INTERNATIONAL CIVIL AVIATION ORGANISATION

AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP (APIRG)
AFI OPMET MANAGEMENT TASK FORCE FOURTH MEETING (AFI OPMET MTF/4)

(Pretoria, South Africa, 10-11 September 2012)

Agenda Item 5: Future Developments with regards to OPMET information

AVIATION SYSTEM BLOCK UPGRADES (ASBU) RELATED OPMET INFORMATION AND PLANS FOR THE INTRODUCTION OF XML/GML

(Presented by the Secretariat)

SUMMARY

This paper presents a brief on the Aviation System Block Upgrades (ASBU) related OPMET information and plans for the introduction the transition to table-driven data representation (XML/GML) for METAR/SPECI, TAF and SIGMET.

1. INTRODUCTION

1.1 The meeting may recall that the Global Air Traffic Management (ATM) Operational Concept contained in ICAO Doc. 9854, describes the ATM system including scope of the concept, guiding principles, expected benefits, system performance, different expectations and coordination, the manner in which the ATM system will deliver services and benefits to airspace users by 2025. The Aviation System Block Upgrades (ASBU) is a methodology to implement the ATM system based on operational concepts extracted from the NEXTGEN (USA), SESAR (Europe) and CARATS (Japan).

1.2 This paper presents a brief on the Aviation System Block Upgrades (ASBU) related OPMET information. Information concerning plans for the introduction of XML/GML for METAR/SPECI, TAF and SIGMET as part of draft Amendment 76 to Annex 3 will be provided to the Task Force.

2. DISCUSSIONS

2.1 The ASBU is a foundation of blocks originates from existing, near term implementation plans and access to benefits that already exist (NEXTGEN, SESAR and CARATS). It is aligned with ICAO ATM Operational Concept and its intent is to apply key capabilities and performance improvements across other regional and local environments

2.2 Block upgrades will allow a structured approach to meet the needs of individual aviation communities worldwide while considering associated business cases. They reflect recognition that all modules are not required in all airspaces.

2.3 The Aviation System Block Upgrades (ASBU) is a methodology to facilitate interoperability of different technologies, accommodate different procedures, cover all elements of AN systems (ATM, CNS, AGA, AIM and MET) and provide harmonization thus leading to seamlessness across regions. This is achieved through progressive, cost effective and cooperative implementation of air navigation systems worldwide.

2.4 The meteorological support to tomorrow's ATM will be based on:

- Service delivery and benefits for airspace users by 2025;

- Network-based (net-centric) environment that is globally interoperable;
- Fusing MET information with aeronautical information and flight information.

2.5 The result of such support will be a transition of Meteorological (MET) *products* into MET *information* supporting collaborative, knowledge-based, decision making through free-flowing information exchange trajectory/performance based operations.

2.6 The Ninth Meeting of the Aerodrome Meteorological Observation and Forecast Study Group (AMOFSG/9) provided in its working paper, SN No. 8, the following information:

Table-Driven Data Representation and Information Management for ATM

2.6.1 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 and making optimum use of all system resources. It is clearly evident that the future ATM system will be a network-based operation formed by four main components. These will dramatically increase the efficiency of it:

a) a robustly networked ATM System will improve information sharing;

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

c) shared situational awareness will enable collaboration and self-synchronization; and

d) deliver enhanced sustainability and speed of decision making.

2.6.2 The availability of timely, high quality information will provide a foundation for effective management of the air traffic system. Nevertheless, the system will continue to be subject to the effects of uncertainty, especially from adverse weather.

2.6.3 The transition towards table-driven data representation for MET is an extremely important component towards the implementation of net-centric oriented ATM. However, due consideration should be given to the fact that data representation is only one aspect of the required move towards net-centricity. The use of meteorological (MET) information in a net-centric ATM environment and satisfying the foreseen performance requirements for MET will have an impact on the information that needs to be made available and exchanged between information providers and users.

2.6.4 These multi domain interoperable solutions will form the data-centric ATM environment and constitute the core building blocks of System Wide Information Management (SWIM). SWIM will increase the required agility of the ATM system by the ability to quickly develop applications and other support tools to meet evolving ATM business needs without having to revisit proprietary data provision standards.

2.6.5 The quality of service (QoS) is another important consideration in the context of information to support net-centric operations and the overall change and reorientation towards data/information services. From an information management perspective, the quality of the information that is exchanged, the so-called payload is not of direct concern. The concern lies in the intrinsic capability of making available information on the QoS aspect of the payload. An approved mechanism to convey QoS information is through the provision of metadata (data about data) attached to the payload.

