



Case Studies on Development of the Internet in Latin America and the Caribbean

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Introduction

Through the Hemisphere Wide Inter-University Scientific and Technological Information Network (RedHUCyT) project, the Organization of American States (OAS) helped local initiatives in the member states in either the creation or expansion of networks in their countries. Through the years, RedHUCyT (<http://www.redhucyt.oas.org/>) became a major contributing force for the development of the Internet in Latin America and the Caribbean region. It collaborated and coordinated with academic institutions, governments, phone companies (PTT) and the private sector to create many of the first Internet points of presence (POPs) in this region. Essential to these developments were the local network managers and officers at participant institutions, and their dedicated teams of experts, who made these projects possible.

Close collaboration was established with many agencies, in particular the U.S. National Science Foundation (NSF), through its ICM program-headed by Dr. Steve Goldstein, which facilitated international Internet connectivity in the United States through an Internet port facility in Homestead, Florida. Important collaboration was established with many of the Science and Technology Councils in the member states. The University of Costa Rica (UCR) and the National Research Network of Costa Rica (CRNet) -- headed by Dr. Guy de Teramond -- provided, through the years, continuous technical support to countries in Central America and the Caribbean. Another important collaboration was from the Network Startup Resource Center (NSRC) of the University of Oregon -- headed by Randy Bush. The RedHUCyT, through its Caribbean University Project (CUNet), in partnership with the University of Puerto Rico (UPR), in the early stages of networking development provided basic support to the Caribbean countries to implement their first electronic nodes for mail exchange. Soon thereafter, the first full interactive Internet POP

was established in the Caribbean (outside Puerto Rico) at the University of the West Indies (UWI) and the Technological University (previously CAST) in Jamaica (Keith Manison from UWI, Archie Marshall a former OAS consultant, and Dr. Guy de Teramond played key roles). An earth station for satellite communication was recently (1999) provided to UWI by OAS and will allow for the rapid expansion of their network. Also, recent support and equipment was provided to many educational institutions in the Caribbean to facilitate their full access to the Internet and to expand their campus information technology facilities. Some examples are the National Institute for Higher Education in Trinidad and Tobago, the Barbados Community College, the Sir Arthur Lewis Community College in Saint Lucia and the College of the Bahamas. Another important recent example is the project's support in funding the equipment (routers, CSUs/DSUs, servers) that was critical in getting five of the main universities connected to full Internet, and initiating the development of the Dominican Republic's academic backbone that supports the *Red Universitaria Dominicana Académica y Científica* (Cf. Dominican Republic).

The United States and other OAS member states provided substantial funding. To match these contributions for training, equipment and seed funding, the governments and participant institutions of member states have made major investments in telecommunications. Also, in recent years, the Inter-American Council for Integral Development of the OAS (CIDI) provided important additional funding to RedHUCyT, which also sponsors workshops and seminars in the region in order to improve skills, share knowledge and train network managers. During the past decade, important support was provided to the Latin American School of Networks (ESLARED), and many of the Latin American and Caribbean Networking Forum workshops that were held annually in different countries of the region. ESLARED is based at *the Universidad de los Andes* (ULA) in Merida, Venezuela. ESLARED organized these important events in 1992, 1995 and 1997. ESLARED is headed by Ermanno Pietroseoli and Edmundo Vitale, from ULA. The first edition of the Forum, "Inter-American Networking," was held in Rio de Janeiro, 1991, coordinated by the Brazilian national research network [Rede Nacional de Pesquisa](#) (RNP) and OAS/RedHUCyT, an event sponsored by several international and national institutions.

A recent example of an OAS co-sponsored training workshop is the [Second Workshop of Internet Networking Technologies](#) (general coordinator, Edmundo Vitale from ULA) that took place at ULA in Mérida, Venezuela, 14-19 June 1999. This activity was part of the Network Training Workshop -- held in parallel in San Jose, California, and Merida -- as part of the annual INET meetings of the Internet Society ([ISOC](#)). The event was organized by the Forum of Latin-American and Caribbean Networks (ENRED) and ESLARED, and co-sponsored by the World Bank and other international organizations. This workshop trained professionals from Latin America and the Caribbean in the design, operation and maintenance of Internet networks. Hundreds of participants from this and past workshops, including ESLARED, have played a vital role in developing networks and starting Internet connections in their countries of origin. In this year's event a new group of professionals in the networking field was instructed on the theoretical and practical aspects of planning, establishing, and managing the infrastructure of domestic and national networks. In 1998, The [Workshop em Tecnologia de Redes para America Latina e Caribe](#) (WALC '98), also as part of the parallel ISOC workshops, took place at the Federal University of Rio de Janeiro (UFRJ). General coordination was provided by RNP (Jose Luiz Ribeiro Filho, coordinator), with support from ESLARED and ENRED. This event also had support from the World Bank, OAS and other international organizations.

