 To describe aeronautical meteorological information constructs with the given foundation, the level of abstraction reflected in the ICAO provisions is the logical data model. This model allows analysis of data definition aspect without consideration of implementation specific or product specific issues. Furthermore, the details of an often complex physical exchange of data are hidden in order to facilitate the communication of it to those who are not familiar with the techniques involved.

2.3.10 A commonly used language to provide the semantics and abstract structure of all the information that needs to be made available by meteorological service providers as prescribed by the existing provisions is the unified modelling language (UML)[1]. Such a description in UML includes the intrinsic data requirements and structural business process rules and is a so-called technology independent description not concerned with code form specifications. More detail on UML is provided in Appendix A.

2.3.11 The ICAO meteorological information exchange model (IWXXM) provides such a logical data model for aeronautical meteorological information in support of international air navigation.

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1 Defined by the object management group. The UML is a graphical language designed to visualise, specify, construct and document the artefacts of a software-intensive system. The UML offers a standard way to write a system's blueprints, including conceptual aspects such as business processes and system functions as well as concrete considerations such as programming language statements, database schemas and reusable software components.

Physical data model

2.3.12 From a system's architectural perspective, a guiding logical data model for aeronautical meteorological information is sufficient. This is the only prerequisite required to develop physical implementations of systems that exchange meteorological information in the ATM domain.

2.3.13 However, for the purpose of international information exchange and to establish true interoperability, it is considered to be beneficial to provide an additional level of structure. Currently, such a structure is provided for METAR, SPECI and TAF by the supporting World Meteorological Organization Publication No. 306 — *Manual on Codes,* Volume I.

2.3.14 This structure in the context of the digital exchange of aeronautical meteorological information is provided by a physical data model. Such a model for the physical implementation of aeronautical meteorological information exchange is for instance based on generic standards for the exchange of geospatial and time referenced information.

Extensibility

2.3.15 As described in previous paragraphs, key to an interoperable data-centric environment satisfying user needs is the application of the common foundation of standards, specifications and modelling practices for all components of ATM information. This includes the possibility of developing an easy and cost effective extension to the global baseline. Without the possibility to develop an extension, regional and State practices based on Annex 3 and user specific requirements will require the development and maintenance of specific solutions for the information of their concern.

2.3.16 The extensibility of the IWXXM is fundamental to successful and affordable digital meteorological information exchange.

2.4 IDENTIFIED COMPONENTS TO SUPPORT THE DIGITAL EXCHANGE OF AERONAUTICAL METEOROLOGICAL INFORMATION

2.4.1 Based on the notions and principles described in 2.1, 2.2 and 2.3, the following structure of (model) components has been chosen to support the digital exchange of aeronautical meteorological information:

> ***IWXXM logical model.*** The exchange model for aeronautical meteorological information in UML, in the form of an ISO 19109 application schema, which, in its version 1, is restricted to describe the exchange of METAR and SPECI (including TREND), TAF and SIGMET only[2].
>
> ***Simple aeronautical features (SAF) logical model.*** Information on aeronautical features in UML in the form of an ISO 19109 application schema. The SAF allow items such as aerodromes or runways to be described to the level of detail required for reporting aeronautical meteorological information. For the first iteration of the IWXXM, the SAF is the representation of the decomposed common aeronautical information constructs used in the digital exchange of METAR and SPECI (including TREND), TAF and SIGMET. Since no ICAO common aeronautical information model exists today, the SAF was developed and maintained as integral part of the IWXXM. In future releases of the IWXXM, the SAF should be a commonly developed, maintained and shared model in ICAO in line with the SWIM principles.

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2 By some architectural frameworks, the current iteration of the IWXXM logical model would not qualify as a data model but as an information service model due to its specific nature of describing the exchange of legacy reports.

IWXXM XML schema. A GML-based[3] implementation of the IWXXM logical model derived programmatically following proven industry standards and best practices.

SAF XML Schema. A GML-based implementation of the SAF logical model derived programmatically following proven industry standards and best practices.

WMO packages[4] which are from an IWXXM perspective foundation elements (2.3.6 and 2.3.7 refers) expressed as logical models in the form of UML class diagrams and as GML-based implementations (schema):

- Modèle pour l'Échange des informations sur le Temps, le Climat et l'Eau (WMO METCE) provides conceptual definitions of meteorological phenomena, entities and concepts in order to underpin semantic interoperability in the weather, climate and water domain in the form of an application schema[5]; and

- Observable Property Model (WMO OPM) provides a framework for qualifying or constraining physical properties based on a draft best practice developed by the Open Geospatial Consortium (OGC) Sensor Working Group[6].

2.4.2 Figure 2-2 provides an overview of the described structure in the form of a UML package diagram.

[3] GML is the XML grammar defined by the OGC to express geographical features. GML serves as a modelling language and an open interchange format for geographic information transactions. The ability to integrate all forms of geographic information is key to the utility of GML.

[4] The manual includes guidance on the IWXXM logical model, IWXXM XML schema and SAF only. For the WMO components refer to the appropriate WMO guidance material.

[5] The relevant schema, in the form of xsd-files, are available at http://schemas.wmo.int/metce/1.0.

[6] The relevant schema, in the form of xsd-files, are available at http://schemas.wmo.int/opm/1.0.

