

**The Network Master Plan  
Connecting  
UConn 2000  
With  
UConn 21<sup>st</sup> Century**

**Draft Copy****Executive Summary**

In the last 15 years the University computer network has grown from a technical novelty used by only a few researchers scattered across the Storrs campus to a necessary component of how our students communicate, our faculty educate, and our staff do business. Currently, state-of-the-art communications networks are being deployed in new buildings funded with capital money, but networks installed in existing buildings are left to degrade well past their lifespan, or are upgraded on an ad-hoc basis. This creates an inconsistent network where a professor in a new building can collaborate effortlessly with researchers at Universities across the globe, but not with professors on campus in older parts of the network. A student in a new residence hall can view live video streams from across the country, but can't show their advisor the same video across campus where older networking equipment is installed. Staff can easily check their email in a new administrative building, but when they plug the same laptop into a colleague's office across campus they may have trouble accessing the older, more congested network.

To remedy this UITS has created a detailed plan for a communications network that would put UConn on par with our peers in the research and academic communities. Our goal is to create and maintain a network that is transparent to our users, who should not be forced to become technicians attempting to diagnose why something works in one part of the campus network and not another. Our plan delivers a common network infrastructure to all University buildings around the state, including aggressive upgrades of sub-standard portions of the network and consistent standards for construction projects slated within 21<sup>st</sup> Century UConn. The Network Master Plan breaks down the network into its three component parts: network hardware, network wiring, and closet infrastructure. Ninety-two percent of the buildings are lacking in at least one of these three categories, and it will take an initial year to plan and a minimum of two years to enhance the design and deploy a consistent network across all University campuses and properties.

The Network Master Plan will create a world-class communications network to mirror the world-class physical facilities built by the UConn 2000 and 21<sup>st</sup> Century projects. A reliable, consistent network allows emerging communications technologies to spread rapidly across campus. The network becomes the accelerant to technological growth at the University instead of the inhibitor. Faculty need equitable access to online material no matter where their office is on campus, just as students need reliable access to course materials any time of the day or night, no matter where their classroom is located across the state. Deploying a centrally managed, modern network across all of our campuses facilitates mobile access to the Internet whether it is walking from Arjona to Northwest Campus, or video-conferencing from Avery Point to a boat in Long Island Sound. Budgeting for the continued funding of an ever-evolving network supports the ability of that network to allow fast file transfers today, steady video streams next week, and wireless virtual study groups next year. Building a consistent University communications network across the state of Connecticut will attract top students and top researchers who understand that a world-class network is a necessary requirement for education, business, communication, and life in the 21<sup>st</sup> Century.

**Draft Copy****State of the Network**

The current state of the network was based upon three criteria: closet electronics (hubs, switches, routers), infrastructure (closets, conduits, fiber, coax) and wiring (copper, coax). Using these criteria and the associated published standards for each, an assessment was made of each building on the Storrs, Depot and Regional campuses. UCONN recognizes and adopts industry standards and practices as interpreted by BICSI (Building Industry Consulting Services International). The implementation of these standards ensures a flexible, uniform communications environment that allows for the growth of high speed and high bandwidth required by specialized applications used in higher educational environments.

After all of the buildings were researched only 25% of the buildings have electronics equipment installed based upon today's standards. Only 33% have rooms that would be acceptable based upon the currently published standards. Only 14.5% have wiring that would be acceptable based upon the current standards. After all of the buildings were researched only 8% are fully compliant based upon the standards, while 92% need some type of upgrades. While virtually all parts of the University, including the regional campuses, have connectivity to the network there is a lot of work to be done to bring every building up to a base standard.

***Attachments A1 & A2:*** are graphical representations of the currently installed closet electronics. ***A1*** represents the status of the Storrs campus and ***A2*** represents the status of the Depot and Regional campuses. Buildings colored green represent compliant closet electronics. Buildings colored red represent non-compliant closet electronics.

***Attachments B1 & B2:*** are graphical representations showing which buildings have closets that meet today's published standards. ***B1*** represents the status of the Storrs campus and ***B2*** represents the Depot and Regional campuses. Buildings colored green represent compliant closets. Buildings colored red represent non-compliant closets.

