Networking Needs Subcommittee
of the
Campus-wide Information Systems Committee

Draft Report
to the
Information Systems/Technology Task Force

June 27, 1995
Summary

A major goal of the strategic planning process that UAB is currently undertaking is to increase the efficiency by which information on campus is collected, processed, and disseminated. Such improvements to campus information systems should not only increase the quality and utility of the information itself, but should also result in a commensurate reduction in costs by, for example, eliminating duplicate systems that are wasteful of resources. These improvements to the handling of information on campus are dependent on a reliable networking infrastructure through which this information moves. This infrastructure consists of wires, computers, and other related hardware, along with software to run these systems. In addition, we must not overlook the people required to install, maintain, troubleshoot, and train others in the use of this infrastructure. The Campus-wide Information Systems Subcommittee on Networking Needs has begun an evaluation of this networking infrastructure to ensure that the goals envisioned for the role of information systems in everyday campus activities can be supported by these components.

To serve the needs of strategic planning and the Information Systems/Technology Task Force, we have evaluated the following aspects of networking infrastructure:

- Central Information Services and User Support
  - Provision of Technical Support
  - Role of Department Information Managers
  - Client-Server Computing
  - Network Information Services
  - Internet Services

- Network Infrastructure
  - Hardware
  - Communication Protocols
  - Internet Access
  - Wireless Networking
  - Fail-safe Standards

- Remote Access from Off-Campus

- Financing of the Network Infrastructure
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Introduction and Acknowledgments

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Charge and Methodology

Campus-wide Information Services Committee

1) To formulate and recommend to the UAB Executive Council a multi-year development plan for the delivery of video and information services to and from the campus.

2) To formulate and recommend to the Executive Council proposals for the financing and implementation of this plan.

Networking Needs Subcommittee

To provide an overall review of campus-wide networking support through solicitations of information from the schools and other relevant areas about current and future needs, recommending and sequencing enhancements to this support, and developing recommendations concerning networking policies and procedures that will be needed. Current issues to be addressed by the Subcommittee include:
Are there network limitations preventing UAB from providing services?

How will future requirements impact the network?

What central networking services and support should be provided?

Should the Data Communications/Networking Support area be involved as departments plan new networking applications?

What are the implications of migrating the network surcharge from the telephone lines to a networking related base?

\[\textbf{Preface}\]

\textit{Information Systems at UAB}

UAB’s mission is to “… add value to Alabama and benefit humankind through excellent, effective, and efficient education, research, and service programs.” All aspects of performing this mission require the collection, interpretation, and dissemination of information. The Campus-wide Information Systems Committee has taken the charge to analyze all aspects of information systems on campus, and determine ways in which these goals can be accomplished in as efficient and cost effective a manner as possible. The Networking Needs Subcommittee specifically addresses the campus network infrastructure that forms the backbone through which all of this information travels.

The importance of information systems on campus is emphasized by examining some of the expenditures that can be identified as relating directly to these needs. For fiscal year 1994-1995, using equipment accounting records, we can identify $8.7 million of expenditures for computers and computer-related equipment. This figure does not include fees to computer consultants and/or companies providing computer services to UAB. This figure also does not include the cost of hiring permanent staff to support information services on campus for individual departments, nor does it represent other costs involved in installing, maintaining, and servicing this equipment. Among the six units at UAB which are clearly definable pieces of our technical infrastructure (The University Computer Center, University Communication Services, University Data Communications Support/Network Services, Health Information Systems, Medical Television, Dental Television, Lister Hill Library, and Sterne Library, more than $30.7 million is budgeted in fiscal year 1994-1995. Therefore total costs of information systems on campus consume more than $40 million per year.

\textit{Role of the CISC Networking Needs Subcommittee}

For the purposes of its deliberations, the CISC Networking Subcommittee has taken a rather broad definition of the campus network. Other CISC Subcommittees deal mainly with the information that should be available on campus and the means in which that information is accessed. The Networking Subcommittee has taken as its responsibility everything related to how this information moves, both on and off campus. This includes wiring, hardware, software, reliability, technical support, and financing. In effect, anything with regards to information systems that impacts the provision of a reliable network infrastructure with an
emphasis on increased efficiency and decreased costs for UAB operations, was considered appropriate to be scrutinized by this Subcommittee.

**Methodology**

For the purposes of this interim report, the CISC Networking Subcommittee was charged with evaluating the Points of Discussion document from the Information Systems/Technology (IS/T) Task Force as a part of the strategic planning process. This document, or “vision statement,” was the basis from which topics for evaluation by this Subcommittee were determined so that it could provide the necessary feedback to the IS/T Task force to allow its members to proceed with their work. The CISC Networking committee through a series of meetings, discussions with individuals, and evaluation of technical and other literature, utilized the following outline for its work:

- Identification of needs
- Analysis of the current environment
- Evaluation of existing technologies
- Evaluation of future technologies
- Cost estimates
- Formation of standards
- Recommendations

Topics covered in this report include:

- Central Services and User Support
- The Basic Campus Network Infrastructure
- Remote Access to Information Systems from Off-Campus
- Financing of the Campus Network Infrastructure

