The SNet Model: Access, Security and E-Services for Students

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ABSTRACT
This paper will explore the SNet model that Hunter College of the City University of New York developed and implemented. During the Spring of 2002, CUNY as a central organization (3rd largest in the country) envisioned a plan and strategy to enhance e-services to all their students, faculty and administrators. From this 'master' vision, Hunter College designed and derived the SNet model to provide efficient and effective services to students. This model not only looks at just providing eServices to students but also takes into account media-independent accessibility (wired, wireless, terminals, WAP, etc) and security in all locations. One of the four layers of this model includes a SNet support component. This model leverages on all existing legacy infrastructure and any other additional new infrastructure that is required. This facilitates the implementation of this model without a big impact on the budget. This model fits any campus where services, support, and security (especially for wireless) is of prime importance.

Categories and Subject Descriptors
D.3.3 [**Higher Education**]: Infrastructure model, Technology initiative, Communication, architecture.

General Terms: Management, Design, Security, Standardization.

Keywords: SNet, model, higher education, Information Technology, wireless, email, communication, eServices

1. INTRODUCTION
Hunter College is part of the City University of New York with a total enrollment of 20,000 students. While it is the only school in the CUNY system, consisting of 20 colleges, which has a residence hall, the student population at Hunter College includes primarily commuter students. Hunter College is located in New York City and occupies five campuses in different parts of the city. One of these campuses is a K-12 school for gifted children.

The technology infrastructure on all the campuses has been upgraded in the last three years. The network has been upgraded from a shared 100 Mbps to a fully redundant and scalable 1 Gbps backbone. Hunter has about 500 computers in open labs that are available to students for doing research or class work, resulting in a less-than-favorable ratio of computers to students of 1:40. Comparatively, other colleges in the CUNY system possess computer-to-student ratios in the range of 1:20.

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2. SYSTEMS AND SERVICES BEFORE THE SNet MODEL
Very basic email services for students at Hunter were being provided by antiquated legacy systems. As a policy, Hunter College created email addresses for all students who were registered. The email system ran on a SUN Sparcserver 1000 using sendmail. The only two methods of accessing the email server were - SMTP to send email and POP3 to receive email. Students were also able to check their email by telnetting to the system, using Pine as an email client. At the beginning of 2001, a webmail server from Infinite Technologies was installed to provide web-based access to this email system.

The webmail system utilized a basic pop3 mechanism to talk between the web server and the email system. The email was now popped from the email server and resided on the webmail server. This process caused some initial confusion for students because when they used telnet to access their account on the SUN system their email was not seen. But, in the end, webmail was a good addition to the Hunter system, as, up to this point, students were forced to use many free email systems like hotmail, yahoo and others to gain web access to their email.

However, due to the overall obsolete nature of Hunter's student email system, there still were not many students using it. In 2001, the email server contained about 35,000 email addresses, but only 5% of the accounts were being used. Many factors contributed to this limited usage. A number of these factors were directly related to the quality of support services provided to the students. There was no active push to inform the students about what their email address was; a generic webpage was created for students to find out their email address, and students had to use their social security number and date of birth to get this information. Even this was not advertised properly and only a few students who coincidently asked about emails in a lab were informed of the existence of the account information page, thereby being able to begin using their email. The only other method for the student to find out their email address was via a professor who may have decided to use Hunter College email for class communication. Students whose classes were at one of the college's four external campuses did not even have the luxury of finding this information.

In late 2001 and early 2002, two significant events required Hunter College to rethink the way it was communicating to students, faculty and staff. The first was the increased level in usage by the faculty, and hence by the students, of Blackboard, the College's course management system. In order to make email communication between the faculty and the students enrolled in a class simpler, a decision was made to facilitate the use of the existing email ID that had been created for the students. This email ID was also used as the login ID for signing onto Blackboard. Hunter's policy was to not allow students to change their email address in the Blackboard system, thereby triggering increased use of the antiquated email system, as Blackboard's utilization grew.

