Julio Ibarra, Peter Allen, and John Munroe – St. Croix VBLA Station

OPERATIONAL PLAN FOR UPGRADING THE INTERNET CONNECTIVITY OF THE UNITED STATES VIRGIN ISLANDS (USVI): UNIVERSITY OF THE VIRGIN ISLANDS (UVI), ST. CROIX VBLA RADIO ASTRONOMY STATION AND OTHER RESEARCH AND EDUCATION FACILTIES

A WHITE PAPER COMPOSED BY AMPATH CO-PRINCIPAL INVESTIGATORS JULIO IBARRA AND HEIDI ALVAREZ AND EDITED BY:
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Background:

The AmericasPATH (AMPATH) network and International Exchange Point (IXP) for Research and Education is an FIU project sponsored in part by the US National Science Foundation CISE-ANIR division, in collaboration with Global Crossing (GC) and other telecommunications product and service providers. Using Global Crossing's terrestrial and submarine optical-fiber networks, AMPATH is interconnecting the research and education (R&E) networks in South and Central America, the Caribbean and Mexico to US and non-US R&E networks via Internet2's Abilene network and the StarLight International Exchange Point.

The purpose of the AMPATH project is to allow participating countries to contribute to the research and development of applications for the advancement of Internet technologies. The mission of AMPATH is to advance research, scholarship and cultural exchange by facilitating high-performance connectivity and the development of advanced Internet applications among the populace of the Americas. AMPATH facilitates international Internet exchange for research and education in the Americas and fosters collaboration for grand challenge e-Science and Educational Outreach to underserved populations both in the US and abroad.

AMPATH uses (10) DS3 connections donated to Florida International University by Global Crossing to link each participating country's Research and Education (R&E) networks to R&E networks in the US and abroad, via Internet2's Abilene backbone. One of these DS3 (45 Mbps) circuits has been designated to the USVI, since the Global Crossing Network has a cable head in St. Croix. Initial contact was made with faculty at the UVI beginning in March, 2000, though no formal investigation of feasibility was done until the start of 2003, since local infrastructure issues and critical need did not surface until recently.

Statement of Needs:

UVI has the need to form collaborative relationships with both US universities and research centers as well as other Caribbean universities to advance their distance learning, educational outreach, and future research capabilities. Professor Lynn Rosenthal, both a Computer Science faculty and the Director of Distance Learning for the UVI has been designated lead to find a way to connect the UVI to Internet2 and to improve commodity Internet services. Rosenthal expressed a strong desire to collaborate closely with AMPATH and FIU whether the most cost effective and bandwidth sufficient physical network connection ends up being through AMPATH or the University of Puerto Rico (UPR).

Research Applications in USVI:

New initiatives in research and EHR development will require increased Information Technology (IT) capacity. Advanced communication and data-transfer capabilities will be needed to support collaborations between UVI and the University of Puerto Rico, the University of Georgia, Woods Hole Oceanographic Institute, the University of Miami, and others. There is a potential for large data sets in GIS representations of marine benthic habitat maps, bathymetric data, or data generated from oceanographic side scan sonar studies. The projected installation of a NOAA oceanographic and meteorological data logger will produce video streams transmitted for inclusion in NOAA dissemination.

University of the Virgin Islands – St. Thomas Campus

Development of meteorological research capacity will require real time access to online weather databases maintained by cooperation among agencies such as NOAA, WMA and the national weather service. Development of 3D visualization technologies will require real time, high bandwidth communications. Application of distributed parallel computing technology to analyze simulations and modeling will require collaboration with U.S. institutions developing computing clusters. IT support will be required for reference library resources including digital video libraries.

IT facilities and equipment upgrades requested under VI-EPSCoR Research Infrastructure Improvement funding to meet these needs will include a maintenance system for tracking of all UVI research equipment and integrated maintenance/help desk response, delivery of 100Mb to researcher's desktops in the three buildings on the St. Thomas Campus and establishing DS3 connectivity to ISP providers. UVI will partner with Florida International University to participate in I2 scientific collaboration initiatives in order to compete for grant funds for the actual I2 connection operating expenses, port charges, etc., and for grants to sustain and extend IT improvements. A network engineer with the high level skills required to design, install and supervise operation of increased network capacity will be recruited.