In Chile, close collaboration was established with Red Universitaria Nacional (REUNA) -- headed by Florencio Utreras -- the Science and Technology Council (CONICYT) and the Catholic University, particularly for training activities. The INFOCYT project, a *regional portal* for science and technology supported by OAS, was launched during a regional meeting in Santiago, Chile,

organized under the auspices of REUNA and CONICYT with support of Red Científica Peruana (RCP) and the other participants' countries. CONICYT is currently providing general coordination, and during 1999, the project branched out to other countries including Guatemala and El Salvador, which also host the system.

Computer networking in Latin America and the Caribbean is a relatively new phenomenon. Most of the networks were established only during the past seven or eight years. Previously, several countries only had e-mail facilities, in the form of store and forward UUCP (Unix-To-Unix Copy Protocol), or something similar. Brazil and Mexico (1989) were the first countries in Latin America to connect to full interactive Internet. Since the introduction of Web-based systems, many of the regional networks have grown impressively. The Internet research company, Internet Software Consortium (ISC, previously Network Wizards, <http://www.isc.com/>), reports that several nations within the region have more than 1000 hosts each (as of January 2000): 446,444 in Brazil; 404,873 in Mexico; 142,470 in Argentina; 40,565 in Colombia; 40,190 in Chile; 25,385 in Uruguay; 14,281 in Venezuela; 9,230 in Peru; 7,471 in Costa Rica; 6,754 in the Dominican Republic; 4,852 in Trinidad & Tobago; 1,922 in Ecuador; 1,772 in Guatemala; 1,660 in Paraguay; 1,235 in Panama and 1,028 in Nicaragua. These statistics include only geographic or "country code," ccTLD, domains. They do not account for hosts in the countries registered in the "generic top level domains," gTLD, ("com", "org", "net" and others). It is important to emphasize that the rate of growth of hosts in many of the Latin American countries is amongst the highest in the world. For example, the number of hosts for Argentina, Brazil, Colombia, Costa Rica and Trinidad & Tobago doubled between January 1999 and January 2000, and grew more than 90% in Guatemala and Peru. In this same period Mexico had an impressive increase of 259%. Still, in absolute numbers, connectivity in the region remains small compared to the more information-technology-advanced countries. The number of Internet users in Latin America and the Caribbean consists of only 2 or 3% of the total worldwide Internauts. According to Jupiter Communications (<http://www.jup.com/>) "more than nine million online users in Latin America will log on by the end of 1999, and the number will increase to 38 million in 2003 -- this projected increase of nearly 50 percent annually marks it as the region with the highest expected growth rate internationally, exceeding that of the U.S., Europe, and Asia." According to Jupiter, however, penetration within the region will remain low, reaching a projected 6.8 percent of the population in 2003 from a current penetration number of 1.8%. An interesting statistic rate is the number of hosts (in the ccTLD domains) per 1000 people, which provides one measure of Internet penetration. The following countries in the region, with over 1000 hosts, have a rate larger than 1: Uruguay 7.7; Mexico 4.3; Argentina 4.0; Trinidad & Tobago 3.71; Chile 2.74; Brazil 2.7; Costa Rica 2.16 and Colombia 1.01. (The World Bank Atlas 1999 was used as a source for the population up to 1997, and ISC for the host count.)

