

Virginia Coast Reserve Long-Term Ecological Research CONNECTIVITY SUPPLEMENTAL PLAN 1999

We request a supplement to the Virginia Coast Long-Term Ecological Research (VCR/LTER) Project (NSF grant DEB-9411974) to support development and maintenance of a high-speed Internet connection to the University of Virginia Coastal Research Center (UVACRC) which is the host laboratory for the VCR/LTER Project, to enhance the on-site network of the UVACRC to allow efficient use of the high-speed connection and to enhance the network connections of our Scholastic Long-term Ecological Research (SLTER) partner institution (Northampton County High School) to better support SLTER activities.

Internet Connection

The first part of the request is to develop and support a high-speed (1.5 MB/s) Internet connection to the field laboratory of the Virginia Coast Reserve Long-Term Ecological Research (VCR/LTER) project. This connection will expand the range of activities that can be conducted at the field site and provide improved communication facilities for researchers.

There are a wide range of research activities that will be enhanced by a dedicated, high-speed Internet connection. Some of them depend on VCR/LTER-specific data sources. The first of these is the use of remote-sensing data. Current transfer mechanisms for voluminous remote-sensing data are restricted to physical media such as tapes, ZIP disks and CD-ROMs. A high-speed Internet connection will allow researchers on the shore to access archives of remote-sensing data that are maintained on the grounds of the University of Virginia in the computer archives of the VCR/ LTER. A second use of the connection goes the other way. Researchers at the VCR/LTER have been making extensive use of the Global Positioning System (GPS) to conduct detailed land surveys of research sites. Recently this system was enhanced by addition of a digital depth sounder and software to allow GPS surveys of lagoon bottoms. Currently the voluminous data derived from these surveys (several megabytes per day of surveying), is maintained on computers at the UVACRC, with no network access to the raw data. Access to this data will permit a wider array of researchers to conduct geographic, topographic and hypsometric analyses using VCR/LTER-collected data. There are additional data resources, such as meteorological, tide and ground-water data, which are collected using automated networks of instruments and data loggers. These data are currently transferred in batch-fashion to the University of Virginia for display on the WWW. However, addition of a dedicated Internet connection makes real-time data displays possible. These real-time displays will be especially useful for reaction to events, such as large storms and for use in education.

Good access to data at other LTER sites and other data resources elsewhere on the Internet will be a major enhancement of research capabilities at the UVACRC. Current access to large datasets collected at other LTER sites is limited due to bandwidth constraints, which will be eliminated by development of a high-speed connection. The connection will also facilitate access to non-LTER resources. Among the most important of these will be access to library resources, including the increasing number of journals supporting full-text access. Current network connections provide insufficient bandwidth to make reasonable use of these resources.

A final use of the increased bandwidth provided by a 1.5 MB connection is in the area of collaborative technologies. Over the past 6 months we have been exploring the use of Internet teleconferencing facilities using commercial software, such as Microsoft Netmeeting[®] using an existing low-speed connection. Our experiments have been only partly successful due to two parts. First, our existing connection is too slow to reliably transfer sound and video. Second, our existing connection needs to traverse the commodity Internet, which is subject to congestion. Addition of a high-speed connection with a direct link to high-speed

educational networks (such as the vBNS) will go a great way in ameliorating these problems. We anticipate that this will be a strong growth area in our use of the network as the network is used as a communication resource between students and investigators and between collaborating investigators.

Existing & Planned Field Laboratory Facilities

The Virginia Coast Reserve Long-term Ecological Research Project utilizes field laboratory facilities in Oyster, VA. The laboratory is known as the University of Virginia Coastal Research Center (UVACRC). The current facilities of the laboratory are in a rented structure which houses up to 20 researchers, chemical laboratory facilities and a small computation laboratory. All necessary equipment for the field stabilization of chemical and biological samples are in place at the UVACRC laboratory including: refrigerators, freezers, filtration equipment and pumps, ovens, muffle furnaces, balances, pH meters, salinometers, oxygen meters, and incubators. We also have the capability to analyze water, soil, and sediment for nutrient concentrations on site: A deionized water system and a Hitachi 200 UV-visible spectrophotometer have been installed. Three out-buildings at the Oyster laboratory are also available for the use by the VCR LTER. One of the buildings has been renovated and equipped as a shop to provide investigators with on-site ability to construct equipment. Another of the buildings contains ovens, muffle furnaces, and tables for drying samples and specimens. The third building is used for storage of field equipment. The basement of the laboratory has been renovated to provide areas for washing and sorting of field samples, and for storage of herbarium samples.

