Networking in Latin America: View from the Fringe

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Abstract

Merida is a small university town perched on a mesa between two rivers at the foot of the Sierra Nevada, the northern end of the Andes range. Although the view of the snow capped mountains has been a source of inspiration for academics for centuries, at a distance of 700 km by mountain roads from Caracas, it hardly qualifies as a technology Mecca. Yet in the last decade it has seen the birth of the first academic computer network in Venezuela and a Wide Area, Broadband, Wireless Data Communication Network that was recognised by SuperComm'98 as the best in the Remote Access category.

It has also spawned EsLaRed, the Latin American Networking School, which, since 1992 has trained a thousand professionals in different aspects of networking and applications. These accomplishments prove that the Internet can empower the residents of many backwater regions to take a more active role in the global arena. Ten years ago the University of Los Andes had 40,000 students and 3000 professors, yet the interaction with the rest of the world was very limited. The postal system was very slow and unreliable, international phone and fax very expensive, and the university libraries made journals available several months after they were published. Books took even longer to arrive.

Although important research was carried out, as the project that led to the development of the Orimulsion (a technique that makes the tapping of shale oil feasible), it was limited to a few well-established research groups that were able to attract financing. Nowadays, thanks to the Internet, a plethora of extramural relationships has brought new life to the university and the city. The city now boasts 60 cyber-cafés.

Five members of the faculty, Luis Nuñez, Cheo Silva, Edgar Chacón, Edmundo Vitale and Ermanno Pietrosemoli began the task of building a computer network and, in short, had a UUCP (Unix to Unix Copy, an early form of computer communication) link running. This link was used to make a daily dial-up connection to the Internet. The magic of e-mail, news and file transfers had arrived.

Early on, we realised that although the technical and economic hurdles to the growth of the net were daunting, the most formidable problem was the lack of enough trained people to manage the network. So we started by offering to a group of our brightest students the opportunity to follow a special extracurricular training in Unix and Network Management. They formed the core of our network administrators.

We did not have expertise in all the areas required, but Luis Nuñez had just attended the First International School on Computer Network Analysis and Management, held by ICTP (Intern-ational Centre for Theoretical Physics) in Trieste, Italy, so he proposed that we should try to do something similar in our town.

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I must confess that I argued that such an enterprise was well beyond our financial and technical capabilities, but was finally convinced by the enthusiasm of my colleagues. Taking advantage of my upcoming sabbatical leave of absence, a plan was drawn for me to spend three months at ICTP during the preparation and realisation of the second edition of the Networking School. The rest of my leave I spent at SURANET (South-eastern Universities Research Network) in College Park, Maryland, working with Professor Glenn Ricart and at BELL-CORE in Morristown, New Jersey, with Dr. Andres Albanese.

Dr. Ricart introduced me to Dr. Saul Hahn, from the Organisation of American States, who was embarking upon an ambitious programme to provide Internet connectivity in the hemisphere. He immediately endorsed the idea of a training activity in Venezuela and pledged a substantial financial contribution.

Back home, the rest of our group had also been very busy gathering support from several organisations. These organisations provided networking gear for our project. During three weeks in November 1992, we were able to assemble a group of 15 international experts who donated their efforts to train 45 participants from 10 countries in the region. The volunteer experts were assisted by a contingent of enthusiastic students from our university that helped in the lab activities.

There was consensus among the participants that these training activities were worth repeating, and so the following year we helped organise the 'Escuela Latinoamericana de Redes - Taller de Lima' in Peru and in 1995 we had the Second EsLaRed, the third in 1997, the fourth in 1999, all in Merida which had proved fertile ground for training activities due to its ideal climate and relaxed atmosphere. The number of participants kept growing steadily, by 1999 we had 200 from 17 countries, distributed among six different training tracks, including one specially dedicated to librarians, under the leadership of Steve Cisler. Gradually the teaching responsibility was shifted to Latin Americans, too many to mention, but I cannot overstress the contributions of Raul Echeberria from Uruguay and Sylvia Cadenas from Colombia. A complete list can be found at www.eslared.org. One of the instructors of EsLaRed'92, Dr. Ben Segal from CERN in Geneva, suggested that we should contact the Internet Society, ISOC, that was conducting similar training activities.

