

Unidata Community Equipment Awards Cover Sheet

Proposal Title:
Upgrading the Rutgers Weather Center to Meet Today's Needs

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Upgrading the Rutgers Weather Center to Meet Today's Needs

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1) Project Summary

The Department of Environmental Sciences at Rutgers University runs three undergraduate programs, one of which is meteorology. In addition, the department is closely linked to the Graduate Program in Atmospheric Science. (Graduate programs at Rutgers are independent of academic departments.) For many years, the department has maintained an LDM/WWW/file server that receives and transmits IDD data, while saving some data to disk primarily to display on the web. The website is known as the Rutgers Weather Center. However, the server currently in use is underspecified in terms of its ability to handle high-volume IDD data streams, let alone generate web graphics and serve web pages. Thus, one component of this project proposes that a new state-of-the-art LDM server be procured.

For many years, upper-level synoptic and mesoscale meteorological courses at Rutgers were dependent on paper-based case studies, computer-based COMET modules, and the occasional use of Plymouth State's "Make Your Own..." website feature. This was deemed unsatisfactory, and a modernization of the curriculum is ongoing. As part of the modernization, internal funding was used to upgrade the Department's computer lab with 11 modern Windows PCs capable of running IDV decently. Combined with 8 somewhat older PCs, the computer lab is now adequate for student use. However, incorporating the GEMPAK suite of tools into the curriculum required the repurposing of a Pentium-class PC into a Linux server. It is a testament to GEMPAK that twenty different GEMPAK or GARP sessions have been run simultaneously on such a machine, but this situation is clearly not ideal. Therefore, a second component of this project proposes that a new "synoptic server" be brought into service for classroom use.

Finally, the current amount of disk space available on the departmental servers is inadequate to store the voluminous amount of weather data available today. Expanding this capability would allow more datasets to be archived as well as facilitate the development of case studies for classroom use. The final component of the project, then, envisions the expansion of the current file storage system.

2) Project Description

Equipment Requested

The equipment requested is as follows:

- An LDM Server consisting of a Dell PowerEdge 2950 with a Quad Core Intel Xeon E5420 running at 2.5 GHz, 4 GB RAM, four 250MB SATA hard drives, PERC6i SAS RAID controller, CD-RW/DVD-ROM drive, and a dual embedded Broadcom NetXtreme II 5708 Gigabit Ethernet NIC
- A Synoptic Server consisting of a Dell PowerEdge 2950 with two Quad Core Intel Xeon E5420 processors, 16 GB RAM, six 250MB SATA hard drives, PERC6i SAS RAID controller, CD-RW/DVD-ROM drive, and a dual embedded Broadcom NetXtreme II 5708 Gigabit Ethernet NIC
- A JetStor SATA 412S 12-bay RAID array with 4 TB storage
- Support equipment including a rack, rack console, uninterruptible power supply, network switch, and KVM switch

Equipment Usage

The Need for New Equipment

The requested equipment will greatly expand the teaching, research, and community outreach capabilities of the meteorology program. The weather data currently available through the IDD is used in undergraduate courses in meteorological analysis, dynamic meteorology, and synoptic and mesoscale meteorology, among others. For undergraduates, the data is used for in-class weather discussions as well as lab exercises and case studies. The current LDM server is inadequate in both respects. Due primarily to inadequate RAM and processing power, the server is unable to receive all of the data currently available via the IDD while also creating images and serving web pages. Even if the server did have the RAM and processing power recommended for a modern LDM server, it has inadequate disk space at its disposal to store all of the data for any length of time. As a result, a comprehensive weather discussion requires accessing numerous websites to find the right data to illustrate whatever weather system is under consideration, wasting valuable class time. The proposed setup would allow much if not all of the weather discussion to be held within the confines of the Rutgers Weather Center website. For example, many of the highest resolution model grids are not currently ingested by the LDM server, nor are any ensemble members, and therefore this information is not available on the website. When the new LDM server is combined with adequate disk space in the form of a 4 TB RAID array, the information available through the Rutgers Weather Center and within the classroom will essentially be unlimited.

