NICARAGUA: Sida-CNU-INASP Project

Bandwidth, Management and Optimisation: Consultation visit February 2009

Christian Benvenuti
February 2009

Document summary

International Network for the Availability of Scientific Publications (INASP) - Programme for the Enhancement of Research Information (PERii) and Consejo Nacional de Universidades (CNU) work together on the Sida supported project *"Strengthening access to and production of research information within the Nicaraguan research and university system*". This report documents findings from consultation visits undertaken as part of this project during February 2009.

Contents

1 Introduction

One objective of the PERii programme in Nicaragua is to enhance access to research information by strengthening ICT support. For research and educational institutions, responding to the high cost and rising demand for internet connectivity and access now forms an essential element of their ICT development plans. Part of this project therefore aims to identify ways of maximising available capacity or bandwidth through effective bandwidth management and optimisation (BMO).

In order to design most appropriate training to address bandwidth related issues in Nicaragua, a consultative visit was undertaken in February 2009. This report documents findings and recommendations resulting from the individual consultation visits and the two-day introductory training BMO workshop.

2 Summary

Fact-finding and consultation visits were arranged by the local PERii Country Coordinator (CC) to 5 of the 10 core CNU universities participating in the programme. These provided a good sample range of institutions, with locations in Managua, Leon and Rivas and varying in computer network and user base size from the 100s (200+ at EIAG) to the 1000s (16000+ at UNA) with corresponding variation in ICT infrastructure. Individual university data is included in this report on:

- Institutional size, number of PCs, IPS, servers, technical support staff, operating systems, open source software, virus (prevalence and anti-virus programmes), email Internet policy, backups, training budget and monitoring. In addition, relevant information such as apparent problems and limitations faced are also included.

Despite obvious disparity between universities, dictating the need for more than one approach, a number of commonalities were evident:

- Prevalence of viruses; insufficient number of available skilled ICT staff; absence of Internet usage or monitoring policy; operating systems – Linux for server and Windows XP for PCs.

Most obvious differences, apart from size, related to:

- Documentation – network maps, informal network usage policies – some institutions had little of no documentation, whilst others had good levels of documentation including drafted policies awaiting approval,
- Cache/proxies – just a few using.

At a national level, ICT infrastructure development has included installation of fibre optic cable but this is currently only available and in use by a few of the universities visited. A national exchange point for routing internal communication is provided by ENTEL but it was noted that this sometimes necessitates communication still been routed via the USA.

A two-day introductory bandwidth management training workshop brought together 24 ICT personnel from the 10 targeted universities. Whilst difficult to choose content without prior knowledge of the local conditions and level of participants, this workshop provided participants with an overview of bandwidth related topics and the opportunity to discuss issues with others working in the same field. It also presented perfect opportunity for the facilitator to further identify and establish most appropriate training activities to best match the needs of the community going forward.

Recommendations:

Based on the findings, it is recommended that the following training and capacity development activities are undertaken:

- A short bandwidth management and usage policy development seminar type activity
    - duration approx. 1-2 days

- A basic/introductory technical bandwidth management workshop and
- An advanced technical bandwidth management workshop
    - content topics and duration recommended apply for both the basic and advanced level but depth of content will vary according to level
    - duration recommended 5½-8 ½ days, allowing -
      ½ day of networking plus Linux system admin concepts;
      1-2 days on monitoring – software and troubleshooting;
      1-2 days on caching servers;
      1 day on firewall;
      1 day on QoS;
      1 day wrap up and minor topics (viruses, network design, bandwidth optimisation);
      1 additional day (ideally) for practical lab exercise.

3 Background data and planning meeting

Transfer and hotel had been arranged by the local PERii Country Coordinator, Ruth Velia Gomez, for arrival in Managua on the 31st of January. On morning of 2nd February we briefly met to discuss plans and I received first draft program of university visits confirmed, with remaining to be added as agreed. Consultation visits were scheduled to take place on the 5th/6th/11th and a training workshop on the 9th/10th. This allowed time prior to meetings for preparation of the presentations and the lab exercises. More details contained at the end of this document in the section "Notes on the two-day training and suggestions for the next training/s".

Since Ruth Velia Gomez organized all the meetings but was unavailable due to other commitments, I was accompanied by her assistant to all the universities we visited as shown in Table-1

Table 1. Scheduled Visits - Nicaragua

University/Institution	**City**	**Date (M=Morning) (A=Afternoon)**	**Contacts (that I met)**
Universidad Nacional Autonoma de Nicaragua, Leon	Leon	5/2/09 M	Jorge Treminio jgtreminio@unanleon.edu.ni
Escuela Internacional de Agricoltura y Ganaderia (EIAG)	Rivas	6/2/09 M	Jaime Molina jambat15@yahoo.com
Universidad Nacional Autonoma de Nicaragua, Managua	Managua	6/2/09 M	Derman Zepeda dzepeda@unan.edu.ni
URACCAN – Universidad Comunitaria Intercultural	Managua	6/2/09 A	A. H. Bucardi informatica@uraccan.edu.ni
Universidad Centroamericana (UCA)	Managua	11/2/09 M	María Elena Saavedra elena@ns.uca.edu.ni

Figure-1 shows where the universities I visited are located in Nicaragua. Leon and Rivas are just an hour and half by car from Managua.

Figure 1. Cities where I visited at least one university

This is how remainder of the document is organized:

- First there is a summary of the data I have collected at the various visits.
- Next, for each university I visited there is a one/two-pages summary of what discussed with the contacts in Table-1.
- Finally some comments on the 2-day training and some suggestions for future workshops.

4 Summary of institutional data

Even though I could not visit many universities, I had a chance to visit both small ones like EIAG in Rivas and big ones like UNA in Managua. The first one serves no more than 200 students and the all network is connected to the Internet via a simple Windows XP machine that is configured as a router, while the second one serves thousands of students and includes pretty expensive devices in its core. It should be clear that the needs of these two universities are pretty different and this proves the necessity of both a basic and an advanced BMO workshop.

