CREATING COLLABORATIVE ANYTIME, ANYWHERE LEARNING ENVIRONMENTS

A Higher Education Networking Solution Guide

Alcatel·Lucent Enterprise

NEXT-GENERATION STUDENTS EXPECT NEXT-GENERATION NETWORKS

Technology has become the most important constant in the life of all students entering higher education institutions. Students expect their chosen college or university to be equipped with the most advanced information technology networks. They expect to be able to leverage any device, anywhere on campus to connect with fellow students, communicate with family and friends, and socialize online. Plus, they expect their school's network to be able to support all that activity, while at the same time enabling online research, communication with professors, and collaborative digital workspaces that they can leverage to further their studies wherever they are on campus. For these students, the way a college or university has integrated information technology into the very fabric of campus life is just as important as their chosen field of study and the structure of the curriculum.

At the same time, the way students learn continues to change. Digital learning processes and experiences have become more important than traditional textbook-based lectures and seminars. Online courses are now an integral part of the curriculum. Laptops have become the primary tool for academic studies. There has been an explosion of mobile devices in the classroom. And students are leveraging an increasing number of applications and gamification sites that are creating new digital learning experiences.

These trends and the fact that the pool of potential students is shrinking have led information technology (IT) teams in colleges and universities worldwide to re-evaluate their network infrastructure strategies. The campus network has become the key to every institution's efforts to attract and retain the best students and faculty, boost learning and research, reach students off-campus, provide lifelong learning, and create a more collaborative learning environment. This guide provides a step-by-step approach IT teams can use to design efficient and cost-effective campus networks that can meet the technology expectations of next-generation students and enable more collaborative, digital learning experiences.

- **60 percent** of students won't even consider a college that does not have free Wi-Fi®.[1]
- **6.7 million** higher education students report that they took at least one online course during the fall 2011 term.[2]
- **86 percent** of college students say they use laptops as their primary computing device for academic purposes.[3]
- **59 percent** of students report that they have three or more connected devices.[4]
- Students take up to **80 percent less time** to accomplish learning objectives by using technology in the classroom.[5]

1 EDUCAUSE STUDY , DEC 2011
2 2012 - CHANGING COURSE: TEN YEARS OF TRACKING ONLINE EDUCATION IN THE UNITED STATES, ONLINE LEARNING CONSORTIUM
3 EXPLORING STUDENTS' MOBILE LEARNING PRACTICES IN HIGHER EDUCATION; EDUCAUSE, OCT. 2013
4 ECAR STUDY 2014. THE EDUCAUSE TECHNOLOGY RESEARCH IN THE ACADEMIC COMMUNITY RESEARCH SERIES
5 US DEPARTMENT OF EDUCATION & NATIONAL TRAINING & SIMULATION ASSOCIATION STUDY 2012.

1: Understand the Limits of the Existing Network

The first step in building an efficient and cost-effective, next-generation campus network is to objectively analyze and evaluate the capabilities of the existing infrastructure. Although most campuses have an infrastructure that supports basic access and mobility requirements, most are not structured to meet the expectations of 21st Century students. The core network itself may be outdated and unreliable. It may be too complex and structured with too many layers to efficiently support multimedia applications. Maintaining this network may be too expensive because many of the elements have reached the end of their life cycle, so parts and support are no longer available. Most importantly, this aging infrastructure may not support the new wave of multimedia applications because it was never designed to provide the capacity needed to meet the instant on, multi-device load generated by today's students.

The wireless portion of the network may also be outdated. It may provide spotty coverage in some areas of the campus, while it is not available at all in others. The access points may not support the latest mobile devices with the new generation of wireless technologies and protocols. And the network may not provide the level of security needed campus wide.

Finally, the network may not be structured to enable efficient, ongoing management. Typically, most campus networks are managed in silos, with different platforms for Local Area Network (LAN) configuration/management, Wireless LAN (WLAN) configuration/management, and Service Level Management. To effectively manage the network, the IT team must tackle each system separately. This makes it difficult to enforce a consistent, reliable level of behavior for the entire network that will meet student and faculty expectations wherever they are on campus.

BUILD A NETWORK THAT MEETS EXPECTATIONS

To meet student expectations for access and communications, build a robust, full-featured, next-generation network that:

- Provides a high-quality of experience (QoE) for students everywhere on campus and on any device
- Supports multimedia learning and test applications that enable immersive teaching and personalized learning
- Has the capacity to support a high density of student devices while avoiding network overload
- Creates a secure communications environment
- Enables instant review and progress reports between teachers and students

2: Plan for an Environment That Supports Multimedia Learning, Testing, and Social Apps

Going beyond the limits of the existing network and delivering a high QoE that meets expectations requires a network environment that can simultaneously support learning and testing applications, as well as the social applications that have become an integral part of student life. Ideally, your network environment should be engineered to:

1. **Ensure all devices coming into the campus environment get their fair share of network resources on both wired and wireless networks.**
   This can best be achieved with a network solution that offers unified access control over network services, and the same QoE over wired and wireless networks.
2. **Prioritize various learning streams and classroom test traffic on both wired and wireless network.**
   This requires a solution that provides application visibility and control to enable IT teams to enforce policy-based access for all users, devices, and applications, and restrict non-learning traffic during classroom hours.

