



Raytheon

**Task Order Proposal to Migrate AWIPS
Functionality in Support of the AWIPS
Software Continuous Technology Refresh
Re-Architecture**

**To Be Performed as Task Order 8 of the
AWIPS Software CTR Re-Architecture Initiative**

Technical Approach

Submitted Under
Contract DG133W-05-CQ-1067
Advanced Weather Interactive Processing System (AWIPS)
Operations and Maintenance

Submitted to:

Ms. Anita Middleton
Contracting Officer
U.S. Department of Commerce
NOAA/NWS Acquisition Management Division
SSMC2, Suite 15318
1325 East-West Highway
Silver Spring, MD 20910

22 May 2007

Submitted by:

Raytheon

Raytheon Technical Services Company LLC
8401 Colesville Road, Suite 800
Silver Spring, MD 20910

RTN AWIPS.2007-018

This document includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed – in whole or in part – for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of – or in connection with – the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government’s right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in all sheets.

Table of Contents

	<i>Page</i>
1. Introduction.....	2
2. Assumptions.....	2
3. Description.....	2
4. Deliverables	7
5. Schedule and Milestones.....	8
6. Labor Estimate	9

List of Tables

	<i>Page</i>
Table 1. Task Order 8 Work Items/Activities.....	5
Table 2. Task Order 8 Deliverables	7
Table 3. Task Order 8: Project Schedule and Milestones.....	8
Table 4. Estimated Labor Required to Complete Task Order 8	9

List of Figures

	<i>Page</i>
Figure 1. Task Order 8: Project Milestone Chart.....	8

Acronyms and Abbreviations Used in This Proposal

ADE	AWIPS Development Environment
AELC	AWIPS Evolution Leadership Committee
AIREP	Air Report
AWIPS	Advanced Weather Interactive Processing System
BUFR	Binary Universal Form for data Representation
CAVE	Common AWIPS Visualization Environment
CONUS	Continental United States
CSCI	Computer Software Configuration Item
CTR	Continuous Technology Refresh
D2D	Display-Two Dimensional
DR	Deficiency Report
EDEX	Enterprise Data Exchange
ESA	Electronic Systems Analyst
GSD	Global Systems Division
GFE	Graphical Forecast Editor
ITO	Information Technology Officer
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NWSHQ	National Weather Service Headquarters
NWSTC	National Weather Service Training Center
O&M	Operations and Maintenance
PIP	Product Improvement Plan
PIREP	Pilot Report
Q&A	Question and Answer
RAOB	RAwinsonde OBServation
RECCO	Reconnaissance
RHQ	Regional Headquarters
RRD	Risk Reduction Demonstration
RTM	Requirements Traceability Matrix
SHEF	Standard Hydrometeorological Exchange Format
SMM	AWIPS System Manager's Manual
SOA	Service Oriented Architecture
SSDD	System/Subsystem Design Description for AWIPS

STD	Software Test Description
SW	Software
SyAT	Systems Acceptance Testing
TIM	Technical Interchange Meeting
UFT	User Functional Test
UM	AWIPS D-2D User's Manual
VTEC	Valid Time Event Code

1. Introduction

Over the course of the next two years, Raytheon proposes to perform a series of software migration Task Orders under the Advanced Weather Interactive Processing System (AWIPS) Software Continuous Technology Refresh (SW CTR) Re-Architecture initiative. Under each Task Order in the series, we will deliver specific migrated end-user functions to the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). The series will culminate in AWIPS II Release 1.0.

In this proposal, we are pleased to present Raytheon's technical approach to completing Task Order 8, under which we will deliver the first in the series of migrated end-user functions. In addition to defining our technical approach, our proposal includes the assumptions on which we based our approach, a description of our objectives, an itemized list of proposed Task Order deliverables, our recommended work schedule, and a summary of projected labor hours required to complete the task.

A Pricing Summary of the costs associated with completing Task Order 8 is presented under separate cover.

2. Assumptions

- A. All conditions and assumptions noted in the Raytheon AWIPS proposal remain in effect.
- B. Travel is Firm Fixed Price.
- C. The performance schedule outlined in Section 5 of this proposal is based on the Task Order award date shown in that section. The final schedule is contingent upon the actual date of Task Order award and test bed availability, and will be mutually agreed upon with NOAA/NWS.
- D. Timely access to appropriate Government personnel and organizations will be provided. Scheduled visits with Labs or NWS organizations will occur within the approximate time frames shown in the final Task Order Schedule and will not delay the project.
- E. Government feedback on interim reviews and deliverables will be timely so as not to delay the project.
- F. The NWS will conduct a "User Functional Test" (UFT) immediately after System Acceptance Testing (SyAT). The UFT will be used to verify, from the forecaster's perspective, that the end-user (i.e., the forecaster) software functionality is equivalent to AWIPS I functionality for the functions delivered.