The second event was that the new President of the college wanted to improve communication by sending mass emails, concerning issues of importance, to all Hunter College students. This created a bigger issue when the mass mailings were sent. Due to the age of the email server, these mass emails overloaded the antiquated email server, causing it to crash completely, resulting in poor service to the students.

An additional issue gaining importance was the fact that Hunter did not offer helpdesk services to the students. The implementation of the Blackboard system required us to consider setting up a helpdesk for students, due to the number of calls coming in asking for email IDs or forgotten passwords.

These service related issues, as well as the hardware obsolescence, required us to rethink the whole process of providing eServices to students.

3. THE PLAN

3.1 Issues

As described above there were many shortcomings in providing a smooth, uniform, reliable and committed service to students and faculty. During summer 2002, Hunter College started planning for providing an integrated set of e-Services to students. The whole idea was to ensure that an end-to-end service was provided. This included everything from providing helpdesk service, setup of email accounts and setup of a simple sign-on to more accessible computers. In the whole process, we wanted to make sure that the more recently installed hardware or software infrastructure was being leveraged. We did not want to invest a significant amount of funds to provide this service. The idea was to provide all the eServices required with a negligible amount of training or support necessary. The eServices being developed had to be beyond a "portal" setup, which is simply a consolidated web page where students can log in and receive personal access to web-based applications.

3.2 Driving Factors

Various factors had to be considered during the planning of this new system. Some of the driving factors considered during the planning stages are listed below:

3.2.1 Communication

Communication is very critical for any type of service that is being provided, in order for that service to be productive. This does not mean just using email communication but includes other communication like instant messaging and face-to-face communication. As research has shown, the amount of people using email has significantly increased since 1999. The number of people using email as a primary means of communication has exponentially increased over the years. It is also noted that most of the students who come to Hunter College already have an email address and are actively using it. During the planning process, we also had to keep in mind that we no longer wanted to "force" a student to use the Hunter issued email address. We had to provide alternatives where students could still use and keep their preferred email address.

3.2.2 Helpdesk

The next issue that we had to consider for the planning was the need to provide an all inclusive student helpdesk. This helpdesk had to be supported for a significant part of the day, and into the evening, as we have classes offered till 10 PM and computer labs open at least until midnight. Also, the helpdesk needed to have the ability to provide support via email, phone and instant messaging, if possible.

3.2.3 Security

Security was another major planning item that we had to put in place. This is of particular significance as Hunter is in an urban setting, located in the middle of New York City. Hunter also was one of few buildings in NYC where anyone from the street can walk in without showing any identification. In the planning stages, we had to ensure that a person using any of the systems available in public places were valid registered students at Hunter for any given semester. We had to design the security level in the strictest sense with the ability to scale it down depending on each area.

3.2.4 Infrastructure

Planning for communication infrastructure was not difficult as the data communication infrastructure was already available and we were going to leverage on this infrastructure. The only planning that had to be done in this case was to add on wireless technology as we did not have this deployed on any major scale. Security needed to be addressed for the wireless setup, similar to the details described above, with an added layer, as we had to make sure that Hunter's wireless signal would not be available to the 25-story apartment complex 10 yards from our building.

3.2.5 Timelines

One of the key driving factors was that when the plan was finalized, we should be able to implement it within two months, in order that the implementation could be completed while the students were on break and all hallways and public areas were fully accessible to us.

3.2.6 Other student consideration:

Another driving factor was to make sure that any type of service being implemented be useable by students. It should be intuitive, easy to use and serve the purpose they are using the service for.

The final piece that we planned for was to make sure that all students would be informed about all new services. There had to be an effective marketing plan in place, otherwise all the services being implemented would not be effectively used.

The planning process led to the development of the SNet model or the Student Network model.

4. SNet MODEL

The SNet model evolved from the idea of providing a total end-to-end eService to students. The guiding principle of this model is to leverage existing infrastructure, add enhanced services and support

the total infrastructure and services. The other over arching principle was to implement this model in a very cost effective fashion.

