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Written by the NTS management team.

Designed and edited by Joshua Welsh.

A PDF file of this document is available at http://www.umn.edu/nts.

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Introduction

The Department of Networking and Telecommunications Services (NTS) reports through the Office of Information Technology at the University of Minnesota. While the information within this document will attempt to convey various aspects of the major areas within NTS and their activities, many reading this document may not be aware of the technology that NTS relies on in order to deliver its services to the University. These technologies can be thought of as roughly aligning with the functions and components of the human body. This analogy can be drawn as so much of technology used by NTS must work cooperatively together in order to deliver services. Within this introduction and where appropriate, this analogy is tendered for consideration.

At first glance, the services NTS provides may simply appear as a wall connection which one uses for computer or phone. A jack in the wall or a wireless signal is the physically noticed component, much like our outward skin. Most people recognize that there are wires in the wall and even that fiber-optic cable is used somewhere in the delivery of services to the desk. These are analogous with the vascular system—they extend life (or services) to everything outward that we see in each other. Few however, may recognize the complex technologies involved in delivery of these services.

Thousands of individual devices—each running its own software and needing its own individual configuration—allow the data network to function. Some, like etherswitches, have lower-level jobs roughly equivalent to the organs in our body. Others, such as routers, support the higher-level functions that our brains take care of for each of us, organizing information and allowing each part of the body to work together. Each of these devices has its own security risks (you may wonder where the name computer viruses came from), can have its own problems, and requires monitoring. NTS does this for the University data network to ensure that it is doing its job. These devices run programs containing millions of lines of code.

The voice network that allows individuals to place and receive calls is no less complex. Electronics for the telephony system exist in many physical locations at the University. These, in turn, need to work together to ensure that they function as one system. Configurations for these systems set by NTS staff allow routing of calls to take place in case of failures, just as with data network electronics. These systems also have their own unique software running millions of lines of code—again, the comparison to the human body can be made.

Given the complexity of all these systems running all of these individual pieces of software and each having the potential to disrupt services overall, an interesting dichotomy exists in how well these systems operate. The potential for issues affecting service is great. To the credit of both the system manufacturers and the staff at NTS, these systems are quite vocal in reporting problems, and NTS staff often react to these cries for help before they affect services. The majority of problems recognized by users of these complex pieces of electronics is usually the result of catastrophic failures of software, hardware, or environmental conditions.
All of these systems must be monitored 24x7x52. Monitoring these systems requires another set of complex software and hardware. These monitoring systems consolidate and classify the thousands of messages coming from these thousands of devices across the University. The monitoring systems themselves have staff dedicated to their own support. Being software and hardware, these too have their own sets of issues. Just like any other computer, all systems must be upgraded, tested, repaired, and tended.

The University is a large entity. The needs for the voice and data networks require many contracts to be in place to support these systems. Public telephone service, Internet capacity, and disaster recovery services all require support or service contracts from vendors. Like many other departments at the University, NTS generates Requests for Proposals (RFPs), evaluates responses, and awards contracts to purchase these various hardware and software technologies. Staff at NTS handle the contracting process for all of these necessary connections to the outside world.

Looking to the future means looking towards convergence. More quickly than one will expect, telephone, data, and video will all work together across the same network and the same sets of electronics. The coming changes in telecommunications technology will add to the complexity of what NTS supports; additionally, these changes continue to “mutate” month by month. This requires NTS to remain ever vigilant about the evolution of applications moving across our networks. Keeping pace with these changes is a constant struggle—NTS needs to understand what implications these changes will have on our existing voice, data, and video networks and how to proactively ensure that existing services are not negatively impacted.

If one thing is to be recognized from the information within this document, please note that NTS does an enormous amount of work behind the scenes to make all of those holes in the wall and our body of services function properly for the University—much more than meets the eye!

Executive Summary

This document describes the activities of the Department of Networking and Telecommunications for the year 2005. It consists of three sections:

1. Our overall technology goals and major projects for the year (Major Projects)
2. A summary of the 15 groups that constitute NTS (Functional Areas within NTS)
3. An analysis of major expenditures and normal business budget allocations (Financial Overview)

Its purpose is to provide a high-level overview of accomplishments and challenges that NTS faced in year 2005.
Major Projects

NTS completed or embarked upon several large projects in 2005. The following are the larger, more visible projects.

Network Upgrade
This one project occupied the majority of NTS’s resources through the year 2005. NTS upgraded the campus network, installing electronics and scheduling cuts for over 50,000 active network connections, 2,000 etherswitches, and the supporting routing. A new network management system was also implemented with the upgrade. This installation effort started in January of 2004 and ended in July 2005. Prior to January 2004, NTS conducted customer interviews and produced the RFP for the project. Some areas of the University have yet to be moved to the new hardware. These areas were left mainly due to the need to coordinate wiring upgrade efforts in these locations. In the case of the major data centers, additional hardware was purchased and should be in service for the University at both border locations in early 2006. This project had an impact on all areas of NTS. As a result, NTS’s need for contract help for day-to-day operations went up dramatically throughout this period. The hardware purchased for this upgrade totaled approximately $13 million. Overall, this upgrade was one of the largest that NTS has ever taken on internally and involved the most effort by all areas within NTS of any project in its history. All areas within NTS contributed to ensure a successful project.

Broadband Optical Research Education and Scientific Network
The Broadband Optical Research Education and Scientific Network (BOREAS-Net) is a partnership between the University of Minnesota, the University of Wisconsin-Madison, the University of Iowa, and Iowa State University to construct a fiber-optic Regional Optical Network (RON) ring through the combined purchase of leased fiber optics to connect these schools. This project started in 2005 with a joint RFP issued by the University of Minnesota for fiber-optic facilities. At the end of 2005, an award was made to WilTel Communications to lease part of the fiber optics needed to complete the ring. In 2006 FiberLink received the award for the remaining portion of the ring. Equipment will be purchased in 2006.

The ring will terminate into the CICNet’s fiber-optic ring in the Chicago area and also into the National Lambda Rail point of presence in this location. NTS staff participated heavily on the technical, administrative, and legal fronts to position these institutions to purchase the fiber optics. This network is anticipated to go live sometime in year 2007.

Internet2
NTS added connectivity for Internet2 to supplement the existing OC-12 (622 Mbps) network link into the University for additional backup and resiliency. An RFP for a gigabit connection was added and awarded to WilTel Communications. The connection was turned up midyear in 2005. This link connects to the Metropolitan Research and Education Network (MREN) in Chicago and is currently being used as more direct routing for Chicago area Internet sites and also in participation with Internet2 peering at the MREN facility. Future plans will include this connection to provide additional Internet connectivity. The OC-12 bandwidth utilization
averages 60-90 Mbps at the time of this writing, with periodic peaks over 200 Mbps. Traffic is predominantly inbound.

**Northern Lights GigaPoP**

The Northern Lights GigaPoP is maintained by NTS. Although peering requests do go through a tedious process, the list of connectors to the GigaPoP is growing. We have seven Internet2 members, two SEGPs (Sponsored Education Group Participants) representing 20 different entities, and four groups such as the Technology Information Education Services (TIES) consortium (representing 38 Minnesota school districts and 400 schools) peering at the University. In addition, there are eight commercial Internet Service Providers (ISPs) connecting different schools to the GigaPoP. This is one area in NTS which requires more focused attention as it is being administered on a part-time basis. Fortunately, the requirements for attention are small.

**Long Distance, Local Trunking, and 800 Service Changes**

NTS issued several RFPs in 2005 based around saving costs for the University and providing the local exchange carrier (Qwest) with competition for the PBX system traffic. SBC Communications was awarded the local trunking contract replacing Qwest services, McLeod Communications continued for long distance services, and Qwest replaced MCI for most 800 services. Long distance usage over the past months has dropped, primarily due to cellular phone usage on campus. The RFPs for these services were issued in late 2004 but actual service did not go into place until the beginning of year 2005.

**Enhanced 911 Conversion**

NTS partnered with the University Police department and the metro Enhanced 911 (E911) board to install and convert the existing 911 service to a state-of-the-art E911 service at the Twin Cities campus. Prior to the conversion, the University was out of compliance with regulations governing telephone service providers by utilizing its own private system. This new system allows University police to integrate with other metro E911 centers allowing proper response assignment based on geographic locations. This project involved support from many areas in NTS to install hardware and special circuits, as well as to provide database integration technology to link our location information to the national E911 database. The result of the conversion is an up-to-date E911 system that complies with the metro E911 requirements, improves emergency response, preserves metro and state E911 funding, and raises the status of our E911 system to an official E911 call center. This project was completed in January 2005.

**Payphone Consolidation**

In the spring of 2005, NTS undertook a project in partnership with its campus pay phone vendor to remove unprofitable pay phones. At that time there were 123 pay phones on campus. Over 90 of those (the ones producing gross revenue less than $1.25 per day) have been removed. About 20 of those have been replaced with standard campus phones. Nearly all locations where payphones were removed have now been repaired or patched.
As a follow on to this project, NTS will be changing location information on campus phones to standardize features and location information.