At each university I tried first to understand their network design, the location of the servers (both those used to serve the Intranet and the Internet) in the network, the connection/s to the service provider/s, and then I investigated on what instruments they were using to optimize the bandwidth usage, such as proxies, firewalls, shapers, etc.
I also tried to understand how many people take care of the network, whether they use open source software or not, and what other institutions they had or are having collaborations with, if any.

Some issues are common to all institutions (ie, viruses), others are not. In this section I'll first list the common issues/points and then the differences. For more details, please refer to the second part of this document which reports the information I collected at each university.

Common points/issues:

- Viruses
  This is a big problem in all universities. They all say that the anti-virus they are using is not sufficient to resolve the problem. None of the universities had an antivirus license for all PCs. In most cases they are just using demo versions. Most laboratories are based on Windows XP machines and this does not help contain the proliferation of viruses.

- Lack of staff
  Number of technical staff is usually insufficient, and rarely can they count on backups, both in terms of hardware and personnel.

- Lack of a formal policy on the use of the Internet
  Half of the universities did not have a written policy on the use of the Internet.

- Monitoring
  Almost none of the institution does any serious monitoring of its links (very few exceptions).

- Linux and Open Source.
  In most cases servers run Linux with open source software and desktop machines run Windows XP (without open source software such as Firefox or OpenOffice). In most cases technicians said they have Linux experience[1].

1 Because of this I would have expected the participants to the workshop to have solid skills on the use of a Linux system,

Differences:

- Lack of documentation
  Half of the universities did not have a good scheme of the network, with all the useful information. This information is necessary to quickly identify the source of a problem when one appears, or to quickly describe the network design to a third person should the need for it arise.

- Proxies
  Only few universities use a proxy to cache content locally.

- Informal policy on the use of the Internet / Firewalls
  With regards to the rules on what is prohibited and what is allowed, in terms of what kind of information or network application the users can access and use, there are some major differences. There are, for example, universities that do not prohibit anything, others that instead of prohibiting apply some rate-limiting, and others which implement some filtering based on the content.

During my visit to the university in Leon I was informed that in Managua they have a national exchange point which ensures that national traffic does not need to exit from the country when routed through more than one national service provider. However, ENITEL seems to have some strange routing in place and sometimes it makes national traffic go to the USA anyway.

NOTE
The opening session of the workshop consisted of a presentation where the participants described the network at their university. I asked them to provide the audience more emphasis on the details that had some relevance with regards to BMO. Given the limited time and complexity of some of the network schemes, it was not possible to complete a good picture of networks during the workshop. However notes and whiteboard diagrams are available for reference if required.

5 Individual Institutional Data

5.1 Universidad Nacional Autonoma de Nicaragua, Leon

(http://www.unanleon.edu.ni/**)**

Table-2

#Students #Professors+Admin #Faculties #Careers #Campus	1200 1500 7. The maximum distance between two faculties is 5 km. 27 5
#PCs	1300 (+wireless laptops)
#Public IPs NAT	A few for the servers + 4 for the “faculty of computer science” that explicitly asked for them. Yes
#Servers	Most of the servers run Debian Linux. Two of them run Windows Server 2003 (domain controllers) and three of them are windows application servers.
#Technicians	The staff consists of around 25 people. Two of them are assigned to the Linux machines.
Operating Systems	Most PCs run Windows XP. There is no plan to move to an Open Source Operating System at the moment.
Open Source Software	Only on the Linux servers. Some windows desktops run Firefox.
Virus	It is a problem. They are using different (demo versions) antivirus software and this is a problem because when the PCs download updates from the Internet they consume quite some bandwidth. They have evaluated different kinds of antivirus for one year and half, and in the end they decided to use NOD32 because they found it not to be too heavy (from the CPU perspective) and updated fairly often. They are going to buy a corporate license that will cover around 65% of the PCs.
Email	A few years back, when the network infrastructure at the university was not too good, users started using external email services. The infrastructure is much better now and users have slowly started using the institutional email again. They have a contract with Google that gives them the gmail service allowing them to use their domain name. This however has an implication on the bandwidth usage: they are accessing Google's email servers when they check their email from inside the university too. They are thinking about installing a local copy of the servers to address this issue.
Policy on the use	They have a written policy and they made it available on their Intranet.

of Internet	They also sent it to all users by email. They document was written in mid 2008, but it has not yet been signed by the University authorities.
Backups	Depending on the data/server, they have monthly, weekly and daily backups.
Annual budget for the network and training	There is no budget for this made available by the University. However, they get some funds from international co-operations (for example with Sweden).
Monitoring Statistics	Yes Yes
Firewall Shaper Proxy	Yes Yes No (they have not thought about it yet but they would like to look at it)
Wifi	Yes. They are investigating on how to best cover the campus with WiFi (both an institute from Venezuela and 3Com are investigating it for them). They think that the current WiFi network is not well managed.
Commercial hardware	Cisco (+Linksys), Dell

5.1.1 Links to the Internet

They have been upgrading their Internet link every year: they had 1Mbit/s in 2006, 2Mbit/s in 2007, 5Mbit/s in 2008. They currently pay 790US$/MBits/month for their 8Mbit/s (fiber) link with AMNET, and are planning on upgrating it to a 12Mbit/s link in 2010.
AMNET is not the cheapest provider but given their good technical support and the quality of the link, the cost difference is justified.
ISPs in Nicaragua are all privates and they do not provide any special deals to universities.