**Implementation**

While evaluation, approval, and finally implementation of the recommendations contained within this report may be a number of months off, it is useful to consider some of the factors involved in making changes to UAB’s information systems in order to ensure that any proposed changes accomplish their intended goals without disrupting something that is already operating efficiently. As currently implemented, information systems at UAB are organized in a generally decentralized manner, with end-users needs determining the structure in which any particular information system is designed. Any centralized organization such as University Data Communications Support/Network Services (DC/NS) exists to facilitate these needs and not as an end in and of itself. In an academic research environment, such decentralization encourages the freedom of intellectual development that
is so important; any change, procedure, suggestion, policy, or standard arising from the current process must not interfere with this freedom. Many of the recommendations outlined below seem to be advocating greater centralization and control at the expense of individual or department-level control. Where this is true, it is done when deemed absolutely necessary to be able to supply an efficient and cost-effective infrastructure for the exchange of information. In many cases we have suggested areas that will need further consideration before necessary policies are determined and implemented. Involvement of end-users, especially information system managers in these discussions is critical to this process. Finally, it will be important to inform Department Chairs, Information System Managers, and End-users of the rational behind these important changes, and provide them with incentives for implementing these changes. Demonstrating how proposed changes will increase ease-of-use, efficiency, and support; along with decreasing frustration and total costs, will be as important as the changes themselves. Without the understanding and cooperation of the people who actually use the information systems on campus, any attempt to enhance their utility will be futile.

**Future Plans**

As has been emphasized in its charge, the Campus-wide Information Systems Committee and its Subcommittee are only in the initial stages of evaluation of information systems on campus. The process is envisioned as an ongoing one, in which current needs and the technologies required to satisfy those needs are being continually evaluated. The campus network will never be “finished”. As newer technology becomes available, its usefulness to campus systems, and its cost to benefit ratio need to be determined. As new ways of dealing with information become available, new policies and standards need to be established. For the future, the CISC Networking committee will need to be positioned with the membership, technical assistance, and user acceptance in order to continue this important process.

**Recommendations**

The current membership of the Networking Subcommittee is reasonably representative of Academic Affairs, Health Affairs, and Central Administration. This diversity should be continued with any future membership changes.

Currently, there is no representative from Health Information Systems (HIS) on this Subcommittee. Many, if not most of the topics considered in this initial review must also be considerations of HIS systems both on its own, and in concert with campus operations. A member representing HIS should be appointed as soon as possible.

The role of DC/NS as support staff is an important one, and is critical in providing the Subcommittee with the background and technical information required for its work. Another source of technical information along with user experience is the Information Managers Group (TIMgroup). This group currently operates on an informal basis exchanging experiences, knowledge, and ideas. This group will be an important asset for UAB in the future both as the backbone support infrastructure for departments and end-users on campus, and as a source of valuable experience for future technology and policy planning. This group
needs to be formalized and be directly recognized by the administration as an important source of information system expertise on campus.

Findings and Recommendations

Central Information Services and Support

The concept of “service” must be clearly understood to mean much more than the installation and maintenance of wiring and switching equipment. A continuum of services are required to each user's desktop, including but not limited to:

- wiring and switching,
- computer purchase, installation, and connection,
- purchase and installation of operating systems and network software (Windows, Novell, UNIX, etc.),
- purchase and installation of desktop software (word processing, spreadsheet, database, presentation, etc.),
- associated hardware and related software purchases and installations (printers, modems, scanners, etc.),
- client software (library interfaces, E-mail, Administrative applications, World-Wide Web (WWW) Browsers, Usenet News Readers etc.) selection and installation,
- problem diagnosis, maintenance and repair,
- training in how to use this hardware,
- and training in how to use this software.

According to reports from the Gartner Group on the total cost of computing, the cost of the basic hardware infrastructure represents only 15% of the total costs. The other 85% of information system costs derive from providing technical support of these systems. Recent analysis indicates that perhaps the least understood and under-funded activity at UAB during the past has been the wide range of personnel required to support computing activities in all units at UAB. As part of the 1994 UAB Self-Study, faculty and staff surveys indicated less satisfaction with available technical support for computing than for the hardware or software computer resources available for administration, research, or teaching. The UAB Instructional Support and Computer Resources and Services Committee of the 1994 UAB Self-Study concluded that there is a real need in most schools for greater access to technical support of both hardware and software for desktop computing.

Different aspects of networking, central information services, and support at UAB are the responsibility of a combination of University Communication Services (UCS), The University Computing Center (TUCC), Health Information Systems (HIS), and Data Communications/Network Support (DC/NS). Right now, the ability of these entities to
provide the services outlined above are limited. To alleviate this problem, some of the larger departments on campus have hired their own computer staff, though they are still usually limited in their ability to cover all of these needs at each location. Many users have no support at all. This is an uneven and inefficient use of people. Now that the basic building wiring and routing equipment is in place, lack of support services can prevent us from benefiting from our investment. Our current organization and staffing patterns must be changed in order to improve support services.

Recommendations

The CISC Networking Subcommittee considers a tiered model of technical support staff appropriate for UAB. This tiered model of support would feature several levels of technical support distributed around campus in different units to meet the various software and hardware support needs of faculty, staff, and students. This tiered structure would consist of DC/NS-HIS supporting departmental information managers, who in turn directly support the end-user. As warranted, central support of widely-used information systems such as administrative applications would continue, allowing those directly responsible for creation and maintenance of these important systems to directly provide end-user assistance.