3. Description

The SW CTR Re-Architecture initiative has entered the Migration Phase. Software delivered with this Task Order builds upon the AWIPS Development Environment (ADE) Release 1.0, and therefore includes the ADE 1.0, selected end-user functionality, and extensions to the ADE/infrastructure.¹ Four software migration Task Orders are currently planned.

The general approach to the software migration effort is described in Section 6 of the current AWIPS Software Product Improvement Plan (SW PIP) (Version 2.0, October 24, 2006). The next version of the SW PIP (Version 3), which is being developed under Task Order 7, will rep-

¹ AWIPS II refers to the total environment and includes the ADE, end-user functionality, and the execution environment.

resent a major update to the SW PIP and will provide a more comprehensive overview of the AWIPS II migration and deployment as well as details of the software migration. The new SW PIP will include a “Capabilities Matrix” that will cross-reference migrated functions to the AWIPS software baseline CSCI and the various software migration Task Orders. SW PIP v3 will be delivered on June 22, 2007, approximately one month after submittal of this proposal. However, because the functions to be implemented and described herein are consistent with the SW PIP, this proposal for Task Order 8 can be evaluated independently of that document.

Work Items and Activities identified in this proposal are organized into four major categories:

a) Software, i.e., Workstation capabilities (CAVE), SOA Service Capabilities (EDEX), SOA Plug-ins, EDEX Common Library, Data Management, and Advanced Development²; b) Testing; c) Documentation; and d) Training. Descriptions of each category follow. Table 1, which concludes this section, identifies specific Work Items and Activities for this Task Order.

- **Software.** The primary forecaster functionality delivered under this Task Order will be D2D functionality.³ Initial GFE and Hydro plug-in frameworks will be addressed with advanced development. A Risk Reduction Demonstration/briefing will be provided showing the results of the advanced development efforts. ADE/infrastructure functionality will be extended. (See Table 1 for more detailed descriptions of this functionality.)
- **Test.** Raytheon will develop a Test Plan, Test Procedures, and a Test Report for this Task Order; copies will be provided at the conclusion of the Task Order. Existing AWIPS I test procedures will be reused to the extent possible. We expect to reuse more end-user functionality test procedures than system-level, infrastructure test procedures. We plan to perform developer testing at Raytheon’s Omaha facility and delivery testing at the Raytheon AWIPS Program Management Office/Test Facility in Silver Spring or NWS Headquarters, depending on availability of test beds. Delivery testing will include installation testing. It is assumed that the NWS will observe the delivery testing. Acceptance of TO8 will occur with the successful completion of Raytheon test procedures, including Delivery Testing and incorporation of critical Deficiency Reports (DR). A demo to be conducted at time of Software delivery will include a repeat of those tests required to demonstrate resolution of critical DRs.⁴

The intent of the User Functional Test, which the NWS will perform immediately after SyAT, is to verify from the forecaster’s perspective that the end-user (i.e., the forecaster) software functionality is equivalent to AWIPS I functionality for the functions delivered. Raytheon will support this effort by responding to and resolving “work stop” defects⁵ as quickly as possible. DRs that are generated from the UFT will be screened and consolidated by the NWS prior to forwarding to Raytheon. Raytheon will disposition all DRs received from the UFT. Disposition may result in a software correction or a written response (e.g., no software correction required, correction deferred to subsequent TO). Other than work-stop, corrections will be applied to the system during any appropriate TO prior to the AWIPS II Release 1.0.

- **Documentation.** The AWIPS II JavaDoc and Architecture briefing material will be updated as with previous ADE releases. Release Notes will be provided.

² An advanced development effort results in a demonstration and/or briefing, not “production” functionality. “Production” functionality is developed in a subsequent Task Order.

³ Not all of D2D will be delivered with this Task Order; some functions will be delivered in later Task Orders.

⁴ Critical DRs are those that prevent the system from working (e.g., “work stops”).

⁵ “Work Stop” defects are those that prevent the UFT from continuing.