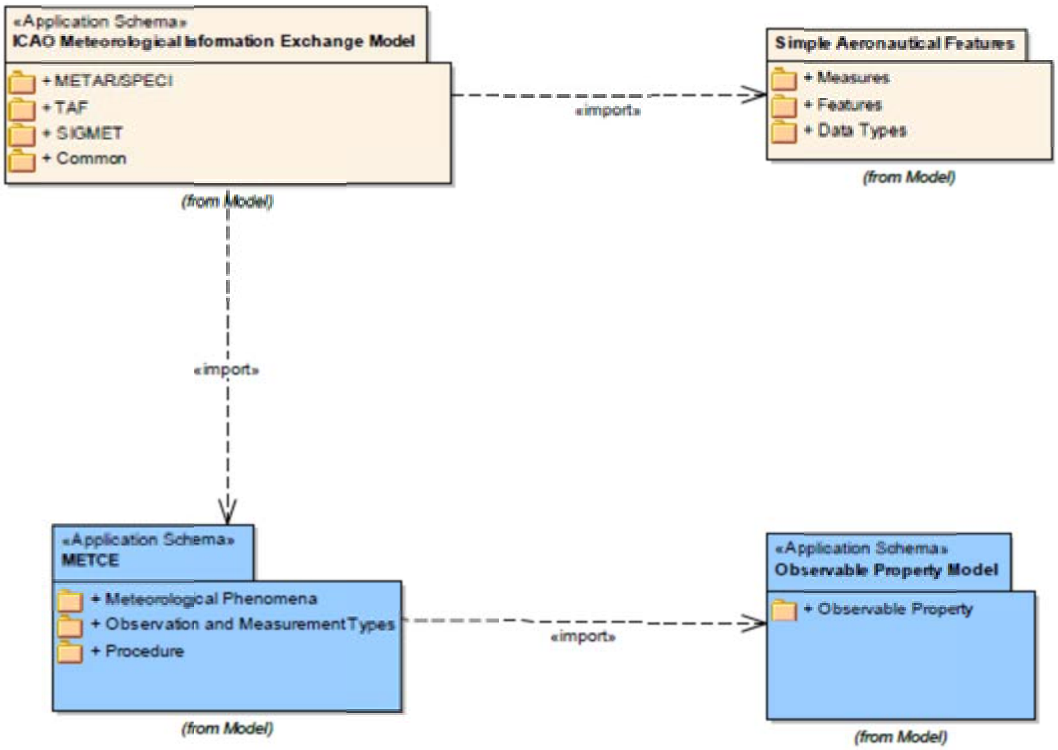

Figure 2-2. UML package diagram

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Chapter 3

IWXXM AND SAF LOGICAL MODELS

3.1 SCOPE

3.1.1 It is important to consider that the scope of the IWXXM logical model will evolve as aeronautical meteorological information requirements and the digital exchange of this required information will change over time. Additionally, not only evolving meteorological requirements but also emerging developments in other ICAO data domains will have an impact on the scope of the IWXXM.

3.1.2 This requires a modular approach for the logical data model which is provided by a strict adherence of next iterations of the logical data model to the declared foundation (inclusive of the WMO packages). The foundation provides the common ground for this modular approach and thus a flexible IWXXM.

3.1.3 Figures 3-1 and 3-2 provide a graphical representation of the potential evolution of the IWXXM. The IWXXM will over time evolve into the single global baseline for aeronautical meteorological information exchange capturing all the global information exchange requirements with the possibility to create IWXXM extensions to satisfy user specific needs.

3.1.4 The stakeholder requirement to have other aeronautical meteorological information exchange models like WXXM[8] available to bridge the gap between the current scope of IWXXM and what is desired will then potentially become obsolete from a global information exchange perspective.

3.2 BASELINE VERSION

The baseline for the IWXXM includes all information constructs relevant to replace the traditional alphanumeric codes. The traditional alphanumeric code formats involved are:

a) METAR (including TREND);

b) SPECI (including TREND);

c) TAF; and

d) SIGMET.

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8 WXXM is a meteorological information model fully aligned with the foundation as described in 2.3.6 and 2.3.7 Where IWXXM covers the specific information exchange requirements for a selected set of ICAO Annex 3 products, WXXM covers a broader scope of aviation meteorological information exchange requirements.