Distance learning is also a strong driver for improved communications, particularly delivery of instruction in the Caribbean region.

Seismic application - Christa von Hillebrandt christa@rmsismo.uprm.edu, UPR faculty on the Mayaguez campus has a seismic application that requires UVI participation.

The Very Long Baseline Array (VBLA)[1] – The National Radio Astronomy Observatory (NRAO) is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc. The VBLA array, which consists of 10 radio telescopes spanning from St. Croix across the continental US to Mauna Kea in Hawaii, is participating in a worldwide project called ***e-VLBI***[2]. The St. Croix VBLA station is located on the eastern end of the island approximately 7 miles from the Global Crossing cable head in Frederiksted. Currently, receipt of data is not real time to the radio astronomers involved. The AMPATH team is working with Alan Whitney, Associate Director of the MIT Haystack Observatory, Gareth Hunt, Deputy Assistant Director Data Management NRAO, Charlottesville, VA and Jon Romney, staff scientist, NRAO, Socorro, NM, and site manager Peter Allan on St. Croix.

Examination of facilities:

On June 5th through 9th, 2003 the AMPATH team consisting of Co-PIs Julio Ibarra (PI) and Heidi Alvarez visited with interested parties in St. Thomas and St. Croix. The primary meeting took place on June 6th on the St. Thomas campus of the UVI. In attendance were the following key faculty and administrators:

Marc Boumedine mboumed@uvi.edu (340) 693-1255, Computer Science Professor
Elizabeth (Beth) Heyliger, UVI CIO bheylig@uvi.edu
John Lucas jlucas@uvi.edu , Computer Science, St. Thomas Campus
John Munro jmunro@uvi.edu, Computer Information Systems faculty on St. Croix
Lynn Rosenthal lrosent@uvi.edu, Director of Distance Learning
Dr. Dave Smith dsmith@uvi.edu, Computer Science
Roy Watlington rwatlin@uvi.edu, VI-EPSCoR Coordinator

On June 5th Ibarra and Alvarez met with Derek Hodge[3], derek@mackayhodge.com Mackay & Hodge, LLC and had subsequent telephone conversations with him. Derek has expressed an interest in acting as a facilitator to achieve AMPATH / Internet2 connectivity in the USVI for the advancement of education and the development of

[1] http://www.aoc.nrao.edu/vlba/html/VLBA.html

[2] With the world increasingly wired for high-speed data communications, the prospects for routine global electronic transmission of VLBI data (dubbed 'e-VLBI') become brighter every day. Not only will e-VLBI help to eliminate costly and complex recording equipment, but it should eventually lead to data rates and volumes unattainable by traditional recording equipment. This will lead to improved sensitivity, allowing new science to be explored at lower costs. http://web.haystack.mit.edu/e-vlbi/meeting.html

[3] Derek Hodge was introduced to the AMPATH team by Washington D.C. telecommunications attorney, Curtis White of Allied Communications. Curtis White delivered the key note address at the AMPATH Workshop http://www.ampath.fiu.edu/miami03_bios.htm#curtiswhite Hodge was Lt. Governor of the USVI 1986 – 1992 and understands both the educational and telecommunications climate in the VI.

research agendas. He is also interested in working with the AMPATH team to offer more cost effective commodity Internet services to research, education, and government run health facilities.

UVI faculty interested in the project but not available during those dates include:

Dr. Al Lewit alewit@uvi.edu, Computer Science faculty on St. Croix
Dr. Michael Henry, Physics faculty - Physicist mhenry@uvi.edu
Dr. Henry Smith hsmith@uvi.edu, Project Director of VI-EPSCoR
Dr. Nora Andresian-Thomas, Physics faculty - Astronomer nthomas@uvi.edu

UVI St. Thomas

The campus is well situated in view of the airport and the Peak of Crown Mountain, where the nearest cross island microwave towers are located. Currently the St. Thomas campus pays in excess of $300 for ½ Mbps per month of commodity Internet service and does not have any Internet2 service. The local networking infrastructure on the campus delivers Fast Ethernet 100 Mbps to the desktop. There are video conferencing facilities available between the St. Thomas and St. Croix campuses that are used regularly over a microwave network connection run through the company operated by Gordon Ackley. The current UVI last mile connection is a T1 microwave service. UVI is a tower tenant with their own radio. UVI would have to build a new microwave system altogether to upgrade to a higher capacity connection to effectively utilize the DS3 of capacity to Internet2 provided by AMPATH.

There is a military link between Roosevelt Roads and Crown Mountain in St. Thomas. Mount St. George in Frederiksted, St. Croix has a clear shot to the UVI St. Croix campus. The USVI may get use of this bandwidth for free, but this is undetermined right now. The St. Thomas campus has a small but well staffed computer science department with faculty expertise in networking and grid computing who are well equipped to look into local networking infrastructure options.

UVI St. Croix

Due to limited time on this trip the AMPATH team was not able to visit the UVI campus in Frederiksted, St. Croix. We did meet with Professor John Munro in St. Croix and spent the day with him on a visit to the NRAO VLBA antennae. This provided the opportunity to learn a great deal about the Frederiksted campus and local telecommunications infrastructure on campus and throughout the island. Like the St. Thomas campus there is limited and pricey commodity Internet access and video conferencing equipment.

UVI Video Conferencing

The UVI Polycom systems on both the St. Thomas and St. Croix campuses use H.323. They have held trial conferences with other locations in the US and Caribbean but the bandwidth on the main connection to the Internet is insufficient for good performance. UVI has recently experimented with a 512 kbps ADSL and have had acceptable quality to St. Martin and the BVI. They have now ordered a dedicated DSL for this purpose and expect students at University of St. Martin to be participating in UVI classes in 2003/2004. The UVI distance learning director has approached institutions such as Hawaii where they hope to test commodity based Internet collaborations with marine science researchers once the DSL is in place. Such collaboration would be significantly enhanced by an Internet2 connection.

Microwave Facilities

Gordon Ackley (son of John Ackley of UVI who attended the first AMPATH meeting on March 8, 2000) runs the majority of the microwave towers between St. Thomas and St. Croix. Gordon Ackley just turned on a new link with Puerto Rico that goes to Crown Mountain (1 mile from UVI STT) and will go to St. Croix by October, 2003. This could eventually be a way for UVI to connect to UPR.

Telephone lines / Cable

Innovative Communications Corporation[4] is the monopoly telephone and cable provider for the USVI. Jeffrey J. Prosser is chairman, president and CEO of Innovative. Sam Eperson, one of the company executives, is a personal friend of Derek Hodge and Derek has offered to set up a meeting with Sam to discuss how Innovative can work with the UVI and the NRAO telescope to further their research and education goals in an affordable and complimentary manner. The meeting was tentatively scheduled for Sunday, June 8th but was postponed to a later date.

Global Crossing St. Croix Cable Station

Jim Smith is Station Manager at Global Crossing in St. Croix and John Munro, a UVI professor stationed on St. Croix has been in touch with Jim. John understands that there is dark fiber available from the Global Crossing cable station to the southwest area in Frederiksted 'town' with several access points along the route ending near Ackley's tower south of Smithfield. This dark fiber does not reach the UVI campus. The radio telescope is on the opposite end of the 7 mile long St. Croix island.