UNIFIED ACCESS PROVIDES SAME NETWORK SERVICES FOR WIRED AND WIRELESS

Alcatel-Lucent Enterprise offers a unified access solution that delivers a high quality user experience on any wired or wireless network. The solution provides a common set of network services, a policy framework, authentication scheme and a single authentication database that are applied to all users accessing the network with either wired or wireless devices. These network services automate many of the processes that are currently done manually, and enable IT teams to ensure that:

- The LAN and the WLAN behave and are managed as one network
- Quality delivery of all applications is enforced consistently at all times
- Security is maintained throughout the network

This unified access solution is delivered with one management system that provides end-to-end visibility, avoids duplication of tasks, and offers better troubleshooting tools for all network management requirements.

APPLICATION FLUENT NETWORK PROVIDES NETWORK VISIBILITY AND CONTROL

Application layer visibility and control is provided through the award winning Alcatel-Lucent Enterprise Application Fluent Network Solution, which includes:

- **Apps Dashboard** that offers application visibility and control, and improved diagnostics for latency sensitive applications, such as test traffic, voice and video calls
- **Roll-based policy engine** that enables policy enforcement per application and application group
- **Airtime fairness and network access features** that ensure all devices get their fair share of network access through role-based policy implementations

USER-CENTRIC NETWORK SERVICES RECOGNIZE, AUTHORIZE, AND CONTROL USER ACCESS

With an Alcatel-Lucent Enterprise solution, access is always secure. Every user must be recognized and authorized by the network to gain access, and a user profile associates a pre-defined set of quality of service (QoS) and security rules to each individual accessing the network.

For example, if a student wants to connect to the network from a wired connection to a desktop computer in his dorm room he must first identify himself by providing the correct user identity and password. A network profile is associated with the user identity that defines the applications the student is allowed to access, the firewall rules that will be applied, and the QoS the student should receive. When the student moves to another location where he is using a wireless connection, the profile follows him and provides the same QoE he had on his desktop. That QoE continues to follow him wherever he goes in the network.

The same approach applies to an alumni student arriving on campus who wishes to access the network as a guest. First, the alumni must provide identification credentials that tell the network how to classify the guest and associate the appropriate guest user profile, which will have a set of QoS and security rules associated with it. In many cases, the guest will be restricted to Internet access. When the guest moves to another location in the network the same profile will follow him and that profile may be pre-defined to restrict access to guest areas only and block access from other areas, such as dorm rooms.

These capabilities enable user mobility in a consistent and secure environment on both wired and wireless connections. And, any user that attempts to access the network without the proper identification and authorization will not be given access.

DEVICE-CENTRIC SERVICES RECOGNIZE AND CONTROL DEVICES

The Alcatel-Lucent Enterprise solution also includes network services that allow IT teams to manage devices on the network.

The device onboarding solution automates and simplifies the onboarding process without sacrificing access security. It automates the configuration of student devices without requiring any intervention from IT. It can also be used to install security certificates on student devices to further enhance security.

The install an agent service performs periodic health checks to make sure the device is compliant with IT requirements. For example, it checks devices for the latest operating system version, whether or not the antivirus software is running and up to date, and blocks access to prohibited applications. It can also prevent the connection of external devices, such as a memory stick, by automatically putting the device under quarantine until it is removed.

The solution also includes a network service that enables the use of multimedia consumer devices on campus networks. This allows professors and students to connect a variety of additional devices, such as an Apple TV®, printers, and TVs and projectors compatible with the Digital Living Network Alliance (DLNA) standards. It also enables professors and students to determine which users should have access to these devices without opening service ticket requests with the IT department.

APPLICATION-CENTRIC SERVICES CONTROL APPLICATIONS

The Alcatel-Lucent Enterprise unified access solution includes network services that manage applications with state-of-the-art techniques, which identify applications and enforce policies at wire rate right at the edge of the network.

An application analytics capability provides the network with the intelligence to recognize applications on the network and control them via a set of pre-defined policies. With this capability, the IT team can prioritize education-critical applications and reserve bandwidth to make sure they can be delivered with a pre-defined QoS. Harmful or non-compliant applications can be blocked from the network. At the same time, a secure environment can be created in which students and professors can explore new applications, or use education, personal, and social applications safely and securely.

ADVANCED ANALYTICS PROVIDE DETAILED TRACKING OF ALL APPLICATIONS

Finally, to enable ongoing, fine-grain network management, the Alcatel-Lucent solution provides advanced analytics capabilities that give IT teams a full, detailed view of all applications on the network at all times.

With application analytics, the network can identify each application encapsulated under an HTTP interface and apply higher prioritization and QoS rules to education-critical applications, such as Blackboard®, compared to social applications, such Facebook®. Networks without this feature see all network traffic as HTTP and treat each application the same way.

ABILENE CHRISTIAN UNIVERSITY CREATES DEVICE-CENTRIC LEARNING ENVIRONMENT

LOCATION: Abilene, Texas

DETAILS: 4,600 students; 245 full-time faculty

CHALLENGE:

- Create a device-centric learning environment to enhance learning and enable students to successfully complete courses by leveraging advanced wireless devices that provide access to information wherever and whenever needed.

