puente
University of Pennsylvania

Puente 2000: Pune, India
Project Summary

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Introduction:

Puente (Spanish for “bridge”) is a global technology-based community service initiative at the University of Pennsylvania in Philadelphia, Pennsylvania, U.S.A. Our mission is to bridge the technology gap in low-income urban communities and to build a global learning network. The Puente network consists of Community Technology Centers (CTCs) that have been installed by our team all over the world.

As we begin the twenty-first century, the need for technology is increasingly apparent. Access to technology and education in computer skills will be essential for children growing up in the next century and vital for a country’s social and economic well being. A key factor affecting global technological advances is the "digital divide," which is the separation between those with access to new technologies and those without. Puente seeks to close the “digital divide,” by providing access to computers and online resources to all.

Forming a global learning network, Puente seeks to facilitate global cultural exchange based on the premise that people around the world have important knowledge, expertise, and experiences to share with each other. It is our firm belief that technology literacy is a gateway to other forms of literacy and self-betterment.

Puente: Brief Program History

The Puente program began back in spring 1999 when Edison Freire, a Philadelphia School District teacher, approached Joseph Sun, Director of Academic Affairs in the School of Engineering and Applied Science, about putting together a team of students to travel to Ecuador and install a computer lab. Mr. Freire had dreams of installing a computer lab in an elementary school in Quito, Ecuador to help facilitate a global learning initiative with a school in West Philadelphia. In addition, Mr. Freire wished to provide high school students in the Philadelphia School District opportunities to participate in a global technology-based service learning experience. With the help of Mr. Sun, a high-caliber student team from Penn Engineering was assembled to come up with a technical plan, operational timeline and funding for the installation of the lab. The Penn student team, along with high school students and students, parents, and teachers from the West Philadelphia elementary school, traveled to Quito in August 1999 to install the lab in a public elementary school.

After returning from Quito, there was a strong interest in building another technology center. A few students had leads for a potential partner in India and so it was decided to pursue these contacts and determine the feasibility for a center. From the University side, Mr. Sun suggested that the Puente program collaborate with the existing Penn-In-India program in Pune, India. Shortly thereafter, he contacted Dr. Surendra Gambhir, director of the Penn-In-India program and Dr. Srilata Gangulee, Assistant Dean in the College of Arts and Sciences. Both were brought on as faculty advisors to the program and proved to be truly resourceful with their network of contacts in the US and throughout India. With a strong support structure in place, Puente was ready to begin its year 2000 project.

Puente 2000: Pune, India

In June 2000, 12 Puente student members, Dr. Gambhir, Dr. Gangulee and Mr. Edison Freire, traveled to Pune, India to install Pune city's first Community Technology Center. This CTC was aimed at providing technology access and instruction to those who couldn't afford the tuition at an NIIT or Aptech center. Through a partnership with the Sukhroop Foundation of Pune, the Pune-Penn Bandhan was formed; a 30 machine lab complete with educational software and a high-speed connection to the Internet.

Execution of the Project

Execution of the entire project was divided among a US team and an Indian team. Leading the US student team was Rohan Amin, a 3rd year Computer and Telecommunications Engineering student at the University of Pennsylvania. Leading the India team was Anil Bora, Managing Director of Li Taka Pharmaceuticals and founding trustee and chairman of the Sukhroop Foundation. The US team consisted of 11 other student members. Other key student leaders from the US include Niral Shah, Director of Global Operations and Stephanie Kirsch, Director of US/Internal Operations. Both are engineering/Wharton students at the University of Pennsylvania. The Puente faculty advisors were Mr. Joseph Sun, Dr. Surendra Gambhir and Dr. Srilata Gangulee. Under the auspices of Mr. Sun, the School of Engineering and Applied Science served as the host school for the program. Because the engineering school provided us with the necessary operational budget and support structure, Puente was well equipped to pursue its goal of installing a technology center in India. The faculty advisors for the program served as a constant source of advice and guidance even when the program faced its most critical moments.

In the early stages of the year 2000 project, only a few people were involved while the basic details of the project were worked out. A site location was picked out and preliminary documentation and project proposals were put together. The basic tasks that needed to be completed were: fundraising, technical design, curriculum development, and community integration.