***Attachments C1 & C2:*** are graphical representations showing the wiring condition of the buildings. ***C1*** represents the status of the Storrs campus and ***C2*** represents the Depot and Regional campuses. Buildings colored green represent compliant wiring. Buildings colored red or yellow represent non-compliant wiring.

***Attachment D1 & D2:*** graphically represents all three criteria together and shows which buildings are fully compliant based upon the published standards. ***D1*** represents the status of the Storrs campus and ***D2*** represents the Depot and Regional campuses. Buildings colored green represent fully compliant buildings. Buildings colored red represent some form of non-compliance.

**Draft Copy****University Community's Projected Needs**

Based upon input from users in the community, standard networking features should include such things as video in the classroom, differing levels of service based upon need, mobile computing and distance learning. Implementing all of these features will require the entire network to be brought up to base line standards to allow for end-to-end delivery and management. This will also help in improving equality between the Storrs and Regional campuses.

All of these improvements can result in better services for the University community and allow the *technology* of communications to become transparent. As a result, the communication is the information that is exchanged, not the process of establishing the communication itself. Just as users don't consider what is happening within the Telephone Switch when they dial the ten-digit number on their telephone today, rich multi-faceted communication on the University Network should not require any more than knowing the identity of the recipient of the communication.

Advanced features and increased speeds will allow users of the University Network to communicate and collaborate without complicated technology hampering the communications. Security in the applications and network devices on the University Network should allow confidential and accountable transactions to occur. The University Network should be managed to allow the necessary resources required to be available where and when needed on the campus.

Some of the advance feature sets include but are not limited to, VLAN(Virtual LAN's) support, QoS(Quality of Service) support, Multicast support, Streaming video, VPN/Firewall(Virtual Private Network), wireless capable, VOIP(Voice Over Internet Protocol) capable, I1(Internet 1) and I2(Internet 2) access.

**Planning Factors**

In order to support these feature sets, the network design must accommodate the increasing demands placed upon it. No longer should the sole key to improving network performance be adding more bandwidth. To support real time voice and video applications, the University Network will require high redundancy, minimal interruptions, little to no delay of the information (latency), and the ability to prioritize traffic. A full-featured network will need to dramatically improve its fault tolerance, resilience and recovery time to fully meet the expectations of the University community.

Today the primary role of network management is to keep the network up and running and to provide an acceptable level of network performance to all customers. Tomorrow different customers and applications may have very different network resource requirements, particularly in a full-featured network. Over the years, the network has operated on a best effort basis with all customers having access to the same service level,

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and with some over provisioning built in to provide room for growth in network utilization. This model will prove to be unsuitable in the future. It is likely that active management and allocation of network resources will be necessary. In the future UITS must be able to manage differentiated service levels, and control access to those service levels dynamically throughout the Network.

Meeting these goals requires a secure, robust network infrastructure capable of supporting both user traffic and management traffic and maintaining the privacy and integrity of management information. It will also require performance management, accounting management, and configuration management software systems.

**Plans to Meet Future Needs for Both Individual User, Department and Building**

Another key aspect of the infrastructure is to ensure that it will support converged (voice, data, video traffic) services and the use of a common cable from the communications room to the work area outlet (WAO) in the room or office. The current industry standard is Cat6 data grade cable.

Our design calls for all buildings on the Storrs, Depot and Regional campuses to be provided with electrical power outlets tied to an emergency generator in all Building Distribution Facilities (BDF's) and other communications rooms.

It is also our intent and to provide both commercial and emergency power to the environmental systems in core distribution areas. One of our requirements for future network design is to evaluate sites in existing or new buildings that have adequate electrical capacity on their emergency generator in order to support the power demands. Should this not be possible the appropriate wiring must be in place to provide power from a portable generator.

Physical security of the network is critical to the reliability of the network. In order to provide a physically secure network, all communications rooms across campus should be secured with a unique lock accessible to UITS and appropriate emergency personnel only. This also makes the assumption that no room will be shared with any other department for multiple functions.

**Interrelationships of the University Wide Network with Departmental Networks**

Wherever possible, UITS Network Engineering should be responsible for network installation, design and management. UITS should set the standards for the physical and logical design with input from the user community. This design should also drive the standards for equipment selection and building design.

