



# University College London

## A Tradition of Innovation

**Breaking new ground isn't at all unusual for University College London, whose leading-edge research in science and technology is supported by a network based on Cisco® AVVID (Architecture for Voice, Video and Integrated Data) technology. Future network enhancements will feature the Cisco Catalyst® 6500 Series Supervisor Engine 720 and Gigabit Ethernet to the desktop, with plans for 10 Gigabit Ethernet in the core.**

### Background

Founded in 1826, University College London (UCL) distinguishes itself as the first university in Great Britain open to all students and faculty, regardless of race, class, religion, or gender. Its radical tradition of refusing to let convention inhibit progress continues into the 21st century, and is reflected in its high standards for teaching and research. The student body hails from more than 130 countries. Its staff and graduates include Nobel Prize winners and numerous fellows of the Royal Society, British Academy, Royal Academy of Engineering, and Academy of Medical Sciences. With 18,000 students, more than 600 full-time faculty, and 3800 academic and research staff in 72 departments, UCL exerts a growing influence on policymaking at local, national, and international levels. It received the highest Scientific Research Investment Fund award of any university in the United Kingdom based on research excellence and volume.

UCL's innovative approach extends to technology and the Internet. It was the first site in Europe to join the ARPANET—the precursor to the Internet—and the first European customer of Cisco equipment.

The network is an integral part of the UCL culture. "In my community, the network is the first thing people need to know about when they walk into any room or go to any other institute," says Professor Peter Clarke of UCL. "Their first question is not to shake hands and say, 'How are you?' It's to say, 'Where is your DHCP [Dynamic Host Configuration Protocol] server?'" Andrew Kerl, assistant director of the Information Systems Department at UCL, adds: "The network is important to UCL because it's not just for teaching and learning. The whole of the college's business goes across the network. When the network isn't available, the college cannot do its business."

The network also enables streaming video applications. One example is surgical teaching at the medical school. A Cisco IP/TV® system is used to broadcast live surgeries and store footage for later retrieval as video on demand. Surgeries taking place at any of three locations at the school are broadcast to seven sites for greater student access. Cisco IP/TV technology provides quality of service (QoS) and multicast features to ensure adequate bandwidth allocation for high-quality pictures.



UCL enjoys a beneficial relationship with Cisco Systems<sup>®</sup>, and has a network infrastructure built entirely with Cisco products and based on Cisco AVVID technology. “I’m pleased that we have a very close partnership with Cisco here in UCL. We’ve had a partnership in many projects over many years,” says Clarke.

## Challenges

UCL has a main campus in the Bloomsbury area of London and satellite campuses in both North and South London, for a total of 200 buildings. The university sponsors advanced research projects in cooperation with educational and research institutions throughout Europe and the United States. Supporting the vast diversity of administrative, research, and instructional applications is a robust network based on Cisco AVVID that was built in 2000. The current infrastructure is ready for an upgrade to meet demands of ongoing research and teaching efforts. The university stresses investment protection, resilience, bandwidth, and intelligent services in its networking decisions.

The redundant core is based on Cisco Catalyst 6500 Series switches, which UCL selected for performance, port density, and features. When the IT team installed the existing backbone three years ago, it had already planned for a mid-term upgrade. “We want to be certain that we are not hitting the end of a road in investing in today’s technology,” says Kerl. “As a research-led university, we want to be able to see that the technology we’re investing in is part of a constant process of upgrading and extending as the technology develops.”

Resilience is important because networked applications also enable the day-to-day activities at UCL. “Myself certainly and I’m sure all the colleagues I work with in my field rely on the network being there twenty-four hours a day,” says Clarke. “We’re on line when we’re at home; we’re on line when we’re traveling. Nobody now goes to a meeting without plugging radio cards into laptops and immediately getting on the network. In fact, people fall apart if there’s no network available wherever they are.”