Fundraising proved to be the most time consuming task by far. Without the appropriate funds, the project would not have been a reality. Our strategy for raising funds was to target the strong Indian community that had developed over the past few years. The contacts we made were through either the University, professors, Indian organizations or family and friends. Our goal was to have several sponsors of the project in order to raise the needed funds.

Technical design also proved to be a difficult task. It was necessary to put together a simple yet highly robust network that would be easily maintained by our team in Pune. Extra consideration had to be given due to resource constraints in a 3rd world country like India. A full software package was developed in order to help manage the day-to-day operations of the lab and give the trustees full reports of the lab progress. It was decided that all the planning would take place here in the United States, while the final purchasing of equipment and the installation would take place in India. We chose this route in order to avoid problems with customs and transporting expensive equipment across international borders. The technical design also included full documentation of the network and it's systems. We also trained the lab directors in systems administration and advanced networking.

Our target audience for the CTC was the underprivileged and low-income families of Pune. We had to develop a curriculum so that we could install the appropriate software and offer courses that would be relevant to their present computer knowledge. Using NIIT as a model, we developed our own course structure that covered the most basic computer tasks such as using the mouse all the way to using office applications and the Internet. We felt that the key to a successful center was not only to provide the technology, but to also provide the knowledge and the ideas about how to use the technology.

During the 8-month planning period, many discussions took place with the US and India teams. We wanted to make sure that the center would have a very strong impact when installed in Pune. Care was taken to make sure that the lab was located in an accessible part of Pune and available to our target audience. While in Pune, we talked to several organizations including the Rotary Club of Pune, the Rickshaw Drivers Association and the Senior Citizens Group. It was important to introduce our center to the city of Pune and to smoothly integrate it as an important member of the local community.

Long Term Sustainability

Installing the technology isn't enough. Measures must be taken to ensure that the technology and the overall CTC are continually used for their intended purpose. It is also essential to ensure that the center will be financially stable for years to come. To this end, we have a 3-phase strategy:

1) Revenue Generation – In order to offset the monthly recurring costs, some lab hours will be used as a Cyber-Cafe and other lab hours will be available for rent to corporations wishing to do corporate training.
2) Network of Volunteers – In order to combat rising labor costs and the need for additional lab administrators, we have formed a network of volunteers with students in the area. By using volunteers we can avoid the costs associated with employing a staff member for the lab.
3) Board of Trustees – In order to guarantee long-term sustainability, we have assembled a board of trustees. This board consists of students, professors, educators and corporate members. The board is ultimately responsible for the financial well being of the center and making sure the center meets its objectives and goals.

Project Replication

Puente's objective over the next few years will be to expand our unique model of service and technology to other countries throughout the world. Our ultimate aim is to connect all of our sites to a global learning network that will facilitate communication and the growth of a global village and spirit. As always, our criteria for determining a site location will remain basically the same: scarce access to technology must exist and a strong local partner must be identified. Our strategy is to first tap into resources at the University of Pennsylvania and to explore relationships with other countries that the university might have already established.

This year we are looking at the following potential locations: Argentina, Dominican Republic, Thailand, Mauritius, Brazil, Mexico and Tanzania.

We will also not be limiting ourselves to one installation during the summer months. With our increasing experience and resources we are developing plans for multiple simultaneous site installations over the course of a few weeks in different locations throughout the world.

Timeline for Pune 2000 Installation

September 1999 – Discussions begin with Anil Bora of Pune. We met Anil Bora through a member of our team who stayed with him as part of the Penn-In-India study-abroad program. Anil was a host father and key contributor for the program.

October 1999 – Feasibility of a project in Pune is realized. Papers, proposals and grants are written in order to start the fundraising process. We also put together our press kits, information package and started development of our web site and interactive CD.

November 1999 – Puente members make a presentation at the Wharton India Economic Forum looking for sponsorship.

December 1999 – Full technical research and design process is underway. Our team had to research critical components such as electricity and Internet connectivity.

January 2000 – Dr. Gambhir, one of our faculty advisors, travels to Pune to meet with the partnering organization and to do some fundraising for our center.

April 2000 – Funding and sponsorship of Pune lab is complete. Our final board of trustees is in place. Work starts on writing the Memorandum of Understanding between Puente USA and the Sukhroop Foundation.

May 2000 – Final travel arrangements are made. Our team develops logistical and operational details for the site installation.

May 30th, 2000 – Puente team leaves for Pune

June 12th, 2000 – The lab is inaugurated in Pune!

