6A.1 THE EVOLUTION OF AWIPS – PROGRESS AND FUTURE PLANS

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1. Introduction

Advanced Weather Interactive Processing System (AWIPS), the integrating element of the National Weather Service (NWS) modernization, is undergoing an extensive software re-architecture and conversion to a Service Oriented Architecture (SOA). Raytheon Technical Services has converted the AWIPS infrastructure to a Service Oriented Architecture (SOA). Raytheon will migrate the current baseline software and functionality to the new architecture by June 2009. Deployment of the next generation of AWIPS, to be called AWIPS-II, will be complete in FY2010. The NWS has plans to extend the AWIPS II SOA throughout NWS operations and to enhance its functionality.

This paper reports the current progress of the transition to the new architecture and future plans of AWIPS Evolution. This paper will also describe some of the attendant benefits of new architecture and approach.

2. Background

AWIPS is America's weather and flood warning system. NWS must upgrade AWIPS to transform its service delivery to Department of Homeland Security (DHS), Federal Aviation Administration (FAA) , emergency managers, decision makers, the American public and industry. Emergency managers, DHS, and industry are demanding increased lead time and more precision in weather, flood, and hurricane forecasts to improve their decisions for resource planning, evacuation planning, and business operations. These decisions are potentially life saving and have multi-million dollar impacts on the economy and livelihoods. Customers and users of NWS products and services will fully exploit NOAA investments through this transformation.

Originally built in the 1990s, AWIPS is unable to meet the demands for increased accuracy, precision, and timeliness of warnings nor with the demands of 21st Century Science. Although patched numerous times, AWIPS has reached the point where further patches only deliver small incremental improvements. These improvements are increasingly insufficient to meet the service demands of DHS, FAA, emergency managers, and the American public. NWS must undertake this critical investment to ensure overall NWS forecast, warning, and service improvements by providing the capacity to exploit the National Oceanic and Atmospheric Administration's (NOAA) planned investments such as advanced weather satellites (GOES-R, NPOESS), Advanced Numerical Weather Prediction, and NEXRAD Super Resolution and Dual Polarization.

3. Structure of the AWIPS Evolution Project

AWIPS Evolution is executed in three distinct phases. The first and most critical phase of the AWIPS Evolution project is the delivery of AWIPS-II. AWIPS-II consists of the current baseline functionality, through Operational Build (OB) 9, migrated into the new SOA. AWIPS-II will deliver today's functionality within the framework of a much more robust and extendable architecture.

The second phase of the AWIPS Evolution project is the extension of the AWIPS-II architecture to all levels of NWS operations. This consists of three major separate sub-projects:

- National Center AWIPS (NAWIPS) Migration

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- Thin Client
- Community Hydrological Prediction System (CHPS)

As part of this phase, NAWIPS will be migrated into the new service oriented architecture and deployed in 2011 (Schotz et al., 2008). Having both NAWIPS and AWIPS functionality within the same infrastructure will enhance the ability to add new science to both families of applications.

The second phase also includes the delivery of a thin client capability. An integrated thin client capability would enable the NWS to better support the Fire Weather and Incident Support missions, Center Weather Support Units and Weather Service Offices. The integrated thin client capability will be deployed in 2011.

The NAWIPS integration and thin client capabilities would provide the foundation of an operational enterprise by a common infrastructure and suite of applications throughout the NWS.

The Community Hydrologic Prediction System is a new river forecasting capability built on an SOA that will be integrated into the AWIPS II architecture. It, too, will be deployed in 2011.

The third and final phase of AWIPS Evolution builds upon the new enterprise infrastructure by delivering new system wide functionality to enhance all levels of NWS operations. These enhancements include:

- Data delivery ("smart push – smart pull")
- Collaboration ("integrated visual collaboration")
- Information generation ("re-architecture of the infrastructure for generating products and service")
- Visualization (developing new user interface standards and three dimensional visualization)

4. Roadmap

The Roadmap for AWIPS Evolution is shown in Figure 1.

