International Civil Aviation Organization

FOURTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP OF APANPIRG (CNS/MET SG/14)

Jakarta, Indonesia, 19 – 22 July 2010

Agenda Item 14: **Regional MET support to ATM**

2) exchange of information on MET support for operations at aerodromes, terminal areas and en-route

METEOROLOGICAL SERVICES (MET) IN SUPPORT TO GLOBAL AIR TRAFFIC MANAGEMENT (ATM) AND PERFORMANCE-BASED NAVIGATION (PBN)

(Presented by United States of America)

SUMMARY

This paper presents a summary of the NextGen concept for meteorological services in support to air traffic management for performance-based navigation.

This paper relates to:

Strategic Objectives:
A. Safety – Enhance global civil aviation safety
D. Efficiency – Enhance the efficiency of aviation operations

Global Plan Initiatives:
GPI-18 Aeronautical information
GPI-19 Meteorological Systems

1. Introduction/Background

1.1 Concepts for Global Air Traffic Management (ATM) and Performance-based Navigation (PBN) are well documented in:

- Performance-based Navigation (PBN) concept in ICAO Doc 9613 *"Performance-based Navigation (PBN) Manual"*,
- Global ATM concept in ICAO Doc 9854 "*Global Air Traffic Management Operational Concept*", and the associated requirements in
- ICAO Doc 9882 *"Manual on Air Traffic Management System Requirements*".

1.2 A new concept document *"Flight and Flow Information for a Collaborative Environment"* (FF-ICE), has been introduced by the Air Traffic Management Requirements Performance Panel (ATMRPP) to improve the efficiency of traffic flow with PBN.

1.3 All of the above documents mention or reference "weather" (meteorological services) in general terms, and do not specify of identify the meteorological services required for global ATM and PBN. The information in the discussion below provides an example of how meteorological information will be much more complex and different from today's simple weather text products and graphics.

2. Discussion

2.1 The United States is progressing well with its Next Generation Air Traffic System (NextGen), and published in September 2009 the NextGen Weather Plan http://www.jpdo.gov/library/NextGen_Weather_plan_1.1.pdf and the NextGen ATM Weather Integration Plan http://www.jpdo.gov/library/JPDO%20ATMWeather%20Integration%20Plan%20v10%5B1%5D.pdf

2.1.2 The United States' national air transportation system, like other national systems, is susceptible to weather disruptions causing flight delays, the impacts of which can be widespread. Summer thunderstorms or winter storms impacting one hub airport or key transcontinental route can ground aircraft thousands of miles away, further propagating flight delays and cancellations. Many delays could be avoided with more proactive ways of dealing with weather throughout the national air transportation system. The current ATM system and supporting decision-making tools are primarily reactive to weather events and are ineffective in implementing the NextGen vision. In the current air transportation system, weather information is not integrated into the ATM process. Many weather tools are added to ATM systems after the fact and are not integrated well. This requires interpretation by the controller who must manually integrate this information into traffic decisions based on his or her understanding of the information presented. In NextGen, weather information, including its future uncertainties, will be integrated into Flight Management Systems, as well as air transportation systems and decision-support systems to support safe and more efficient flight and a more proactive reduction of air traffic delays by balancing demand with system capacity. This translates into user cost savings and air transportation system efficiencies.

2.1.3 This new paradigm promotes sharing weather information and data and replaces the use of individual and potentially conflicting weather products with network-enabled common weather information that supports a common situational picture. Enhanced tailored, probabilistic weather information that has been transformed and integrated into air transportation automation and decision-support systems enables users and service providers to more precisely identify specific weather impacts on operations (e.g., trajectory management and impacts on specific airframes, arrival/departure planning) to ensure continued safe and efficient flight.

2.1.4 NextGen will use the concept called the Single Authoritative Source (SAS). The SAS will be a subset of the weather information provided in the 4-Dimensional Weather Data Cube (4-D Cube), and will support the civil ANSP's ATM decisions. The SAS will be comprised of 4-dimensional (4-D) datasets of aviation-specific observations, analyses, and forecasts organized by 3-D spatial and time components (x, y, z, t) that extend from the surface to low earth orbit. To enable a common weather operating picture and enhance collaboration, the SAS provides a single value at each grid point that is the "best representation" of a weather element (e.g., wind speed and direction, runway visual range, and turbulence).