The four major divisions of this model are (i) Communication; (ii) Access; (iii) Central Services and (iv) Support. These four areas contribute to a solid model.

4.1 Communications

Communication is integral to any service occurring effectively. Communication in this model focuses on any type of electronic communication, such as email, WAP-enabled web access and instant messaging. The model requires that the communication be available at all times and should be accessible by any method a student wishes to use. Besides the accessibility, the communication model must also be stable, reliable and resilient.

For any enterprise implementation, Hunter College follows open standards. In the past, any email server that was installed was based on sendmail or postfix. Both these are open standards based email servers. They also provided source code which enabled us to have the flexibility to modify the email server to the needs of Hunter College employees (faculty and staff) and students. The consideration of using one of these email servers was quickly out run by the basic need of getting the student to use the Hunter -issued email address. Hunter realized that students were using free email systems like yahoo or hotmail that were providing them with many additional features like calendar, address book, etc in addition to email. Even though they might not use any of the additional items that are available to them in the free system, they have the underlying sense of satisfaction that they have all these items available and can use them if they need to. This was one of the major obstacles we had to overcome. Hunter decided to develop a plan to provide a similar set of services with the proposed new email. We had the option to either develop an in-house system or look at existing proprietary systems. We decided to evaluate proprietary systems as the amount of time and effort that would have been required by us to pull together an email system with all the frills would not have been cost efficient (in terms of human resources and time) and would have many isolated items that might not integrate well. Some of the proprietary systems we looked at were Microsoft Exchange, Novell's groupware system, Lotus Notes and others.

4.1.1 Available Services

Once the decision was made to go with a proprietary system that would provide students with more than just the email, we started looking at services on the email system that we could provide that would surpass those provided by hotmail and yahoo.

What we found was that most of the "free" services being used by Hunter students provided their users with only 6Mb to 10 Mb of storage space, they only allowed 1Mb for attachments and if the user did not use the account for a particular period of time, the account was cancelled. An additional issue was that spam would fill up the user's mailbox preventing them from receiving any more email. This provided us with a baseline that would enable Hunter to provide much better service than that offered by the free email vendors.

4.1.2 Services Planned

The baseline for Hunter College email was then set at providing every student with 20 Mb of space, allowing attachments of up to 5 Mb, keeping the account open even if there was no activity, providing virus checking of all emails received and providing both web access as well as access via any email client like Eudora or Outlook. We planned to provide students with access to their email by any WAP-enabled devices like cell phones, PDA's etc. Additionally, students were going to be provided with an integrated application set, including a calendar, contact management (address book) and a journal. We also planned to incorporate a general public area where students could post items, if they want to sell a book, concert tickets or the like.

4.1.3 Architecture

Having decided on this set of services, we started to look at the infrastructure to see if we could support the plan as designed. Before evaluating servers and storage arrays, we looked at what architecture we had to design. Providing 20Mb of storage space to each of the 20,000 students would require us to have more then half a terabyte of storage space.

As one of our planned goals was to provide a resilient, redundant and stable system, this forced us to look into the direction of server clusters. The final architecture is shown in figure 1. We clustered two servers running Windows 2000 Advanced Server and using the Windows clustering services. These two servers were then connected to two redundant SAN switches to the disk array. As can be seen from figure 1 all the systems are redundantly connected.