Bandwidth is another priority, and UCL needs as much as it can get. Many research efforts generate vast quantities of data. One such project is the UK Grid for Particle Physics, or GridPP, a collaboration of particle physicists and computing scientists from the United Kingdom and the Conseil Européen pour la Recherche Nucléaire (CERN). Professor Clarke is Chair of the Technical Board for GridPP. “One of the key drivers of very-high-demand bandwidth comes from the large hadron collider at CERN, where proton collisions at the highest energy that’s ever been achieved will produce terabytes of data per second at the detectors. The high-speed network that offers not only best-effort IP services but other additional valuable services is mission-critical to these experiments. I myself am in a community where we can easily generate gigabit-per-second traffic from the desktop, and we need 10 Gigabit Ethernet in the core.” GridPP aims to develop and deploy a large-scale science grid in the United Kingdom for use by the worldwide particle physics community and is closely allied to the EU-DataGRID project, in which UCL also participates.

But raw bandwidth is insufficient. The network must also support intelligent services such as QoS mechanisms that enable UCL to prioritize particular applications for optimal performance, and incorporate innovative technologies such as IPv6, the emerging Internet standard that increases the available number of IP addresses worldwide. UCL is actively involved in testing and developing IPv6 and related applications with its participation in projects such as 6NET, a 3-year, trans-European effort to demonstrate the viability of IPv6 for continued growth of the Internet.

