INTERNATIONAL CIVIL AVIATION ORGANIZATION

WORLD METEOROLOGICAL ORGANIZATION

MET/14-WP/18
CAeM-15/Doc. 18
7/5/14

Meteorology (MET) Divisional Meeting (2014)

Commission for Aeronautical Meteorology Fifteenth Session

Montréal, 7 to 18 July 2014

Agenda Item 3: Integrating meteorological information exchange developments into the future system wide information management environment

3.1: Meteorological information exchange developments in support of future international air navigation requirements

PROVISION OF METEOROLOGICAL SERVICES IN A SWIM-BASED ENVIRONMENT

(Presented by China)

SUMMARY

This paper considers the provision of aeronautical meteorological (MET) information in the future system-wide information management (SWIM) environment and brings out a number of issues that needs to be addressed before finalizing the implementation of SWIM. Action by the meeting is in paragraph 3.

1. INTRODUCTION

1.1 System-wide information management (SWIM), introduced in MET/14-WP/9| CAeM15/Doc. 9 and MET/14-IP/6|CAeM-15/INF. 6, is a key component of the aviation system block upgrade (ASBU) to support the future ATM systems. SWIM intends to create an "interoperable" environment to cope with the full complexity of operational information exchange. Meteorological information and non-meteorological information will be combined by the SWIM-enabled applications, including decision support tools (DSTs), to support users' operations.

1.2 Associated with the introduction of SWIM, the provision of meteorological services will undergo a paradigm shift from a point-to-point product-centric service to a service based on data- and net-centric system-wide data discovery and accessibility. This paper raises some of the issues that need to be addressed in the implementation of SWIM.

2. DISCUSSION

2.1 Today's aeronautical meteorological information includes "products" such as observations and reports, forecasts, warnings and alerts. They are provided by national, regional and global meteorological centres including aerodrome meteorological offices, meteorological watch offices (MWOs), aeronautical meteorological stations, tropical cyclone advisory centres (TCACs), volcanic ash advisory centres (VAACs) and world area forecast centres (WAFS). The area of responsibility of each

institution is very clear. While the coverage of some of these "products" overlap, the kind of data that goes into each "product" and the intended use of each "product" are clearly laid down in Annex 3 — *Meteorological Service for International Air Navigation* and related guidance documents to avoid mis-use.

2.2 In the future SWIM context, meteorological data services will be set up to provide the above information for global, regional or local exchange accordingly. To make them discoverable and accessible through SWIM, relevant metadata[1] indicating the information type (gridded data, weather objects or text messages), quality, availability and granularity in space and time of the information, and in the context of aviation meteorological information levels of uncertainty and varying error margin, etc., will be registered with the SWIM Registry[2]. SWIM-enabled applications would operate either on the side of the aeronautical meteorological service provider — who supplies aeronautical meteorological information exchange services — or on the side of the user of these services.

"Fit for purpose" from authoritative data source

2.3 The accompanying information papers on windshear (MET/14-IP/16|CAeM-15/INF. 16), nowcasting (MET/14-IP/11|CAeM-15/INF. 11) and development of fine-scale numerical prediction model (MET/14-IP/17|CAeM-15/INF. 17) to support aviation operations highlight the importance of high resolution (both spatial and temporal) local weather information and local expertise in the provision of quality meteorological services, in particular, for near-term and immediate applications. It should be borne in mind that many of these services rely on the basic infrastructures of the national meteorological and hydrological services (NMHSes). The performance of global NWP models also depend on the assimilation of the basic observation data exchanged under international cooperation framework of the World Meteorological Organization (WMO). The viability of NMHSes should be ensured so that such basic infrastructures and observation data could be sustained and further developed. Otherwise it would be detrimental to both the meteorological and aviation communities in the long run.

2.4 While from application development perspective, it would be much easier to use the weather data from a single source on a well-defined grid, the accuracy and spatial-temporal resolution of the global models, though advancing very rapidly, are still unlikely to fully meet the performance requirement for MET especially for near-term and immediate applications, and for high density aerodromes and high complexity TMA. Means to feed the local knowledge and expertise as inputs to the forecasts/warning/advisories issued by the regional centres need to be further developed. Requirements and guidance should also be developed such that the data set retrieved by the SWIM-enabled application would be fit for the intended purpose. Consideration should also be given to the downlink of the on-board meteorological data via ADS-B for purposes such as aircraft sequencing, continuous ascent and descent, input to high resolution NWP models and last but not the least for verification.