Raytheon will “red-line” affected areas of existing O&M documentation that Raytheon is responsible for maintaining in preparation for reissue of this documentation with Release 1.0. The specific documentation referenced here are the AWIPS D2D User’s Manual (UM), the AWIPS System Manager’s Manual (SMM), and the AWIPS System/Subsystem Design Description (SSDD). [Note: “Red-line” documentation will not be provided as a deliverable until after Release 1.0 of AWIPS II.]

- **Training.** Training and training support will be addressed in a separate Task Order. Under this Task Order, a Technical Update Briefing of ADE changes will be provided to the developers previously “trained” in Task Orders 3 through 6 to provide a bridge to the formal training to be offered in the future. The briefing will highlight changes to the ADE affecting creation of end-user applications software.

The Software Architecture Briefing material will be updated to reflect changes to the environment, and a briefing describing those changes will be delivered as part of the TO8 Out Brief identified in the schedule of milestones in Section 5.

ITO/ESA and other related operational training is provided by the NWSTC. Support for this training is also addressed under the separate Training Task Order.

A Technical Interchange Meeting and two demonstrations (via WebEx) have been included to provide a mechanism for direct interaction between the Raytheon development team and field operations personnel. The intent of the TIM is to discuss existing Local Applications and the techniques available to replace or convert them, as well as the AWIPS environment. This TIM can be held at an AWIPS site (e.g., a Regional Headquarters), or some other CONUS location. The intent is that more than one site will be represented. The TIM will also provide field personnel with the opportunity for a technical Q&A with representatives of the Raytheon AWIPS II Team.

Raytheon considers communications with the field to be a very important activity. In light of this, we have planned two demonstrations (via WebEx) to give field personnel the opportunity to view AWIPS II capabilities such as CAVE and see how AWIPS II can be extended with examples. At this point, we still need to verify that WebEx can be used to demonstrate certain types of capability (e.g., intensive graphics.) However, demonstrating some extension techniques should be viable. We plan to continue this type of activity throughout the migration Task Orders.

The major work items and activities of this Task Order are shown in **Table 1**.

Table 1. Task Order 8 Work Items/Activities

Work Item	Description/Activity
<p>Work Station Capabilities</p>	<p>Implement the following:</p> <ul style="list-style-type: none"> • General Vector/Raster/XY/Text Rendering: Extend general CAVE rendering to include cross sections, dash lines for vectors, meteogram type display, 4- and 5-panel display, and lightning rendering. • Workstation Toolbar/Menu Bar [Framework]: Create the menus for D2D look and feel from [File ... to Help] and toolbar [Valid time seq. ... to Density]. Create the menus and toolbar for a GFE prototype perspective. <i>Note:</i> This work item includes only toolbars/menu bars. Toolbar actions other than those already implemented in ADE 1.0 are not included here. Non-ADE 1.0 actions invoked by these toolbars/menu bars are addressed elsewhere. • Workstation Modes [normal practice test]: The ability to put CAVE in a practice and test mode. • Workstation Localization [Base Site User]: The localization data model and localization persistence to support local configuration of application capability in CAVE. Localization will include an API and will work with CAVE being off-line or connected to services. • Workstation History & Procedures: D2D procedures menu and history widget in CAVE. • Volume Browser [Products, Load Modes]: Extend the ADE 1.0 Volume Browser to replicate the D2D capability for plan, cross section, height, and time series views. Prototype a capability for derived fields and the product maker. • Plot Model and Model Maintenance: Extend the ADE 1.0 plot model to include D2D-style configurability with a persistence schema and interface. A mechanism will be provided for plot model maintenance and successive disclosure. • Color Map Editor: Port the D2D color widget and add an interface for color table management. • Text Display and Edit: Port the main display window of the text workstation into CAVE. Include the AFOS text product browser and quality control checks. The text editor with product controls will be ported along with tabular text. Provide prototype capability for message alerting and text scripting. • Warning Generation [GIS Source]: Extend the ADE 1.0 warning generation to include the storm track. Reengineer the D2D template language into XML. • Warning Generation Cont.: Update the dialog boxes to match D2D and provide an interface to the VTEC pattern and text data base. • Radar Display: Update the radar display to include storm motion, the ability to request products, and receive status messages. • Skew-T [Plot Grid]: Extend the ADE 1.0 skewT display to match D2D including the hodograph, parameters, and controls. Include an interface to the meteo library for thermodynamic functions.
<p>SOA Service Capabilities (EDEX)</p>	<p>Implement the following:</p> <ul style="list-style-type: none"> • UtilSrv [Color Maps misc. static data]: New service for centralizing color map operations. Includes porting existing D2D color maps into XML. The service will support centralizing localization data. • MapSrv [Topo GIS]: Service to provide topo map data including retrievals for points and lines and vector map data. • Radar Msg Handler
<p>SOA Plug-ins</p>	<p>Implement the following:</p> <ul style="list-style-type: none"> • bin Lightning: support metadata, decoding, and storage.