June 18th, 2000 – The Puente team returns to the US.

Technical Details – Executive Summary

What follows is a brief executive summary of a developing document that includes detailed analysis of past operations and specifications for future ones. Technical details have been suppressed in many cases.

Definition of Requirements: Summary

The technical requirements for a Community Technology Center (CTC) in Pune, India, were framed to meet Puente's social and operational goals within the constraints of cost and infrastructure. Its principal features include the local sourcing of equipment, use of commodity hardware, open-source software solutions which are low-cost and reliable, and a redundant, secure, and extensible network which can be remotely managed and upgraded. The network must also support the CTC's business initiatives towards self-sufficiency; this implies the necessity of an account management system and database (hereafter the Puente Internal Network), together with a clear partition between the internal network and the external internet.

Definition of Goals

There are three modalities of operation that the Pune installation must accommodate, and each imports a unique set of operational goals. The laboratory must serve, foremost, as a technology-training center. Each computer must therefore have a relatively identical configuration of current software useful in job and computer skills training, and each user must have his own allocation of space on a file-sharing server. Second, the lab must have uninterrupted, reliable, safe, and fast Internet access with acceptable uptime and latency to each terminal. The third, goal, related to the second, is that the lab administrators must be able to monitor computer usage in order to bill users when the lab is operating as a cyber café. Finally, technical requirements on local staff must be minimal, and so it should be possible to remotely administer all aspects of the installation.

Definition of Services

The method proposed to achieve all these goals was to clear partition services into desktop and server categories. The desktop services are those services which are completely under local control. They include essentially core operating system functionality and a standard set of applications useful in the training program. The services provided by the servers are those which can be clearly partitioned on physical and logical grounds. These include file sharing, authentication and authorization, logging, and the infrastructure required to deliver Internet access in a secure and reliable way.

Specifically, desktop services are limited to standard configurations of Windows 2000 desktop-class machines with core applications and Internet support. Server and network services were entirely Unix-based, as this approach minimizes cost, facilitates remote administration, and is generally more robust. An IP-masquerading (network address translation) firewall is used to insulate details of the external network from the internal one and also to protect key services from unprotected external access. The file sharing and authentication solution is implemented on a redundant commercial-grade server. Finally, the installation should be protected against unreliable electrical infrastructure through the use of power conditioners and redundant power systems.

Hardware Sourcing

3COM donated all network peripherals and interface cards, and we transported these from the United States to India. The server and desktop machines were acquired through Acer India. Miscellaneous but critical hardware was also obtained through local channels. This included redundant power units and network interface devices such as ISDN and analogue modems.

Phased Implementation Plan

We felt that several aspects of the plan were prone to modification, and thus should be implemented after the lab was operational for some time. In particular, design of the Puente Internal Network, including the cyber café billing system, is a task that required extensive discussion with the local NGO partner. Finally, the specification of firewall configuration was dependent on a host of factors, including the nature of the internal network, the precise mechanism of Internet access, and, finally, which, if any, services were to be delivered by the Pune site to the Internet. For these reasons, we decided to implement our plan in a phased approach. The first phase involved the connection of machines to the Internet using an IP-masquerading (NAT) firewall alone. The second involved connection of local machines to the Internet using a IP-masqueraded firewall with application proxies for some services (such as an HTTP object cache). In this phase, we also configured the file sharing and authentication servers to provide for user accounts and cyber café billing. The third phase involved deploying a Puente Internal Network, which would not only provide a clean and effective user interface to the cyber café process, but would also integrate users of the Pune lab to Puente labs elsewhere. We intended to implement the third of these phases remotely; its implementation is currently incomplete.

Contingency Plan

The minimally acceptable mode of operation is one in which all the principal features of the Community Technology Center remain intact, including the ability to teach courses, deliver internet access, and charge for that access. Even the first phase of the plan meets these minimally acceptable criteria.

Operational Implementation

The implementation of the proposed plan was hampered by difficulties in three critical areas. Specifically, we found unreliable, unsafe, and incomplete electrical and physical infrastructure that threatened the security of personnel and equipment and delayed installation. Second, the quality of Internet connectivity was far below a minimally acceptable standard. Third, our implementation inappropriately assumed a level of competence in local human assets that proved to be lacking. Less severe problems included equipment procurement difficulties and a software incompatibility between Windows 2000 and Unix Samba acting as a Primary Domain Controller (PDC). In each case, we were able to find solutions that allowed us to deliver a solution far above what we thought was minimally acceptable (our contingency plan).