SOLUTION:

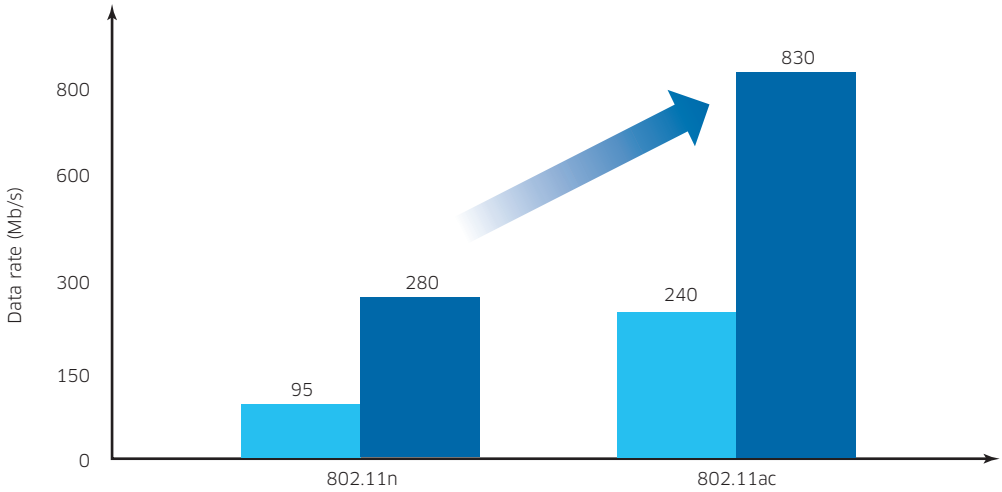
Integrated Alcatel-Lucent Enterprise Unified Access Solution, which includes:

- OmniPCX™ Enterprise and unified communications
- OmniTouch Contact Center solution
- Alcatel-Lucent LAN switches and WLAN
- ClearPass™ Policy Management System

BENEFITS:

- Students are attracted to the university by the advanced network capabilities
- Anywhere, any device access has improved mobility and the QoE on campus
- Students can access course calendars, campus maps, receive homework alerts, security alerts, and answer in-class surveys and quizzes, and other web applications developed by the university
- Full visibility of network and resources enables management of day-to-day usage

Figure 1. Faster data rates are possible with 802.11ac



3: Embrace a High Density of Student Devices Without Overloading The Network

Supporting digital learning, especially in one-to-one environments, requires a WLAN infrastructure that can handle a large influx of mobile devices and the bandwidth-hungry applications running on them. There are several things you can do to prepare for this:

1. PLAN FOR DENSITY

Plan to support three to four mobile devices per student, as well as teacher devices, wireless printers, and other wireless equipment in the classroom, corridors, cafeteria, quad, and dorm rooms. For example, in an average classroom of 30 students the network should have the capacity to support more than 120 devices at any given time.

2. ASSESS WLAN BANDWIDTH REQUIREMENTS

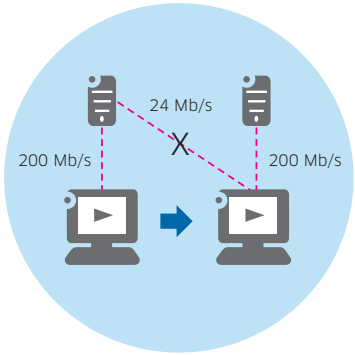
Assess classroom application needs by collaborating with professors to determine what is required to support a rich multimedia curriculum. For example, if your professors expect to use video-based teaching aids that stream video to multiple devices, you'll need a WLAN network capable of supporting multiple, high quality video streams. The average HD-quality video stream uses 4 Mbps of bandwidth per user and interactive learning games require 1 Mbps of bandwidth per user.

3. CHOOSE A SOLUTION THAT ALLOWS SIMPLE ONBOARDING

Simplify device onboarding by allowing users to self-enroll and granting network access privileges based on user roles, device types and location. The ideal solution should support:

- Self-registration of computers, tablets, smartphones, printers, game consoles, and stereos
- Wi-Fi multicast optimization and media streaming across the campus

Figure 2. ClientMatch technology automatically matches devices to the right AP



4. PREPARE YOUR NETWORK TO HANDLE MASSIVE BANDWIDTH NEEDS WITH 802.11AC TECHNOLOGY

Gigabit Wi-Fi devices are already available to students. Whether they are smartphones, tablets, or laptops, most of these devices are capable of receiving and sending massive amounts of multimedia traffic. Your network should be able to support all these devices and the traffic they generate.

Consider adopting the new 802.11ac Wi-Fi technology standard to address classroom density requirements with a pervasive WLAN network. The new standard also provides faster data rates and more reliable connections for all devices, including those based on 802.11n.

5. ELIMINATE ROAMING ISSUES

Finally, look for a solution that solves sticky client issues. As students roam between access points (APs), their devices can get stuck on an AP instead of associating with a closer one that has a stronger signal. The ideal campus network infrastructure should eliminate this so that poor AP performance does not drag down the entire network.

PERVASIVE WLAN SOLUTION ENABLES SMARTER Wi-Fi

The Alcatel-Lucent Enterprise pervasive WLAN solution offers maximum network architecture flexibility to enable smarter Wi-Fi for the next-generation college and university campus.

We offer a wide array of APs, from entry level to industry leading 802.11ac and 802.11n APs, which support advanced security and a single set of features at all locations. And our 802.11ac access points provide the speed and density required to support today's Gigabit Wi-Fi devices in a wireless network architecture optimized for high-performance, secure wireless communications.

To ensure all users get the high performance connection they need, our WLAN solutions include our unique ClientMatch™ RF management technology. ClientMatch monitors all devices and automatically matches them to the right radio on the right AP, boosting overall WLAN performance and delivering consistent, predictable performance to every user while eliminating the sticky client problem. This ensures all users get the highest QoE and optimizes the overall performance of the network.

Plus, our advanced radio management and firewall technologies allow your network to adapt automatically to changing RF conditions, while protecting your network against radio interference from Bluetooth® and microwave networks. And the built-in deep packet inspection capabilities in our access points provide the visibility and control you need for multi-function testing and collaboration applications.

MORAVIAN COLLEGE ENABLES MORE COLLABORATION, TEAMWORK AND KNOWLEDGE SHARING

LOCATION: Bethlehem, Pennsylvania

DETAILS: 1,461 undergraduate students; 226 graduate students

CHALLENGE:

- Create a new network that can support an all- Apple MacBook Pro™ environment
- Improve wired and wireless access everywhere on campus
- Provide high quality data, video and multimedia communications at any time
- Attract students with an advanced wired and wireless network infrastructure

SOLUTION:

- Alcatel-Lucent Enterprise Unified Access solution
- ClearPass Policy Management System
- Alcatel-Lucent OmniSwitch™ 6900 (OS6900) Core, OmniSwitch 6450 Gigabit Stackable LAN Switches and OmniSwitch 6850E Stackable LAN Switches
- Alcatel-Lucent OmniAccess™ 110 series and OmniAccess 220 series access points
- Alcatel-Lucent OmniAccess 4750 and 4550 Wireless LAN Controllers
- Alcatel-Lucent OmniVista™ 3600 Air Manager

BENEFITS:

- Full support for an all-MacBook Pro environment
- More ubiquitous coverage for any user, anywhere on campus, in and out of the classroom
- Competitive positioning with students based on advanced network capabilities
- Leadership positioning in higher education based on an innovative approach to the use of corporate and commercial technologies
- More collaborative knowledge sharing environment for tailored, interactive learning

4: Remove "IT" Overhead While Still Providing Secure BYOD and Guest Services

Students, faculty, staff and guests that will connect to your campus network with a variety of personal devices will create a difficult access and traffic management challenge. How do you provide wired and Wi-Fi access to these devices and keep the network secure with limited resources? Choose a device onboarding solution that automates and simplifies the onboarding process without sacrificing access security.

With an advanced Bring Your Own Device (BYOD) solution you can:

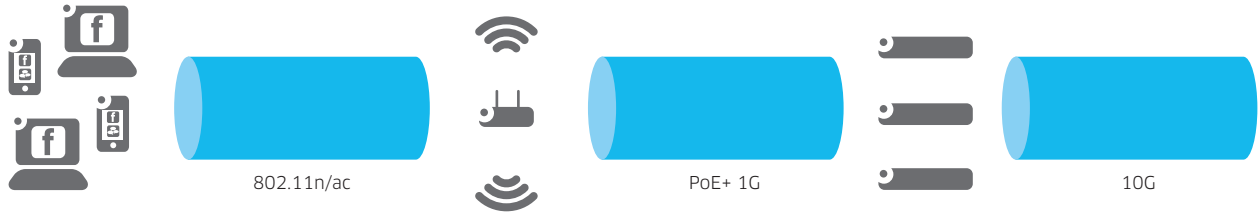
- Create a simple captive portal that displays a web page, similar to a Wi-Fi hot spot where students can simply accept the connection or sign in using their school credentials, if you want to map traffic back to an individual user
- Simplify device onboarding by allowing users to self-enroll and granting network access privileges based on user roles, (students, faculty, staff), device types (laptops, tablets, smartphones), and location (classrooms, common areas, dorm rooms)
- Opt for 802.1X authentication with Advanced Encryption Standard (AES) security features, which allow users to enter a user name and password or self-enroll by automatically generating and installing device certificates through a web portal with no IT assistance
- Eliminate difficult and time consuming tasks for providing Wi-Fi access to campus visitors by enabling sponsors to self-register and validate guests through a university-branded portal they can use without calling your Help Desk
- Enforce differentiated network access based on contextual information, such as user roles, device types, and location, which enables secure management and enforcement of differentiated policies

BYOD AND GUEST ACCESS SOLUTION SIMPLIFIES ONBOARDING, MAINTAINS SECURITY

The Alcatel-Lucent Enterprise BYOD and guest access solution makes it easier to onboard and manage network access for personal devices and guests in any college or university network infrastructure. Built with Workspace, Onboard, Guest, and OnGuard features, and the ClearPass onboarding solution, this simple, powerful package provides a sophisticated, secure method for onboarding personal devices anywhere on campus with:

- Automated device provisioning
- Certificate authorization
- Mobile device management
- Restricted access
- Secure user and device access
- Profiling
- Health checks
- Single sign-on
- Compliance and audit reporting
- Self-registration
- Sponsor enablement
- Bulk registration
- Hot spot/Captive portals
- Bandwidth restrictions
- MAC Caching

Figure 3. Gigabit Ethernet ports and uplinks eliminate traffic congestion issues



5: Prepare the Access Layer to Handle an Enormous Amount of Incoming Data

To support next-generation digital learning applications in the classroom, as well as full mobility for students, choose wired network solutions that are ready to apply policies to users, devices and applications based on the same contextual data as your wireless network. So instead of creating and managing separate access policies for wired and wireless networks, you'll have one consistent set of policies for both. This simplifies your network deployment and management efforts and gives you full control over all traffic.