**Capital Project Work**

NTS worked on more than 20 large capital projects this year. The total cost of all these capital projects was $681,238.39.

Below are examples of large projects completed or in progress during FY 05–06:

- Project to disconnect voicemail in residence halls
- Service Gateway Web application development oversight
- IP Unity voicemail (Gopher Messaging) system rollout
- Auto Attendant conversion to Gopher Messaging
- Soudan Mine data service rollout
- Centery reports development
- Bundled service offerings development
- UMP Auto Attendant & ACD conversion
- Pay phone conversion project, maps, and Web site content development
- Toll-free conversion from MCI to Qwest and audit of 800 service
- Room 185 disaster recovery audit projects, other service audit projects
- Mysoft audit and planning for review steps
- Construction phase of Nicholson, MTRF, Equine Center, and Jones
- State Fair telecom planning and coordination
- Special events planning and coordination (e.g.: athletic media, event on the Washington Bridge for Hurricane Katrina victims, political events, etc.)
- Design phase of Ben Pomeroy, Kolthoff, CMRR, Education Sciences (Mineral Research), Mayo Auditorium, Minnesota Department of Health Building, Rowing, and MBB
- Communications Restoration Project (pre-work or labor in this FY): Mondale, Ecology, WBOB, Folwell, Wilkins, Shepherd, and Johnston
- Communication coordination for Web sites and publications
- Moves and renovations such as MacNamara Events, Minnesota Daily, Blegen, 110 Anderson, Survey Research, 20 Coffey Hall/CCE, and Disability Services Remodel (three phases), Classroom Services, and WBOB (flood recovery)
- Stadium-related planning (Poucher, Holman, University of Minnesota Press demolition)
- International Center consulting
- Extension projects and moves (Hutchinson, Mankato, Brainerd, and design of telecommunication for all regional sites)
- Project view design and process examination

**Service Gateway**

Service Gateway, the new self-service tool that University departments will use to request services from NTS, has been developed to allow our customers better control over their
network resources. The objective of rolling this application out is to centralize points of information for our customers and to promote a closer tie between data and voice connections and the administrative entities responsible for them. NTS has begun meeting with each department to help identify the voice and data network connections that it manages.

These new tools will make it easier for our customers to comply with federal privacy policies such as HIPAA. The rollout process will also simplify network problem solving by dividing the network into smaller groups, thus reducing the complexity of individual problems.

**Design**

NTS worked with the University’s Usability Services department for initial testing of the Service Gateway product to ensure it was intuitive and useful for our customers. The project group consists of staff from several departments within the Office of Information Technology.

**Priority**

This work needs to take priority for those involved in the day-to-day activities associated to the project. Situations may arise where people will be temporarily assigned to work on other initiatives or daily work at NTS. To complete this work in a timely fashion, group dynamics are important. All members are expected to participate fully. Since customers are impacted by our work and play an important role in the process, project members must work effectively with our customers.

**Approach**

NTS has identified and contacted a group of departments to act as beta testers for the Service Gateway. Part of the process involves identifying which communication jacks should be managed by each department and putting those jacks into management groups. NTS then provides in-depth customer training to familiarize the customer with the Service Gateway tools.

A separate piece of the process, but just as important, is the re-evaluation of each department's subnets. In most cases this results in creating new subnets for the department. New subnets allow for a cleaner network for the departments to support and provide NTS with the opportunity to collect unused IP addresses. Collecting these addresses gives NTS the chance to clean up the entire University network.

Eventually, the entire Twin Cities campus will use the Service Gateway to manage their communications jacks. In addition to providing our customers the opportunity to compartmentalize their unit’s voice and data connections, the Service Gateway will become the entry point for NTS web-based information.

**Communications Restoration Project**

The Communications Restoration Project (CRP) is a multi-year effort which aims to act on evaluations and audits from previous building surveys and from the recent network upgrade project. Buildings with known or discovered wiring deficiencies will be upgraded. By upgrading these wiring or infrastructure deficiencies we will enable reliable network communication performance for current and projected data electronics. The building wiring
will be upgraded by replacing out-of-date wiring, distributing electronics to keep wiring distances within tolerances, and upgrading facilities where network electronics are housed. Work on buildings will be in an orderly sequence according to a schedule.

A given building upgrade will begin by compiling a detailed assessment of the telecommunication facility spaces, noting what is necessary to bring the building up to current infrastructure and wiring standards. This information will be compiled from past site visits and audits. The required materials will be ordered. Construction tickets will be opened based on the individual needs for each building. Based on the time line from the previous steps, work will begin and the project will proceed.

The highest priority for building selection is to complete existing building infrastructure upgrade requests followed by buildings that have been scheduled for upgrading from past efforts. A time line and building upgrade order will be developed based on these assessments and the following building criteria:

- Research areas
- Classroom areas
- All others

Building occupants will be notified of service upgrade times and completion. The University community will be able to see progress information on NTS Web pages. Project costs will be documented and building improvements will be tracked, recorded, and compared to projected timelines.

The Project Management group will orchestrate and communicate with all groups including building occupants and Facilities Management to complete each individual building project efficiently and according to schedule. NTS field service engineers and infrastructure design engineers will be responsible for completing the field work. As the engineers design the upgrade for each building, they will consider current and future voice and data service delivery needs in the buildings.

We have rewired part of Norris Hall which had little to no data access, and in a joint effort we were able to wire half of Folwell Hall in 2005. The other half will be done in 2006. We have also completed the entire Ecology building. As of May 1, 2006 over half of the wiring at the Minnesota Landscape Arboretum has been completed.

A team of one project manager, four field engineers, and one infrastructure design engineer, all current NTS staff, will implement the upgrade.

Zone Efforts

In an effort to have a closer relationship with the people who use the services NTS offers, a zone effort, focused on customer contact, was initiated in 2005. NTS management and staff have been split into zones roughly following the Facilities Management geographical zones on campus. NTS management visited over 130 customers on campus with the goal of visiting all departmental IT contacts in each zone by mid 2006. The focus of these visits was to hear the good, the bad, and the ugly directly from our customers. In future months, the leads of
Each zone will switch to a different part of campus so that all NTS management will meet our customers across campus. While it does require some people to allocate time and get over their own personal shyness of meeting new people, there are benefits. NTS managers meet monthly to discuss visits and feedback related to these visits.

**Department Restructure**

A major restructuring of staff and management took place in the fall of 2005. Louis Hammond and Pete Bartz changed roles; Pete has moved to operations and Louis to design. New managers were appointed for the Technical Assistance Center, Inventory, and the newly-created Web Development, Quality Assurance, Training, and Prototyping groups. The Training group addresses multiple requests of staff for more one-on-one training in the telemanagement and process areas within NTS. The Web Development group was separated from the Information Systems group in order to better address the needs for effective Web services. The Quality Assurance group is tasked with improving service delivery performance, identifying process problem areas, and tracking improvement in different areas of NTS. The Prototype group will jump-start testing and concepts with new technology outside the normal controls and methodology needed in order to fully support services in an ongoing manner. NTS staff were invited to give feedback on where they feel their interests lie. All were invited to provide feedback on how NTS can improve. The result was several staff moves and openings that are still being set into place at this time in year 2006.
Functional Areas within NTS

Figure 1 contains the new organization chart that resulted from the departmental restructure. The following sections explain NTS’s constituent groups in detail.

Figure 1: NTS Organization Chart (May 4, 2006)

Quality Assurance Group
The Quality Assurance (QA) group is newly formed in our department. The QA group will be tasked with examining our processes and looking for improvements. The group’s main goal in the coming year is to improve database accuracy. The auditing will also include physical walk-throughs in our service closets throughout the campus.

Technical Assistance Center
The Technical Assistance Center (TAC) fields higher-level problem reports from campus and is a direct escalation point from the Tier 1 support center (1-HELP). Through 2005, the support center has streamlined from 12 to 10 staff, covering until 10 p.m. Monday through
Friday. With the NTS reorganization, four of these staff are in training, moving from other areas within NTS to assume these support roles.

The TAC receives calls that are escalated from Tier 1 as well as directly from University staff, students, and faculty. This group is also the hub for repair communications from and to the University community, for our relationships with the State of Minnesota, and with other telecommunication vendors.

One metric to note on repair issues is the rough categories of repair calls. Figure 2 shows a breakdown of tickets based on type, with a further breakdown of how security tickets have decreased over the 2004–2005 year.

Figure 2: OIT TAC Virus/Abuse Tickets

Table 1 compares calls answered, wait time, and call time for both tiers of support.

