

## Smarter Solutions for Education: **Intelligent** Networking 101

**Primary, secondary, and higher education:**

**From kindergarten to college, intelligent networks are in a class by themselves.**

*“We saw wireless as the next logical step for our network, since 25 percent of students have a laptop and that number will probably grow. We wanted to provide wireless service and have it up and running before the demand started, so we wouldn’t be playing catch-up.”*

**—Rusty Smith, Network Engineer,  
University of Wisconsin, Madison**

These are wondrous times in education: students and faculty are using technology to break down barriers, bring people together, and fire the imagination.

Intelligent networks are erasing the physical boundaries of the classroom, allowing learning to continue anywhere wired or wireless connections exist. They are linking people, buildings, campuses, and institutions as never before, allowing resources to be shared and ideas exchanged across any distance. And they are reinforcing lessons with rich, interactive content that engages the mind in powerful and memorable ways.

Best of all, advancements in technology have made these and other benefits available to schools of every size and stature. Today’s networks are simple and cost-effective to manage and own, so even organizations with limited expertise and

resources can deploy sophisticated solutions to the challenges they face.

As this guide illustrates, colleges, universities, and primary and secondary schools around the world are using technologies such as intelligent switching, Gigabit Ethernet, wireless connectivity, and IP telephony to invigorate lessons, improve communications, automate administrative processes, safeguard important resources, and enhance the learning process in countless other ways.

Cisco Systems has helped numerous schools, school districts, colleges, and universities develop standards to deploy networking solutions tailored to their needs. Cisco offers end-to-end solutions that are designed to expand and evolve, allowing organizations to incrementally grow their networks as requirements change or new technologies emerge. Nowhere is this



*“We relocated our offices in about 15 minutes (following a bomb threat) utilizing the Cisco IP phone technology, where we just literally unplugged our phones, brought them over here, and put a switch in place. Fifteen minutes later, all of our phones were operational, as if we were still in the central office. The technology was invaluable and allowed us to communicate with our schools and keep our business operations running smoothly.”*

**—Mike Vasquenza, IT Director, Hartford, Connecticut public schools**



future-proof approach to networking more evident than in the Cisco Catalyst® family of stackable and chassis switches. Offering basic connectivity or the power of Gigabit Ethernet, they can instantly boost network capacity to accommodate today’s bandwidth-hungry applications, with plenty of room to grow tomorrow. That means any network, whether it’s based on old copper telephone wires or the latest fiber-optic lines, can deliver the productivity and efficiency enjoyed by leading corporations.

Yet Cisco Catalyst switches offer more than raw speed—they extend intelligent services from the core of the network to the edge, where the students, teachers, and administrators are. This provides the advanced quality of service (QoS), high availability, and enhanced security needed to ensure everything operates efficiently, reliably, and securely as the network grows. These industry-leading features clear the way for new opportunities, such as wireless networking and IP telephony, further empowering students, faculty, and staff.

### **With Cisco Systems, It’s Easy and Affordable to Make the Move...**

#### **...From Hubs to Switches:**

To accommodate today’s applications and demand for bandwidth, it’s critical to replace any 10 megabits per second (Mbps) hub in the wiring closet with 100 Mbps Fast Ethernet or 1000 Mbps Gigabit Ethernet switches.

Unlike a hub, which forwards data packets to all connected ports, a switch forwards packets only to the port that matters—the one leading to their final destination. This reduces the overall volume of traffic on the network and enhances security, because packets are restricted to their designated ports.

Besides offering more bandwidth, Cisco Catalyst switches deliver intelligent services that enhance security and maximize network

uptime. They also provide QoS features that identify types of traffic and prioritize how each packet is handled. This ensures that time-critical applications like voice and video transmissions—where delays can seriously affect quality—function properly.

Depending on the infrastructure in place, migrating from hubs to switches may be as simple as unplugging one and plugging in the other. Cisco Catalyst switches can integrate broadband into any network infrastructure, whether it uses Category 1, 2, or 3 copper telephone wire, Category 5 copper cabling, or fiber.

