AMPATH

Valdivia Group Report

First International AMPATH Conference

"More network capability means more scientific discovery"

Valdivia, Chile
April 12, 2002

NSF Award No.
ANI-0220176

Prepared by:
The AMPATH
"Valdivia Group"

FIU

NSF

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Radio Telescope cover picture courtesy of the NAIC - Arecibo Observatory, a facility of the NSF David Parker / Science Photo Library http://www.naic.edu/about/photos/aoviews.htm

Cover Quote from *The Terascale Supernova Initiative,* F.D. Swesty, I2/Abilene Joint Techs Presentation: http://www.ncne.nlanr.net/training/techs/2002/0728/presentations/200207-swesty1.htm

Executive Summary

THE AUTHORS OF THIS REPORT AND ITS PURPOSE

This report was prepared by a group of scientific participants of the *AMPATH First International Conference* held in Valdivia, Chile in April 2002. These individuals, known as the AMPATH Valdivia Group, are listed within the report. The purpose of this report is to document the observations and findings of the attendees of the conference and to make recommendations for the future success of AMPATH. The Valdivia international conference was organized with support from the U.S. National Science Foundation.

BACKGROUND

AMPATH (AMericasPATH) began in March, 2000 at Florida International University (FIU) in Miami. Its principal mission is to provide Internet2 connectivity to South and Central America, Mexico, and the Caribbean in support of scientific collaboration and education. By August, 2001, AMPATH had already developed cooperative agreements with its industrial partners. These agreements included a three-year donation of ten DS3 (45 Mbps) circuits by Global Crossing valued at $25M. Other industrial partners by that time included Cisco Systems, Lucent Technologies, Juniper Networks and Terremark Worldwide. With these assets, AMPATH was able to connect two regional Research & Education Networks (RENs), Chile's REUNA and Brazil's RNP2. By April, 2002, AMPATH connected two more RENs, ANSP in Brazil and RETINA in Argentina as well as Arecibo Observatory (Arecibo PR) and Gemini South Observatory. Remarkably, these achievements are the work of a very small AMPATH staff, none of whom works full time on the project. The staffing at present includes just seven individuals who amount to less than four FTEs (§ 3.4 of this report). Salary support for these individuals comes from FIU, cost-sharing agreements with the RENs already connected, and partial funding from the NSF CISE-ANIR.

GOALS AND STRATEGIES

AMPATH seeks not only to provide high-speed connectivity to its service area, a region quite underserved at present. AMPATH also seeks to foster effective use of such connectivity for scientific and educational purposes, especially those of interest to the U.S. With this latter goal in mind, AMPATH has sought to (1) identify connectivity applications in the service area of interest to U.S. science, and (2) foster collaborations between U.S. scientists and their counterparts in the service area. A principal purpose of the Valdivia conference and of the AMPATH Workshop held in August, 2001 on the FIU campus (also supported by the NSF) was to identify such applications and encourage such collaborations.

VALUE TO U.S. SCIENCE

Although AMPATH seeks to strengthen science and education in its service area *per se*, it also seeks to enhance U.S. science and to foster closer research and educational ties between the U.S. and the service area. In this sense, AMPATH provides benefits in its service area similar to those already realized by high-speed NSF-sponsored connectivity to Europe and the Asia-Pacific Rim research networks. A number of U.S. science initiatives depend critically upon facilities or environments located in the AMPATH service area. One example is observational astronomy. Astronomical observatories located, or to be located, in the Caribbean and South America include Arecibo Observatory, Pierre Auger, the Gemini South tele-

scope and the Atacama Large Millimeter Array (the latter two in Chile). Another example is the Inter-American Institute for Global Change Research (IAI). This intergovernmental organization coordinates research into environmental and socio-economic change in the Americas, and it counts 17 member countries in the AMPATH service area as well as the U.S. and Canada. Also, NASA's International Space Station (ISS) project seeks to provide access to the ISS for scientific investigators worldwide, including those in the AMPATH service area. All of these U.S.-led initiatives now depend or will depend crucially upon high-speed connectivity between the U.S. and the AMPATH service area. Several federal agencies currently operate networks in Latin America using point-to-point low-bandwidth circuits. The AMPATH project can provide a coordinated and effective approach to these connectivity needs.

FUTURE NEEDS

AMPATH has developed so far with very minimal funding and personnel. Further development of the project and fuller realization of its goals will require more resources. Additional needs include the full-time services of a network engineer and an outreach coordinator. The duties of the latter individual will include an aggressive program to raise awareness in scientific and government circles in the AMPATH service area of the project. Also, AMPATH will need stable funding in the future for permanent office staff, office space, publications, staff travel and meetings. Funding sources for these needs may include participation dues from member organizations and governments, U.S. Agency support for specific science and education projects, and the State of Florida.

VALDIVIA GROUP RECOMMENDATIONS

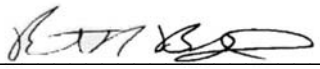
The Valdivia Group views AMPATH as an important, viable initiative to enhance science and education in both the U.S. and in the service area. With this view in mind, we offer a number of specific recommendations to enhance the success of the project in the future. The first three recommendations are particularly crucial. Without them, the full potential of AMPATH is very unlikely to be realized. Also, the remaining recommendations are important for the operational viability of the project. These recommendations are as follows:

1: Increase AMPATH Staffing
2: Implement an Awareness Program
3: Develop a Comprehensive Funding Plan
4: Create an "NGIX South" in Miami
5: Create Alternative Access Points within AMPATH
6: Continue to Develop Long and Short Term Planning
7: Help Solve the National Infrastructure Problems
8: Revise the AMPATH Mission Statement
9: Create an AMPATH Acceptable Use Policy
10: Diversify AMPATH to support Production, Research and Experimental Networks

The AMPATH Valdivia Group and AMPATH Project Managers

(The email signature and all concurrences are on file with AMPATH.)

Prepared by:



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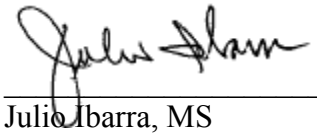

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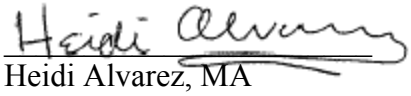

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1 Introduction

A group of scientists and networking professionals met in Valdivia, Chile, in April 2002, under the auspices of the AMPATH (AMericas PATHway) project. The meeting was funded by the National Science Foundation to discuss the scientific uses of AMPATH and AMPATH's future direction. As a result of this meeting, the following report is respectfully submitted.

2 Purpose of this Report

The purpose of this report is to document the observations and findings of the attendees and participants at the First AMPATH International Conference held in Valdivia Chile in April, 2002, and report these to the AMPATH project as well as to fulfill a commitment to the National Science Foundation. Attendees represented all Latin American national research and education networks, as well as representatives from various science disciplines who are currently using AMPATH in their endeavors, or are considering using AMPATH. A committee was formed, calling itself the AMPATH Valdivia Group, to prepare this report from an independent viewpoint for AMPATH. The Valdivia Group recognizes that AMPATH is entering into a new stage in its development. The implementation of the wide area connectivity is well underway – with some exceptions, e.g. Colombia and Cuba. AMPATH has been very successful in this implementation, and the next logical step is now to increase use by the scientific community, increase bandwidth connecting to other networks and enter into an operational phase. To do this it is necessary to assess the current position of AMPATH and make recommendations based on this assessment. For example, Grid technology is making great strides in its development and AMPATH must keep abreast of the Grid technology evolution. This takes manpower and the proper skill mix to insure success.

This report was prepared to provide adequate detail for the casual reader to ascertain the rationale for the recommendations made. The Valdivia Group members are:

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The report provides an overview of AMPATH, the network, its service area, its accomplishments and its challenges, along with recommendations to further AMPATH's mission and goals. The accomplishments, challenges and recommendations are the observations made at the Valdivia Conference through presentations, discussions and observations by the Valdivia Group members. In the time between the Valdivia meeting and the preparation of this report, several circumstances have arisen that the Valdivia Group

considered pertinent to this report (e.g. the Global Crossing Chapter 11 filing) and we have therefore included additional observations.

This report represents the opinions and observations of the Valdivia Group members and the AMPATH Staff. A section of this report will be made available for any dissenting view points or for minority reports that may be contrary to the majority's observations and recommendations.

3 Introduction to AMPATH and the AMPATH Staff

3.1 Background of AMPATH

On March 8, 2000, IT officials at FIU recognized the need for high speed research-related Internet connections to the service area, connections similar to those already developing between the U.S. and Europe, and Asia. IT officials also recognized the unique position of FIU to provide such connections. As a result, the AMPATH project was conceived.

Figure 1: AMPATH Service Area

AMPATH is a project of FIU in cooperation with global industrial partners and national and regional research networks in its service area – South and Central America, the Caribbean and Mexico. AMPATH's value to the future of science and education in Latin America is significant. The AMPATH network provides a link to the international networking scheme that is invaluable to the Latin American and US science community. Connectivity between the nations of the Service Area and the international community provides a means of scientific collaboration that until AMPATH was not possible. Day-to-day operational aspect of networking provides a stable system on which science can depend. The international exchange point in Miami is an indicator of the type of facility that AMPATH employs. Global Crossing's submarine and terrestrial network provides the infrastructure that connects these countries to the international exchange point in Miami. The NAP of the Americas is a top-notch facility designed specifically for networking. AMPATH is provided with the 24-hour support needed to maintain a reliable network by the Network Operations Center (NOC) located at Indiana University. AMPATH staff continuously negotiates the necessary bandwidth to enable growth as well as providing for a foundation for experimental networking. The collaboration services being offered by AMPATH through its connectivity are invaluable to the science and education community.

AMPATH is part of the University Technology Services organization at FIU. Executive Sponsorship is provided by John McGowan, Vice President and Chief Information Office. It is managed by Julio Ibarra, Director, and Heidi Alvarez, Associate Director of University Technology Services. The AMPATH staff also consists of Melyssa Fratkin (International Development Coordinator), Fiorella Salinas (Junior Coordinator), Eric Johnson (Chief Network Engineer) and Hassan Iroegbu (Network Engineer), and Jacqueline Estay (Bookkeeper). The AMPATH project is supported in part by its industrial partners Global Crossing, Lucent Technologies, Cisco Systems, Juniper Networks and Terremark Worldwide. These partners have donated communications hardware, bandwidth, and have provided network access facilities allowing high-speed (45 Mbps) connectivity to national research networks and research institutions in the service area. AMPATH is connected to the Internet2 Abilene backbone at 155 Mbps; this connection also serves Florida Atlantic University, Florida International University and the University of Miami. AMPATH is currently funded by cost-sharing arrangements with the national research and education networks (RENs) and other research institutions. This cost sharing supports AMPATH administration, network engineering personnel and hardware maintenance. AMPATH has also received support from the NSF to organize two workshops dedicated to identifying applications requiring high-speed connectivity to its service area.

AMPATH has already been successful in developing cooperative agreements with industry and national RENs to provide high-speed connections to a number of countries and institutions in its service area. FIU, a public Research I university in South Florida, has been a leader in high-speed Internet operations, having been connected to the Internet2 Abilene backbone at 155 Mbps since 1999 through its development and operation of the South Florida GigaPOP. South Florida is the site of a number of undersea fiber cable landings and a major network access point (NAP), the NAP of the Americas. The FIU mission includes being the principal educational and research interface between Florida universities and South and Central America, Mexico and the Caribbean. FIU has the largest contingent of Hispanic

students of any doctoral-granting institution in the continental U.S[1]. No other organization or institution has positioned itself to facilitate high-speed connectivity to the service area as effectively as FIU through AMPATH. Early on, there was an interest in providing connectivity to the Gemini Project; this has recently been accomplished. Gemini became operational by connecting to the AMPATH International Exchange point to achieve it link between Hawaii and Chile on Tuesday, April 23rd, 2002. Figure 2 shows the many applications that can take advantage of the AMPATH connections.