Work Item	Description/Activity
	<ul style="list-style-type: none"> • GINI Satellite: Refine the metadata for the ADE 1.0 plug-in. • Grib [AVN,ETA,MesoEta,MRF,NBM,RUC]: Remaining grib parameter mapping tables. • RAOB (BUFR): General BUFR pattern and interface to BUFR tables. Implement a RAOB data model and decoder using the BUFR pattern. • Text [ColDBDecoder,StdDBDecoder]. • Aircraft: Support metadata, decoding, and storage. Includes AIREP, RECCO, and PIREP decoding. • Maritime: Reuse the synoptic decoding pattern. Support metadata, decoding, and storage. Include decoding for ship synoptic, buoy synoptic, CMAN synoptic, and MAROB. • Radar: Refine the ADE 1.0 radar plug in to cover the range of products coming from the ORPG interface. • TAF: Refine the ADE 1.0 TAF plug in. Include changes for the new TAF format. • Synoptic: A general decoding framework that is useable for Maritime. Includes implementations for the data store. • METAR: Refine the ADE 1.0 Metar plug-in by extending decoding into the remarks section.
EDEX Common Library	<p>Implement the following:</p> <ul style="list-style-type: none"> • VTEC management pattern: A general VTEC pattern. The pattern will include a persistence schema, object model, and API. • Meteo Library: A central library of meteo functions with an API. Port most the functions in the D2D meteolib baseline. Some review of similar functions in gempak to choose the best common function. • Text Generation Pattern: A pattern to convert XML text documents into pure text. Leverage work done at GSD for XML text schemas. • Generalized Time: * Standardized use of time through the ADE.
Data Management	<p>Implement the following:</p> <ul style="list-style-type: none"> • Data Access Refinement: Refine the data access API to accommodate the new plug-ins. • Data Repository Refinement: Refine the static data storage such as the station catalog. • Hydro PostgreSQL Database IHFS + Purge: Rehost the IHFS data base and develop a new object to relational mapping. Develop IHFS data access objects. • Text database: Rehost the text database and develop a new object to relational mapping. Develop new text data access objects.
Advanced Development	<p>Prototype the following:</p> <ul style="list-style-type: none"> • Workstation <ul style="list-style-type: none"> — Plug-in Initial GFE Framework: A perspective in CAVE for GFE. Provide basic ability to retrieve and display GFE grids from the grid storage mechanism. — Plug-in Initial Hydro View Framework: A prototype hydro view CAVE plug in. — Rules Framework: A rules framework to support XMAS tree tools. The framework will include a "rules syntax," a rule repository, access API, and a rules evaluation engine. — SOA Service — GridEditSrv: Basic database and weather element messages. Includes a SOA plug-in for implementation. Basic capability for locking, updating, and sampling GFE grids. • SOA Plug-ins <ul style="list-style-type: none"> — HEF: SOA plug in for SHEF data including a new decoder.

Work Item	Description/Activity
	<ul style="list-style-type: none"> — Metar2Shef: An approach that allows hydro apps to access metar data. — GagePP: Review access mechanism to PC and PP data for Hydro apps.
Test	<ul style="list-style-type: none"> • Develop and document Test Plan, Test Procedure, and Test Report. • Update Regression Test Procedures. • Perform combined Delivery/SyAT Testing on Silver Spring or NWSHQ Test Bed. • Support User Functional Test as described in Sections 2 and 3.
Documentation	<ul style="list-style-type: none"> • Update JavaDoc. • Update Architecture Briefing. • Redline appropriate sections of the UM, SMM, and SSDD for later incorporation into production documentation.
Training	<ul style="list-style-type: none"> • Update existing training materials for currency. • Provide a technical briefing for previous trainees, highlighting ADE changes. <p><i>Note:</i> Developer training and training support are addressed in a separate Task Order.</p>
Briefings	<ul style="list-style-type: none"> • Provide delivery briefing (Architecture Updates, delivered end-user functions). • Provide Technical ADE update briefing to previous ADE trainees. • Provide Risk Reduction Demonstration of advanced development items.

4. Deliverables

Deliverables for this Task Order are identified in **Table 2**.