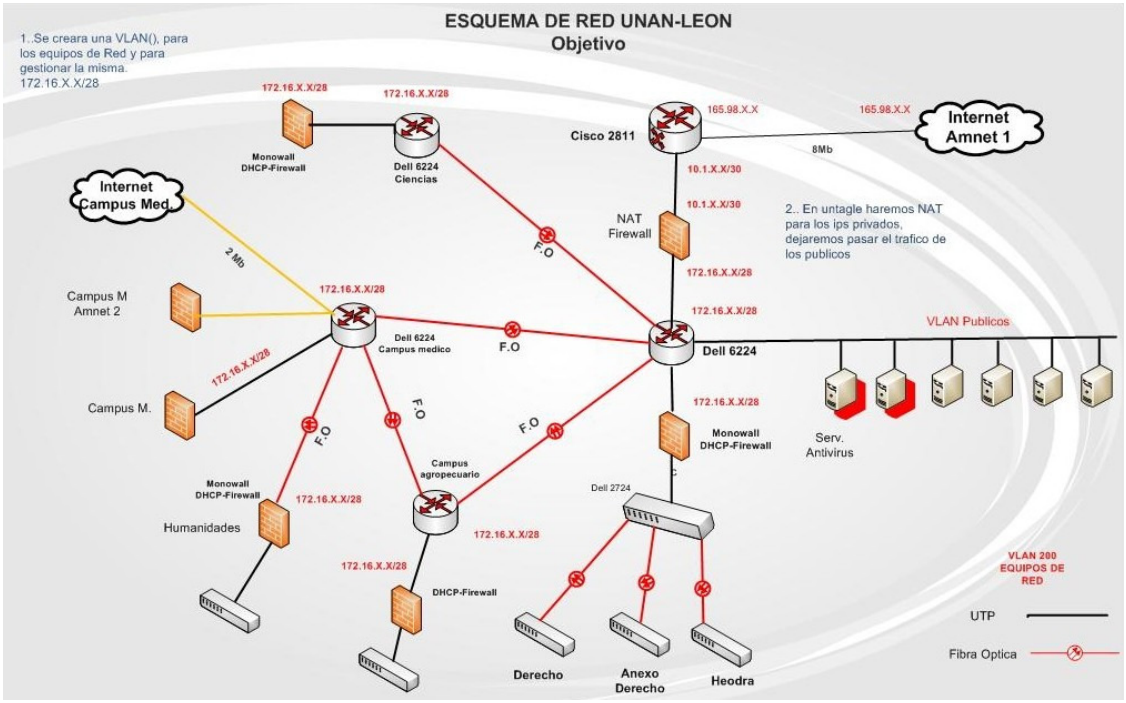

Figure 2. Network Design at the university of Leon

5.1.2 Monitoring

- They use CACTI to monitor the links in the main router (see figure-2).
- They also use the “Traffic-graph” option of the M0n0wall firewall (see *http://m0n0.ch/wall/*). During the interview (which took place in the morning) the firewall showed that the University was using between 4 and 6Mbit/s out of the 8Mbit/s on the Internet link.

5.1.3 Firewall

- They use several features of the open source M0n0wall firewall, including the DHCP server, the DNS forwarder and VPN.
- The default firewall policy is to block everything: the explicitly define what to allow.
- They use the DHCP server's log to determine (from the IP/MAC associations) what users are generating/consuming the most bandwidth.
- Their slogan is “Internet for everybody but not for everything”. They are in the process of providing internet access to a good portion of the city (outside the campus), including to non-students. However, in order to be able to do that, they need to optimize their use of the Internet link because it can get easily saturated otherwise.
- They use the DNS-forwarder option to deny access to specific URLs. They manually add URLs to the list of forbidden sites. They sometimes disable the DNS-forwarder (therefore allowing all URLs) in the week-ends or in the evening after 6pm (for example when the students explicitly ask for it).
- Among the type of traffic that they do not allow there are P2P and Games

5.1.4 Shaping

- They are not doing any shaping.
- They do not use any shaper to reserve bandwidth for their virtual conference sessions because they mainly do videoconferencing with Europe: given the time difference between Nicaragua and Europe, they usually happen to have videoconferences when there are not many users at the university (ie, early in the morning or late in the night).

5.1.5 Collaborations

- They have some collaborations with UNA in Managua.
- They have some collaborations (trainings) with a university in Spain.
- All the service providers are based in Managua. For this reason here they had to create a technical group with some knowledge on all areas.

5.1.6 Caching

- They are going to install a local antivirus update server so that the local hosts can update their antivirus signatures locally and only one machine (the server) needs to do it via the Internet link.
- They are thinking on doing something similar for the Windows Updates. For now they have simply disabled the automatic windows update feature on the hosts.

5.1.7 Open problems/limitations

Here are some of the problems explicitly mentioned:

- Electricity. They have UPS systems for network devices like routers and wireless access points, but not for PCs. Since 2008 the situation is a little better (thanks also to the fact that they are located close to a hospital, which is the reason why the area is considered higher priority by the provider). They would need more monitoring facilities to detect power failures and automatically restart those devices that need it (right now for example they need to physically go to remote sites and restart some pieces of equipment that can't do it automatically).
- They would like to learn better how to interpret/read the various statistics/graphs generated by their monitoring software. They also would like to find software that can better summarize the information they are currently monitoring with different pieces of software.
- They would like to get some more experience with network security. They got some attacks already, where the attackers managed to hide (according to them) all clues, making it impossible for them to understand how and what happened. Since the last attacks they have enforced some security checks based on the MAC addresses.

5.1.8 Generic notes

- None of the faculties is thinking on building its own network (or buying its own Internet link). However they did think about that possibility a few years ago when the status of the university network was much worse (they redesigned it completely in the last few years).
- In 2006 they started re-cabling the all network with certified cables. There are however buildings where they do not have permissions to lay down cables (because historical for example).
- They have plenty of fiber installed in the campuses and are going to put more.
- They use VLANs and the Spanning Tree protocol.
- They are using IP telephony (100%) between the admin offices of all faculties. They use Asterisks.

Figure-3 and Figure-4 show the servers and network equipment in the main computer room.

Figure 3. Network Equipment at the University of Leon

Figure 4. Network Equipment at the University of Leon

5.2 Escuela Internacional de Agricoltura y Ganaderia (EIAG), Rivas

(http://www.eiag.edu.ni/**)**

Table-3

#Students #Professors+Admin #Faculties #Careers #Campus	250 40/45 1 3 1
#PCs	40 (+/-)
#Public IPs NAT	1 Yes
#Servers	1 (the windows XP router is also a server for a piece of software used in admin). The web server is hosted by UNI.
#Technicians	1 (no Linux experience)
Operating Systems	Windows XP (and few Windows Vista). No licences.
Open Source Software	No
Virus	It is a problem.
Email	They only use external (public) email servers.
Policy on the use of Internet	No
Backups	No
Annual budget for the network and training	There is a small budget but it is used for other purposes.
Monitoring Statistics	No No
Firewall Shaper Proxy	No No No
Wifi	Yes (half of the machines in the computer lab use WiFi).
Commercial hardware	LinkSys, Encore, 3Com

5.2.1 Links to the Internet

They connect to the internet via a Windows XP PC that is currently being used as a desktop PC too (!).
They connect to the Internet via a 1,5 Mbit/s link with Cablenet.
The quality of the link is acceptable but not good, and it costs 250 US$/month.