Human Resources

Technical team members included Rohan Amin, Vikram Bajaj, Oliver De Grate, Edsel Tan, Arti Kalidas, and Farokh Irani. Continuity of the core technical team is of great importance to future Puente operations. In particular, the development of a robust Puente Internal Network (PIN) requires on-going efforts and refinement. Thus, the members of this team were selected on the basis of technical ability as well as likelihood of continued involvement in the organization. Rohan Amin is a student in the School of Engineering and Applied Sciences (SEAS) Telecommunications Engineering Program. He has extensive experience in Windows internals and web-based applications programming and content development, including employment in industry as a database and data mining consultant. He is also serving as Puente Coordinator. Vikram Bajaj is a doctoral student at the Massachusetts Institute of Technology with over 6 years experience in Unix systems administration, network security, and network engineering. In addition, he has previously deployed information technology and communications systems in field conditions, and has experience in technology training. Oliver De Grate is a Computer Science Engineering student, where his interests lie primary in software engineering theory and practice. He is employed by Eastern Research Inc. in the development and implementation of low-level algorithms for core and embedded internet protocol routing products. Edsel Tan is a Chemical Engineering student with experience in hardware and software development. More importantly, he brings to our table a battery of engineering and process analysis skills which have proven invaluable in the evaluation of electrical utilities, internet access routes, and methods of redundant power distribution. Arti Kalidas is both a student in the Wharton School and a Computer Science Engineering major in SEAS. She is a skilled C/C++ programmer in the Windows and Unix environment and has been employed in this capacity in the financial services industry. Arti's analytical business knowledge has been essential in providing a rigorous economic justification and foundation for technical implementation options. Finally, Farokh Irani, like Arti, is a student in both the Wharton School and SEAS. He worked extensively on aspects of technology training while in Pune, and was able to mediate between technical and training requirements very effectively. His knowledge of local procurement channels allowed us to obtain critical equipment that would otherwise have been impossible to find.

Equipment Procurement

Much of our equipment was procured locally, but all networking hardware (hubs and network interface cards) were transported from Philadelphia to India as part of a large donation by 3COM. Unfortunately, it proved impossible to make formal arrangements with Indian Customs and Excise to secure the duty free importation of these items. As such, it was a mere matter of luck that our team was not forced to pay any duty.

Next, equipment purchased locally from Acer arrived largely as expected and without complication, with a few exceptions. Technicians from Acer made a number of handling errors in installing devices sensitive to electrostatic discharge, with the result that several memory chips were damaged. They also delivered many non-functional network adapters, but these were easily replaced from our 3COM stock. Finally, it proved difficult to procure an additional hard drive required for the file server.

Provisioning of redundant power and miscellaneous (but critical) equipment such as splitters, line conditioners, and ISDN modems proved extremely difficult. Suppliers did not give reasonable estimates of either stock or delivery date, as many items are kept in central warehouses and not locally.

