On a regular basis, college and university presidents must make decisions about large expenditures on campus and must determine whether or not these expenditures are necessary and strategic for the institution. Many of these large budget requests are made to directly support the campus network, and can range in size from a few hundred thousand to millions of dollars. Our campus computing networks are made up of wires and cables, electronic equipment, software and people that connect the computers on campus to each other and to the Internet, and represent a complex investment of dollars and effort. What should you do when as president you are presented with a request to replace, upgrade, or overhaul all or part of this critical infrastructure?

The Network is Critical

Any institution’s network must be reliable, available almost all the time, and be able to support the processes that are dependent upon it for electronic communication and interaction. The network, much like a utility, is fundamental to the operation of many essential campus services, as well as to the academic and research pursuits of faculty and students. These campus services not only include things like e-mail, online courses, technology in the classroom, faculty research, and the campus web sites, but also (at most institutions) internet-based, personalized self-services, payroll, grades, bank transactions, admissions, student health services, and much more. The list is long.

Many institutions began “wiring” their campuses in the late 1980’s, and these initial efforts continued through the 1990’s. Often, early network investments were not part of an overall strategic and fiscal plan and were not funded through regular budget processes, but rather were made possible through grants, one-time disbursements or special allocations. Now, in the early part of the 21st century, a significant number of campuses are faced with aging wiring and network equipment that is no longer able to support today’s increasing demands for bandwidth (the network’s capacity to carry information) and services. The need to improve and expand has been spurred on by advances in technologies such as online library resources, desktop video, convergence of voice, data and video on the same network, wireless computing, and peer-to-peer (P2P) file sharing. In addition, the need to consider security measures requires the upgrade of most existing

1 College and university students are increasingly using their institutions' networks to access and illegally duplicate MP3 music files and other copyrighted digital content, in violation of the Digital Millennium Copyright Act (DMCA) and other applicable laws. This practice of sharing files via P2P software has had a significant impact on campus networks. Greater awareness of the issues, pending legislation, and legal action being brought against students, are causing campuses to examine policies and practices. Institutions of higher education are challenged to restrict P2P file sharing on their campuses through education, policy, and technology while searching with the entertainment industry for viable and legal online alternatives. It is clear that any alternatives that may be developed will continue to affect campus bandwidth needs. For more information on file sharing, P2P technology and current and pending legislation, visit www.educuase.edu/issues/p2p.html
networks to meet more stringent standards. The Internet, and our campus networks, represents the fundamental way all of our communications and services are or will be offered. Our dependence upon the network is great.

The questions of how much we should be spending on the network or how robust our networks need to be have no “right” answers. There is no general prescription or formula to follow for your institution. Each institution has unique needs. However, there are questions that presidents and senior executives can and should be asking when the chief campus technology officer brings forward funding requests. The answers will help put the overall network budget request into context alongside competing campus priorities and allow the status of the network to be considered in the context of the institutions’ strategic resources.

**Is this request part of the strategic plan?**

Ideally, the campus information technology unit should have a strategic plan that supports the overall campus strategic plan. Ongoing maintenance and upgrades of the network should be part of that plan. Similarly, networking must be taken into consideration when building new facilities or renovating existing buildings. With that in mind, then, the first question that should be asked about network budget expenditures is “How does this fit in with the overall strategic plan and established budgets?” Has the need for the upgrade been well-documented and the implementation well planned? Has there been an emergency, such as an old piece of equipment failing, that was unanticipated and for which there is no contingency? While these kinds of problems can and do happen, good planning and good contingency planning can minimize risk.

If the budget request brings a great divergence from the strategic plan as written, then one should ask why. Most plans are put together with careful consideration, so changing overall course in mid-stream deserves some review and discussion. If there is a crisis situation (e.g., key network electronics have to be replaced, or a rapid bandwidth increase to the commodity network is necessary, for example) then funding may be required to restore services to a steady-state, but good plans need to be put in place to mitigate this risk in the future.

If no strategic plan for campus information technology (IT) exists, it is time to develop one. Senior executives at the institution can provide the strong personal leadership necessary to change culture, from reactive to proactive, with the overall goals of the institution in mind.

**What is the current state of our network?**

The president must rely on the institution’s senior information or technology officer to understand the details of the operation of the campus network and provide the vision, consensus building and planning required to support the mission of the institution. However, it is also necessary for the president to understand the current state of the network as requests for additional funds are put forth.
What growth rates have we seen and who is using the bandwidth?

It is a guarantee that network bandwidth consumption will continue to rise, even while Metcalf’s Law, which says the price of bandwidth decreases by 50% every 9 months or so, remains relatively true. When looking at network growth and upgrades, it is helpful to understand trends on your campus. Has bandwidth consumption increased all over campus? Or have you seen increases just in certain schools or departments? Where are the bottlenecks? By using network management software, the IT staff can analyze network traffic and make decisions and recommendations about the need for more bandwidth on campus or a bigger to the Internet that is able to handle more traffic to and from campus. They can often diagnose problems that can be solved by repairing hardware or upgrading software, rather than simply increasing bandwidth.

It is important to “build out” in anticipation of increases in consumption of network resources (for example, many research projects require that large amounts of data be gathered and transferred across multiple networks,) and this should be considered in planning upgrades to existing services.

Who is being inconvenienced now?

Understanding if there is a particular crisis or problem to be solved, and the immediate impact of that problem on the faculty, students and staff can facilitate the decision making process. If there is a problem within a particular building, an entire department or school can be negatively affected. If there is a problem with the gateway to the commodity network, the residence halls, the academic buildings or even the entire campus could be affected.

Again, common sense says that institutions should not wait until a problem arises, but rather by using available data to make projections about need, and plan accordingly.

When were the last network upgrades completed?