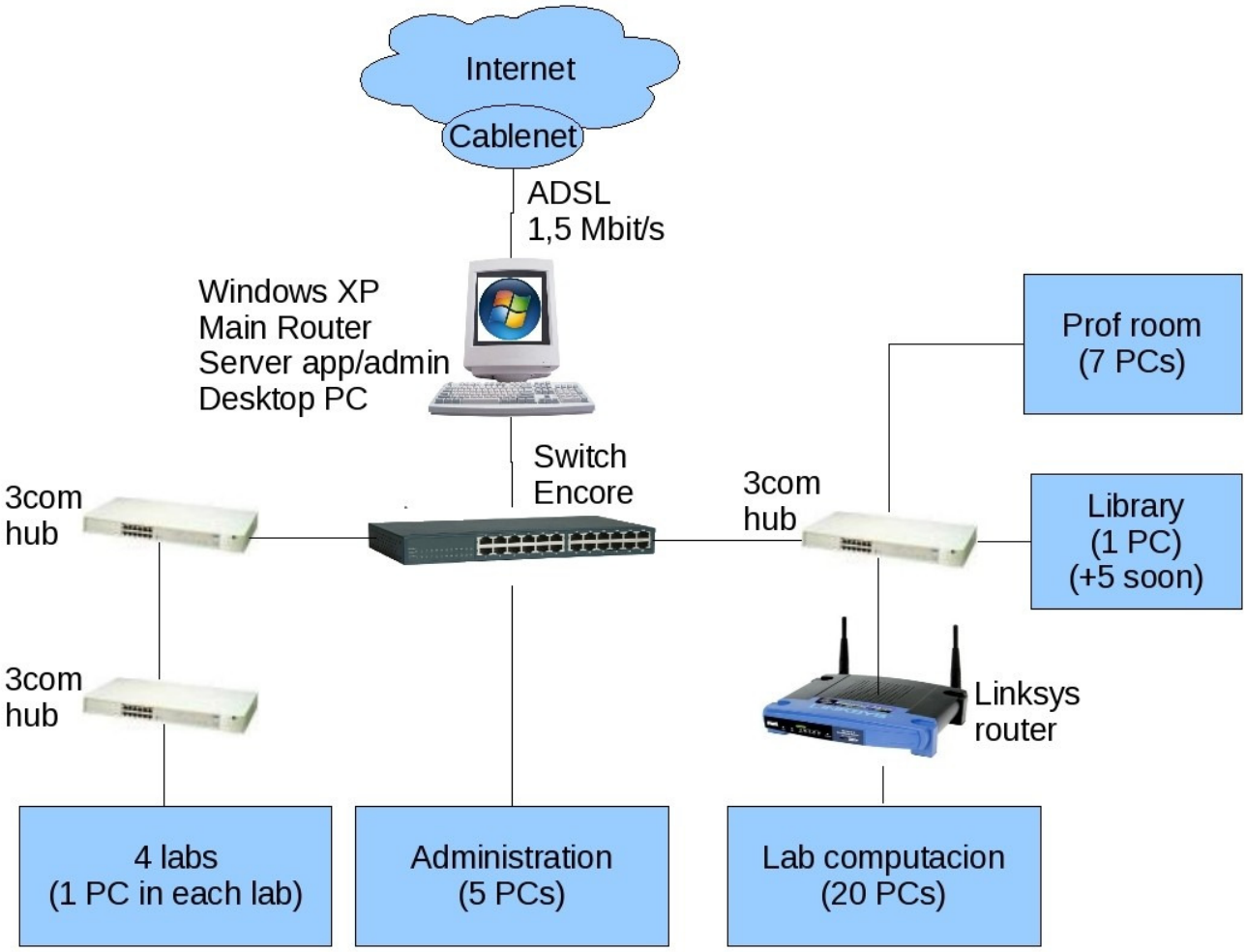

Figure 5. Network Design at EIAG

They could not show me a diagram of the network because they did not have a printed copy and the digital version was in the PC of a person temporary on vacation. Actually they never had a scheme of the network: 5/6 years ago an external company installed it and since then they kept updating/fixing it without ever documenting anything. Only recently they decided to create a diagram of the network.

5.2.2 Collaborations

- They do not have active collaborations with other universities in Nicaragua.
- They do have co-operations with foreign groups (Chile, Japan, etc).

5.2.3 Open problems/limitations

Here are some of the problems they explicitly mentioned to me:

- Electricity. When they have power outages, they often get their devices (ie, routers/switches) misconfigured.

5.3 Universidad Nacional Autonoma de Nicaragua (UNA), Managua

(http://www.unan.edu.ni/**)**

They have 5/6 campuses. The one described here is the main one in Managua. The other ones are similar but smaller.

Table-4

#Students #Professors #Admin #Faculties #Careers #Campus	16000 683 6 (plus 3 regional centers, plus 7 research centers)
#PCs	1272 (July 2008)
#Public IPs NAT	1 Class C (/24) network Yes
#Servers	15 physical servers. The real number of servers is higher because they use virtual servers too. Most of the servers run Suse Linux.
#Technicians	In the main node: 1 email admin 1 servers admin 1 network admin 1 web master + one technician in each one of the other nodes. Not all technicians have Linux skills.
Operating Systems	Windows XP (and few Windows Vista). The licence is paid only for those PC with a brand name that come with Windows pre-installed. No licences for M$ Office.
Open Source Software	Only on the servers.
Virus	It is a problem. They currently use demo versions of the antivirus because there is no budget for them. However, they have an hardware device that allows them to filter around 85%/95% of spam/viruses that arrives from the Internet. This device (from ASTARO) costed them 20K US$.
Email	Most users have an institutional account. The university's mail server used for the student accounts is hosted by Google, which allows them to access it via the university domain (this means that checking the email from the campus consumes bandwidth on the Internet link). See Figure-6.
Policy on the use of Internet	No. They only have a policy document on the use of the email service. This document is available online.
Backups	Yes. They do not have a complete backup system in place, but they do some backups.