Figure 2: AMPATH Scientific and Other Applications

3.1.1 Progress up through August, 2001 Miami workshop

By August 2001, AMPATH had developed a cooperative agreement with its industrial partners to provide Internet2 connections to its service area. This agreement included donation by Global Crossing of ten DS3 (45 Mbps) circuits for three years valued at $25M at the time

[1] The University of Puerto Rico has the largest contingent of Hispanic students in the entire US and connects to Abilene through the AMPATH International Exchange Point in Miami.

of donation to FIU. As of the publication of this report, the fiscal situation that has come to light concerning Global Crossing has not affected AMPATH network services. In addition to Global Crossing's major participation in AMPATH, Cisco Systems provided a GSR 12012 router, Lucent Technologies provided a CBX-500 ATM switch, Juniper Networks provided an M10 router, Terremark Worldwide Inc. provides 3 racks of collocation space and a GigE port into the NAP fabric in the NAP of the Americas. Epik Communications made a one-time cash donation through the AMPATH Industrial Affiliates Program. In addition, AMPATH has partnered with Internet2 and the Global Research NOC at Indiana University. By August 2001, AMPATH had already connected two national RENs, Chile's REUNA and Brazil's RNP2. AMPATH hosted an NSF-sponsored workshop in Miami to identify and nurture areas of scientific collaboration between the U.S. and its service area that require or will require high-speed connectivity. Over eighty scientists and researchers from nine countries attended the Miami workshop. Their fields of study included Astronomy, Physics, Biology, Geology, Aerospace and Computer Networking. A workshop committee wrote The AMPATH Workshop; *Identifying Areas of Scientific Collaboration Between the US and the AMPATH Service Area* at Florida International University on August 15-17, 2001 CONFERENCE REPORT[2] evaluating the degree to which AMPATH could establish a foundation for growth of research and education via networking with its service area countries. The report commented on how current and future science collaborations would be enabled by high-speed connectivity and made recommendations regarding the growth and utilization of the AMPATH project. Identified in the report were the key needs for high-speed connectivity and the science disciplines that will benefit.

3.1.2 Progress up through April, 2002 Valdivia, Chile AMPATH's First International Conference

By April, 2002, AMPATH connected two additional RENs in Latin America: Brazil's Advanced Academic Network of Sao Paulo (ANSP), and Argentina's RETINA, as well as the Gemini South Observatory in La Serena, Chile. Table 1 shows currently connected AMPATH participants, and the speed of their connections. In March, 2002, Terremark Worldwide announced the NAP do Brasil, the first, largest and most significant peering point in Brazil – the only peering point in that country operated by a state or federal government. Similar to the NAP of the Americas, this new telecommunications center will increase AMPATH's effectiveness in the Sao Paolo region. FAPESP, the Sao Paulo State Science Foundation, is Terremark's chief partner in this venture.

[2] To see the report go to: http://www.ampath.fiu.edu/workshop.htm

Connector	Country	Date Connected	Speed of Connection
REUNA	Chile	June 2001	45Mbps
RETINA	Argentina	Nov 28, 2001	45Mbps
RNP2	Brazil	August 2002	45Mbps
FAPESP	Brazil	March 2002	45Mbps
UPR	Puerto Rico	Sept 2001	45Mbps
Arecibo Observatory	Puerto Rico	Sept 2001	Shared with UPR
Gemini North[3]	Hawaii, USA	April 2002	45Mbps
Gemini South	Chile	April 2002	10Mbps

Table 1: Current National REN & Project Connectivity

3.1.3 The Valdivia Conference

Building on last year's success with the Workshop to Identify Areas of Scientific Collaboration between the US and the AMPATH Service Area, the First AMPATH International Conference sought to further delve into the benefits of utilizing the AMPATH advanced networking infrastructure for scientific research and education. The main objective of the conference was to create an environment for AMPATH participants, potential participants and those with a regional, hemispheric or international interest in the project to exchange ideas, form new and solidify existing collaborations, and evaluate AMPATH's future direction.

The conference continued the work of identifying the universities and research centers in the AMPATH service area who require, or would take advantage of, high-performance connectivity to research institutions in the US and worldwide if it were available. Speakers at the conference included researchers that participate in projects between collaborators in the U.S., Canada, the AMPATH service area, Europe and Asia/Pacific.

U.S. researcher scientists working on the following types of projects were invited to present their applications, collaborative strategies and advanced networking requirements.

1) Projects being led by the US and the Europeans for Grid development are ATLAS and CMS at the Large Hadron Collider (LHC) at CERN. Data acquisition, storage, and processing requirements for these experiments led to the idea for "GriPhyN" – the "Grid Physics Network" and iVDGL – the International Virtual Data Grid Laboratory, both supported in the NSF-Information Technology Research program. The LHC experiments are highly collaborative. Principal Investigators, Drs. Harvey Newman and Paul Avery, along with colleagues in Brazil provided presentations using VRVS and in person. AMPATH is working with the HEP collaboration to provide the necessary advanced networking infrastructure to support a tier-1 data center in Rio de Janeiro and a distributed Tier-3 data center in Miami at the NAP of the Americas.[4]

[3] Connection provided through University of Hawaii to Abilene

[4] A Data Grid is defined by 4 tiers of data centers. Each Tier is defined roughly by the scale of its storage and I/O throughput capabilities. Tier-1 centers are regional in nature and a Tier-3 represents the computing re-

2) Astronomical observatories located in the AMPATH service area are already engaged in planning and deploying applications such as remote observing, video conferencing between base, summit and / or remote locations, data archiving and educational outreach programs. These strategies aim to solve both access and economic challenges created by the placement of multi-million dollar instrumentation in remote, hard to reach, and in some cases humanly inhospitable areas, to obtain the best observations possible from earth. Jose Garcia with Gemini South Observatory provided a project update. Alexander Szalay, Principal Investigator for the National Virtual Observatory gave a remote presentation using the Access Grid provided by the University of Kentucky. Eduardo Vera, a Chilean astronomer with the ALMA/Access Nova project provided a presentation and also agreed to chair the AMPATH Astronomy Working Group. Figure 3 shows the topology of the network for the Access Nova project. The diagram shows the interconnectivity between the National Astronomical Observatory connected to the NTT Labs Musashin in Japan, and the University of Chile, in Santiago, Chile. These two sites are interconnected by the GEMnet transpacific network, Internet2's Abilene network, AMPATH, and Chile's REUNA2 network.

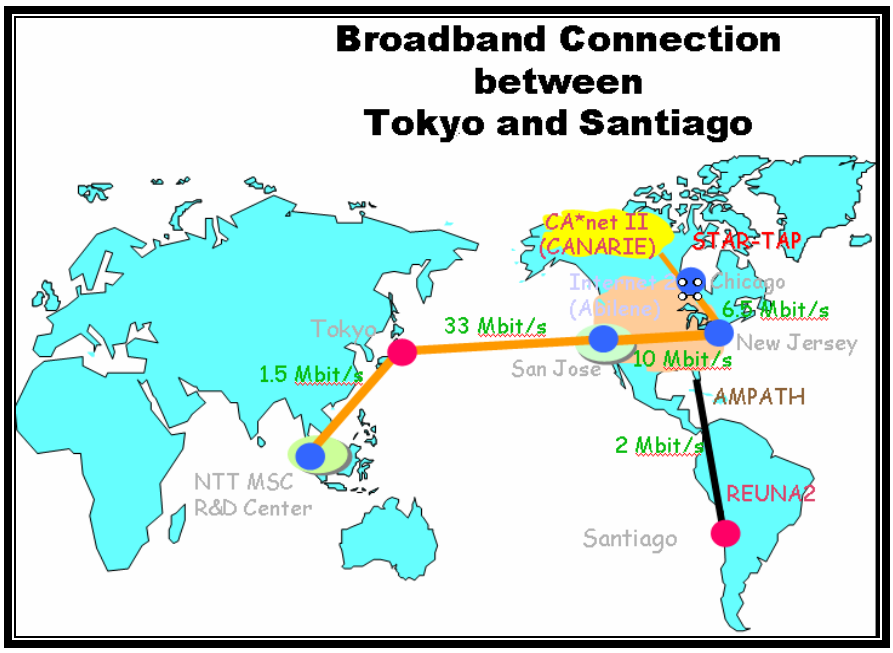

Figure 3: Broadband connection between Tokyo and Santiago

3) The Inter-American Institute for Global Change Research (IAI)[5] is an intergovernmental organization supported by 19 countries in the Americas dedicated to pursuing the principles of scientific excellence, international cooperation, and the open exchange of scientific information to increase the understanding of global change phenomena and their socio-economic implications. The IAI pursues the principle of scientific excellence, international cooperation and the full and open exchange of scientific informa-

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sources of a university research group. FIU's Tier-3 is expected to expand into a Tier-2, so it can share resources with AMPATH connectors participating in CMS and other grid intensive e-science applications.

[5] http://www.iai.int/

tion relevant to global change. The United States Nacional Science Foundation hosted the IAI Secretariat from September 1994 until September 1996. Afterwards, the IAI became fully operational at the IAI Directorate located in the campus of the Instituto Nacional de Pesquisas Espaciais (INPE) in São José dos Campos, Brazil. (in March of 1996). The IAI is supported in large part by the NSF, with 14 PIs conducting research programs throughout the AMPATH service area. A fledgling database information system exists with plans to tie together nodes in all participating countries in North and South America.

4) During the AMPATH Workshop in Miami there were several collaborative presentations in the areas of biology, environmental research and education, and the geosciences discussing how high-performance network connectivity can significantly facilitate goals of data gathering and dissemination in remote local and metropolitan areas, and all terrains in between. Coordinated efforts between aeronautic, terrestrial and submarine scientists using advanced sensing communications tools have potential. For this conference, we asked speakers to discuss how fundamental Grid concepts can further successful scientific collaborations in biology and the geosciences. Dr. Guy Cormier of the University of Puerto Rico agreed to act as an information conduit so we can learn more about biomedical applications that would benefit from AMPATH. Dr. Yasmin Detres, also working out of the University of Puerto Rico will help with the Environmental Sciences Working Group. In order to jump start the working group concept, Melyssa Fratkin developed a set of guidelines to be used as a springboard by individual working groups. These guidelines can be found in Appendix A.

3.2 AMPATH Service Area

As shown in Figure 1, the AMPATH service area is extensive. It covers all of South America, Mexico and the Caribbean. The population of the AMPATH service area is approximately 515 million people as of 2000. According to the CEASAR report[6] there are approximately 800 upper division schools including: universities, research centers, government institutions, libraries, and labs connected through 13 organizations in Latin America: RETINA, BOLnet, RNP, REUNA, RedUniv, FUNDACYT, and other national and regional research and education networks. The AMPATH grants specialist has devoted 8 hours of research to find out how many upper division schools are not connected, but this information is not readily available.

3.2.1 Challenges in the AMPATH Service Area

The challenges associated with the AMPATH service area are its immense size, the total number of secondary schools, colleges and universities and the unknown number of scientific activities that are going on. Some of the individual countries are well advanced in their networking evolution, e.g. Chile and Brazil, while others are not so well connected. It is the opinion of the Valdivia Group that most of the countries in the service area have problems with their infrastructure. Figure 4 shows the countries that have adequate networking infra-

[6] Cathrin Stöver,, Contract Number: IST-2001-35412, DANTE, June 26th 2002 http://www.dante.net/caesar/public/documents/2002/CAE-02-039.pdf

structure, those that are evolving to an adequate infrastructure, and those countries that are not well connected. This issue is what is referred to in the US as the "last mile" problem, in that in the US, the last mile of copper wire into the home was considered a difficulty. The last mile - and in many cases the "last thousand miles" in many Latin American countries - is a challenge that needs to be addressed. The in-country infrastructure of some Latin American countries is severely underdeveloped. When the AMPATH staffing level is compared to these figures and challenges, it is obvious, even to the casual observer, that the staffing level and skill mix are not adequate.

Figure 4: AMPATH Service Area Bandwidth Distribution indicating the last 1000 mile problem

3.3 AMPATH Network Architecture and Connectivity

The AMPATH network architecture, as shown in Figure 5, provides access to the wide area network provided by Global Crossing over an ATM based Internet Protocol (IP) enabled network. Each national REN connects to AMPATH via this architecture. All AMPATH traffic routed to other international networks flows through the NAP of the Americas located in Miami, Florida. From Miami, the traffic is routed to either Abilene or STARTAP. Abi-

lene is the US-based research and education network, and STARTAP/StarLight is the ATM/optical exchange point for international traffic, located in Chicago.