<table>
<thead>
<tr>
<th></th>
<th>Tier One</th>
<th>Tier Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calls Answered</td>
<td>22,431</td>
<td>9,001</td>
</tr>
<tr>
<td>Average Wait Time</td>
<td>37 seconds</td>
<td>6 seconds</td>
</tr>
<tr>
<td>Average Call Time</td>
<td>4:07 minutes</td>
<td>2:21 minutes</td>
</tr>
</tbody>
</table>

The following three tables analyze customer services calls handled by the TAC in greater detail.
Table 2: TAC Customer Service Statistics, May 1, 2005 through May 1, 2006

<table>
<thead>
<tr>
<th>Service area</th>
<th>Number of calls</th>
<th>Percentage of calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>10,517</td>
<td>53.3%</td>
</tr>
<tr>
<td>Facilities</td>
<td>96</td>
<td>0.5%</td>
</tr>
<tr>
<td>Gopher Messaging (Voicemail)</td>
<td>2,100</td>
<td>10.6%</td>
</tr>
<tr>
<td>Network Upgrade</td>
<td>499</td>
<td>2.5%</td>
</tr>
<tr>
<td>Other</td>
<td>495</td>
<td>2.5%</td>
</tr>
<tr>
<td>PBX</td>
<td>68</td>
<td>0.3%</td>
</tr>
<tr>
<td>Phone</td>
<td>4,076</td>
<td>20.7%</td>
</tr>
<tr>
<td>Security</td>
<td>20</td>
<td>0.1%</td>
</tr>
<tr>
<td>Service Gateway</td>
<td>2</td>
<td>0.0%</td>
</tr>
<tr>
<td>Videojack</td>
<td>19</td>
<td>0.1%</td>
</tr>
<tr>
<td>Voicemail</td>
<td>1,838</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

**Total calls taken** 19,730

13,608 TAC calls taken

12,220 minutes in TAC calls

2,062 6-wire line calls taken (field tech calls)

Table 3: Requests Originating via the Web

<table>
<thead>
<tr>
<th>Location</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Bank, South of Washington Ave (Health Sciences area):</td>
<td>83</td>
<td>34.60%</td>
</tr>
<tr>
<td>East Bank, North of Washington Ave:</td>
<td>61</td>
<td>25.40%</td>
</tr>
<tr>
<td>West Bank:</td>
<td>50</td>
<td>20.80%</td>
</tr>
<tr>
<td>St. Paul:</td>
<td>31</td>
<td>12.90%</td>
</tr>
<tr>
<td>Off Campus and other:</td>
<td>15</td>
<td>6.30%</td>
</tr>
</tbody>
</table>

**Total** 240
Table 4: Work Orders Written

<table>
<thead>
<tr>
<th>Service area</th>
<th>Total Orders</th>
<th>Voice</th>
<th>Percentage of Voice</th>
<th>Data</th>
<th>Percentage of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Bank north of Washington Ave (EBN)</td>
<td>3,678</td>
<td>748</td>
<td>6.6%</td>
<td>2,930</td>
<td>25.7%</td>
</tr>
<tr>
<td>East Bank south of Washington Ave (EBS)</td>
<td>2,435</td>
<td>1,753</td>
<td>71.5%</td>
<td>682</td>
<td>6.0%</td>
</tr>
<tr>
<td>St. Paul</td>
<td>1,102</td>
<td>234</td>
<td>21.2%</td>
<td>778</td>
<td>6.8%</td>
</tr>
<tr>
<td>West Bank</td>
<td>1,992</td>
<td>1,711</td>
<td>85.7%</td>
<td>281</td>
<td>2.5%</td>
</tr>
<tr>
<td>Off Campus</td>
<td>392</td>
<td>119</td>
<td>30.5%</td>
<td>273</td>
<td>2.4%</td>
</tr>
<tr>
<td>Other (vendors, etc.)</td>
<td>1,806</td>
<td>1,584</td>
<td>88.0%</td>
<td>222</td>
<td>1.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,405</strong></td>
<td><strong>6,149</strong></td>
<td><strong>53.9%</strong></td>
<td><strong>5,166</strong></td>
<td><strong>45.3%</strong></td>
</tr>
</tbody>
</table>

Note: Percentages are of total work orders written

Finally, Figure 3 breaks down work order volume by campus zone.

**Figure 3: Work Orders**

---

**Overview of Work Orders Written 05-06**

**Project Management Group**

**Telecommunications Service Representatives**

Requests for voice, wireless, video, and data services, as well as changes and moves in service usually begin with our telecommunications service representatives who consult with our customers in the Twin Cities and across the state. They document service requests, changes, and moves in our database, and they write the orders from which our field services and installation staff perform work. They also execute software-based work needed to create, add, and delete phone numbers, phone service, and voicemail.

**Project Managers**

From May 2005 to May 2006, the project management group spent over 683 hours consulting with users and programming Automatic Call Distribution applications (ACDs) and auto
attendants for call centers and communication centers (e.g., 1-Help, One Stop, UMP Access Center, Facilities Management, School of Nursing, Athletics Ticket Office, School of Dentistry) across campus. Fielding questions, troubleshooting, training, testing features, creating reports, and general advising of call center staff required additional hours.

Roughly 91% of the total effort (623 hours) was spent on call centers in the Academic Health Centers (AHC) zone.

Project management staff averaged about 57 hours per month, or 684 total hours for the year, consulting and programming call centers. Because of the nature of call center business, many of those hours were spent outside the normal business hours.

Out of the 145 auto attendants we support, 44% (64 of them) of them reside in the AHC area, 30% (44 of them) are located on the East Bank campus, north of Washington Avenue. The rest are divided between West Bank and St. Paul campuses. There are 120 ACDs across the Twin Cities campus.

Call centers have evolved considerably and are an essential part of many University departments. New technologies, new channels of contact, and new customer support strategies continue to emerge. As technologies emerge, and as business units and departments work to improve their operations, limit costs and increase overall customer service, they come to NTS. Our Project Management group provides creative and sound technical strategies, as well as deployment of efficient, professional solutions.

Infrastrcture Design and Engineering Group
The Infrastructure Design and Engineering Group most often leads designs for fiber-optic and copper cable infrastructure from building to building or longer routes to other locations such as between the main Twin Cities and St. Paul campus. Additionally, this group works on building pre-design processes for new buildings on campus to ensure that proper telecommunications cabling infrastructure and adequate grounding and environmental requirements are achieved. This group also reviews and authors the University wiring standards on campus with help from other areas within NTS.

Code Compliance
Adoption of the Minnesota State Building Code by the University Code Office brought about significant changes in the permits NTS is required to request for installing communications and networking equipment and cabling. We have met with the University Building Code Office on several occasions and clarified permit requirements as well as establishing working line of communications.

Voice/Data Room Security Key Upgrade
This project has been going on for the last four years and we have re-keyed about 550 of the approximately 700 rooms on the campuses. The decision to re-key the rooms was based on a report by the University auditors that stated that we need to improve security in our voice/data rooms to protect data security and the electronics that are distributed throughout them. We estimate this project will be completed by the fall of 2006.
Minnesota Department of Transportation Agreement

This was a landmark year in that we established a good working relationship with the Minnesota Department of Transportation (Mn/DOT). As a result of this we established an agreement that will allow the University and Mn/DOT to share communication facilities, mainly fiber-optic cable, communications duct space and right-of-way. The first cable under this agreement was placed in early 2006 between the West Bank Office Building (WBOB), the Minnesota Technology Center, and the Mn/DOT Hiawatha Avenue communications hut. This will allow a reliable high speed connection between Mn/DOT and the University’s Center for Transportation Studies and NTS. Traffic management and streaming video are just two of the many possible applications that are being studied.

Storage Area Network

We continue to hook up fiber circuits for the University Storage Area Network (SAN). We have installed fiber circuits from WBOB to the St. Paul campus and to other locations including the Carlson School of Management, NTC, Child Rehab, Cargill, and the McNamara Alumni Center. This is an ongoing multi-year project. We also provide support and troubleshooting for the fiber circuits that have been installed for SAN to date.

Project Status Reports

In an effort to eliminate double entry between two databases, the Infrastructure Design and Engineering group worked closely with the MIS group and were able to successfully develop new project tracking status reports in the MySoft.net database. The report status has been set to 100% complete with changes being processed when requested. These reports are essential to tracking project labor and material costs as well as progress completion.

Fiber Statistics

The following statistics show the amount of fiber optic cable we installed from 2002 to April 2006.