Annual budget for the network and training	There is a budget for the maintenance of the network. There is also something for trainings but they most of the time do self-learning.
Monitoring Statistics	Yes (Cacti, Nagios, plus a software/page provided by the provider) Yes
Firewall Shaper Proxy	Yes (Cisco PIX plus Suse Linux embedded firewalls) Yes Yes (Squid)
Wifi	Yes. They are currently investigating whether to implement a mesh network. The WiFi network is completely open (no authentication).
Commercial hardware	Cisco, Dell, 3com, Dlink, Astaro

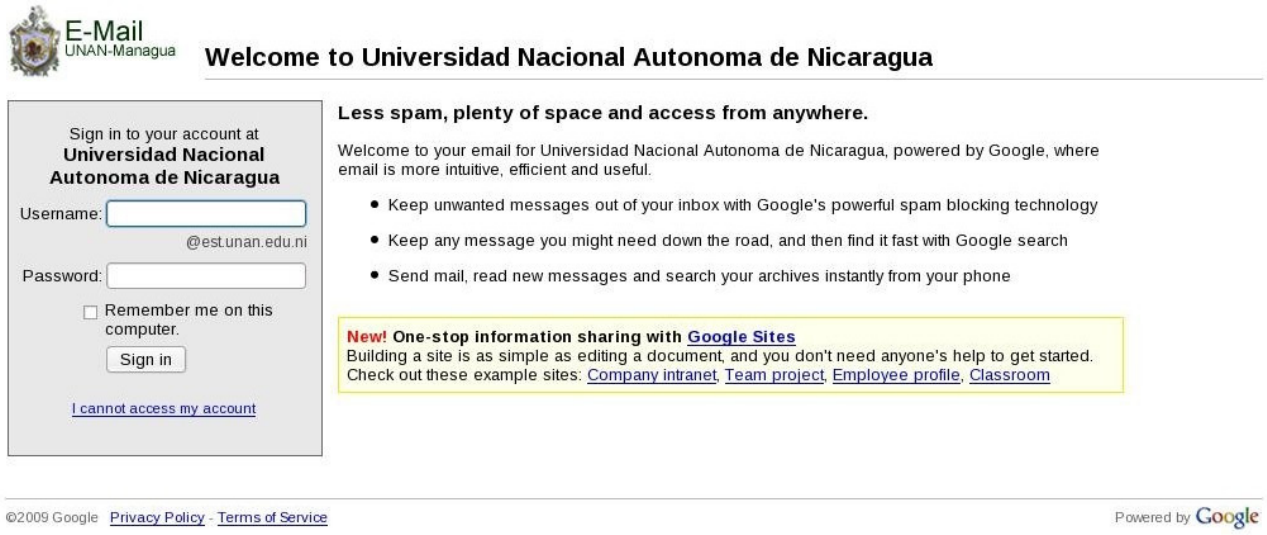

Figure 6. Student email service (correo estudiantil)

5.3.1 Links to the Internet

They pay for a 5Mbit/s link but they actually get a 10Mbit/s link.
The link costs 600US$/Mbit/Month.
They are happy with the stability of the link.
The service provider is AMNET.