Facilities available to the VCR LTER investigators include the UVACRC, the Department of Environmental Sciences (UVA) laboratories, and three computing

facilities (one at the UVACRC laboratory in Oyster, VA, one housed in Environmental Sciences Building at UVA and the other in the Academic Computing Center at UVA).

Computational resources include pentium-based PCs running Windows NT, 98 and 95 and UNIX workstations (Sun and RS6000) running ERDAS IMAGINE and ARC/INFO software. Field equipment includes three Global Positioning System (GPS) units, two of survey (<0.1m accuracy) quality and a Pentax SC-5 Laser Total Survey Station. Three permanent meteorological stations are in place; one in Phillips Creek Marsh on the mainland, one on Hog Island and an additional station in Oyster VA. Seven permanent water-level recorders are used to monitor tides on the barrier islands and mainlands. Additional tide gages are available for short-term deployment at specific research sites. Meteorological and tide data collected at the permanent stations are available on the VCR LTER homepage (<http://www.vcrlder.virginia.edu>). The VCR LTER maintains and operates a small fleet of 5 boats ranging in size from a 13' boston whaler to a 24' privateer with cabin. The boats are available for use by qualified operators or reservations can be made with the two full-time, on-site staff for a boat operator to assist with field logistics.

Within the next 12 months we anticipate the initial construction of a new and expanded laboratory facility. The expanded laboratory will house up to 40 researchers and chemical, microbial, sediments and vertebrate laboratories, along with an expanded computational facility.

Existing Network Facilities

Current Internet access at the UVACRC field laboratory is extremely limited. A 56 KBS modem is used to connect to a commercial Internet provider located in Norfolk, VA. Due to limitations of the phone lines, modem throughput is typically limited to 33 KBS or less. This modem-based connection is shared among 6 computers in the laboratory using Wingate software. Although adequate to provide basic email and limited WWW access, this system is rapidly being outgrown by researcher and staff needs. It is insufficient to support development of WWW resources on the shore due to lack of a dedicated connection and associated stable IP addresses. As noted above, limited bandwidth has hampered our attempts to utilize collaborative

technologies to allow remote participation in meetings.

Proposed Network Facilities

We propose to enhance the connection to the UVACRC laboratory by increasing the bandwidth to 1.5 MB/S and connecting directly to high-speed educational networks. Our proposed connection will be provided by Network Virginia.

The Network Virginia WWW page (<http://www.networkvirginia.net>) provides the following description of Network Virginia:

"NET.WORK.VIRGINIA is an advanced, broadband network delivering ATM (asynchronous transfer mode) service statewide. It is the result of a project led by Virginia Tech in association with Old Dominion University and the Virginia Community College System to develop universal access to advanced digital communications services for all of Virginia.

With over 400 participating sites, NET.WORK.VIRGINIA offers access to an incredibly rich array of educational and information resources. Participants include four year colleges and universities, the Virginia Community College System, private schools, and several K-12 school systems. Also, many state agencies are taking advantage of NET.WORK.VIRGINIA including the Department of Health, the Virginia Employment Commission, the Department of General Services, the Virginia State Library, the State Police, the Institute of Marine Science and others. Any site can be connected to NET.WORK.VIRGINIA by an eligible institution for the purpose of delivering educational programs to that site.