<table>
<thead>
<tr>
<th>Date</th>
<th>Buildings with fiber</th>
<th>Buildings with riser fiber</th>
<th>Number of fiber riser cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3/2006</td>
<td>116</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>4/5/2006</td>
<td>142</td>
<td>1,350</td>
<td></td>
</tr>
<tr>
<td>4/6/2006</td>
<td>205</td>
<td>154</td>
<td>1,451</td>
</tr>
</tbody>
</table>
Table 6: MDF Fiber

<table>
<thead>
<tr>
<th>Date</th>
<th>Cables</th>
<th>Strands</th>
<th>Cable Length</th>
<th>Strand Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total #MM #SM Feet Miles Feet Miles</td>
<td></td>
</tr>
<tr>
<td>12/3/2002</td>
<td>297</td>
<td>12,132</td>
<td>7,507 4,625</td>
<td>440,859 84 26,588,449 5,036</td>
</tr>
<tr>
<td>4/19/2005</td>
<td>415</td>
<td>19,323</td>
<td>11,074 8,249</td>
<td>568,993 108 39,275,267 7,439</td>
</tr>
<tr>
<td>4/3/2006</td>
<td>435</td>
<td>20,855</td>
<td>11,532 9,311</td>
<td>616,766 117 47,382,904 8,974</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cables</th>
<th>Strands</th>
<th>Cable Length</th>
<th>Strand Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Installed</td>
<td>Total #MM #SM Feet Miles Feet Miles</td>
<td></td>
</tr>
<tr>
<td>2005-2006</td>
<td>20</td>
<td>1,532 458 1,062</td>
<td>47,773 9 8,107,637 1,536</td>
</tr>
</tbody>
</table>

SM = Single Mode
MM = Multi Mode

MDF is short for main distribution frame, a cable rack or, in our parlance, a telecommunications electronics room that interconnects and manages the telecommunications wiring between itself and any number of IDF’s (intermediate distribution frame). The MDF connects private or public lines coming into a building with the internal network.

Riser refers to cabling facilities which carry distribution for a given building vertically through the building. The riser cables usually carry aggregate signals from IDF locations to the MDF.

Computer Aided Design Developments
The purpose of this project is to establish a uniform basis for transfer of information between NTS Infrastructure Design and Engineering with contractors and vendors.

General work was done toward writing a document which lays out NTS Computer Aided Design (CAD) standards. To date many of the important concepts have been drafted. The intention is not to have a rigid set of standards, but rather a minimum set of rules that is easy to automate and enforce through custom menus and macros. Some training in advanced customization is necessary to make it easier to produce drawings for all in the group.

Rack Management Software Evaluation
We have identified key factors we want to keep track of in data center racks. Four potential vendors have been identified and contacted. Demonstrations are currently being scheduled and selection criteria or Requests of Information (RFIs) or Requests for Proposals (RFPs) may go out based on the information gathered from those demonstrations.
**Biosystems and Agricultural Engineering to Biological Sciences Fiber**
We placed 144 strands of single mode fiber between these two facilities using the existing tunnel system to provide increased network capacity.

**West Bank Office Building to Minnesota Technology Center**
We installed 432 strands of single mode fiber-optic cable between the West Bank Office Building and the Minnesota Technology Center. This cable provides a redundant and diverse route along with providing expanded capacity for critical services.

**Minnesota Technology Center to Minnesota Department of Transportation**
We installed 144 strands of single mode fiber-optic cable between the Minnesota Technology Center and the Minnesota Department of Transportation Hiawatha Street fiber hut. This cable provides connectivity between the Mn/DOT Waters Edge Facility and the University’s Center for Transportation Studies.

**Translational Research Facility**
A switch room was constructed in the new McGuire Translational Research Facility. Copper facilities previously fed from the YMCA switch room were relocated and are now fed from the McGuire Translational Research Facility.

**Information Technology Building to Heller Hall**
We placed 228 strands of single mode and 60 strands of multimode fiber-optic cable between the Information Technology Building and Heller Hall. This cable provides a redundant and diverse route along with providing expanded capacity for critical services.

**YMCA to McNamara**
We have installed a 1200 pair copper cable from the YMCA building to the McNamara Alumni Center. This cable will allow us to reroute the existing copper facilities that are currently fed from the YMCA and feed these buildings from the McNamara Alumni Center. We will be able to remove the telephone switch from the YMCA and reinstall it in the Department of Health building.

**Technology Corridor**
We have been attending meetings to provide technical support for the buildings for the proposed technology corridor on the north side of the proposed new stadium site.

**Installation Group**
The Installation Group is charged with installing voice and data connections throughout the Twin Cities campus. During the 2005 calendar year the installation group supplied the people power for the installation of the new electronic switches in the network upgrade. With a reduced staff we saw a 23% increase in contracted services and a 132% increase in overtime hours worked as we worked to deliver our day-to-day services without a disruption. In 2005 the group consisted of five full time technicians. Table 7 illustrates the work performed in 2005. In addition, the group installed some fiber-optic cable.


Table 7: Installation Group Statistics

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Connections</td>
<td>1,897</td>
<td>23.60%</td>
</tr>
<tr>
<td>Data Connections</td>
<td>5,920</td>
<td>73.60%</td>
</tr>
<tr>
<td>Wireless Connections</td>
<td>223</td>
<td>2.80%</td>
</tr>
<tr>
<td>Total Connections</td>
<td>8,040</td>
<td>100.00%</td>
</tr>
<tr>
<td>Average installations per day</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>1,036,092 feet (196.23 miles) of wire</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Repair Group

The Repair group is comprised of several field technicians rotated as needed to handle in-field repairs of voice and data services. This group reports through the Installation group manager. However, repair works closely with the Technical Assistance Center, which dispatches work out to the field. This group handles initial field review of service issues and will rectify these by changing out phone sets, wiring, or etherswitch electronics in order to bring the affected connection back within normal operating parameters. On occasion, Repair will engage desktop support groups in other parts of the Office of Information Technology for support where needed. Technicians are staffed in the major geographical locations on the Twin Cities Campus and augmentation is provided as needed from the main field installation group.

Field Repairs

The repair group responded to 3,260 calls on the Twin Cities campus in 2005. Table 8 shows the areas on campus where work was performed this year.

Table 8: Repair Group, Field Repair Statistics

<table>
<thead>
<tr>
<th>Area</th>
<th>Data</th>
<th>Percent of Data</th>
<th>Voice</th>
<th>Percent of Voice</th>
<th>Total</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Paul</td>
<td>176</td>
<td>13.3%</td>
<td>271</td>
<td>14.0%</td>
<td>447</td>
<td>13.7%</td>
</tr>
<tr>
<td>Health Sciences area</td>
<td>367</td>
<td>27.8%</td>
<td>616</td>
<td>31.8%</td>
<td>983</td>
<td>30.2%</td>
</tr>
<tr>
<td>Other locations</td>
<td>779</td>
<td>58.9%</td>
<td>1,051</td>
<td>54.2%</td>
<td>1,830</td>
<td>56.1%</td>
</tr>
<tr>
<td>Total</td>
<td>1,322</td>
<td></td>
<td>1,938</td>
<td></td>
<td>3,260</td>
<td></td>
</tr>
</tbody>
</table>

Wiring and Facility Locates

The NTS repair group is responsible for locating wiring facilities on the Twin Cities campuses. This involves using a sounder to find and mark wire locations. Once a locate request is received, the field engineer evaluates whether the locate is needed; not all requests require sending a technician into the field because it may be known that there are no facilities in the area. On average we perform a locate on about 40% of the requests. In 2005 our staff performed approximately 850 locates, or 16+ per week.
The Training Group supports both internal and external NTS customers. The internal training support is provided in an effort to help personnel better understand the MySoft telemangement database functionality as well as departmental processes. The focus is on the improvement of database accuracy by providing documentation and hands-on training experience, followed by documentation updates as needed. The training addresses NTS standards and supports the adherence to those standards. This is also a resource for the NTS management team to promote employee adherence to processes and procedures.

The Training Group has created training documentation and is working toward the development of an efficient method to track NTS personnel’s access levels within the MySoft database. The process will include a method to request database access changes while maintaining departmental consistency.

The Training Group acts as a customer service resource. When a unique customer challenge arises, the training area will take ownership of the problem and work through to resolution. This will be followed by documentation to be used for future training, as appropriate. The group works closely with Quality Assurance when a pattern in database errors is found and provides internal NTS training accordingly.

External training support is currently focused on customer training of the newest NTS product, the Service Gateway. This will allow our customers to make requests and perform some self-service functions through a common Web-based interface. The support will include the following:

- Preparing and updating documentation for customer training
- Coordinating customer training for using the Service Gateway
- Scheduling trainers, meeting rooms, and equipment
- Collecting customer evaluations and consolidating results
- Ongoing customer training as the Service Gateway evolves and as customer contacts change

Our first customer group was trained in March 2006.

Internal training support is currently focused on providing administrative training for the Service Gateway. This includes documentation and preparation for the initial training, as well as conducting the training sessions. The NTS initial training attendance rate was 90.6%, equating to approximately 100 hours of personnel training. In addition, initial training has been provided for Tier 1 support personnel in OIT. Efforts are currently underway in documenting and preparing for the second set of NTS training on the Service Gateway which will have a focus from our customers’ perspective.

The Training Group will continue to offer internal training for using the MySoft database. Thirty-nine NTS employees have been trained on the installation, replacement, and removal of network equipment, each on an individual basis, geared specifically toward what the person’s job needs dictate. This training includes documentation and hands-on database experience. The network equipment training will be followed by additional group training on
the advanced usage of MySoft, including documentation and hands-on experience. The Training Group will continue to be involved in internal documentation and process support for new NTS products.