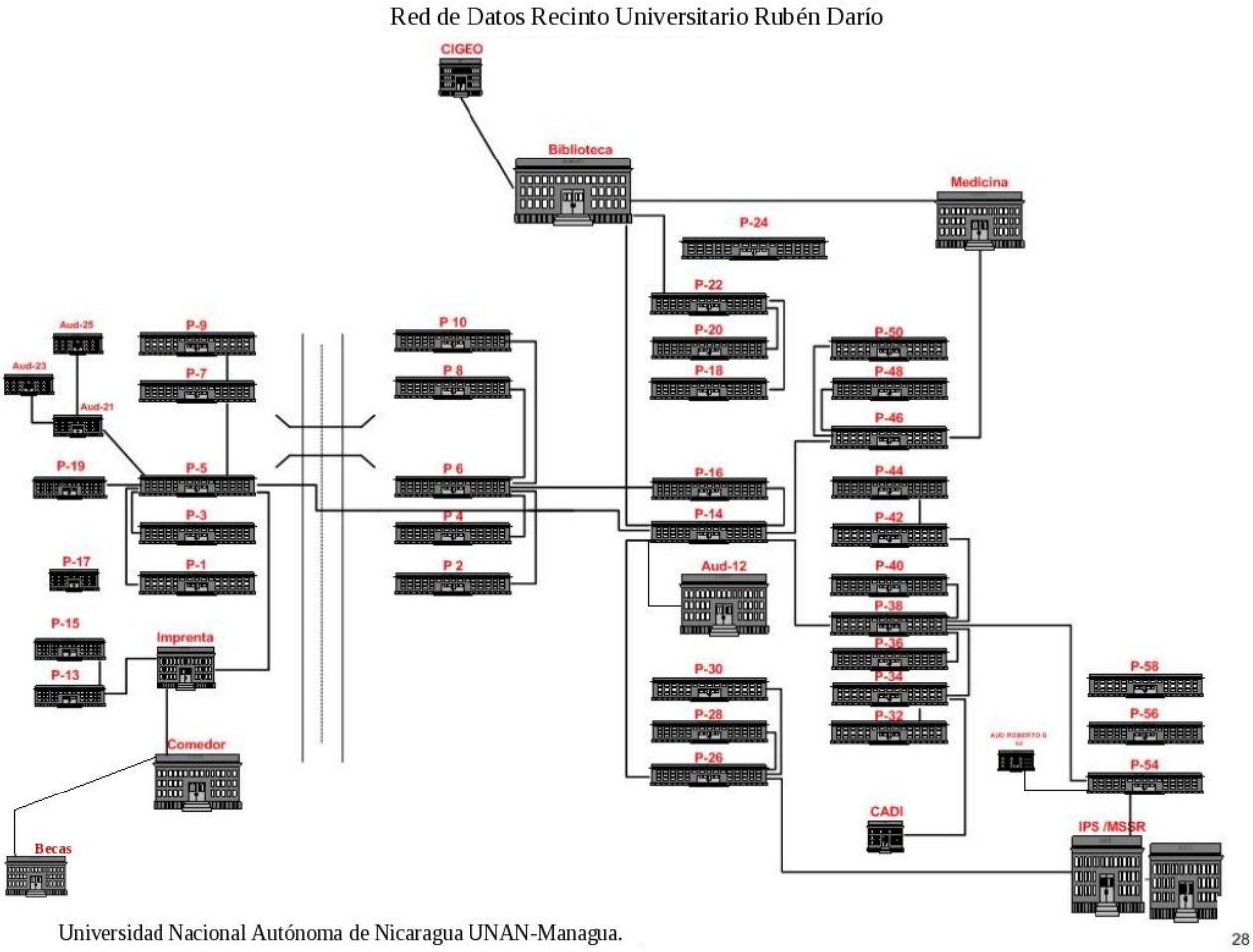

Figure 7. Network Design at UNA

5.3.2 Monitoring

- All switches run SNMP and are monitored with Cacti.

5.3.3 Firewalling

- Instead of blocking services and applications, they prefer to shape/ratelimit their bandwidth usage.
- Here are examples of traffic that they block:
  - P2P
  - Youtube (it was allowed until one month ago).

5.3.4 Shaping

- They shape the WiFi network to 384Kbit/s during the day, and to 1Mbit/s during the night.

5.3.5 Open problems/limitations

Here are some of the problems explicitly mentioned to me:

- The need more training.
- They would like to learn more about IDS systems (network security).

5.3.6 Generic Notes

- Around 30% of user machines are served with 10/100 Mbit UTP cables, with the rest already served with fiber at 1Gbit/s![2]
- In their layer-two network they run the 802.1W STP protocol and use VLANs.

2 I did not visit any lab, but it seems strange to me that 70% of 1200+ PCs have a 1GB Ethernet card. There may be a mistake in my notes of in the information I was supplied with.

Figure 8. Network Equipment at UNA

5.4 URACCAN – Universidad Comunitaria Intercultural, Bilwi

(http://www.uraccan.edu.ni/**)**

This University has four campuses on the Caribbean coast: Bilwi, Bluefields, Siuna, Nueva Guinea[3]. I did not visit one of those campuses, but I actually visited an office in Managua that provides some services to the various campuses, including hosting some of the servers. The person that received me, which also participated to the workshop, described the status of the network in the Bilwi campus.

Table-5

#Students #Professors #Admin #Faculties #Careers #Campus	4000 16 full-time, 36 part-time
#PCs	110
#Public IPs NAT	4 in the office I have visited, plus 1 in each campus Yes
#Servers	The servers are located in the office in Managua (Apache/HTTP, Postfix/Email, Mysql, etc). Each university campus has a Squid proxy server.
#Technicians	2 in Bilwi (without Linux experience)
Operating Systems	Windows XP on the desktops and Linux on the servers.
Open Source Software	No (there is just one person using OpenOffice).
Virus	It is a problem. They do not have a budget for antivirus.
Email	Users used not to use the institutional email due to the excessive spam, but recently they started using it a bit more thanks to the spam-filtering done by the firewall. Many users still send email in double copies (one copy to their institutional email and one to the private email).
Policy on the use of Internet	No
Backups	Yes/No: they just backup some data manually on an USB hard-drive.
Annual budget for the network and training	No
Monitoring Statistics	No No
Firewall	Yes

3 See http://www.uraccan.edu.ni/recintos.php.

Shaper Proxy	No (but the firewall they have is capable of doing it) Yes, but only in the office I have visited (not in the campuses).
Wifi	Yes (With Linksys in the office in Managua, and with RedFire in Bilwi)
Commercial hardware	Cisco, LinkSys, HP, RedFire, Fortinet

5.4.1 Links to the Internet

They have a 1Mbit/s ADSL link with ENITEL[4], which costs around 500US$/Month.
They are happy with the stability of the link.
The link utilization reaches 100%.