Most of the existing departmental technical support staff are members of TIMgroup. There are over 100 members including, in addition to departmental information managers, technical staff of DC/NS, HIS and the Libraries. Their background/training varies from junior college or technical school graduates to people with graduate level degrees in Computer Science; some support staff have no formal training in computing or computers, but have an interest in computers which has made them the “designated expert” for their departments. All are faced with the challenge of keeping current with rapid technology changes; disseminating information about UAB’s plans, policies and knowledge base; and providing department personnel with installation, maintenance, and assistance in the use of information system hardware and software. A tiered support structure will rely heavily on this level of support personnel. To ensure that this critical link is available for all UAB faculty, staff, and students, we suggest the following possible organizational alternatives for support staff in areas currently lacking the support of a department-specific staff:

1. Share staff with another department. The strength is you may be able to afford someone. The shortcomings are the difficulties of agreeing to whom the person reports, how to split up their time (which is more related to how they are funded than where the bulk of work might be), and how the departments find a “good match” for a joint hiring.

2. Hire a consultant when needed. The strength is the department pays only when help is needed. Serious drawbacks are that the consultant has very little contact with DC/NS and may not know that a particular solution has already been worked out, or may propose a system which is incompatible with UAB systems and does not adhere to UAB computing standards. Also, some consultants have a “hidden agenda” for selling certain types of equipment or software, whether that is best for you or not.
3. Create an in-house consulting group. The UAB model for this are our two computer repair shops. Aside from the obvious question of why we would have two such shops, they operate on an as-needed basis, and bill by the hour plus parts. A software equivalent could manage software site licenses and handle upgrades and installations. The problem is how to establish a service which has appeared “spontaneously” within a UAB division. Also, how would such a group coordinate its activities with DC/NS?

4. Expand DC/NS and support this expansion by establishing a fee-for-service operation. This proposal creates the in-house consulting group as an expansion of Network Support, but with departments paying for in department services when they need them.

Minimal Level of Competence

One additional means of ensuring that UAB personnel have adequate training to use the computer systems they are provided with is to define a minimal level of competence for both employees and students in the use of information systems; and to define higher levels of proficiency that would be dependent on particular needs. A training program would need to be established to provide the necessary education to assist employees and students in fulfilling these goals. This training program would probably be unit-specific allowing for appropriate methods, topics, and goals to be defined as necessary.

Network Services and Information Exchange

Current network services provided by DC/NS includes a wall jack connection to the UAB network for about $260. It is the end-user's responsibility to purchase the computer and the network card, as well as to install any software, including network software. DC/NS also provides an E-mail account and E-mail address if desired. DC/NS provides signal transport so that inter-campus and off-campus connectivity are possible; however, DC/NS is responsible only for assisting connections to the mainframe computing systems that provide a minimal level of services; other types of connections are permitted, but unsupported. DC/NS maintains a help desk through which network problems can be reported, though they do not have the staff to come to your desk and diagnose the problem. DC/NS provides dial-in modem support for faculty, staff and students so that they can access the Internet or our libraries from home. DC/NS also provides and maintains our links to the outside world mainly through our connection to the world-wide Internet.

The network wiring infrastructure on campus is basically in place, and we anticipate that it will provide the speed currently necessary for the majority of non-video communications in the short-term. As long as a program of continued maintenance and upgrading of equipment is continued, along with a programmed introduction of higher-speed communications as necessary, this basic infrastructure will continue to adequately service campus needs (see Network Infrastructure).

The number of E-mail accounts and volume of electronic messages on the campus network has overwhelmed the equipment currently in place. DC/NS has already ordered an equipment upgrade to accomplish the following:
- support E-mail accounts and WWW pages for students, faculty and staff,
- eliminate delays in current switching/routing equipment,
- handle 500,000 E-mail messages per day,
- permit creation of an on-line “white pages” for E-mail address look-up and FAX forwarding,
- have the physical space needed to support local on-line discussion groups for information exchange and problem solving,
- provide more dial-up lines for remote access.

The future direction for off-campus access will be addressed elsewhere in this report. It is anticipated that this equipment will be adequate for E-mail and WWW page service for the short and long term.

An attempt to count the number and variety of computers, local networks and computer professionals on campus reveals that a great deal of guestimating is involved. Our accounting system does not code paid consulting services in a way that computer support can be examined. We can summarize total software expenditures, but not what type of software or for which type of computer. UAB does not own the management software/hardware components needed to accurately count how many items are on the network and find out what they are. Our educated guestimates are:

- E-mail accounts - UABDPO (the campus computer system that handles E-mail accounts among other services) supports 6000 E-mail accounts. In addition, there are a large, unknown number of E-mail accounts residing in approximately 125 local department networks (that is, the user has an account on a machine in their department, but all messages going outside the department need UABDPO services for delivery).

- There are greater than 4000 computers/devices known to be connected to the campus backbone. These are devices that have been connected in the past several years by DC/NS personnel and adhere to campus network connection guidelines. Inclusion of unknown devices connected prior to the establishment of current network standards substantially increases this number. Approximately 25% of these devices are Macintosh systems (More than 1000 devices, 92 zones); approximately 25% are Novell related systems (140 servers, 1/3 belonging to HIS, with over 1000 devices filling our routing tables); approximately 12% are UNIX systems; and the remaining 38% or so are an unknown combination of Microsoft NT, Microsoft Windows for Workgroups, and many stand-alone machines.

- Hundreds of PC’s are not yet connected to the network, either because their technology is too old, or because the user does not yet perceive a need for network connectivity, or because the support issues make network connection too difficult or expensive for the end user. As a larger number of less-sophisticated users come on-line, the need for support will be even more important.

- These numbers do not include hundreds of portable/laptop computers in use on campus.
Client-Server Computing

Relational, client/server information systems require a big change of thinking about what we are doing at both ends of the wire. Steps should be taken now to try to communicate plans and intentions across departments, divisions, and end-users. In order to maximize UAB’s benefits from client/server technology, communication about and adherence to reasonable standards will be necessary - otherwise, a significant portion of users could be locked out of accessing data they need. Our committee was asked “Should the Data Combinations/Networking Support area be involved as departments plan new networking applications?” We say yes, DC/NS should be involved in at least an advisory capacity for all network application development, to be sure that expectations of what can be supported are accurate. For some network applications, such as those that transcend the interests of any one department and thus should be developed as an institutional resource, we recommend that DC/NS, in cooperation with the departments and end-users, play a larger role, in which they assist in the development and maintenance of the applications and not simply advise.

The current reality is that there are a variety of “standards” for database access being developed and clients chosen for use at UAB. These need to be in compliance with international standards and with campus standards. We anticipate rapid changes and improvements in this technology in the next 5 years, and recommend that a mechanism for involving a collaborative effort among database developers on campus be created, in cooperation with any administrative or department accounting efforts being developed centrally. The purpose of such a collaborative effort would be to keep current on standards, evaluate implementations, and assess how they apply to institutional data.

Information Services

UAB, through DC/NS will shortly be able to provide a number of different services to the individual that can enhance hers or his ability to communicate throughout the world, and provide access to the myriad of available information sources. UAB itself needs to take better advantage of the ability these information access tools have of advertising ourselves to the world. Central Administration should to be the leader in establishing a central UAB WWW home page. This central home page should be designed by a group consisting of appropriate faculty and staff members to provide suitable information content, along with graphic artists and public relations personnel to provide a visually interesting and stimulating package. The charge of this group should be to design a central home page which projects an appropriate image of UAB and to establish guidelines for all associated home pages to follow. Individual schools and departments would then be encouraged to develop their own home pages with assistance from knowledgeable staff that follow the established guidelines and serve to promote UAB to the world. How well UAB is portrayed on the Internet will have an impact on our future, and affect our ability to recruit new faculty, staff, and students.

Future considerations by the Networking or other Subcommittees, will need to develop guidelines for usage of a number of services that are being made available. These include:

- Individual WWW pages. In addition to departmental WWW pages, DC/NS will be able to offer individual home pages to faculty, students, and staff for research and teaching
purposes. Guidelines need to be developed to determine who can utilize this service; what, if any limits should be placed on information content; and what limits on the use of available resources need to be in place?

- Local Usenet News groups. Similar to WWW pages, DC/NS will shortly be able to support the establishment of local, Usenet newsgroups. These newsgroups can provide an extremely valuable asset servicing a wide variety of needs. They will allow discussion of computer-related problems; dissemination of course information; “classroom” discussions; and research-related discussions. Guidelines on the establishment and use of this resource need to be developed.

- A campus-wide E-mail system. As indicated above, E-mail on campus consists of a central system supported by DC/NS, along with a variety of departmental systems with varying degrees of compatibility. Consideration of ways in which compatibility between these systems can be enhanced, or development of a common, university-wide system, need to be addressed. The University should define an E-mail standard that provides for the transport of documents and facilitates work-flow activities. This standard may include choosing a “supported” product, but it may be more desirable to only choose the transport and data standards based on international standards like MIME and/or X.400/X.500. This decision will need to be made with broad participation from the University community and reviewed periodically.

These and other issues will be an ongoing aspect of providing these services in the future. DC/NS will need the input of UAB personnel to provide assistance in developing these policies. The CISC structure, with the help of TIMgroup, and as necessary other groups such as the UAB Faculty Senate, should be able to provide the assistance required for DC/NS to develop a reasonable set of policies and standards for use of these services.

**Network Infrastructure**

The UAB Networking Infrastructure provides basic network service to the desktop in all UAB buildings. Additionally, central services such as connection to the Internet, connectivity between all UAB users, limited technical support, and suggested standards are part of this networking infrastructure.

The basic networking scheme is based on:

- central services such as routers, name services, “post office” server,
- central connection to the Internet,
- central interconnection between UAB entities,
- fiber network backbone interconnecting campus buildings,
- building risers (fiber or coax),
- wiring closets with managed hubs (and/or bridges and/or switches),
- twisted pair (Category 5) wiring to offices with AT&T SystiMax connectors and 10BaseT cable,
• central computing equipment.

Today, the infrastructure allows up to 10 megabit per second (Mbps) capability to most desktops. This capability is shared amongst all systems interconnected to the same wiring closet if the wiring closet is based on hub technology. Technologies like bridges and switches exist to increase individual stations’ capabilities by reducing the sharing. These technologies need to be carefully deployed to achieve the desired benefit.

The basic infrastructure is sound and is similar to other institutions. Based on this similarity and existing industry trends, it appears that UAB is well positioned to increase the capability to the desktop as demand and technology warrant. In addition to sharing mechanisms (such as bridges and switches), ATM (Asynchronous Transfer Mode) switches allowing increased data rates to either the wiring closet or to the desktop. ATM technology appears to be developing as the next major innovation in networking with the possibility of combining voice, data, and video transport. While impressive, the technology is too immature to deploy today.

In attempting to improve networking beyond the deployed shared 10 Mbps Ethernet, several options exist: bridges, switching hubs, and 100 Mbps Ethernet. Before choosing, the network traffic characteristics should be known:

• Is the traffic workgroup oriented? If so, bridges which don't forward local traffic to the rest of the building would effectively provide additional capability to each workgroup by freeing them of the cross-traffic. Many situations involving heavy departmental server use fall in this category when the workstations and the server can be placed on the same side of a bridge. The cost of this approach is limited to purchasing the bridge and wiring changes to partition traffic. This expense should be considered an infrastructure expense in the same way that building hubs are handled since it benefits all building occupants not only a single workgroup. The University should be monitoring building traffic periodically and preparing to deploy bridges where appropriate in the short term.

• Is much of the traffic distinct point-to-point routes? If so, switching hubs can give each distinct route increased capability. This approach may offer improvement when there are client server systems involving high traffic between servers. This “fix” needs careful planning to be effective. The cost of this approach is limited to purchasing the switch and wiring changes to partition traffic. Generally, switch deployment is more expensive than a bridge deployment. This expense should also be considered an infrastructure expense since it benefits all building occupants as well, and not only a single workgroup. The University should be monitoring building traffic periodically and preparing to deploy switches where appropriate in the short term.

• Is the traffic Internet related? If so, the problem may be the University's 1.544 Mbps Internet route. This problem is solved by increasing the capacity of this route at the central site. It is recommended that the University immediately double the capacity of this route and plan on incrementally increasing it by 1.544 Mbps per year during the next five years provided usage patterns warrant this increase and the University's network supplier can effectively deliver this capacity (see below).
Is traffic unsolved by the previous approaches? The problem may be non-pattern oriented traffic by many computers or one or more computers may need high data rates above 10 Mbps. If so, the solution is to change the basic networking scheme. Approaches include 100 Mbps Ethernet (100Base-T), FDDI (fiber-distributed data interface) (providing 100 Mbps speeds), and ATM (providing up to 155 Mbps speeds). Both 100Base-T Ethernet and ATM are still immature and should only be deployed in pilots and in situations where present need must be solved immediately. FDDI is a more mature technology. All approaches require changes in closet electronics (hubs) and user computers (network cards). The highest bandwidths are supplied by ATM schemes that require fiber to the desktop. In both cases, if implementation of these schemes result in increased traffic volumes out of the building, then changes in the Rust Center are also required.

**Recommendations**

It is recommended that the University plan on beginning to change the basic transport to buildings and to the wiring closet within five years. If it were to begin today, FDDI should be used as it would not practical to deploy ATM today based upon higher costs and a more immature technology. Costs to deploy 100 megabit FDDI today would be estimated to be on the order of $500,000 to $1,000,000 per building. This represents a cost of approximately $2,000 to $3,000 per connection (including the port and network interface card) for up to 300 users. It is not clear that the pricing for FDDI will improve substantially with time. It is also not clear that FDDI would provide the long term needs to warrant the investment.

The cost per building to deploy 155 Mbps ATM is estimated to currently be $500,000 to $1,000,000. This again represents a cost of $2,000 to $3,000 for each connection. Additional changes would also need to be made in RUST Computer Center equipment to support ATM. These costs should drop substantially in the next several years and by the time ATM pricing becomes more affordable, standards should be sufficiently stable to allow wide-spread deployment.

The University should plan to improve the basic data rate of the network infrastructure in the 3-7 year time frame and continue to study the emerging technologies delaying a choice until prices decrease, technologies mature, and clear standards and market trends are available. Until then, the University should be prepared to supply higher traffic rates for special needs that are mostly funded by the unit needing the higher rate. However, the University should be prepared to contribute to these projects treating them as pilot projects. While it is expected that existing standards for wiring to the majority of the individual computers will remain acceptable for the short term, the University should also have a plan for accommodating a growing number of requests for higher capacity lines without a single request supplying the funds for the entire upgrade.

Infrastructure investment policy has been to track industry development, deploy special case applications as needed, and deploy “base” infrastructure technologies after the “leading edge” when economies are available. This approach is appropriate and should be continued. The University is presently deploying FDDI, 100 Megabit Ethernet, and ATM in special case applications and should gain experience from these efforts that will provide deployment guidance in the future.
Internet Access

UAB’s Internet link is through BBN/Planet--Southeast Region (formerly SURAnet). The link is currently clear-channel T1 (1.544 Mbps).

Costs for fiscal year 94/95 include:

- A $7,000 fee, formerly called a “membership fee” and paid by the Alabama Supercomputer Authority this and last year. UAB formally paid this fee and will likely pay it again next fiscal year due to ASN budget cuts.
- An $18,000 backbone share for a T1 speed pipe.
- $1,800 for router maintenance.

These figures do not include on-campus support, connections to campus equipment, and various other hardware and software costs.

Costs for the coming fiscal year are not yet known. This will be the first year that the national backbone has not been funded by the National Science Foundation. These costs are now paid directly by providers. Our best estimates are to expect a 15 percent yearly increase over the next three years. BBN has stated (not in writing) that they would “try” to keep prices the same for next year as this year.

Short term plans include upgrading UAB's Internet link to 3 Mbps. This will require upgrading the central routers and other related equipment. In addition, since UAB’s Internet link is so critical, there are plans to provide for spare hardware to avoid the more than 24 hour downtime that would result should any one of these components fail. In the long term (5 years) the Internet link will probably have to be T3 (45 Mbps) or higher. DC/NS is currently pricing these possibilities, though no figures are available at this time.

Wireless Networking

Computer applications in health care are expanding beyond accounts receivable and special purpose stand alone systems. An integrated computer based patient record with text, graphics, and images is an objective described in an Institute of Medicine publication, *The Computer-Based Patient Record, An Essential Technology for Health Care*. In a major academic health center such as UAB, wireless technology could be an important component in such a computer based record system.

Wireless technology allows computers to be connected to a Local Area Network (LAN) without wiring. With current technology the range is up to 500 feet within typical offices and 1,000 feet in open environments. A couple of years ago predictions were made that in 1996 sales for wireless LANs would amount to $820 million. However, a recent estimate of sales for 1994 was $100 million. This large discrepancy between expectation and performance can be explained by a poll made of large corporations that has found little interest in the technology. The primary application identified was that for physicians.
Helping to drive adoption in the medical market are new reimbursement procedures that provide health care organizations with financial incentives for better records management. Direct physician input of treatment and billing information during rounds saves the transcription of handwritten notes and accelerates insurance reimbursement.

The IEEE 802.11 committee has circulated a proposed wireless LAN adapter standard for manufacturers’ review. Agreement on it is expected this fall. The adapters now cost $600 to $700 per node but that price could be cut in half through volume production after standards are agreed upon. Concerns of potential users include RF battery drain, portable unit damage, and theft.

Manufacturers promote the technology as LAN extension rather than as a replacement for wired networks. Except in special circumstances where building construction makes wiring difficult, it is more economical and the network can support greater transmission speeds when wired.

Interference is one of the technical hurdles for wireless communications. Spread spectrum is a solution that distributes a radio signal over many frequencies in order to avoid blockage by an interference signal at a particular frequency. Current products are based on two spread spectrum techniques: direct sequence, DSSS, and frequency hopping, FHSS. Due to greater effective bandwidth, DSSS can achieve a 2 Mbps data rate compared to the 1 Mbps for FHSS. This technique can be applied at various frequencies but the 2.4 GHz band offers adequate bandwidth, better data rates and general-purpose mobility through PCMCIA adapters suitable for portable computers. It’s also widely accepted abroad for wireless LANs.

**Recommendations**

Currently, wireless technology is used within the UAB hospital on an as needed basis. Given the current state of the technology and the costs involved, this policy should continue with the bulk of implementation costs incurred by the user.

**Fail-safe Standards**

Fail safe networking is an example of proactive network management. The concept involves planning “on the front end” so that disastrous outcomes do not occur on the “back end”. Drawing background information primarily from DC/NS representatives, this section outlines the chief components of fail safe networking and problematic areas at UAB. We also offer recommendations for providing comprehensive fail safe networking in essential/critical areas. Finally, cost effective alternatives to fail safe networking are also described for those areas that are not defined as critical.

**The Base Component: A Reliable Power Source**

According to the American Power Conversion Corporation, “Power problems account for as much data loss and downtime as all other causes combined. And the bigger the network, the greater the risk.” At UAB, power events (i.e. outages, brownouts, and overvoltages)
would be the principle antagonist of campus fail safe networks. Because power events (principally consisting of power outages) are common and unavoidable, they will pose a frequent threat to the reliability of the University’s fail safe networks. Indeed, historical events indicate that each power outage experienced by DC/NS results in the breakdown or destruction of one or more hardware/software components. In addition, components not initially damaged by these outages will eventually begin to breakdown and become affected over time.

Until 1994, the University relied on a generator back-up system for its central networking components. The chief disadvantage of this system was that the network’s normal electrical supply would have to be completely discontinued before the generator’s supplemental electrical supply could initiate network reinstatement. This “start and stop” method of power source change also occurred when the normal electrical supply was eventually restored. Therefore, each of the network's hardware components was subjected to two forced shutdowns for each break in normal electrical service. At best, this method of backup combined very slim data protection with a less than graceful means of server shutdown.

Realizing these difficulties, DC/NS undertook the critical task of installing an Uninterruptable Power Supply (UPS) in 1994. This supply is attached to all Central Networking Components. Additionally, DC/NS suggests that every major/critical file server have a UPS to protect valuable hardware, software, and data.

**Recommendations**

Existing or nearly completed systems would greatly benefit from following three modest protocols. First, arrangements should be developed and implemented for installation, maintenance and upgrades as necessary for uninterruptable power supplies across the UAB campus. Second, strong consideration should be given to installing UPS monitoring software in existing UPS supported systems and in future UPS installations. Finally, the appropriate time, human resources, and fiscal strategies need to reflect a strong commitment to this basic yet critical strategy in Fail Safe Networking. As the UAB campus expands, so should effective networking systems expand. Unfortunately, UPS systems have yet to be placed on “building wiring hubs”. In order for constructive advancement of computer systems to occur at UAB it is imperative that UPS systems be included in plans for future expansion.