2.6.6 Current Annex 3 provisions provide no explicit reference to metadata for MET information. However, in the evolution towards a data-oriented environment metadata is considered to be an essential component to be included in the transition, and in consequence reflected in the roadmap. From this perspective the logical approach would be to adopt technical specifications from organizations such as ISO and OGC to assure the earlier discussed multi data domain –interoperable- solution set. These technical specifications will provide the baseline for specific metadata profiles that could be used for aeronautical MET information.

Logical data model versus physical data models

2.6.7 International consensus exists on an overall migration of the numerous code forms and code descriptions for operational meteorological (OPMET) data towards the notion of one weather information exchange model (WXXM). The WXXM provides the semantics and abstract structure of all the information that needs to be made available by MET service providers as prescribed by Annex 3. It includes the intrinsic data requirements and structural business process rules. It provides a so-called technology independent description (a static description, in the Unified Modeling Language (UML), of the structure of the 'Meteorological Information Exchange system' by showing the system's classes, their attributes, operations (or) methods and the relationships between the classes) not concerned with code form specifications such as GRIB, binary universal form for the representation of meteorological data (BUFR), and Traditional Alphanumeric Codes (TAC) for aerodrome routine meteorological report (in meteorological code form) (METAR), aerodrome forecast (in meteorological code form) (TAF), etc.

2.6.8 From a system's architectural perspective, this WXXM suffices as the guiding logical data model for all physical implementation of systems that exchange MET information in the ATM domain. However, for the purpose of the international exchange of OPMET data it is considered to be beneficial to provide an additional level of structure and as a consequence to describe a model for the physical implementation of OPMET exchange.

2.6.9 As a comparison between such a physical implementation and existing Annex 3 provisions, the GRIB and BUFR code forms could be considered physical implementations of a format to exchange information. What is not in the current provisions is the overarching structure and interrelations between the information conveyed by the two data formats and how it correlates with the overall ATM business. However, and especially true for the BUFR code form, these forms are considered to be relatively specific to MET, not widely adopted by ATM or other industries and are therefore expensive to integrate, use and maintain from a user application' perspective.

2.6.10 Consequently, there is already an established general agreement on the migration of the BUFR code form used on a bilateral basis for METAR/SPECI and TAF to be replaced by a format that is widely accepted and based on the earlier mentioned generic standards. A code form based on Extensible Markup Language (XML) was identified. Moreover, the same consensus extends to the need to migrate towards a specific XML grammar to express geographical features which meteorological information in essence is. This specific XML grammar to describe MET information in function of time, place, coverage, etc. is : Geography Markup Language (GML).

2.6.11 SESAR and NextGen, two of the regional ATM developments programmes have developed a GML based format for OPMET data called the weather information exchange schema (WXXS). This specific GML based format enables the exchange of information formally captured in Traditional Alphanumeric Code. (TAC) but also has the intrinsic capability to provide so called GML-wrappers for other code forms including GRIB.

2.6.12 However, as the logical data model is close to the performance-based information requirements and in a fully data-centric environment the only representation for information (exchange) needs and the interrelationships, the ownership should be with ICAO.

2.6.13 An XML schema for the exchange of OPMET is a development that is very much content oriented and close to the development of code forms in an OPMET context. Therefore, ownership of the OPMET XML schema should be with WMO.

Evolution of non-Traditional (non-TAC) code formats

2.6.14 A complete transition toward data-centricity will require a review of other existing code forms used for the exchange of OPMET.

2.6.15 The currently used code forms for OPMET, besides TAC, are GRIB and BUFR. In addition, the GRIB and BUFR code forms are proving to be difficult to utilize in a trajectory based ATM environment. There are intrinsic issues with respect to a required core capability of the trajectory planning and execution function using these code forms.

2.6.16 It is recognized that the focus of the transition – and the remit of the Aerodrome Meteorological Observation and Forecast Study Group (AMOFSG) – towards a data-centric environment should be in the first instance through the evolution of TAC. However, in the evolution towards a data-oriented environment the existing (other) code forms should be considered and be included in the roadmap. This does not necessarily mean that every code format should be replaced by an XML based code format. Especially gridded data can be exchanged in other more efficient manners. However, XML could still be used as the so-called 'wrapper' of the information. Essential to it all is the fact that the information constructs, also for the gridded data, are captured at the technology and format independent layer of the WXXM.

Evolution of products structured according to ICAO templates and non-structured info

2.6.17 Similar to the discussion on non-TAC code formats, the different products currently supported by a template in Annex 3 only should be incorporated in the full evolution towards data-centricity. Therefore, within the evolution towards a data-oriented environment, the ICAO templates should be considered appropriately and included in the roadmap.