AMPATH offers a variety of network services. Among the major services are:

- ATM and Optical Ethernet peering fabrics
- Intra-regional peering over Layer 2 services, including IP VPNs
- Native IPv6
- Multicast capable
- End-to-end performance measurement and monitoring
- *AMPATH Reflector* VRVS server for Video over IP
- Flow based and QoS based monitoring using NetFlow tools capabilities[7]
- NOC Services through the Global Research NOC at Indiana University

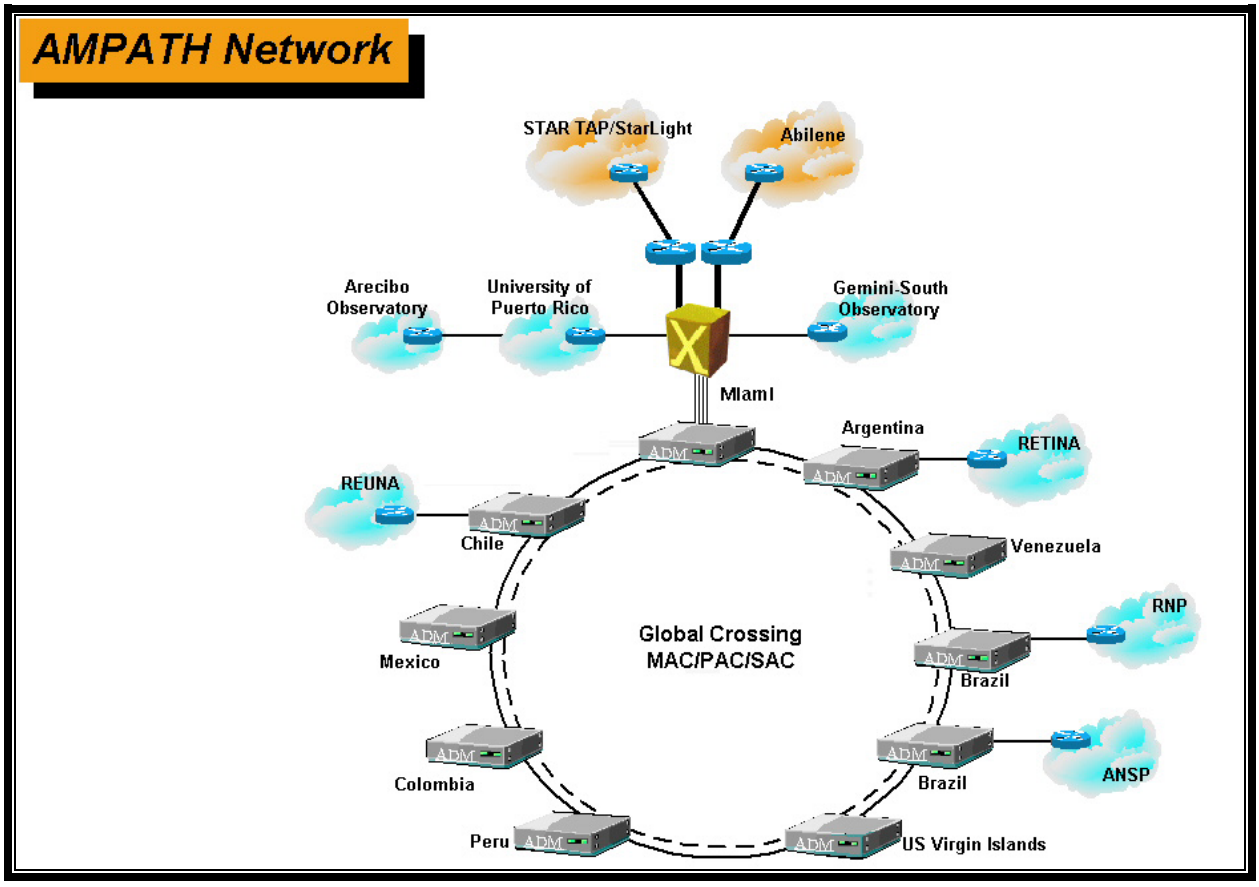

Figure 5: AMPATH Network Architecture and Connectivity

The figure above presents the basic network architecture employed by AMPATH. This architecture is representative of the research and educational networks worldwide. It also depicts the current AMPATH connectivity to the national RENs. As can be seen, the only interface between AMPATH and the rest of the world is through Miami to STAR-

[7] Contingent on network engineer or programmer availability to provide customized reports

TAP/StarLight. Through the STARTAP and Star Light interfaces in Chicago, virtually any location in the world is accessible to the national RENs. This interface is extremely important to the success of AMPATH in that it allows truly international collaboration to be conducted.

3.3.1 AMPATH Connectivity in Miami—And Beyond

AMPATH is built on robust self-healing ring architecture[8], for circuits provided by Global Crossing. Even so, there are target countries RENs that will not be able to receive donated DS3 bandwidth, and have to rely on their own resources to reach the AMPATH POP in Miami. Obtaining adequate bandwidth at an affordable price is a challenge. If there were connection points in closer proximity to these target countries that do not have Global Crossing cable landings, new possibilities could open up. For example, if a research institution in Uruguay could connect to AMPATH at the NAP do Brasil in Sao Paulo, it might make AMPATH connectivity obtainable whereas having to purchase a circuit to Miami might be cost prohibitive. Introducing distributed connection points to AMPATH's services is an idea worth further exploration. The figure below shows the points of presence for the international cable landings in the Miami area.

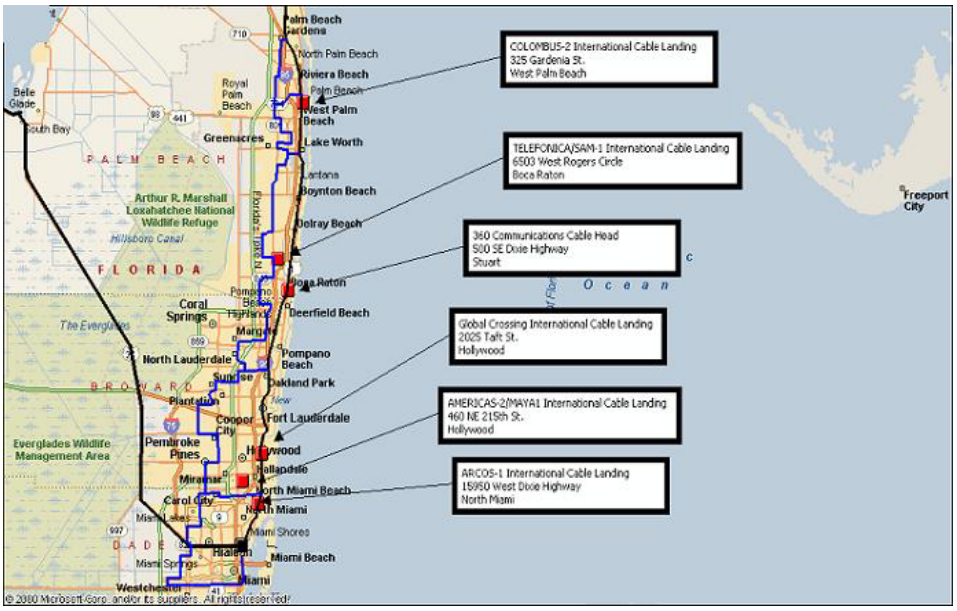

Figure 6: International Cable Landings Miami

Also, the Abilene prohibition of international traffic traversing its network to reach STARTAP and StarLight requires AMPATH to access StarLight through a separate link. Collaborative e-science applications, such as the CMS experiment, require a Gigabit Ethernet (GigE) type of connection for optimal network performance at relatively economical cost (Ethernet

[8] The Global Crossing private network line specification includes SONET/SDH self-healing rings, which means that if there is a cut in one part of the ring, network traffic will automatically be re-routed back around the ring in the opposite direction, so it will still reach its destination. This is a form of disaster recovery. http://www.globalcrossing.com/xml/services/serv_cap_priv_line_spec.xml

active equipment is less expensive than other equipment supporting other protocols). Funding a robust link that can provide two tiers of network services (production and research) from the AMPATH International Exchange Point in Miami to StarLight in Chicago presents both a funding and an operational challenge.

3.4 AMPATH Staff

Table 2 provides the full complement of AMPATH staffing. The organization of AMPATH is headed by a Principal Investigator/Director and a Co-PI/Associate Director. They direct the AMPATH activities with regard to its mission and all aspects of funding and collaboration.

Employee	**Position**	**Time/Year Dedicated to AMPATH Activities**
Julio Ibarra	PI / Director	4 Months per year
Heidi Alvarez	Co-PI / Assoc. Director	6 months per year
Melyssa Fratkin	Int'l Coordinator	7 Months per year
Fiorella Salinas	Jr. Coordinator / Administrative Assistant	9 Months
Eric Johnson	Chief Network Engineer	10 hours per week (~3 Mos/Year)
Hassan I. Iroegbu	Network Engineering Intern	24 hours per week (~7 Mos/Year)
Jacqueline Estay	Bookkeeper	24 hours per week (~7 Mos/Year)
Total Time		**~43 Work Months/Year**

Table 2: AMPATH Staffing

Principal Investigator / Director of AMPATH, Julio Ibarra, originated and leads the AMPATH project. Ibarra was directly responsible for the significant industrial partnerships that enabled AMPATH to begin in 2000 and progress as far as it has to date. He has successfully brought together a well-qualified project team with national and international participation and support, opening up new possibilities for research and education networking and collaboration. The PI has a solid advanced network engineering background, honed diplomatic skills, and a deep understanding of Latin American culture that in combination make Ibarra uniquely suited to lead AMPATH.

Co-PI / Associate Director of AMPATH, Heidi Alvarez, holds primary responsibility for matters related to funding the project. She develops and maintains relationships with world-class US and international scientists and funding program directors with research projects and collaborations in the region. The business of developing, submitting and administering grants in consideration of a variety of disciplines and collaborators falls under her purview.

The AMPATH International Development Coordinator (IDC), Melyssa Fratkin, joined the AMPATH team in the Fall of 2001, after the AMPATH Workshop. Fratkin's role as senior personnel on the project is to perform tasks over the next three years related to outreach activities. The IDC is responsible for strengthening current ties to AMPATH Participants, and

establishing relationships with future members. In addition, this individual is responsible for orchestrating AMPATH conferences around the world, for which the IDC must manage the budget, contracts, and expense process in close collaboration with Co-PI Alvarez. She is uniquely qualified for this position due to her excellent knowledge of the Spanish language and culture, as well as her significant work experience with high-performance R& E networking at both the MAX GigaPOP and at Internet2 as the first meeting coordinator.

The AMPATH Grant Specialist, Fiorella Salinas, works closely with the IDC and Co-PI Alvarez. Salinas is taking on responsibilities related to improving contact with Latin American and Caribbean researchers, educators, and network executives to support the outreach activities related to the AMPATH project. She is assisting in the development of an outreach program to increase awareness and participation in AMPATH. Salinas is also assisting in developing collaborative relationships for the purpose of grant development and program direction with researchers in Latin America and the Caribbean. Fiorella is a native of Peru and will graduate from FIU with a Bachelor's degree in International Relations in December 2003. She is fluent in English, Spanish and Portuguese.

Although FIU has demonstrated a significant commitment to AMPATH by partially underwriting both the PO and Co-PIs salaries, AMPATH currently has no full time employees. All the activities which led to a successful implementation were accomplished by part-time employees! While noteworthy, this situation can be expected to create a drain on the dedicated individuals that oversee AMPATH and ultimately impact the long term success of the endeavor.

3.4.1 Future Issues with the AMPATH Staffing Level and Skill Mix

The staff listed in Table 2 was adequate during the implementation of AMPATH, as evidenced by its success. AMPATH personnel worked in concert with Global Crossing and other carrier companies to coordinate the provisioning of the existing connections. Although not reflected in the staffing levels listed in Table 2, a major contribution by the AMPATH staff in unpaid overtime was made.