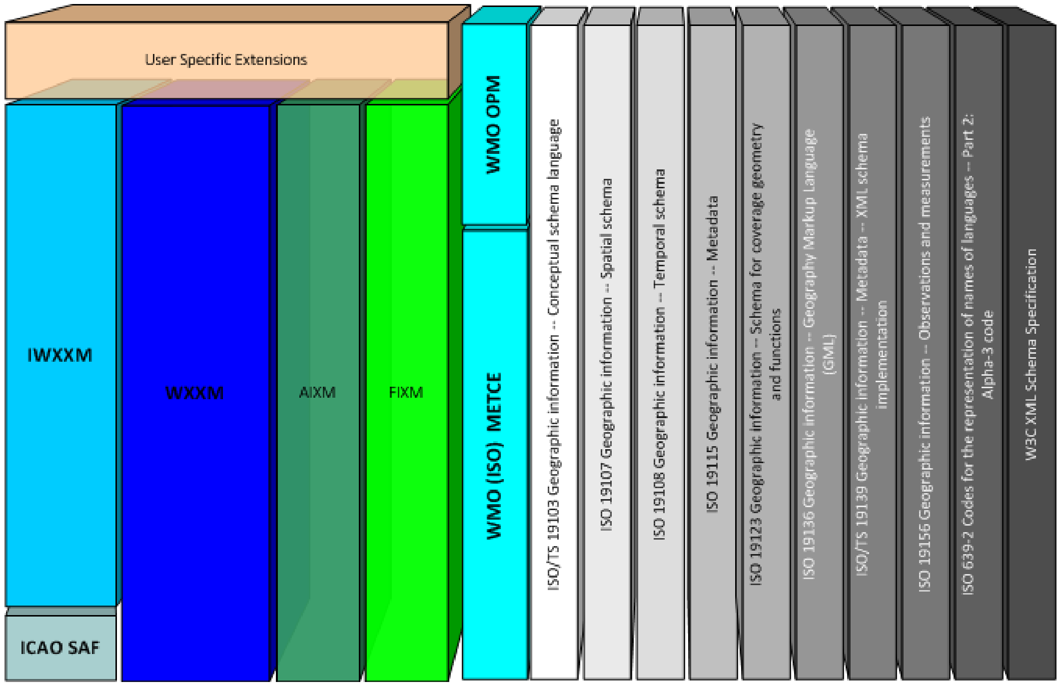

Figure 3-1. IWXXM positioning 2013

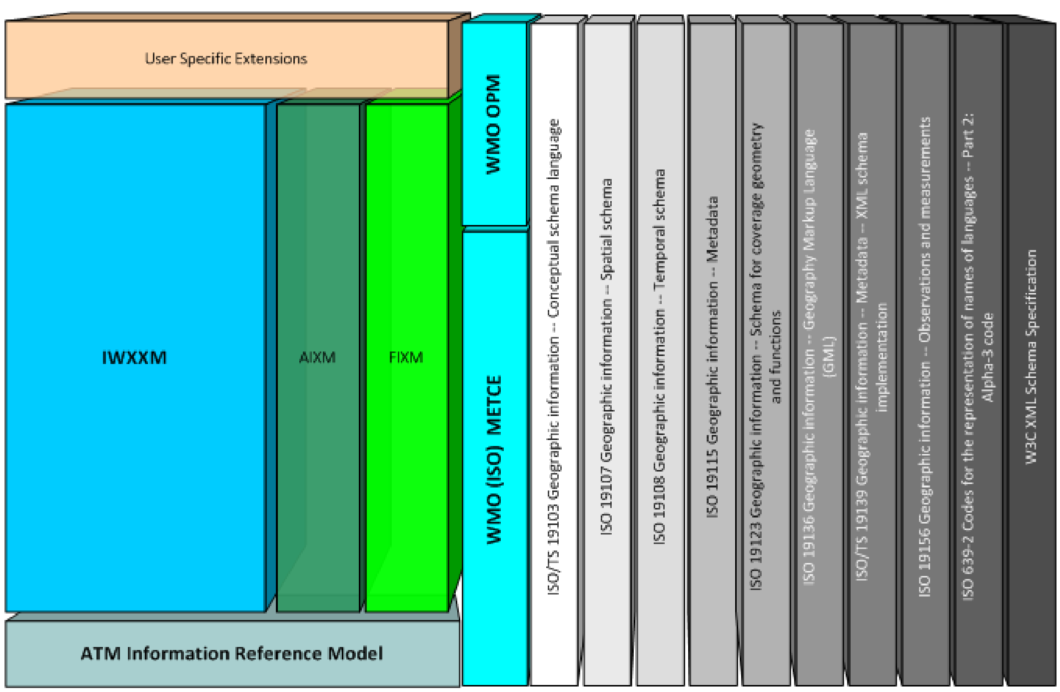

Figure 3-2. IWXXM foreseen positioning 2019 onwards

3.3 SPECIFICATION

3.3.1 The IWXXM logical model describing the exchange of METAR and SPECI (including TREND), TAF and SIGMET is specified by a number of interdependent context (class) diagrams (UML). The context (class) diagrams describe the interrelationships between identified features, types and allowed enumerations.

3.3.2 The following context (class) diagrams specify the IWXXM at the logical level:

a) METAR/SPECI;

b) MeteorologicalAerodromeObservation;

c) MeteorologicalAerodromeTrendForecast;

d) METAR/SPECI Weather;

e) METAR/SPECI Runway State;

f) TAF;

g) MeteorologicalAerodromeForecast;

h) SIGMET;

i) SIGMETEvolvingConditionAnalysis;

j) SIGMETPositionAnalysis;

k) cloud;

l) surface wind;

m) weather; and

n) in the SAF component: measure, aerodrome, airspace, and unit and service.

3.3.3 Figure 3-3 provides an example of a context diagram for MeteorologicalAerodromeObservation.

3.3.4 All the IWXXM context (class) diagrams with identified features, types and allowed enumerations are published at www.icao.int/iwxxm/1.0/doc.

3.3.5 All the SAF context (class) diagrams with identified features, types and allowed enumerations are published at www.icao.int/saf/1.0/doc.