Some campus networks are still functioning on old, re-purposed equipment that the IT departments maintain with band-aids and luck. Most network technology, such as the electronics and main routers, should be upgraded or replaced every three to five years. If these replacements are being requested, it is important to understand the age of the equipment and history of the upgrades. If the electronics are greater than five years old, replacement is probably necessary.

Wiring within and between buildings has seen many changes over time, but generally has a longer lifespan. Fiber optic cable is necessary for longer distances, such as between buildings or to serve as the main connection within a building, while something called “Category 5e twisted pair” cable goes the shorter distances to the desktop. For a campus network to function, these are the current standards. If budget requests include wiring upgrades, it will be important to meet these minimum requirements.
What is the speed of our campus network?

In higher education today, many of our desktop computers have connection speeds of 100Mbps (millions of bits per second or megabits per second) and the remainder run at the older standard of 10 Mbps. However, some campuses still operate completely at the older, slower 10Mbps speed. The applications we are rapidly moving toward will demand much faster, Gigabit (billions of bits per second) Ethernet speeds. (On many campuses, the equipment that is installed in the network closets will support these faster speeds.) But the speeds are determined by a combination of the computers on the desks and in the labs of our faculty and students, the equipment in the network closets and the wiring within and between the buildings. Any new purchases should be capable of Gigabit speeds.

Are we doing any management of the bandwidth now? Why or why not?

Current technologies and software allow IT staff to “shape” and monitor network traffic, and these functions are critical to the ability to manage and troubleshoot the network. “Network Traffic Shaping” allows the institution to determine what kinds of processes get what portion of the bandwidth – for example, higher priority can be given to traffic that is critical to the mission of the institution, such as e-mail or web-based course management systems, while backup traffic would run at a lower priority. These tools make it possible to refuse access to traffic coming from a particular destination, deny access to a particular type of traffic and disable unneeded services, and will even allow access to be granted selectively based on time of day and other factors.

These same technologies allow the institution to monitor network traffic, at very broad as well as very detailed levels. It is necessary for the network staff to have a solid understanding of the kinds of traffic that pass across the network – how much is e-mail, how much is web-based, how much is P2P sharing of music files, and what areas of campus are generating or receiving various types of network traffic. This information can feed network planning and traffic management decisions, so that optimal use of the network can be achieved, and can inform institutional policy makers as they deal with issues such as intellectual property in the digital age, P2P file sharing and related current issues that have the campus network as a component in the discussion or resolution.²

Does our network have acceptable levels of security?

During the last few years, the number of security-related incidents on campuses has increased dramatically. Hacking attempts occur all day long, every day, against almost every computer on campus. Regularly reported in The Chronicle of Higher Education and other media, incidents ranging from loss of research data to exposure of SSNs or other

² Network traffic monitoring and shaping technologies can be used to do things like enforce policies related to copyright infringement, but also introduces concerns related to violations of privacy and higher education’s role in copyright and intellectual property issues. For further explanation and current news, please see www.educause.edu/policy
confidential information to the disabling of web sites and key services result in bad publicity for the institutions, threats of legal action and huge amounts of effort to investigate and recover from the incident. The campus network plays an integral role in the institution’s security plan, and the institution has a responsibility to its community and to the broader Internet community to be sure that good security practices are in place. Any requests for new network technologies should include a discussion of how the network upgrades fit in to the overall security plan. Are procedures in place that require all system owners to adhere to security policies and practices? Are firewalls employed appropriately? How do we monitor security alerts on our network?

**How does the request relate to the current budget?**

The expenditures being proposed may be additions to the existing capital or operational budget. If so, this raises some considerations that will vary from institution to institution, depending upon funding models. If special one-time funding is being requested, the IT organization should be able to clearly articulate the plan for long-term sustainability of the new functionality being proposed. For example, if new network electronics are being requested for the campus, how will they be replaced in three to five years’ time? What funds are available for equipment maintenance (which is typically 10-15% of the purchase price of the equipment per year)? What, if any, IT expenditures could be reduced to support all or part of this request? What would the impact be on campus?

*Are there other sources of funding?*

Campus networks are supported through many different funding mechanisms, depending upon the institution. Central funding for unlimited services to campus, charging a flat fee to departments for each computer address, and charging based on usage are all models for funding the ongoing maintenance and support of the campus network and related services. At many institutions, all or part of a student technology fee is directed toward IT infrastructure, of which the campus network is a key component. If an institution has not considered other models of network funding, it may now be appropriate to have the discussion of other options. Campus culture will, of course, guide what can and can’t be considered. (A campus that never charges back for services will have a difficult time promoting a network fee, for example.)

*What are the risks?*

As with any significant request for institutional funds, the request must be weighed against all other university needs. However, it is also necessary to approach any request for funds to support the campus network from the perspective of risk – what will happen if we don’t do this? What institution services, operations, processes are at risk? What are the tradeoffs between funding this endeavor and other IT projects? What are the tradeoffs between funding this project and other campus projects?

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3 More detailed information on IT security in higher education is available at www.educause.edu/security
Conclusion

The campus network provides a foundation for teaching, library access, research, administration and myriad university services. Though most institutions have “wired” their campuses, networks must be constantly renewed. The network is never “finished.” Ideally, planning for network renewal should be ongoing as part of the IT planning processes, and should support the institution’s strategic plan. When faced with requests for funds to support the campus network, presidents and senior executives need to be armed with as much information as possible in order to most effectively make decisions and set campus priorities. Working in partnership with the key IT staff and other campus leaders, the president can use the questions presented in this paper to inform executive level deliberations. Every college and university must make decisions about what levels of network services should be provided based upon its mission, goals and its own unique plan for the future.

References

For more details on campus network design and development in higher education, you may wish to consult:
