

Wireless Communication for Research and Education at the Virginia Coast Reserve LTER Project

The Virginia Coast Reserve Long-Term Ecological Research project has as its focus the ecology of the relatively pristine barrier islands off the coast of the Delmarva Peninsula. In response to a logistically challenging environment, characterized by large but shallow bays and blood-sucking insects, we have developed wireless networks using commercial-off-the-shelf components that link the barrier islands to one another and to our laboratory on the mainland. The network backbone connects the Anheuser-Busch Coastal Research Center on the mainland to Hog Island, 22 km distant, via a proprietary 900 MHz network radio at 3 Mbs. It includes amplified Wi-Fi (802.11b,g) access points at two major nodes at both ends of Hog Island. These provide broad coverage of the adjoining barrier islands and bays.

Integral to exploiting the scientific utility of the network are database systems that automatically ingest, process and disseminate information in both numerical and graphical forms via the World-Wide Web. To this end we have developed systems that control web cameras to monitor selected sites and harvest and store images in a relational database system. Currently over 560,000 images from 2002-2007 are available in a relational database via the “Ecocam” web site. This database is then linked to query tools that support a variety of display options, including change detection and animations. See the attached resources for more information on the system and some demonstration products.

Additional Needs

Scientific research and educational needs both would benefit from an expanded network that provides access to a wider array of field sites, both on the barrier islands and on the mainland. Cyberinfrastructure, including computers and software development, to support the collection, analysis and archiving of images and other data are required.

We would like to expand our existing network to include additional research locations including: Smith Island, Cedar Island, Fowling Point Marsh and Phillips Creek Marsh ([see web map in resources](#)). Additionally, we would like to implement a high-speed wireless connection to Northampton High School (existing wired network links are insufficient to support IP-based videoteleconferencing). Additionally, we would like to make our network more robust by adding multiple links to each node, so that failure of a single node will not lead to a cascade of failures as more remote nodes are disconnected. Equipment cost per node is estimated at \$1250 for an amplified-Wi-Fi radio with directional antenna and 100 watts of solar panels (sufficient to allow daytime operation, with limited night-time operation). Adding an additional link to each node is estimated at an additional \$750.

Additionally, we would like to develop “turnkey” nodes that can be easily set up by researchers to support specific research applications. These nodes would be similar in cost to the fixed nodes.

We would also like to expand development (preferably collaboratively) on developing information systems for the management and display of webcams and other data. Equipment costs would be for two Linux workstations equipped with large capacity (1 TB+) disks are estimated at \$2000 each.

Personnel costs are harder to estimate (especially for the information system development), but are estimated at \$10,000 for configuring and installing the additional nodes and an additional \$10,000 for programming support for developing improved data systems.

VCR/LTER Contacts

- John Porter (jporter@virginia.edu) – VCR/LTER Information Manager
- David E. Smith (des3e@virginia.edu) – Lead investigator on “Ecocam” project, who also has been working on field videoconferencing for education
- Thomas Williams (tom@airnetworking.com) – Works on connectivity issues within the VCRLTER including connection of networks of wells and meteorological stations
- Steven Macko (sam8f@Virginia.EDU) – Has organized numerous remote education projects with Africa, the Eastern Shore of Virginia and local high schools

Resources and Links

Google Map of Wireless Nodes and Proposed Nodes.

<http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&ll=37.527154,-75.684814&spn=1.877534,3.718872&t=h&z=8&om=1&msid=118142616587666633825.0000011369c3878e8ed42>

Recent Paper on VCR/LTER Wireless uses

<http://cheetah.cs.umb.edu/ocs/viewpaper.php?id=33>

Virginia Environmental Endowment “Ecocam” web site – educational materials, tools for accessing image database and change detection. See below for some highlights.

<http://ecocam.evsc.virginia.edu>

Hurricane Isabel as seen from Broadwater Tower in 2003 (sample image animation display from the Ecocam web site):

Animation (works best with Mozilla):

<http://ecocam.evsc.virginia.edu/archive/img1098733322/>

Hog Island Bay freezing in the winter of 2003

<http://ecocam.evsc.virginia.edu/archive/img1099700134/>

Timelapse video of Heronry on Chimney Pole Marsh (44 MB)

<http://ecocam.evsc.virginia.edu/html/modules.php?op=modload&name=Downloads&file=index&req=getit&lid=2>

Panoramic webcam scan of the area around the Machipongo Station node that is used for analyzing foraging habitat use by Egrets.

<http://www.vcrlter.virginia.edu/wwwcam/machipongo/pan/2007/06/birdpan0706261430/index0706261430.html>

Wireless Networking for Ecology web site – contains information on wireless networking technologies. A companion to the 2005 Bioscience paper.

<http://wireless.vcrlter.virginia.edu>

Meteorological Data from Hog Island updated every few hours using a wireless link

<http://www.vcrlter.virginia.edu/data/metdata/index.html>