[4] Headquartered in St. Croix with operations throughout the U.S. and British Virgin Islands, St. Martin, Martinique, Guadeloupe and in France, Innovative Communications Corporation is the parent organization of Innovative Telephone, Innovative Cellular, Innovative Cable Television St. Croix, Innovative Cable Television St. Thomas-St. John, and Innovative Business Systems. CONTACT: Thomas Dunn, Director Public Relations, +1-340-775-8694, or cell, +1-340-771-1317

VLBA

Control and monitoring of the St. Croix telescope is done real time over a modest 56 kbps frame relay private circuit. Astronomy data is currently written directly onto magnetic tape and shipped to the data processing center; for normal VLBA operations. The processing center is in Socorro, NM. In order to do coordinated experiments with other antennas, a network data rate today of 100 Mbps would be desirable with the expectation that this could expand to 1 Gbps in a few years. Unfortunately, this raw data stream is essentially random noise and so is incompressible. Computer scientists at UVI are interested in employing local computational grid techniques to do test correlations of signals from more than one antenna. This is even more challenging. It would require that the 100 Mbps data from another antenna be added to the St. Croix VLBA antenna data stream into the computational center.

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Fiber vs. Microwave

All radio observatories detect extremely weak radio signals from the cosmos; the VLBA and collaborating observatories are no exception. Any stray radiation from electrical and electronic devices can overwhelm these weak signals. For this reason, microwave transmission systems are, in general, undesirable for communication close to the antenna. It is therefore preferable that all high speed communication be done on optical fiber. However, microwave transmission systems can be used, but they must be carefully selected so that the primary frequency does not interfere with the desired observing frequencies; they must also be thoroughly tested to ensure that no intermodulation or stray harmonics interfere with the astronomical signals.

International Educational Outreach

UVI is providing undergraduate instruction to two island nations, St. Martin (USM) and the British Virgin Islands (BVI) and is seeking articulation agreements with other Caribbean institutions. Distance learning provided by the UVI to St. Martin uses a proprietary ADL software delivery platform written by UVI faculty which is functionally equivalent to Blackboard[5] operating through the regular commodity Internet. There is an E1 dedicated line of Internet commodity service from New York to the British Virgin Islands. The BVI, and many nations from which UVI has traditionally drawn students, are members of the British Commonwealth served by the University of the West Indies (UWI) which has campuses on Trinidad, Barbados, and Jamaica, known therefore as the "campus islands." Educational services to the "non-campus islands" are perceived as unsatisfactory and some have suspended contributions to the UWI system. UWIDITE is a distance learning system offered by UWI but that system has been slow to utilize emerging technologies and presently only provides audio conferencing. A number of

[5] http://company.blackboard.com/

distance learning providers have begun to try to penetrate the Caribbean market but penetration is relatively low, partly because mixed mode delivery is more acceptable to local students. UVI has strong name recognition (and graduates in key positions) in the region and its location allows economic delivery of mixed distance learning/outreach modalities. Strong relationships with U.S. institutions supported by increased connectivity to the commodity and I2 networks would position UVI as a conduit for U.S. education into the Caribbean region.

USVI High School Educational Outreach
The UVI has a plan to reach out to local high schools through the EPSCoR program. There are local public high schools that are wired with Fast Ethernet but they either have no commodity Internet service, or very limited bandwidth made available. There is at least one private school that receives a donation from Innovative Communications, the monopoly telephone company, for Internet connectivity.

St. Croix Technology Park Planned
Technology Park in St. Croix already has an established board of trustees that is similar in membership to the board of trustees of the UVI. Part of the St. Croix Technology Park mission is to further the development of UVI. The Technology Park Board of Trustees has contracted UVI's Vice President, Malcolm Kerwin, to do the first year development plan. The technology park tenants would be able to take advantage of the proposed AMPATH and Internet2 connections for research and education. Cruzan Global is a telecommunication company that is a tenant in the park and they may be in current negotiations with Global Crossing for services.