In addition, a plan for monitoring the backbone to building network connections should be developed and deployed. The purpose of the monitoring would be to find problems before or immediately after they occur. As dependencies on the network continue, and the cost of redundancy makes completely fail-safe systems unattainable, this monitoring is critical to department operations.

Finally, there needs to be a complete maintenance evaluation of all electrical circuits that are attached to Local Area Networks (LANs). All LAN servers should be placed on “isolated” circuits.
Second Level Components: Redundancy

The Campus Backbone is where all networked buildings converge. UAB has not gone so far as to build two completely identical networks, because at this point, the complexity would add to the risk. Instead, hardware components are purchased in “twos”. For instance, dual process controllers, dual flash devices, and dual routers are purchased to provide redundant systems. In addition, the goal has been one of “quality” rather than “price” in purchasing any major networking parts that will be attached to the Central Network. By doing so, we are one step closer to a Fail Safe Network.

Recommendations

Building completely redundant network paths to all buildings on campus would be cost prohibitive. Consequently, the University needs to address the economic factors on an “area” by “area” basis to determine critical spots on the campus. Areas of critical priority that are dependent on network connectivity should eventually be provided with completely redundant systems. Areas that are considered low and non-critical, should not incur the expense of completely redundant systems, but rather have recovery alternatives that will allow employees access to the Central Network. These plans should also be highlighted in Disaster Recovery Policies that are being developed at the University.

Remote Access

Faculty and students today want the ability to access campus computing facilities including E-mail, and Internet services such as World-Wide Web pages from their homes. They want the same sort of comfortable, easy to use graphical interface for such connections that they enjoy when on campus. The problem is that telephone connections, serviced by the UAB telephone switch, are very demanding of resources. There is also reason to believe that it is impossible to totally satisfy the expected demand. Until recently the state of the connectivity options at UAB, which amounted to rather primitive access to facilities by modem and terminal emulation (usually emulating an IBM 3270 terminal) tended to discourage all but the most persistent users. Recently Point to Point Protocol (PPP) modem connections have been made available on campus that greatly enhance this process. There is, however, reason for concern that this improvement will prove to be too much of a good thing. Examination of utilization of trunk lines coming into UAB for a period of 24 hours reveals some interesting patterns. In particular, current capacity is maximally utilized during the periods 9:00 am - 12:30 PM and 1:30 PM - 5:00 PM. During the time from 5:00 PM until nearly midnight the usage is very flat at a level which correlates highly with the estimated number of modem lines available for dial-up access to the campus. Although there is no guarantee that most of this traffic is actually due to modem usage, it is still suggestive of this possibility and cannot be ignored. Based on these observations, it can be conjectured that if 288 (the number of trunk lines presently coming into UAB) modems were available, the activity on the phone system would stay at the maximum level for most of the day. Extrapolating from this to the potential number of users who might want service, suggests that an almost unlimited amount of resources might ultimately be needed to support remote access.
If it is taken as a given that the part of UAB’s mission should be to provide remote access for faculty and students to the campus network and the Internet, then UAB must explore the different possibilities to achieve this goal. The June 16, 1995 issue of the Chronicle of Higher Education has a lengthy article addressing these issues and the fact that many colleges and universities are currently trying to address this problem. The consensus seems to be that this is an important mission for a university. To this end three strategies are possible:

1. **UAB directly provides this service with some method of charging for usage:**
   
   **Pros:**
   
   • Except for usage charges, this approach would be popular and simple for faculty and students.
   
   **Cons:**
   
   • UAB currently lacks a billing system suitable for the task. It would also have to be determined how to bill.
   • This would require utilization of outside phone lines rather than trunk lines that utilize the central switch. These trunk lines are expensive and their numbers cannot be unlimited.
   • This service would require a dramatic increase in support staff.
   • Constant recurring costs of modem upgrades would be required on about a two year cycle.
   • UAB would be responsible for finding and supporting access software with a point and click Graphical User Interface (GUI) which users would need to simplify access.

2. **A Vendor/University Partnership:**

   Proposals for this type of service have already been supplied to the University by two vendors, MCI and Bell South. Within this type of contractual relationship, many options can be considered and negotiated. Among the types of service which could be considered in addition to modem connections would be high speed connections utilizing the Integrated Services Digital Network (ISDN) protocol.

   **Pros:**
   
   • The vendor guarantees a level of service and assumes the risks.
   • Would free up some UAB communications resources such as the modem pool.
   • Vendor would supply a help desk for technical assistance.
   • Could off load all costs to users.
   • The vendor provides their own billing and accounting scheme.
• A cost of $10.00 per month for 10 hours of connectivity is competitive with vendors such as American On Line.
• GUI access software provided by the vendor.
• UAB as desired could subsidize user costs by providing funds directly to the vendor.

Cons:

• This is a new type of service for vendors so there is no installed base of users to query about the quality of the service.
• UAB must house certain equipment of the vendor and grant access to some of its own equipment.
• UAB must provide the vendors with the means to market their product to the UAB community.

3. Students and Faculty contract directly with an outside provider:

In this scenario, the faculty member or student would buy Internet access through an outside commercial enterprise such as America Online, Delphi, CompuServe or IBM Advantis. There are several local companies also providing this service.

Pros:

• Communications can freeze the level of modem service supplied to the campus at whatever level seems warranted.
• Individual departments could still have their own dial-up connections within the limits of existing trunk lines.
• UAB is not involved in the billing or marketing of these services.
• Some controls to login time on UAB computers could be put in place to regulate the use of the UAB controlled dial-up lines.
• GUI access software supplied by the outside service.