#### **...To Gigabit Ethernet:**

The performance advantages of full Gigabit Ethernet switching are becoming increasingly essential for schools, districts, and campuses on the cutting edge of technology. The reason is simple. With every increase in traffic or introduction of a more demanding, bandwidth-hungry application, the network comes under greater stress.

At speeds of 1000 Mbps, Gigabit Ethernet provides the bandwidth that networks need to evolve and meet new demands, alleviating bottlenecks, boosting performance, and increasing the return on existing investments in infrastructure.

As the industry leader in LAN switching, Cisco makes the transition to Gigabit Ethernet faster and easier with standards-based solutions for both fiber-optic and copper cabling. Cisco products can also be deployed in stages for a more gradual migration to Gigabit Ethernet, starting at the core and moving on to the wiring closet.

Schools and universities can use Cisco Catalyst switches to extend Gigabit Ethernet to the desktop, simply and affordably, to support today’s powerful computers, sophisticated applications, and high traffic volumes. Delivering up to 10 gigabits per second (Gbps), the range of solutions offered by Cisco will satisfy even the most bandwidth-intensive requirements, including campus- and district-wide connectivity.

### ...To Converged Networks:

Maintaining separate networks for voice, video, and data is no longer necessary—and is just plain inefficient. Merging all three services over a single network—known as convergence—is the obvious answer. And it is widely accepted and acknowledged by the communications industry and analysts that the Internet Protocol (IP) will become the standard way of delivering them.

Supporting everything from Web and e-mail access to telephone calls and videoconferencing, converged networks offer several benefits, including simplified administration, increased reliability and redundancy, and significant cost savings in terms of both IT resources and long-distance telephone charges.

The greatest demand today is for IP telephony, also known as voice over IP, an application that allows telephone calls to be carried over networks originally designed for data. The cost benefits of merging voice and data services onto one network can be dramatic. This is particularly true in education, since even the largest school districts and universities are often forced to hire outside contractors to manage separate networks.

Cisco Catalyst switches provide the advanced QoS features needed to support IP telephony, and are available with network-based inline power support for Cisco IP phones, so separate power outlets aren't required in each room.

Cisco Systems is a recognized leader in network convergence. When appropriate, Cisco AVVID (Architecture for Voice, Video and Integrated Data) provides an open, standards-based foundation that makes it easy to roll out IP telephony services and other Internet-based applications.

### ...To Wireless:

Though much has been made of the freedom and mobility of wireless connectivity, its benefits go well beyond the basic luxury of “anytime, anywhere” network access. In some situations, this technology offers a simpler and more cost-effective alternative to

traditional wired connections. In other cases, such as in historic buildings or areas where asbestos poses an environmental hazard, it may be the only viable means of extending high-speed network access. Even a fully wired campus can benefit from a wireless network, giving staff and students additional mobility and flexibility to teach and learn in new ways.

The Cisco Aironet® family of wireless products sets the standard for reliable, secure, high-speed wireless connectivity. A range of equipment is available to meet different needs, including access points and client adapters for indoor wireless connectivity, and wireless bridges for long-range outdoor links between buildings. Wireless bridges deliver several times greater throughput than T1/E1 lines, eliminating the need to install fiber-optic cable or pay for leased line services.

Within buildings, Cisco Aironet access points provide constant access to network resources virtually anywhere these products are deployed. This not only gives network users the ability to roam freely throughout an extended area while maintaining uninterrupted network access, but saves organizations the time and expense of rewiring. Changes in the size or location of workgroups can be accommodated simply by adding or moving access points, further lowering facilities costs.

Cisco Aironet technology is Wi-Fi™ compliant, making it ideal for a multivendor client environment. Advanced security features, scalability, and manageability allow network managers to easily deploy a wireless LAN within a complex campus environment.