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Where there are special needs, departments should be allowed to maintain and manage their own networks consistent with University standards. However, Service Level Agreements (SLA's) need to be established spelling out what can and cannot be done on that network. This will ensure that features are transportable across the entire network.

**Implementation Strategies**

The recommended Network Master Plan calls for a phased approach to the upgrade. The entire upgrade will occur over a three-year period. The first year will be a planning year and a time where the electronics in the distribution layer and academic core get upgraded. This will allow the above mentioned feature sets and baseline standards (*Attachment I*) to be implemented early on in the plan.

The estimated cost \$40 million dollars to complete, with an immediate need for \$2.5 million to upgrade key areas of the Academic Core, and an additional \$40 million over the next two to five years. An estimated \$2 million per year is required to maintain the network after completion of the initial installation.

Approximately \$2.5 million should be allocated during this first year of planning and initial implementation. By upgrading the Academic cores at all the campuses many of the advanced feature sets become available in academic buildings. This allows early technology adopters a chance to exploit these new and advanced features and provides more consistent network access to all faculty/researchers in the Academic cores.

*Attachment F*: shows that the total cost for the project is estimated at \$40,000,000.00 for all campuses.

## Summary of Costs

	Storrs & Depot	Regional/Law Sites
Equipment Costs	\$5,831,910.45	\$1,196,280.50
Wireless Costs	\$1,400,000.00	\$ 300,000.00
Building Infrastructure	\$20,183,313.19	\$3,384,443.60
Storrs Campus Infrastructure	\$2,500,000.00	
External Consulting Service	\$4,050,000.00	\$ 495,000.00
Total	\$33,965,223.64	\$5,285,718.10
Total Project Cost	\$39,250,951.74	

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***Attachment G:*** is the detail that went into calculating the needs and estimated costs. In pricing the electronics portion actual retail prices were used. Retail pricing was used, as we do not know at this time when the plan will be approved and phased in. In actuality, equipment pricing may change and discounts will be available.

The next set of priorities will come out of the planning effort from above. Working with A&E services and some outside planning consultants we need to map the wiring and infrastructure efforts with the campus Master Plan. However, we believe that an aggressive schedule could be followed to complete this part of the plan in two years.

***Attachment H:*** shows a proposed schedule to be followed.

**Annual Maintenance Program for Networking Hardware**

On a yearly basis the entire core and distribution layer devices should be covered by proper vendor maintenance contracts. Should a device fail the contract should call for a guaranteed replacement to be on site within 4 hours.

Further, we should keep on site, spare equipment for each device type within this core. If failure occurs then restoration would be immediate and the failing device replaced within the 4 hour window.

The cost for the maintenance is not expected to exceed \$200,000.00 per year.

**Annual Replacement for Networking Hardware**

Once the installation is complete we would begin to look at the core, distribution, and access layers as these will now be in the fourth year of their lifecycle. Industry standards put equipment life at 3 years, our current network has much equipment reaching a 10 year active lifecycle. We feel a compromise at 4 to 5 years for equipment replacement would be reasonable.

The cost of the annual revolving replacement of network components should not exceed \$2,000,000.00 per year. This cost could vary somewhat in future years depending on how many new connections get added to the network.

**Draft Copy****Replacement of Network Wiring**

The wire installed to support the network has a 10 year lifecycle. However, the contracts with our wiring installer, extends this out to 25 years. This does not mean however that the wire will support the technological advances over the next 25 years.

This means that money has to be budgeted for, in order to anticipate wiring changes 10 years out. This could be done on a yearly basis or in one lump sum. Since the infrastructure to support the wiring will be in place, the cost will be wire only. The amount needed to replace the wiring should be approximately \$8,500,000.00.

**Summary of Risk:**

The risk of not upgrading and maintaining the University network will result in UConn being left behind in technology advances. The University must assemble a strong infrastructure of communication related facilities and services throughout the campuses, tailored to meet the needs of our faculty/researchers. If it does not, the result will be vast inequities between faculty and researchers at UConn, compared to their peers in other institutions.

The University should be committed to advancing a communication rich learning infrastructure that benefits students and faculty across all Schools and fields of inquiry. UITs in collaboration with members of the community must anticipate advances in the technology arena and be ready to support them when needed. If we leave things unchecked, "the technology will run us over".