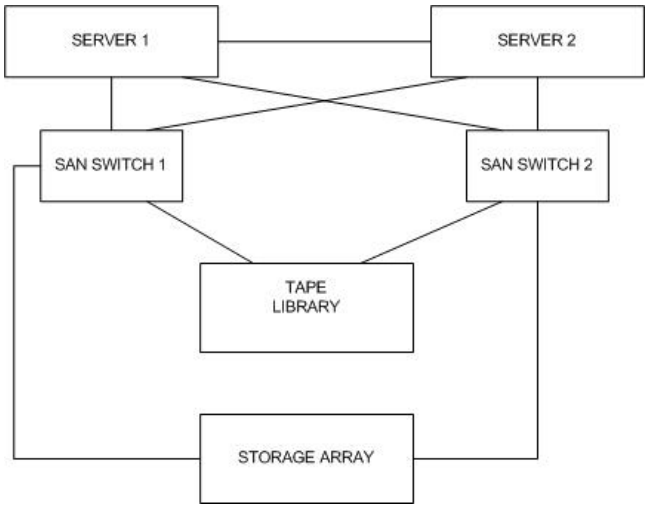

Figure 1. Server and SAN Architecture

In designing the disk array we made an initial assumption that not all students will use the system. In doing this we were able to start with a disk array of less than half a terabyte. Even though the total space required if all the students were to use the email to full capacity is only 400 GB, when designing the array, particular thought had to be given because there are drives that will sit on standby and whose space cannot be used as an active storage area. Using a total of 20 disk drives, we made two RAID 5 arrays. In designing, we did not want to have a single array of all 20 drives under RAID 5 structure because if two drives were to fail simultaneously, there would be a total loss of data in the structure. This had happened to us, previously, and we wanted to have reliability built into the new system. In this structure, the probability of two simultaneous drives failing in one of the two arrays is much

smaller than two drives failing in one big array made up of the previous two arrays. The design called for the creation, in the future, of a complete mirror of the SAN, housed in a different building as part of disaster recovery.

Referring to our planning guidelines, we wanted to ensure that this system, even if it crashed, would be able to be reinstalled from a tape backup. This required us to setup a tape backup system to backup the entire SAN on a regular basis. The initial plan was to do an incremental backup every day with a full backup on Friday. Due to various reasons, we planned on doing full backup three days a week and incremental the other days. A tape library system was connected to this architecture as shown in figure 1.

When the architecture was finalized, the next major design function was to look at the connection of this server and SAN architecture to the network and how the authentication was going to happen for students accessing the system. Hunter College has a gigabit backbone and has very strong redundant network architecture. The server farms are directly connected to the core of the network. The server cluster was redundantly connected to the server farm switches. For authentication we wanted to use an LDAP system as we were going towards providing single login information for multiple services to students. The LDAP system that was finally chosen was Microsoft's active directory system. The architecture for the network connection and the authentication system is shown in figure 2. As seen in figure 2, there are two LDAP systems in two different locations of the campus.

With the total architecture in place, it was time to decide on the application that we were going to use. As mentioned earlier, the driving criterion was to provide attractive "bells and whistles" in the product that we were going to provide the students. The major factor that we were now confronted with was the time factor. Which systems will be stable, could be implemented and provide all the necessary services, using our own technical staff, without contracting to consultants and that can be installed and tested in a month's time. This brought us quickly down to selecting Microsoft Exchange. A deciding factor was they also had a Mobile Information Server that enabled us to provide a WAP front-end to the system.