A network solution that allows you to unleash the full potential of Gigabit Wi-Fi enabled by 802.11ac should:

- Avoid traffic congestion with at least 1 GbE port and 10 GbE uplinks at the edge
- Take full advantage of 802.11ac with Power over Ethernet+ (POE+) ports

VERSATILE SWITCHES TRANSFORM ACCESS LAYER

Alcatel-Lucent Enterprise offers a wide variety of versatile, secure, high-performance wired network access layer switches with advanced policy frameworks. These switches offer:

- Built-in embedded security
- POE+ capability
- In-service software upgrade (ISSU) features
- Application fluent network software

And our flexible deployment approach allows you to pay for 100M/1G today and upgrade to 1G/10G by simply paying for a license upgrade at a later date.

6: Ensure Your Core/Data Center Is Not a Bottleneck While Reducing Cost Per Student

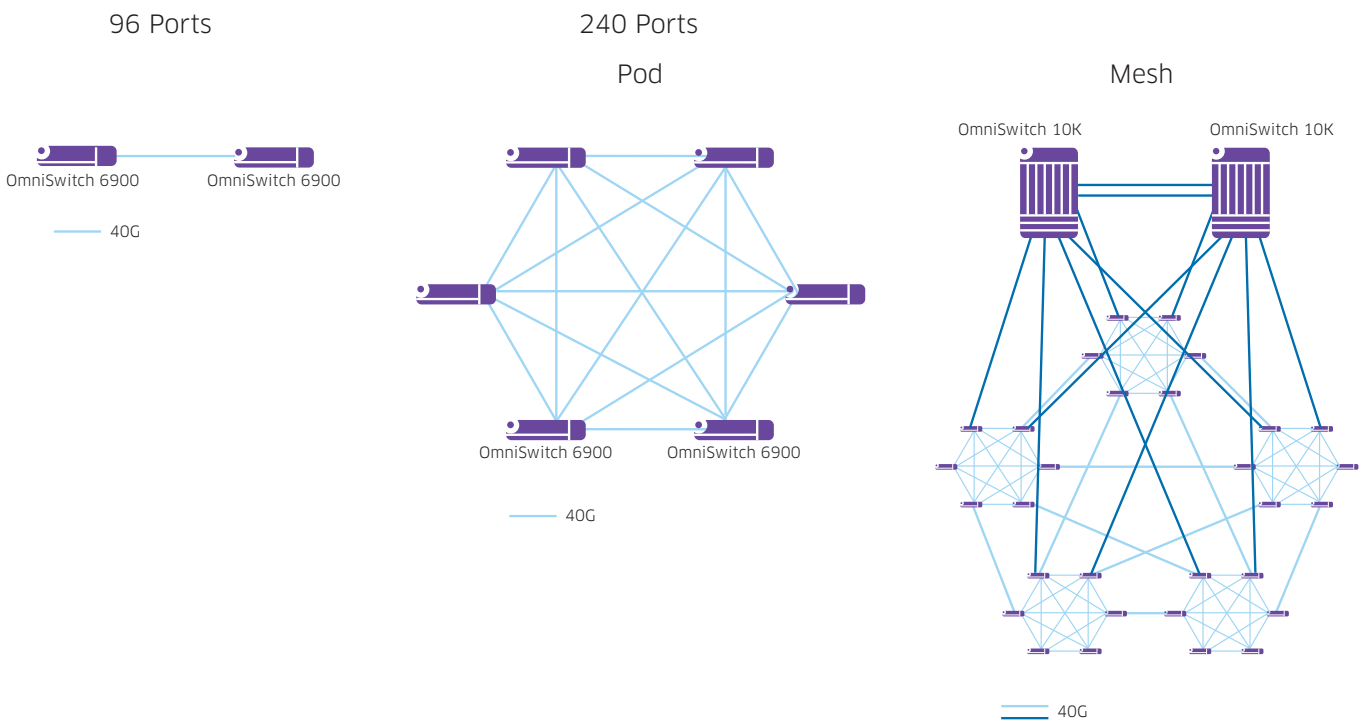
An efficient, high performance access network is only as good as the core network it connects to. The core is the most critical part of your campus infrastructure because it must support more than 80 percent of all LAN and Wi-Fi user traffic for applications and communications.

To get the full benefit of a next-generation access infrastructure, you'll want to ensure your core network is ready to handle all the traffic coming from the access layer. Evaluate the network to determine where the bottlenecks could occur, what you'll need to ensure the network can identify and process education-critical applications, and the type of network elements you need to reduce latency for all traffic.

When planning your new network consider:

- Deploying 10G/40G switches that eliminate bottlenecks and support virtual network design
- Right-sizing with small, high capacity switches that can form a virtual chassis and provide more than seven Terabits/sec of switching capacity
- Streamlining your wired infrastructure by reducing the number layers in your network design and eliminating a separate distribution layer to reduce your capital expenditures (CAPEX) and operating expenditures (OPEX)
- Rethinking Virtual LANs (VLANs) with software-defined, flow-based policies that optimize wired and wireless traffic paths without changing your existing network
- Choosing newly-designed, less power hungry switches with lower power requirements
- Vendors that support pay-as-you-grow strategies that reduce budget pressures, but don't compromise product features

Figure 4. Flexible, pay-as-you-grow, plug and play fabric provides any-to-any connectivity



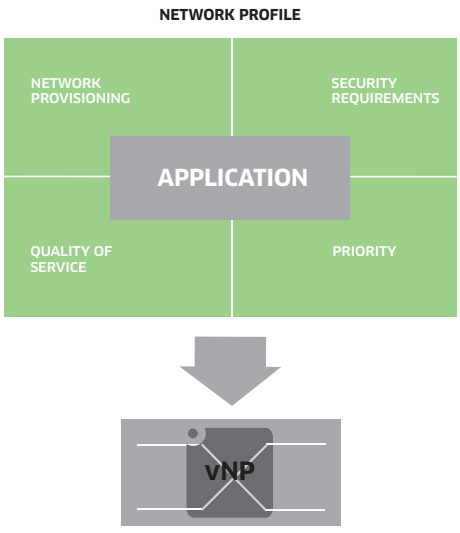
INTELLIGENT FABRIC ENABLES ADVANCED CORE AND DATA CENTER NETWORKING

Alcatel-Lucent Enterprise offers a complete solution for core and data center networking. Built on an intelligent fabric, our solution provides any-to-any connectivity with the low latency, low power consumption and overall switching capacity needed to deliver optimal performance for real-time, education-critical applications. The intelligent fabric includes pod and mesh technology with built-in automation for configuration and dynamic adjustment of application traffic flows, simplifying the complexity of the network.

The mesh can scale linearly, both in architecture and in pricing model, to connect from under 100 to over 10,000 servers. And it delivers all the requirements of virtualized workloads:

- **Performance:** Low latency, 10 and 40 GigE multipath connectivity
- **Automation:** The network automatically adjusts as a virtual machine is moved within and between data center sites
- **Scalability:** Pay-as-you-grow business model and direct connect architecture, which enables cost-effective small to very large deployments with no rip and replace requirement
- **Converged Management:** Visibility and performance tools that link application level views with network topology for improved troubleshooting capabilities for Software Defined Networking (SDN) enabled by standards-based RESTful Application Programming Interfaces (APIs)
- **Storage Convergence:** Enables storage model of choice for customers (iSCSI, FCoE, Fibre Channel)

Figure 5. Network profiles enable application management



AUTOMATION BRIDGES THE APPLICATION NETWORK DIVIDE

With this solution, applications are managed as a service based on application profiles embedded into the network fabric. User network profiles provide the unique prioritization, switching provisioning, QoS, and security requirements for each application and enable the network to automatically adapt to optimize performance. This eliminates the manual IT effort needed to support server virtualization and reduces the management burden on your IT team.

DATA CENTER SOLUTION ENABLES RIGHT-SIZED, VIRTUALIZED NETWORK CORE

The simplified network core of the Alcatel-Lucent Data Center solution for digital learning infrastructures is built on a new generation of switches that have non-blocking, high performance capability. Our OmniSwitch 6900 switches use network virtualization techniques that make a set of switches behave like a single unit, while providing the necessary redundancy, fast recovery on link or switch failure, and full utilization of all links to the access layer. These switches behave as a single unit, so your entire core network is simpler to manage. You use less space and consume less energy. And the switches are configured with expansion slots that allow you to scale and add higher speed ports all the way up to 40 G, whenever you need to grow.

Plus, our data center solution enables deployment of a two-tier network instead of a traditional three-tier design. This approach and our virtual chassis core technology delivers 30-70 percent CAPEX savings in addition to 30 percent or more OPEX savings over traditional architectures.

PENN STATE COLLEGE OF ENGINEERING EVOLVES DATA CENTER TO 10 GBE SERVERS

LOCATION: University Park, State College, Pennsylvania

DETAILS: 1,719 students; 353 faculty

CHALLENGE:

- Eliminate server backup replication issues in the data center
- Migrate 1 GbE connectivity to servers to 10 GbE
- Create stronger network infrastructure redundancy

SOLUTION:

- Alcatel-Lucent OmniSwitch 6900 (OS6900) Core
- 10 Gigabit Ethernet (GbE) servers and 1 GbE Small Form Factor Pluggable (SFP) transceivers

BENEFITS:

- Server redundancy improvement with implementation of virtual chassis
- Improved multicast server replication to backup data center
- Higher performance and low latency in data centers by upgrading the path to 10 GbE for servers, and 40 GbE between data center switches

7: Invest in Solutions for Today and Tomorrow

While you're upgrading your data center to meet immediate needs, consider how your infrastructure investment can also be leveraged to meet future requirements. Create an application fluent, converged campus network with best-of-breed technologies and solutions that:

- Provide end-to-end orchestration and automation
- Are built on open standards and industry-leading SDN controllers
- Enable interoperability with a strong and flexible partner ecosystem

Remember that network programmability is the future of networking, but integrating SDN into your infrastructure should not be a rip and replace process. Integrate SDN software at your own pace. Start by building a robust network with elements that can leverage the embedded intelligence needed to optimize traffic flows. Then optimize application behavior by adding the programmability for specific traffic.

INTEGRATED SDN CAPABILITIES SIMPLIFY NETWORK EVOLUTION

All Alcatel-Lucent Enterprise LAN and WLAN infrastructure solutions support OpenFlow and OpenStack standards. They are SDN-ready and can be enabled with SDN capabilities

through a simple software upgrade. With these solutions, you can avoid costly vendor lock in. And your investment for today is protected when you are ready for SDN tomorrow.

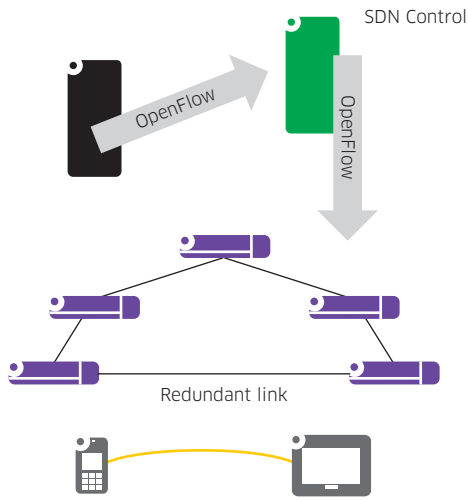
When you are ready, we will work with you to develop and implement a SDN solution tailored to your needs, which may include:

- QoE optimization for unified communications
- Virtual machine mobility automation
- Secure user/device/application on-boarding
- Wireless traffic optimization

EXTENSIVE PARTNER ECOSYSTEM ENSURES INTEROPERABILITY

To make it easier for you to leverage the best technologies and products available today and in development for tomorrow, our infrastructure solutions are compatible with those from an extensive partner ecosystem. We have established relationships

Figure 6. SDN control optimizes flows for better network utilization



Multiple network management platforms create reactive management processes

with technology companies that provide some of the most innovative networking solutions for:

- Applications and services
- Orchestration
- SDN control
- Management
- Server virtualization
- Server network interface controllers (NICs)
- Virtual desktop, Application Detection Controller (ADC), and Wide Area Network (WAN) optimization
- Fiber channel storage convergence

With Alcatel-Lucent Enterprise and our extensive ecosystem of partners, you have the flexibility to build a data center network without limits.

8: Simplify Network Operations Management

Once you have your access and core network designed, you'll want to consider more efficient network management options. Eliminate multiple management silos and their disparate platforms for Wi-Fi, LAN, application delivery, and service-level management. By streamlining your management platforms you will reduce costs, break the cycle of reactive network support, and enable a transformation to more proactive network management processes.

Look beyond traditional solutions and opt for a simpler, more cost-effective unified network solution that meets your campus needs and can manage both wired and wireless networks. With an integrated solution, you can better manage the application and device experience of users on networks that extend across the entire campus.

Choose a solution that enables you to provision, monitor and manage:

- Policies across the access layer on both wired and wireless networks
- Application fluency across all access networks
- Data center/server room elements and resources
- BYOD services (which device, what privilege, when, where, etc.)

This approach will enable you to better manage IT time and resources compared to multiple, siloed point-products that solve only one or two management issues. And to optimize all IT resources, consider a cloud-based management solution, which can reduce the cost and complexity of IT operations by eliminating the need to install and maintain multiple individual management appliances.

UNIFIED NETWORK MANAGEMENT SYSTEM DRIVES EFFICIENCY AND PRODUCTIVITY

The integrated, easy-to-use Alcatel-Lucent OmniVista™ 2500 Network Management System (NMS) provides centralized management, bulk operations, simplicity and scalability that simplify network management in any college or university infrastructure. It uniquely combines a full set of end-to-end network operations and security management features for unified access with the LAN and Wi-Fi equipment of an Alcatel-Lucent Enterprise network solution within a single cohesive platform.

The OmniVista 2500 NMS puts a full range of applications, tools and analytics in the hands of network managers. This makes

it easier to meet the complex demands associated with new services, fast growing and evolving technologies, such as unified access, BYOD, virtual desktop and constant security threats.

Adding an OmniVista Network Management System to an Alcatel-Lucent Enterprise network infrastructure can:

- Deliver savings of up to 20 percent in costs compared to separate LAN and WLAN infrastructure management
- Optimize CAPEX and enable pay-as-you-grow through node licenses
- Enable operations on a virtual machine, thereby eliminating the purchase and maintenance of a dedicated server

9: Enable Wireless Screen-Sharing and Printing to Maximize Collaboration

To enable interactive learning on your new network you'll want to explore network-shared devices, such as Apple TV® or other digital sharing solutions based on DLNA standards as low-cost alternatives to traditional projectors. Maintaining the security of these devices is critical. You'll want to prevent students from hijacking them to share inappropriate content or cause disruptions in class. At the same time, you'll want to enable professors to grant access to groups of students to present their projects in class.

Confidently deploy all digital sharing devices on your network by:

- Choosing an access management solution that securely enables network-based digital sharing over the air and supports policy-controlled access enforcement
- Controlling the visibility of AirPlay®, AirPrint™ and DLNA devices to teachers, students and staff, based on a user's role, location and what device they're using

AIRGROUP TECHNOLOGY SIMPLIFIES CLASSROOM DIGITAL SHARING

Apple® devices, such as Apple TV and Apple printers, and other DLNA devices, were designed for easy connectivity in a residential network. When these devices are added to a more complex network environment, such as a campus network, they just don't work. This is because there are multiple subnets and VLANS, as well as too many users that should not have access.