Recently, the OAS provided earth stations for satellite communication to the UCR and CRNet, UWI, and the National Science and Technology Research Council (CONCYT) in Guatemala. Through the years, CRNet, under the leadership of Dr. de Teramond, has had a vigorous expansion. It recently installed an additional new receive-only antenna with a capacity growth up to 10 Mbps to deal with traffic congestion, and UCR completed an ambitious project to interconnect about 80 different locations with a state-of-the art [high-capacity campus network](#). As a second phase of the original OAS projects that supported the first full Internet connections in Honduras and Nicaragua, in 1999 a project was developed -- with the Ministry of Commerce and Industry and the support of a local Internet service provider (ISP) -- to install new networks in Nicaragua. This will allow access to many more academic institutions located in remote areas, particularly in the Caribbean region. These include the Bluefields Indian and Caribbean University (BICU) and the *Universidad de las Regiones Autonomas de la Costa Caribe Nicaragüense*, among others.

Early OAS projects provided satellite earth stations to the National Research Council of Mexico, *Red Científica Peruana* (RCP) of Peru, *Universidad de los Andes* in Venezuela and the *Universidad Nacional de Asuncion* in Paraguay. These facilities, added to other basic equipment, helped some countries in the initial phase to expand and develop the networks, and in others, to facilitate growth. RCP -- under the leadership of Jose Soriano -- for example, has had through the years a spectacular growth, and RCP has expanded to new and innovative projects. In Bolivia, RedHUCyT originally assisted the [Bolivian Data Network \(BOLNet\)](#) (headed by Clifford Paravicini) to provide full Internet access for the first time, in 1995. Three main public universities were connected to the Internet. In Argentina support was provided to the Secretariat of Science and Technology, and to RETINA -- the Red de Teleinformática Argentina -- that connects to the U.S. Internet through a separate satellite link. The National Nuclear Energy Commission (CNEA) is one of RETINA's main institutional members which integrates more than 25 education and research institutions. Some of these networks have become national service providers with thousands of users. In Uruguay, for example, basic equipment was provided to the Technological Laboratory of Uruguay ([LATU](#)) to facilitate its connection to the Internet through the *Universidad de la Republica*. Also, support was given to the National Institute of Agricultural Research (INIA) to implement the [Regional Network for Information on Agricultural Research in the Southern Cone](#), a regional consulting service with databases with information about researchers, publications and projects on agriculture.

Case studies

Paraguay

Paraguay is located in the central part of South America and is a member of MERCOSUR along with Argentina, Brazil and Uruguay. In 1995, the OAS, through RedHUCyT, in coordination with the Universidad Nacional de Asuncion and the Catholic University, established a project to install the first fully interactive Internet POP in the country. At the time, because of lack of infrastructure, the PTT (ANTELCO) could not provide a high-speed circuit outside the country. Therefore the adopted solution was for the OAS to provide an earth station for satellite communication. The universities paid for the recurrent telecommunication satellite link, via PanAmSat, to Homestead, Florida. The NSF paid for the port charge connection in the United States to facilitate Internet access. The OAS also provided for additional equipment like routers, modems and workstations, as well as training and consultants. Blanca de Trevisan and her excellent group of people, from the Universidad Nacional de Asuncion, did an outstanding job of putting the project together. This new technology provided Paraguay with a technological boost because for the first time it allowed students and professors at the university to learn a new form of communication and access to information. This was a medium quite different from the basic telephony to which they were accustomed. Very soon, new ISPs were established in Paraguay. Some of these were advised by the same students who participated in the original installation at the *Universidad Nacional de Asuncion*. Also, private companies realized the potential that this technology could offer to their businesses and started to install similar equipment. Some companies, especially banks, used this technology and created private networks. Companies like Uninet, Netvision, Rieder and others were established in Asuncion, the capital city.

It is remarkable that this project, which began at the university level to provide Internet access for students and professors, grew into a major development for the country. Companies like Citibank started to use satellite technology for their private use. Previously, this was not even contemplated because of the lack of personnel trained in the use of telecommunications and information equipment. This, in turn, reduced costs for these corporations and facilitated access to their

offices both in Paraguay and abroad. Some ISPs were also established outside the capital city. Some companies that have installed this infrastructure include:

- EDESA: commercial company, with one central station and three remote ones;
- BNF-Cellular: banking, one central and 17 remote stations;
- of Parana: banking, one central and five remote stations; and
- Ministerio de Hacienda: government, one central and 17 remote stations.

(The author wishes to acknowledge Gerardo Jimenez Guerra from Interlink Communications, Inc., for his excellent personal report and communication on private-sector developments in Paraguay.)