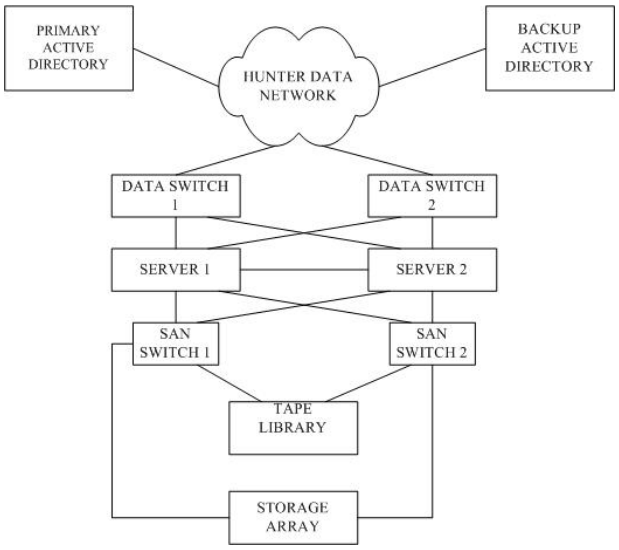

Figure 2. LDAP and Network Architecture

Having decided on the architecture and the product, the next item was to look at the product exhaustively. It provided us with everything we had set out to implement. The product even had a reasonable web-based front-end. In our plan and design, we had iterated that we did not want to force a student to use Hunter issued email but would provide flexibility for the students to chose the email program they would like to get their Hunter email on. This required us to have a forwarding function available to the students. This feature would enable students, if they wanted, to forward their Hunter email to their preferred email. This posed a significant problem as the Outlook Web Access (OWA) did not come with this functionality pre-built. To provide this functionality, we used the SDK provided and wrote our own code to create a "forwarding" icon on the OWA page that would enable this service for any student who wanted to use this to forward their email to their preferred address.

The architecture and the application now set the stage for creating a robust foundation for a communication system. This forms one major pillar of the SNet model.

4.2 Access

Implementing the communication infrastructure to provide access to the SNet system was the next step in Hunter's overall process. We were determined to provide as many methods and opportunities for our students to gain access as possible. They should be able to access information by going to a lab and logging into their SNet account or by using a kiosk to just access quick information. They should have the option to sit on campus with their personal laptop and access information through a wireless connection in their laptop or even via a cell phone or PDA. The intention here is that students should be able to access any information wherever they are by any means available to them.

4.2.1 Public Access Computer (PACs)

Student labs are present all over the campus but there are not enough computers for the number of students enrolled at the College. In looking at why students predominantly use the computers in the lab it was found that a majority of the students go to the lab to just check email or access the web. This prompted us to think of a way to provide a service to satisfy this type of user: a "quick-access" center where students could login and check their email or other web related items. This led us to design the Public Access Computers (PACs).

In our planning, we had identified that any design we draft should be cost effective. The PACs were designed taking this into consideration. The first item in the design was to identify the location. It was decided that these PACs should be located in student "congregation" areas, such as student lounges, student lobbies, student centers, the cafeteria, and other public locations. The next driving force was to look at the furniture setup for these PACs. Taking cost into consideration, we did not want to install any type of a desktop system, including a small form factor system. The idea here was for students to access a browser to access any web applications such as email. Because these were to be "quick access" locations, we did not want to encourage students to attempt to save anything to a floppy or the hard drive. So we were looking for a system that just provided students with basic web access. This focused our attention on using terminal services.

By using terminal services, we could now reduce the size of the desktop systems by going to thin clients. Thin clients are systems

that consist of a network card, a processor, a video card and some memory. Thin clients do not have any moving parts such as hard drives, floppy drives, cd-roms or a fan in them. The thin clients are designed as information access devices. They use very low power and have a very tight Internet compatibility. All applications are run from the server. The main idea behind thin client computing is centralized computing power, storage, applications, and data on servers. The other significant factor, apart from the low power consumption, was the size of the device itself. The device that was selected for our installation was the Compaq T20. This device fits in a small electrical junction box that could be purchased from any electrical store. The design of the PACs setup became simple. Inside the electrical junction box, the Compaq T20 and all the electrical and network connections were housed and connected. A 24" depth counter top was fixed to the wall as work surface. A flat panel monitor encased in a wooden and Plexiglas frame was installed on the wall. A picture of one of the PAC installations is shown in figure 3.

Figure 3. Students using PACs

The thin client had to be connected to a server which provided the users' desktop and applications. Windows Terminal Services was used as the server application. Terminal Services allows the same set of applications to run on any number of these thin devices. This design provides for a more effective roll-out of applications for the students and also enhances the manageability of these devices. There is very low maintenance on both the thin clients and the terminal server. As all the applications are executed on this server, the server has to be both processor intensive and memory intensive. Initially, we had installed this on a medium workgroup server with almost 1 GB of memory and with 40 thin clients connected to this server. When all 40 devices were logged-in, the server crashed as it was not able to withstand the load. The server was upgraded with about 2 GB of memory and a faster processor to provide a standard quality of service when the students login. The first set of applications that are provided from the server are the web browser and all type of document viewers (Word, Excel, PowerPoint, etc).