With the focus required in the new phase of AMPATH to recruit and advise national RENs, adequate technical expertise within the AMPATH project is critical. As networking technology changes, AMPATH is required to maintain a technically viable network. With the networks that AMPATH connects to – such as Abilene -- evolving to extremely fast bandwidth using DWDM and Gigabit Ethernet and phasing out ATM, AMPATH needs to maintain a technical level commensurate with their peering networks. This cannot be accomplished without a specific level of full-time staff and the correct skill mix.

As shown, there is an obvious shortage of staff to accomplish the continuation of this new phase of AMPATH. The Director, Associate Director and Chief Network Engineer are the only technical personnel on the AMPATH staff. However, the Director and Associate Director cannot, by definition of their positions, provide day-to-day operational support to the

AMPATH network in any meaningful technical capacity. Thus, all aspects of the network are supported by only one (1) part-time chief network engineer and one (1) part-time network engineering intern. The Valdivia Group considers the staffing level to be a major weakness – one that requires immediate attention. The fact there are no full-time employees also raises the question of the continuity of the project in the future. Without an adequate depth in staffing, any loss of personnel could be catastrophic. Moreover the staff with other duties will eventually burn out if not relieved of other duties!

Other crucial areas to AMPATH's operational success include obtaining funding, providing network engineering for application-specific demands, operational maintenance, planning, implementation of new hardware, circuit provisioning, and consulting with participating national RENs. In addition, AMPATH may be asked to coordinate and implement projects such as Dr. Michael McLain's Inter-American Institute for Global Change (IAI) Research, which adds a certain complexity level to the staffing needs. AMPATH must display a greater presence at the national REN level, to understand local architectures and the strengths and weaknesses of these networks, raise awareness, and nurture existing relationships. Also, there is a pressing need to obtain funding and manage the funding process

4 Current Science Projects/Disciplines Supported by AMPATH

AMPATH is currently supporting several highly visible scientific projects. Examples of applications supported by high-speed networks include: remote operation of unique data-intensive instruments; use of distributed digital archives and libraries; transferal of large data sets; distributed processing of data; and video/audio and application sharing communications among scientific collaborators. Science fields in the AMPATH service area requiring such capabilities include astronomy, remote biological, marine and atmospheric sensing, high-energy physics, and materials science and biodiversity studies. In many cases (e.g. astronomy, biology and biodiversity) geographical or climate considerations require that the research and instrumentation be located in the service area. What follows is a brief summary of applications that are documented more completely in the AMPATH Workshop Report, August 15-17, 2001[9].

4.1 Astronomy

- Gemini Observatory
- Cerro Tololo Inter-American Observatory (CTIO)
- Southern Observatory for Astrophysical Research (SOAR)
- Carnegie Institution of Washington (OCIW)
- Atacama Large Millimeter/Sub Millimeter Array Radio Telescopes (ALMA)
- National Astronomy and Ionosphere Center Arecibo Observatory (NAIC)
- Pierre Auger Cosmic Ray Observatory

4.2 High Energy Nuclear Physics (Brazil)

- UERJ - Universidade do Estado do Rio de Janeiro[10]

[9] http://www.ampath.fiu.edu/workshop.htm
[10] Dr. Alberto Santoro leads the Brazilian HEP collaboration with all universities listed in this section.

- UFRJ - Universidade Federal do Rio de Janeiro
- UNESP - Universidade Estadual Paulista (S.Paulo)
- UFBA - Universidade Federal da Bahia
- UFRGS - Universidade Federal do Rio Grande do Sul
- CBPF - Centro Brasileiro de Pesquisas Físicas
- USP - Universidade de São Paulo
- UNICAMP - Universidade de Campinas

4.3 Advanced International Internetworking Services

- LAGRID – Inter-Regional Computational Grids for e-science collaborations
- Access Grid
- VRVS Service
- Other e-Science Internetworking Applications

4.4 Strategic US Science Interests in the South – Driven by Geography

- Global Warming and Ecology
- Astrobiology
- Atmospheric Lightning Research
- Counter Drug Research
- Inter-American Institute for Global Change Research

4.5 Strategic US Science Interests in the South – Driven by Collaborations

- Physical and Organic Chemistry
- Remote Biological, Marine, and Atmospheric Sensing
- Biodiversity
- Materials Science

4.6 Potential NASA applications

Change to bullets

- Application of AMPATH for the NASA Astro-biology Institute
- Hector D'Antoni – PI NASA Ames Astro-biology center
- Principal Investigators for various NASA International Space Station (ISS) experiments
- Provide to NASA access to ground stations using AMPath for distribution of space based telemetry
- Provide network services between NASA and Brazil in support of the Brazilian ISS involvement

5 Broader Impacts

The broader impacts to the service area and science in general are significant. If the recommendations in this report are adopted, science will benefit in ways that cannot even be pre-

dicted. Connecting the minds of millions of people will have unforeseen impacts that will change the way people in the service area live, work and view the world. Even though there is no way to predict whether these impacts will be positive, it is part of the human psyche to grow and develop in positive ways. As the Internet has changed the US in many ways, AMPATH will do the same for its service area. Specifically, there are a number of areas that may be impacted by AMPATH. AMPATH can serve as a catalyst to stimulate, engage and train future IT and science professionals for government and commercial entities.

5.1 Broader Impact for Science Staff Recruitment

Another benefit to AMPATH connectivity is the ability of scientists and educators to "telecommute," allowing scientific partnering along with science educational outreach without the need for relocation from Latin America to the US, or vice versa. This ability to telecommute is much more involved than scientific collaboration. An individual who wishes to work for a specific entity could do so without having to leave his or her home region. This arrangement would be especially attractive to individuals whose expertise is in demand. To recruit qualified staff, AMPATH could provide a tele-presence service, which would allow these individuals to stay at their home base instead of moving to a foreign country. This could lead to a low cost method to recruit scientists who otherwise would not be able to participate, for financial or other reasons.

5.2 Broader Impact to Education and Public Outreach

Common sense dictates there would be a broad impact to education in the AMPATH service area. Access to educational tools through AMPATH will contribute significantly to the quality of education. Remote areas of the service area would have access to math, science and engineering courses that they could not afford to have in place within their institution. A broader implication to AMPATH is the energizing of interest in science and technology of US students and the US workforce in general[11].

[11] American Institute of Physics (AIP) Bulletin of Science Policy News, Number 95: August 12, 2002, Concerns Over the Future of NASA's S&T Workforce

5.3 Broader Impact to Science and Engineering

To enable science and engineering collaboration worldwide the STARTAP/StarLight facility located in Chicago provides international network access. The following figure shows STARTAP/StarLight connectivity.

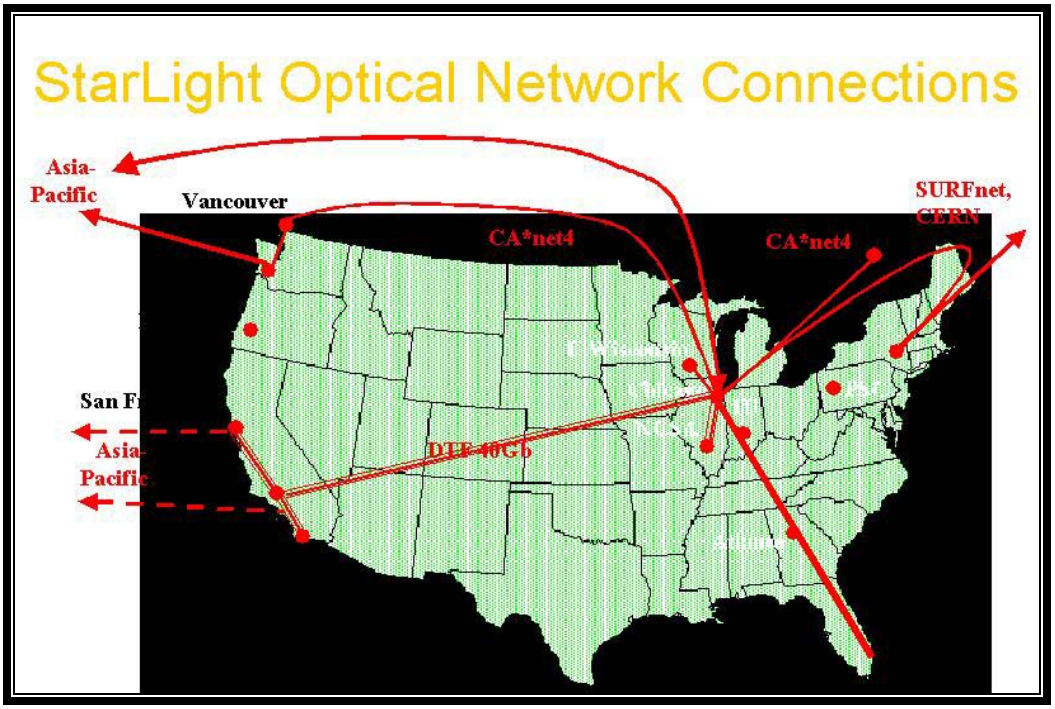

Figure 7: STARTAP/StarLight Optical Connectivity

The networks that scientists are able to reach via AMPATH (through STARTAP/StarLight) are shown below.

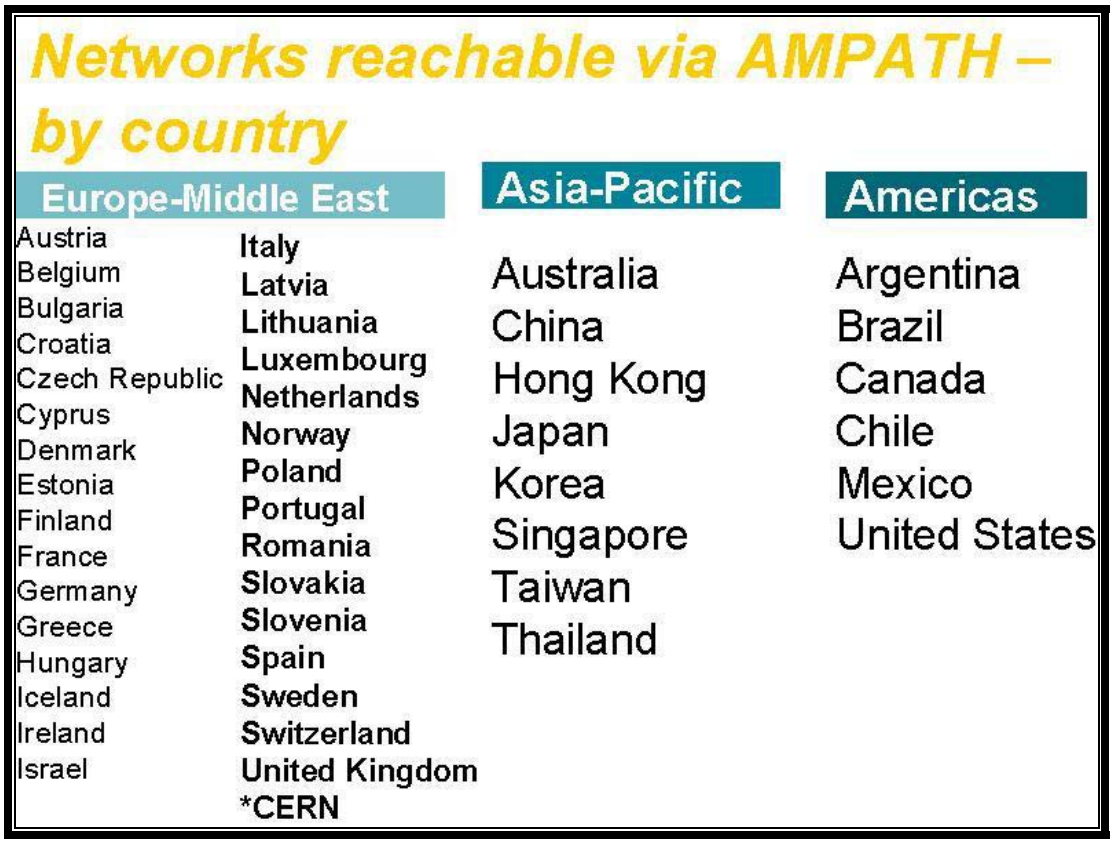

Figure 8: Reachable Networks from AMPATH

As is indicated in Table 3 on the following page, the impact to all disciplines is an overarching factor to the continued evolution and growth of AMPATH.

