

LTER Field Station Connectivity Supplement for the Andrews Forest

Introduction

This supplemental request by the Andrews Forest LTER is being made to advance long-term environmental science through the broader and more consistent applications of internet connectivity. Although a T-1 (1.54Mb/s) is considered to be the minimum speed for effective data communication to field sites, our site has only had access to basic telephone service that allows data communications at a maximum rate of 56Kb/s. Andrews is therefore considered a remote site for the purposes of this supplement. Despite being a remote site as far as connectivity is concerned, facilities at the Andrews are generally excellent as far as housing, laboratories, and other workspaces are concerned. Unfortunately, computer facilities are antiquated with only one Pentium machine that is publicly available to user scientists, and the rest of the computers are lower powered machines (486's and 386's). We propose to establish a T-1 connection to the Andrews Forest and improve the LAN so that: 1) those using the site have full access to our main data repository in Corvallis; 2) high-speed connectivity is possible to other field sites via the internet; 3) those not at the site have access to the latest data on climate, hydrology, and conditions relevant to their research; and 4) fast access to electronic mail is possible. The value of these capabilities should not be underestimated. For example, we were able to make very important observations during the February 1996 flood because our existing telemetry provided on-line hydrographs that indicated a "big one" was developing. That alert enabled us to get to the field to record observations (including by video). Unfortunately, as the storm developed, the only real time records available were from the USGS; our own data was not available for several weeks. The proposed connectivity upgrade will greatly enhance our ability to observe extreme and episodic events, times when ecosystems can change radically. Connectivity Improvement Plan

The overall goal of this supplement request is to convert our existing information system at the Andrews Forest from an isolated, irregular, low-tech situation to a high-end system that is fully-integrated with offices and data archiving facilities on the OSU campus, as well as linked to the Internet via a high-speed connection. The short-term objective of this supplement is to provide a minimum standard connectivity installation from the Andrews Forest to other locations including our principal offices in Corvallis. This will consist of connecting to and maintaining a T-1 line to the site and upgrading our current on-site LAN to a uniform and modern system. We will also install an uninterruptible power supply at the site to compensate for the frequent power outages that have plagued this remote site since its inception.

In the long-term, we will build data connections among the various Schoolyard LTER programs with whom we are currently developing working relationships. We feel it is premature, however, to connect with these sites at the T-1 level at the present time because the specific measurement programs that will be maintained by the schools have not yet been developed to a level that requires a T-1 connection. To foster this higher level of interaction, we will move on two fronts: (1) we will train educators how to interact with us via our website, this will also expose them to the rich possibilities of Internet-based research and scholarship; and (2) we will develop web-based protocols for simple data entry, archiving, and analysis that will allow schools to be truly interactive with our research program. The classes will be held in the new education facilities at the Andrews Forest.

Installation of the T-1 line. Our plan is to connect the Andrews Forest via T-1 line to a hub at the Willamette National Forest Supervisor's Office in Eugene from where it would be routed to the OSU campus at the Forest Science Laboratory. We previously arranged for US WEST to lay a T-1-capable line when they were upgrading phone lines to the Andrews Forest. In the 4 years since this line has been in place, we have not been able to afford either the connection or the annual service fees. This supplement is therefore crucial to exploiting the current resources potentially available to our site.

To connect to this T-1 line we will need to purchase a T-1 junction box for the Andrews Headquarters site and do a modest upgrade on the connection on campus; these items will total \$16,000. In addition we would like to link our phone system to the T-1 line in order to handle voice as well as data; the cost for a Y2K-compliant phone switch to achieve this objective will be \$25,000. The service cost to establish the actual T-1 connection by US WEST is \$5,000.

Continuing Connection Costs. The T-1 link for internet service will be provided by US WEST for a yearly fee of \$13,000. This will be arranged in a long-term service agreement that is paid in advance.