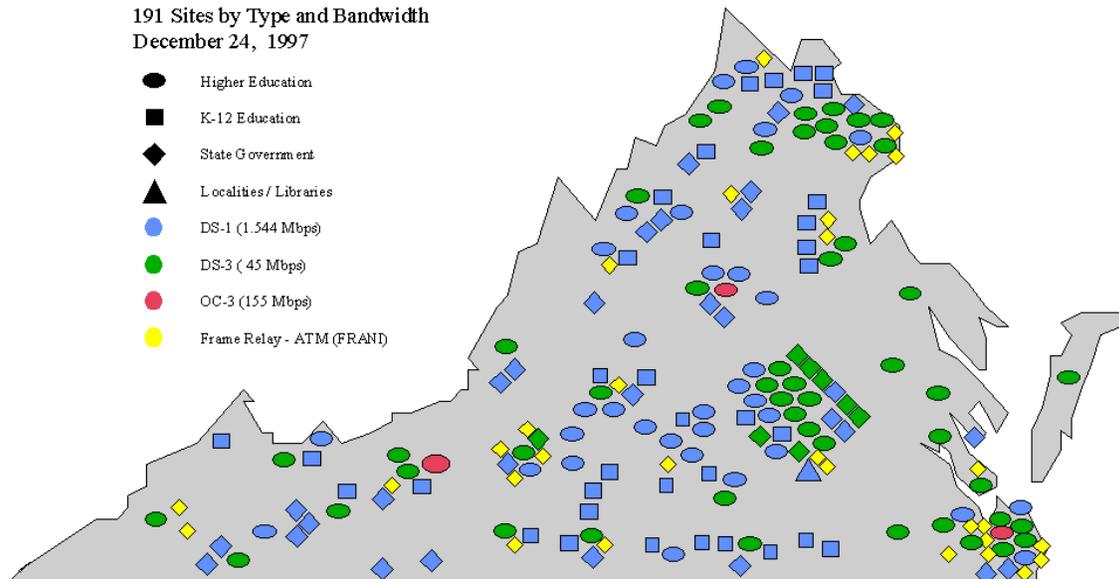
The network has very high capacity and can deliver simultaneous transmission of fully interactive voice, data, and video services. An Internet gateway is included which is open to all participants. A single connection to NET.WORK.VIRGINIA can be used to support different types of multimedia connections simultaneously. The bandwidth can be flexibly allocated and reallocated as needed. ATM services have built-in, quality of service controls allowing users to prioritize resources and tailor capacity utilization to match application requirements. Virtually any type of application or communication service can be transported across NET.WORK.VIRGINIA.

Gateways currently deployed and under development to the Internet, to the National Science Foundation's vBNS network, to the Department of Energy's ESnet network, and to numerous other national and regional network initiatives extend the reach of this powerful information resource beyond the bounds of the Commonwealth. Also, value added services will provide shared access to important information resources greatly expanding the scope of access to those resources and reducing the cost for all participants."

Figure 1 shows institutions already connected to Network Virginia.

NET.WORK.VIRGINIA
 191 Sites by Type and Bandwidth
 December 24, 1997

- Higher Education
- K-12 Education
- ◆ State Government
- ▲ Localities / Libraries
- DS-1 (1.544 Mbps)
- DS-3 (45 Mbps)
- OC-3 (155 Mbps)
- Frame Relay - ATM (FRANI)



By Bandwidth

DS1 Sites	100
DS3 Sites	57
OC3 Sites	3
FRANI Sites	31

By Type

Higher Education	86
K-12 Education	35
State and Local	70

(From <http://www.networkvirginia.net>)

Network Virginia will provide a DS-1 connection at 1.5 Mbps. We will provide the router (a Cisco 3810 Router). The budget includes installation fees for both the existing UVACRC laboratory and the enhanced UVACRC.

Upgrade of VCR/LTER Network

In order to make efficient use of the increased bandwidth provided by the Network Virginia connection we propose to enhance the internal network of the UVACRC. First, we propose to upgrade and extend the local area network. The current network is a 10Base2 network using coaxial cable, restricted to a single room of the existing laboratory. 10Base2 networks are widely being replaced by 10BaseT or 100BaseT networks due to their greater speed and/or reliability. We propose to expand the LAN to include all the laboratory and living structures in the expanded laboratory facility and to upgrade the capabilities to 100BaseT to maximize the utility of the system for bandwidth-intensive tasks.

We also propose to add a server running Windows NT to the network. This server will provide support for a local WWW site, disk storage for large datasets and backup capabilities for the network.

Scholastic Long-Term Ecological Research Enhancement

The VCR/LTER has developed a link with teachers and administration at Northampton High School and other schools within the Northampton Co., VA public school system. Scholastic Long-Term Ecological Research (SLTER) projects focusing on fostering an approach to long-term research at the K-12 level and on sharing data between LTER and SLTER associated sites. Our primary connections in our developing SLTER effort have been at Northampton Co. High School.

Good network connections are a primary route for data and information sharing between LTERs and their associated SLTERs. The Northampton County School System has a T1-based link to the Internet via Bell Atlantic and WHRO Internet. Individual schools are then connected with high-speed ISDN lines. However, Internet, and other network connections at the high school have been troubled by failures of outdated network equipment on their LAN. We propose to improve the networking of the VCR/LTER with the VCR/SLTER by upgrading switching equipment and converters. The enhanced connections will facilitate improved network interactions between the high school and both UVA and UVACRC resources.