Provision of Electrical Utilities and Facilities Management

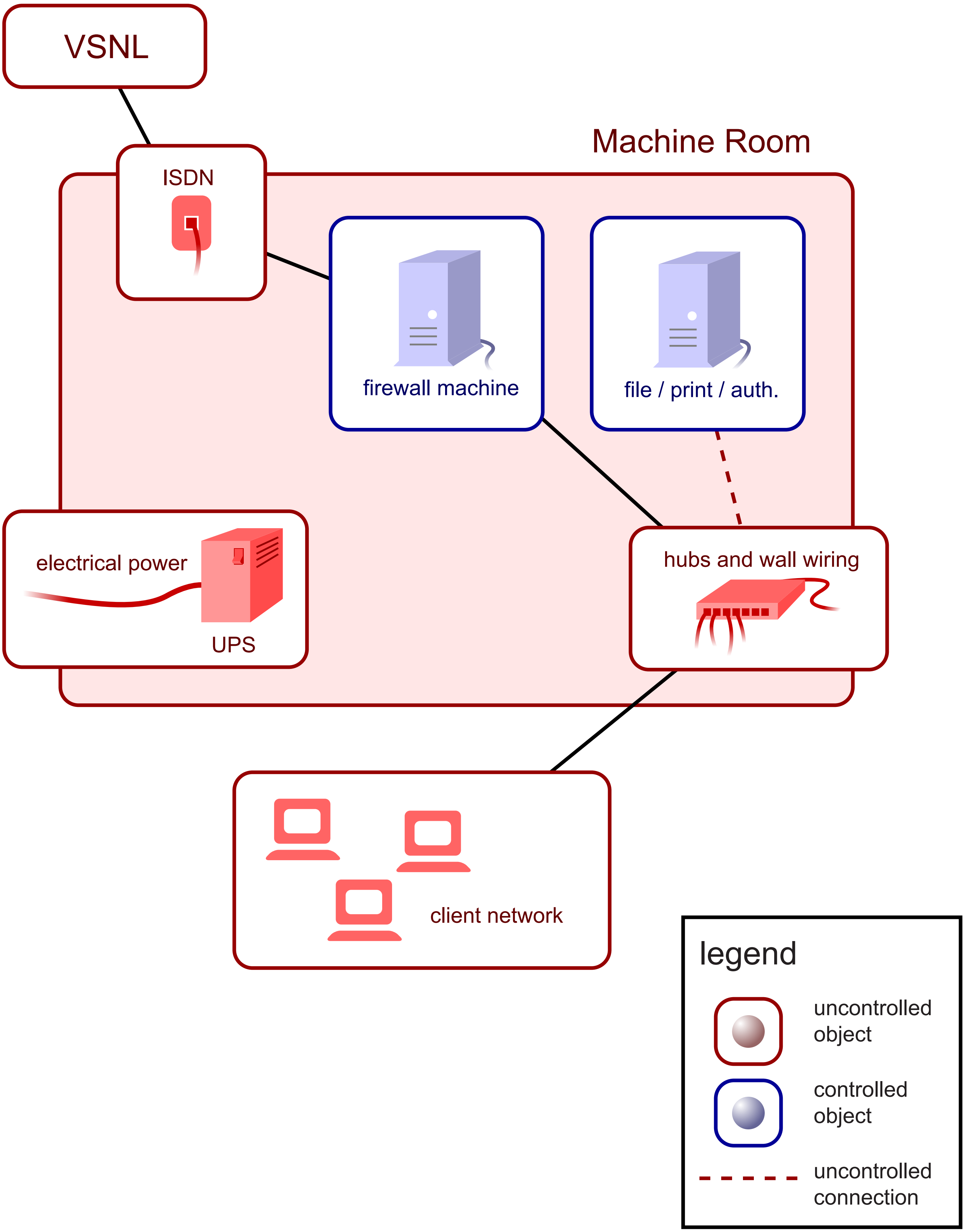
Incomplete physical plant was the primary barrier to Puente operations in Pune. Upon our arrival, we discovered that the lab construction was largely incomplete. This necessitated both delay and operation of equipment in unsafe circumstances and around work such as painting and carpentry. Next, the electrical infrastructure did not meet a minimally acceptable standard. There was no effective earth ground, with the result that a floating voltage of several hundred volts developed between pieces of equipment. Several individuals received minor shocks, and, in once incident, a series of component explosions and electrical fires in the server room were stopped only after a member of the technical team manually unplugged all equipment. Worse still, the installation suffered two electrical transformer explosions in the transforming substation immediately adjacent to the lab. The cause of these incidents remains uncertain, but they occurred at critical times during the installation and caused delay. Finally, the server room and equipment room were unprotected from dust, debris, and insects during the period of the installation and for some time after.

The redundant power system that we installed in Pune, however, completely insulates the server system from the electrical system of the building. In the event of power failure, the machines have enough battery power to undergo a normal shutdown cycle without loss of data.

IP Connectivity

Connectivity to the Internet is delivered through two (non-bonded) 56K ISDN channels to VSNL India. This connectivity was not arranged prior to the Puente team's arrival in India; arranging it on short notice required extensive and time-consuming negotiation with local technicians, ISPs, and the telephone utility. The data throughput of each ISDN channel is quite low in practice, and is approximately equivalent to the bandwidth of a dial-up modem in North America. A second problem, though, is that VSNL's dial-up pool for ISDN users is heavily overloaded, requiring approximately one hour on average for a free line to be obtained. Finally, VSNL networks are misconfigured, with the result that bonding of two channels into one is impossible, and that the network is bombarded with out-of-specification routing packets from inappropriately configured VSNL routers upstream of our site.