Endpoint equipment. To take full advantage of this improved communication with the "outside" world we will need to make investments to upgrade the LAN at the Andrews Headquarters site. One machine currently serves as both our LAN and web server; an older Pentium operating at 90 mhz with an 8 Gigabyte RAID. This is already inadequate and will only be worse with a T-1 line. We propose to replace this out-dated machine with 1) a separate Novell network server and 2) an NT-based web server; each would have a 54 Gigabyte RAID attached.

Our mail server will be a Spark Ultra-10 UNIX machine with 18 Gigabytes of harddrive storage. By moving to a UNIX-based system we will be able to support PopMail locally, and thereby significantly reducing network traffic over the T1 line. This will also

allow us to completely integrate the Corvallis and Andrews mail systems, thus reducing administrative costs.

In addition to these machines, we plan to upgrade several of the workstations available to visiting scientists, students, and various teacher trainees. We have over 200 resident visitors to the site each year that fall into this category. We receive many comments about our **arcane and out-of-date computer network**. While the network backbone is modern (100-base hubs, switches, wiring), the computer workstations are out-of-date (mostly 486 computers) and host a mix of operating systems, including DOS, Windows 3.1, Windows 95, and Windows NT. This makes maintenance difficult and it is sometimes impossible to provide current software or to use the Internet fully. Our plan is to switch to a Windows NT-based system run off a Novell network and to replace some of the older workstations with current technology that can fully utilize our proposed Internet connectivity improvements. The two NT-based machines requested will primarily be used by visiting scientists, trainees, and students. We feel this is the minimum number of new machines that should be available for general use. During our peak season this means that we'll have between 35 and 40 potential users per machine. Clearly we will need to find support beyond this request for additional computers, but the investments provided by this supplement will make this an easier task and a very worthwhile goal – a major constraint, the connectivity bottleneck will have vanished.

Finally, we have developed a telemetry system to download, reformat, and store data on a website from our remote climatological and hydrological stations. Unfortunately, the computer currently used for this purpose also serves as the primary computer for the LAN manager. This arrangement is less than ideal as it leads to conflicts that slow the performance in providing real-time data. We will therefore add an NT machine that will be solely dedicated to the task of querying and downloading data from these remote stations as well as reformatting the data for web access. This will improve response times dramatically, allowing access to real-time field data for those interested in scheduling sampling around certain climatic or hydrologic events.

Uninterruptible Power Supply. Being a remote field site, steady electrical power to the Andrews Forest is not guaranteed. The frequency of power outages varies from year to year, but 5 to 20 times per year has occurred historically. Unfortunately, these power outages tend to occur when "interesting" events are happening at the Andrews Forest. To provide ready access to data from the Andrews we need to invest in an uninterruptable power supply for the site's computer network. This would allow the site to continue to update data from remote measurement stations during these events. Additionally, permanent staff, visitors, and local conference attendees will be afforded continuous computer network and phone services during the outages.

Benefits. The Andrews Forest is a world-class research site that has been living with a severe connectivity bottleneck. The linkage to campus and the internet has been via a 56-kbs port that has limited the nature of the research possible. For instance, we do not have good, on-site GIS capability or ability to conduct remote-sensing research because of hardware limitations, and inability to move the kinds of large data sets associated with these two areas. This award would make these kinds of uses possible.

Our ability to handle e-mail has been problematic, and Internet activity is severely limited by the low level of connectivity. It is not unusual for several minutes to pass while a dozen e-mail messages are downloaded on a pop mailer. Web pages paint VERY slowly on the screen, and users find themselves trying to work on something at the same time they use the web. This is not conducive to establishing the kinds of web-based interactive educational programs we envision for our Schoolyard LTERs. This award will greatly speed e-mail traffic and create wonderful opportunities for K-12 interactive learning.

In general, if this request is funded, we will no longer need to struggle to find ways around the sorts of information/communication problems that have hobbled development in several areas. In sum, our Internet connectivity will have caught up with the creativity of the Andrews Forest LTER program.