The Training Group is also responsible for seeking out pertinent training resources for the NTS management team, serving as the interface with human resources and other sources as appropriate. A wide range of management topics have been presented with at least one training session per month, beginning November 2005. The topics included retention of good employees, team development, effective coaching, managing performance, strategies for managing change, and team decision making. Training attendance has included six managers that attended all seven training sessions. The remainder of the management team attended an average of 5.4 training sessions. This all adds up to approximately 364 hours of management’s dedication to improvement in less than six months. Considering the fast pace of NTS, that is quite an impressive show. Upon completion of the initial base training in May 2006, there will be ongoing management training of at least one session per quarter.

**Design Group**

The NTS design group is engaged at the start of many large projects and focuses on new technology and its applications for NTS. This group is called into play for architectural design for the voice and data networks or when new technologies are pulled together into service such as the network upgrade or Gopher Messaging projects. This group is responsible for configuration development and initial roll-out of technologies and their transition to operational support. This work entails design document development, training, high-level support until the technology is grasped by other areas within NTS.

**Data Centers**

Following the network upgrade, NTS designed, installed, and implemented the data center network infrastructure at the West Bank computer center. This installation resulted in a fully redundant network electronics routing and aggregation infrastructure for these 550 data connections and was funded by an additional $250,000 from the network upgrade project. Independent data center installations and conversions moved forward at data center sites on the St. Paul and East Bank campuses.

**Voice over Internet Protocol**

In 2005 NTS evaluated several Voice over Internet Protocol (VOIP) telephony solutions and implemented an Asterisk open-source telephone system (also known as a private branch exchange or PBX) in pilot mode. This pilot integrated with the main campus telephone system and demonstrated how this technology would work on campus. The system provided many features and worked well. It did not resolve the issues related to the implementation of E911 through VOIP, but did work well in this pilot test environment. NTS will be rebuilding this system in 2006, this time with production service support in mind to help augment our current PBX. The VOIP system features available in this pilot included desktop video conferencing and the ability to make calls from just about anywhere on the Internet.
**Modem Pool**
The existing modem pool was resized to 1,600 modems, down from over 2,000 lines in 2004. Since the proliferation of high-speed networks, the need for low speed modem lines has dropped considerably. We further reduced the lines to 1,344 in 2005. This saved the University nearly $40,000 per year.

**Wireless Networking**
In 2005 NTS finished the installation of over 500 wireless access points across campus representing $225,000 to support this important technology. Most of these installations were in network equipment closets. This addition increases the campus 802.11b wireless footprint significantly.

**Web Design Group**
The Web Design group is newly created as separate from the Information Systems group and is charged with providing world-class customer service via the NTS Web site. To that end the group is working in the following areas.

**User-centered Design**
A user-centered approach is applied to the design of the entire site. This involves actively soliciting user ideas in our designs. Individual users and groups of users will be involved in testing the designs and providing feedback through the University’s Usability Services lab. We are designing a new Web site navigation structure with the help of card sorting, in which users create topic categories and sort the topics of NTS Web pages into these topics. This will also allow users to apply their own “tags” or labels to Web pages. Popular tags may be promoted to become part of the official site navigation.

**Accessibility**
We work closely with the Computer Accommodations Program and test our designs with their accessibility laboratory to ensure that the NTS Web site is accessible to people of all physical abilities.

**Cross-platform Web Sites via Web Standards**
To ensure that our Web site works in any reasonably recent Web browser running on any operating system, the NTS Web site complies with the latest XHTML, CSS, DOM, and Javascript (ECMAScript) standards supported by those browsers. Not only will the NTS Web site continue work with newer browsers that discontinue support for old standards, it will also be more accessible since accessibility tends to depend on adherence to newer standards and clean design.

**Self-service Tools**
A high priority is to provide customer self-service applications wherever possible. We are contributing to the Service Gateway project to help automate service requests, especially by providing a remote application programming interface (API) to the phone switch. We are currently working on a graphical browser for the Gopher Messaging Telephone User Interface (TUI). An online survey instrument is now in production that allows customers to provide us
with feedback. When technical assistance trouble tickets are closed the customer is automatically sent an invitation to visit this page and provide us with feedback. We are taking advantage of recent standardization of Javascript across browsers to provide more rich and interactive user interfaces. Test-driven development will make our applications more reliable and secure.

**Web Services**

We are working to provide a Web services interface to all applications, both those we develop and those we purchase from vendors. This will allow for integration of all NTS applications with each other and thus allow for a more unified, less fragmented user experience.

**Information Systems Group**

In the mid-year reorganization of NTS, the Web Development group and the Information Systems (IS) group were created from the single MIS group. The IS group is charged with development and maintenance of the database systems that are used by NTS to handle its business records and to track customer support. The two major systems used for these purposes are MySoft and ServiceCenter.

**MySoft Telemanagement Database**

The network upgrade process was automated to generate work orders from an Excel spreadsheet. This allowed the field staff to get the work orders much more quickly than if they had to be entered manually. The creation of work orders for moving private LANs to the network was also automated.

Custom Web applications in MySoft were written to create network ports when new distribution points or switches are installed and for post audit and error tracking on work orders.

An audit process was created to report discrepancies between the PBX and MySoft for 911 purposes. Additional follow-up work is needed to assure the data is consistent and correct.

An automated procedure was written to change building numbers throughout the system to eliminate manual data entry and reduce errors.

There were two upgrades to MySoft that were installed, tested, and implemented during the year. Release 6.08.18 included our network port modifications that we requested so we could more easily track the ports in the new network. Release 6.08.21 incorporated several fixes we had requested including prorating equipment charges, saving reports to history, an enhancement for serial number processing so once a device is installed, the serial number Web page will reflect where it is currently installed, and changes to better support secure http pages. These upgrades added new functionality in a number of areas.

We wrote custom Web applications within MySoft to add multiple Userinfo records (database elements that we, as licensees of the MySoft product, can manipulate as needed without concerns for how the fields might be used by the product itself in future releases). This allows us to add as many Userinfo records with the same G/L (General Ledger, or CUFS account)
number as is needed. This is used for projects and was designed to support the network upgrade so that private LANs could be handled more quickly, eliminating much manual data entry.

**ServiceCenter Ticketing System**

Seven database instances were upgraded in April. An application upgrade to version 5.1 was completed in May. This was applied to two database instances and at this writing we are working on a third. Get-Answers, the knowledgebase component of ServiceCenter, was implemented and the FSS (Financial Systems Support) data was migrated from Knowlix to Get-Answers. This was ready for production in June. Demos and training were provided to several functional units.

The Reporting instance was set up to have static data for 30 days for reporting purposes. A ServiceCenter Change Management process was developed and implemented. In addition, a process for opening NTS trouble tickets through the Web and SCAuto, a mechanism for generating trouble tickets automatically, was developed to automate this. Monthly ServiceCenter reports for FSS, Central OHR, and Employee Benefits are being run. A survey process for ServiceCenter tickets and contacts was developed.

Administration and production support is being provided for the ServiceCenter application. This is provided to over 600 end users. The IS group provides on-call support as well as maintenance and development support for the application.

Projects were begun to develop archive, retention, and purge policies and procedures as well as to address ServiceCenter disaster recovery with functional users. Table 9 and Table 10 outline ServiceCenter statistics for the calendar year 2005.

**Table 9: Trouble Tickets Processed Through Service Center by Functional Area for Calendar 2005**

<table>
<thead>
<tr>
<th>Area</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Application Support (EAS)</td>
<td>641</td>
<td>0.4%</td>
</tr>
<tr>
<td>Employee Benefits</td>
<td>28,184</td>
<td>17.5%</td>
</tr>
<tr>
<td>Central Computer Operations (CCO)</td>
<td>4,050</td>
<td>2.5%</td>
</tr>
<tr>
<td>EAS-System Support</td>
<td>791</td>
<td>0.5%</td>
</tr>
<tr>
<td>Enterprise</td>
<td>6,288</td>
<td>3.9%</td>
</tr>
<tr>
<td>Financial Systems Support</td>
<td>24,186</td>
<td>15.0%</td>
</tr>
<tr>
<td>Central Human Resources</td>
<td>31,401</td>
<td>19.5%</td>
</tr>
<tr>
<td>Micro/Internet Helpline (1-HELP, Tier1)</td>
<td>44,818</td>
<td>27.8%</td>
</tr>
<tr>
<td>Networking and Telecommunications Services</td>
<td>17,554</td>
<td>10.9%</td>
</tr>
<tr>
<td>OIT Security &amp; Assurance</td>
<td>3,417</td>
<td>2.1%</td>
</tr>
<tr>
<td>Web</td>
<td>68</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>161,398</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 10: Estimated Work Effort Distribution for Information Services

<table>
<thead>
<tr>
<th>Type of Work</th>
<th>Hours per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production support (includes admin, reports, on-call)</td>
<td>80</td>
</tr>
<tr>
<td>Projects</td>
<td>80</td>
</tr>
<tr>
<td>Maintenance and new development</td>
<td>60</td>
</tr>
<tr>
<td>Implementations</td>
<td>80</td>
</tr>
<tr>
<td>Upgrades</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>380</strong></td>
</tr>
</tbody>
</table>

Inventory

As with many other areas within NTS, the network upgrade project in 2005 impacted inventory operations to a large extent. The NTS Inventory group categorizes and tracks 1,892 unique parts which add up to 38,637 total parts. Through 2005, the network upgrade project alone processed 2,231 individual parts or almost 6% of the total parts that NTS holds within inventory. This impacted University inventory services significantly, doubling the equipment tracked by this group. Each individual capital part is tracked by serial number through the NTS telemanagement system for location through the NTS work order and inventory processes.