Alcatel-Lucent Enterprise AirGroup™ Network Service enables Apple and other devices based on DLNA standards to be used

CALIFORNIA STATE UNIVERSITY

LOCATION: Long Beach, California

DETAILS: 430,000 students and 44,000 faculty and staff

CHALLENGE:

- Increase performance of backbone and server connections
- Install state-of-the-art technology to replace products at the end of their support life cycle and associated cost savings

SOLUTION:

- Alcatel-Lucent OmniSwitch 6900 (OS6900) for core
- Alcatel-Lucent OmniSwitch 6900 (OS6900) and OmniSwitch 6850 (OS6850) for server farm switches
- Alcatel-Lucent OmniSwitch 6450 (OS6450) at the edge

BENEFITS:

- Backbone, server, and border router connections upgraded to 10 Gbps
- Faster downloads, less latency, less time to do backups, less congestion
- Enabled introduction of more services like video, unified communications, closed-circuit TV (CCTV) security cameras, high definition TV in the network, and BYOD processes

on any campus, safely and securely. With AirGroup technology you can control access to these devices through policies that define and limit which devices are shown to professors and students based on who they are and where they are.

For example, AirGroup allows you to define policies that allow:

- A professor to access Apple TV in the classroom and auditorium, as well as a printer in the library
- Students to access a library printer, as well as an Apple TV/Projector in the classroom, but not in the auditorium
- Staff to access Apple TV in an auditorium, but not in the classrooms

AirGroup manages access based on VLAN stitching. It also allows users to self-register devices based on pre-defined policies. It does not require any service set identifier (SSID), VLAN or routing table configuration.

Alcatel-Lucent Enterprise is the first vendor to support AirGroup for both wired and wireless devices.

10: Interconnect Campus Networks and Extend Network Connectivity

Your new network should be able to go beyond your main campus and interconnect with a satellite campus. To ensure this is managed efficiently and cost-effectively, choose a vendor who can provide a one-stop-shop, end-to-end network solution. This will simplify your network design and deployment process and lower your costs. More importantly, it will provide you with a single point of contact for any future service and maintenance requirements.

When considering network extension options, choose:

- Environmentally hardened access switches and access points to provide connectivity at outdoor locations, such as play fields
- WLAN-based point-to-point and/or point to multipoint bridging connections, which offer a great way to extend your entire network to another premise without having to lay cables
- Network solutions that support IP cameras, which you can use to secure campus

While you're at it, you may also want to consider extending your network connectivity to include campus bus systems. This will make it easier to:

- Improve safety by enabling tracking and monitoring of vehicles at all times, as well as video streaming from onboard cameras
- Extend teaching applications via the campus bus to keep students engaged and connected
- Enable one-to-one computing on route to and from campus to enable students to continue working on school projects while they are riding the bus

HIGH CAPACITY, MULTI-FUNCTIONAL SOLUTIONS ENABLE NETWORK EXTENSION

Alcatel-Lucent Enterprise offers high capacity multifunctional enterprise network solutions that can be used to extend your campus network anywhere you want to go:

- The Alcatel-Lucent OmniAccess 5850 is ideal for medium to large campus networks where it can be deployed as a WAN device. Its integrated Wi-Fi functionality can be leveraged to provide Wi-Fi connectivity to satellite campuses, as well as to students and staff on campus buses. And its 3G/4G capabilities can be used to connect sites back to a central operations center.
- The Alcatel-Lucent OmniSwitch 6855 is an environmentally hardened, wire-rate Gigabit switch that provides outstanding performance when supporting real-time voice, data, and video applications. It includes the same set of security features for access control, policy enforcement and attack containment that are present in our indoor switch products.
- Our OmniAccess outdoor WLAN APs are designed to extend network access in outdoor locations, such as stadiums, play fields, and parking lots.

Create the Next-Generation Networks Students Expect

With the pool of potential students shrinking, you can't afford to let your campus network infrastructure lag behind the technology curve. Integrate advanced information technology into the very fabric of your campus environment and create the next-generation network today's students expect from a modern, post-secondary institution. With an application-, device-, and user-centric network you can deliver the personalized digital learning environment, better multimedia experiences, and BYOD support that will attract 21st Century students and keep them engaged throughout their campus life.

Alcatel-Lucent Enterprise provides a one-stop-shop for next-generation college and university campus network design. Our application fluent network solutions offer excellent value with solid investment protection and seamless high quality experiences. They provide:

- Common operating system/software across all data center, core, and edge platforms
- Unified policy with pervasive WLAN
- Optimized LAN core and edge and network extension capabilities with a wide range of choices
- Simplified network management capabilities

Our digital learning network solutions enable device freedom, whether devices are university-provided, personal, wired or wireless. And our solutions ensure critical assets are secure at all times.

With Alcatel-Lucent Enterprise campus infrastructure solutions you get network designs that can provide reliable learning and test environments, empower professors in the lecture hall, and enable collaboration anytime, anywhere.

In addition, we offer professional service auditing, assessment, and design, as well as 24x7 support and training.

Find out how we can help you deploy the optimal collaborative anytime, anywhere learning environment on your campus:

enterprise.alcatel-lucent.com/education

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