The cost of implementing this solution is very small compared to the cost of implementing a kiosk or some other form of access. The big savings in this design is the manageability of the entire system. If software has to be upgraded or patched, it can be done on the server, once, compared to going to each machine to do the job. As there are no moving parts, there is almost no, or very few, maintenance issues. This provides more time for the IT staff to work on other important items. As the cost of the thin clients is less than $500, we purchased a number of spares which allow us to replace, at a moments notice, any system that has a problem. This allows the system to be in operation with minimal downtime. The IT technician can then troubleshoot an issue on a particular thin client from his work area at a more convenient time. To access these PACs, students must login using the same LDAP system that has been described above.

4.2.2 Wireless

The next important access component is the implementation of wireless technology. Hunter is an urban college located in the middle of New York City with a student population of a little more than 20,000. The buildings, unlike other buildings in New York City, are open access buildings. This means that anyone from the street can walk into Hunter College without showing identification. This created a significant problem in implementing a wireless infrastructure for students, due to security issues. One security issue, among many others, is to ensure that the person jumping on to our wireless network is an authorized Hunter student.

The overall expectations for the wireless implementation are as follows: (1) any authorized faculty or student should be able to log onto the wireless network. This also means that it should prevent anyone who is not in the school's student system or the human resource system from gaining access. (2) There should be reliable service in areas and locations where these services are being provided. There should not be a conflict of channels or attenuation of signals, etc. There should be the capability of roaming between subnets, spanning multiple access points, (3) the system should have the capability of encrypting data during wireless transmission to the level of 3DES encryption. This would only be used if the students, in some future time, wanted to pay their bills with a credit card using their laptop connected to a wireless network. (4) The IT staff should not need to touch any wireless device to configure it for use on the campus wireless network. This means that we do not want to have the students come to give us the MAC address of their wireless card and/or have Hunter provide them with a WEP key. To have to provide that type of support would be overwhelming and would delay student access to the wireless service. (5) Similar to the above scenario, we do not want to create dynamic configuration changes on network switches when the network sees a wireless device come online. This is like creating a VLAN for the wireless devices on the fly, putting those devices in that VLAN and restricting what can be done on the network. (6) The final plan was to see if the wireless infrastructure could be robust enough to deny access to systems that are identified to be off-limits.

Other criteria that went into the planning of the wireless infrastructure are the capability for the students to use the LDAP described above to provide authentication service. Once the system verifies and authenticates the student, then the system should provide an IP address to the student's wireless device. Before this authentication occurs, the student should not be able to get onto the network. The access and the security of this student then will be based on role. There could be a role called "students" on this wireless infrastructure which would only allow the student access to a specific set of resources and blocks them from accessing other resources, such as the Human Resource system. Planning considered whether this infrastructure could handle class of service. The class of service would permit us to provide control over bandwidth and other resources on the network.

The above defined expectations and plan required us to go with the architecture shown in figure 4. In this architecture, we implemented a wireless gateway. All the access points (AP's) are connected to the Hunter LAN through this device. When a student opens the wireless

enabled laptop and wants to get to the network, they will have to open their web browser and the default page that will appear will have login information. When they login, their login information is passed to the LDAP (active directory) for authentication. Once their identity is cleared, the gateway will provide them with a valid IP address and this will enable them to access the internet. This architecture will also support moving between access points without dropping connections.