The distribution of NTS inventory can be split roughly among four areas—PBX, data, fiber cable, and other (phones, relay racks, etc.), which are broken down as follows:

- PBX : $343,475
- Data: $1,679,182
- Fiber cable (mostly jumpers): $84,892
- Other: $821,445

Figure 4 illustrates these numbers by percentage.

Figure 4: Distribution of NTS Inventory 2005

Usage rates for inventory vary depending on the item. As an example, NTS Inventory distributes up to 100 analog stations every month.
Turnover rates for NTS inventory are difficult to establish. Major projects, sometimes taking years to complete, have an impact on reporting. For commonly used goods and services, the turnover appears to be monthly. Holdovers such as the fiber jumpers in the graph above can be associated with larger projects such as the network upgrade. Reporting is being put into place to measure this as one of the NTS inventory goals for 2006.

**Facilities**

Maintaining the communication facilities for an organization as large and complex as the University of Minnesota can be a daunting undertaking. NTS maintains not only the equipment that runs the campus voice and data networks, but also works to ensure that there is adequate facility support and oversight so these networks function properly. In 2005, NTS made several changes to improve its ability to manage and support the campus.

A 200kw transportable generator was purchased in order to adequately support one of NTS’s largest core voice and data network sites. NTS already supports the ability to dispatch three additional 90kw mobile generators should the need arise, as not all of 23 current sites have backup available through a dedicated generator. We now have four portable generator systems.

We also began to review and prepare for upgrading general NTS facilities at all core sites. The current facilities infrastructure at all of the initial installation sites was installed approximately 17 years ago. This equipment (UPS, battery, fire protection, and air conditioning) has since seen its lifespan move to become a candidate for replacement and upgrade. Initial investigation to gather budgetary information and next steps was started in 2005.

NTS maintains the Information Technology Building on campus in a non-support model through facilities management. This means that the upkeep and changes to this building and the Telecommunication building on campus are sole responsibility of the NTS organization and its budget. As a part of this responsibility, NTS implemented landscaping improvements in 2005 along with building maintenance upgrades (tuck pointing, repainting, etc.) to ensure that these facilities continue to support the campus into the future.

NTS started to work with small Universal Power Supply (UPS) installations to gain experience for possible deployment in a system-wide infrastructure. Note that NTS’s top service-affecting issue is power-induced outages.

With the network upgrade, many locations were added with NTS electronics. With this, inheritance of environments requiring additional facilities work needed to be addressed, especially in added cooling capacity and power augmentation.

Several code changes for fire protection required NTS to change facilities to comply with these new requirements. New issues were identified in 2005 and changes to NTS infrastructure locations in turn have been made to facilitate compliance.

To maintain a neutral appearance to our surrounding neighborhood and welcoming appearance of all visitors to our administration building, we have repainted the building
exterior to a lighter color and done considerable work to the landscaping surrounding the building.

With the introduction of small packaging high density electronics installed inside our communications rooms, cooling of these spaces has become a challenge. We have added dedicated cooling systems to spaces where temperatures could be the cause of service interruptions. Additionally we continue to perform preventive maintenance and replace aging system components as found.

In response to fire protection and building insurance audits at our various sites on campus we continue to develop and deploy compliancy or corrective action plans to address all concerns presented by the University’s Department of Audits.

Disaster Recovery & Business Continuity Preparedness

As part of the campus infrastructure, NTS is actively involved in refining its business continuity plans. With the work involved with the network upgrade, much of the normal testing and exercising of this plan fell to the wayside. With the reorganization that NTS implemented in the end of 2005, this important function was given to two individuals in NTS to update and enhance. Specifically, as it relates to this function, these individuals have been given the following tasks:

- Updating all NTS materials surrounding business continuity planning (BCP), including verification of call-out trees, as well as updating vendor and internal staff contact names and numbers.
- Putting into practice periodical testing of the call out trees
- Exercising NTS management staff as it relates to BCP by holding mock table top exercises simulating disaster circumstances on campus and NTS ability to adequately react to these disaster scenarios
- Ensuring that each emergency operations center (EOC) on campus is stocked correctly so that in event of an emergency, NTS will be able to efficiently drive decisions to address any issue which may arise in a disaster situation

With national security a high priority, we continue to review, update, and change our business continuation documentation. Training of our staff on procedures and process are completed by performing scenario exercises. We continue to review our tools and technologies to enhance our preparedness. Each exercise provides valuable feedback for necessary changes to our processes and procedures. We have found having one command center on campus is not the best choice. We have recently located another site for operating an alternate command center. This second site provides the necessary redundancy into our overall business continuation plan.

Safety

The Safety group is charged with assuring a safe workplace for NTS employees as well as a safe environment for others who use facilities maintained and operated by NTS. The Safety group develops standard operating policies and procedures governing the various activities performed by the department. This group develops and delivers safety training programs to
inform NTS staff of the policies and procedures and then monitors practices and records safety issues that arise.

In 2005 there were four incidents that were significant enough to be recorded and no lost work time.

**Operations**

The NTS Operations group takes care of the daily and after-hours maintenance and support of the voice and data network equipment for the University. When things go "bump in the night," Operations responds to fix the problems. They perform daily and weekly preventative maintenance on equipment that many across campus do not even know exists. Both the voice and data networks have various redundancies built into the equipment and design that needs to be checked and tested on a periodic basis and the operations group is assigned this task. In addition, Operations handles calls escalated by the Technical Assistance Center, functioning as a type of third tier support for issues. Often Operations is also called into play with handling large technology implementations as they are transitioned from initial implementation and design into fully supported operations.

**Network Reporting and Monitoring Changes**

As part of the network upgrade we implemented Entuity's EYE product for network monitoring. We focused on three key areas in 2005.

*Improved Inventory Accounting*

We now account for all of the online network devices. We removed more than 90% of the old network switches. As an example, our Cisco 1900 etherswitch counts went from 936 to 20. Also we removed 75% of our old Cat5 router base. Daily changes were monitored by EYE.

*Proactive Edge Device Management*

As we implemented the new network we saw dramatic increases in packet corruption from the switch ports to the edge devices. The visibility we get through our monitoring system has helped us identify the problem devices before customers call, allowing us to address problems proactively and reduce the number of problem devices by 85%.

*Network Reporting*

We implemented standard reports to monitor issues and better manage bandwidth use outside of the University. In addition, in collaboration with OIT’s Java and Web Services (JaWS), we developed a Web portal where we will be making information available on the status of the network and network usage in key areas (Internet, Internet2, and coordinate campus links). These dashboard reports are available and sourced from data that is gathered from EYE.

In addition we performed a major code upgrade on our monitoring system along with a modified hardware configuration.

*Firewall Development*

We implemented a number of pilot firewalls for customers using the Cisco Firewall Services Module (FWSM) blades we purchased as part of the network upgrade. During this time we
needed to do two major code upgrades on the blades themselves. There are a few hundred customers in the Academic Health Centers using these devices. We also implemented four stand alone firewalls to support specific customer requirements using the Cisco PIX systems. These will be transferred to the FWSMs in 2006.

**Router and Switch Upgrades**
To stay current with released Cisco code, correct bugs that were uncovered, and implement new service functionality, we processed three major version upgrades for the 6509 router platforms and two upgrades for the 3750 etherswitches.

**Major Implementations**
- New data center design to support higher resiliency
- Soudan mine facility installation
- Credit card Visa implementation—(There are now over 50 Virtual Local Area Networks (VLANs) supporting the new server and desktop security policies for credit card processing.)

**Wireless Implementation**
In 2005 we augmented the wireless services significantly, adding capacity and improving services. We finished deployment of about 500 access points (APs) located in our NTS closets. The intent is to provide at least a footprint of service in nearly all campus buildings. At the end of 2005 we were running more than 1000 concurrent users at peak during a typical day.

**Internet and Internet2**
During the year we implemented the Minneapolis to Chicago fiber circuit and a second link to Internet2 via the Metropolitan Research and Education Network (MREN) in Chicago. Our Internet2 bandwidth was about 130 Mb across the two circuits. Our regular Internet bandwidth is in excess of 800 Mb. (Please note that this combines the University of Minnesota and state of Minnesota.) For regular Internet we reduced the Mb cost for our circuits by about 15%, leveraging the Quilt contracts (a consortium of colleges working together to aggregate Internet bandwidth) and increased our overall usage by about 16%.

**Internet2 Participants.**
We added a number of private college members: College of St. Catherine, St. Olaf College, University of St. Thomas, Macalester College, Carlton College, and the Mayo Clinic.

**Financial Overview**
The University measures and reports activities based on a fiscal year running from July through June. As such, the information provided here will be based on the fiscal year 2005, which runs from July 2004 through June 2005. Figure 5 shows the larger NTS expenditures during this timeframe.
nts budgets are based on a roughly $25.6 million annual expenditure. Table 11 outlines major expenditures for 2005.

Table 11: Major Expenditures

<table>
<thead>
<tr>
<th>Expenditure Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>26%</td>
</tr>
<tr>
<td>Capital Expenditures (equipment and network infrastructure)</td>
<td>21%</td>
</tr>
<tr>
<td>PBX system payments (Final loan payment June 30, 2008)</td>
<td>10%</td>
</tr>
<tr>
<td>External Telecommunication Vendor costs</td>
<td>9%</td>
</tr>
<tr>
<td>Repairs and Maintenance / Support costs</td>
<td>5.50%</td>
</tr>
<tr>
<td>Other Services, including contract labor</td>
<td>5%</td>
</tr>
<tr>
<td>Network Upgrade payments – (Final loan payment June 30, 2010)</td>
<td>3.20%</td>
</tr>
<tr>
<td>General Operating supplies and equipment</td>
<td>3%</td>
</tr>
<tr>
<td>2218 Building (InfoTech Building) – Final loan payment Dec 31, 2018</td>
<td></td>
</tr>
</tbody>
</table>

The above expenditures account for roughly 83% of all NTS expenses.

As shown by a study done by Gartner, these figures show that NTS is staffing prudently for the overall budget when compared to other IT organizations. See http://www.gartner.com/4_decision_tools/measurement/measure_it_articles/july01/mit_spending_history1.html for an article discussing IT spending distribution as recent as 2003. Of note is that predictions based on this article suggest a 40% allocation of budget to salaries for IS budget allocations.

Income for the NTS budget is a combination of central funding for the data network and charge back (ISO) for voice services. A change to the funding model was made during this fiscal year. The costs for maintaining the network are now paid for from central funds. Departments remain responsible for the costs to add services. One of the larger challenges will be to adequately fund the growth of the data network. During the network upgrade
project in 2005, many private networks on campus took advantage of an offer by OIT to upgrade their private networks to networks supported centrally by NTS. While this provides many advantages for security and consistency in services, it presents challenges in how to keep the funding for the data network commensurate with growth. For reference, the growth of the data network was charted from year 2002 through recent past. The reader will note the growth during the 2005 calendar year largely attributed to departments on campus switching from privately managed LAN connections to those centrally supported (see Figure 6). This change was aided by the offer of a free conversion if the private LAN were to convert prior to the upgrade. Many departments chose to take advantage of this offer, and by September 2005 NTS was administering 52,497 centrally managed connections.

Figure 6: Total Data Connections

The NTS income distribution appears over several different categories of services which NTS provides. Some of these are optional, depending on the needs of the end user. Additionally, there is an injection of central funding to the NTS budget to support the data network. This funding in 2005 was approximately $10 million or roughly 42% of the NTS overall budget. With new budget allocation work taking place, central funding will need to change, with the growth of electronics for the data network. In the future and in order to alleviate the possibility of subsidy of data electronics and services by voice services, it is planned to move the voice services to a centrally funded model sometime in year 2007. Figure 7 illustrates NTS’s income distribution. Not shown in the figure are material and telephone set costs from installation sales. These represent another 1.5% of the NTS budget.
Figure 7: Income Distribution

Table 12 demonstrates income based on a count of each classification of service which NTS supports.

**Table 12: Income Distribution by Service Type**

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Distance (annual, minutes)</td>
<td>6,576,261</td>
</tr>
<tr>
<td>Digital Telephones</td>
<td>8,199</td>
</tr>
<tr>
<td>Analog Telephones</td>
<td>21,650</td>
</tr>
<tr>
<td>Qwest Telephones</td>
<td>795</td>
</tr>
<tr>
<td>800 minutes (monthly)</td>
<td>45,150</td>
</tr>
<tr>
<td>Voicemail boxes</td>
<td>18,500</td>
</tr>
<tr>
<td>Residence Hall voicemail</td>
<td>425</td>
</tr>
<tr>
<td>ACD (Automatic Call Distribution)</td>
<td>811</td>
</tr>
<tr>
<td>Auto-Attendant (minutes)</td>
<td>35,110</td>
</tr>
</tbody>
</table>
Appendix I: NTS Goals to Help the University Achieve Top Three Standing

The following information comprises NTS’s goals moving forward into the near-term future. While some of these goals are actually projects which have taken shape in terms of allocation of resources within NTS, others are goals that still must gel and are in need of organization to determine just what the goal means in terms of focus and to adopt these directions and the moving from experimental stages to active projects and a service portfolio. Please keep these thoughts in mind when reading this section below. It is for these reasons that some goals and objectives are not described in terms of exact timelines and detailed information.

NTS is in the process of defining goals that will help to enable President Bruininks’ objective of bringing the University of Minnesota into a top three ranking. As a land-grant University, the three areas addressed are instruction, research, and outreach. To that end, NTS has identified the following goals to help to enable the broader goals of the institution. These are not complete, but give a good idea of the directions we see the department moving.

**Install Framework for Quality of Services (QoS)**

*What?* Implement a type of classification of data network traffic so that some types of services can be treated with higher priority and better characteristics than others. This may mainly apply to voice and video, but there may be other types of high-priority traffic.

*Why is this strategic?* If we have this framework and work towards a skeletal way to handle this question now, we will be prepared when traffic levels on our network require QoS in order to function correctly and where QoS will help applications. This also has implications for traffic as it travels over our wide area network (WAN) connections. This framework sets up NTS and the University to improve delivery of network sensitive information to its customers.

*What does this entail?* This will require design and operational work on the network along with administrative and customer communication to let others know of what types of treatment can be applied to network traffic. No doubt this will require help and backing of upper OIT senior management in cases where policy is needed in order to get out of the role of subjective application of this technology. This effort will require the help of design, operations, and communications.

**Improve Overseas Communications with Commercial-grade VoIP**

*What?* Voice over IP will eventually replace the large PBX for most telephony needs. This is a major paradigm shift as a service provider but largely a small shift for users. In the shorter term, VoIP provides a cheaper alternative to using long-distance telephone service, especially for overseas calling. It can provide the added advantage of visual communications.

*Why is this strategic?* As the large PBX ages and needs replacement, and as the Internet continues to grow, VoIP will likely become a much cheaper alternative to replace the PBX services. With a commercial-grade service, we will be able to keep pace with developing technologies that provide added benefits to our customers such as on demand video conferencing, white board communications, and other features.
**What does this entail?** This will require a design that can accommodate a large user base and the ability to add new services as they become available. Because it allows unlimited user mobility, 911 becomes a major issue with VoIP service.

**IPTV Supported from Network (QoS) and also Main Central Hardware Support**

*What?* This offering will provide high-quality, high-definition, cable-style television across the network.

*Why is this strategic?* The need to communicate within the organization as well as with other organizations will become increasingly important. This is not a replacement for the video network, which provides a different suite of services. IPTV will provide us with a mechanism to provide a variety of channels of television-type services to the desktop.

*What does this entail?* In order to provide a high-quality service, QoS is needed. In addition, it will be necessary to provide a service that can gather the appropriate signals and repackage them for distribution. Signals will originate from a variety of sources and then be distributed through a University resource. It will be necessary to engineer the hardware that runs this service to accommodate a large audience requiring a large base of programming.

**Support Video Conferencing over the Network—Scaling from Network Support or Application Costs**

*What?* This is a mechanism whereby groups or individuals on campus can communicate in a video conference with one or more groups on campus and elsewhere.

*Why is this strategic?* It will allow for better ways for researchers, instructors, user groups, and others to collaborate directly and at a much lower cost. Online meetings can be held in a timely fashion with no costs for transportation and housing.

*What does this entail?* This will require infrastructure to support the specific hardware used, communications hardware and software to provide the transport, and appropriate space to accommodate groups for participation. In order to make this application as self-service as possible, appropriate online documentation is crucial.

**Conference Services and Collaboration Sharing**

*What?* NTS needs to provide services to allow for effective conferences. Where this entails a meeting with network needs, NTS must be able to provide those services efficiently and at a high level of connectivity. Where it entails a digital conference, the quality of service for the conference must be at a level such that the conference has the feel of an in-person meeting. The tools must be robust, allowing for multimedia sharing. Some of these tools and services exist at the UofMN today but others are needed.