Cons:

• A person who opted to use UAB dial-ups would have no guarantee of being able to get on the system at any given time.
• Time on UAB systems may need to be rationed
• This will put heavy loading on the Internet connection into UAB and might cause delays in gaining access from the Internet.
• Potential for increased cost to the University in the form of increased utilization of the Internet link.
When the Pros and Cons of each possibility are examined, choices 1 and 3 leave the most room for unpredictable recurring costs to the University in the form of equipment enhancement. In addition, choice 1 would require a substantial initial investment in both equipment and technical support personnel. It seems likely that most end users will want a specific set of services which might include E-mail, Internet services like the World-Wide Web, Usenet, Gopher, Telnet and FTP, and access to a University workstation from off the campus. There is one other complicating issue that must be considered in planning. That is the fact that some units on the campus support their own modem pools. These are used to provide access to specific facilities and often require special software currently supplied by the individual departments. These groups must be remembered because of their potential impact on the existing and any future university telephone system.

**Recommendation**

UAB should prepare bids for outside vendors to provide dial-in service to the campus network along with Internet access. This service, as described in choice 2 will be in partnership with UAB with costs in general, paid for by the user, though departmental, school, and university subsidies are possible.

**ISDN**

Modem connections into campus are limited by the highest speed of current modem technology. This speed is presently 28.8 Kbps. High-speed ISDN connectivity to campus that can provide up to 128 Kbps is currently available from South Central Bell. The costs of installation (approximately $200.00), necessary hardware for the home (between $500.00 and $900.00) and a monthly charge of about $75.00 make this option unlikely to have mass appeal to students and faculty. In addition, a recent ruling by the Federal Communications Commission (FCC) which would have the effect of increasing the monthly charge, is likely, if upheld, to slow or even eliminate interest in this technology. This ruling is currently being appealed by all segments of the ISDN industry. Thus, although ISDN is an important consideration for the future, its appeal to the end user will not be great until prices become more competitive. Never-the-less, University Communications Services can presently provide ISDN links into campus as needed, with the costs borne by the user.

**Recommendation**

Current technology and costs prevent wide-spread use of ISDN access. The current policy of providing access on an as-needed basis should continue with costs borne by the user.

**Financing**

The present funding model for the infrastructure is a shared funding model. Basic network service to the wiring closet in each building and maintenance to infrastructure all the way to the desktop is provided centrally. New building projects and acquisitions must include
funding for creating this standard infrastructure. The central administration is funding a multi-year project to install the standard infrastructure in existing buildings which is scheduled to be complete in 1996. Each user (Department) funds the initial connection from an office to the wiring closet. Each user (Department) is also responsible for the interfaces necessary to connect the office network cable to their equipment. Presently, central funding for ongoing expenses (infrastructure maintenance and improvements) is recouped through surcharges on the telephone system. This funding approach must be changed but only with the participation of all affected parties.

The central network provided by DC/NS represents direct expenditures of around 1.5 million dollars per year. The expenditures cover the cost of providing the wiring infrastructure (fiber to the building and wiring from floor to floor), the routers, E-mail service, wiring hubs with some management/monitoring function, and technical support for the above components including some technical support for departmental network managers supporting the end users and UAB’s connections to the world. Currently, these items are funded through a surcharge on each telephone line, connection charges, and subsidies from Central Administration and the Telephone System. The financing plan was designed to have the subsidies decrease each year as the surcharge (which would be moved from a surcharge on telephone lines to a user charge which would relate to some type of network connection) increased. By FY 99/2000 the subsidies would have ended and the network would be financially self-supported. The current network surcharge for FY 94/95 is based on 11,600 telephone lines @ $2.75 each per month or an annual cost of $382,800. FY 95/96 costs will be $417,600.

Complicating the current plan is the fact that the Telephone System has been classified as a service center and must base its rates on real expenses for a particular item. Therefore, charging network expenses to the telephone line rate is noncompliant with the guidelines for service centers.

**Recommendations**

The University must develop a plan for how to make the transition from telephone line charges to something more applicable to the network and its devices. We should expect to make the transition within the next two years so we must begin the discussions now. The issue is so complex in nature that the Network Subcommittee recommends forming a team to aid in this process of evaluating alternatives for billing and making a recommendation for a charging model. We suggest the team include individuals from this Subcommittee, Financial Affairs, Central Administration, Academic and Health Affairs, Health Information Systems and any other groups that would be payees under some of the charge-back approaches.

Considerations for the team:

1. Users must be given ample time to plan and budget for the new charging structure.
2. Assistance in this project will be needed from the TIM Group.
3. When reevaluating the charges, portray all costs involved in Central Network such as, personnel time dedicated to network functions but not charged to the cost center for the network.

4. Reevaluate the trend in spending for capital items such as hubs, routers, computers etc. The original assumptions that expenditures would decrease may not hold true.

5. Review trends in network installations and the impact that decreased connections will have on the revenue base.

6. Be mindful of charging models which would tend to make users circumvent the system and ultimately cause harm to the network.

7. Not all devices connected to the network are known. Locating and identifying all the connections will be difficult and labor intensive.

8. Consider how changes in future technology will impact network services.

9. Consider existing models such as those supporting electrical, water, and telephone services.