2.5 According to the *Convention on International Civil Aviation*, each Contracting State shall determine the meteorological services which it will provide to meet the needs of the international air navigation, contributing towards the safety, regularity and efficiency of international air navigation. This fundamental provision should continue. The meteorological authority of each State shall be the one to determine the authoritative data set to be used in the provision of meteorological services for international air navigation by the State.

2.6 While the amalgamation of meteorological information, from different authoritative sources with different temporal and spatial resolution and update frequency, might appear difficult in first

[1] For example on definition and use of discovery metadata, see WMO Core Metadata Profile at https://www.wmo.int/pages/prog/www/metadata/WMO-core-metadata.html.

[2] See WMO Codes Registry at http://codes.wmo.int which has been developed to support the new data exchange standard IWXXM.

set, the SWIM environment will make this much simpler. Once registered and thus made discoverable and accessible through SWIM, rules can be set for the type of data to be extracted. Consolidation of information can then be done with geographic information system (GIS) processing techniques which can merge grid points and objects at user selected projections. Figure 1 at Appendix B shows how a SWIM-enabled application interacts with the SWIM Registry and the collection of meteorological data in the SWIM environment.

2.7 The key concept behind the ATM service delivery management is that information services will be established on an as-required basis and, once established, the information will be provided on an on-request basis. However, for time- and mission-critical information such as windshear, as the users have no idea of when such information would be triggered, it would not be proper for such information to be provided only on an on-request basis. Instead provision to "push" such event-driven information to the users should be available in the SWIM environment.

Information Integration

2.8 Traditionally, there is a clear separation between providers of aeronautical meteorological information and providers of air navigation services. The associated roles and responsibilities are respectively included in Annex 3 and Annex 11 — *Air Traffic Services* and supporting procedures, manuals and guidance. However, in the future ASBU environment, information will be translated according into specific threshold or constraint for air transport which in turn will be translated into an impact on air transport stakeholders. Such information will then be integrated into the DSTs. In such scenario, the separation will be less distinct. The allocation of functions to providers should depend on local implementation considerations including the available and foreseen capability of the providers. As such it should not preclude that either the provider of aeronautical meteorological information services will be responsible for the conversion of translated information to operational impact in an ATM environment or the provider of air navigation services will be responsible for the same, as illustrated in Figure 2 at Appendix B. All three service provision scenarios illustrated in Figure 2 should be possible, subject to local agreement and arrangement.

2.9 Given the varying local constraints, the same phenomenon may bring very different impact to different aerodrome and TMA. The translation of aeronautical meteorological information to impact should thus be specific to each airport and TMA. Nonetheless to support an interoperable environment, and to facilitate proper interpretation of the impact, there may be a need to also register some basic information of the translation such as the method and the information source, etc. through the relevant metadata. Otherwise, it will be difficult to ascertain if a particular piece of aeronautical meteorological information will be fit for the intended purpose of the user and application concerned.

2.10 In the future ASBU environment, there will be increasing integration of translated meteorological information with ATM DSTs. In an unforeseen situation or in case of a data problem, it might be more difficult to locate the problem in the complex system and rectify it. Meanwhile air navigation services might find it difficult to handle the situation manually, especially for high density aerodromes and TMAs, and/or under the influence of high-impact weather.

Governance

2.11 Currently the Standards and Recommended Practices contained in Annex 3 are supplemented by Air Navigation Plan and Regional Supplementary Procedures. The aeronautical meteorological services provided by each State are then audited against the Standards and Recommended Practices of Annex 3. For the current practice, the meteorological services providers have a very clear idea of the meteorological information provided to each individual user and thus the cost involved. In

future, as the users may rely mostly on SWIM-enabled value-added applications that reside on the user side to retrieve the data automatically, it might be more difficult to clearly identify exactly the information that an individual user is using at a particular time, making efforts such as cost apportionment and accident/incident investigation much more difficult, if at all possible, compared with today.

2.12 The observation, forecast and warning products provided to pilots depends on the operator's safety risk assessment system. Currently, with limited number of "products", the confidence and thus risk associated with each "product" is better understood. Moreover the services to aviation users are well governed by Annex 3. With the introduction of SWIM-enable applications, the variety and different combination of "products" is likely to increase. A good understanding of these applications, and the risk associated with their usage, would be required. Consideration should be given for the need of a standardized "baseline" weather information package, similar to the flight document for flight crews today, to be provided by the meteorological services provider for all parties participating in collaborative decision making (CDM) for common situation awareness and harmonization.