*Why is this strategic?* By providing high-quality conferencing services, work can be done at disparate locations more quickly than it could if the individuals were to travel to a distant location. Not only can this deliver a quality experience but it saves the additional travel and lodging expense.
What does this entail? This requires locating and deploying appropriate software. It involves configuring the network connections to provide a high-level quality of service. Customers need to be educated in the use of the tools. For some services it may be necessary for a network professional to be on hand or available to assure that all functions well.

Timely Prototyping
What? In order to bring the needed services to the University community NTS must work continuously to find new solutions to old and new problems.

Why is this strategic? By working on new and innovative products and services we can help to provide needed services and keep the UofMN at the forefront providing the support for a higher quality experience for students, researchers, and instructors and to support the outreach mission.

What does this entail? We need to encourage all staff to think about what kinds of products and services we can offer to the community. We also need to listen to customers when they express wants, needs, and frustrations. We then need to invest some time into researching potential solutions, developing and testing new products, and introducing them to the community. We need to recognize that not all ideas will result in new products and not see that as failure.

How do we get closer to Classroom video support, VNS, Unite, Classroom Management?

What? NTS needs to develop and build relationships with other organizations that can provide the needed services to the University community.

Why is this strategic? By working together we pool resources and deliver better products in a more timely and cost-effective fashion, benefiting the entire institution. This will allow us the resources needed to bring even more products to the community.

What does this entail? NTS needs to work with the other organizations to determine areas where we can support each other in delivering on the goals of the institution.

Tools that we can provide and support for instructional and research use? NTS will be talking with instructors and researchers to learn more about their needs.

Improve Network Security
What? The world of the network is becoming increasingly more hostile with viruses, system crackers, spyware robots, and other nefarious devices and individuals attempting to obtain information. Better tools are needed to prevent them from obtaining the “keys to the kingdom.”

Why is this strategic? Without protection secrets can be stolen, network and computer system performance suffers, and the most valuable resource of all—time—is wasted trying to recover.
What does this entail? Accomplishing this goal will require safeguards to help prevent attacks, vigilance on the part of operations staff, and the cooperation of our customers. The tools used to increase the safety must be augmented regularly to ensure that they are able to defend against new and more virulent attacks.

Improve Network Reliability
What? Some of the network outages are caused by errors that might not have happened had we been more vigilant. This may be due to incorrect installation of hardware, incorrect or missing data, mistakenly removing a connection, or a number of other problems. NTS needs to work constantly to keep these sorts of errors to a minimum, striving for 100% accuracy. In so doing, those problems that are under our control will not come back as big problems later.

Why is this strategic? If we reach 100% data accuracy and 100% error-free installations, we will minimize outages and allow our customers to use a reliable network. This, in turn, brings higher quality instruction, research, and communication, which then helps bring the institution closer to the top three ranking.

What does this entail? This requires a high degree of attention to ensure that all work performed by NTS is done in such a manner as to minimize the number and severity of installation errors and that all staff take a high level of ownership in the data for which they are responsible and keep that data accurate.

Provide an Upgraded Wireless Network.
What? The current wireless network works reasonably well and with decent security. The University needs a ubiquitous, more robust, highly secure, high-speed wireless network in order to provide better service throughout the campus.

Why is this strategic? In order to provide wireless network services to the entire University community and offer the kinds of services that instructors and researchers require, an upgrade of the current system is needed. The new wireless will allow for most services in a secure mode at almost any location on campus. This will allow greater mobility, and instructors will be able to count on services being available in one form or another in all classrooms.

What does this entail? This involves putting a replacement for the current WireWall service in place, including new wireless access points, probably using the new 802.1x wireless specification, with highly secure wireless connections and secure wired connections from the access point to central services.

Measurement of our ability to improve
What? NTS needs to look constantly at how we are delivering service to our customers. We can measure our performance in a variety of ways. How long (on average) does it take to install a telephone or network jack? How long does it take to repair a broken connection? How accurate is our network and telephone database? How do we measure up to other standards?

Why is this strategic? By looking at how well we are doing in comparison to standards developed elsewhere and by checking to see that we are continuously improving the delivery
of services and correcting problems that we find in the process, we will deliver a better, more robust, less expensive product to our customers.

What does this entail? The standards we use to measure our progress need to be meaningful and able to identify problems. There need to be multiple ways of examining how we are doing and we need to check our progress on a regular basis. NTS will be developing metrics that will help us to understand how we are doing and identify areas where we need to pay more attention.

Introduce Tools to Allow Customers to Manage Their Business Better

What? NTS already has a number of tools that are either already available to support people or which will soon be introduced to them. The goal is to make as many of these tools available to knowledgeable IT support staff as possible. We need to search for or invent other tools to resolve new problems and get these to the support people as well.

Why is this strategic? It puts the tools into the hands of the people who are closest to the action, allowing them to make changes as appropriate to their area. When a problem occurs, the IT professional can take measures to correct the problem in a timely fashion without always having to contact central support.

What does this entail? We need to find the best tools to resolve the most problems and educate our partner IT professionals to use these tools appropriately. This involves a partnership in which NTS has the ultimate responsibility for keeping the network running efficiently while relying on our partners to handle a large portion of the day-to-day work.

Research support

NTS will be speaking with researchers in various areas to learn how we can support their mission.

Outreach support

NTS will be speaking with Extension Service representatives to learn how we can better support the outreach mission.
Appendix II: Managers’ Goals

In April, 2006, NTS managers looked at the question, “What can my group do to help bring the president’s vision of bringing the University of Minnesota to the level of one of the top three research institutions in the world?” While the information below is a first snapshot of the responses from each of the functional groups within NTS, further refinement is taking place to formulate this information in terms of measurable projects, resource allocation and timelines. What follows are the responses from the individual managers.

Facilities / Disaster Recovery: In facilities, we can work to modernize each core site (they are old) and add secondary space and environmental controls. In disaster recovery, we should update and maintain documents and test procedures. Expand documentation for pandemic risks.

Information Systems: We need to come up with a change control process automated to push system changes to all of the places they need to be. Disaster recovery is underway with service center. With changes to MySoft duties, it is a mission critical system. We need to look at this and determine what is needed to assure it is available. Server equipment upgrades are needed. Automate testing so it doesn't grab so many people cycles. A function is needed to check system tuning prior to when new products go into production so we catch problems before they go into production.

Design: We need to look at stability and diversity through the mid-life of the network. We also need to implement quality of service, work on wireless initiatives, and push VoIP. Video infrastructure appears to be strategic. We need to think about how to deal with next generation 911 centers. We need to rebuild our card access audit capabilities. We should look again at border connections and how to support them better. Data centers are more strategic than feature-based services like wireless. We need to investigate incubator support and how to get ahead of game for providing services for this. Finally, we need to prepare for IPv6 support.

Quality Assurance: The more accurate information we have, the faster we can provide help to our customers. The more information we have about our customers, the better. Eventually our customers will evaluate NTS by how fast and reliable we can provide services to our customers.

Repair: We should step up the pace of Communications Restoration Project and concentrate on research-oriented buildings. We can also work with zone to begin upgrading closets where issues such as hydra cables are the only problem.

Finance: We are participating in University Enterprise Financial Systems. We are also gaining efficiencies in OIT finance overall. We will work at improving quality of the data. We will assist with financial reporting of projects, both billable and non-billable.

Operations: We will work to review traffic that is bound for outside the University but which can actually stay inside the University’s network. This will help reduce unnecessary bandwidth use to the Internet. We can make connections to those private LANs that still exist. We should determine if there is a link to research information that can make NTS more
helpful to researchers. Finally, we can do a better job of troubleshooting private LANs and create more resources for them.

Customer Service (includes Training, Technical Assistance, Project Coordinators, and Work Orders): We should support research, distance-learning, and customers wherever they are. We can also strive to improve database accuracy, which will help make us faster and more reliable. Finally, we can become more adaptable at delivering technologies when they’re ready to be deployed and continue to provide robust design.

Training: We need to provide services to help customers handle their own needs. Training works with all NTS personnel to aid in understanding of database and processes, helping to provide better services in more efficient and effective ways and to help identify problems. Training can also provide help with improving the skill set of all NTS employees.

Technical Assistance Center: The Technical Assistance Center is working on processes in order to respond more quickly. LiveHelp will move to the NTS home page to make it more visible and accessible.

Web Design: The Web Design group will look at dealing with alternative browsers on different types of devices. Accessibility, especially for people with special needs, needs to be kept in mind in developing Web pages. We are looking for ways to create more interactivity in Web pages. All will assist with the goals.

Inventory: Inventory supports Infrastructure, Design, and Operations. Sandy is going to CRP meetings to keep informed of what’s going on and what’s needed. They would like to get involved with the Infrastructure group in the same way so as to support them better.