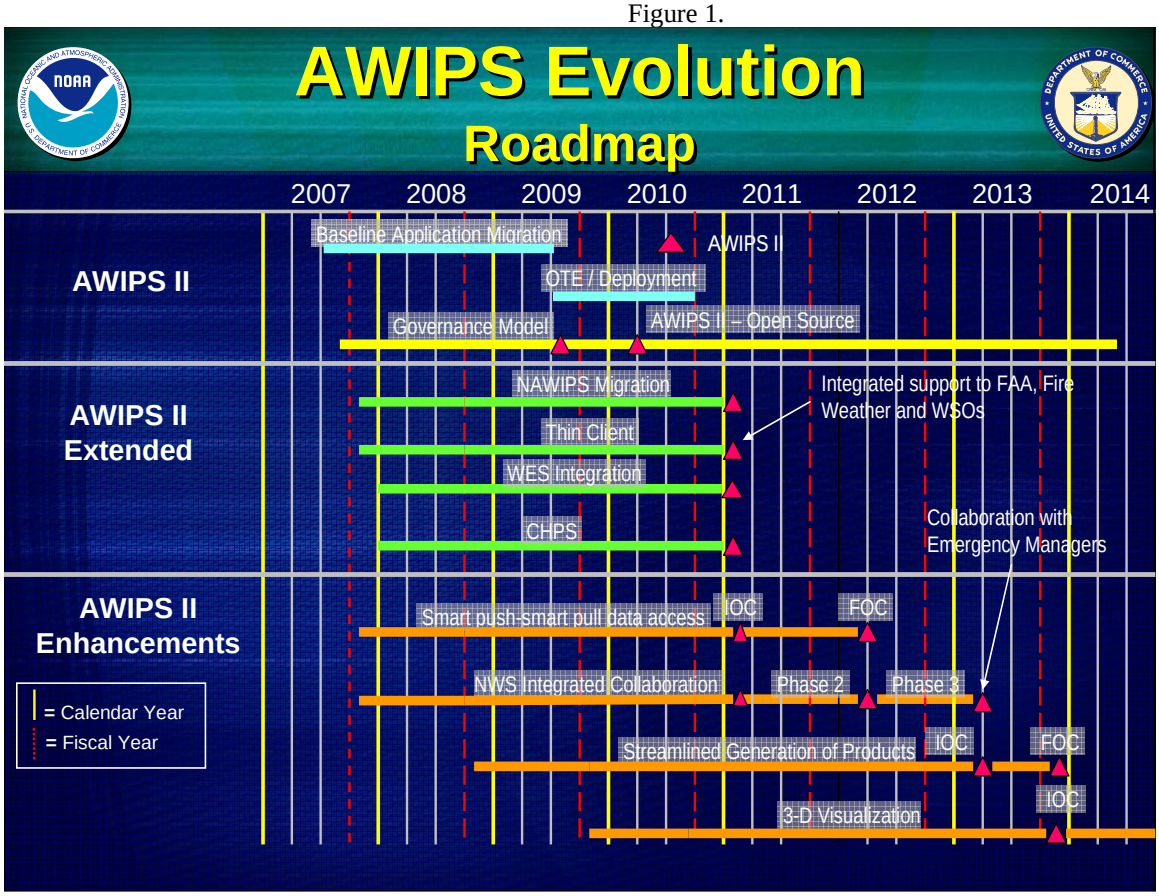

Figure 1 AWIPS Evolution Roadmap

Raytheon will deliver AWIPS-II in June 2009. We anticipate an approximately six month period during which we will conduct an Operational Test and Evaluation before deploying AWIPS-II. (Stricklett, et al, 2008) We expect deployment of AWIPS-II to be complete by October 2010.

Defining a new Governance Model is a management activity that is just as critical as the delivery of AWIPS-II. The new Governance model must exploit the new capabilities of the architecture (e.g., easier local development, applications installed as plug-ins, system wide scripting, etc.) while at the same time insuring a robust and managed system. The initial new Governance Model must be available at the same time of the AWIPS II delivery.

5. Exciting Features of AWIPS-II

There are a number of significant features that have already been demonstrated in the new AWIPS-II architecture. Among these are:

- Dynamic load balancing
- Mathematically intensive calculations handed off to the graphics card array processor
- Progressive-like disclosure of imagery, grids and observations
- Integrated drawing and graphical collaboration
- Improved reliability - LESS CODE

Dynamic load balancing will eliminate statically assigned processing. Failover will happen automatically as processes are automatically re-assigned to the available servers. This will enable us to make more efficient use of our hardware resources.

AWIPS-II borrows some techniques from the video game industry and hands off mathematically intensive calculations, e.g., map re-projections, to the graphics card. This will yield performance improvements in the display.

AWIPS-II also supports progressive disclosure of all imagery, grids and observations with full pan and roam capabilities. This will enable forecasters to view data at larger scales and be able to zoom in on specific areas, taking advantage of the highest resolution data commensurate with the scale.