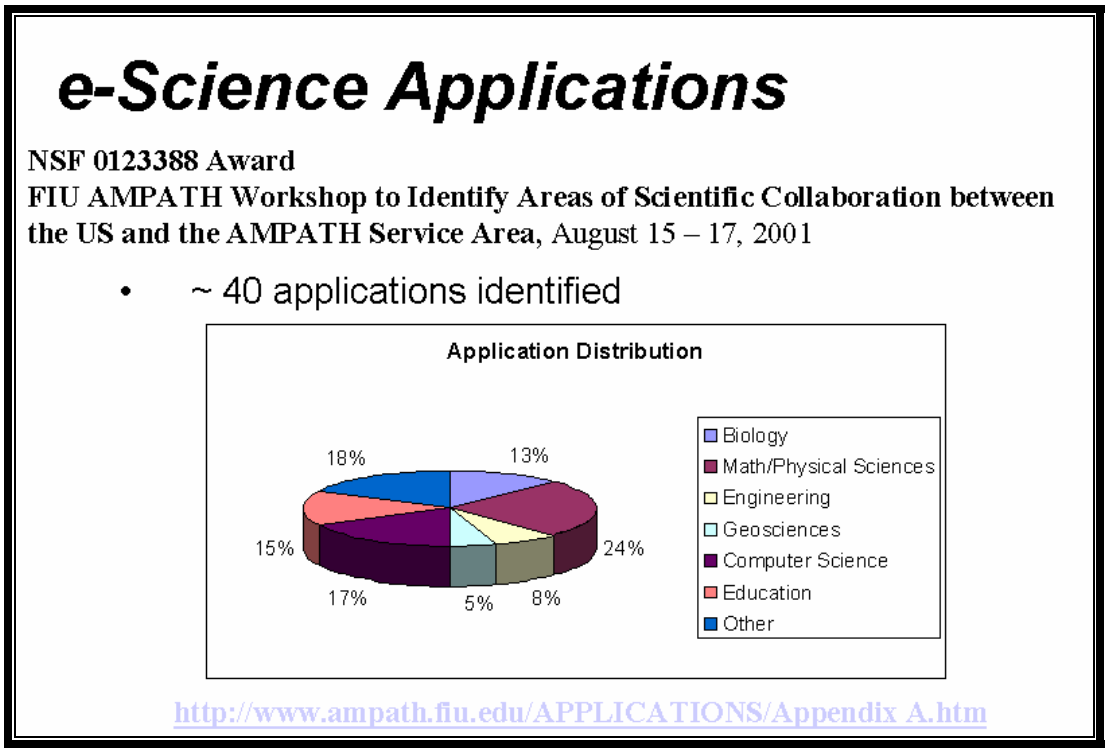

Table 3: e-Science Application Potential Identified During the Miami Workshop

Putting it into perspective: The figure on the following page, derived from the various cognizant web sites, shows a flow from or to the University of Cyprus Computer Center and the University Austral de Chile in Valdivia Chile. This picture shows the connectivity through REUNA (the Chilean Research and Education Network) to AMPATH to STARTAP/StarLight at Chicago. From STARTAP/StarLight the connection is through the GEANT network which is one of many connectivity routes between STARTAP/StarLight and Europe. At Frankfurt, through DANTE, the connectivity joins up with the Greek REN, where it is passed to Cyprus.

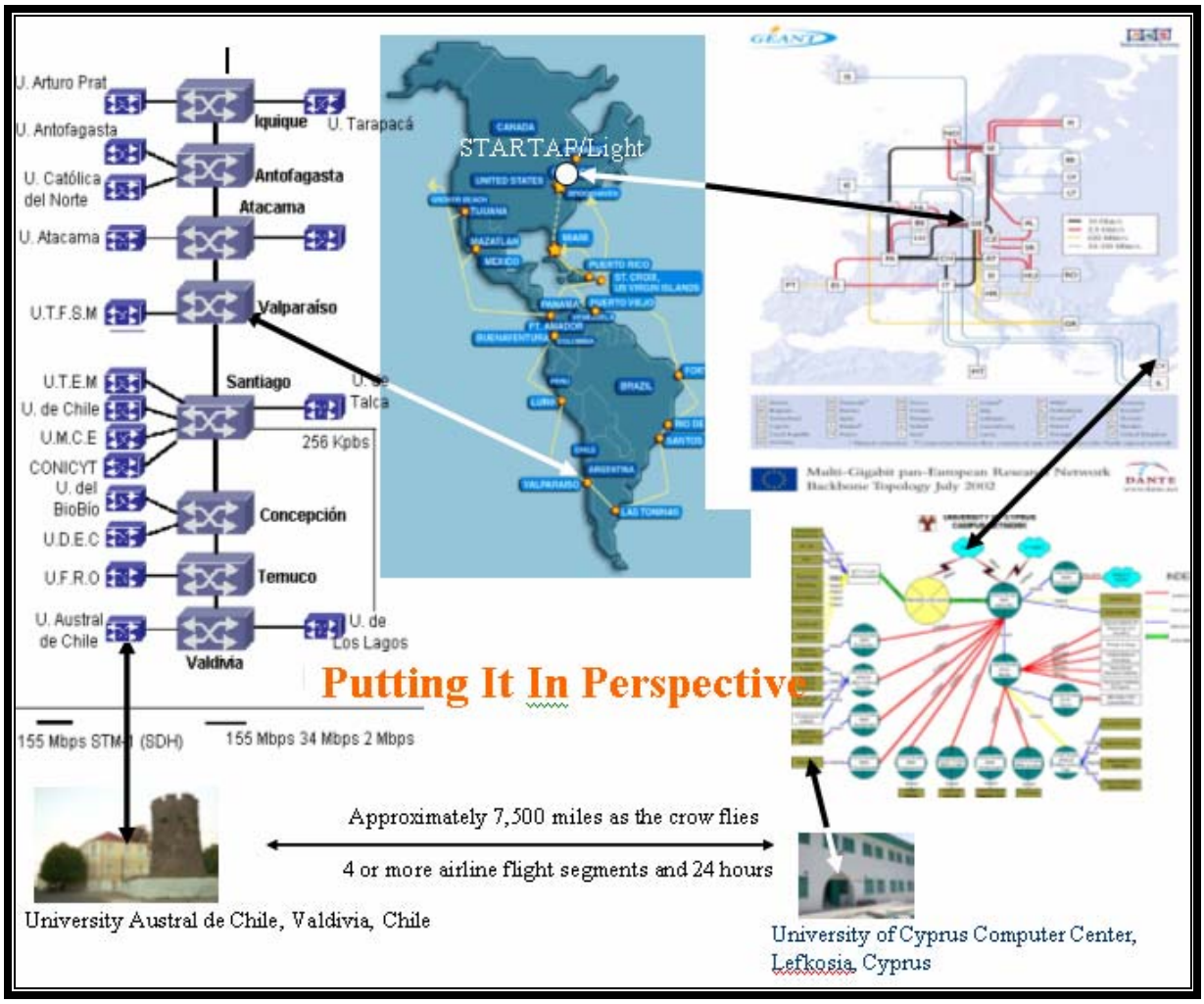

Figure 9: Putting It in Perspective

6 AMPATH Performance Statistics

To effectively determine the benefit of a research and education network service, a review of the overall network performance should be made. The following shows current network use[12]. In Tables 4, 5 and 6, the data shows a constant flow consistent with what would be expected measured in a short timeframe. Table 7, however, shows a fairly constant trend that doubles by the end of the year.

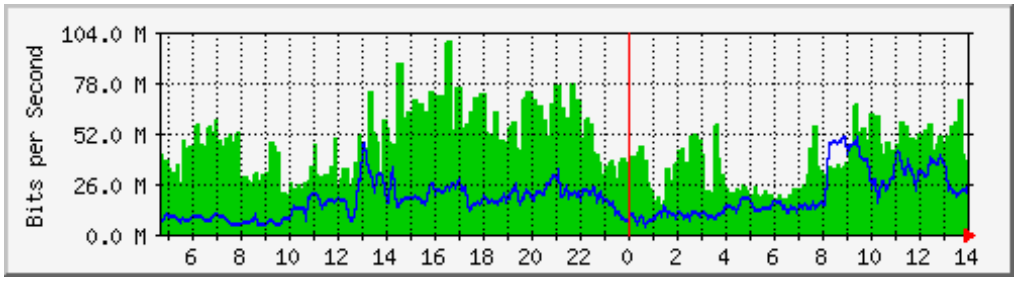

Table 4: Daily Traffic

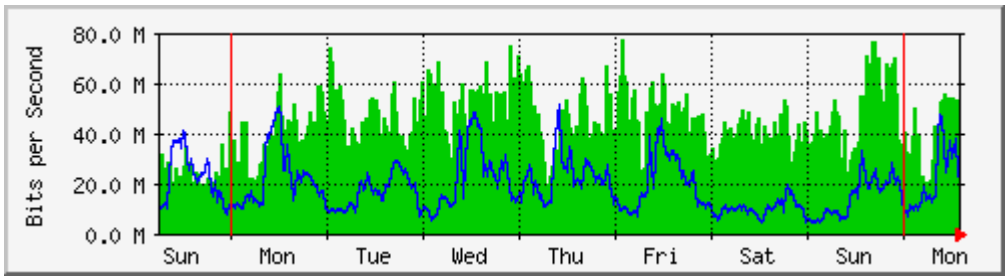

Table 5: Weekly Traffic

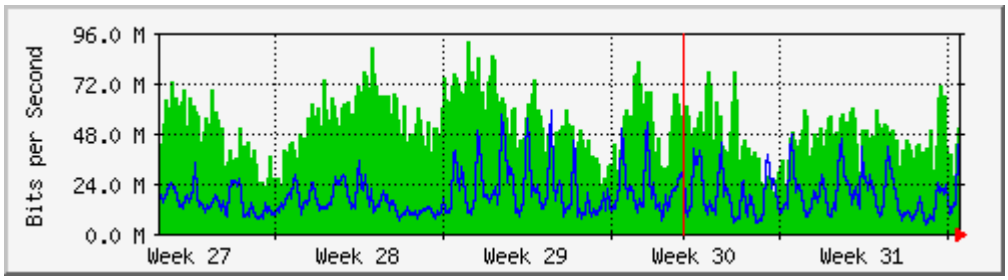

Table 6: Monthly Traffic

[12] Traffic measure available at http://www.net.fiu.edu/mrtg/ampathgsr.html

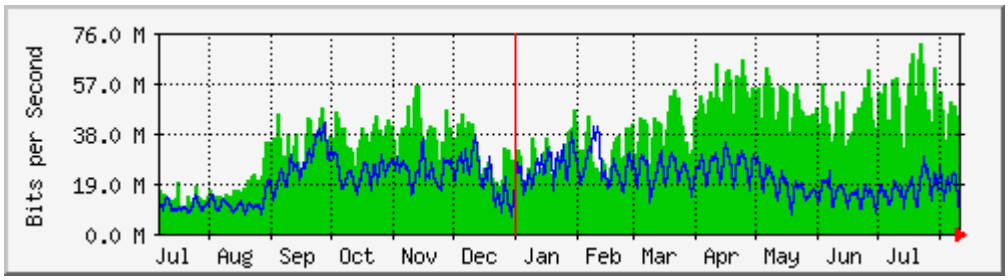

Table 7: Annual Traffic July 2001 through July 2002

Tables 4-7 Source: http://www.net.fiu.edu/mrtg/ampathgsr/198.32.252.33.abilene.1.html

6.1.1 Observations of AMPATH Annual Traffic

As indicated in Table 7, the annual traffic doubled during the measured year. As more users start passing traffic on AMPATH, the need to upgrade AMPATH will become more critical. As the awareness of AMPATH increases this growth may increase exponentially. The first step in addressing this growth is upgrading AMPATH's connection to Abilene. The OC3c AMPATH is currently using will be upgraded to an OC12c by the calendar year end.

Round trip time latency graphs are available for the REUNA, RNP2, and RETINA networks (shown below).