2.6.18 In addition, a number of MET information exchange provisions of Annex 3 are not expressed as a distinct product or service in line with a code format or template description. Requirements on the display of wind, cloud and runway visual range (RVR) information at a controller working position have implicit information exchange requirements. As a minimum, this information exchange needs to be reflected at the level of the WXXM. As such, the currently existing implicit information exchange requirements should be considered appropriately and included in the roadmap.

New information requirements

2.6.19 Fortunately, the proposed structure of the single WXXM and associated exchange schema(s) is extremely flexible. This will enable the agility of the ATM system discussed earlier in this paper. It will confer the ability to quickly satisfy information needs and to develop the appropriate applications and other support tools to meet evolving ATM business needs. This without having to revisit proprietary data provision standards as is currently seen as a limiting factor.

Transition Approach

2.6.20 This roadmap is designed to enable the exchange of all aeronautical meteorological information in a flexible, easy expandable, open and transparent manner. Nevertheless it remains clearly focused on the transition of currently defined user products as prescribed by Annex 3.

2.6.21 Activities related to the implementation -by States- of provisions developed in the context of identified roadmap (steps) are not included in this SN. An implementation roadmap or general guidance to support implementation could be considered by the Secretariat in conjunction with the publication of an amendment of Annex 3. Potential issues to consider in this context are:

- XML coding at source (e.g weather observation system at an airport) versus XML coding exclusively by collecting centres that will distribute information international;
- Transition of OPMET Databanks towards new formats including XML;
- Implication for information providers to fulfil metadata requirements.

2.6.22 A proposed logical structured flow of actions to be considered in the transition, thus roadmap, are the development of:

- XML/GML format for TAC OPMET;
- Metadata requirements;
- Weather Information Exchange Model;
- Information Management for ATM / SWIM.

2.6.23 The associated milestone dates for these components are linked to the currently known revision cycle of ICAO Annex 3 to provide the timing dimension of the required transition. However, this does not suggest that the listed components all need to be included in the Annex itself. Some of the identified steps are clearly related to guidance material, specifications or otherwise and not a Standard or Recommended Practice per se. **Error! Reference source not found.** outlines the revision cycle / time schedule involved.

Edition	***Applicability date***	***Publication date***	***Start State consultation***
18th / amd.76	November 2013	July 2013	January 2012
19th / amd 77	November 2016	July 2016	January 2015
20th / amd 78	November 2019	July 2019	January 2018

Table 1 Amendment cycle time schedule

Roadmap: Annex 3 | 18TH Edition | Amendment 76

2.6.24 The following evolutionary improvement steps need to be incorporated:

- **XML/GML format for TAC OPMET;** States in a position to do so should exchange METAR, SPECI and TAF in a digital form under bilateral agreement;
- **Metadata requirements;** States in a position to exchange METAR, SPECI or TAF in a digital form under bilateral agreement should include metadata;
- **Weather Information Exchange Model;** States in a position to exchange METAR, SPECI or TAF in a digital form under bilateral agreement should structure this information in accordance with defined features, attributes and associations[1].
- **Information Management for ATM / SWIM;** N/A.

2.6.25 A series of activities can be summarized to support the aforementioned improvement steps. These need to be completed ***before January 2013***:

- Develop and publish a first iteration of the weather information exchange model (WXXM) which will specify the semantics and abstract structure (features, attributes and associations) for aeronautical MET information. There should be a clear focus on METAR, SPECI and TAF exchange in a digital form.
- Develop and publish a first iteration specification for METAR, SPECI and TAF exchange in digital form which shall:
  - ✓ use XML;
  - ✓ comply with the GML specification for the encoding of geographical information;
  - ✓ be expressed in the form of an XML schema;
  - ✓ be structured in accordance with defined features, attributes and associations (WXXM).
- Develop and publish a first iteration metadata profile for METAR, SPECI and TAF exchange in compliance with ISO 19115 and ISO 19139.
- Propose and obtain the approval of States for the modification of the appropriate provisions in Annex 3.

Roadmap: Annex 3 | 19th edition | Amendment 77

2.6.26 The following evolutionary improvement steps need to be incorporated:

- **XML/GML format for TAC OPMET;** METAR, SPECI and TAF should be exchanged in a digital form.
- **Metadata requirements;** METAR, SPECI and TAF in a digital form should include metadata.

- **Weather Information Exchange Model;** When METAR, SPECI and TAF are exchanged in a digital form, the information should be structured in accordance with defined features, attributes and associations. States in a position to do so, under bilateral agreement, should structure all meteorological information in accordance with defined features, attributes and associations.
- **Information Management for ATM / SWIM;** States in a position to do so, under bilateral agreement, should adhere to general principles with respect to information management and consequent communication services and digital data provision.