This problem was ameliorated by modifications to the firewall configuration. We now use a subset of the Advanced Router functionality of the latest Linux Operating System Kernel to load-balance connections over two ISDN interfaces, giving the bandwidth of both channels in aggregate. This also provides for the ability to activate ISDN connections remotely, on-demand, or according to particular schedules. Finally, we tuned the masquerading configuration to provide low-latency priority to services that require it. Though this functionality has not been deployed in a production-strength Linux distribution, we felt it was mature enough to use in this case, and it has proven itself robust in the field since. Nevertheless, we desire improved connectivity prior to full deployment of the Puente Internal Network.


VSNL
Machine Room
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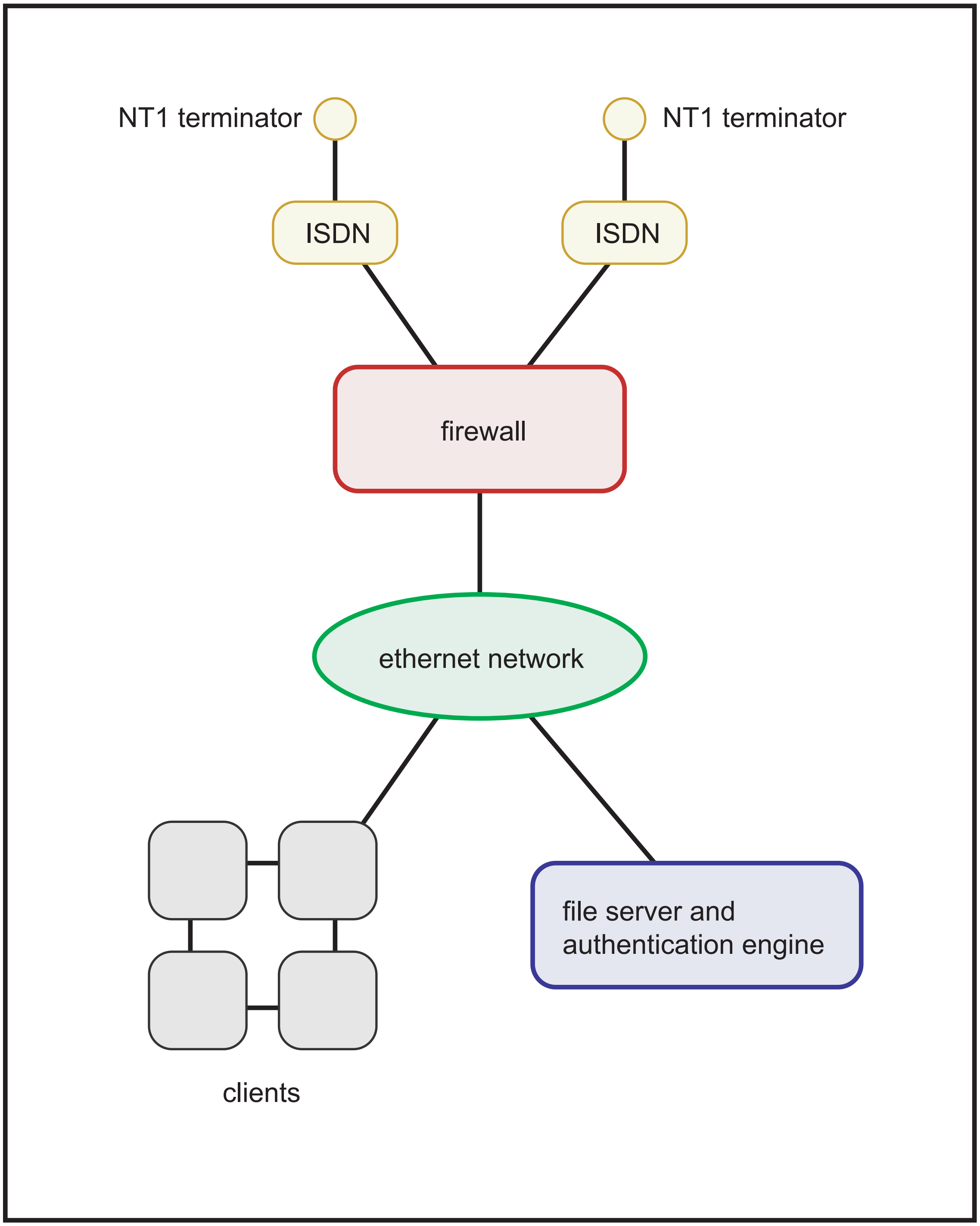