2.1.5 ATM will require Decision Support Tools (DST) that can deal with the information from the 4-D Cube which has been translated into air transportation system impacts and provide ATM with best choice options. DSTs are generally software applications used to automate the weather impact evaluation and air traffic/customer response. For example, a flight trajectory through space and time are input into the DST along the particular weather sensitivities or risk tolerance of the flight under consideration. According to the spatial and temporal attributes of the flight (takeoff time/place, flight level, waypoints, and estimated landing time/place) relevant weather information is accessed from the 4D Cube. The DST then automatically compares the weather parameters to particular sensitivities of the flight under consideration. By applying relevant rules and thresholds (e.g. pilot landing minima, aircraft weather avoidance limits, risk tolerance, Federal Aviation Regulations, etc.) the DST converts weather information into weather impacts. The result of this logical integration is an output decision aid. For instance, the latter segments of a proposed trajectory may enter an area of forecast turbulence. If this forecast turbulence exceeds certain severity or probability limits the DST automatically flags these segments as, for example; Red. More sophisticated DSTs may recommend weather-optimized trajectories through an iterative process of query and response. Thus, the trajectory flagged as Red for turbulence initially may be rendered Green by an earlier takeoff, a higher flight level, or a different route.

2.1.6 DSTs will take a number of forms and functions as NextGen evolves. There are 4 levels of integration each with increasing levels of complexity:

Level 1: Stand alone (little to no weather integration)

Level 2: Over-lapping (high "glance value" weather impact information overlaid with decision support tool outputs)

Level 3: Minor human involvement (user-in-the-loop tools: Weather fully integrated within tool but separate weather information also provided for human understanding)

Level 4: Fully integrated (machine-to-machine: Weather and uncertainty fully integrated into decision tool outputs)

2.1.7 Integration of weather information from the 4D Cube into ATM and the use of sophisticated decision-support tools, will enable trajectory-based operations (TBO) and high-density operations. TBO is a major transformation in NextGen and is the main mechanism for managing air traffic in high-density or high-complexity airspace. A major element in calculating optimum trajectories is knowledge of where key weather phenomena are located, their intensity, their movement, and so on. Integration incorporates weather information into the decision-support tools that formulate the most efficient air traffic routing solutions and continually account for inherently dynamic weather phenomena. The ultimate goal of integration is to translate weather information as purely meteorological data into weather impacts on air traffic operations – essentially making weather transparent to its end users. As more meteorological parameters are fully integrated into DSTs, the need for direct Machine to Machine (M2M) ingestion of weather data will increase. At the same time, the numbers of human-readable graphical displays and text messages may be allowed to decrease as appropriate. By 2025 it is expected that weather information will be automatically translated into probabilistic weather impacts on air traffic and be ingested into decision algorithms (ground and aircraft).

3. Conclusion

3.1 The information provided above clearly shows that the meteorological services for the next decade will be far more complex than the traditional services currently provided. This fact has been identified by the Aerodrome Meteorological Observations and Forecasts Study Group (AMOFSG), where an ad hoc working group has been established to formulate an initial sets of requirements, elements and metrics for MET in support to global ATM for PBN. This ad hoc group is expected to complete its initial proposals by November 2010, according to the groups Terms of Reference, and these preliminary findings may be suitable for presentation at the MET/ATM Seminar in November 2010 in Japan.

3.2 Given the above information the group may wish to consider the following draft conclusion:

Draft Conclusion 14/xx – Requirements for MET support to global ATM for PBN

That, the AMOFSG Secretariat or Corapporteurs for the AMOFSG/8 Ad Hoc group 6, provide an Information Paper to the MET/ATM Seminar in Fukuoka, Japan on their progress in formulating proposals for MET in support to global ATM for PBN

4. Action required by the meeting

4.1 The meeting is invited to:

a) note the information in this paper; and

b) decide on a draft conclusion for the meeting report

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