J6.1 Evolution of FAA's Weather and Radar Processor (WARP) into the Next Generation Air Transportation System (NextGen)

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1. INTRODUCTION

The FAA's WARP program has been providing weather products to the en-route Air Route Traffic Control Center (ARTCC) personnel for over a decade now. During that time the system has evolved to meet the needs of not only the ARTCC but National Airspace System (NAS) users as well.

As the FAA solidifies its plans for NextGen, WARP will continue to evolve, using the NextGen architecture as its roadmap. In this paper, we describe the current WARP system, the current NextGen vision of weather support to the NAS and finally how WARP is evolving to become part of NextGen.

2. What is WARP?

WARP is an operational system that currently provides weather products and tools for the FAA's en-route and oceanic environment. Its four main functions are to (1) provide weather for the controllers' situation displays (see ARAM paper 4.4 for more details); (2) provide operationally significant weather information to air traffic supervisors and traffic flow managers; (3) provide a weather workstation for Center Weather Service Unit (CWSU) meteorologists; and (4) distribute weather products to other NAS customers. This fourth function is currently performed by the WARP Weather Information Network Server (WINS) primarily using File Transfer Protocol (FTP).

WINS currently provides weather data to other FAA systems such as the User Request Evaluation Tool (URET), Advanced Technologies and Oceanic Procedures (ATOP), Dynamic Ocean Track System Plus (DOTS Plus) and Alaska Flight Data Processor 2000 (FDP2K).

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3. What is NextGen?

NextGen is a restructuring of the NAS to vastly increase capacity between now and 2025. The effort involves multiple agencies under the umbrella of the Joint Planning and Development Office (JPDO). It focuses on new technologies such as satellite-based navigation, surveillance and networking. An example is the satellite based Automatic Dependent Surveillance Broadcast (ADS-B) which is described on the FAA WEB site as follows:

"With ADS-B, both pilots and controllers will see radar-like displays with highly accurate traffic data from satellites – displays that update in real time and don't degrade with distance or terrain. The system will also give pilots access to weather services, terrain maps and flight information services."

In order to ensure orderly traffic flow and mitigation of weather hazards, all NextGen users must be operating from a common weather picture. The universe of available aviation weather information is envisioned as a virtual four dimensional (three spatial plus time) database, referred to as the 4D Weather Cube. This vast array will certainly contain conflicting information such as forecasts from different modeling algorithms. To provide seamless and consistent weather for air traffic management decision making, a Single Authoritative Source (4D Wx SAS) will provide a view into the 4D Wx Cube. The JPDO is currently performing a functional analysis to determine the requirements for the 4D Wx SAS. At a high level, it will arbitrate among the various 4D Wx Cube sources, and provide data in formats ready to be incorporated into decision tools through a Network Enabled Operations (NEO) architecture.

The FAA summarizes its vision for NextGen weather as follows: "With NextGen, the impact of weather is

reduced through the use of improved information sharing, new technology to sense and mitigate the impacts of weather, improved weather forecasts, and the integration of weather into automation to improve decision-making. Better forecasts, coupled with new automation, will minimize airspace limitations and traffic restrictions."

Furthermore, the NextGen Concept of Operations lists three weather tenets:

- "A common picture of the weather for all air transportation decision makers and aviation users
- Weather directly integrated into sophisticated decision support capabilities to assist decision makers
- Utilization of Internet-like information dissemination capabilities to realize flexible and cost-efficient access to all necessary weather information."

As part of the third tenet, the FAA will incorporate a System Wide Information Management (SWIM) data sharing system in a move toward NEO concepts. SWIM will provide the core services for a service-oriented architecture (SOA). NEO will incorporate similar capabilities from other agencies, such as the Department of Defense's Global Information Grid (GIG). The 4D Wx SAS will be part of the array of available services in this architecture.

4. What Role Does WARP Play in NextGen?

WARP is already making strides toward the last two NextGen weather tenets. The WARP WINS already provides weather products directly to traffic management algorithms and WARP WINS is migrating toward a SWIM-compatible concept of operations. By the middle of 2009 it will convert from an FTP-based interface to a publish-subscribe interface using commercial off-the-shelf (COTS) software.

For the past 5 years WARP has provided gridded upper-air wind and temperature information from the rapid update cycle (RUC) model that are used by the URET conflict probe. URET uses these data to calculate aircraft trajectories for the next 20 to 40 minutes. The results of these trajectories are then displayed to the controller, highlighting any potential aircraft-to-aircraft or aircraft-to-airspace conflicts. Using this information, the controller can adjust aircraft flight paths as necessary.

The WARP/URET interface is in many ways a first case of weather information flowing directly into an air traffic decision-assistance algorithm without human intervention. In the case of the URET conflict probe, the controller doesn't have to assimilate the weather and aircraft information separately, but can let the URET assimilate them for him/her.

The current WARP WINS relies on FTP to send its data to most of its customers. As part of an ongoing limited technical refresh of the WARP system, WINS will replace FTP with a COTS publish-subscribe architecture based on IBM Websphere MQ. Fig. 1 shows how the WINS system will interface with NAS subscribers.

Data from various sources, including the National Weather Service Telecommunications Gateway (NWSTG), will flow to the WARP systems at all 21 ARTCCs and the Air Traffic Control System Command Center (ATCSCC). Each ARTCC WARP WINS will incorporate a Data Manager and Dissemination Unit (DMDU) that will serve as a data "broker" using the IBM Websphere MQ software.