network topology

Software Interoperability

The server acts as both a file server and a Primary Domain Controller (PDC) for a network of Windows 2000 machines, and also carries an HTTP object cache. With one exception, the software interoperated flawlessly and across platforms. The exception involves a noncompliant modification to Windows 2000 authorization and authentication code which rendered Samba, the Unix file sharing and PDC software, inoperative as a PDC. This problem was circumvented through an experimental patch to the Samba distribution that changed Samba's behavior to match that of the Windows 2000 operating system. Though the system now works as a PDC, the Samba distribution is experimental, and a fair degree of technical competence is required to modify it.

Personnel issues

On-site personnel had neither Windows nor Unix networking experience sufficient to administer a lab of this size. However, the principal manager of the lab has since enrolled in courses that will lead to the development of these skills, and his abilities have increased greatly.

Physical and Network Security

Since the technical team left Pune, there have been three prolonged service outages. Each case resulted not from equipment failure or intrinsic design flaw, but from human error that could have been prevented with adequate physical and network or host security. These are the principal integrity threats to the Pune installation.

Physical security at the Pune installation is accomplished largely through guards and not locked doors. The server room is slightly larger than the footprint of the equipment it contains, and it adjoins a room that is used for another purpose. Thus, there is a fair amount of traffic in and out of this sensitive area. One service outage occurred, then, when administrators unplugged cables connecting the firewall machine to the ISDN modems and replaced them inappropriately, resulting in a nonfunctional system. Diagnosing this problem over email and telephone took several days but, after the pattern was identified, two other minor service outages that occurred later were also traced to similar causes.

Next, network security at the Pune installation is weak. A three-day service outage occurred when an unknown member of the organization called VSNL and changed the VSNL account password without informing the technical team. Since VSNL terminal servers do not advertise a failed authentication differently from a failed connection, it was difficult and very costly to diagnose this simple problem. In addition to this, the installation receives regular scans and probes from putatively compromised machines on the VSNL subnet, which are monitored and logged by our Intrusion Detection System (IDS).

Finally, there is an integrity threat to the Pune Network that results directly from lack of training. First, personnel who felt themselves to be knowledgeable enough to diagnose and troubleshoot Unix systems were not; with the exception of the lab manager, no lab employees have the required training. Unfortunately, for some amount of time, they all had administrative passwords to the server and firewall machines. The third service outage occurred when an individual inappropriately modified configuration files on the firewall machine without consulting either the lab manager or the technical team for help. In this case, the command history revealed that he was using the firewall machine for client tasks (web browsing, email) and attempting to execute DOS commands at the Unix prompt. Second, though the Samba PDC is functional, many lab computers are operating from the “default” account. Multiple concurrent logins from a single default account pose technical difficulties that could result in the temporary slowing of the entire authentication system.

Modifications to Implementation Plan

Perceptions of these events have lead us to further modify the operational plan as it was implemented. Currently, the lab is in a fully operational state, but we would still like to implement additional functionality. Nevertheless, we are going to move forward gradually and only as the level of technical competency and training of the lab administrators improves. The modifications are summarized here.

Delay in deployment of functionality:

Additional functionality brings the possibility of eventual operational simplification: rather than enter commands to add a user account, for example, the administrator can use a web-based client. However, any additional functionality brings with it an initial period of potential instability. It is inappropriate to deploy new functionality, then, unless two criteria are met. The modifications, first, must be completely reversible and, second, the lab administrators must be technically able to assess their effectiveness.

Security through obscurity: Remote Administration:

Clear documentation of technical configuration is essential to any networking project. However, we have observed a propensity for unnecessary modification of effectively operational configurations and a lack of version control. Also, we do not wish for this configuration to be a final one for the Pune site. For these reasons, we have temporarily avoided giving extensive documentation of our configuration details and instead make ourselves available to fix problems, install upgrades, and answer any and all questions.

In a subsequent trip to Pune, we intend to resolve these final details (including the security concerns), implement a new configuration, and find further local resources that can be of assistance.