2.13 In future, the SWIM-enabled applications would operate either on the side of the provider or the user. Nonetheless for provision of basic weather information such as wind observation for landing aircraft or windshear data, for proper governance that the data retrieved would be fit for the intended purpose and from authoritative source, and for compatibility across the whole range of users, there should be a requirement for these SWIM-enabled application to be governed and thus included in Annex 3 and/or the proposed PANS-MET as appropriate. Indeed the SWIM environment would facilitate the development of new value-added applications to meet the individual needs. It is debatable whether they should come under the scope of Annex 3 and/or the proposed PANS-MET. An appropriate balance should be struck to ensure proper governance and regulation while maintaining flexibility and agility.

2.14 From the above discussion, the meeting may wish to agree that there remain a number of outstanding issues that need to be properly addressed before implementation of the future SWIM environment. The meeting is invited to formulate the following recommendation:

Recommendation 3/x — Further development of the future SWIM operation concept

That the ICAO expert group tasked with developing the provisions to enable the inclusion of aeronautical meteorological information in the future system-side information management (SWIM) environment addresses the issues listed in Appendix A and provides further details on the operation concept for endorsement at appropriate forum.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) consider the adoption of the draft recommendation proposed for the meeting's consideration.

— — — — — — — —

APPENDIX A

LIST OF ISSUES TO BE ADDRESSED IN THE FURTHER DEVELOPMENT OF THE FUTURE SWIM OPERATION CONCEPT

a) Ensuring that the Contracting State shall continue to determine the meteorological services which it will provide to meet the needs of the international air navigation;

b) Ensuring that the Meteorological Authority of each State shall determine the authoritative data set to be used in the provision of meteorological services for international air navigation by the State;

c) The provision of time- and mission-critical weather information to users shall be event driven;

d) The parties to be responsible for conversion of translated information to operational impact in an ATM environment shall be determined by local agreement and arrangement;

e) Ensuring that the data retrieved by the SWIM-enabled application shall be fit for the intended purpose, supported by appropriate metadata, e.g. registration of the impact translation methodology and information source;

f) Ensuring traceability in the SWIM environment of the actual weather information used by operations, for accident/incident investigation;

g) Need for a standardized baseline weather information package to be provided by the meteorological services provider for all parties participating in CDM;

h) Use of ADS-B to downlink real-time on-board meteorological data; and

i) Proper governance of SWIM-enabled applications in Annex 3 and/or proposed PANS-MET.