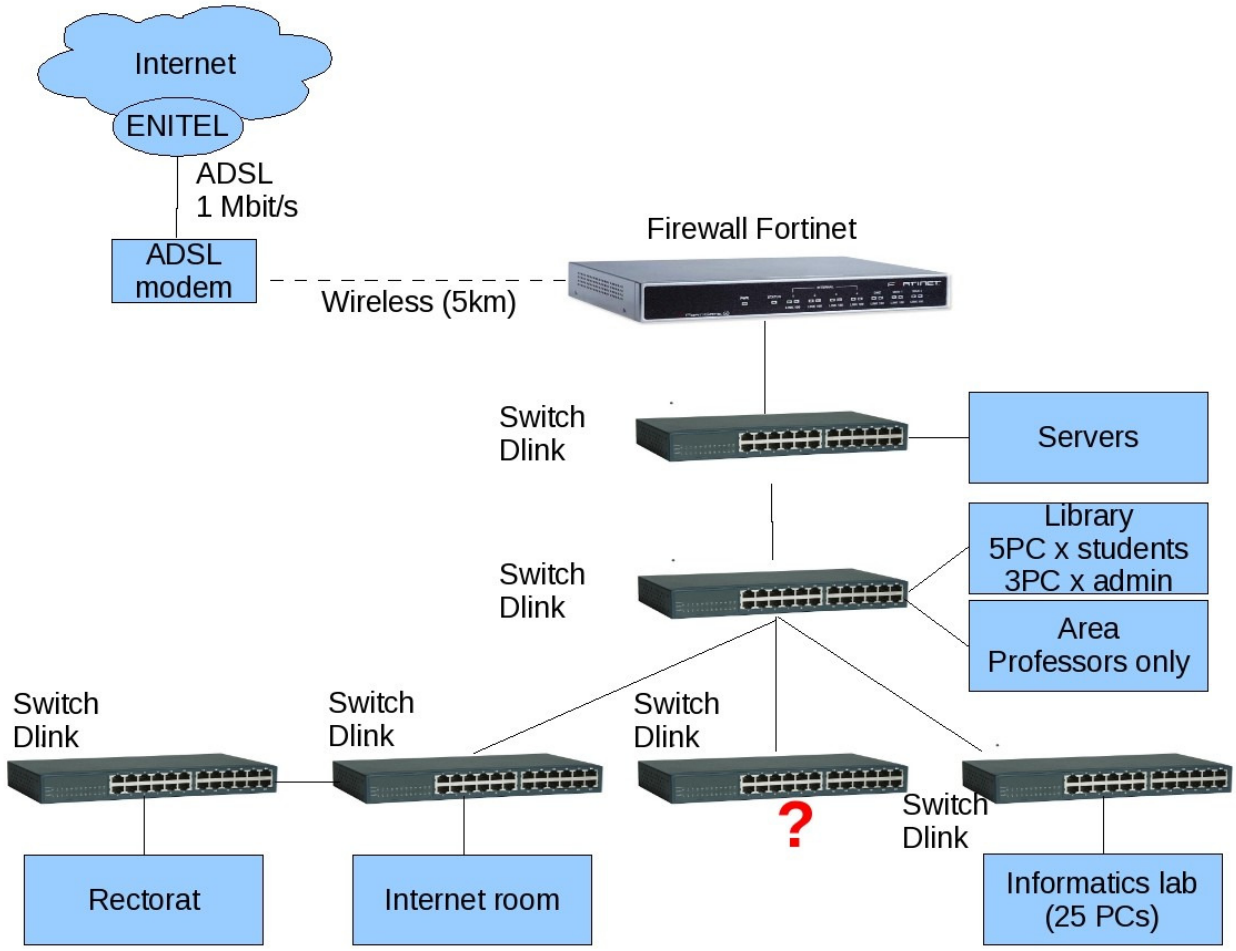

Figure 9. Network Design at Bilwi

5.4.2 Firewalling

- They are happy with the graphical interface provided by the Fortinet firewall.
- They block porn and P2P.
- They do not block YouTube, radios, msn, FaceBook, etc.

4 They use other service providers in other campuses. In the other campuses have slower links (ie, 256/512 Kbit/s).

5.4.3 Collaborations

- They have collaborations with the university of Leon and UNA in Managua.

5.4.4 Generic Notes

- They are planning on setting up VPN links between the campuses. The cost of a sinlge link is around 220US$.

Figure-10 shows the network equipment used by the office in Managua (not by the Bilwi campus) to connect the local network to the Internet. Here they use a Cisco modem instead of a Pelki modem.

Figure 10. Network equipment at the office in Managua

5.5 Universidad Centroamericana (UCA), Managua

(http://www.uca.edu.ni/**)**

Table-6

#Students #Professors #Admin #Faculties #Careers #Campus	7400 (University), 2000 (Postgrade), 169 (Saturday courses), 2000 (Centro Superior de Educacion) 600 (full-time + part-time) 600
#PCs	1000 (of which 330 are located in the 40 labs)
#Public IPs NAT	
#Servers	
#Technicians	They have 5 persons permanent, and the rest are students that spend some time there to make some experience. They do not have a budget to hire more personal.
Operating Systems	Windows XP
Open Source Software	They use open source software mainly to handle local university services like student registrations, exam results, etc.
Virus	Yes it is a problem. They have only 250 licenses for the antiviruses. The antiviruses do not seem to solve the problem.
Email	They use the IPSwitch email server with takes care of spam for them.
Policy on the use of Internet	Yes, it is available online.
Backups	
Annual budget for the network and training	They have an annual budget (for example they had 45K US$ in 2008) with which they have to take care of everything. They said they use part of it for training too, but I could not be given an example.
Monitoring Statistics	Yes Yes
Firewall Shaper Proxy	
Wifi	
Commercial hardware	

5.5.1 Links to the Internet

They pay for an 8Mbit/s link, but they get up to 12Mbit/s; they are old clients of their service provider and therefore get treated very well. For example they get some bandwidth reserved (for free) for other services like:

- VoIP (which is currently used only by the group of informatics that takes care of the network)
- Cisco Academy (they give connectivity to a local Cisco academy)
- Videoconferencing

Unfortunately I could not get a scheme of their network, but just a picture of the campus which shows where they have fiber installed.

Figure 11. Fiber installation at UCA

5.5.2 Monitoring

- Their service provider provides a web page with some MRTG graphs (see Figure-12).