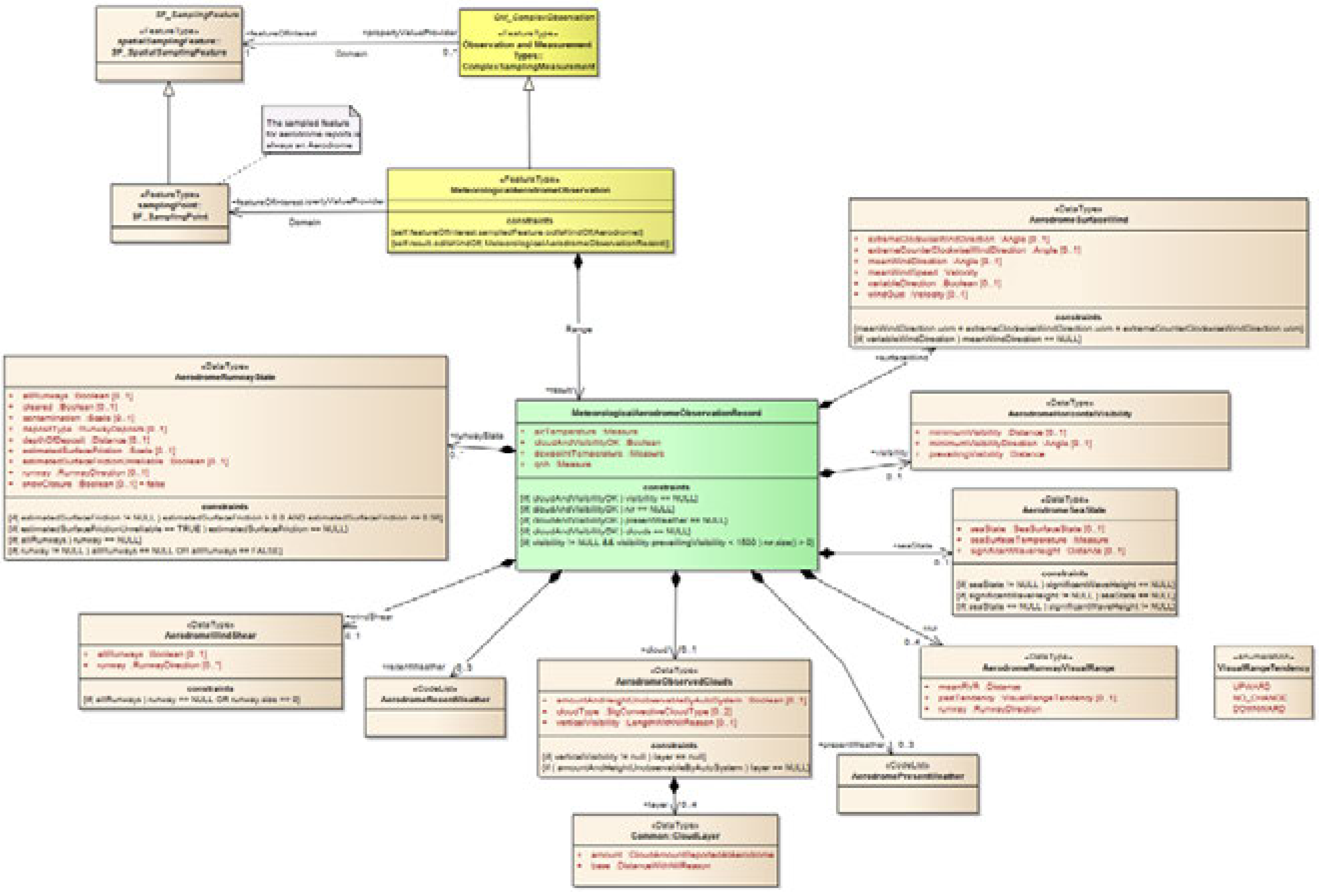

Figure 3-3. Example of a context diagram MeteorologicalAerodromeObservation

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Chapter 4

IWXXM AND SAF XML SCHEMA

4.1 INTRODUCTION

4.1.1 The IWXXM XML schema is a physical data model for aeronautical meteorological information in support of the meteorological service for international air navigation. It is a GML-based application of the logical data model. It uses pre-defined XML/GML elements and is based on industry standards and the available WMO packages; the physical model elements of the so-called foundation.

4.1.2 A physical exchange form based on XML was identified as the most suitable for the digital exchange of aeronautical meteorological information. Moreover, this general consensus extends to the need to migrate towards a specific XML grammar to express geographical features. The specific XML grammar selected to describe meteorological information in function of time, place, coverage, etc. is GML. More detail on XML/GML is provided in Appendix B.

4.1.3 It is worthwhile noting that not every existing or emerging code format to exchange aeronautical meteorological information should necessarily be replaced by a GML-based code format as is currently implemented for METAR and SPECI (including TREND), TAF and SIGMET. For example, gridded data can be exchanged in other more efficient manners. Optionally, GML could still be used as the so-called 'wrapper' of the information when found necessary.

4.1.4 However independent of the exchange format, it is essential that all the information constructs, also for the gridded data, are captured at the technology and format independent layer of the IWXXM logical data model.

4.2 SPECIFICATION

XML/GML schema for aeronautical meteorological information exchange

4.2.1 The IWXXM XML/GML schema describing the physical exchange of METAR and SPECI (including TREND), TAF and SIGMET in the form of XML is specified by a number of XML schema definitions (XSD).

4.2.2 The following XSD specify the IWXXM at the physical exchange level:

a) iwxxm.xsd;

b) common.xsd;

c) metarSpeci.xsd;

d) sigmet.xsd;

e) taf.xsd; and

f) in the SAF component: saf.xsd, features.xsd, measures.xsd and dataTypes.xsd.