Revised Implementation Plan

In planning for Pune, we were motivated by our conviction that technical detail should be a mere afterthought. We are in the business of developing sustainable Community Technology Centers, not in the networking business. Our principal error, then, was in relying far too heavily on local resources. On the basis of this experience, we have drafted a revised technical plan for future Puente installations. Its principal feature is an absolute minimization of our dependency on any extrinsic physical asset. The realization of a highly reliable, self-contained, generic, “plug-and-play” Puente installation that could be deployed in any location, irrespective of internet connection medium or lab topology, is our new agenda.

Revised Service Philosophy: The Puente Internal Network

There is a powerful logic which holds that a system should be minimally complex for any given set of tasks. Contradicting this is our desire to remotely add functionality to any Puente installation without extensive reconfiguration or operational downtime. The solution is to abstract as much of the functionality as possible away from the core operating system services into an unprivileged space where it can do no harm. Here, we can enable and disable functionality at-will without compromising lab operations. The collection of open source software, web content, and custom applications that will deliver this functionality is the *Puente Internal Network*. It will simplify lab administration and allow users of one Puente lab to mingle seamlessly with those of another. Indeed, it will allow us to completely and remotely administer all aspects of a lab’s operation, should that become necessary. This technical project is equally in the realm of human factors; we must provide an interface to an incredibly complex and interacting set of services, and it must be simple enough for any lab administrator to use safely and effectively. The technical team is actively developing a set of tools to make this vision a reality, and we intend for Pune, India, to be our first proving ground.

Centralized Hardware Design

The integrated software design motivates an equally integrated hardware design. Since the principal integrity threat remains inadequate physical security, we can simply integrate all the hardware required to deliver server functions into one physical box. This multi-purpose device would contain a firewall/router that can route traffic across arbitrary and heterogeneous media, and a server that can deliver all the features of the Puente Internal Network. More radical than this, we have determined a significant savings in both cost and complexity is to be had if we dispense with the notion of individual desktop computers and replace them, instead, by small thin-client machines which are visual terminals to a central server. This server would also be integrated, as would all networking peripherals such as switches, and hubs into the same enclosure. All interconnections between these components would occur within this box, and so installation would involve connection only to external resources. Finally, the power supply for this agglomeration of machines will be housed in a separate enclosure. This enclosure would contain a redundant power system including appropriate run-time Uninterruptible Power System (UPS) which can be charged on 120V, 240V, or 12VDC alike, and a switching system to enable a generator for prolonged power outages. The advantage of powering all devices directly on DC power is that a costly inversion step in the UPS is eliminated, resulting in higher efficiencies. In areas with very poor electrical infrastructure, this will have a large advantage. Indeed, we intend to produce a low-power version of the Puente hardware solution using commercially available low-power processors and peripherals.

Deployment Schedule

Due to the integrated nature of our new technical solution, deployment can occur in a much more efficient manner. In large installations, the fully configured products can be shipped to the remote site and installed by the local lab administrators. The technical team can then arrive for final configuration and troubleshooting. This will shorten trips and allow us to be more productive, installing up to 2-3 labs in a single trip. Maintenance is also simplified for the same reason.

Courses Offered and Curriculum

On the day of our center's inauguration we were able to offer several introductory courses. Our curriculum was modeled strongly after that of NIIT but was modified accordingly to fit our specific needs. Our course offering included the following:

- Jump Start - This course provides an understanding of the basic underlying fundamentals of computers and operating systems. It serves as a strong foundation for future learning and skills development.
- Jump Start Pro – This course takes an in-depth look at office productivity tools such as Microsoft Office. Users learn how to use these applications and tools to help them solve problems in their everyday lives.
- Web Surf Pro – This course is an introductory course to the Internet and related technologies. Topics such as browsers, email, FTP and doing research on the Internet are discussed.

The courses listed above represent a small subset of the full menu of courses that we hope to offer. Our goal is to develop plans for rollout of an advanced set of courses that will include such topics as: Programming in C/C++/Visual Basic, Java, network security, and network architecture.

Conclusion

Overall, the Pune lab installation was an amazing triumph. Our team receives bi-weekly reports of the lab's status. Our program is reaching its target audience and we are on schedule to become fully self-sustainable within the next few months. We look forward to expanding our program to other countries in our attempt to bridge the digital divide around the world.