Unidata Community Equipment Request

Upgrading LDM Server and Archive Systems to support Atmospheric Sciences at Texas A&M University and in the Broader Community

by

Gerald J. Creager
Associate Research Specialist
Phone: 979.862.3982
Fax: 979.862.3983
The Academy for Advanced Telecommunications and Learning Technologies
AATLT, 3139 TAMU
College Station, Tx 77843-3139
Email: gerry.creager@tamu.edu

[redacted]

Submitted by

Texas A&M Research Foundation
400 Harvey Mitchell Parkway South, Suite 100
College Station, TX 77845-4321
Phone: 979.862.4138
Fax: 979.862.3520
Email: preaward@rf-mail.tamu.edu

[redacted]

Jane Zuber, Associate Vice President

Amount Requested: $20,000
March 22, 2011

Upgrading LDM Server and Archive Systems to support Atmospheric Sciences at Texas A&M University and in the Broader Community

Gerald J. Creager
Academy for Advanced Telecommunications and Learning Technologies
Texas A&M University

Project summary

Unidata funding will be used to replace the aging LDM servers (bigbird.tamu.edu and sasquatch.tamu.edu) with a cluster of servers to provide high performance and availability service to the campus users and the Research & Education community, as well as other users who have a defined requirement for the data. The funding will also be used to replace the aging archive infrastructure supporting data and metadata presentation using THREDDS and RAMADDA software.

Project Description

Background

Texas A&M University's (A&M's) Atmospheric Sciences Department boasts some 150 undergraduate students, and over 50 graduate students. The department is an element of the College of Geosciences, which also includes departments of Geography, Geology and Geophysics, and Oceanography, as well as several dedicated research units.

The department places strong emphasis in undergraduate education, with significant emphasis on hands-on activities, ranging from our new Weather Wall and weekly student-led briefings, to storm chasing. The department's computer labs utilize Gempak as a training facility to acquaint students with applications similar to the National Weather Service's AWIPS software, used operationally nationwide.

The Academy for Advanced Telecommunications and Learning Technologies (Academy) is an interdisciplinary research unit serving Texas A&M University. The Academy's scientists are committed to strengthening interdisciplinary research and learning at A&M by providing and exploiting advanced computing, data, networking, visualization, and other cyberinfrastructure.

As an interdisciplinary bridge between theoretical work and high-performance applications, the Academy provides leadership and exceptional expertise in communications technology, networking and cyber security on behalf of Texas researchers and the state's higher education community.

The Academy hosts several A&M centers and initiatives including a research High Performance Computing facility, and an Immersive Visualization Center.

For more than five years, the Academy has operated two high availability servers (bigbird; sasquatch) which are available to the research and education community at large, and a variety of public service activities, as well. In addition, the Academy instituted an Internet Data Distribution (IDD) framework using Unidata Local Data Manager (LDM) software to support a major effort involving transit of initialization data for models, and receipt and archive of data related to coastal and ocean models. The Academy has also provided a data cache of the

WSR-88D NEXRAD Level II and III data, originally of 30 days duration, but recently increased to 90 days duration, available to all users. These servers also provide redundant services to the Atmospheric Science Department for academic use. In addition, data derived from these servers (NOAA simulations and observations) are used to facilitate local tropical cyclone, air quality and other research efforts. Data and metadata are also available on an archive interface at scoopdata.tamu.edu using the THREDDS and RAMADDA software packages.

Proposed Project

The servers and RAID (redundant array of inexpensive disks) infrastructure supporting the Academy data services (LDM, THREDDS, RAMADDA) was originally purchased for other projects or experiments. Virtually all of the hardware has passed its useful life. Most of the servers have been "refreshed" with refurbished hardware merely 4-5 years old, although some remain that are, at best, outdated. Of the RAID hardware, while disk replacement has occurred within the last 2 years, the life expectancy of a disk rotating virtually all the time is on the order of 3 years. All funding for this infrastructure was either institutionally provided, or derived from past projects. In the current funding environment, institutional resources for *pro bono* data services are hard to secure, and redirecting project funds to hardware is becoming more difficult.

We propose to purchase replacements for our aging LDM infrastructure, and our archive server. The LDM hardware requested in this proposal will allow us to switch from a redundant server to a cluster model for LDM service, as has been used by Unidata itself.