4.2.2 Figure 4-1 provides an example of the common.xsd from the IWXXM.

```
<?xml version="1.0" encoding="UTF-8" ?>
- <schema xmlns="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:iwxxm="http://icao.int/iwxxm/1.0RC2" xmlns:saf="http://icao.int/saf/1.0RC2" targetNamespace="http://icao.int/iwxxm/1.0RC2"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.0RC2">
- <!--
 Schema auto-generated by FullMoon, applying rule suite xmi11ea
  -->
- <annotation>
  <documentation>Common constructs used across multiple packages. This package includes constructs closely related to the aviation
weather domain.</documentation>
- <appinfo>
  <sch:title xmlns:sch="http://purl.oclc.org/dsdl/schematron">Schematron validation</sch:title>
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="iwxxm" uri="http://icao.int/iwxxm/1.0RC2" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="saf" uri="http://icao.int/saf/1.0RC2" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="sam" uri="http://www.opengis.net/sampling/2.0" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="sams" uri="http://www.opengis.net/samplingSpatial/2.0" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="xlink" uri="http://www.w3.org/1999/xlink" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="om" uri="http://www.opengis.net/om/2.0" />
  <sch:ns xmlns:sch="http://purl.oclc.org/dsdl/schematron" prefix="gml" uri="http://www.opengis.net/gml/3.2" />
  </appinfo>
  </annotation>
  <import namespace="http://www.opengis.net/gml/3.2" schemaLocation="http://schemas.opengis.net/gml/3.2.1/gml.xsd" />
  <import namespace="http://icao.int/saf/1.0RC2" schemaLocation="http://schemas.wmo.int/saf/1.0RC2/saf.xsd" />
  <include schemaLocation="iwxxm.xsd" />
- <element name="AerodromeCloudForecast" substitutionGroup="gml:AbstractGML" type="iwxxm:AerodromeCloudForecastType">
- <annotation>
  <documentation>Forecast cloud conditions, including predicted vertical visibility and cloud layers. A single vertical visibility may be
reported, but cannot be reported with cloud layers.</documentation>
  <appinfo />
  </annotation>
  </element>
- <complexType name="AerodromeCloudForecastType">
- <complexContent>
- <extension base="gml:AbstractGMLType">
- <sequence>
- <element maxOccurs="1" minOccurs="0" name="verticalVisibility" type="gml:LengthType">
- <annotation>
- <appinfo>
  <quantity>http://codes.wmo.int/common/c-15/ae/verticalVisibility</quantity>
  </appinfo>
  <documentation>The vertical visibility. Vertical visibility is defined as the vertical visual range into an obscuring medium.</documentation>
  </annotation>
  </element>
- <element maxOccurs="1" minOccurs="0" name="cloudType" type="iwxxm:SigConvectiveCloudTypeType">
- <annotation>
  <documentation>Cloud type (e.g., cumulonimbus, towering cumulus)</documentation>
```

```
  </annotation>
  </element>
  <element maxOccurs="4" minOccurs="0" name="layer" type="iwxxm:CloudLayerPropertyType" />
  </sequence>
  </extension>
  </complexContent>
  </complexType>
- <complexType name="AerodromeCloudForecastPropertyType">
- <sequence minOccurs="0">
  <element ref="iwxxm:AerodromeCloudForecast" />
  </sequence>
  <attributeGroup ref="gml:AssociationAttributeGroup" />
  <attributeGroup ref="gml:OwnershipAttributeGroup" />
  </complexType>
- <element name="AerodromeSurfaceWindForecast" substitutionGroup="iwxxm:AerodromeSurfaceWindTrendForecast"
type="iwxxm:AerodromeSurfaceWindForecastType">
- <annotation>
  <documentation>A forecast of wind conditions at an aerodrome. This extends AerodromeSurfaceWindTrendForecast to allow for a variable
wind direction to be reported. This class differs from a aerodrome wind observation in that the observations may include a min/max
directional variability. This class only carries a true/false indication that it will be variable.</documentation>
  </annotation>
  </element>
- <complexType name="AerodromeSurfaceWindForecastType">
- <complexContent>
- <extension base="iwxxm:AerodromeSurfaceWindTrendForecastType">
  <attribute name="variableWindDirection" type="boolean" use="required" />
  </extension>
  </complexContent>
  </complexType>
- <complexType name="AerodromeSurfaceWindForecastPropertyType">
- <sequence minOccurs="0">
  <element ref="iwxxm:AerodromeSurfaceWindForecast" />
  </sequence>
  <attributeGroup ref="gml:AssociationAttributeGroup" />
  <attributeGroup ref="gml:OwnershipAttributeGroup" />
  </complexType>
- <element name="CloudLayer" substitutionGroup="gml:AbstractObject" type="iwxxm:CloudLayerType">
- <annotation>
  <documentation>A cloud layer, including a cloud amount, cloud base and cloud type</documentation>
  </annotation>
  </element>
- <complexType name="CloudLayerType">
- <sequence>
- <element name="amount" type="iwxxm:CloudAmountReportedAtAerodromeType">
- <annotation>
  <documentation>The observed cloud amount</documentation>
  </annotation>
```

```
  </element>
- <element name="base" nillable="true" type="saf:DistanceWithNilReasonType">
- <annotation>
- <appinfo>
  <quantity>http://codes.wmo.int/common/c-15/me/heightOfBaseOfCloud</quantity>
  </appinfo>
  <documentation>For a given cloud or cloud layer, height of the lowest level in the atmosphere at which the air contains a perceptible
quantity of cloud particles.</documentation>
  </annotation>
  </element>
  </sequence>
  </complexType>
- <complexType name="CloudLayerPropertyType">
- <sequence>
  <element ref="iwxxm:CloudLayer" />
  </sequence>
  <attributeGroup ref="gml:OwnershipAttributeGroup" />
  </complexType>
- <element name="AerodromeSurfaceWindTrendForecast" substitutionGroup="gml:AbstractObject"
type="iwxxm:AerodromeSurfaceWindTrendForecastType">
- <annotation>
  <documentation>A trend forecast of surface wind conditions at an aerodrome.</documentation>
  </annotation>
  </element>
- <complexType name="AerodromeSurfaceWindTrendForecastType">
- <sequence>
- <element maxOccurs="1" minOccurs="0" name="meanWindDirection" type="gml:AngleType">
- <annotation>
- <appinfo>
  <quantity>http://codes.wmo.int/common/c-15/me/windDirection</quantity>
  </appinfo>
  <documentation>The forecast average wind direction from which wind is blowing</documentation>
  </annotation>
  </element>
- <element name="meanWindSpeed" type="gml:SpeedType">
- <annotation>
- <appinfo>
  <quantity>http://codes.wmo.int/common/c-15/me/windSpeed</quantity>
  </appinfo>
  <documentation>The forecast average wind speed</documentation>
  </annotation>
  </element>
- <element maxOccurs="1" minOccurs="0" name="windGustSpeed" type="gml:SpeedType">
- <annotation>
```

Figure 4-1. Example of common.xsd

4.2.3 All the IWXXM XSD are published at http://icao.int/iwxxm/1.0.

4.2.4 All the SAF XSD are published at http://icao.int/saf/1.0.

Encoding of present and recent weather in METAR/SPECI

Present Weather

4.2.5 Annex 3 includes a number of provisions with respect to how present weather shall be reported in terms of type and characteristics and how they need to be qualified with respect to intensity or proximity to the aerodrome as appropriate.