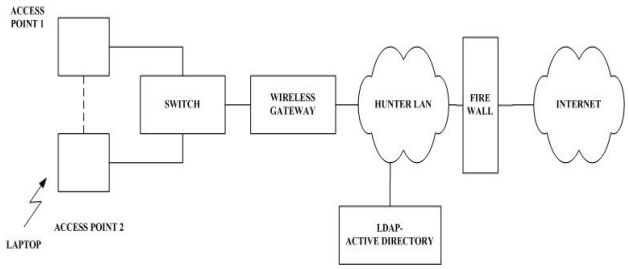

Figure 4. Wireless Architecture

Another service that was setup for students to use the wireless service was a wireless card loaner program through the library. If students have a laptop but do not have a wireless card, they can go to the library and check-out a wireless card for the semester. They can now install the card in their laptop and be able to use the Hunter wireless network infrastructure.

Access forms the second major pillar of the SNet model.

4.3 Support

Support forms the foundation on which the two pillars mentioned above can stand strong and without crumbling. Support is critical; without it the amount of technology that is deployed does not make sense. The key point to note here is that there need not be a significant number of IT technical staff. Support that is well managed and staff that are trained can accomplish much more than many poorly-trained technicians.

In the SNet model, a student helpdesk was setup. This helpdesk is staffed by students. The students here are trained on all aspects of technology available to Hunter students. This helpdesk also provides hands-on training to students who would like to obtain quick training on how to use the email or how to log into the Blackboard system, etc. The helpdesk is open seven days per week. Support is available from 9 AM to 10 PM and on weekends from 10 AM to 5 PM. All the requests that come into the helpdesk are logged and the students are provided multiple ways of accessing the helpdesk. They can call on the phone, fax, submit over the web, email, or instant message. The goal of the helpdesk is to provide instant support to the caller or expedited service, within a few hours, for email requests.

Apart from the helpdesk, the SNet infrastructure is supported by a system administrator and a technician. The primary function of the system administrator is to manage and maintain all the servers, storage arrays and tape library system. The management of, as well as both addition and deletion of, accounts on the email system, are provided by the system administrator.

The SNet helpdesk staff and the technician support all day-to-day running of the thin clients and other computer desktops. Every day, a SNet staff member makes four rounds, visiting all the PACs, to make sure that they are all operational. If there are any not working, staff immediately troubleshoots the system or replaces the module, bringing the non-operational one back to the office for repair.

Hunter begins admitting students for the Fall semester in the middle of the previous Spring semester. As soon as they are admitted to the college, the IT department runs a job to create an email address for the new admits. They are then sent a postal letter notifying them about their email address and their password. If the student entered an email address in their application form, the IT department automatically creates a forward from the SNet email address to the address they entered. If, in the end, the students do not register in fall, their email ID is removed. The plan is to provide the new students early on with their email address and this will at least smooth their transition into the Hunter address.

All freshmen at Hunter have to attend an orientation seminar. This academic year, the IT department has taken an active role to meet with the entire freshman class to go over some basic technology training such as how to use email and Blackboard. This is an aggressive step to inform students of all the technology that is available to them.

As can be seen here the support has to be strong for the infrastructure to survive. Support forms the foundation of the SNet model.

4.4 Central Services

Central services can be considered the portal of eServices for students. The primary component of Hunter's central services is the web page that provides links to all the eServices available for the students. This web page also has a section where student news and happenings are posted and kept up-to-date. This can be seen by visiting the web page at http://snet.hunter.cuny.edu.

A critical SNet service from the student's perspective is the ability to forward their email. We have provided the students with four ways of forwarding their email. They can log into the outlook web access, click on the forward button and enter their forwarding address. Secondly, they can use the application provided on the main SNet page to enter their forwarding address. The third method is to walk in to the SNet helpdesk and ask the SNet staff to change the forwarding address. Finally, we automatically forward their Hunter email to their preferred email if it is present on the student application form. All these methods are well advertised to students and they can choose the method they prefer to forward their email.