2.6.27 A series of activities to support the aforementioned improvement steps which need to be completed ***before January 2016*** are summarized as follows:

- Publish a Major Release of the WXXM which will specify the semantics and abstract structure (features, attributes and associations) for aeronautical MET information.
- Publish a Major Release specification for METAR, SPECI and TAF exchange in digital form which shall:
  - ✓ use XML;
  - ✓ comply with the GML specification for the encoding of geographical information;
  - ✓ be expressed in the form of an XML schema;
  - ✓ be structured in accordance with defined features, attributes and associations (WXXM).
- Develop and publish a first iteration specification for MET information exchange (exclusive of the METAR, SPECI and TAF schema) in digital form which shall:
  - ✓ use XML;
  - ✓ comply with the GML specification for the encoding of geographical information;
  - ✓ be expressed in the form of an XML schema;
  - ✓ be structured in accordance with defined features, attributes and associations (WXXM);
  - ✓ allow for the exchange of gridded information and associated exchange formats.
- Publish a Major Release metadata profile for METAR, SPECI and TAF exchange in compliance with ISO 19115 and ISO 19139.
- Develop and publish a first iteration metadata profile for aeronautical MET information exchange (exclusive of the METAR, SPECI and TAF) in compliance with ISO 19115.
- Develop or modify existing guidance on the application of generic information management principles for MET.
- Modify and obtain States approval of the appropriate provisions in Annex 3.

Roadmap: Annex 3 | 20th edition | Amendment 78

2.6.28 The following evolutionary improvement steps need to be incorporated:

- **XML/GML format for TAC OPMET;** METAR, SPECI and TAF shall be exchanged in a digital form.
- **Metadata requirements;** METAR, SPECI and TAF in a digital form shall include metadata.
- **Weather Information Exchange Model;** When METAR, SPECI and TAF are exchanged in a digital form, the information shall be structured in accordance with defined features, attributes and associations. All other MET information should be structured in accordance with defined features, attributes and associations.
- **Information Management for ATM / SWIM;** To be further developed for AMOFSG/10.

2.6.29 A series of activities to support the aforementioned improvement steps which need to be completed ***before January 2019*** are summarised as follows:

- Publish a Major Release of the Weather Information Exchange Model (WXXM) to specify the semantics and abstract structure (features, attributes and associations) for aeronautical meteorological information.
- Publish a Major Release specification for MET information exchange in digital form which shall:
  - ✓ use XML;
  - ✓ comply with the GML specification for the encoding of geographical information;
  - ✓ be expressed in the form of an XML schema;
  - ✓ be structured in accordance with defined features, attributes and associations (WXXM);
  - ✓ allow for the exchange of gridded information and associated exchange formats.

- Publish a Major Release metadata profile for MET information exchange in compliance with ISO 19115 and ISO 19139.
- Modify and obtain States approval on the appropriate provisions in Annex 3.

2.7 The Task Force may wish to request the Secretariat to follow up the regional implication of the roadmap on the transition towards Table-driven data representation for OPMET and report back after the publication of the 17th Edition of ICAO Annex 3. In this regard, the Task Force may wish to formulate the following decision:

Decision 4/xx: Transition towards Table-Driven Data Representation for OPMET

That the Secretariat liaises with the concerned ICAO study groups to follow up the regional implication of the roadmap on the transition towards Table-driven data representation for OPMET, and report on time for the MTF/6 meeting.

Considering the important role the databank provider States will continue to play with the introduction of meteorological information in digital format, the meeting may wish to encourage AFI databank provider States to start developing the necessary capability of handling OPMET bulletins in digital format as the exchange of the same on bilateral basis is expected after the applicability of Amendment 76 to Annex 3 in November 2013. The meeting is informed that necessary assistance and guidance will be provided to the provider States. In this regard the meeting may wish to formulate the following recommendation.

Recommendation 4/xxx

That both Pretoria and Dakar RODBs are encouraged to:

a) **start developing capability of handling OPMET data in digital format as soon after November 2013 as possible;**

b) test the codes based on the table-driven data representation (XML/GML) schema for METAR/SPECI, TAF and SIGMET with a view to fine tuning over the first year; and

c) take a leading role over the transition aspect of XML/GML and assist other AFI States in implementing table-driven data representation wherever possible.

3. ACTION BY THE TASK FORCE

3.1 The meeting is invited to:

1) note the content of the paper; and

2) decide on the draft decision and recommendation proposed for the Task Force's consideration.