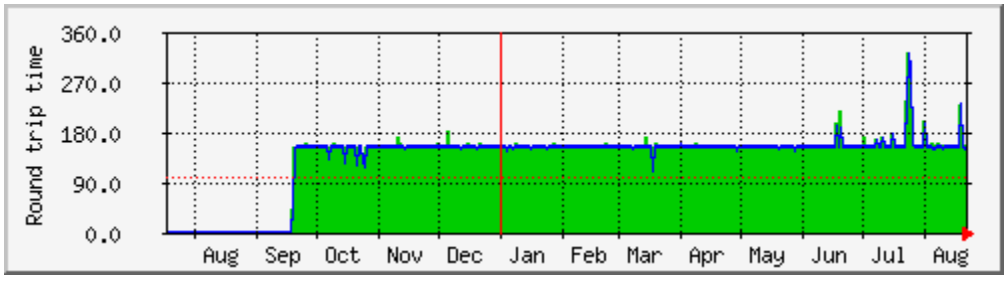

Table 8: REUNA Yearly Round Trip Latency Graph

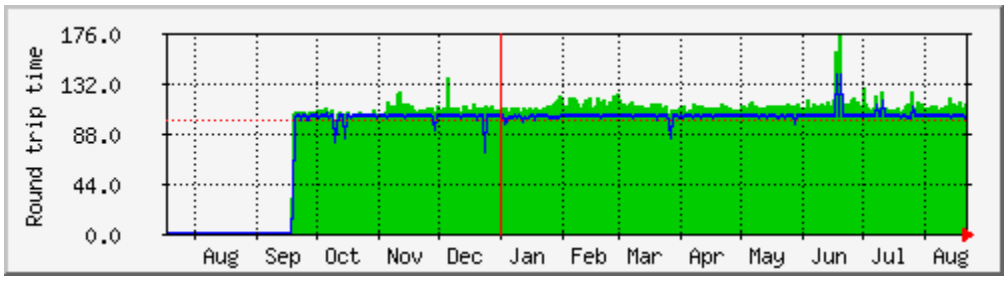

Table 9: RNP2 Yearly Round Trip Latency Graph

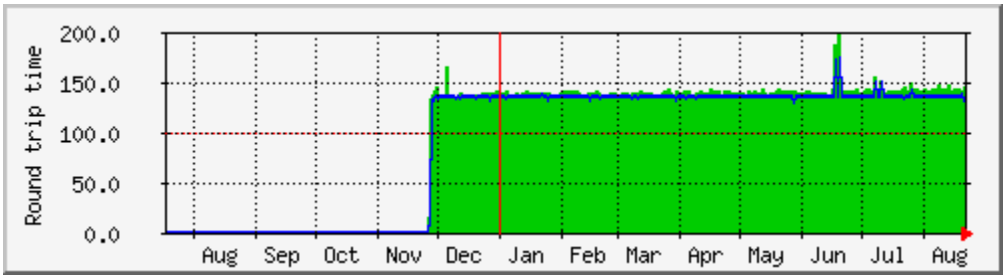

Table 10: RETINA Yearly Round Trip Latency Graph

Tables 8 through 10 demonstrate the stability of the connections to Chile, Brazil and Argentina. There is little variation on the round trip time latency for each of these connections.

6.1.1.1 Peering Statistics:

Site	Peer AS	Networks	Downstream AS's
AURA	AS19226	14 networks	1 AS
UPR	AS5786	97 networks	1 AS
ANSP	AS1251	28 networks	1 AS
RETINA	AS3597	39 networks	3 AS's
RNP	AS1916	87 networks	18 AS's
REUNA	AS11340	124 networks	2 AS's

Typical day (8-22-2002) observed 29797 unique IP addresses making use of the SFG/AMPATH connection. (Based on sampled Netflow data)

The above table shows how many autonomous system numbers and distinct networks are presently using the AMPATH network. On a typical day, 29,797 unique IP addresses sourced from these networks transited the AMPATH international exchange point.

7 Valdivia Group Recommendations

Many of these recommendations are interrelated, but they are of significant importance to be singularly recognized. There currently are no full-time staff positions assigned to AMPATH. During AMPATH's inception, this was obviously the correct level of staffing, as evidenced by the successful implementation of AMPATH. The Valdivia Group recognizes the outstanding efforts of the AMPATH staff particularly Julio, Heidi and Eric in their ability to put an operational network in place. However in the opinion of the Valdivia Group, AMPATH is entering a new phase. The AMPATH services and connectivity are in place, and the need to "get the word out" about these services and connectivity are critical to the effective use of the AMPATH bandwidth. With an increase in the user community, the need to maintain an operationally viable, quality network becomes paramount. These recommendations are not in order of importance, with one exception: Without the implementation of Recommendations One through Three, in the opinion of the Valdivia Group, the full potential of AM-

PATH will not be realized. Without the implementation of the remainder of the recommendations, operational viability will be uncertain.

The committee of science and engineering attendees at the AMPATH First International Conference, known for the purposes of this report as the Valdivia Group, respectfully submits the following recommendations:

7.1.1 Recommendation One: Increase AMPATH Staffing

It is the recommendation of the Valdivia Group that AMPATH staffing be increased to support the remaining recommendations made in this report.

Discussion: As AMPATH enters the new phase of operations, it must meet many new challenges, while still addressing all of the basic challenges encountered in its initial implementation. In addition to keeping the AMPATH network technically functional, it must continue to implement new technologies, such as GigE and IPv6, while providing for even higher levels of bandwidth in the near future. It must now engage with the various national RENs for technical and science briefings, collaboration briefings, and provide technical assistance in solving the last-thousand-mile problems that plague many nations; activities which often require travel and time. It must now deal with strategic efforts to acquire sustained long-term funding. Moreover, just the management of these efforts requires intense attention to planning and execution.

These new challenges require a higher level of dedicated, concentrated effort, and a rather wider skill mix than needed or provided during the original implementation phase. Despite these new demands, there has been no corresponding enhancement of the staff in number, mix, or focus. Currently, there is no full-time staff dedicated to AMPATH in any discipline: management, engineering, or support. Comparisons to other organization, such as APAN and Abilene, also indicate that the network is understaffed.

Therefore without an adequate increase in staffing, including full-time positions, and a broader staffing skill mix, it is the opinion of the Valdivia Group that the full potential of AMPATH cannot be met. Some of these needs are rather immediate. For example, there are a number of network engineering projects that must be accomplished in the near term, but insufficient staff exists to complete them in a timely way. At least one additional full-time engineer is needed immediately to address issues such as: 1) collection and dissemination of data on demand, 2) network planning, such as the planning of an optical infrastructure to support the ever increasing bandwidth scales being generated by global e-science collaborations in astronomy, high energy physics, environmental studies, and other applications, 3) and conduct engineering workshops and be actively engaged with the AMPATH participant engineers as well as Abilene, StarLight and the Global Research NOC at Indiana University network engineers.

Additionally, a programmer should be added to assist all AMPATH technical users with network monitoring through efficient NetFlow tools database management and reporting on the AMPATH web site. The programmer could also work on the AMPATH registry, mailing lists management, and daily web site management.

Immediate benefits are foreseen if AMPATH obtains the services of one full time awareness person as described in Recommendation Two. (7.1.2) which follows.

7.1.2 Recommendation Two: Implement an Awareness Program

The Valdivia Group recommends that an AMPATH Awareness Program be formulated and implemented.

Discussion: The progress that has been made in the implementation of the current AMPATH connectivity and services is remarkable. The next step is to populate the network with science and education users through connectivity to national RENs and additional international connectivity. To do this, an aggressive and well-planned awareness-outreach activity must be initiated, to identify potential users and inform them of the particular services that AMPATH can provide. Without an Awareness Program, identification of users will be unpredictable. The scope of an awareness program must, by the nature of collaborative science, include not only the AMPATH service area, but also an international component. Except for the two meetings sponsored by the NSF, and another planned in Miami at the end of January 2002, no program exists within AMPATH to provide awareness in the science community within the AMPATH service area. Without the knowledge that AMPATH services exist to enable scientific collaboration on an international level – and in particular with the USA – the full potential of AMPATH will not be met. This type of program will require an awareness plan to be developed, and will require technical briefings to schools within the AMPATH service area and attendance at various national and international science conferences. Awareness needs to be increased on an International level. Scientists in Russia or Europe should be made aware of the ability of AMPATH to provide collaboration services to scientists in South America.

As part of the Awareness Program, it is also recommended that AMPATH immediately develop an approach and plan to identify potential users for AMPATH services through various types of activities. Because of the diverse nature of the AMPATH service area in terms of population, the large area comprised of the South American continent, Mexico and the Caribbean, with many science and engineering disciplines spread across 58[13] nations, the Valdivia Group believes that a specific concentrated effort is needed to acquire a committed user community. This user community must then be nurtured and developed into a strong support group that has a vested interest in maintaining a strong networking strategy for AMPATH's future.

The Valdivia Conference was a positive step in Awareness of AMPATH in Latin America. Attendees were asked to complete a conference evaluation following the

[13] http://www.travelnotes.org/LatinAmerica/ Lists 58 distinct destinations, though some are territories rather than independent nations, such as the US Virgin Islands.

meeting. Overall, the attendees enjoyed the conference, giving it an average of a 4 rating (out of 5). However, the over-laden one day schedule was highly criticized by those who completed the evaluation. Many of the respondents suggested that the conference be extended to two days, to accommodate longer presentations, technology issues (distributed PowerPoint), and question & answer sessions. This time extension will permit more in-depth conversations about collaborative research projects among participants in the US and Latin America, and will serve to increase awareness of AMPATH's potential to non-connected RENs and other interested international researchers. A copy of the evaluation, and compilation of the results, may be found in Appendix B.

7.1.3 Recommendation Three: Develop a Comprehensive Funding Plan

The Valdivia Group recommends that AMPATH initiate the development of a comprehensive AMPATH Funding Plan, based on the short and long term planning described Section 10 of this report.

Discussion: This Funding Plan should identify major network upgrades required to maintain a cohesive and operational network. Included in this plan are: schedules and cost of implementation and estimated costs (staffing and hardware/software) associated with operations and maintenance, and a description of funding sources and how to develop them (i.e. NASA and Small Business Innovative Research contracts (SBIRs)). The plan should also include current and potential AMPATH members, both corporate and educational/scientific; identify and aggressively pursue grant opportunities and integrate these and other opportunities into the plan.

The Valdivia Group reaffirms the following observations noted in the AMPATH Workshop Report, 2001[14]

> *The Committee recommends that the NSF consider providing additional funding to AMPATH for operations during the three-year period of the Global Crossing gift. The ANIR strategy has been to engage the community with these enabling technologies by providing seed-money funding for limited periods of time for both backbone programs and institutional connections. The intention has been to allow institutions to prove the mission-related efficacy of those technologies during a start-up period, and then for them to develop long-term funding for continued services from their normal programmatic funding sources. It is hoped that this report will provide a basis for one or more proposals to appropriate division(s) of NSF and/or other funding agencies in support of the AMPATH project.*

The Valdivia Group believes that the AMPATH project is in a much better position to articulate a detailed strategy for the optimum use of such funding. However, one approach might be for AMPATH to use this suggested funding to offer their services

[14] AMPATH Workshop Report http://www.ampath.fiu.edu/Report%20Final.pdf page 35

free, or at deeply discounted rates, to some or all of the national REN recipients of the free-DS3s.

This would ensure that the less-well-developed national RENs could connect quickly, and immediately enhance bilateral access to the science collaborations in those countries in the timely interests of both US and international science.

At the same time, such access would undoubtedly result in the stimulation of their own internal development and allow orderly insertion of realistic sustaining funding into their out-year budgets. Circuits will be cheaper by then, and Global Crossing has not closed the door on the possibility of extending free access to the DS3s beyond the first three years.

7.1.4 Recommendation Four: Create an "NGIX South" in Miami

The Valdivia Group recommends that AMPATH develop a proposal for the addition of a Next Generation Internet Exchanges (NGIX) in Miami at the NAP Of The Americas (NOTA) to complement the east, west and central NGIXs located in the continental USA[15].

Discussion: By doing this, AMPATH would be established to become the premier network servicing the science and education disciplines in all of its service area. The current NGIX configuration provides access to Asia and the Pacific Rim, Europe and Russia, but does not service the Caribbean, Mexico and South America. With an NGIX located in Miami and other access points discussed in Recommendation Six, an NGIX South would provide connectivity to these points. The map in Figure 6 shows the cable landings on the east coast of South Florida, with nearby access to the NAP of the Americas.