In 1997 Professor Edmundo Vitale attended the Internet Society workshop in Montreal for countries in the early stages of Internet connectivity. There he met Dr. George Sadowsky then ISOC president of Education. They agreed that EsLaRed should organise a Spanish version of the Internet workshop, then being taught in English and French. So in 1998 we went to Rio de Janeiro where Jose Luis Ribeiro Filho from the Rede Nacional de Pesquisa sponsored WALC'98, (Workshop para America Latina y el Caribe) at Universidade Federal de Rio.

WALC'99 held in Merida was merged with EsLaRed'99, while WALC2000 took place at the Universidad Autonoma de Mexico (UNAM) in Mexico City spearheaded by the president of the Mexican Chapter of the Internet Society, Dr. Alejandro Pisanty. "...in a country with such a limited telephonic infrastructure that the number of Cellular phone lines is three times the number of land lines, wireless is clearly the way to go."

While all these training activities were taking place, the University of Merida computer network, REDULA (Red de Datos de la ULA) was vigorously expanding, making use of 26 km of single-mode fibre optics cable that supports both a 100 Mbit/s TDM (Time Division Multiplexing) Data and Voice network and 155 Mbit/s ATM (Asynchronous Transfer Mode) transmission, that span the city of Merida. It is worth noting that we installed the University fibre optic network when the Venezuelan PTT had no fibre in Merida.

But what about the neighbouring villages and even those places in town out of reach of the fibre cables? Access by telephone modem is provided, but in a country with such a limited telephonic infrastructure that the number of Cellular phone line is three times the number of land lines, wireless is clearly the way to go.

During the Lab Sessions of EsLaRed'92, the participants were able to get acquainted with wireless data networks based on radio amateur equipments making use of the KA9Q, a software suite developed by Phil Karn that implements TCP/IP over radio. Ham radio bandwidth is limited to 25 kHz in the VHF band and 100 kHz in the UHF band. This limits the attainable speeds to 9600 bit/s in VHF and 56 kbit/s in UHF. For faster speeds, up to 2 Mbit/s, WAVELAN radio-modems cards built by NCR, which worked at 915 MHz using the Spread Spectrum technique, were used, albeit with a more limited range. The participants were able to compare both wireless data solutions and choose the one better suited to their needs.

We also made use of these techniques to provide access to REDULA and the Internet, taking advantage of

a nearby 3500 m mountain, La Aguada, on which we installed a repeater that commands the city of Merida and its surroundings. The repeater initially worked in the VHF band, trading transmission velocity for greater range. By fitting the Wavelan cards with Yagi antennas built in the university communications lab by Professor Nestor Angulo, we were able to reach up to 10 km at 2 Mbit/s from the same site.

By 1996 FUNDACITE MERIDA, a government organisation chartered to promote scientific activities in our state, started chipping-in to provide Internet Access to remote towns and villages. Our early efforts were focused on Spread Spectrum techniques, both at 915 MHz and at 2.4 GHz. Some of the limitations we encountered were interference in these unlicensed bands and diminished throughput as the number of users increased. Clearly, a better solution was called for. In the quest to surmount these shortcomings, our attention was called to a startup in Nashua, New Hampshire, that claimed a bountiful 10 Mbit/s throughput per sector on 6 MHz channels in a multisectored narrow band frequency reuse solution. Upon visiting Spike Technologies we were convinced that their approach was best suited to our data communications needs, because their patented antenna solved the interference problems. Their IP switching based scheme allowed for easy integration into our data network and the system's low latency was well suited to streaming video and IP telephony services.

With funding from FUNDACITE, a trial system was set up in 1997. The system had four subscriber stations in Merida, a base station at La Aguada and one repeater 40 km away that gave service to the city of Tovar, located 41 km from the repeater and 80 km from Merida.

The performance of the system impressed the Governor of the state of Merida who provided funds for a full blown system of 400 remote units, deployed across the state, providing Internet access to schools, health care facilities, libraries, NGOs and government agencies. The subscribers enjoy LAN speeds within a region of several hundred of square kilometers. Several concurrent video streams are supported for applications such as telemedicine, distance learning and remote surveillance.

Conclusion

The base station has eleven sectors, each with a 15 degrees beamwidth. Adjacent sectors have different frequencies, but frequencies are reused in distant sectors. A total of four frequency pairs 6 MHz wide are used (including repeaters), for an aggregated throughput of 220Mbit/s. Each sector is an independent LAN, interconnected by a high speed switch. This network received the SuperQwest Award at SuperComm'98 as the best in the Remote Access Category.

Now, people like myself that have been waiting for twenty years for a telephone line without getting it, can nevertheless access a high speed data network and communicate with the world.