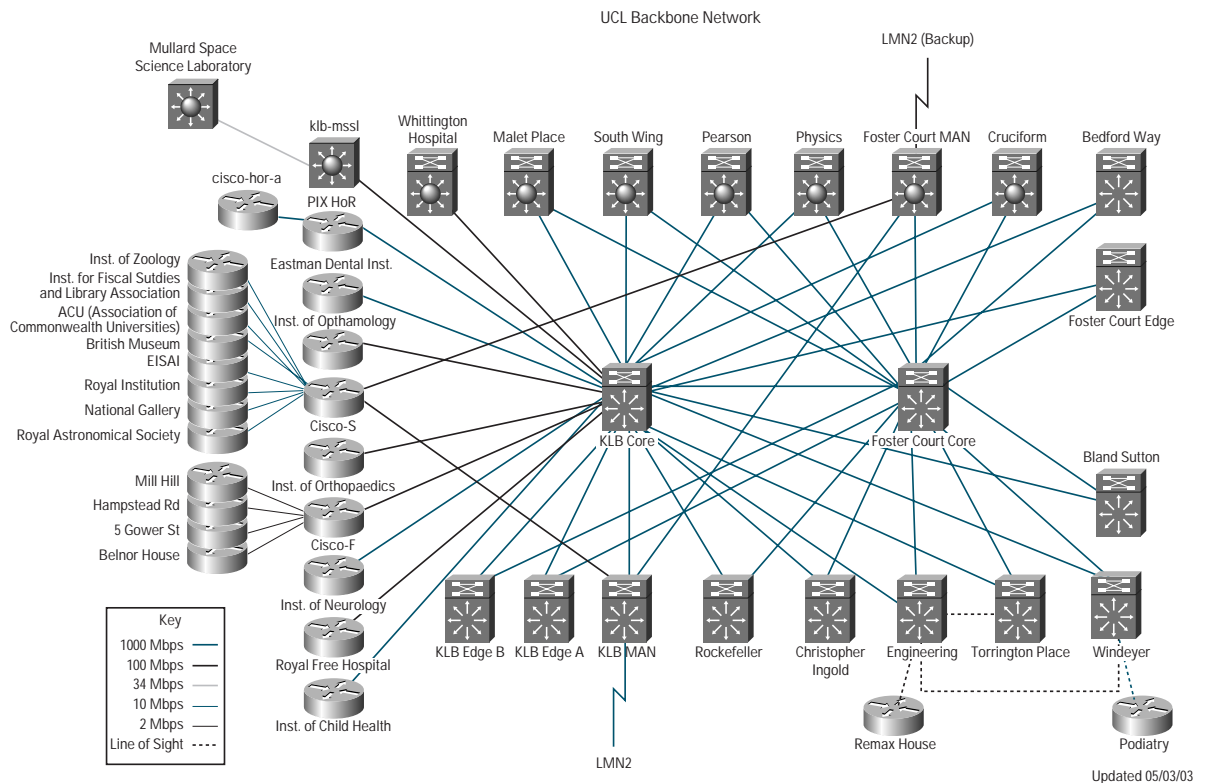


## Solution

Fortunately, UCL can upgrade and expand its Cisco AVVID infrastructure with minimal disruption and optimal investment protection. The new Supervisor Engine 720 for Cisco Catalyst 6500 Series switches meets the requirements for investment protection, resilience, bandwidth, and intelligent services. Its advanced application-specific integrated circuits (ASICs) enable high-density Gigabit Ethernet and 10 Gigabit Ethernet. With hardware-based support for the IPv6 protocol suite, the Catalyst 6500 Series Supervisor Engine 720 offers scalability for 6NET and other Internet growth initiatives.

The existing Cisco Catalyst 6500 Series core has a dual-star topology, ensuring network resilience with two switches in separate locations. Should a link or switch fail, the network automatically reroutes around the failure, providing nonstop service. Cisco Catalyst 6500 Series switches also comprise much of the distribution layer throughout the larger campus buildings, and Cisco Catalyst 3524 and 2950 switches reside in wiring closets. The Engineering, Computer Science, Physics, and Medicine departments use Gigabit Ethernet directly from the local Catalyst 6500 Series switch to certain desktops. The network is configured for 45,000 data points, of which approximately 20,000 are active. A central server farm has more than 400 servers enabling campuswide applications and services, while most departments house their own servers for their particular requirements. The Bloomsbury campus has fiber connections between buildings, while connectivity to remote campuses uses leased-line services (Figure 1).

Figure 1  
Cisco AVVID network at University College London



## Investment Protection

Because UCL was among the first customers of Cisco Catalyst 6500 Series switches, most installed chassis have Supervisor Engine I modules. Upgrading to the Catalyst 6500 Series Supervisor Engine 720 allows UCL to leap from first-generation to third-generation networking, according to Ian Bridge, network analyst in the Information Systems department at UCL. "The Supervisor Engine 720 came at just the right time for us," he says. "The main advantage is that we can shift from the flow-based architecture of the older supervisor engine to the distributed Cisco Express Forwarding architecture of the new one. Among the benefits we expect to see are improved latency for short term flows (e.g. Domain Name Server lookups), and greater protection against distributed denial-of-service attacks."

UCL enjoys investment protection by upgrading the performance and functions of the modular Cisco Catalyst 6500 Series platform, enabling a transition to the new Supervisor Engine 720 without a complete equipment upgrade. "This is the third time in three years that we have achieved a major transition with minimal consequences to the network environment," says Bridge. UCL can

also redeploy older line cards from the core switches into distribution-layer switches closer to users, increasing the number of ports at the edge while boosting bandwidth in the core.

## Results

UCL is testing the Cisco Catalyst 6500 Series Supervisor Engine 720 and planning deployment throughout the network in mid-2003. The network has capacity to accommodate unforeseen or unplanned activities. The upgraded, high-capacity Catalyst 6500 Series core gives UCL the flexibility it needs.

Among the predicted needs is greater security. UCL is testing a number of firewall solutions, including the Firewall Services Module for the Catalyst 6500 Series. Its future ability to create multiple virtual firewalls in a single module gives UCL the option to offer firewall services to subsets of users in individual departments. UCL believes it is more cost effective to implement multiple logical firewalls instead of hardware appliances. The team is also investigating VPN solutions for its hot desk users.

Essential to the UCL strategy is introducing 10 Gigabit Ethernet into the core when it becomes available. Says Clarke, "You ask me whether gigabit to the desktop is going to become a standard, and 10 gigabit in the core is going to become a standard? Absolutely."



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