We propose to "match" the funding by relocating our LDM and archive services to a data center with both a battery-based Uninterruptable Power Supply (UPS) and a diesel generator, co-located with the campus network site (also on UPS and generator) which provides diverse 10 gigabit (Gb/s) connectivity to commercial and Research and Education (R&E) networks. We will locate a server and smaller RAID system in the Eller Building at A&M, where Atmospheric Science is housed, to provide an off-site data cache that will facilitate data recovery in the event of data loss at the primary data center.

These upgrades will allow us to offer service to more users in R&E, both within the Texas A&M community, and outside it. Among the known users external to the R&E community are NOAA, the U.S. Department of Defense, and various public service users in storm spotting and Amateur Radio communities nationwide.

Intellectual Merit

Data provided by IDD are, in general, limited to R&E communities due to the sources of funding, e.g., National Science Foundation, and restrictions placed on how funds may be used. However, providing data to other users, outside the normally recognized R&E groups, is, in its own way, a form of outreach and education. A&M, and the Academy in particular, have striven to facilitate access requests from weather enthusiasts, storm spotters, and some commercial organizations seeking to determine if the IDD was something they needed to utilize for their work rather than other mechanisms. The benefits have been enlightening, ranging from the telecommunications engineer who returned to obtain a Masters of Science in Atmospheric Science based on his "hobby" and access to more data, to the retiree who eventually began running his own numerical simulations, at home, using data derived from A&M LDM feeds.

Others, in disciplines beyond meteorology, also benefit from the availability of such resources, and access to skilled personnel to help them get started. In a previous project (SURA [Southeastern University Research Association] Coastal Ocean Observing and Prediction project; SCOOP), all participants were persuaded to replace a plethora of scripts used to download model data from NOAA's National Centers for Environmental Prediction (NCEP) with LDM, and to use LDM to send all their data to the SCOOP archives at A&M and Louisiana State University, creating a unified and manageable system for data handling. Over time, LDM resources were also employed to create automated model workflows.

On campus at A&M, a number of researchers in various disparate disciplines, including hydrologists and agronomists, use data available via LDM. In the course of improving the local infrastructure, these researchers can also be reached and served.

Finally, the IDD system is a branching tree structure. By creating redundancy toward the top of the structure, subsidiary downstream users can fail over more gracefully in the event of an outage affecting a single site or a region. Such regional outages are not extremely common in today's Internet, but a variety of situations may arise which could lead to situations, including some seen as recently as last December, where significant portions of the R&E community lost data or were recipients of untimely (delayed) data due to an unlikely cascade of anomalies at several key sites.

Budget Justification

LDM server replacement

We propose to replace bigbird.tamu.edu and sasquatch.tamu.edu, which have been used in a fail-over redundant manner, with a cluster of servers as described at http://www.unidata.ucar.edu/newsletter/2005june/clusterpiece.htm . This model uses six servers as a director, three "real" servers, and two accumulators. These servers will be housed in a 4-server enclosure that the Academy successfully employs as dense-nodes in high performance computing environments, and will be connected to the Academy's HPC storage to provide data directly to disk for the benefit of users requiring those data (i.e., Atmospheric Science faculty and students; others).

Archive server replacement

Another server will be used to act as the archive server, providing THREDDS and RAMADDA services to the community. This server will utilize storage associated with the Academy’s existing Storage Array Network (SAN) to provide access to the environmental data available from past projects, as well as ingested data, and those data deemed accessible from future projects. RAMADDA and THREDDS (with OpeNDAP) form the core of the current archive efforts for environmental data.

AWIPS-II EDEX server

The Academy and Atmospheric Science faculty have expressed interest in gaining early access to AWIPS-II software, and to consider the possiblilty of using it in classes as soon as the fall semester of 2011. To this end, an EDEX server will be required. We propose to make the server available, after initial testing has determined the requirements for stable operation, to the broad community.

University in-kind support

A&M and the Academy will provide systems/software support personnel. In the our

experience, this requires minimal personnel outlay once basic expertise is acquired. It is anticipated that initial configuration will require less than one week of sys-admin time, and ongoing operations and maintenance will require on the order of one hour per day or less. Unscheduled maintenance due to hardware failures will require significant variations from the anticipated workload, but one main reason to request Unidata funds for hardware replacement is to reduce the problems associated with maintaining equipment being maintained past its reasonable end-of-life.