Miami offers a strategic location to establish an NGIX with focus on serving US international interests. The infrastructure going north and now south, because of AMPATH, is in place to support applications and services of interest to the national agencies. There are seven undersea cable landings in South Florida that connect the US to Latin America, the Caribbean, southern Europe and Africa. An NGIX-South located in Miami would facilitate the FedNets in co-locating their facilities at the NAP and extending their networks south.

[15] An NGIX is an exchange point to enable peering of Joint Engineering Team (JET) US Federal networks driven by the short-term objective of interconnecting current JET networks but also the longer term view of evolving high performance R&E infrastructure HPNSPs (being defined by NSF). The use of NGIXs should be a goal. An NGIX is a Layer-2 Acceptable Use Policy (AUP)-free facility. Information derived from a Joint Engineering Team of NGI, Fednets and Intenet2 Joint NLANR/Internet2 Techs Workshop November 2, 1998 presentation by Javad Boroumand, NSF CISE-ANIR http://www.cise.nsf.gov/anir/ http://www.nsf.gov/search97cgi/vtopic.

Several federal agencies currently operate networks in Latin America using point-to-point low-bandwidth circuits. Federal agencies, such as DoE and NASA, are conducting research in South America, mostly over low-bandwidth point-to-point circuits. Cost reductions are projected if these agencies were to connect to AMPATH and reduce the number of circuits with 1 or 2 wide-bandwidth circuits. The NAP serves as one of the best equipped and secure telecommunications peering points in the world, offering access to service providers at zero (0) miles. Miami is located in a strategic location due to:

- Infrastructure with NAP
- Fibers going north and south
- Geographic location with access to Latin America and Caribbean

7.1.5 Recommendation Five: Create Alternative Access Points within AMPATH

The Valdivia Group recommends that AMPATH develop a plan for the addition of new access points spread over multiple locations within the AMPATH service area.

Discussion: Currently, the South Florida location is a single point of access for AMPATH. If AMPATH had been operating during Hurricane Andrew, service would have been interrupted. The probability of another hurricane hitting South Florida is high in any given year. With new access points located throughout the AMPATH service area, possible service interruptions resulting from a single point of access would be eliminated and robust traffic engineering can be implemented, which would increase service availability. Additionally, a distributed AMPATH access point design would open up new possibilities and economic feasibility to the 48 countries, territories and research centers that will not be able to receive donated bandwidth through AMPATH.

7.1.6 Recommendation Six: Continue to Develop Long and Short Term Planning

The Valdivia Group recommends the continued development of a near-term two year implementation plan, and a broader three to five year strategic plan for network evolution.

Discussion: With the steady evolution in network systems, it is essential to the continued operation of AMPATH to maintain a mature technical level commensurate with other research and education networks. If one looks at the Abilene network's implementation of end-to-end performance, IPv6 and elimination of ATM by July 2003, AMPATH must maintain a similar level of technical operation, expertise and configuration. The continued development of a two-year plan is necessary to ensure a seamless inter-network operation. Also it is imperative that funding be linked to this planning process. Likewise, as networks evolve it is also imperative that a longer planning process be continued to ensure that the short-term plans are valid and are implemented. Without a longer term planning process feeding into the short-term plan, the validity of the short-term plan becomes suspect. Without adequate planning the mission statement cannot be adequately carried out.

7.1.7 Recommendation Seven: Help Solve the National Infrastructure Problems

The Valdivia Group recommends the AMPATH project work with the various entities in their service area to solve the "last mile" or "last thousand mile problem" in some areas.

Discussion: This is similar to the "last mile problem" in the USA. It's just longer. Without a solution to this problem, a substantial part of the service area will not have access to AMPATH network services. Figure 4 depicts the areas that may have a problem with the last thousand miles. The Valdivia Group recognizes that this problem is essentially a national one. For each country where this problem exits, the AMPATH project must assist national networking efforts to ensure far-reaching connectivity into each country to the scientist, and ensure that there is compatibility with this connectivity between networks. Figure 4 also illustrates the significant bandwidth disparity between the nations in the AMPATH service area. By a large margin, most nations are not connected in a meaningful way. There are 10 nations that have very little or no network infrastructure and only a few nations i.e. Brazil and Chile, which have what would be considered a modern infrastructure. Even there, the AMPATH team has encountered challenging situations to connect astronomy and HEP projects of significant interest and financial investment to the USA because the research sites had fewer than ten (10) Mbps of bandwidth to the national REN backbone.

7.1.8 Recommendation Eight: Revise the AMPATH Mission Statement

The Valdivia Group recommends that the AMPATH Mission Statement be revisited and changed to reflect the new phase in the development of AMPATH, and to reflect the recommendations of this report, as appropriate.

Discussion: Also included in a revised mission statement should be the collaboration at the science discipline level that AMPATH can enable between the USA and the AMPATH service area, and AMPATH's involvement in the up-and-coming grid technologies. NASA has approached AMPATH on a project to demonstrate grid technology. If an agreement is reached between NASA and AMPATH, this will require the dedication of key AMPATH resources. The Valdivia Group recommends adding to the mission statement specific activities to enhance AMPATH's value to its service area, such as: public and educational outreach, scientific collaboration and involvement in new technologies i.e. grids, providing connectivity to and from the US and the Americas with special emphasis on US-based Research Extensive institutions and Latin American national RENs, and between any given US school and any school in the Americas. The figure below based on the Gemini Observatory's StarTeachers program[16] shows an example of this type of connectivity.

[16] http://www.gemini.edu/project/announcements/press/2002-12.html

Figure 10: Example of Connectivity Classroom to Classroom

7.1.9 Recommendation Nine: Create an AMPATH Acceptable Use Policy

The Valdivia Group recommends that AMPATH develop an Acceptable Use Policy.

Discussion: This policy should broadly define what purposes should be supported on AMPATH, and should provide protection against using AMPATH as a commodity Internet provider in direct competition with science and educational uses. However, this should not preclude the use of AMPATH as a commodity Internet Service Provider as part of an AMPATH funding plan.

7.1.10 Recommendation Ten: Diversify AMPATH to support Production, Research and Experimental Networks

The Valdivia Group recommends that AMPATH develop a plan to support Production, Research and Experimental[17] networks to support the nation's e-Science programs

Discussion: This report, as well as the report from the August 2001, AMPATH workshop, clearly shows the number of important US-led research activities that are taking place in South America and the countries of the AMPATH Service Area. These research activities would benefit from being able to utilize networks that support research and experimental networking environments. A plan should be developed by the AMPATH team to enhance the AMPATH network to support applications over research and experimental network infrastructures (as well as continue to operate a Production network) consistent with the nation's e-Science cyber-infrastructure. It is essential that AMPATH support computers and networks, and the Grid middleware that enables coordinated resource sharing and problem solving among distributed facilities.

8 AMPATH Near Term and Strategic Planning

As a result of the two AMPATH workshops, AMPATH has established a number of key science applications in its service area of significance to U.S. science. The network is now operational, connecting three (3) national RENs, one (1) regional REN, the University of Puerto Rico / Arecibo Observatory and the Gemini South Observatory. As was stated previously, this was accomplished by a part-time staff that donated a sizable amount of their time to ensure a successful implementation. From a technical and public relations perspective (awareness), full-time staff will be required to implement the next phase of the network's operations. Also, to realize the potential that has been identified, AMPATH will need to expand is connections both within its service area and to other U.S. and international networks. The planning process is divided into four categories: bandwidth, connectivity, funding and other risks.

[17] Definitions for Production, Research and Education networks can be found in the **NSF CISE** Grand Challenges in e-Science Workshop Report at http://www.evl.uic.edu/activity/NSF/index.html

8.1 Bandwidth

8.1.1 Limited bandwidth to Internet2 Abilene as compared to bandwidth to the AMPATH service area

8.1.2 Existing bandwidth to Abilene is shared with other Florida universities

8.1.3 Develop an AMPATH traffic plan

8.1.4 Increase bandwidth between service area and I2/Abilene

8.1.5 Increase bandwidth to StarLight and STARTAP

8.1.6 Begin implementation of optical interface to StarLight

8.2 Connectivity

Enhance connectivity to the various national RENs and the ease of routing traffic over AMPATH between international RENs and the AMPATH service area networks. This would also include traffic between national RENs within the AMPATH service area.

8.2.1 Establish stably-funded multiple access points to the service area and from AMPATH to other U.S. and international networks.

8.2.2 Identify national REN funding problems to solve the "last thousand mile" problem to enable US scientist to reach counterparts in service area.

8.2.3 Investigate using satellite service to solve the last 1000-mile problem within the AMPATH service area

8.2.4 Establish at the NAP of the Americas a "southern NGIX"

8.2.5 Establish peering relationships to the various FedNets i.e. NASA, DOE, DREN and others

8.2.6 Connect additional national RENs and research facilities (which ones have indicated a serious interest and are likely to have cost-sharing funds available?)

8.3 Funding

At the heart of all solutions to AMPATH's challenges is identifying and obtaining adequate funding to increase staff, add bandwidth and connectivity and rectify the last 1000 mile problem. Although AMPATH cannot fund national RENs, AMPATH staff could facilitate funding measures with and for them.

8.3.1 Develop a comprehensive funding plan based on national membership, aggressive pursuit of grant opportunities, corporate memberships and provision of commodity Internet services to and from South America on a non-interference basis with science.

Long-term funding sources for AMPATH might include:

1. Participation dues
2. US science projects (advanced network infrastructure) w/support from US agencies
3. Intergovernmental personnel agreements
4. International support for e-Science collaborations – from other countries' national or state science foundations
5. Collaborative, developmental and outreach grants and contracts with Internet2, Federal and state governments
6. State of Florida funding[18]

8.3.2 Identify the science and infrastructure requirements that need to be supported by an enhanced AMPATH. This includes the funding problems of the national RENs that AMPATH would like to connect.

8.3.3 Establish AMPATH as a stably funded research center with support for permanent staff, office space, publications, travel and meetings.

8.4 Other Risks

Other Risks is a category that is not necessarily technical but represent challenges or the identification and mitigation of risks not discussed in sections 8.1 thru 8.3.

8.4.1 Continue to define network applications of interest to U.S. science

8.4.2 Involve others in AMPATH planning and coordination by establishing working groups, an external advisory committee and recruiting subject matter experts.

8.4.2.1 Instigate working groups and conference committees that have been recommended in this report, the Miami Report and the Valdivia Conference evaluations.

8.4.2.2 AMPATH working groups will be structured around AMPATH's key science areas, including Physics, Astronomy/Space applications, Biology, and Environmental Sciences. Each will have an appointed Chairperson, who will help to establish the mis-

[18] Illinois, California, Washington and Michigan are example states for investment in advanced research and education networking facilities to improve research, education, and economics.

sion and goals of the working group, including deliverables and a timeline for reaching these goals.

8.4.2.3 Instigate a conference program committee to set the direction of AMPATH conferences

8.4.2.4 Implement an AMPATH Steering Committee

8.4.2.5 Implement an AMPATH Technical Committee

8.4.2.6 Implement an AMPATH Membership Committee

8.4.3 Establish AMPATH registry, listing connected schools and research centers in all participating countries.

8.4.4 Develop a contingency plan on Global Crossing uncertainties and how to deal with them.

8.4.5 Establish an AMPATH Awareness Program to provide the science community with the knowledge of AMPATH services

8.4.6 Begin involvement in LAGRID & International Virtual Data Grid Lab

8.4.7 Enable Irrefutable Right of Use (IRU)

8.4.8 Enable collaboration services for scientists i.e. virtual labs, VoIP

8.4.9 Implement activities listed in the table below as needed:

1	Gigabit Ethernet switch (carrier class)
2	Servers for monitoring
3	Four routers (IPv6, Multicast)
4	AMPATH as a Research Center or 501(c)3
5	Additional collocation space at NAP
6	Additional Office Space at FIU
7	Publications funding (brochures, annual report, etc)
8	Circuit for StarLight – layer 2
a.	IPVPN or GigE – solves the Fednet connectivity problem, and can serve as a backup to Abilene.
b.	International traffic routed through StarLight, domestic traffic to Abilene, or
c.	Production traffic to Abilene, experimental traffic to StarLight
9	Blanket funding for biannual meetings (one domestic, one international)
10	Additional Staff Support for:

a.	Director and Associate Director
b.	Network Engineer – Add one full-time position
c.	International Development Coordinator
d.	Grants Specialist
e.	Travel – Domestic & Foreign
11	NOC Services from Indiana
12	On-site managed services from Terremark
13	Electric bill!
14	Funding to replace/upgrade equipment after multi-year usage (reserve funds)
15	Optical transmission equipment for lambda connectivity
16	Identify and assist e-Science application collaborations requiring lambda connectivity.