— — — — — — — —

APPENDIX B

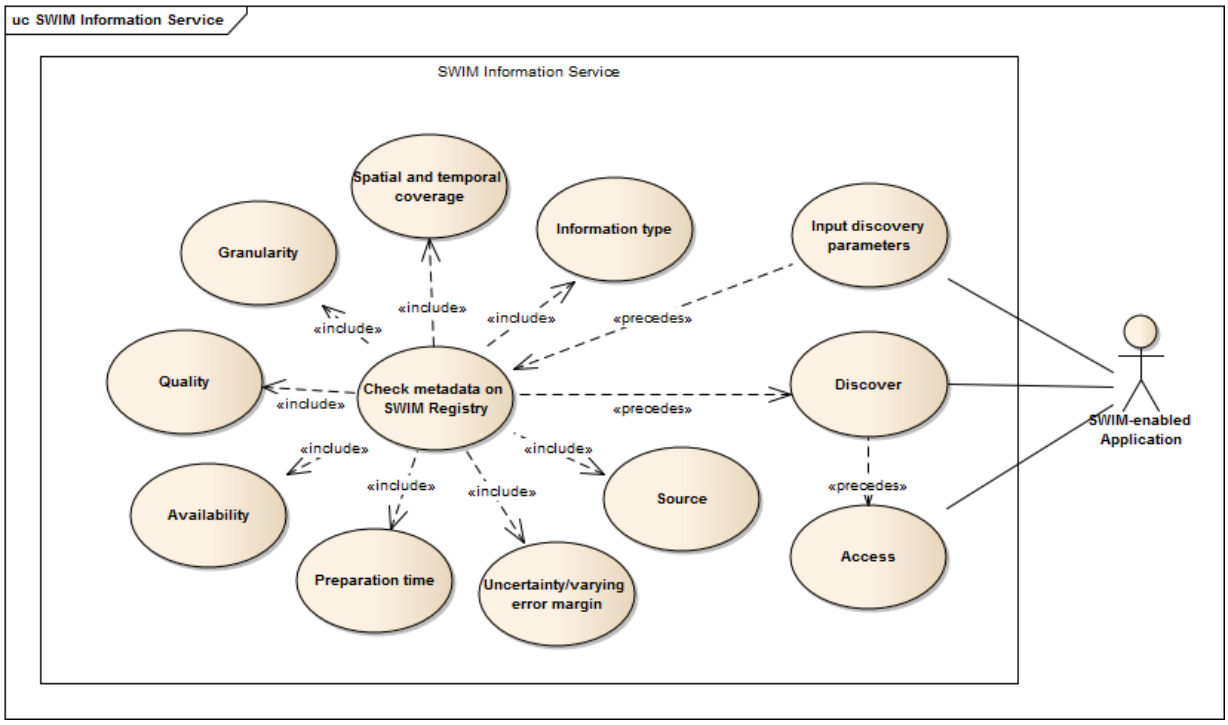

Figure 1. Interaction between SWIM-enabled application and SWIM information service

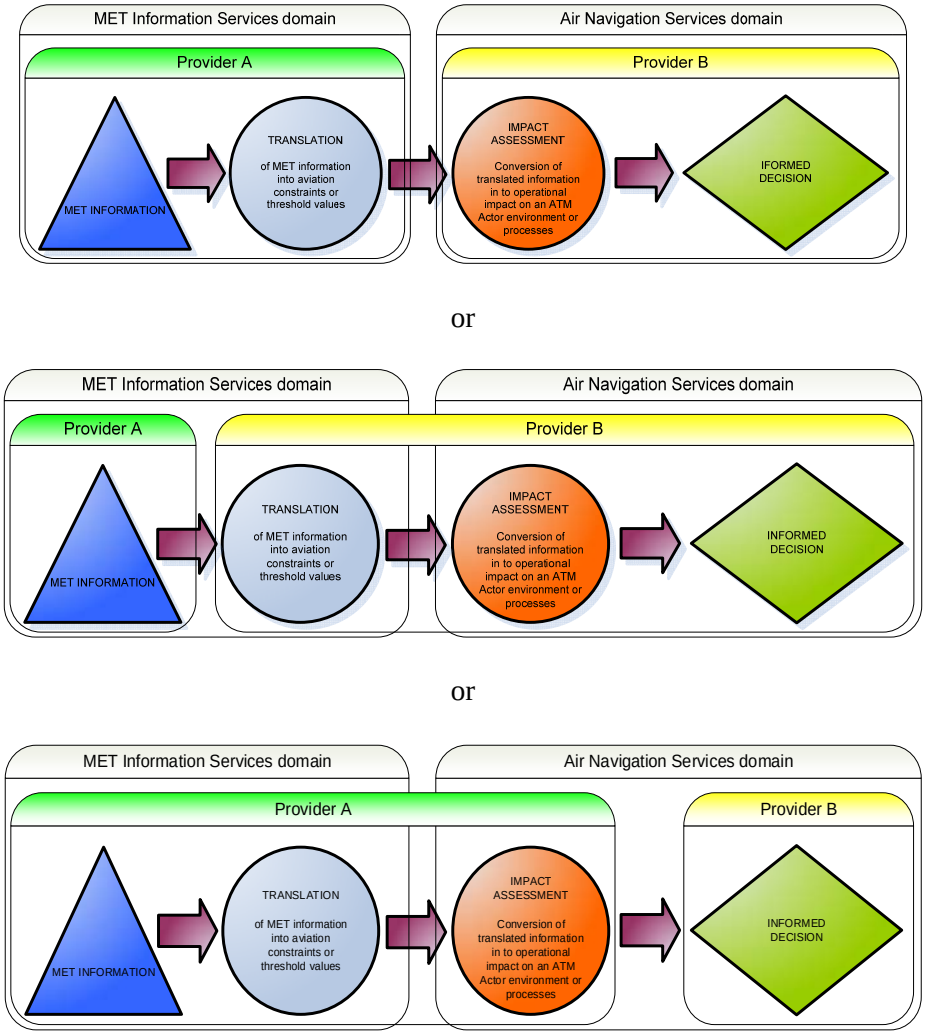

Figure 2. Roles and responsibilities of the three possible implementation options to translate meteorological information to ATM decision.

— END —