Cisco Aironet access points leverage the same management tools used for wired networks, and are designed for simple, rapid deployment. Inline power support, for example, enables the access points to draw their operating power from Cisco Catalyst switches via Ethernet ports. Where no switch is available, inline power can be provided via a power injector. This eliminates the need for separate power sources, such as a wall outlet, greatly reducing the cost of installation.



*“We were constantly reinstalling the fiber connections to keep the desktops and laptops in these classrooms connected with the campus LAN. With wireless, there’s no need, since the mobile classrooms are always connected. We save a lot of money by not having to make these adjustments every year.”*

**—Vass Johnson, Director of Networking,  
North Carolina’s Wake County Public School System**

### The Cisco Catalyst Family



- **Cisco Catalyst 2950 Series Switches** make it easy and affordable to deploy basic or intelligent services at the network edge with standalone, fixed-configuration, and stackable models that provide wire-speed Fast Ethernet and Gigabit Ethernet desktop/access connectivity. Catalyst 2950 Series Intelligent Ethernet switches can be paired with a Catalyst 3550 Series Intelligent Ethernet switch to enable IP routing from the core of the network to its edge.



- **Cisco Catalyst 3550 Series Switches** are a new line of enterprise-class, stackable, multilayer switches. With a range of Fast Ethernet and Gigabit Ethernet configurations, this series can serve as both a powerful access layer switch and as a backbone switch for small networks. For the first time, customers can deploy network-wide intelligent services—including IP routing—while maintaining the simplicity of traditional LAN switching. For converged networks, the Cisco Catalyst 3524-PWR XL switch offers inline power, eliminating the need to connect Cisco IP phones and Aironet Access Points to a wall outlet or other power source. In addition, the Catalyst 3524-PWR XL switch offers advanced QoS fully integrated with Cisco IP phones and high-availability network features.



- **Cisco Catalyst 4000 Series Switches** extend control from the backbone to the network edge with intelligent network services and other features, including advanced QoS, scalable performance, comprehensive security, and simplified management. Their modular, high-density, high-performance design supports 10/100/1000 switching in the LAN, packet telephony, enhanced security, and integrated WAN capabilities for converged networks.



- **Cisco Catalyst 6500 Series Switches** offer industry-leading scalability, flexibility, and performance, supporting the industry's widest range of interface densities and services modules. They are designed to address the growing need for security, gigabit scalability, high availability, rich services, and multilayer switching in backbone, distribution, and wiring closet topologies as well as data center environments, including support for 10 Gigabit Ethernet interfaces and WAN connectivity up to OC-48 speeds.

### The Cisco Aironet Series



- **Cisco Aironet 1200 Series Access Points** deliver maximum security, manageability, and reliability wireless connectivity, while also providing investment protection and a smooth path to future high-speed wireless LAN technologies. This series of IEEE 802.11b-compliant (Wi-Fi) access points supports data rates of 11 Mbps today, and enables a seamless migration to the emerging IEEE 802.11a standard. A modular design supports both single- and dual-band configurations, and allows for additional field upgrades as requirements change and technologies evolve.



- **Cisco Aironet 350 Series Access Points and Wireless LAN Client Adapters** offer the advantages of wireless networking in a cost-effective and easy-to-manage solution. These products support data rates of 11 Mbps, and are compliant with the IEEE 802.11b (Wi-Fi) standard. Cisco Aironet 350 Series Access Points are available in two versions: standard and rugged. The standard model has a plastic case and integrated antennas. The rugged model features a metal case and external antenna connectors for auxiliary antennas, and is designed to operate in an extended temperature range. Cisco Aironet 350 Series Wireless LAN Client Adapters are available in PC Card and PCI Card models.



- **Cisco Aironet 350 Series Wireless Bridges** enable high-speed building-to-building links of up to 25 miles (40.2 km). Supporting several times greater throughput than T1/E1 lines at a fraction of the cost, wireless bridges are ideal for data-intensive, line-of-sight applications, such as connecting hard-to-wire sites, campus settings, satellite offices, and temporary networks. They can be configured for point-to-point or point-to-multipoint applications, allowing two or more sites connect into a single LAN and/or share a single high-speed Internet connection.