Guatemala

The OAS/RedHUCyT funded similar projects in Guatemala that resulted in establishing the first full Internet connections at seven universities and research centers in that country in 1995. These efforts were coordinated with the National Science and Technology Council (CONCYT), headed by Magaly Morales, the Telecommunications and phone company (GUATEL), the main universities, coordinators of the national project MAYANet, and the support of UCR and CRNet. The National Network of Guatemala, [MAYANet](#), was connected to the Internet in December 1995 through a satellite link to the United States. Key negotiations were needed between CONCYT and GUATEL to ensure the signature of the contract required for the international link to the United States so as to guarantee the sustainability of the project. During Phase I of MAYANet, communications equipment, training and technical assistance were provided. This facilitated the interconnection of several institutions, including CONCYT, GUATEL, the *Universidad de San Carlos*, *Universidad del Valle*, *Universidad Rafael Landivar*, *Universidad Mariano Galvez*, *Universidad Francisco Marroquin*, the Central American Institute for Industrial Research and Technology (ICAITI) and the Institute of Nutrition for Central America and Panama (INCAP). The communications costs are shared by the institutions in accordance with a special agreement reached between GUATEL and CONCYT.

Phase II of the MAYANet project involved the investment of additional OAS voluntary funds allocated to the Guatemalan government. Phase II implemented a metropolitan backbone with several POPs, and the expansion of local area networks (LANs) in many institutions, in benefit of the academic, scientific and technological sectors. In addition, the expansion of MAYANet to the interior of the county was promoted. Guatemala has gone through an important telecommunications privatization process that included the sale of GUATEL, currently TELGUA, and new regulations allow private ISP providers to offer competitive service.

In 1998, with OAS funding, CONCYT bought and installed a terrestrial station that supports satellite connections of the metropolitan area and regions where telecommunication infrastructure was nonexistent. This new station also improved the access to the Internet. This new equipment, which became fully operational in early 1999, is an important component to attend to the demand for a reliable network for the academic and scientific community of Guatemala and the region. The terrestrial station not only improves connection to the Internet, but it also makes possible teleconferences, videoconferences and distance learning programs. This new station will also serve as an alternate access to the Internet for Guatemala and other Central American countries.

In collaboration with CONCYT, RedHUCyT sponsored the [First Central American Seminar on Internet Security](#), held in Guatemala on 27-28 May 1997. Network managers from Costa Rica, El Salvador, Honduras, Nicaragua and Panama attended the event, as well as instructors from

Mexico and Spain. The seminar advanced several legal and technical issues on Internet security. Similar Regional Workshops were held in Panama in 1998 and 1999 (see Panama).

CONCYT also plays an important role in the expansion of the regional project on Information System on Science and Technology (INFOCYT) in Central America. Guatemala, in coordination with National Councils of the region, developed a Web site on science and technology to serve users from Central America and Panama. This site is now part of the INFOCYT regional information system.

Panama

A very interesting project is *Intered* in Panama. The first full Internet connections in Panama were established under the leadership of *Universidad Tecnologica de Panama (UTP)*. Originally, in June 1994, the OAS/RedHUCyT supported the implementation of the first full Internet nodes in Panama through Pannet -- a consortium of universities -- with technical assistance, provision of routers and communications servers, and training of network managers. Pannet, under the leadership of UTP, was connected through a microwave link to Costa Rica, facilitating Internet access of the Technological University of Panama (UTP), the University of Panama (UP), and the University of Santa Maria la Antigua. The project had important technical assistance from CRNet. This was a pioneer project in the region because it allowed a terrestrial microwave link between two Central American countries, which then, in turn, shared the satellite link to the United States, operated by CRNet. At the time, a very similar project was established with the Universidad Nacional de Ingenieria, in Nicaragua.

Thereafter, several commercial ISPs were established in Panama. The largest have their own independent satellite connections to the United States. The problem was that customers of different providers had to interchange packets through these satellite connections, even for local traffic. With the implementation of Intered this is no longer necessary. Intered is a national access point that allows the interchange of local information without leaving the country. This project sponsored by OAS, under the leadership of the National Secretariat for Science and Technology (SENACYT) and Pannet, is a model for the region. Randy Bush and Dave Meyer of the NSRC trained the participating Panamanian engineers in BGP (Border Gateway Protocol), peering points, the Internet Routing Registry, and Autonomous Systems. They also built the tools to automate configuration, and helped set up the InteRed eXchange in July 1997 -- the first open, cooperative exchange point in the region (cf.

