Date: March 14, 2014

A Proposal to the

2014 Unidata Community Equipment Awards Program

for Support of a

Linux Server in the Cloud

Name and Address of Institution	Embry-Riddle Aeronautical University 600 S. Clyde Morris Blvd. Daytona Beach, FL 32114-3900
Institutional Identifiers	DUNS: 052104791 Cage Code: 7B563 TIN: 59-0936101
Desired Starting Date	June 1, 2014
Proposed Duration	35 months
Amount Requested	$20,000

Principal Investigator Name: Curtis N. James, Ph.D.
Title: Associate Professor
Institution: Embry-Riddle Aeronautical University
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Prescott, AZ 86301-3720

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Signature of PI: Curtis N. James

Name of Institution Official: Robert Lang
Title: Controller
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Signature of University Official:

Project Summary

This project will help to bridge the gap between meteorology education and local operational forecasting through collaboration with the National Weather Service (NWS). By leveraging emerging cloud computing technology and the expanding accessibility of the Internet, local NWS personnel and Embry-Riddle Aeronautical University (ERAU) students in Prescott, Arizona, will have real-time meteorological analysis capability using virtually any operating system or mobile platform where Internet access is available. The successful implementation of this project will serve as a testing ground that may be expanded to the larger meteorological community in support of education and emergency management operations.

This proposal meets all of the 2014 Unidata Equipment Awards Program's special emphases and serves as a pilot project for cloud-based weather data storage and analysis. ERAU seeks funding for a fast virtual server through a reliable cloud service provider. This Linux-based virtual server will possess adequate GPU capability, processing, and memory to enable real-time weather data acquisition and visualization by multiple users simultaneously. The Local Data Manager (LDM) system will be installed by Unidata on the virtual machine to provide real-time data, remote sensing imagery, and gridded forecast model output. The AWIPS II EDEX server and CAVE client, along with the RAMADDA server, will also be configured on the virtual machine enabling real-time meteorological analysis and forecasting.

The cloud server will render a variety of graphical weather displays using the aforementioned software tools. Additional software tools may also be installed and configured by the National Weather Service (NWS) and ERAU for fire weather, hydrology, dispersion modeling, aviation meteorology, and/or severe weather applications. The graphical output from these software tools will be available via the Internet, enabling remote data access and visualization capability for NWS forecasters as well as ERAU students and faculty. The system will support ERAU's new focus on emergency response meteorology (ERM).

Project Description

The services provided by the NWS are continually evolving towards decision support and emergency response services. Recent discussions with two of ERAU's industry advisors, the Meteorologists In Charge at the Flagstaff and Phoenix NWS Forecast Offices, reveal that employees with skills in ERM are in high demand at the NWS. Consequently, in order to provide our students with better career preparation and employment potential, the Department of Meteorology at ERAU's Prescott Campus is revising its meteorology degree offerings by the Fall 2015 semester to include a strong emphasis on ERM. We anticipate that ERAU will become the first atmospheric science curriculum in the nation to offer this degree emphasis.

Our focus on ERM will require ERAU students to develop stronger meteorological analysis and forecasting skills, including more proficiency in the use of state-of-the art software tools. Moreover, students will need to have efficient remote access to these tools and real-time data in order to support emergency response training and operations. Because the Department of Meteorology does not have dedicated Linux or UNIX support, the optimal solution is to create an online weather server accessible to ERAU students, staff, and faculty. The server should also be available to Unidata technical support staff to install and help configure the software and NWS personnel who may share in the development and use of the software tools.

ERAU therefore proposes to create a fast Linux server through the use of a reliable cloud service provider such as Amazon or Google. This server will requre adequate GPU speed, processing capability, RAM, and data storage capacity to support the LDM data stream and the graphical processes that will be computed and displayed simultaneously to multiple users. The LDM feed will provide vital data sets for emergency response applications, such as high-resolution NAM Fire Weather Nest output and HRRR output grids.

Based on personal communication with Unidata staff, LDM could be configured on the server to pull data from the Unidata server to the ERAU server within the cloud service free of charge to ERAU. Unidata staff are also willing to install a prototype AWIPS II EDEX server and CAVE client to enable detailed meteorological analysis of the data supplied by LDM. Moreover, the RAMADDA server will be installed by Unidata for added analysis (quick look) capability and to facilitate efficient data browsing capabilities.

Case study data sets will also be created on the server so that students may practice forecasting in simulated real-time weather events. It is anticipated that either the Warning Event Simulator (WES) could be utilized or sequential XIDV bundles could be sent to students during a simulated event, enabling new data to be ingested into AWIPS as in real time. Thus, students will gain confidence and skill providing operational forecasting support for emergency weather-related events.

In addition to Unidata software, there are other software tools that we will likely be installed on the server that are applicable to emergency response meteorology. We envision the NWS or ERAU may install software packages such as the HYSPLIT dispersion model (http://www.arl.noaa.gov/HYSPLIT_info.php), the RAL Thunderstorm Auto Nowcasting system (http://www.ral.ucar.edu/projects/nowcast/), and/or other specialized modeling or analysis systems.

Benefits to the Larger Meteorological Community

This project has many potential benefits to the university and operational meteorology communities. First, it would serve as a pilot project to explore the benefits of computing in the cloud for meteorological applications. Because of its accessibility wherever an Internet connection is available and on virtually any computer hardware or mobile device, this project is especially important for meteorological applications in the field such as aviation weather forecasting, severe storm forecasting, etc. The tools could be used in emergency applications such as fire weather, dispersion modeling, flash flooding, severe storm forecasting, hurricanes, etc. This study will serve as a proof of concept for such applications. A paper reporting the benefits and challenges of in-cloud computing will be submitted for presentation at the 2015 Annual Meeting of the American Meteorological Society (AMS) in Phoenix, Arizona, and/or for publication in an appropriate AMS journal.

Second, because the computational speeds and the storage capacity can be expanded with time, there is potential to add trusted users to the server over time. These additional users could include other NWS offices and/or university campuses such as ERAU's Daytona Beach campus. Although additional funding would be necessary to expand the capacity of the server with time (through individual subscriptions or supplemental funding sources), there is potential to easily expand this tool for use by a larger user community.

Third, this project will test a new forecasting client capable of providing operational forecast guidance to field meteorologists. Currently, FX-Net (http://fx-net.noaa.gov/) is the primary mobile forecasting framework used by the NWS, yet it is not configured for AWIPS II and will likely be discontinued in the near future. The Thin Client is a Windows and Linux-based server that enables AWIPS II access and display, but it is currently available only on a limited basis to operational NWS personnel. The Windows version is only used by IMETs (incident meteorologists) working on fire weather applications. The Linux version is used exclusively by the Salt Lake CWSU (Center Weather Service Unit) in the Western Region of the NWS. Other NWS regions are beginning to expand usage of the Thin Client, yet it has a reputation of being unreliable or prone to software glitches. The proposed cloud-based server could therefore prove to be a viable solution for operational forecasters, and this project has the support of the NWS Western Region (personal communication with Brian Klimowski, MIC, NWSFO Flagstaff).

Finally, this project serves as an opportunity to bridge the gap between meteorology education and operational meteorology. By providing a common environment where students, faculty, and operational forecasters may collaborate to install and configure software tools, important synergies may be achieved that benefit both education and operational forecasting. This framework will engender fruitful collaboration and an environment that encourages applied research towards improving forecasting tools and practices.

Personnel Expertise

Although Linux support is limited at ERAU's Prescott Campus, hardware issues and data backup requirements will be avoided because this server will be hosted in the cloud. With the assistance of Unidata, ERAU and the NWS should be able to adequately maintain the functionality of the software on the server.

Budget

The server will be operated by the Department of Meteorology located on the Prescott, Arizona Campus of Embry-Riddle Aeronautical University. Server access will be required for approximately 30 users initially, with the potential for expansion to additional users over time. The server will be created using a reputable cloud service provider such as Amazon or Google, with initial software installation and ongoing technical support provided by Unidata staff and collaboration with local NWS offices in Flagstaff and Phoenix. Monthly charges for cloud service providers are largely dependent on the computational resources and network bandwidth required. Therefore, it is difficult to estimate what the monthly charges will be. Based on preliminary estimates using the Google Cloud Pricing Calculator for a quad-core machine with 26 GB of RAM, 200 GB of storage, 100 GB of snapshot storage, and 1 TB per month of network bandwidth, the monthly charge would be approximately $500 per month (https://cloud.google.com/products/calculator/). Nevertheless, the usage would fluctuate throughout the year, with much less usage and expense anticipated during summer months or when classes are not in session. Therefore, the total requested funding for this proposal is $20,000 for the virtual Linux server for an estimated time of 35 months from June 1, 2014 - April 30, 2017.

Total Direct Costs

The total direct costs for this project are $16,260.

Total Indirect Costs

The total indirect costs for this project are $3,740. This reflects a 23% off-campus overhead rate per Embry-Riddle Aeronautical University policy.

Total Project Costs

The total costs for this project are $20,000.

Project Milestones

Below is a brief timeline highlighting the plan of action and expected milestones for this project:

- May 2014: Award notification—Create the server through the cloud service provider recommended by Unidata
- June 2014: Unidata configures the server directory structure, user accounts, and required software (LDM, AWIPS II EDEX server, CAVE client, RAMADDA server)
- July - Sept. 2014: Install and test other software vital to Emergency Response Services
- Sept. - Dec. 2014: Create case study data sets for real-time event simulations
- Jan. 2015: Server available online for educational use and operational development
- Feb. 2015: Report results at the 2015 AMS Meeting and/or an AMS journal

U.S. Department of Commerce
NOAA/National Weather Service
Weather Forecast Office
P.O. Box 52025
Phoenix, AZ 85072

March 7, 2014

Unidata Program Center
UCAR Office of Programs
P.O. Box 3000
Boulder, CO 80307-3000

Dear Sir or Madam:

I am writing to express my support for the grant proposal “A Linux Server in the Cloud”. I believe this project will be a beneficial addition for the students at Embry-Riddle, and to National Weather Service (NWS) staff members across Arizona. Additionally, I envision this being a pilot project to address an important component in the NWS’ evolving decision support culture.

As you probably know, the concepts of providing weather support to key government decision-makers and public safety officials are rapidly spreading through the NWS. Indeed, the concepts have become a central focus for future operations. In many cases, the support provided will take place outside of the local forecast office. The ability to provide a suite of data to the NWS forecasters at an on-site location is a challenge facing us as we move forward. The successful deployment of a secure cloud-based server would solve this challenge. Additionally, since the client would be a version of AWIPS II’s CAVE, the NWS staff would be using a display package with which they were already familiar.

I applaud Embry-Riddle’s steps in establishing an “emergency response meteorologist” curriculum option. To my knowledge, Embry-Riddle is the first university in the country to take this step. The cloud server project, as a companion initiative, will provide critical real-time data to students and forecasters alike.

Thank you for your time and consideration.

Sincerely,

Gary R. Woodall
Meteorologist in Charge

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service
NWS Weather Forecast Office - Flagstaff
P.O. Box 16057
Bellemont, Arizona 86015-6057

March 6, 2014

RE: Proposal to the 2014 Unidata Community Equipment Awards Program

For your consideration,

I would like to communicate my support and recommendation for the Proposal to the **2014 Unidata Community Equipment Awards Program** from Embry Riddle University (Dr. Curtis James).

The National Weather Service is evolving toward an environment which promotes enhanced communications and 'Decision Support Services' – the direct support of the NWS partners during high impact weather events which may demand the use of remote service options. The aforementioned proposal addresses one of the primary foundations of such services – that is – the acquisition and interrogation of large meteorological datasets from remote locations. As such, the work accomplished through this proposal would serve as a valuable testbed for technology beneficial to the National Weather Service.

We hold a very solid relationship with Embry Riddle University, meeting regularly on a variety of student and research oriented topics, and have collaborated in the past on several scientific and operational endeavors. We hope that this will become another of the projects on which we can work together toward the enhancement of student development and associated support services.

Sincerely,

Brian A. Klimowski
Meteorologist in Charge
WFO Flagstaff, AZ