Table 2. Task Order 8 Deliverables

Item	Description	Comments	
1	Software		
	1.1	Workstation Capabilities	As described in Section 3.
	1.2	SOA Service Capabilities (EDEX)	
	1.3	SOA Plug-Ins	
	1.4	EDEX Common Library	
	1.5	Data Management	
2	Documentation		
	2.1	Software	<ul style="list-style-type: none"> • Javadoc Library for All Developed Code
	2.2	Test	<ul style="list-style-type: none"> • Copy of Raytheon Software Test Plan, Test Procedures, associated Requirements Traceability Matrix, and Test Report • User Functional Test DR Disposition Report
	2.3	Technical Briefing Material	<ul style="list-style-type: none"> • Task Order Out Brief including updates to the Software Architecture Briefing • ADE Technical Update Briefing (to be delivered as part of TO8 training) • Risk Reduction Demonstration / Briefing
	2.4	Training Material	<ul style="list-style-type: none"> • Updates to previous training material for currency with this release
	2.5	Release Notes	
3	Briefings	<ul style="list-style-type: none"> • Delivery Out Brief • ADE Programmers Briefing (remote) • Risk Reduction Demonstration / Briefing 	

5. Schedule and Milestones

Key milestones in the Task Order 8 schedule are shown below. **Figure 1** graphically depicts the performance timeline; **Table 3** itemizes all schedule activities. All proposed milestone dates are approximate and subject to Government availability and the date of Task Order award.

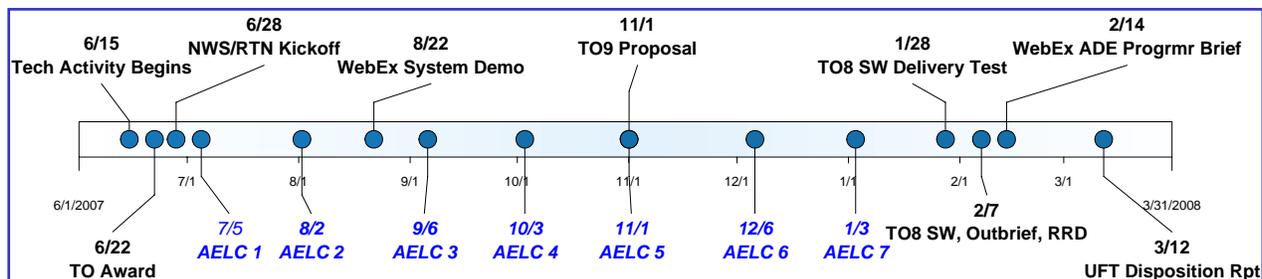


Figure 1. Task Order 8: Project Milestone Chart

Table 3. Task Order 8: Project Schedule and Milestones

Item	Description	Date
1	Start Technical Activity	6/15/07
2	Task Order Award	6/22/07
3	Kickoff With NWS	6/28/07
4	AELC Status Updates	7/5/07, 8/2/07, 9/6/07, 10/3/07, 11/1/07, 12/6/07, 1/3/08
5	Demo system via WebEx to Field Personnel	8/22/07
6	Technical Exchange Meeting: Location TBD	9/19/07
7	Demo system via WebEx to Field Personnel	10/24/07
8	TO 9 Proposal	11/1/07
9	TO8 Software Delivery Test*	1/28/08
10	TO8 Software Delivery, Out Brief, and RRD*	2/7/08
11	ADE Programmers Briefing (Remote via WebEx)	2/14/08
12	All UFT DRs screened, consolidated, and delivered to Raytheon (NWS milestone)	2/29/08
13	UFT Disposition Report	3/12/08
* Travel required for Raytheon Team		
Key: AELC = AWIPS Evolution Leadership Committee DR = Deficiency Report		RRD = Risk Reduction Demo UFT = User Functional Test

6. Labor Estimate

Table 4 presents the estimated labor required to complete Task Order 8.

Table 4. Estimated Labor Required to Complete Task Order 8

Labor Category	Labor Hours
AWIPS Evolution Manager	312
Principal Subject Matter Expert	1,040
Senior Contracts Administrator	24
Business Manager	144
Procurement Specialist	24
Quality Assurance Specialist	32
Senior Documentation Specialist	40
Total Raytheon Hours	1,616
Engineer (Subcontract)	9,350
Senior Engineer (Subcontract)	2,879
Junior Engineer (Subcontract)	3,680
Principal Subject Matter Expert (Subcontract)	480
Total Subcontractor Hours	16,389
Total Hours	18,005
*Hours may differ slightly from the Pricing Summary due to rounding.	