<http://www.redhucyt.oas.org/webing/ABUSH/sldoo1.htm>).

Intered has its own organization -- the Asociacion Intered Panama is formally in charge of the project and the Intered node -- and is funded by its members (ISPs) according to its by-laws. Intered has been operating for the past two years and has nine institutional members. Included on its Board are Orbinet, Sinfonet, Cable & Wireless, Pannet and SENACyT. According to information recently provided by Asociacion Intered, each provider has an E1 connection to the central location and the average traffic is 1,862.8 Kbps income and 1,780.8 Kbps output.

In October 1999, a regional Workshop on Internet Security was sponsored by RedHUCyT in Panama and was coordinated by SENACyT and Asociacion Intered. Some of the topics include importance of network security, access rights and control of networks, security classification, sniffers, configuration and installation of firewalls, cryptography, certification authority, infrastructure of public/private key, etc. A similar workshop was also held in Panama during 1998 coordinated by Pannet and SENACyT with participants from all the Central American countries.

Dominican Republic

RedHUCyT and UPR, through its Caribbean University Project (CUNet), originally provided basic assistance to the Catholic University (PUCMM) in the Dominican Republic to implement its first electronic node for mail exchange. As mentioned in the introduction, in its early stages, CUNet facilitated access to electronic mail, for the first time, to many universities and institutions in the Caribbean.

Extensive negotiations with the government, university representatives and the phone company (CODETEL) of the Dominican Republic were conducted to design a project for the full Internet connection of institutions of the *Red Universitaria Dominicana Académica y Científica* (RUDAC), including the *Pontificia Universidad Católica Madre y Maestra* (PUCMM), the Autonomous University of Santo Domingo (UASD), the Technological Institute of Santo Domingo (INTEC), CONES and UNAPEC, among others. The project involved significant OAS funding for the purchase of several high-capacity routers, modems and additional communications hardware and software. Jose Dominguez -- a national from the Dominican Republic and ex-professor at INTEC -- currently at NSRC, played a key role in these developments as the technical coordinator for the project, in collaboration with Rodham's Mejia, vice president of PUCMM, and his team of experts. All these universities are now fully connected and part of the Internet academic backbone. For more information please refer to Rudi's Web page at INTEC:

<http://www.rudac.net.do/>

As part of the training activities to strengthen this project, the OAS/RedHUCyT sponsored the *First Network Technology Workshop - RUDAC* in Santo Domingo, Dominican Republic. The four-day workshop was held 20-23 September 1999 in the PUCMM with approximately 40 participants of RUDAC and other institutions. The [NSRC](#) provided technical assistance and the instructors for the workshop. [Cisco Systems](#) and [O'Reilly & Associates](#) also sponsored this event. Cisco Systems lent routers, and O'Reilly & Associates donated about 300 books that were distributed among the participants. Jose Dominguez and Steve Hunter from NSRC and Rodham's Mejia and his team at PUCMM provided general coordination.

Topics covered in the RUDAC workshop included Transmission Control Protocol/Internet Protocol (TCP/IP) network administration, UNIX security, Domain Name System configuration, IP routing design, providing Web services in an academic setting, Squid caching, and Internet mailing list management, and the workshop concluded with a session on organizing Help Desks to answer questions and assist end users with problems.

El Salvador

The implementation of the National Network of El Salvador ([SVNet](#)) in August 1996 was the result of continuous negotiations between diverse institutions of the country and the coordination and consultants of RedHUCyT. Of particular importance were the negotiations between the National Telecommunications and phone Company (ANTEL), the National Council for Science and Technology (CONACYT) and participant universities. SVNet phase I facilitated and expanded access to the Internet of many institutions, including ANTEL, CONACYT, the *Universidad de El Salvador* (UES), *Universidad Don Bosco*, and *Universidad Centroamericana Jose Simeon Cañas* (UCA). The project provided important financial resources for the purchase of routers, communications servers and additional communications equipment and training and technical assistance. RedHUCyT also coordinated with CONACYT the implementation of [SVNet's Phase II](#) that expands Internet connectivity to many more institutions in the country. Equipment was co-located at ANTEL and key negotiations were needed between ANTEL, CONACYT and OAS to