Table 11: The AMPATH To Do List

8.5 Long-term goals, 3-5 years

8.5.1 Funding challenges discussed above are expected to persist through the 3-5 year period.

8.5.2 LAGRID: A grid for the Americas in collaboration with the International Virtual Data Grid Lab

8.5.3 Involvement in collaboration

8.5.4 Define what type of connections and to what organizations does AMPATH imagine providing to its service area in the next 3-5 years. For example the HEP CMS Experiment Grid will need[19]: Gigabit Ethernet (GigE) in 2003; 3-4 GigE by 2004; up to 10GigE by 2007. A short list of other US Science organization's research projects that must be addressed include: ALMA, Pierre Auger, HEP, iVDGL, USVO.

[19] Data provided by Professor Harvey Newman of Caltech and CERN

9 AMPATH Success Measurements

9.1.1 Number of applications and projects supported and collaborations facilitated (especially) along with number of publications based upon AMPATH-facilitated research if attainable

9.1.2 Amount of connectivity provided and number of clients receiving connectivity

9.1.3 Amount of traffic traversing AMPATH

9.1.4 Number of goals attained

9.1.5 Number of secondary and primary schools connected

9.1.6 Number of IP sessions created and IP Networks connected

10 Dissenting Opinions and Minority Reports

There were no dissenting opinions or minority reports.

APPENDIX A: AMPATH Working Group Guidelines

Each Working Group (WG) should establish the following:

1. A Chairperson (or co-chairs) – identified by AMPATH staff or by nomination who is from an AMPATH service area country and has research interests.
2. Working Group Charter/Scope
3. Description of Working Group, i.e., Goals and Milestones/timeline
    a. "The goal of this Working group is to …";
    b. The products of this Working group will be:" (including specific tasks, if applicable)
4. Mailing List – for example: <biology-WG@ampath.net>
5. A dedicated page on the AMPATH website, where all relevant information may be posted, including documents for comments, related news items, meeting minutes, etc. May also include WG-members-only access.

DETAILED INFORMATION:

The Chair: The duties of the WG Chair shall be to coordinate the group's tasks. The Chair will set goals, with the help of WG members; schedule and oversee meetings, and determine content for the WG's web page. The WG Chair shall be the contact person for AMPATH staff.

The Charter must include the following information:

- The group's mission (e.g., develop a process, track advances and developments in a specific area, etc.)
- The scope of work and criteria for success
- The duration of the group's work (from six months to two years)
- Membership & participation (i.e., level of involvement) requirements for WG members
- Meeting mechanisms (face to face vs. teleconference) and expected frequency
- The level of confidentiality expected for the group's proceedings and deliverables
- Voting procedures for the WG
    - Requirements that a quorum or simple majority of group members support any formal decision made by the WG
- The method/requirements for forming subcommittees, if applicable

***: WG Membership Rules:** Individuals who request (or are asked) to join a WG must agree to abide by the participation terms set forth in the charter.

Good standing in a WG may include:

- Attending most meetings of the WG
- Providing deliverables or drafts in a timely fashion
- Following discussions on relevant mailing lists
- Or other requirements, as determined by the Chair

The Description of the WG's **Goals and Milestones** must contain:

- A list of deliverables (reports, reviews, software, etc.), milestones, and the process for WG approval of these deliverables.
- The proposed timeline for reaching the WG's goals (subject to alteration as needed).

A Mailing List will be established by AMPATH for each Working group. The WG Chair (or designated AMPATH staff person) will be responsible for maintenance of the mailing list, as well as archived messages to/from the group members.

A web page will be established by AMPATH for each WG. The WG Chair (and designated AMPATH staff person) will be responsible for maintaining the information on the page, including meeting announcements, agendas and minutes; WG Goals & Overview; Related News items; WG Participation & Structure; FAQ (if needed); Previous Work & Surveys.

Examples of 'Working Groups' areas:
http://www.w3.org/Consortium/Process-20010719/groups.html - This was used as a reference document.

http://grouper.ieee.org/groups/

http://www.ietf.org/html.charters/wg-dir.html

http://www.web3d.org/WorkingGroups/

APPENDIX B: Valdivia Conference Evaluation and Results

First AMPATH International Conference

Valdivia, Chile

VALDIVIA CONFERENCE EVALUATION

We are asking for your assistance in evaluating the First AMPATH International Conference. Your experiences and opinion of the meeting will help us to plan and organize future conferences and events. Thank you for your time and input.

Overall Evaluation of this Meeting: (1=Worst, 5=Best) 1 2 3 4 5

1. Please rate the following 1-5, with 5 being the best

Scientific value of conference	1	2	3	4	5
Information/Publicity about the meeting	1	2	3	4	5
Conference layout and functionality	1	2	3	4	5
Length of sessions	1	2	3	4	5
Registration process	1	2	3	4	5
Speaker support	1	2	3	4	5
Attendee services	1	2	3	4	5
Audio/Visual capabilities	1	2	3	4	5
Location of meeting	1	2	3	4	5
Accommodations	1	2	3	4	5
Social events	1	2	3	4	5
Access to email	1	2	3	4	5
Food (in general)	1	2	3	4	5
AMPATH Staff assistance	1	2	3	4	5

2. Was this your first AMPATH meeting? Yes No

3. Did you attend the meeting as a:
   Non-presenting attendee
   Presenter

4. What is your opinion of the meeting format? (All presentations in one day)
   Extend to two days (or 1.5 days)
   Just right

5. Please rate the effectiveness of each of the following:
   (Positive, Negative, or N/A)

Speaker presentations
Users Group Meeting
Tech Users Group Meeting

Coordination with REUNA Conference
General Comments & Suggestions:

6. What did you like most about this Conference?

7. What did you like least about this Conference?

8. How would you improve the next conference?

Additional Questions for AMPATH Participants:

Bandwidth and service interests:

9. Would you like more Bandwidth? Yes No
a. If so, what kind? ATM Lambda IPVPN
b. How much?

Should we provide other services such as:

10. Network Monitoring out to the university edge? Yes No
11. Network security to the university edge? Yes No
12. IP Telephony among AMPATH participants and other connected R&E network users:
a. Would you participate in a pilot program? Yes No
b. Who / Where do you think you would call?

c. How many potential users of IP Telephony at your institution or on your network do you anticipate?
13. What other types of network or AMPATH research related services would you like to have available?

VALDIVIA CONFERENCE EVALUATION: RESULTS:

I. General Conference Evaluation.

Overall, the attendees enjoyed the conference, giving it an average of a 4 rating (out of 5). The categories on which the conference was rated are:

- Scientific Value
- Information/Publicity
- Conference Layout
- Length of the Conference
- Registration Process
- Speaker Support
- Attendee Services
- Audio Visual Support
- Location
- Accommodations
- Social Events
- Access to Email
- Food
- Staff Assistance

The highest rated categories were Scientific Value, Location, Accommodations, Staff Assistance and Social Events. The most commented-upon category was Length of Conference. (In the first group of respondents – likely those who had the strongest views – this category received an average rating of 2.75. Later respondents were not as harsh.) In the comments section, most of the respondents suggested that the conference be extended to two days, to accommodate longer presentations, technology issues (distributed PowerPoint), and question & answer sessions.

In terms of effectiveness, the speaker presentations received 100% positive response. The Users Group meeting and the Tech Users Group received positive feedback from 75% of respondents – others did not provide input.

Twelve of the respondents were presenters; six were attendees.

Here are some direct quotes from the attendees.

What did you like best about this conference?

- Good idea to collocate with REUNA. Need to take better advantage of similar collocation opportunities from content and attendees perspective in future.
- The presentations were good but the networking in the human sense was excellent.
- The speakers. Wonderful! There was not enough time to appreciate them.
- Quality of images and video of the presentation
- Diversity of the speakers

- The opportunity of knowing the capabilities of others groups in net communication, and also the assistance to improve our local communication.
- The opportunity to discuss with people from many different backgrounds and affiliations
- sharing information with north and south America tech's
- Learning in detail what other countries are achieving with regard to projects that require high bandwidth capacity. [*Conocer en detalle lo que otros paises estan realizando en torno a los proyectos que demandan capacidades de altos anchos de banda*.]

What did you like least about the conference?

- The disorganized execution of the agenda.
- The time restriction, including the time spent "setting up" between PowerPoint presentations. The presentation switching process needs rethinking. It was difficult to keep track of website references and names; a contact list would have been useful. I had to chase people down for business cards.
- Only 10 minutes for each participant. This survey will [sic] be in Spanish, we represent a Latin American community
- Not having enough time; not having efficient tech/equip to switch speakers
- The overall "compactness" of the schedule. Not enough time to discuss individual presentations and too many presentations in that one day

What improvements could be made, for the next AMPATH conference?

- Engage a program committee of AMPATH stakeholders to help develop agenda. Don't try to put so many 10 minute or less presentations into the agenda.
- Make it two days minimum.
- I would not combine it with another conference, certainly not with a late night event between them. The registration process needs rethinking. The documentation needs rethinking. Portable computer use was not exactly comfortable. The size of the auditorium (in this case too big) affects the experience; if the number of attendees is confirmed, a proportional space will improve quality.
- More time
- Presentation time schedule
- More publicity to the people
- I would like to have 2 days at least for presentations.
- Increase time for participation and clarification of issues. [*Ampliar los tiempos para la participacion y aclaracion de inquietudes]*

Number of respondents: 18 (31% response rate)

Average rating for each category:

(Ratings from 1 to 5, with 5 being best.)

Scientific Value	**4.125**
Information/Publicity about the meeting	3.375
Conference Layout	3.5
Length of the Conference	3.75
Registration Process	3.5

Speaker Support	3.375
Attendee Services	3.625
Audio Visual Support	3.625
Location	**4.375**
Accommodations	**4.25**
Social Events	**4.125**
Access to Email	3.25
Food	3.625
Staff Assistance	**4.375**

II. Specific Technical Questions

Respondents were also asked about their countries' bandwidth requirements, as well as possible demand for IP Telephony and network monitoring.

Of those who specifically responded that they would like more bandwidth, one requested a 2.5G Lambda connection; one requested 600Mb IPVPN (for the HEP Grid), and one requested an OC-3 ATM connection. Others were not specific about bandwidth levels.

The demand for other services such as Network Monitoring out to the university edge and Network security to the university edge received positive response from 12 of the respondents (63%). The need for IP Telephony among AMPATH participants and other connected R&E network users was not as prevalent – only 50% of respondents agreed that AMPATH should provide such a service. Most were unsure as to how many users they would have for an IP Telephony pilot program, and/or who they would call if this service were available.

Only one notable comment was received for the question, "What other types of network or AMPATH research related services would you like to have available?" :

- Internet conferences or presentations about Grid, networks, education.

Respondents who identified themselves:

Bob Bradford, NASA <bob.bradford@msfc.nasa.gov>
Sarah Darocha, REACCIUN, Venezuela <sdarocha@reacciun.ve>
Mario Vaz, CBPF, Brazil <mariovaz@cbpf.br>
Marta Ferraro, Universidad de Buenos Aires, Argentina <marta@df.uba.ar>
Jorge Garcia, Gemini Observatory, Chile <jgarcia@gemini.edu>
Guy Cormier, University of Puerto Rico <guy@hpcf.upr.edu>

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APPENDIX C: Applications presented at the Valdivia Conference

Please see:
http://www.ampath.fiu.edu/publications/Valdivia_Report/Chile%20APPENDIX%20C.htm
on the web, for Appendix C as HTML.

The printed Appendix C follows.

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