The WARP WINS makes a wide variety of information available for subscription, both WARP-generated and from original sources. Original data includes NWS alphanumeric and graphic products, satellite imagery, gridded atmospheric models, radar products, and observations from Automated Weather Observing Systems (AWOS). WARP generated information includes regional and national radar mosaics and customized subsets of gridded models, such as ARTCC-based RUC models for URET. WARP also has the capability of producing additional customized products which may be published as the need arises.

5. Conclusion

NextGen is the JPDO's plan for upgrading the nation's air transportation system to vastly increase capacity between now and 2025. WARP, on the other hand, is a fully operational system providing weather products to ARTCC and other NAS systems now.

WARP has already pioneered some of the NextGen weather concepts. Its interface with URET is very much aligned with the second weather tenet of NextGen. In addition, within the next two years WARP will implement a publish/subscribe weather dissemination system. While not a complete SOA solution, the updated WARP WINS provides a platform to demonstrate initial operating capabilities of key NEO concepts. As NextGen evolves, WARP capabilities in some form will continue as services available through SWIM.

6. REFERENCES

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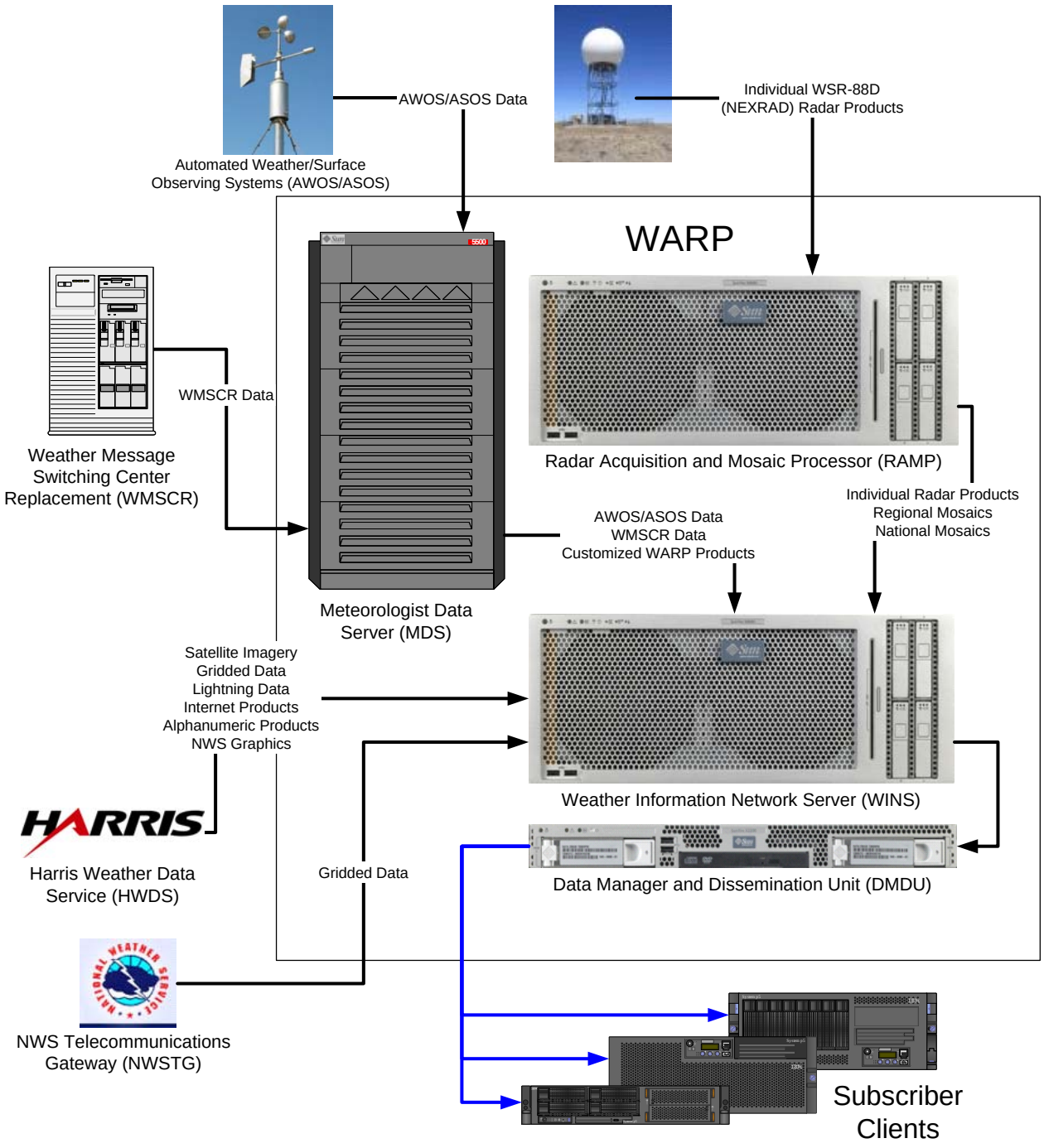

Fig 1. Design for WARP publish/subscribe data dissemination system (after technical refresh), illustrating data flow from various sources aggregated through WINS/DMDU to provide a common interface for a variety of clients.