The computer lab in which the senior-level meteorology courses in synoptic and dynamic meteorology are held is stocked with 11 modern and 8 nearly modern Windows PCs. The department has obtained these machines using internal instructional support provided by the university. With around 15–20 students in each undergraduate meteorology class, the size of the computer lab is fine for the time being. The lab machines perform well enough to run IDV (especially the newer PCs), and they run a commercial X-Server through a university site license. However, the lab is used by numerous environmental sciences courses as well, so it is essentially in use non-stop during waking hours Monday–Friday. Because of this, rather than installing a dual-boot setup including Linux on each PC, a

“synoptic server” has been set up that each PC can be logged into. The synoptic server has access to stored weather data via NFS, and has the full suite of GEMPAK software installed. Students working on an assignment using their own computer or a university-run computer lab can log into the synoptic server and run GEMPAK from anywhere in the world. The current synoptic server is a repurposed Pentium-class PC with 512 MB RAM. It has proven itself adequate to handle concurrent command-line driven GEMPAK sessions, but the system quickly bogs down when GARP is brought into the picture, let alone a web server. The proposed synoptic server is powerful enough to handle multiple logins for GEMPAK, GARP, etc., while also relieving the LDM server of web server and most graphic generation duties.

Usage by Undergraduate Courses

Synoptic Meteorology:

The laboratory portion of the senior-level synoptic meteorology course has been revamped to make extensive use of GEMPAK. Students access GEMPAK by logging into the synoptic server from the departmental computer lab or their own machines. The upgraded synoptic server will allow students to carry out labs more quickly. Students are also required to lead weather discussions throughout the semester. As part of their weather discussion, students must incorporate their own GEMPAK-based figure illustrating some process relevant to the class. The increased data choices made feasible by the upgraded LDM server will provide the students with more options to fulfill this requirement.

Mesoscale Meteorology:

Mesoscale Meteorology in particular makes use of GARP to display real-time animated overlays of satellite and radar imagery during severe weather season. The upgraded synoptic server will allow these animations to flow much more smoothly on students’ workstations, especially when approximately twenty students may be attempting to display animations simultaneously. The ability to access large amounts of Level II radar data will be a boon to this course as well. Students in both the synoptic and mesoscale meteorology courses are encouraged to volunteer plot-generating scripts that may be useful additions to the Rutgers Weather Center website.

Meteorological Analysis:

Students in this course use the Rutgers Weather Center website to lead a weather discussion. The revamped website made possible by this proposal will allow the discussion leader more flexibility in choosing the particular data to show.

Dynamic Meteorology:

The occasionally obscure mathematics of dynamic meteorology is applied to current weather using GEMPAK tools during a few lectures of this course. The upgraded equipment will allow this to continue.

Usage by Research Groups

Various groups within the department carry out research runs of the Advanced Research Weather Analysis and Forecasting Model (WRF-ARW). Those runs require boundary conditions, which in the case of real-time runs are best provided in the form of NWP output from varying models on varying grids, all of which are ingested by the LDM server. The LDM upgrade and increased storage space will allow all model runs transmitted through the IDD to be ingested, increasing the flexibility of the WRF-ARW runs. Model comparison and verification studies will also be enhanced by the availability of additional model runs.

Additionally, the Center for Environmental Prediction (CEP) housed within the department carries out climate change, paleoclimate, and NWP model runs on a set of computer clusters. However, disk space on those clusters is at a premium, so any space available on the 4TB array requested in this proposal will be able to be utilized to store model runs, at least on a temporary basis.