Added, but integral to the whole infrastructure, is the marketing of this model to the students and faculty. Without this, neither students nor the faculty will know the services that are being offered by this model. During the initial months, a strong marketing campaign was held. This included placing posters around campus, meeting with the student newspaper to write an article, doing presentations for various student groups, and making presentations in classes.

5. SNet model

The SNet model can be visualized as shown in figure 5. The foundation of the model is the Support. The stronger the foundation, the stronger the model will be. Having cracks in the foundation can lead to ineffectiveness in the model and finally to crumbling in the structures.

The two pillars of the model are communication and access. One cannot be there without the other. The wider the pillars in the model

the stronger the services provided. The thinner the pillars in the model, the lower the level of service is provided. As shown in the model, the pillars stand on the foundation, which is Support. If the pillars are very wide, the foundation should be strong enough to carry them. This strength is a result of having trained and competent IT staff.

The roof of the model is all the services that can be supported by the pillars and the foundation. The set of services provided here are collections of all eServices that are required by a student. This could be a College portal with integrated services or could be a web site with links to services. If the roof is very deep, with a significant number of services being provided, the underlying structure should be strong enough to hold these services in place.

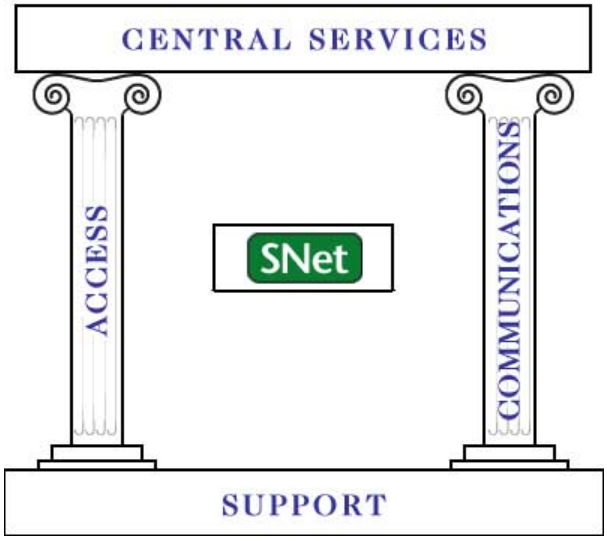

Figure 5. SNet Model

6. Effectiveness and Impact of the SNet Model

This model and the underlying structure have made a significant change in the way information is being communicated to students. There has been a more strategic use of computer labs by students. Students who tend to just check their emails or are between classes tend to use the PACs a lot more than the students who want to write a paper or do a research using computer, the latter predominantly going to the labs. During the first semester, there were 13,000 unique students who logged into the PACs at least once. We thought this number could be due to the "newness" of this system but in the subsequent semester, the number of unique logins went up to approximately 16,000.

The use of email, which was insignificant before implementing this model, almost took on a life of its own. Students were using both login methods into SNet, checking email, using the web client and/or forwarding their email to their preferred email address. During the first semester of this model, there were about 7,000 students using our email system, a dramatic rise from a few hundred using it in the previous years. In the next semester, this number increased to almost 11,000 students using our email system with almost 4,000 students (not included in the 11,000) preferring to forward their emails. A positive impact was also gained when administration took an active part in our roll-out by informing the students that all official messages would be sent to their Hunter email address.

The support structure that was put in place handled all the needs of the student who had problems using these new services. The helpdesk's hours of operation were found to be adequate for providing the necessary services in a timely manner, allowing students to quickly get back to using the services for their various needs.

7. Future Enhancements

There are many initiatives that are in the works to enhance all four aspects of the model, especially in the areas of communication and access. The implementation of instant messaging for students and the enhancement of wireless into the classrooms are two of the planned enhancements. The concept of "floating computer labs" is being investigated. This involves the use of computer carts with wireless laptops which can be rolled into a classroom for a class unable to meet in a computer lab due to time and space conflicts. This model has the flexibility to be enhanced as each of the four sections is addressed equally. The model becomes unsuccessful, if it is not flexible.

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