complete the project. ANTEL facilitated access lines to the participant institutions. Access was provided to many institutions, including various campuses of the University of El Salvador in San Miguel and Santa Ana -- *Facultad Multidisciplinaria de Occidente (UES OCC)* and *Facultad Multidisciplinaria de Oriente (UES ORI)* -- as well as the National Library, the *Instituto Tecnológico Centroamericano*, *Universidad Evangelica*, *Universidad Politecnica de El Salvador* and *Casa Presidencial*, and the National Foundation for Economic and Social Development (FUSADES). SVNet's Phase II plays a major role by expanding a national backbone in the country and by facilitating the consolidation of the Central American Backbone that will interconnect all the Central American countries among themselves, without having to first route packets through the United States. As with Guatemala and Panama, UCR and CRNet provided important initial technical support for this project. El Salvador has gone through an important telecommunications privatization process that included the sale of ANTEL, currently TELECOM, and allows private ISP providers to offer competitive service. CONACYT also plays an important role in consolidating the INFOCYT project that, as mentioned above, is a portal for science and technology in the region.

Belize

In the early stages of CUNet, basic equipment was provided for the implementation of an electronic node at the University College of Belize (UCB) for e-mail Internet exchange. Connections were made via dial-up to UPR, and later through NSRC, using a UNIX box, at the time (1994) the only e-mail hub in Belize.

Negotiations between UCB and the Belize Telecommunications Limited (BTL) provided the framework to implement a project that facilitated the University's access to full Internet connectivity. OAS/RedHUCyT provided the telecommunication s equipment and BTL provided free access to the College.

The OAS sponsored a Belize Schools Internet Workshop at the Corozal Community College, 31 March - 5 April 1997, with the collaboration of BTL and the participant schools. This Seminar also had local financial support and support from Belizeans living abroad. Many network managers received hands-on training on computers and telecommunications, including configuration of hardware and software programming. The success of this workshop encouraged the participant schools to organize and develop a project for their interconnection to Internet with OAS funding. In recognition of the assistance provided, the Belize Postal Service released on 22 July 1998 stamps in commemoration of the 50th Anniversary of the OAS. On issuing the stamps the Postal Service of Belize made the following remarks:

The OAS Provides Funds, Computer Equipment and Training for Schools and the Internet in Belize. In a project begun in 1997, the Organization of American States provided Computer Equipment and Training to enable Belize High Schools to link to the Internet via the free connection provided to each school. 32 High Schools and affiliated Institutions were included in this project and each school received Networking Components, and a Modem to link their Computer labs to the Internet. The OAS also funded Training with two workshops in Corozal and Belize City, with provision for a third. There is also an electronic forum for discussing ideas and problems of a technical or non-technical nature for all schools.

It is relevant to mention that Brian Candler, who at UCB was at some point local coordinator of CUNet and played a key role in overseeing these developments, including his role as principal instructor of Corozal, became very active in volunteer training for other fellow networkers. In particular, he has participated for a number of years as an instructor in the "Networking Technology Workshops for Countries in the Early Stages of Internet Networking" organized by ISOC within their INET annual meetings. He is currently assisting NSRC with a project at the University of Kinshasa, in the Democratic Republic of Congo, Africa, providing e-mail services to several academic departments.

Conclusion

All of these projects, originally established to allow access to the academic community, had totally unexpected ramifications for other sectors, especially the commercial one. Experts trained under the project's programs have, in some cases, become entrepreneurs in their own countries. Initial work with the academic sector resulted in an unexpected partnership among government, university, and private sectors -- a cooperative effort that produced vigorous development of the Internet in the region.

These results encouraged the development of the telecommunication sector due to the introduction of satellite and other technologies and advanced information systems. But, most important, this expansion was possible due to the development of specialized human resources capable of handling and implementing these complex technologies within their own countries in a self-sustaining manner. It is important to emphasize, as has been stressed by Randy Bush and other colleagues, that cultivating the volunteer ethic to assist fellow networkers in the same way that you were once helped has been invaluable in terms of scaling the Internet. So many instructors who have devoted their time and effort to train and help others have provided this help.

Disclaimer

The opinions expressed in this article are those of the author and not necessarily those of the OAS.