Benefits to the Community

As the land-grant university for the State of New Jersey, Rutgers includes within its mission service to the citizens of the state. The Rutgers Weather Center is one of the ways that mission is fulfilled. The upgrades envisioned within this proposal would support an ongoing overhaul of this website, which is viewed by the public as well as students and faculty within the department. Of course, many websites exist that provide basic weather information, but few if any focus on the state of New Jersey as a whole. Even the National Weather Service divides the state into two County Warning Areas. This allows the Rutgers Weather Center to fill a niche. An example of a product not currently available online would be graphics of high-resolution model output covering just the New Jersey area. AWIPS Grids 211 and 212 do not contain many grid points within the borders of the state!

In addition, the equipment upgrades will provide benefits to the Unidata community. The current LDM server provides data to the University of Massachusetts Lowell, so an upgraded server will immediately be able to feed that institution additional data. The new server will also be able to play a more active role within the IDD hierarchy, fulfilling any data routing requests of the community at large.

Relationship to Existing Facilities

In addition to the LDM server, synoptic server, and 19 Windows PCs previously mentioned, the Department of Environmental Sciences currently maintains a departmental web/email server, Active Directory server, and approximately 150 individual workstations, many of which are used for purposes completely unrelated to meteorology. Several printers, a scanner, and a large format poster printer are also available. The department's assessment of the current computing facilities shows the

weakest link to be the current LDM and synoptic servers, which this proposal addresses. It is not anticipated that any other computer needs relevant to the UPC will be evident in the short or medium terms.

The department also maintains the following three Linux clusters used by CEP:

- 1) An AMD-based x64 cluster with one head node and 6 cluster nodes
- 2) A Dell PowerEdge 2650 x86-based cluster with one head node plus 6 cluster nodes.
- 3) A Dell PowerEdge 1650 x86-based cluster with one head node plus 12 cluster nodes.

The total disk space maintained by the department (including space on the clusters) runs to about 15 TB.

It should be noted that the Department of Geography at Rutgers also runs an LDM server. That department, located about five miles distant on a separate Rutgers campus, is home to the New Jersey State Climatologist Office and the New Jersey Weather and Climate Network, but it is not involved in undergraduate education in meteorology. However, any new data sources stored by the upgraded LDM server within Environmental Sciences will be made available to the Department of Geography upon request.

3) Budget

This proposal contains hardware costs only. The Environmental Sciences system administrators will procure, install, and maintain the systems. Quoted prices come from Dell, taking into account the current discounts negotiated between Rutgers and Dell. Rutgers will waive all indirect costs associated with this proposal, but will not offer cost sharing. However, the university does support the overall computing needs of the meteorology program, as the previous upgrade of the PCs in the computer lab has shown.

Justification for the primary equipment is interwoven within the above narrative, but it is worth noting the rationale for the supporting equipment here. The uninterruptible power supply is necessary to protect the computer equipment from the transient power fluctuations and brief under/overvoltages known to plague the electrical grid on the Rutgers campus. The network switch will provide dedicated connectivity between the servers and the RAID array. Finally, the KVM switch and rack console will allow the new equipment to be efficiently housed and managed while providing room for future expansion.

The budget is as follows:

LDM Server	\$2700
Synoptic Server	\$3850
4TB RAID Array	\$6100
<i>Primary Equipment Subtotal</i>	<i>\$12650</i>
Rack	\$1000
Uninterruptible Power Supply	\$750
Network Switch	\$420
KVM Switch	\$300
Rack Console	\$1335
Indirect Costs (Overhead)	\$0
<i>Supporting Equipment Subtotal</i>	<i>\$3805</i>
Grand Total	\$16455

4) Project Milestones

The hardware will be purchased in June 2008 if not sooner. In order to set up the machines in an optimal manner, our system administrator with Linux expertise will participate in the July LDM and GEMPAK training workshops (and perhaps others). Installation will be complete before the beginning of the Fall 2008 semester. Students taking synoptic and mesoscale meteorology during the 2008–09 academic year will be introduced to the additional weather data available so they can make use of it during weather discussions and case studies. Students will also have the opportunity to contribute their own scripts that may be used to generate plots of interest on the Rutgers Weather Center website.