The infrastructure supports includes integrated drawing and collaboration capabilities. The collaboration capability is built on the Jabber open source project. The full integrated collaboration capability will be implemented in 2011-2012.

Most importantly, the AWIPS-II system will be more reliable and easier to maintain because there will be significantly less software and it will have much lower complexity.

6. AWIPS-II work in 2007

Raytheon delivered the foundation of the AWIPS II architecture in June 2007 in the form of the AWIPS Development Environment (ADE). The ADE contains the infrastructure and development tools necessary to develop new applications in the new SOA.

Raytheon started the application migration into AWIPS-II in June 2007. The migration will take place between June 2007 and June 2009 in roughly four incremental deliveries spaced approximately every six months. In the first task order, to be delivered at the end of January 2008, Raytheon will migrate significant portions of the D2D and WarnGen applications (Tuell et al, 2008).

7. AWIPS-II in 2008

Raytheon will continue the migration work in FY2008. In the second task, Raytheon will migrate the Gridded Forecast Editor for delivery in September 2008. Raytheon will migrate hydrological applications in July 2008 with delivery in January 2009. We should have migrated almost 75% of the current AWIPS functionality by the end of 2008.

We also will be planning for tasks that will start in 2009. There will be four major activities that will start in Fiscal Year 2009: Migration of National Center AWIPS (NAWIPS), development of a thin client capability, data delivery improvements and integrated collaboration

8. Near Term Challenges

The NWS is taking an almost unprecedented step in re-architecting an operational system while it

is still being used to deliver critical warnings and forecasts. The challenges ahead are as follows:

- System Performance
- Migration of local applications
- Testing

The original AWIPS was designed around the short fuse warning (i.e., Tornado, Severe Thunderstorm, etc.) mission. The new architecture must support the timeliness requirements of the severe weather warning mission of the NWS. In addition, the system must also support the ability to ingest and visualize global data sets.

We are defining a rigorous testing program to measure the critical performance requirements of the new system as well as to insure the successful migration of existing AWIPS functionality (Stricklett et al., 2008)

The largest challenge faced on the road to AWIPS-II is the migration of local applications (Tuell et al., 2008). Field personnel developed local applications needed to meet critical local requirements. The local applications are not considered to be a part of the formal AWIPS baseline. Thus, the Government is responsible for their migration rather than Raytheon.

We have identified approximately 3300 unique local applications, of which local users rated ~1300 critical to local warning and forecast operations. The challenges with migrating the local applications is three fold: training the local developers in the new environment, the sheer workload associated with migrating even a smaller subset of the local applications and the fact that approximately two thirds of the local applications were written by about 60 very prolific local developers. Thus, the workload falls on a relatively small number of local developers.

9. Benefits of AWIPS Evolution

AWIPS improvements will significantly advance preparation and delivery of weather and flood warnings and forecasts needed by the American Public, DHS, emergency managers, aviation, and industry.

In short, AWIPS Evolution will:

- Accelerate and streamline support to key decision makers
  - Enable emergency managers to make faster and better decisions from products in formats they can fully exploit;
  - Engage NWS expertise through integrated visual collaboration
- Streamline operations
  - Improve forecasts through advanced integrated graphical collaboration at all levels of NWS Operations
  - Deliver a 50% reduction in development time for new products; more responsive to the American Public and Partners;
  - Improve warnings and forecasts by reducing transition of research to operations by 50%
- Improve continuity of operations
  - Reduce system downtime due to software upgrades by >50%
  - Ensure no impact from component failure due to enhanced failover – uninterrupted local operations
- Control spiraling software maintenance and development costs
  - Decrease lines of code by >50%
  - Reduce system complexity by at least 25%
- Optimize Utilization of NOAA Investments
  - Improve tornado (50% increase on range of small tornado detection) and hail warnings, along with 25% more accurate precipitation amount forecasts and reduce false alarms for flood forecasts through full exploitation of NEXRAD Dual Polarization and Super Resolution improvements
  - Improve forecasts through exploitation of advanced data to be provided by GOES-R.

10. Summary

The NWS has a requirement to update the AWIPS system. The migration to AWIPS-II is well underway and will be ready for testing in June 2009 with deployment complete in October 2010. The NWS plans to build on the new architecture and extend it throughout NWS operations and then deliver system level enhancements following the AWIPS-II deployment.

The views expressed are those of the authors and do not necessarily represent those of the National Weather Service.

11. References

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