### Cisco IP Telephony Solutions

- **Cisco IP Telephones** are next-generation intelligent communication devices, providing toll-quality audio anywhere on a local- or wide-area network, without requiring companion PCs. The latest models of Cisco IP



phones are fully programmable to support changing needs and preferences. When used in conjunction with inline power models of Cisco Catalyst switches, Cisco IP phones can draw their power from the network, eliminating the need for separate outlets. Models include Cisco IP phone 7910G/7910G+SW, 79406, 7960G, IP expansion model 7914, and IP Conference Station 7935.



- **Cisco IP SoftPhone** is a Windows-based application that takes voice-and-data convergence to the next level. With Cisco IP SoftPhone running on a laptop you can receive calls wherever you are connected to the corporate network. Even dial-up connections can be used to check voicemail and place calls. Integrated directories and drag-and-drop controls can simplify any call. Conference call participants, for example, can be invited by dragging and dropping directory entries onto the user interface to create a virtual conference room. Once a voice conference is established, you can share applications running on your desktop with others by selecting them from a list or dragging documents into the virtual conference room.



- **Cisco CallManager** is the software-based call-processing component of the Cisco IP telephony solution. This software extends enterprise telephony features and functions to packet telephony network devices such as IP phones, media processing devices, voice-over-IP (VoIP) gateways, and multimedia applications. Additional data, voice, and video services such as unified messaging, multimedia videoconferencing, collaborative contact centers, and interactive multimedia response systems interact with the IP telephony solution through Cisco CallManager's open telephony application programming interface (API). Cisco CallManager is installed on the Cisco Media Convergence Server 7800 series and the Cisco Integrated Communication System 7750.

### Leading the Way

Primary, secondary, and higher education professionals turn to Cisco Systems for efficient, reliable, secure networking solutions. Here are a few reasons why:

- **Increased productivity** Cisco solutions make it easy for schools and universities to enhance network access and deploy leading productivity applications, improving communication, streamlining operations, and extending the reach of network resources so students, faculty, and staff can accomplish more.
- **End-to-end solutions** Cisco offers end-to-end solutions for a variety of applications, from basic connectivity to high-speed wireless access and edge-to-core IP telephony.
- **Greater return on investment** Cisco has a record of protecting customer investments by supporting new features across several generations of Catalyst switches, Aironet wireless devices, and IP telephony products.
- **Simplified management** Cisco Catalyst switches provide tools that simplify all aspects of network management, from deploying new devices to configuring edge-to-core intelligent services. The CiscoWorks2000 family of Web-based tools offers a proactive approach to network planning, monitoring, and troubleshooting, including support for Simple Network Management Protocol (SNMP) and Remote Monitoring (RMON). Cisco Cluster Management Suite (CMS) Software, embedded in Catalyst 2950 and 3550 switches, further simplifies network management by enabling the simultaneous configuration of up to 16 clustered switches using any standard Web browser.
- **Gigabit Ethernet connectivity** Cisco Catalyst 2950, 3550, 4000, and 6500 Series switches provide a complete Gigabit Ethernet switching solution, from the core of the network to the edge.
- **Unparalleled performance** The Cisco Catalyst family provides industry-leading performance, functionality, scalability, and flexibility, which delivers valuable enhancements to your network operations.
- **Cisco IOS® Software** Cisco Catalyst network platforms run on the Cisco IOS Software, which creates a unified system and provides a solid foundation for building Internet applications. Extending common services and interfaces across the network also reduces training, management, and troubleshooting costs.

## Advanced Features to Support a Range of Needs

Cisco Systems offers solutions to the challenges confronting education professionals. Common scenarios include:

**Situation 1** *Class sizes and room assignments are always changing—which means classroom networking requirements are too.*

**Solution** Wireless access can be quickly integrated into any environment, eliminating the time and expense associated with rewiring classrooms and labs as requirements change. Cisco Aironet access points let you instantly extend wireless connectivity to everyone in the room, or even beyond the room, allowing teachers and professors to take classes outside while maintaining network access. Many schools and colleges have set up carts with Cisco Aironet access points and wireless notebook computers using Cisco Aironet client cards, creating “mobile wireless classrooms” that can be used to extend network resources whenever and wherever they’re needed, so classes aren’t disrupted by moving students to a computer lab. Cisco Catalyst switches support wireless networking with inline power options, which enable Cisco Aironet access points to draw operating power from the network connection, eliminating the need for separate power sources. Wireless technology can also be used to connect remote classrooms or offices, eliminating the need for leased lines or cabling. Cisco Aironet 350 Series Wireless Bridges provide high-speed links between buildings up to 25 miles (40.2 km) apart.

**Situation 2** *There aren’t enough phone lines to go around. But the setup costs for expanding the existing PBX phone system are extremely high.*

**Solution** Converging voice and data onto a single network offers dramatic cost benefits, eliminating the need for services and equipment needed to maintain a separate phone system. Cisco IP telephony makes it affordable for each teacher to have a phone with voice mail, improving communication with colleagues and parents, while also ensuring help can immediately be summoned in the event of an emergency. Cisco IP phones dramatically simplify location changes as well, since they can be moved anywhere on the network and their extensions remain the same. Converged networking also enables IP phones to be used for other things, such as attendance tracking and announcements over the school’s public-address system. Meanwhile, Cisco Catalyst switches can be used to provide network-based inline power for Cisco IP phones, eliminating the need for separate power sources.

**Situation 3** *There’s so much great educational software and multimedia content available these days, it would be great to incorporate it into lesson plans. The trick is distributing it to students, and keeping different classes in sync.*

**Solution** Cisco Catalyst switches make it easy to implement and manage video multicasts, providing the advanced QoS and multicast features needed to support broadcast-quality video. Educational content can be stored on a Cisco IP/TV® server, so it’s always available on demand. Cisco video-over-IP technology also supports videoconferencing for enhanced communication and collaboration.

**Situation 4** *Warranted or not, there are growing concerns about personal safety on campus. But major expenditures on staff or equipment are out of the question.*

**Solution** The same multiservice network that supports videoconferencing and e-learning applications also supports a potent, yet inexpensive security measure: IP video surveillance. IP video cameras plug directly into the local- or wide-area network, eliminating the need to rewire a building or campus. Yet they are just as much a deterrent to crime as a conventional surveillance system—and just as reassuring to students and staff.

**Situation 5** *Heavy network traffic during peak times of the school day decrease network response times. This hinders network performance for important applications, such as delivering bandwidth-intensive e-learning content.*

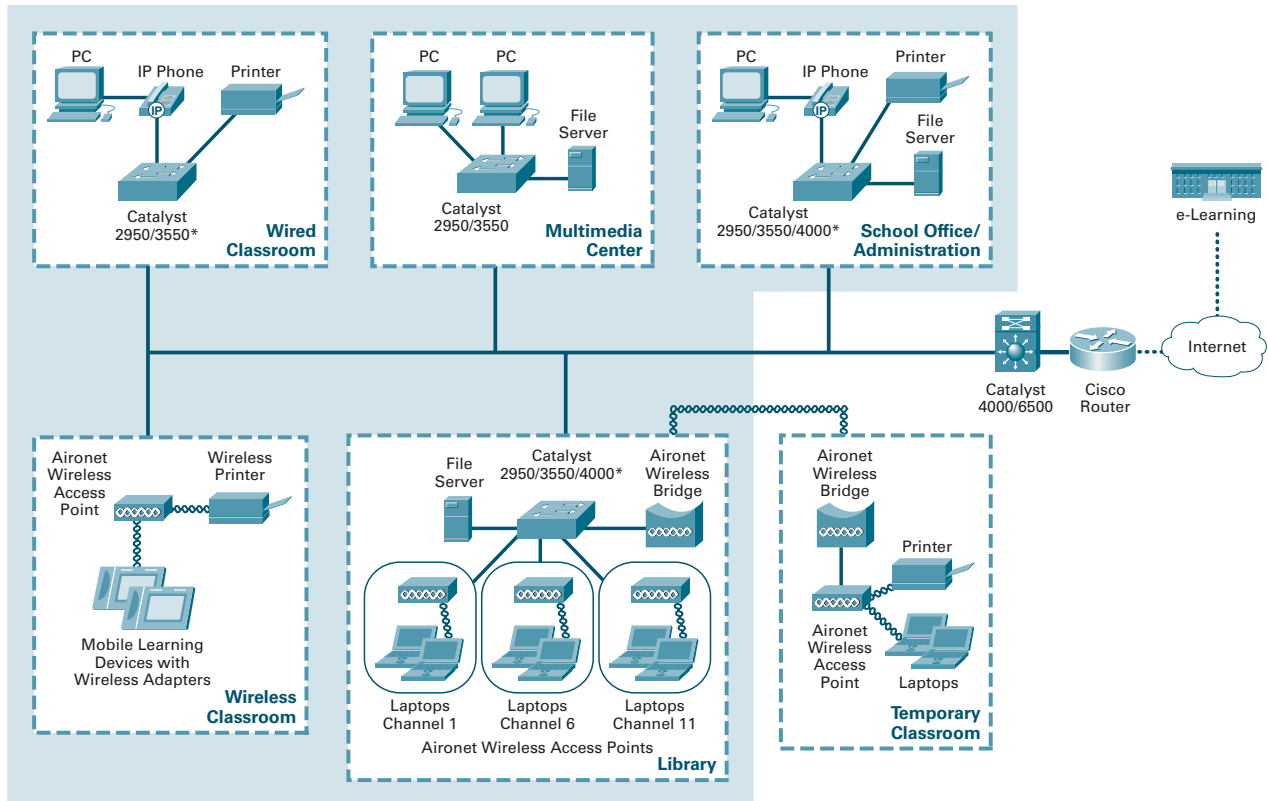
**Solution** Cisco Catalyst switches offer extensive network monitoring capabilities, making it easy to track granular traffic details on the network at all times. Advanced QoS and rate-limiting features allow traffic to be prioritized and controlled, so critical applications and staff are given the bandwidth they need, without starving other users.

**Situation 6** *The unauthorized use of network resources is a major concern. In some cases, the problem is as simple as students wasting precious bandwidth downloading large music and video files. In others, the threat is much more serious, involving deliberate attempts to access or damage sensitive data and other resources.*

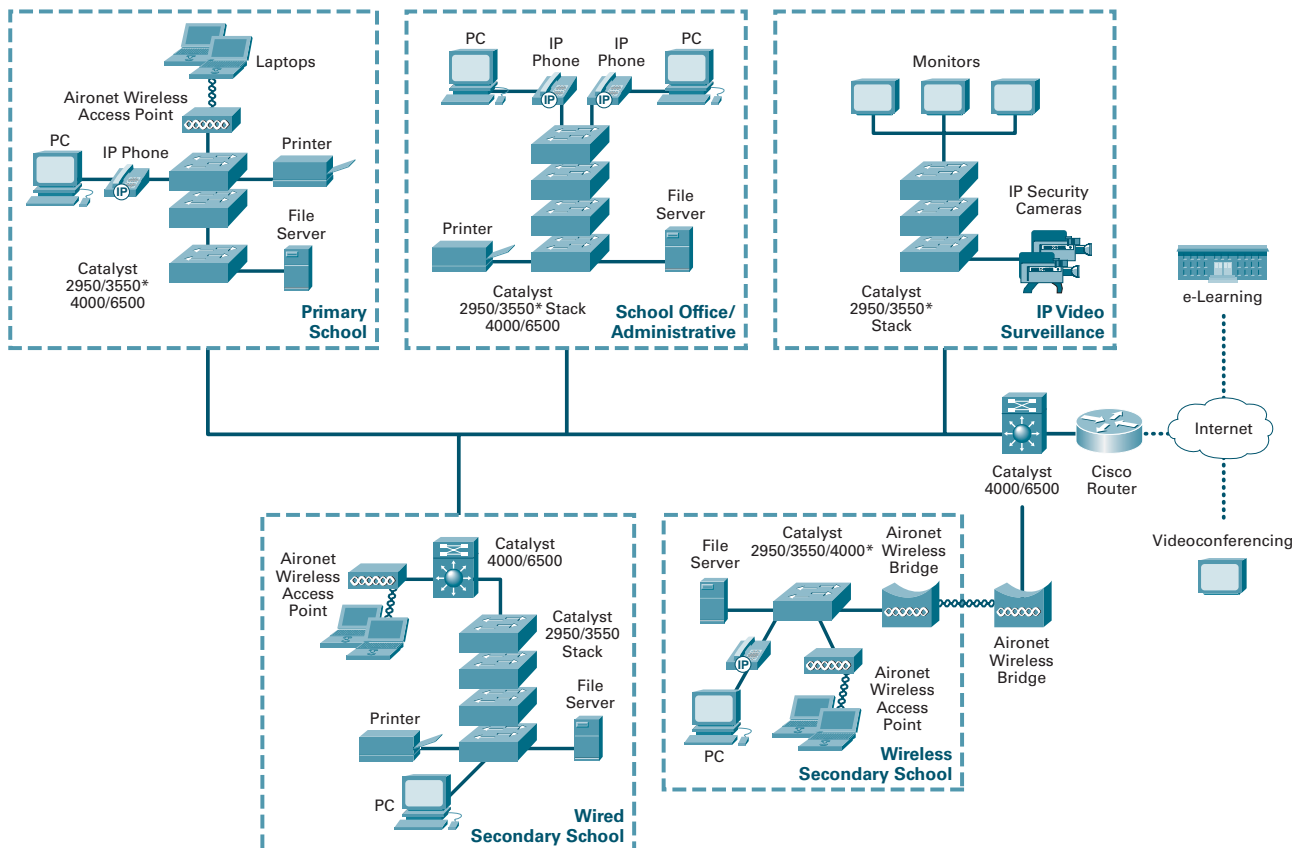
**Solution** Cisco Catalyst switches provide an array of security and management features to safeguard the network from internal and external threats. Access control lists, for example, can be easily configured to repel unwanted visitors, monitor communications, and filter content, ensuring the network is used appropriately. Meanwhile, rate limiting provides desktop-level control over the amount of bandwidth available to users, helping to ensure network resources are not being used inappropriately.

## Sample Network Designs

### 1. Sample High-Function Network Diagram for Primary and Secondary Schools



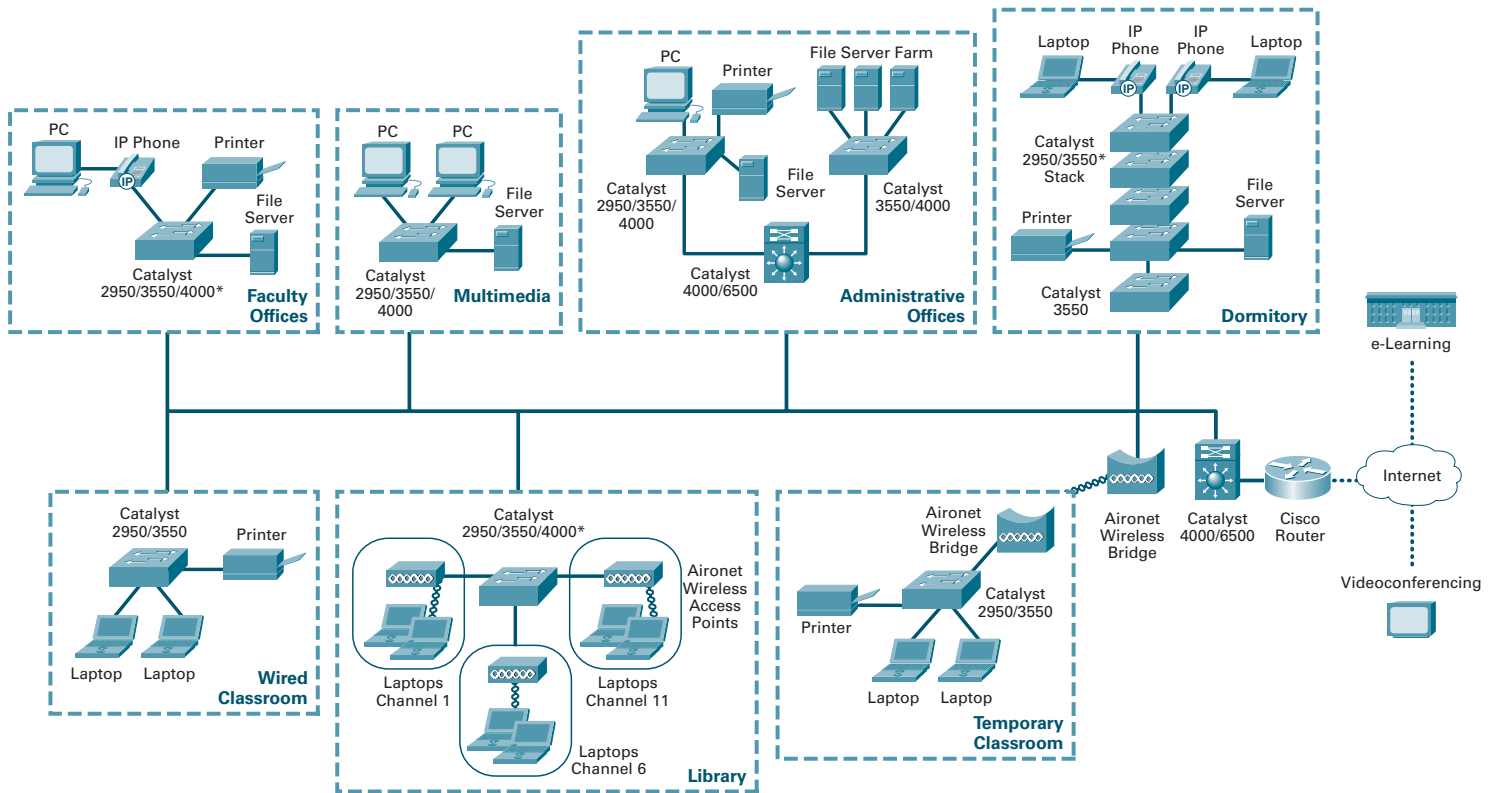
### 2. Sample High-Function Network Diagram for Primary and Secondary School Districts



\* For implementations that require inline power for IP telephones or wireless access points, Catalyst 3524-PWR XL switches can be deployed as an alternative to Catalyst 2950 and 3550 switches. Catalyst 4000 and 6500 support inline power, and remain ideal choices in such situations.

## Sample Network Designs (continued)

### 3. Sample University Diagram



\* For implementations that require inline power for IP telephones or wireless access points, Catalyst 3524-PWR XL switches can be deployed as an alternative to Catalyst 2950 and 3550 switches. Catalyst 4000 and 6500 support inline power, and remain ideal choices in such situations.



*“The technology-savvy generation of students at the college did not have any problems adopting the use of [high-performance networks], and their learning has been transformed as a result of better and easier access to online resources and tools.”*

—Walter Chieng, IT Director, Saint Kentigern College, New Zealand

For more information

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