4.2.6 From a validation perspective it is necessary to list the various combinations of types, characteristics, intensity and proximity that exclusively can be encoded in a METAR/SPECI exchanged in an IWXXM complaint GML format.

4.2.7 The following defined present weather phenomena combinations are permissible to be used in METAR/SPECI exchanged in an IWXXM compliant GML format:

a) light precipitation;

```
-DZ -RA -SN -SG -PL -UP

-DZRA -RADZ -SNDZ -SGDZ -PLDZ

-DZSN -RASN -SNRA -SGRA -PLRA

-DZSG -RASG -SNSG -SGSN -PLSN

-DZPL -RAPL -SNPL -SGPL -PLSG

-DZRASN -DZSNRA -RADZSN -RASNDZ -SNDZRA -SNRADZ

-DZRASG -DZSGRA -RADZSG -RASGDZ -SGDZRA -SGRADZ

-DZRAPL -DZPLRA -RADZPL -RAPLDZ -PLDZRA -PLRADZ

-RASNSG -RASGSN -SNRASG -SNSGRA -SGRASN -SGSNRA

-RASNPL -RAPLSN -SNRAPL -SNPLRA -PLRASN -PLSNRA

-PLSNSG -PLSGSN -SNPLSG -SNSGPL -SGPLSN -SGSNPL
```

b) moderate precipitation;

DZ RA SN SG PL UP

DZRA RADZ SNDZ SGDZ PLDZ

DZSN RASN SNRA SGRA PLRA

DZSG RASG SNSG SGSN PLSN

DZPL RAPL SNPL SGPL PLSG

DZRASN DZSNRA RADZSN RASNDZ SNDZRA SNRADZ

DZRASG DZSGRA RADZSG RASGDZ SGDZRA SGRADZ

DZRAPL DZPLRA RADZPL RAPLDZ PLDZRA PLRADZ

RASNSG RASGSN SNRASG SNSGRA SGRASN SGSNRA

RASNPL RAPLSN SNRAPL SNPLRA PLRASN PLSNRA

PLSNSG PLSGSN SNPLSG SNSGPL SGPLSN SGSNPL

c) heavy precipitation;

+DZ +RA +SN +SG +PL +UP

+DZRA +RADZ +SNDZ +SGDZ +PLDZ

+DZSN +RASN +SNRA +SGRA +PLRA

+DZSG +RASG +SNSG +SGSN +PLSN

+DZPL +RAPL +SNPL +SGPL +PLSG

+DZRASN +DZSNRA +RADZSN +RASNDZ +SNDZRA +SNRADZ

+DZRASG +DZSGRA +RADZSG +RASGDZ +SGDZRA +SGRADZ

+DZRAPL +DZPLRA +RADZPL +RAPLDZ +PLDZRA +PLRADZ

+RASNSG +RASGSN +SNRASG +SNSGRA +SGRASN +SGSNRA

+RASNPL +RAPLSN +SNRAPL +SNPLRA +PLRASN +PLSNRA

+PLSNSG +PLSGSN +SNPLSG +SNSGPL +SGPLSN +SGSNPL

d) light showery precipitation;

-SHRA -SHSN -SHGR -SHGS -SHUP

-SHRASN -SHSNRA -SHGRRA -SHGSRA

-SHRAGR -SHSNGR -SHGRSN -SHGSSN

-SHRAGS -SHSNGS

-SHRASNGR -SHRAGRSN -SHSNRAGR -SHSNGRRA -SHGRRASN -SHGRSNRA

-SHRASNGS -SHRAGSSN -SHSNRAGS -SHSNGSRA -SHGSRASN -SHGSSNRA

e) moderate showery precipitation;

SHRA SHSN SHGR SHGS SHUP

SHRASN SHSNRA SHGRRA SHGSRA

SHRAGR SHSNGR SHGRSN SHGSSN

SHRAGS SHSNGS

SHRASNGR SHRAGRSN SHSNRAGR SHSNGRRA SHGRRASN SHGRSNRA

SHRASNGS SHRAGSSN SHSNRAGS SHSNGSRA SHGSRASN SHGSSNRA

f) heavy showery precipitation;

+SHRA +SHSN +SHGR +SHGS +SHUP

+SHRASN +SHSNRA +SHGRRA +SHGSRA

+SHRAGR +SHSNGR +SHGRSN +SHGSSN

+SHRAGS +SHSNGS

+SHRASNGR +SHRAGRSN +SHSNRAGR +SHSNGRRA +SHGRRASN +SHGRSNRA

+SHRASNGS +SHRAGSSN +SHSNRAGS +SHSNGSRA +SHGSRASN +SHGSSNRA

g) light thunderstorm precipitation;

-TSRA -TSSN -TSGR -TSGS -TSUP

-TSRASN -TSSNRA -TSGRRA -TSGSRA

-TSRAGR -TSSNGR -TSGRSN -TSGSSN

-TSRAGS -TSSNGS

-TSRASNGR -TSRAGRSN -TSSNRAGR -TSSNGRRA -TSGRRASN -TSGRSNRA

-TSRASNGS -TSRAGSSN -TSSNRAGS -TSSNGSRA -TSGSRASN -TSGSSNRA

h) moderate thunderstorm precipitation;

TSRA TSSN TSGR TSGS TSUP

TSRASN TSSNRA TSGRRA TSGSRA

TSRAGR TSSNGR TSGRSN TSGSSN

TSRAGS TSSNGS

TSRASNGR TSRAGRSN TSSNRAGR TSSNGRRA TSGRRASN TSGRSNRA

TSRASNGS TSRAGSSN TSSNRAGS TSSNGSRA TSGSRASN TSGSSNRA

i) heavy thunderstorm precipitation;

+TSRA +TSSN +TSGR +TSGS +TSUP

+TSRASN +TSSNRA +TSGRRA +TSGSRA

+TSRAGR +TSSNGR +TSGRSN +TSGSSN

+TSRAGS +TSSNGS

+TSRASNGR +TSRAGRSN +TSSNRAGR +TSSNGRRA +TSGRRASN +TSGRSNRA

+TSRASNGS +TSRAGSSN +TSSNRAGS +TSSNGSRA +TSGSRASN +TSGSSNRA

j) light freezing precipitation;

-FZDZ -FZRA -FZUP

-FZDZRA -FZRADZ

k) moderate freezing precipitation;

FZDZ FZRA FZUP

FZDZRA FZRADZ

l) heavy freezing precipitation;

+FZDZ +FZRA +FZUP

+FZDZRA +FZRADZ

m) other combinations (without precipitation types); and

DS +DS VCDS

SS +SS VCSS

FG FC PO VA

VCFG VCFC VCPO VCVA

TS VCTS VCSH

VCBLSA VCBLDU VCBLSN

BLSA BLDU BLSN

DRSA DRDU DRSN

SA DU

MIFG PRFG BCFG FZFG

BR HZ FU SQ IC

n) missing w’w’ group.

//

Recent weather

4.2.8 Annex 3 includes a number of provisions with respect to how recent weather shall be reported in terms of type and characteristics and how they need to be qualified with respect to intensity or proximity to the aerodrome as appropriate.

4.2.9 From a validation perspective it is necessary to list the various combinations of types, characteristics, intensity and proximity that exclusively can be encoded in a METAR/SPECI exchanged in an IWXXM complaint GML format.

4.2.10 The following defined recent weather phenomena combinations are permissible to be used in METAR/SPECI exchanged in an IWXXM compliant GML format:

REBLSN

REDS

REDZ

REFC

REFZDZ

REFZRA

REFZUP

REPL

RERA

RESG

RESHRA

RESHSN

RESHGS

RESHGR

RESHUP

RESN

RESS

RETS

RETSGS

RETSGR

RETSRA

RETSSN

RETSUP

REUP

REVA

Other aeronautical meteorological information exchange

4.2.11 The scope of IWXXM is limited to representing the exchange of METAR and SPECI (including TREND), TAF and SIGMET in a GML compliant format. With future versions of the IWXXM, the introduction of other physical exchange formats will be considered and related specifications will be covered in this paragraph.

———————————

Chapter 5

METADATA FOR AERONAUTICAL METEOROLOGICAL INFORMATION EXCHANGE

IWXXM version 1 has no specific requirements on metadata. Future iterations (versions) of IWXXM are, however, expected to have specific requirements on metadata which will be included here as appropriate.

Appendix A

UML

1. UML is a widely used modelling methodology, developed primarily for "object oriented" software engineering. In the context of this manual, only UML "class diagrams" are considered with the following elements:

UML class. The abstraction of a concept in the application domain. A class is shown in a class diagram as a rectangle giving its name (e.g. aircraft).

Properties. Properties represent structural features of a class. Properties are a single concept but they appear in two quite distinct notations: attributes and associations. Although they look quite different on a diagram, they are really the same thing.

Note.— Attributes are represented as a line of text in the second compartment of the class symbol.

2. Figure A-1 shows an example of a UML class (of data type) representing the trend forecast of wind at an aerodrome with the following attributes:

a) meanWindDirection (data of angle type);

b) meanWindSpeed (attribute of velocity type); and

c) windGustSpeed (attribute of velocity type).

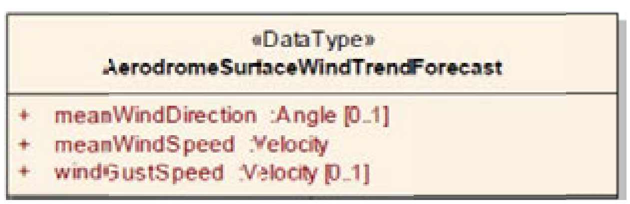

Figure A-1. Example of UML class

3. From a modelling perspective, you can conclude from the example provided in Figure A-1 that the forecast of wind will be provided with the mean direction, and speed of wind, and the speed of gusts. For information, each attribute may define its type (in this case, angle or velocity, but could also be, for example, CharacterString, Real or DateTime).

4. Associations express the relationship between classes. UML represents an association between two classes by drawing a line between their symbols. The role on the association end describes how the related class is used. Figure A-2 provides an example of an association and can be explained as follows:

a) the “runway” has the property of being associated with an AirportHeliport. This is the role of “aerodrome” in the association; and

b) such a diagram could also explicitly indicate that an aerodrome has (at least) one runway.

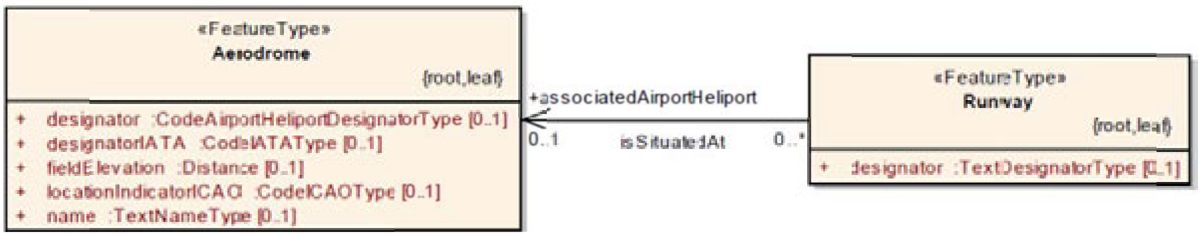

Figure A-2. Example of UML association

5. It is sometimes necessary to have unidirectional navigability. This is indicated by adding an arrow at the destination end of the association. This means that the association is easily navigated in the direction indicated by the arrow. This does not mean that the associations cannot be navigated in the other direction but the directionality is a hint that implementations should make the navigation in the primary direction convenient and efficient. One class knows about the existence of the other in the direction of navigation but the reverse is not necessarily true.

6. The multiplicity of a property is an indication of how many values are allowed for that property. Multiplicity of [0..1] means that the attribute is optional (i.e. it can appear once or not at all); for example, a runway is associated to maximum one aerodrome.

____

Appendix B

XML/GML

1. The geography markup language (GML) is an XML encoding in compliance with ISO 19118 for the transport and storage of geographic information modelled according to the conceptual modelling framework used in the ISO 19100-–series and including both the spatial and non-–spatial properties of geographic features. This specification defines the XML Schema syntax, mechanisms, and conventions that:

a) provide an open, vendor-neutral framework for the definition of geospatial application schemas and objects;

b) allow profiles that support proper subsets of GML framework descriptive capabilities;

c) support the description of geospatial application schemas for specialized domains and information communities;

d) enable the creation and maintenance of linked geographic application schemas and datasets;

e) support the storage and transport of application schemas and data sets; and

f) increase the ability of organizations to share geographic application schemas and the information they describe.

2. GML serves in daily life as a modelling language for systems as well as an open interchange format for geographic transactions on the Internet. The concept of feature in GML is a very general one and includes not only conventional "vector" or discrete objects, but also coverage. The ability to integrate all forms of geographic information is key to the utility of GML.

3. GML contains a rich set of primitives which are used to build application specific schemas or application languages. These primitives include:

a) feature;

b) geometry;

c) coordinate reference system;

d) topology;

e) time;

f) dynamic feature;

g) coverage (including geographic images);

h) unit of measure;

i) directions; and

j) observations.

4. Application schemas such as IWXXM (and SAF) are XML vocabularies defined using GML and which reside in an application-defined target namespace. In the case of IWXXM, the application schema resides in the icao.int/iwxxm namespace. Application schemas themselves can be built on the full GML schema set or use specific GML profiles.

5. GML profiles are logical restrictions to GML, and may be expressed by a document, an XML schema or both. These profiles are intended to simplify adoption of GML, to facilitate rapid adoption of the standard. Different then for application schema, GML profiles are part of the GML namespaces (open GIS GML).

Appendix C

FREQUENTLY ASKED QUESTIONS

1. What's the smallest unit during exchange, a bulletin or a report?

The IWXXM includes the required components to exchange individual METAR and SPECI (including TREND), TAF and SIGMET in a GML compliant format. The grouping of individual reports in the form of bulletins and associated schema for bulletin is not supported.

2. Should compression techniques be considered when exchanging XML/GML coded METAR and SPECI (including TREND), TAF and SIGMET?

While XML/GML coded METAR and SPECI (including TREND), TAF and SIGMET bring significant improvements to global interoperability, the individual file size of a report increases compared to the traditional alphanumerical code. Depending on the operational context, the performance of the supporting infrastructure and the number of reports to exchange, compression techniques could be considered. It should be noted that compression and decompression of reports requires infrastructural resources which could negatively impact the overall performance of the exchange.

3. What are recommended compression techniques?

The preference for a specific compression technique is strongly dependent on the operational environment it needs to operate in. Mainly three categories of compression could be considered. These are: general purpose compression, XML-wrapped binary code and binary XML encoding. Clearly recognizing the different operational requirements that could exist and determine a specific choice, a binary XML encoding has some observed benefits. A binary XML encoding remains compatible with other specifications such as style sheets, X-path, etc., and is efficient with respect to the compactness of the encoded report and with respect to the required processing.

4. In which system should the XML/GML conversion be done preferably?

The basic principles applied in a SWIM context prefer that the origination of XML/GML encoded METAR and SPECI (including TREND), TAF and SIGMET would be done at source. Typically for observations, fully- or semi-automated observation systems could expose the METAR and SPECI in the required XML/GML format. For TAF and SIGMET, the systems that assist the forecaster could do this as well. The benefit of originating the XML/GML encoded information at source lies in the prevention of having the same data exchanged and stored at multiple locations in different formats with the potential risk of introducing alteration and jeopardizing common situational awareness.

5. Are there alternative means to implement a conversion function for XML/GML encoded METAR and SPECI (including TREND), TAF and SIGMET at source?

A number of local or regional considerations could exist to not consider the origination of XML/GML encoded METAR and SPECI (including TREND), TAF and SIGMET at source at a first instance of implementing the Annex 3 provisions on the exchange of these types of reports. It could suffice to convert and exchange the information relevant for international air navigation at national or regional centres such as regional OPMET centres.

— END —