The Academy will provide siting of the servers in a secure data center on the A&M campus. This facility is equipped with battery-supported uninterruptable power (UPS) and a backup diesel generator. In addition, the primary network access point for A&M is co-located in this facility, with its own battery power, which is also supported by the diesel generator. UPS power for the computers is designed to be up for at least the period of generator start-up and stabilization. Failover tests have demonstrated over one hour of UPS power is available in the event of a loss of commercial power.

The Academy will arrange for connectivity to the network facilities offered by A&M. These include access to the campus network, supporting the Atmospheric Science department as well as other users on the campus, and connections to the commodity and R&E networks A&M utilizes, including Internet2 and National LamdaRail. A&M's connection, via the Lonestar Research and Education Network (LEARN) is diverse, with connections to both commodity and R&E peerings in Dallas and Houston.

In the past, Academy personnel have provided expertise to the community for configuring and troubleshooting LDM installations. Although not as skilled as Unidata personnel in this regard, continuing to offer this service, especially to non-UCAR members, serves to provide a relief mechanism for Unidata. As additional experience is gathered with other products, i.e., IDV and EDEX/AWIPS-II, we will offer additional help in these areas, if desired.

Budget

Texas A&M University requests $20,000 from Unidata to acquire the hardware indicated above. Non-disposable (capital) equipment does not incur indirect costs.

Specific hardware is detailed below:

- Supermicro SC827 chassis (houses 4 nodes); qty 2
  - dual (redundant) 1400 power supplies
- Supermicro 22TT-H6IBQRF servers; qty 9 (includes one hot spare)
  - Intel Xeon processor 5600/5500 qty 18
  - 64GB DDR3 memory/server
  - 1 (x16) PCI-E (Low Profile) (supports 10Gb ethernet interface)
  - 2 terabyte enterprise disk drive; qty 18 (2/server)

Actual hardware purchases will be guided by costs and availability at the time of the award, but the intent of the acquisition is indicated in the specified items.

The Supermicro SC827 chassis houses four individual servers in a 2 rack-unit (u) footprint. The Academy has extensive experience with this configuration in its High Performance

Computing (HPC) systems and has found these servers reliable, readily serviceable and cost-effective.

The 22TT-H6IBQRF server is the current Intel Xeon multicore server in the high density footprint. It supports up to 64 gigabytes of error correcting memory per server. It also provides an onboard InfiniBand adapter allowing connection to the HPC storage at rates of more than 10 Gb/s. The redundant power supplies allow connection to two power sources, allowing maintenance, as well as survivability in the event of a power casualty in the data center. It can be equipped with 10 Gb/sec ethernet adapters to provide connectivity to the campus and external networks. Dual drives per server allow a mirrored RAID for reliability. In our experience, the component most likely to fail on a server has been its hard drive; all of our systems are now configured for RAID 1 (mirror) operation.

Personnel time is expected to be limited. Our typical personnel expenditure is on the order of 1 hour per week for a suite of 7 LDM servers, including two facing the outside, requiring reconfiguration when new access requests are received. Similarly, while initial configuration of the THREDDS and RAMADDA servers is time-consuming, we anticipate little ongoing software maintenance, on the order of 4 hours per new dataset to configure and enter metadata, and approximately one hour of routine inspection per week.

Project Milestones

Upon award of the funds, The Academy will solicit quotations for the systems and initiate purchase. Our experience with purchases of this magnitude is that approximately one month is required from issuing a purchase request to completion of the process resulting in an order. Our experience with the hardware in question is that it can usually be delivered in less than two weeks after a purchase order is issued.

Upon receipt of the hardware, we will initiate installation, which is anticipated to take approximately two days, including checkout of the power and installation of new network connections.

Completion of software installation should be accomplished within two days of the completion of hardware installation and connection. Thus, within one week of hardware acquisition, we should have the system ready for operation.

Some period will be required to adequately configure the THREDDS and RAMADDA servers. An initial, incomplete configuration, allowing initial operating capability (IOC) will require up to one week. Full operating capability should be realized within one month.

Therefore, within approximately 10 weeks of the notification of award, the new system should be completely operational.

Critical dependencies

No critical dependencies are currently anticipated; a significant price increase in the preferred hardware could result in a change of method but not of operation and performance. Significant price rises could result in moving away from a cluster design to a multiple-server/redundant server design utilizing less hardware. No problems in infrastructure are anticipated; cooling and power are not constraints in the data center, and the uses defined for this hardware falls under A&M’s defined research network planning.