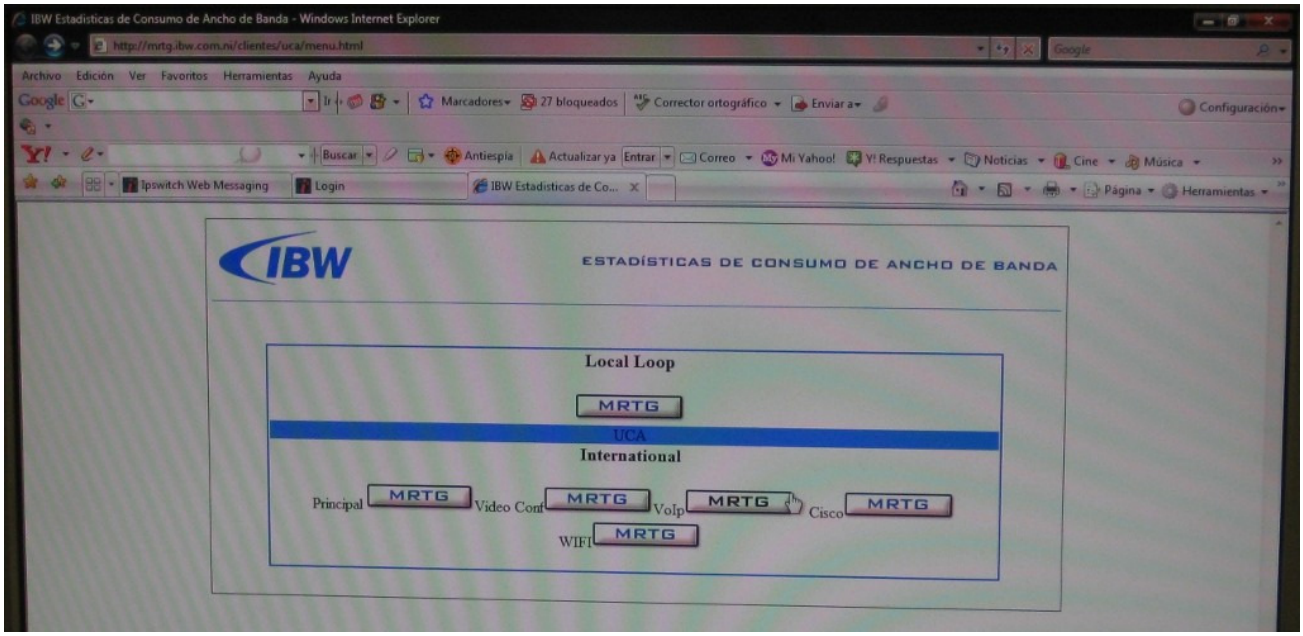

Figure 12. Monitoring page provided by the ISP

5.5.3 Shaping

- The provider reserves 1,5Mbit/s of the 8Mbit/s link for videoconference.

5.5.4 Collaborations

- They mentioned a collaboration with the university Puerto Cabezo in Bluefields. They are helping them develop their Intranet/Internet admin services.

5.5.5 Open problems/limitations

Here are some of the problems they explicitly mentioned:

- The rooms where the network equipment is located are too small.

5.5.6 Generic Notes

- All the software they use internally is produced locally, but they do not release it with an open source license. However, those universities that ask for their collaboration can also ask the permission to use their software.

6 Notes on the two-day training and suggestions for the next training/s

Here is the original schedule for the two day training:

Day-1, Monday 9/2/2009

- Introduction of the participants (each participant describes the status and design of the network at the university he/she comes from)
- LAB: Review of basic Linux/Fedora concepts
- LAB: Simulation of a network of networks
- Introduction to Monitoring (ntop, nagios, cacti, etc).
- LAB: installation and configuration of the monitoring software

Day-2, Tuesday 10/2/2009

- Review of Day-1 material
- Overview of the various types of caching you can use (DNS, WEB, etc)
- LAB: installation of some caching servers
- Review of basic Firewalling/QoS concepts
- LAB: Firewalling with Linux (iptables)
- LAB: QoS with Linux (Traffic Control)
- Quick review of what seen today and yesterday
- Open discussion: what would you like to see/do/cover in a future workshop on BMO?

Unfortunately we could not go over all the points above. Here some of the reasons:

- There was a big difference in experience between the participants. There were those who had never used a Linux PC before, who had very little experience, and who had some experience but with no real good knowledge of a Linux/Unix system as sysadmin.
- Regardless of their knowledge of Linux, most of them had serious problems understanding the basic concepts of networking, which are necessary to understand, for example, where to put a monitoring machine, or how to read/interpret the graphs generated by the latter.

Due to the varying technical knowledge of the participants, I adapted the content to first review basic Linux and Networking concepts, which took almost an entire day (out of two). Installing the various pieces of software is not difficult, with modern Linux distributions you just need a couple of commands. Sometimes the applications/servers work (even if not optimized) even with the default configuration file. However, in order to understand how they work (and be able to troubleshoot and configure them), you need to have some knowledge about the web server, the Mysql server, the crontab service, etc. In other words, you must have some Linux sysadmin experience.
I did not want to just make some demos for participants. In a workshop, unlike a conference, participants are supposed to learn *how to* and not just *to see what they can potentially do* with open source software.

The Country Coordinator and staff worked hard to help organize everything during my stay, which was not simple given that there was another important congress going on at the same

time. For this type of practical technical workshop, prior preparation is very important. For example this workshop required pre-installation of Linux on all PCs and access to install others such as 2nd NIC. Time is required to enable this to be completed and tested prior to day of workshop so that any problems can be addressed. It is also important that a list of participants together with a profile is available as early as possible prior to event. This enables appropriate content development to match the level of participants so that they get maximum benefit from attending. It also allows the facilitator when preparing materials, to spend more time focusing on the relevant areas for inclusion.

Even though I could not cover intended programme, I think the training has been useful because:

- The participants realized the importance of having solid basis of networking to understand how to best design the network, monitor it and optimize it.
- The participants had an overview of how monitoring can help and how the various graphs can help understand what's going on in the network.
- Since each participant described the design of the network at his institute, all of them had a chance to see what other universities had already in place or how they solved some common problems.

Based on what I saw at the first workshop and what I learned with the visits, here is what I suggest for the next workshop/s:

- The first day and part of the second if necessary should be used to review basic networking and Linux sysadmin concepts. This is necessary if you do not want to waste much more time later in the workshop. Of course, if the participants are selected using the knowledge of Networking and Linux as requisites, the duration of this part can be reduced to just half day.
- Since only very few universities had some proper monitoring in place, a day or two on monitoring is necessary. This part would not just consist of installing the software, but would include some fine-tuning and troubleshooting.
- Another couple of days on the installation and fine-tuning of the most common caching servers (DNS, Web, etc).
- An entire day is necessary for the firewall.
- An entire day is necessary for the QoS part.
- I would add another day to glue everything together and cover minor topics like viruses, proper network design, etc. Here is where, together with the participants, we could all together review the design of their university networks and explore possible ways to optimize their bandwidth usage.
- Time permitting; I would add one more day at the end where participants put into practice all they learned during the previous days: an all day lab exercise. This kind of lab is fun and allows them to realize how much they have learned at the workshop (but also to clarify the last doubts).

I believe both a policy and basic/advanced technical workshops are needed.
I would cover the same topics both in a basic course and in an advanced course; what I would change would be the complexity of the configurations and exercises.

---

7 Further information

Martin Belcher, Head of ICT Training
International Network for the Availability of Scientific Publications (INASP)
60 St Aldates, Oxford, OX1 1ST, UK
E-mail: mbelcher@inasp.info
Tel: +44 1865 249 909

Christian Benvenuti, Report author and network consultant
E-mail: [christian.benvenuti@libero.it]
Tel: +39 347 831 9420