Experimental Program to Stimulate Competitive Research (EPSCoR[6])
Roy Watlington is the VI-EPSCoR coordinator working on a 4-year infrastructure grant proposal for a 4-year infrastructure grant proposal for $7 million under which funding is being requested for the capital costs of network enhancements for connectivity to AMPATH and Internet2, as well as local high schools and down island cost-sharing. Brad Weiner, Puerto Rico's EPSCoR coordinator, Guy Cormier, Director of the University of Puerto Rico (UPR) High Performance Computing Facility and the UPR GigaPOP, and Dan VanBelleghem[7], Director for the Alliance-EPSCoR Liaison Office visited the UVI in February, 2003 and are interested in giving support and guidance in the grant proposal process along with the AMPATH team.

Recommendations:
For long range networking to Internet2 and to improve bandwidth and performance of commodity Internet service for UVI, NRAO and possibly other educational and governmental purposes (such as hospitals), the AMPATH DS3 (45 Mbps) donation should be connected to a local area network within and between the islands of St. Croix and St. Thomas. An assessment should be made to determine if an STM-1 (155 Mbps) shared between Internet2 and commodity Internet service at research and education

[6] http://www.ehr.nsf.gov/epscor/
[7] Biographical information for VanBelleghem can be found at http://net2002.unb.ca/sessions/session4a.htm
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pricing provided through AMPATH would be of greater benefit to the parties. The STM-1 would include the DS3 donation. A consortium approach to operational cost-sharing to cover local needs and AMPATH will provide the most cost-effective and sustained opportunity for the USVI.

For local area networking within and between the islands of St. Thomas and St. Croix, there are a number of options to explore further. As noted above under Facilities, there are at least two microwave options, the local telephone company option, and the WAPA fiber-on-poles option. One or a combination of these methods may make the most sense to the parties involved. It is recommended that a feasibility study team be formed, led by Dr. Lynn Rosenthal of UVI and including a representative of NRAO, EPSCoR, FIU/AMPATH, Global Crossing, and Derek Hodge to interface with both government and telecommunications providers on the islands. Dr. Rosenthal will most certainly add Beth Heyleiger, the UVI CIO, to a team involving as appropriate several computer science and research faculty in other disciplines due to their expert knowledge of both local area networking in the USVI and application development opportunities and collaborations. Of course the final team leadership and participants should be determined by those in the USVI. The team should assess the above Facilities options and select one or a combination that provides both quality of service (QoS) and cost-competitive attributes. This can be determined by creating a weighted assessment matrix and grading for each solution.

Plan of work:

There are several steps that must be considered to establish AMPATH and Internet2 connectivity in the USVI.

AMPATH Principal Investigator Ibarra

Establishing DS3 Availability for donation: First, further talks with Global Crossing must take place to determine if a DS3 of capacity can be groomed for the research & education interests on the islands. It is the AMPATH team's current understanding that the smallest physical circuit available is an STM-1. This should be resolved quickly.

A Point of Presence (PoP) must be established to aggregate R&E traffic from UVI campuses on St. Croix and St. Thomas, the NRAO station, as well as other local research and education organizations. The AMPATH team will coordinate this discussion with Global Crossing, UVI and NRAO to arrive at the most cost-effective solution.

Local Loop Acquisition: Each Party is responsible for establishing local loops (and possibly backhauls) to the PoP where connectivity to AMPATH will be available. There are now at least three local circuit providers that we are aware of in the USVI that have been documented above. Each would be expected to respond to a request for pricing. Pricing is based on the infrastructure of the provider as it corresponds to the infrastructure

requested. An RFP process will likely expose other options, and more competitive pricing.

AMPATH Memorandum of Understanding (MoU) signing between FIU and the Parties: There is a standard MoU used by the AMPATH project to establish a relationship and lay out responsibilities between the parties. The MoU addendums will detail terms for AMPATH / Internet2 connectivity as well as commodity Internet service as desired.

Sponsored Participant Status with Internet2: FIU will submit letters to sponsor the UVI and the NRAO sites so they can exchange network traffic with other Internet2 participants. Sponsored participation with Internet2 may carry some limitations. Check http://abilene.internet2.edu/community/sponsored/faq.html for details.